PSSOH 2021, DOI: https://doi.org/10.5281/zenodo.5522984

xSample: A FREE, USER-FRIENDLY APP FOR COLLECTING EXPERIENCE SAMPLING DATA

Ljiljana B. Lazarević[1] & Goran Knežević[1]

1: Faculty of Philosophy, University of Belgrade, 11000 Belgrade, Serbia
e-mail addresses: ljiljana.lazarevic@f.bg.ac.rs, gknezevi@f.bg.ac.rs

ABSTRACT

In this paper, we introduce xSample, a free, open-source platform that our lab developed to use in experience sampling studies. The experience sampling method (ESM) belongs to the group of ambulatory assessment techniques and presents a novel assessment tool in (social) sciences. Human-computer interaction (HCI) as a multidisciplinary field focuses on the design of computer technologies and interaction between humans and computers. The fast development of smartphones enabled methodological advancements and the development of smartphone apps suitable for ESM. This enables researchers to collect various behavioral measures, like the number of phone calls, text messages, GPS data, in addition to data collected using ESM. We provide a brief overview of xSample features as well as the pros and cons of using smartphone-based apps for ESM.

Keywords: ambulatory assessment, experience sampling method (ESM), smartphone-based apps, xSample app, human-computer interaction (HCI).

1 Introduction

Moving survey research from lab to online setting provided researchers with several benefits [1]. Van Selm and Jankowski [2] report that online surveys enable access to more diverse populations. A recent report done by Pew Research Center revealed that as of 2015, 84% of American adults use the Internet, while in the population of older adults, which is the fastest-growing group of Internet users, 58% are using it [3]. Online data collection also reduces the biases of the researcher being present in the lab together with the participant and decreases the cost and time necessary to collect data [4]. Online data collection also reduces human errors and standardizes administration, and is proven to be of the same quality as traditional methods in terms of reliability and validity [5].

Development and increase in online survey research took a parallel path with technological advancements. Smartphones are amongst the fastest-changing devices and their usage in psychological research is increasing stunningly [6]. Technical characteristics of smartphones, like memory capacity, processors, operating systems, onboard sensors, different connectivity options, GPS tracking, visual and audio output, haptic and motor output, the possibility of recording visual, audio, and haptic signal, call logging, data usage tracking, etc. (for a detailed overview see [6]) are making smartphones very attractive research tool in social sciences and psychological studies. Thus, searching through Elsevier's database "Science Direct" - either within the title or abstract - with the following keywords, ("experience sampling" OR "ecological momentary assessment" OR "ambulatory assessment") in the last 10 years (from 2011 onwards), and limiting this search to articles (research and review) and book chapters, yields 1034 results. Searching through all databases of publisher EBSCO with the same keywords, again in the last 10 years, and limiting research to academic journals only, yields 6932 results. Assuming that these databases are not

overlapping it means that, in the last decade, at least two full articles (or book chapters) relying on ESM methodology were published on average per day - by these two publishers only. Experience sampling methodology appears to blossom, indeed.

1.1 Experience sampling method

The experience sampling method (ESM, [7]) presents a novel assessment tool in social sciences and psychological research [8, 9]. The ESM method is used to collect data on everyday behavior, emotions, and cognition and allows researchers to gain insight into the dynamics of people's cognitive and emotional processes, and characteristics influencing these dynamics [10]. The ESM is also referred to as the daily diary method [11], ecological momentary assessment [12], event sampling [13], and intensive longitudinal assessment [14]. The ESM belongs to the broader group of techniques known under the umbrella term ambulatory assessment techniques [8, 15], which are used also to collect data on verbal behavior [16, 17], to obtain reports on various physiological states [18, 19], etc.

The ESM offers several advantages compared to other assessment methods. The first is an increased ecological validity, as ESM offers very direct and more valid insight into people's mental and behavioral patterns [9, 20]. It enables us to study people in their "natural habitat", thus, allowing us to understand behavior and factors influencing our behavior which is not available when using retrospective questionnaires or artificial manipulations [7, 15]. Additionally, real-life contexts are diverse and less constrained than laboratory settings, allowing us to observe a wide range of people's responses [21]. Repeated measurements in different contexts allow researchers to understand variability in mental states and psychological constructs, and to disentangle sources of variances using multi-level modeling [22]. Repeated measurements also reduce assessment error and improve the reliability, validity, and transparency of individual pattern assessments [20].

