“E” for Accuracy! Comparing Survey, Diary, and E-tracking Methods for Measuring Internet Use

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Abstract

Considerable debate exists over the accuracy of self-reported media use measures. This report compares three methods for studying Internet and computer use: online surveys, diaries and e-tracking. This study was conducted with undergraduate students from two universities. Participants were asked to (a) complete a survey (b) keep a diary over the course of one day, and (c) download Internet software which logs all Internet related activity. All methods assessed how frequently they engaged in Web surfing, information seeking, entertainment activities, email sending and receiving, and on and off-line video game playing. Results indicate that e-tracking estimates of Internet use are consistently lower than diary and survey estimates.

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The research debate over the accuracy of self-reported media use is not new (Coffey & Stipp, 1997; Reagan, 1996; Sheehan & Hoy, 1999; Yun & Trumbo, 2000; Zillmann & Bryant, 1985). Recent technological advances and increasing Internet penetration have stimulated new forms of data collection and new methodological research questions. For example, the Internet has recently enabled some survey research to move from expensive phone or direct mail methods to faster, less expensive email or web-based surveys. Initially low penetration of home Internet access thwarted obtaining generalizable samples through the web. As Internet penetration continues upward, so does the realization that the Internet can be the source of valid, representative samples.

To date, the vast majority of research assessing online data collections has focused on response rates and generalizability. Little empirical research exists from which to understand response differences between retrospective self-report web-based data and such other measures as diaries or electronic measurement. Our own plan has been to concurrently study and compare all three methods – self-reports, diaries and electronic assessment from the same individuals. Findings will indicate how data collection method influences time use estimates.

Web-Based Surveys

Web-based surveys can be used efficiently to collect demographic, behavioral and attitudinal data, among others. The notable benefits to using web-based surveys include design flexibility (Schillewaert, Langerak & Duhamel, 1998), large samples (Kehoe & Pitkow, 1996), efficient data collection from time and cost perspectives, (Eastin, 2002;

Shannon & Bradshaw, 2002), increased anonymity (Kiesler & Sproull, 1986), access to difficult populations (Duffy, 2002; Truell, Bartlett, & Alexander, 2002), minimized interviewer error and bias (McCullough, 1998), as well as its relative novelty.

Limitations also exist. Although the generalizability of online samples is improving (Riva, Teruzzi, & Anolli, 2003), they continue to be problematic (Gunter, Nicholas, Huntington, & Williams, 2002). Further, multiple responses and ethical considerations (Greenberg, Eastin & Garramone, 2002) present problems for online data collection. Although these issues are relevant in the overall assessment of web-based data collections, they do not address how the response patterns in web-based surveys may differ from alternative forms of data collection.

Diary Estimates

Diary entries, on the other hand, have been considered by some a more accurate representation of use (Anderson, Field, Collins, Lord & Nathan, 1985). However, completing the diary entries places a heavier burden on the user throughout the data collection period. They must remember to use it each time. In addition, it may require users to report engaging in sensitive behaviors such as viewing sexual content or visiting pornographic web sites, if that is the focus of the research.

While there is a tendency for respondents to over-report their use of traditional media, research has generally found a moderately high correlation between retrospective self-reports and other benchmark measures. Van der Voort & Voojis (1990) found a correlation of .54 between diary data and self-reported television viewing. Further, this relationship increased to .77 for older children with higher education and family income. For the Internet, Yun and Trumbo (2000) compared snail-mail survey responses on

various types of email use to email and web-based responses. Results indicated that both web and email survey formats produced significantly higher response levels of email sent and received, social email use, and task email use. Finally, and most relevant to this research, LaRose, Eastin and Gregg, (2002) reported for general Internet use a significant correlation ($r = .65$) between retrospective recall and diary data.

Estimating Patterns

Generally speaking, how do people estimate behavior frequencies? Cognitive scientists such as Sudman, Bradburn and Schwarz (1996) posit that people expend cognitive effort only to the extent required to form a minimally satisfying response. In other words, when asked to complete a survey, people are "cognitive misers" when it comes to estimating behavior frequencies. As cognitive misers, people use such response strategies as estimating an ongoing rate of behavior, then approximating this to the time period specified by the question. This method of reasoning typically leads to overestimating the behavior.

