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Pocket-sized psychology studies: Exploring daily diary software for Palm Pilots

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Daily dairies, also known as experience sampling methods (ESM) or everyday experience methods, are a common methodology utilized to provide insight into momentary psychological processes. Traditionally, such studies often have utilized paper-and-pencil surveys administered several times each day over a span of several days or weeks. However, advances in technology now allow these studies to be conducted using palmtop computers (i.e., personal digital assistants; PDAs). Three software packages for running these studies on the Palm operating system were explored and compared on a number of features. Specifically, ESP (Experience Sampling Program, by Feldman Barrett & Barrett, 2001), iESP Version 3.2 (Intel Experience Sampling Program, by Intel Research Seattle & the University of Washington Computer Science and Engineering Department), and PMAT Version 2.0 (Purdue Momentary Assessment Tool, by the Military Family Research Institute at Purdue University) were examined, with their key features compared. These advances in software for running diary studies include a number of features that provide researchers with methods and information previously unavailable in diary studies and may expand the range of possibilities in diary study designs.

The aim of *everyday experience methods* (Reis & Gable, 2000), also known as *experience sampling methods* (ESM) or *daily diary studies*, is to capture momentary psychological processes operating outside of laboratory settings. These methods provide researchers with a window into experiences occurring "in the ebb and flow of everyday life" (Reis & Gable, 2000, p. 190) and provide data that may be richer than those collected in the lab. These data offer insight into ongoing affective, cognitive, and social processes over time, with considerably less retrospective bias (Robinson & Clore, 2002). In addition, this methodology is ideal for tracking phenomena of interest over time as discrete events, rather than relying on global reports that require participants to mentally aggregate their experiences over a given span of time. Furthermore, these designs may have increased external validity because they represent participants' experiences within the context of everyday life, rather than as a function of the laboratory setting.

Early diary studies have revolved around participants' reporting on phenomena of interest at several points each day for multiple days. Often, the participants have been alerted (e.g., with a pager) multiple times each day (i.e., *signal* or *interval contingent*; Wheeler & Reis, 1991) and have been asked to report on their current state or their states since the prior reporting period. In addition, the participants may have been asked to complete reports following events of interest (i.e., *event contingent*), rather than at specific times. The duration of these studies typically has ranged from several days to several weeks, during which time the participants were trusted to accurately respond to these alerts and events in a timely manner and to record their reports in a notebook of survey forms provided to them by the researcher.

The aim of this article is not to outline or review the rationale for using these methods or to detail how the data are collected and analyzed. There are a wealth of reviews (e.g., Beal & Weiss, 2003; Bolger, Davis, & Rafaeli, 2003; Reis & Gable, 2000) and reports of empirical studies (e.g., Wirtz, Kruger, Napa Scollon, & Diener, 2003) available that provide these details thoroughly. Instead, the goal of this article is to provide information regarding the conducting of diary studies electronically, using personal digital assistants (PDAs), with the specific aim of summarizing the features offered in three readily available software packages for conducting diary studies on the Palm operating system (OS).

The Role of PDAs in Diary Research

The cost of palmtop computers has dropped substantially (in some cases, to under $100 per unit), making

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them an attractive alternative to traditional paper-and-pencil diaries. There are potential advantages to using PDAs to collect diary data, including the possibility of higher compliance rates (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002), use of complex survey structures, and linking of responses to the real-time trajectory of specific events.

For example, computerized methods can control timing to help verify that respondents complete their reports when they are instructed to, as opposed to taking the survey at an unknown time. Researchers can choose to make surveys unavailable after a set amount of time if participants skip a data collection period, thus eliminating responses that would be made outside of the desired time frame. In addition, if researchers do not wish to restrict response times, electronically collected data are time/date stamped, allowing them to identify (and exclude, if desired) responses made outside of the determined time frame and providing more precision and certainty in linking responses to signaling times.

In addition to the advantages related to data verification, computerized procedures allow greater flexibility in item presentation (e.g., items may be presented in fixed and/or random order) and can record additional information, such as response latency for each item. Also, *branching* can be employed, allowing researchers to provide follow-up questions to specific responses. Finally, events that have known or hypothesized durations and decay lengths (e.g., the *rise and fall* of an emotional episode; Frijda, 1993) can be tracked more precisely because of the connection between survey responses and time since the occurrence of the target event. So, respondents using PDAs might report an event of emotional consequence at one time, and follow-up signals from the PDA would allow researchers to examine the duration and decay of the resulting emotional response.