In ESM, participants are providing self-reports similar to diary studies, but different from typical self-report, here participants are proactively triggered at various points throughout the day [23]. Participants do not have to rely on their long-term memory to reconstruct past events or experiences, and data collection is primed to those particular events that are of interest to the researcher [24]. Another advantage is the possibility to overcome typical drawbacks of self-reports, like socially desirable responding, acquiescent or extreme responding [25, 26]. Since respondents answer to the items at the moment (or very close to it) ESM enables reduction of recall bias, and available evidence suggests that the accuracy of responses collected using ESM is substantially higher than with traditional retrospective methods [27, 28].

ESM enables the assessment of experiences, behaviors, thoughts and emotions, and moment-to-moment changes in mental states. In a typical study, a respondent is asked to complete a short questionnaire, usually, a couple of minutes, in response to beep prompts. Typically, respondents are triggered randomly, in an unpredictable random time sampling protocol, but event sampling is also used [13]. ESM studies cover a range of different question types, Likert-type scales, open-ended questions, visual analog scales, checklists, etc.

On the flip side, ESM has some drawbacks. First, it is very time-consuming and demanding for the participants [22]. Study protocols include repeated daily assessments for at least 7 consecutive days, which can create a significant burden for respondents, despite assessments being kept as brief as possible. Second, although some studies suggest good compliance [29], other scholars report that compliance with the research protocol can be jeopardized because subjects are completing the study during the day, without the presence of the researcher [22]. Third, there is a possibility of selection bias, as respondents can miss assessment as a response to their current mood. Nevertheless, recent findings suggest that time of the day predicts non-response stronger than mood [30]. Finally, the order and the content of the questions, and repeated assessment can induce the reactivity of the respondents [22]. Therefore, it is important to balance questions and carefully select the items [20].

2 Human-computer interaction (HCI) in social sciences

Recent methodological advancements are challenging researchers to move beyond lab experiments to understand how people behave and function in everyday, real environments. Human-computer interaction (HCI) or human-machine interaction (HMI), or man-machine interaction (MMI) as a multidisciplinary field focuses on the design of computer technologies and interaction between humans and computers. In the field of HCI, the fast development of smartphones enabled methodological advancements and the development of smartphone apps suitable for ESM.

2.1 Advantages of smartphone-based ESM

The usage of HCI and smartphones in scientific research (especially ESM) has several important advantages. The first is (flexible) control over the whole process of data collection, as researchers can overview the whole process of data collection in real-time and record behavioral data like movement and communication. Second, based on the completion time we can determine whether respondents were skipping or inattentively completing questions [24].

Another advantage is its cost-efficiency since long-term studies of everyday behavior and collecting a rich body of data without the researcher's intervention is enabled, which reduces the work needed. As already said, ESM allows for studies of increased ecological validity. By using smartphones, we have relatively easy access to a variety of behavioral data without asking participants to report on them and without constant observation. Thus, using smartphones for ESM offers unobtrusive data collection and enables context reconstruction. Furthermore, using smartphones to collect ESM data enables researchers to collect and analyze data in real-time, which allows us to identify respondents who do not comply with the study protocol, participants' drop-out, or some technical problem [24]. Moreover, ESM offers a possibility to embed logic in the order of the questions.

In psychology, the ESM proved to be a valid assessment method of very different outcomes, e.g., those related to mood dysregulation [31], anxiety [32], substance-use disorders [33], premenstrual disorders [34], and psychotic-like experiences [35].

2.2 Challenges in smartphone-based ESM

- *Programming*. Although for researchers who have the technical knowledge to program an ESM study in freely available software packages, study costs and technical requirements are reduced, accessible tools for researchers without programming skills are still lacking [36].
- *Study equipment.* Another challenge is the cost of the study since the equipment used for ESM can be high. Therefore, researchers consider using the participant's own devices during the study [24].
- *Heterogeneity of platforms.* Furthermore, the large number of different devices developed by different manufacturers creates another challenge: variations in both hardware and software components. Thus, the software used for ESM has to be flexible enough to accommodate and support different devices. The development of smartphone devices is extremely fast, thus imposing new challenges and requirements for developers of ESM apps.
- *Technical characteristics of smartphones.* Although each generation of smartphones has improved technical characteristics, there are still significant differences in their performances. Memory capacity, battery duration (especially when using GPS data), limited-accuracy sensors, and interference of different apps (third-party application intervention) may cause difficulties in functioning and influence the quality and the accuracy of collected data [6, 37].
- *Biases in sampling and difficulties in participant recruitment.* Despite the growing popularity of smartphones and their widespread use, some data suggest that adoption of smartphones is slower in people of lower SES, coming from developing countries, introverted, mentally ill, older people, etc [38]. Moreover, a bias in sampling will also

happen because certain people might perceive data collection via smartphones as intrusive, and fear for their privacy [6].