Recently, Larose, Lin, & Eastin, (2003) concluded that Internet activity is driven by habit behavioral patterns. They discussed the possibility that repeated participation eventually decreases cognitive awareness, which subsequently leads to habitual behavior. If this is true then as cognitive awareness decreases, recall of that behavior should diminish. That is, actual use (e-track) and self-reported use (survey and diary) should differ dramatically when assessing online activity that is considered to be daily or routine such as emailing and instant messaging (Pew Research Report, 2003). However, given the lack of empirical evidence for this claim, the current study will examine the differences among a variety of more and less frequent activities.

E-tracking: An E-Z solution?

Self-report measures of Internet use are clearly wrought with problems, but many of these problems can be circumvented by supplementing or replacing self reports with electronic usage assessment, aka "e-tracking." Indeed, TV ratings services such as A. C. Nielsen have already begun to replace diary and other audience-dependent methods with unobtrusive electronic ones, in an effort to stamp out charges that self-report measures are distorted (Downey, 2001). Internet researchers have jumped on the electronic bandwagon as well—the high-profile HomeNet study, for example, employed electronic measures of Internet and e-mail use (Kraut et al., 1998). But most Internet scholars continue to use self-report methods, perhaps due to a belief that e-tracking is difficult and expensive. In defense of this position, both Nielsen and the HomeNet project had considerable financial support in getting their projects running, something quite lacking in today's cutback-laden academic environment. However, there are many low-cost options available for computer-based e-track research to occur.

The easiest way to electronically track Internet use is to simply examine the history file of an Internet browser. A glance at the history file of the popular Internet Explorer browser, for example, provides an alphabetical list of all the sites visited by a user during the course of a day. While somewhat useful, this e-tracking method is missing several key ingredients of a good use measure, the most important of which is *time*—thought it tells what sites were visited and can even tell the order they were visited in, it fails to specify the exact times these activities occurred. This "Achilles heel" of history files renders the method useless for most practical purposes.

A better method, and the one used in this study, is "spyware" based e-tracking. Though the word "spyware" may conjure up images of the "dark side" of the information superhighway, e.g., personal privacy spiraling out of control, this need not be the case. Granted, spyware software is typically used to spy on workers, cheating spouses, and for other questionable purposes (Kornblum, 2002). But spyware has the capability to be an extremely useful, easy to use, and low-cost tool for the academic community to better measure computer-based media use. A typical spyware program can log all the Web sites a user visits, all the windows they open, and even capture keystrokes and screen shots, at the discretion of the researcher (and perhaps human subjects boards). Furthermore, the programs can provide complete, chronological usage data with precise time coding. This can be used to measure times spent engaging in computer and Internet activities, patterns of use, and other handy information that may not be possible to glean through self reports, at least accurately. Thus, e-tracking holds much promise to communication scholars interested in going beyond traditional methods into ones more reflective of the rapidly changing technologies they are being used to study.

Hypotheses

Given that two of these methods involve active recall – survey and diary – we anticipate that responses to both methods are likely to be more problematic by comparison with the passive provision of information through e-tracking. That reflection is more likely to result in an inflation of time because time is not the conceptual base we use when we engage in Web surfing or computer application processing. Bases we use include information-seeking, message sending and receiving, etc., without any particular

regard for the amount of time that may be involved. From this, the working hypothesis evolved has been:

H1: E-tracking time estimates of Web activity and computer usage will be smaller than estimates obtained from surveys and diaries.

This has been coupled with a research question for surveys and diaries. Research cited indicates a moderate correlation between findings from those two methods, but little evidence as to correspondence between their absolute levels of activity.

RQ1: Will surveys and diaries differ systematically in overall time estimates?

It also would be possible to compare more routine activities with more novel ones, or time spent with more and less desirable web sites, but those efforts will be delayed until these initial questions are answered.

Methods

Participants

In the spring of 2003, undergraduate students (N = 50) from two large Midwestern U.S. universities enrolled in introductory communication and telecommunication classes participated in this study, for which they received course credit. They were between the ages of 18 and 25 (M = 19), and 74% were female. Approximately 46% were freshmen, with 28% sophomores, 10% juniors, and 16% seniors. They came from a variety of academic disciplines, 72% lived on campus, and 45% said they had some type of outside job.