Although PDAs certainly present advantages in flexibility over paper-and-pencil measures, it is unclear how important some of these advantages may be. For example, recent work has suggested that compliance rates between PDAs and paper diaries do not always differ substantially and that these differences do not greatly affect the psychometric properties of questionnaire measures (Green, Rafaeli, Bolger, Shrout, & Reis, 2006). In addition, the flexibility in structuring surveys on PDAs also carries with it more complex data structures that often can be difficult to deal with when one attempts to analyze the data from a PDA diary study. So, although PDAs certainly offer potential advantages, it is only fair to point out that traditional paper-and-pencil diary methods often can be effective and easy to employ.

Available Software Packages

Although reviews of techniques for collecting and analyzing diary data are readily available in the literature and hardware is becoming more affordable for conducting these studies, little information has been collected regarding the software available for conducting these studies. There are a handful of software options available to researchers for running diary studies on the Palm OS, and the goal of this review is to summarize the features of three of these programs in order to assist researchers in choosing the one best suited for their research needs. The three programs reviewed are ESP (Experience Sampling Program, by Feldman Barrett & Barrett, 2001), iESP Version 3.2 (Intel Experience Sampling Program, by Intel Research Seattle & the University of Washington Computer Science and Engineering Department), and PMAT Version 2.0 (Purdue Momentary Assessment Tool, by the Military Family Research Institute at Purdue University). ESP is the original program developed for PDAs running Windows CE or the Palm OS. iESP is built upon ESP and has modified the original program so as to greatly expand the available features. PMAT was independently designed from the ground up in order to maximize its flexibility for use in a range of research contexts. All three of these programs are free to download and use in research (see the Appendix for information on downloading) and are open source, thus allowing researchers with programming skills to modify them to suit their needs.

OVERVIEW OF FEATURES

Although it is acknowledged that each research application may have somewhat different software requirements to successfully execute the design of the study, it is likely that there is a core set of features of interest to researchers as they select software suitable for diary studies. We should note at the outset that ESP, the original diary software application, has not changed much since its inception. As a result, it does not contain many of the features included in the other two applications. However, we recommend ESP as a good place to start in order to understand the more complex software packages available. We mention this now in order to provide readers with an appropriate context for evaluating the various features included in each application. Below, many of these features are identified and described, and Table 1 summarizes these features relative to ESP, iESP, and PMAT.

General Information

Platforms supported. ESP is designed to run on both Windows CE and Palm OS machines. iESP and PMAT are compatible only with machines running Palm OS.

Palm OS supported. The developers of ESP report that it runs on older versions of Palm OS (3.1 and 3.5). iESP and PMAT support newer versions of the Palm OS (3.5 and higher for iESP; 4.x and higher for PMAT).

Programmer interface. The three available packages differ in the methods used to create a study (i.e., entering items, selecting response formats, and creating schedules). ESP and iESP require the researcher to input questions via the Memo Pad function of the Palm Desktop application on the desktop machine. This task is relatively straightforward but requires knowledge of the program's syntax. Specifically, users will find that they need to be-

Table 1
Features in ESP, iESP, and PMAT

Feature	ESP	iESP v3.2	PMAT v2.0
	General Information		
Platforms supported	Palm OS Windows CE	Palm OS	Palm OS
Palm OS supported	3.1; 3.1.1 3.5.0, 3.5.1	3.5 and higher	4.x and higher
Programmer interface	Palm Memopad (either on desktop or Palm)	Palm Memopad (either on desktop or Palm)	Java-based Windows or Mac PMAT desktop application
Availability of instructional resources	Online ESP Web page	Online iESP Web page	PDF, downloadable from PMAT Web page
	Question Administration		
Random ordering of questions	yes, but limited	yes, but limited	yes, but limited
Branching	no	yes	yes, but limited to one level
Signal contingent	yes	yes	yes
Event contingent	yes	yes	yes
Combination of signal and event contingent in one study	no	no	yes
Alerts fire at random times	yes	yes	yes
Alerts fire at fixed times	no	no	yes
Different forms at different times per day	no	yes, with some effort	yes
Set multiple days	no	yes (weekends vs. weekdays only)	yes (each day can be different)
Participant-defined time spans	no	no	yes
Can-take-over device	yes	yes	yes
Alerts fire when program is not open	no	no	yes
Response time windows	yes, in seconds	yes, in seconds	yes, in minutes
"Do not disturb"	no	yes; alerts on or off	yes; alerts off for a set time
Feedback regarding study progress	yes; participants notified at the end of the study	yes; study progress provided and notification at the end of the study	no
	Question Formats		
Multiple choice/one response	yes; only buttons with limited formatting options	yes; as buttons, lists, pop-up menu, or slider	yes; as buttons, lists, or slider
Multiple choice/multiple response (i.e., check boxes)	no	yes	yes
Scaled response with slider	no	yes; endpoint labels	yes; endpoint labels; labels also appear upon rolling over other points with the slider; also, a 0–100 numeric format is available
Open-ended responses	no	yes	no
Record response latency	yes	yes	yes
Time/date stamp	yes	yes	yes
External application	no	no	yes
	Data Handling		
Save data to memory card	no	no	yes
Exported data format	text	text or CSV	CSV