- *Participant behavior*. The quality of the collected data depends on the responsibility of the participants. Namely, respondents can forget to recharge smartphones, change the device during data collection, or lend their smartphone to someone else (someone else's behavior is tracked in those situations), or even purposely change their behavior because they know they are being studied. Another challenge is the fact that a lot of people have two smartphones, one using for their work, and another using outside their working hours which creates biases in behavioral data collected or even restricts data collection to certain days in the week or time during the day [6, 37]. Additionally, device ownership influences the behavior of respondents. If participant uses a study-specific device it influences the quality of the data - participants might feel uncomfortable using unknown device and carrying several devices can influence participant's behavior [24].
- *Sensor usage.* Despite being highly relevant for assessment of participants' behavior, sensors are still relatively rarely studies thoroughly [36]. For the app developer, sensor development is very costly, while on the user side, its usage and recording imposes some requirements because participants also have to be very familiar with the features their smartphone is offering or carrying additional devices collecting sensor data such as bracelets, fitness trackers, etc.
- *Data management and analysis.* The amount of data collected using smartphones and their complexity pose a new challenge to researchers. To adequately analyze and interpret collected data, researchers have to gain expertise in complex multilevel analysis, signal processing, feature extraction, machine learning, and pattern recognition [6].
- *Ethical issues*. Using smartphones for data collection imposes certain difficulties in maintaining the privacy of respondents participating in the study. Although most of the apps do not record the content of the calls, text messages, and e-mails, the majority of smartphone apps collect GPS data, call logs, and the logging of sensors. Collected data may allow for inferences of participants' gender, life stage, marital status, home address, etc, thus making absolute anonymity very difficult to achieve [6].
-

2.3 Essential features of smartphone ESM apps

Several features are essential for high-quality data collection. First, an app should offer researchers the possibility to design a questionnaire using a variety of item types. The app should offer a choice between multiple-choice, open-ended questions (text, numbers), multimedia audio, video, images, sliders, etc. Furthermore, branching logic is a very useful feature, so that based on previous responses, a researcher can decide what will be the next question a respondent will see. This feature positively influences a completion rate, as respondents are only asked to respond to questions they should see. An adequate app should also be able to collect GPS data and collect data on the movement of respondents.

The app should offer a possibility to have reliable reminding system, as this is one of the most important features of ESM. Several different types of reminders are possible: fixed dates, rolling dates (e.g., every Saturday at 1 PM), and random times which are used in most ESM studies. In addition, a system reminding the respondent should be reliable and available when the phone is offline, thus, the majority of smartphone apps are using push notifications. Push notifications are mobile alerts that are visible even on locked screens, accompanied by sound or vibration. A good smartphone app should be able to collect data when offline. Offline data collection is highly important since a good-quality internet connection is not possible all the time or when using mobile data is expensive. Finally, a high-quality smartphone app should be safe and offer security for collected data. Thus, data should be stored on safe servers, and respondents should be aware of what kind of data is collected and what safeguards are.

3 About xSample

xSample is an open-source smartphone android-based ESM app developed by the Laboratory for research of Individual differences at the Faculty of Philosophy, University of Belgrade. The app is quite configurable, user-friendly, and does not require programming knowledge. xSample is freely available to researchers. Researcher conducting a study are given credentials to access the platform free of charge and can set up their study. It serves as a research tool for tracking the emotions and actions of respondents.