Procedures

Data collection was completed in three stages. The first phase required participants to complete an online survey about their Internet and computer use yesterday. In the second phase, participants kept a diary of their Internet and computer use activities during one day. For the final phase, students were asked to install Internet use tracking software on their computers. This software recorded usage data for two weeks.

The survey instrument was created in HTML and placed on the Web. When voluntary participants accessed the survey site, the survey provided instructions about how to complete and submit it. Students could complete the online survey from Tuesday through Saturday of the first data collection week.

Immediately after submitting their survey, participants received a screen online with information about the second phase of the study, the Internet use diary. Researchers visited classes the following week and handed out the diaries. The four-page diaries, printed on heavy cardstock, each had a day identified on them ranging from Monday to Friday, with all days represented equally. Students were instructed to fill out their diary on one designated day, yielding a composite of weekday media use from the diary data.

For the last phase of the study, which took place for two weeks after the diaries were filled out, participants downloaded and installed e-track software on their computers. The specific software used is Boss Everyware, a commercially available monitoring program that can be downloaded from the Web for a fee. The software generates detailed usage logs with information about Web sites visited (including the exact URLs), application file names, the title of each opened application Window, and the starting and stopping times for each entry (see Appendix B for a sample log). A

license for the software was purchased and a specially tailored version was posted on a Web server from which recruited subjects could obtain their own copies. Once installed, the software automatically sent usage information back to the researchers either by transmitting it to a server on the campus network (in the case of on-campus participants) or to an e-mail account (in the case of off-campus participants). Students had the software on their computers for two weeks, after which they were provided with a program to uninstall it.

The received usage logs were then printed and content analyzed. Since two weeks of data were available from each participant, a randomly selected weekday after the third day was selected, and the corresponding log was printed out. A later day was selected to reduce the possibility of participants changing their habits while being monitored. A coding scheme produced usage data from the logs that was parallel to the data from the survey and the diaries. Thus, what constituted each category of use (e.g., instant messaging, surfing for entertainment) had to be carefully defined. This was done by first creating a codebook with definitions and examples of each use category. Then, the e-tracking software was pilot tested to determine what cues were associated with particular types of uses (e.g., the application file names and window titles associated with Instant Messenger programs). The logs of pilot subjects, who described what they did while online, were scanned for cues, and this information was added to the codebook.

Five coders were recruited and trained to extract the information used in this study. After reading the codebook, the coders participated in two weeks of practice coding. Then, a reliability check was performed on a subset of 16% of the received e-track logs. Each coder analyzed eight logs using specially formatted coding sheets (a

sample sheet, which shows the exact information that was coded for, is in Appendix A). Percent agreement on lines was used as a measure of inter-coder reliability. Average percent agreement between pairs of coders was 84%, with no two coders falling below 80% agreement. A qualitative scan of the "missed" lines revealed that disagreements were mostly due to splitting activities (e.g., making one Instant Messenger session into two) or missing very short uses (of 30 seconds to a minute). Based on this work, e-track coding was judged to be a reliable method of measuring computer use.

Variables

Parallel sets of variables, corresponding to time spent engaging in Internet and computer activities, were included in the survey and diary, and these also were coded from the e-track logs.

On the survey, all the "time spent" items used a scale ranging from "0" to "6 or more hours." To avoid a basement effect on short-term use items such as specific types of Web content, a "1/4 hour" choice was added between "0" and "1/2 hour.

Respondents were asked about time spent engaging in a broad array of *Internet activities* yesterday, including chatting, using Instant Messenger, posting on or reading message boards, and emailing, plus the following specific Web activities (culled from a scan of popular categories on the portal site *Yahoo*): surfing (1) for school or class information, (2) for current events news, (3) to shop or buy things, (4) for sports news and information, (5) for financial information, (6) for computer or Internet information, (7) for entertainment information, (8) for recreation or hobby information, (9) for travel information, (10) for sites with pornographic content, and (11) to play online games.

Items were added to assess time spent using general computer software (such as a Word processing program), file sharing services (such as Napster and KaZaa), and off-line computer games.

The diary required participants to keep track of their Internet and computer use over the course of a single, randomly assigned weekday. After an introductory cover page, each page of the diary had 10 rows, each corresponding to an Internet or computer use session. Columns enabled the participants to write down the start and end times for each use session and to identify in what type(s) of use(s) engaged. The uses were parallel to those in the survey, as were those in the e-track coding scheme.