come familiar with ESP's and iESP's specific ways of denoting the text of each item, as well as question orders and response options, using the correct commands, format, and symbols to accomplish the desired research design. Creating a study in ESP or iESP is accomplished by writing a line of syntax for each item, by providing the content of the item (i.e., writing the question), in addition to specifying the response format and the order in which the item should be presented. The complete study emerges as a series of these lines of syntax, which are transferred to the Palm's Memo Pad application. For simple applications, this syntax is not difficult to learn. In addition, because ESP and iESP rely on the Memo Pad to program studies, they can be created or edited on the PDA itself, using the Palm OS Memo Pad application. It is unlikely that researchers would choose to create entire studies using the PDA as the only method

of input, but this feature may be useful in making small modifications to a program once it has been loaded onto the PDA. In addition, the ability to upload whole studies to the PDA as text may be essential in situations such as research being run off site, so that updates to the program can be sent electronically (i.e., a text file with new syntax), rather than needing to return the PDAs to the lab for updates.

PMAT is a Java-based *point-and-click* program. Creation of the study takes place within a Windows- or Macintosh-based desktop application and does not require use of syntax to program the study. All commands are specified via the desktop computer interface, and beyond the inputting of item text with the keyboard, most functions use the mouse or keyboard shortcuts. In addition to copying and pasting text, PMAT 2.0 allows for copying and pasting of individual questions or large question sets. Specifically, to create a study, researchers first input individual items or sets of items (via the keyboard or by pasting copied text from other applications). In addition, response options are specified by selecting the desired format from a menu and adding any text to those response options. Next, time spans (in an interval-contingent study) that designate the periods of time during which participants can be signaled are specified using menus and windows. In the most basic context, this would be designating when the participants' days start and end but could include more complex schedules, such as separate morning, midday, and evening periods. Signal patterns are then set for those time spans (again, using windows), which provide the schedule of alerts that the participants will receive during the time spans. Finally, question sets (i.e., groups of items) are assigned to each of those signal patterns, thus specifying which items will be presented at each time period. The completed study is then exported to the Palm as a PalmDatabase (.PDB) file.

Availability of instructional resources. Both ESP and iESP provide online user manuals (i.e., hyperlinked Web pages), available at the same sites as those at which these respective programs are downloaded. They are not extensive but provide the necessary information to understand the syntax used and the options available in setting up a study. Although the Web-based interface is easy to navigate, it does require that the reader be connected to the Internet to access them. PMAT's user manual is available as a .PDF file, which can be downloaded and easily printed, and provides detailed instructions about using each of the program's features.

Question Administration

Random ordering of questions. All three programs allow items in a given survey to be presented in a random order; however, they accomplish this in different ways, and none provides total control and flexibility in creating complex designs that include random and fixed order presentations. In ESP, all items or a subset of items can be set to be presented in a random order. However, if only a subset of items are randomized, they must always come last in the sequence. iESP follows the basic structure of ESP but allows for somewhat more flexibility, in that it allows researchers to specify the probability that an item will be presented at a particular time.

PMAT differs from ESP and iESP in that items are designated within blocks of questions (*question sets*). The order of items within each question set can be randomized; however, the order of the question sets themselves cannot be randomized. Therefore, if a researcher needs all the items to be presented in a randomized order, all the items are placed in a single question set. If multiple question sets are employed, the items within each set can be randomly ordered.