3.1. Structure of the xSample platform

After logging in, a researcher can configure items that will be displayed to the respondent (i.e., "poll" section in the platform) and information about the participants (i.e., "examinee" section in the platform). In the "poll" section, the researcher first should create a survey that will be administered i.e., labels the survey, adds disclaimer text if wanted, and sets the number of days. Additionally, a number of polls that will be administered during one day of ESM is set, as well as poll periods and reminders (random or fixed). After that, the researcher creates items, that is, selects a type of the item (multiple-choice, open-ended questions, sliders, visual stimuli), enters the text of the item, possible answers (if an item is a close-ended question), select whether the item will be displayed only in the first period during the day, and selects the poll to which the item will be assigned (if several polls are created). The researcher can determine the order of the questions, how often to run trials. The app also allows for branching logic. The app uses push notifications and respondents can be reminded to complete the survey at predetermined or random times.

In the "examinee" section, an ID number of the respondent is mandatory, while gender, age, education, and name are optional fields. The ID number is created by the respondent using the instructions for generating the code provided by the researcher (preferred option) or the ID number can be assigned to the respondent by the researcher. Only respondents with IDs that are entered into the platform can take part in the survey. Each respondent has to be assigned to the poll in which they will participate (by selecting it from the drop-down menu if several surveys are existing in the platform).

3.2. Functionality of the xSample app

In terms of functionality, xSample covers several important features, like sensor logging, triggering, and branching. Specifically, the app allows tracking the number of incoming and outgoing calls and the number of text messages exchanged, but the content of the conversation is hidden to researchers. That is, the data about the calls and messages are restricted only to the amount of mobile traffic, not to its content. Researchers also can analyze GPS data and data collected using Google fit app. The app also gives the amount of internet data usage in bytes. Researchers also have the possibility to provide their participants with feedback on the moods and emotions they experienced throughout the survey. To create feedback, a researcher has to select items that will be used for it, and the algorithm calculates the score representing the mood and/or emotions of the respondents compared to the reference group, i.e., respondents participating in the study. To sum up, functionality features available in xSample allow researchers to collect data of similar quality like other available apps[24].

3.3. xSample and participants

To be able to participate in the study, a respondent has to download the xSample app from the Play market on their android device. Internet connection is necessary during the download of the app and during the last period of the day when data is stored on the server. The respondent has to accept terms and conditions to be able to continue using the app. Upon opening the app, the respondent has to enter their personal code, and the app is ready to use. Respondents are reminded to answer the survey in each poll period by push notifications. Questions are displayed to the respondents one by one and the app records their answers and their response times. If a survey is

administered several times during the day, after the first and subsequent period(s) responses are stored locally on the phone, while after the last period in the day, data is sent to the server. It is also possible to have the same respondent participating in several surveys (their personal code can be connected to several surveys in the platforms). In that case, upon opening the app on their device, the respondent chooses between available surveys. Respondents also can easily withdraw from the study by uninstalling the app from their device, after which the questionnaire is not delivered to the respondent nor are sensor data collected.

3.4. xSample data security

Collected data is stored on the central server where it is completely secure. Data is used exclusively by the researchers conducting the study. Collected data is easily downloaded in .csv format and pre-prepared adequately for multilevel modeling (i.e., all daily entries for each respondent are organized in rows, while responses to items and other data are organized in columns). Researchers have information about the date and time when responses were collected for each period of the day, and items are downloaded including their labels.

4 Conclusion

By making the xSample application freely available to researchers, we aimed to promote and facilitate the adoption of ESM. The xSample app is an easy-to-use platform that allows researchers to design an ESM study without the need of having programming knowledge. The variety of question types, reminder types, censor data that are collected, and push notifications are features that satisfy the majority of requirements of a high-quality ESM study. For the time being, the xSample is designed to be an app used solely for research purposes, that is, only users registered by researchers can use the app and participate in an active survey. This feature allows researchers to have high control over the usage of the app and the quality of the data collected.

However, we have to highlight some drawbacks of the app as well. First, due to financial restrictions, for now, the app runs only on the Android operating system. Another drawback is that, due to privacy issues, the app does not allow for tracking the usage of internet data while using most common communications apps like Viber, WhatsApp, Signal, Messenger, etc. This makes researchers blind to the significant part of verbal communication that respondents make during the day.

References

[1] Youngs A, Graf AS. Innovating the innovation: Applying mobile research methods to experience sampling. Journal of Social, Behavioral, and Health Sciences. 2017;11(1):8. https://doi.org/10.5590/JSBHS.2017.11.1.08

[2] Van Selm M, Jankowski NW. Conducting online surveys. Quality and quantity. 2006 Jun;40(3):435-56. https://doi.org/10.1007/s11135-005-8081-8

[3] Perrin A, Duggan M. Americans' internet access: 2000-2015. Pew Research Center. 2015 Jun 26;26(6):1-2. Retrieved from http://www.pewinternet.org/2015/06/26/americans-Internet-access-2000-2015/

[4] Crews TB, Curtis DF. Online course evaluations: Faculty perspective and strategies for improved response rates. Assessment & Evaluation in Higher Education. 2011 Dec 1;36(7):865-78. https://doi.org/10.1080/02602938.2010.493970

[5] Emery K. So you want to do an online study: Ethics considerations and lessons learned. Ethics & Behavior. 2014 Jul 4;24(4):293-303. https://doi.org/10.1080/10508422.2013.860031

[6] Miller G. The smartphone psychology manifesto. Perspectives on psychological science. 2012 May;7(3):221-37. https://doi.org/10.1177/1745691612441215

[7] Csikszentmihalyi M, Larson R. Validity and reliability of the experience-sampling method. In Flow and the foundations of positive psychology 2014 (pp. 35-54). Springer, Dordrecht. https://doi.org/10.1097/00005053-198709000-00004

[8] Fahrenberg J, Myrtek M, Pawlik K, Perrez M. Ambulatory assessment-monitoring behavior in daily life settings. European Journal of Psychological Assessment. 2007 Jan;23(4):206-13. https://doi.org/10.1027/1015-5759.23.4.206

[9] Trull TJ, Ebner-Priemer UW. Using experience sampling methods/ecological momentary assessment (ESM/EMA) in clinical assessment and clinical research: introduction to the special section. https://doi.org/10.1037/a0017653