In short, all three programs provide researchers with some options allowing for randomization of items. Each allows for randomizing of a subset or all items to varying degrees. In addition, PMAT allows for randomizing items within multiple blocks of questions; however, none of the programs offers random ordering of groups of items.

Branching. Branching refers to the possibility of specifying that the presentation of subsequent items depends on responses to previous items. In other words, participants' paths through the survey depend on their previous responses. Both iESP and PMAT include this feature (however, ESP does not) but differ in their study design interfaces. In iESP, by using syntax tags, researchers can specify the sequence of items, contingent on responses to previous items. With an understanding of this syntax, iESP allows for complex branching structures and study designs. With PMAT, branching is accomplished by linking specific sets of items to a particular response option, using dialogue boxes. PMAT is limited to one *level* of branching, so that branches cannot be made off of item sets that already serve as a branch off of the main set of items, which may be limiting in some research designs.

Signal- and event-contingent study designs. In signal-contingent studies, the researcher determines the number of data collection times each day, at either set or random intervals, and the device alerts participants to complete surveys at each of those times. For instance, the participants may be signaled several times each day to report on their current moods. In event-contingent studies, the participants activate the diary program themselves when events of interest occur during each day. For example, researchers interested in relationship conflict would have participants initiate the diary program following each argument they have with their spouses during the duration of the study. All three programs support either of these designs; however, only PMAT supports designs that incorporate both in the same study (e.g., a study in which the participants both are signaled periodically to report on mood and are asked to respond following each instance of marital conflict).

Alerts fire at random or fixed times. One of the most important features of any signal-contingent design is the necessity to set alerts that sound at random times within a designated time frame (e.g., the participants respond at four randomly picked times during the day). ESP, iESP, and PMAT all include this indispensable feature. In

addition, PMAT includes the ability to set alerts at fixed times (*interval contingent*; the device sounds at a previously designated time).

Different forms at different times of day. With ESP, all forms each day must have the same format (i.e., contain the same items). PMAT, however, allows the researcher to set different forms for specific time spans throughout the day. For example, using PMAT, one could have a *morning* form that randomly fired between 9:00 a.m. and 11:00 a.m., a *midday* form between 11:00 a.m. and 1:00 p.m., and an *afternoon* form between 1:00 p.m. and 3:00 p.m., and each of these forms could contain different items.

Likewise, iESP will allow for different items to be presented at different times each day, using syntax to specify these items. iESP works from a pool of items created for the whole questionnaire (whereas PMAT works with sets of items, each assigned to a specific time span), and researchers could use the branching function to create different paths of questions for different times.

Set multiple days. ESP requires that the schedule for each day be identical. For example, a given study may run between 9:00 a.m. and 9:00 p.m. for all days. iESP allows different schedules to be set for weekends than for weekdays (e.g., on a weekday, the study runs from 9:00 a.m. to 5:00 p.m., but on weekends, it runs from 11:00 a.m. to 9:00 p.m.), and PMAT allows each day to have its own schedule. The ability to set different schedules for weekdays and weekends may be especially useful, given that response patterns may differ between weekdays and weekends (Kennedy-Moore, Greenberg, Newman, & Stone, 1992).

Participant-defined time spans. All three of these packages allow the researcher to determine time spans for daily schedules (e.g., the study may run from 9:00 a.m. to 9:00 p.m.). PMAT also allows participants to define their own time spans. For example, if the participants have schedules that differ from one another (e.g., some participants have a 9:00 a.m. to 9:00 p.m. schedule, whereas others have a 10:30 a.m. to 10:30 p.m. schedule), it might be useful to let them determine their own starting and ending times. In ESP and iESP, it would be possible for the researcher to manually set the times on each PDA to correspond with each participant's schedule (i.e., to create separate schedules for each participant). PMAT differs in that in addition to the option of setting each PDA separately, participants can set their own schedules immediately prior to the start of the study.

Can-take-over device. All three programs allow researchers to specify whether the program takes over the PDA, thus "locking out" participants from using other programs on the Palm (e.g., playing solitaire or using the datebook). If this option is enabled, once the study is initiated, the participants cannot exit the diary program. However, if it is disabled, the participants are free to exit the program and open other applications.