[10] Conner TS, Tennen H, Fleeson W, Barrett LF. Experience sampling methods: A modern idiographic approach to personality research. Social and personality psychology compass. 2009 May;3(3):292-313. https://doi.org/10.1111/j.1751-9004.2009.00170.x
[11] Bolger N, Davis A, Rafaeli E. Diary methods: Capturing life as it is lived. Annual review of psychology. 2003 Feb;54(1):579-616. https://doi.org/10.1146/annurev.psych.54.101601.145030
[12] Stone AA, Shiffman S. Ecological momentary assessment (EMA) in behavioral medicine. Annals of behavioral medicine. 1994.
[13] Reis HT, Gable SL. Event-sampling and other methods for studying everyday experience. In Handbook of research methods in social and personality psychology 2000 (p. 190–222). Cambridge University Press.
[14] Hurlburt R, Heavey CL. To beep or not to beep: Obtaining accurate reports about awareness. Journal of Consciousness Studies. 2004 Jan 1;11(7-8):113-28.
[15] Trull TJ, Ebner-Priemer U. Ambulatory assessment. Annual review of clinical psychology. 2013 Mar 28;9:151-76. https://doi.org/10.1146/annurev-clinpsy-050212-185510
[16] Lazarević LB, Bjekić J, Živanović M, Knežević G. Ambulatory assessment of language use: Evidence on the temporal stability of Electronically Activated Recorder and stream of consciousness data. Behavior research methods. 2020 Oct;52(5):1817-35. https://doi.org/10.3758/s13428-020-01361-z
[17] Pennebaker JW, Mehl MR, Niederhoffer KG. Psychological aspects of natural language use: Our words, our selves. Annual review of psychology. 2003 Feb;54(1):547-77. https://doi.org/10.1146/annurev.psych.54.101601.145041
[18] Hawkley LC, Burleson MH, Berntson GG, Cacioppo JT. Loneliness in everyday life: cardiovascular activity, psychosocial context, and health behaviors. Journal of personality and social psychology. 2003 Jul;85(1):105. https://doi.org/10.1037/0022-3514.85.1.105
[19] Miljković N, Dubljević O, Bjegojević B, Milosavljević N. Biosignals: Measurement and Analysis with Applications in Psychology. EMPIRICAL STUDIES IN PSYCHOLOGY. 2020 Oct 15:26.
[20] Verhagen SJ, Hasmi L, Drukker M, van Os J, Delespaul PA. Use of the experience sampling method in the context of clinical trials. Evidence-based mental health. 2016 Aug 1;19(3):86-9. http://dx.doi.org/10.1136/ebmental-2016-102418
[21] Reis HT, Gosling SD. Social psychological methods outside the laboratory. In Handbook of social psychology 2010 (pp. 82–114). Hoboken, NJ: John Wiley & Sons.
[22] Myin-Germeys I, Oorschot M, Collip D, Lataster J, Delespaul P, Van Os J. Experience sampling research in psychopathology: opening the black box of daily life. Psychological medicine. 2009 Sep;39(9):1533-47. https://doi.org/10.1017/S0033291708004947
[23] Larson R, Csikszentmihalyi M. The experience sampling method. In Flow and the foundations of positive psychology 2014 (pp. 21-34). Springer, Dordrecht.
[24] Van Berkel N, Ferreira D, Kostakos V. The experience sampling method on mobile devices. ACM Computing Surveys (CSUR). 2017 Dec 6;50(6):1-40.
[25] Paulhus DL. Socially desirable responding on self-reports. Encyclopedia of personality and individual differences. 2017:1-5.
[26] Vazire S, Carlson EN. Self-knowledge of personality: Do people know themselves?. Social and personality psychology compass. 2010 Aug;4(8):605-20. https://doi.org/10.1111/j.1751-9004.2010.00280.x
[27] Solhan MB, Trull TJ, Jahng S, Wood PK. Clinical assessment of affective instability: comparing EMA indices, questionnaire reports, and retrospective recall. Psychological assessment. 2009 Sep;21(3):425. https://doi.org/10.1037/a0016869
[28] Stone AA, Schwartz JE, Neale JM, Shiffman S, Marco CA, Hickcox M, Paty J, Porter LS, Cruise LJ. A comparison of coping assessed by ecological momentary assessment and retrospective recall. Journal of personality and social psychology. 1998 Jun;74(6):1670. https://doi.org/10.1037/0022-3514.74.6.1670
[29] Johnson EI, Grondin O, Barrault M, Faytout M, Helbig S, Husky M, Granholm EL, Loh C, Nadeau L, Wittchen HU, Swendsen J. Computerized ambulatory monitoring in psychiatry: A multi-site collaborative study of acceptability, compliance, and reactivity. International journal of methods in psychiatric research. 2009 Mar;18(1):48-57. https://doi.org/10.1002/mpr.1803
[30] Silvia PJ, Kwapil TR, Eddington KM, Brown LH. Missed beeps and missing data: Dispositional and situational predictors of nonresponse in experience sampling research. Social Science Computer Review. 2013 Aug;31(4):471-81. https://doi.org/10.1177/0894439313479902
[31] Ebner-Priemer UW, Trull TJ. Ecological momentary assessment of mood disorders and mood dysregulation. Psychological assessment. 2009 Dec;21(4):463. DOI: 10.1037/a0017075
[32] Alpers GW. Ambulatory assessment in panic disorder and specific phobia. Psychological assessment. 2009 Dec;21(4):476. https://doi.org/10.1037/a0017489
[33] Shiffman S. Ecological momentary assessment (EMA) in studies of substance use. Psychological assessment. 2009 Dec;21(4):486. https://doi.org/10.1037/a0017074
[34] Bosman RC, Jung SE, Miloserdov K, Schoevers RA, aan het Rot M. Daily symptom ratings for studying premenstrual dysphoric disorder: A review. Journal of affective disorders. 2016 Jan 1;189:43-53. https://doi.org/10.1016/j.jad.2015.08.063

[35] Knezevic G, Lazarevic L, Zoric A. The meaning of momentary psychotic-like experiences in a non-clinical sample: a personality perspective. https://doi.org/10.31234/osf.io/pmhvy
[36] Raento M, Oulasvirta A, Eagle N. Smartphones: An emerging tool for social scientists. Sociological methods & research. 2009 Feb;37(3):426-54. https://doi.org/10.1177/0049124108330005
[37] Oliver E. The challenges in large-scale smartphone user studies. In Proceedings of the 2nd ACM International Workshop on Hot Topics in Planet-scale Measurement 2010 Jun 15 (pp. 1-5).
[38] Devaraj S, Easley RF, Crant JM. Research note—how does personality matter? Relating the five-factor model to technology acceptance and use. Information systems research. 2008 Mar;19(1):93-105. https://doi.org/10.1287/isre.1070.0153