This feature may be important as a means of conserving batteries (i.e., participants can diminish power while engaging in other activities on the Palm). Also, in ESP and iESP, we found that upon exiting the program, notification alerts did not consistently sound, and therefore, prohibiting the participants from closing the iESP (or ESP) was essential to maintaining the schedule for the study. Although in many situations it is desirable to have participants locked out from using other applications on the device, it is possible that researchers will choose not to enable this function. In situations in which battery power is not a concern (i.e., short-duration studies, or very long studies in which the device will need to be recharged periodically, regardless of whether it is locked or not), allowing the participants to utilize other functions of the PDA may encourage participation in the study.

Alerts fire when the program is not open. In ESP and iESP, if the participant exits out of the diary program, alarms will not sound as scheduled. This problem can be avoided by "locking out" other programs, using the "takes over device" function, but if this feature is not engaged and the participants close ESP or iESP, the diary software is essentially disengaged until the program is opened again. PMAT is designed so that if the participants exit out of PMAT, it will automatically open when a signal is scheduled to occur.

Response time windows. In ESP and iESP, researchers can specify the window during which the questionnaire is available following the alert (in seconds). Specifically, how long the questionnaire will be available for (e.g., 120 sec) and how often during that window reminder alerts will fire (e.g., every 10 sec) can be set. Likewise, in PMAT, the response time window (in minutes) can be specified, with an option of having reminder beeps sound every 30 sec for the first 2 min of the window.

"Do not disturb." With signal-contingent studies in PMAT, if participants are currently busy and cannot complete a survey, they can set the "do not disturb" feature. This allows the participants to block out signal beeps until a more convenient time (5, 15, 30, or 60 min later). Essentially, it is akin to a mute button for a particular period of time. Surveys may become available, and participants can complete them; however, the corresponding alerts will not sound. It is important to note that the purpose of this feature, as opposed to a "postpone" feature (such as a snooze button), is to not compromise the schedule of the alerts and responses, whether set at random or fixed intervals, while giving the participants the option of not being bothered if busy. With the "do not disturb" feature, schedules of alerts remain intact; the alerts are simply silenced. Postponed signals would not constitute a random sample of daily experiences; rather, they would represent a convenience sample of daily experiences.

In ESP, assuming that the "takes over device" feature is engaged, alerts will sound as scheduled. However, in iESP, there is a feature allowing participants to turn the alert sounds on or off (and, if supported by the hardware, alerts can be set to vibrate), even if they are locked out. The important difference to note is that in iESP, the alerts are turned off and remain off until the participants turn them back on. This is somewhat different from PMAT's "do not

disturb" function, which is timed (i.e., 5–60 min, as described above), although it serves the similar function of allowing the participants to silence their PDA device if necessary. Thus, with iESP, researchers rely on participants to turn their alerts on when it is once again convenient, whereas PMAT automatically turns alerts back on after the designated time.

Feedback regarding study progress. iESP provides feedback for participants at the completion of each daily form (e.g., "form 3 of 15 completed"), as well as a notification at the end of the study. ESP notifies only at the end of the study, and PMAT does not include either of these features.

Question Formats

Multiple choice/one response. All three programs allow for this essential item format; however, ESP is somewhat limited in display and labeling of buttons. iESP allows for much more flexibility, providing several formats for this type of item, including buttons, a pop-up menu (with up to 9 response items), a list (with up to 6 response items), and a sliding scale (see the Scaled Responses With Slider section below). PMAT also allows for multiple-choice/one-response items with up to 50 response items but does not include a pop-up menu format. In addition, PMAT includes a sliding scale format.

Multiple choice/multiple responses (i.e., checklists). Both iESP and PMAT feature check lists that allow for multiple responses (ESP does not); iESP offers up to 6 alternatives, and PMAT allows up to 50.

Scaled responses with slider. Both iESP and PMAT (but not ESP) feature a scaled-response-with-slider format (i.e., a continuous scale in which participants use the stylus to move an indicator along a horizontal line to specify their responses). In iESP, the maximum number of increments in the scale is 100, with the endpoints labeled. PMAT provides similar functionality with two types of sliders. The first allows the two endpoints to be labeled, with the labels for intermediate points also appearing as the participants roll over other points with the slider. In addition, a numerical slider is available, with values ranging from 0 to 100 (i.e., for percentages). Neither program allows for the starting point to be specified. In iESP, the slider defaults to the middle of the scale; in PMAT, it defaults to the right side.

Open-ended responses. iESP allows for free-form text entry, using the stylus with *graffiti* (i.e., character recognition) or the virtual keyboard. Neither ESP nor PMAT includes this response format.

Response latencies and time/date stamp. All three programs record response latency for each item (i.e., how many milliseconds it took the participants to respond to the item), in addition to recording the exact time and date that each survey was completed.

External application. In addition to the more standard item formats, PMAT allows researchers to attach an external application as an item in a questionnaire. External applications can be one of the many available for download for Palm OS or one designed for a particular purpose by the researcher. For example, if researchers are interested in changes in performance on a vigilance task, a Palm-based application that presents such a task can be included as part of the questionnaire.

Handling Data

Save data to memory card. In addition to storing data in the Palm's internal memory, PMAT will save data to a memory card (if the PDA supports external media). If a memory card is present in the unit, data are backed up to the card at midnight each day. This may be an important feature, so that data will not be lost should the batteries run out or the Palm is reset.

It should be noted that some PDA units employ internal rechargeable batteries; these units will need to be recharged periodically for long diary studies (i.e., several weeks). Other units using nonrechargeable batteries require that batteries be replaced periodically. If batteries die (or are removed for a period greater than a few minutes) or the machine is *hard reset* (all internal memory is reset to factory conditions), the device will revert to the default software. This means that no add-on applications are retained; therefore, in all three programs, all data, as well as surveys, will be lost. In PMAT, if there is a memory card present, data will be retrievable as of midnight the night before the batteries died.

Whereas hard resets or dead batteries result in a loss of all files and data associated with the diary software, a *soft reset* (i.e., akin to restarting the device) will not affect any of these programs. Surveys loaded on the PDA, as well as any data that have been previously collected, will be retained, and the diary program should resume normal operation following the soft reset.

Export to a comma-separated value format or as plain text. ESP exports data to plain text, whereas iESP outputs as text or in a comma-separated value (CSV) format. Likewise, PMAT data are exported as CSV. Overall, because of the flexibility of programs such as Microsoft Excel and most commonly used statistical packages (e.g., SPSS and SAS) in importing common file types (such as CSV and text), data gathered with ESP, iESP, and PMAT can be used easily with a wide variety of statistical software. We note, however, that the output data structure for these programs may not be one to which some researchers are accustomed. In particular, all three programs provide a separate line either for each signal (ESP and iESP) or for each survey item (PMAT). This allows for maximum flexibility in terms of the desired analysis type (e.g., multilevel modeling) but also requires some work in formatting the data to fit the desired analysis.

SUMMARY

Once they have become familiar with the PDA and Palm OS, both of which are designed to be quite user friendly, it is likely that researchers can become proficient with ESP, iESP, and PMAT 2.0 rather quickly. In our experience, learning the basics of these programs can be accomplished in several hours, and once a simple study

is planned, it can be implemented on the PDA with these programs with a day or two of work.

As was mentioned earlier, ESP is the original diary application and has somewhat basic functionality. In comparison with the available alternatives, it has several limitations and is not as strong as either iESP or PMAT. It is, however, perfectly capable of running diary studies that employ simple designs, and researchers would be wise to examine it as an introduction to these sorts of data collection methods. In addition, iESP and PMAT owe much to Feldman Barrett and Barrett's (2001) work, which serves as the conceptual foundation for both of these programs.

iESP is a reliable and user friendly computerized diary program. It incorporates most of the features necessary in basic ESM designs, and with the many available question formats (including pop-up menus and open-ended responses) and feedback provided to participants, iESP is very user friendly. iESP does require some knowledge of syntax to program studies, but this syntax is straightforward to learn and implement in simple study designs. For more complex designs (i.e., branching or different surveys at different times), more familiarity with the syntax is necessary. In addition, because the syntax can be edited with the Memo Pad application on the Palm, changes in the program can be made directly on the PDA (without having to reload the program from the desktop computer) or with any text-editing program.

Because programming is done in a *point-and-click* Java-based environment, PMAT provides an accessible interface for creating studies. Users may appreciate not having to learn new commands or syntax to set up their studies, and the interface (i.e., menus and windows) may be accessible to most researchers. In addition, PMAT supports many different question formats, including external applications. Furthermore, it is not overly complicated and is flexible for creating complex scheduling options and question patterns, including branching, interval- and event-contingent designs in the same study, and differing question sets at different time points each day. In short, PMAT is a user friendly, yet very powerful, program for both simple and advanced applications.

The differences in user interfaces and methods for entering questions between iESP and PMAT have implications for the learning curves for each of these packages. The syntax for iESP is easy to learn for simple diary studies. However, as study designs become more complex, a more sophisticated knowledge of iESP is necessary. Researchers need to be quite familiar with iESP syntax to create intricate studies, whereas simple designs can be executed quickly and with minimal effort with this program. PMAT, on the other hand, takes time to become familiar with because it requires users to learn how to navigate various menus and windows to create a study. However, once researchers are familiar with the PMAT interface, creating both simple and complex designs can be done with little difficulty. In short, novice users wishing to run very basic diary studies will find iESP to be a good choice. Likewise, researchers with the time and expertise to fully learn iESP syntax will have the ability to create very complex studies. On the other hand, researchers learning the software will find that they can create both simple and complex studies with PMAT. It does take more initial familiarity with the software to build a simple study in PMAT, in comparison with iESP, but once one has a basic knowledge of the software, creating complex studies in PMAT may be more straightforward.

Limitations and Future Directions

Although both iESP and PMAT have made great strides in advancing the tools available for daily diary research, there are still many features that should be considered for future generations of palmtop diary software. In particular, allowing truly dynamic timing of daily forms is desirable. A program that provides participants with the ongoing ability to modify their daily schedules themselves would be ideal. iESP and PMAT begin to provide some flexibility, in that different days can differ in schedules (weekends vs. weekdays in iESP; PMAT allows each day to differ) and participants can set their schedule at the beginning of the study (in PMAT); however, neither of these programs allows for "on-the-fly" scheduling changes.

In addition, increasing the flexibility of item presentation and formats would be desirable. For example, more flexibility in randomization of items and groups of items is still needed. Furthermore, although PMAT and iESP offer a range of response formats, others (such as a rank order format) might be useful to researchers. In addition, other features, such as providing researchers with the ability to change the default position of the slider, allowing multiple items to be presented on a single screen, and giving the option to allow participants to go back and modify previous responses (within the same survey; i.e., to correct a response made in error), would make these programs even more attractive. Finally, software that provides the ability to assign one PDA to several users (e.g., one Palm for a dyad in a study of marital interaction, rather than one PDA for each partner), while limiting access to surveys to each user and keeping track of each individual's responses, would help maximize researchers' resources in conducting diary studies with PDAs.

One of the most exciting aspects of using palmtop computers for diary studies is that new avenues are opened regarding the types of data that can be collected electronically. The external application feature in PMAT hints at the future possibilities of these methods. In addition, as the hardware and software continue to evolve, it is likely that researchers will be able to capture many other types of data electronically. For example, as PDAs begin to integrate digital cameras, it will be possible to acquire literal snapshots (or video) of participants' environments. It should be noted that C.A.E.S. (Context Aware Experience Sampling Tool by the Changing Places Consortium at MIT) is a new ESM program that is optimized for multimedia inputs. Although not ideal for the flexible presentation of survey items (and therefore, not ideal for social scientists), C.A.E.S. clearly provides insights into the future possibilities of this technology.

Likewise, PDAs with sound-recording capabilities will be able to document participants' cognitions (i.e., verbal-

izing current thoughts) or interactions (i.e., conversations; akin to the EAR technology developed by Mehl, Pennebaker, Crow, Dabbs, & Price, 2001). Furthermore, as wireless technologies are expanded, data from PDAs may be available instantly, rather than only upon the completion of a study. Given that ESP, iESP, and PMAT are all open source, it is only a matter of time until these software packages evolve to utilize these advanced PDA hardware features.

Thanks to the pioneering efforts of Feldman Barrett and Barrett (2001) and the advances made by iESP and PMAT, researchers armed with a handful of Palm OS machines running these software packages can conduct complex studies to obtain daily diary data. These applications for collecting diary data include a number of attractive features that provide researchers with methods and information previously unavailable in diary studies (e.g., random ordering of items and time/date stamping of responses) and may expand the range of possibilities in diary study designs.

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APPENDIX
Internet Links for ESM Programs and Resources

ESP	www2.bc.edu/~barretli/esp/
iESP	seattleweb.intel-research.net/projects/ESM/iESP.html
PMAT	www.mfri.purdue.edu/PMAT/
General ESM resources	www2.bc.edu/~connert/esm.htm

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