All time figures were transformed into both hours and minutes to make appropriate comparisons. Since the survey items had "capped" maximum times, e.g., "more than 5.5 hours," the diary and e-track figures also were capped so that their unlimited ranges did not inflate variances or means when the methods were compared.

Findings

The basic results are in Table 1. Consider two sets of findings in that table, one for 10 different Web activities in the top half of the table and the second for a group of eight computer-based activities in the lower half. Let us first describe the overall trends obtained and then the individual activities.

Across the 10 Web activities, the E-track results provide the lowest estimates for each one of the 10, the online survey results the second lowest estimates, and the diary data provide the highest estimates. This pattern is significant at $p < .001$ ($X^{2r} = 18.05$, Friedman rank-order analysis of variance).

Within the set of Web activities, half the individual activities provided statistically significant differences. E-track estimates for use of the Web for school-related purposes and for entertainment purposes were lower than the diary and survey estimates. E-track estimates for use of the Web for news, for computer information and for hobbies were lower than the diary estimates. E-track estimates for sports information yielded borderline significance ($p<.10$) between those estimates and the other two. The multi-method analyses did not differ in terms of Web times estimated for shopping, financial, and travel information, nor for pornography; for three of these, the E-tracking estimates more closely matched the survey estimates.

A secondary analysis, comparing the E-track averages with the combined diary-survey averages, is equally productive. Eight of the 10 Web use comparisons demonstrate statistically significant differences ($p<.05$), Web use for shopping is marginal ($p<.08$), and Web use for porn is not significant.

In the lower half of Table 1, the same pattern is found for the E-track estimates. In eight comparisons, the E-track estimates are the lowest for seven of the computer-based activities; diary and survey estimates vary in terms of which is the highest. Nonetheless, the overall pattern of results is significant at $p<.02$ ($X^{2r} = 7.75$, Friedman rank order analysis of variance).

Here, two individual variables demonstrate significant differences. One, for time spent with discussion boards, is artificially significant because of zero entries. The second – use of email – is more substantial. Estimates from the diary method yield twice as much time as was derived from survey data or from the E-tracking method. In addition, the estimates for file sharing show a smaller amount of time from the E-tracking

($p<.10$), and the difference between E-tracking and the other two methods combined is significant ($p<.02$).

Clearly, the passive method of E-tracking yields consistently lower time estimates of Web use and a variety of general computer-based activities than do traditional diary and survey methods of estimation.

Discussion

The goal of this study was to compare two self-report measures of Internet use with an electronic measurement technique. The results revealed e-track estimates to be consistently lower than those of the self-report measures, especially for Web surfing. This finding was somewhat surprising considering that electronic television use measures have, in some cases, resulted in higher estimations than their traditional self-report counterparts (Downey, 2002). But the Web is a different medium than TV, and this modality difference may explain the discrepancy.

Web surfing and TV watching occur in distinct ways. TV watching typically unfolds in longer time blocks than Web surfing, which involves quick jumping from site to site to find information. Thus, time spent on websites is not akin to time spent watching TV shows, making "time spent" a problematic measure of different types of web activity. In our survey, we asked respondents to indicate their times spent on each of several types of websites by choosing a category, i.e., fifteen minutes, one-half hour, etc. However, the coded logs revealed that many web activities occurred for only a few minutes at a time. Thus, traditional time block categories do not seem to capture the nuances of Internet use except in cases of longer activities such as instant messaging, where survey, diary, and e-track estimates were more consistent.

Though the diary did not have fixed categories, the inflated time estimates from that method may be due to a related problem. In the diary, respondents were asked to check which activities they were engaging in during media use sessions over the course of a day. Given how short visits to different web sites seem to be, there may have been a tendency to treat surfing different types of sites as a single multitasking activity instead of several discreet ones. For example, instead of using five different lines to indicate five, three minute site visits, respondents may have treated it as one, fifteen minute session, in which case each type of site visit would be counted as having been surfed for fifteen minutes. A post-hoc examination of the diaries revealed many instances where this was the case. Thus, in addition to demonstrating the capabilities of an e-tracking system, these findings indicate a need to rethink how self report measures are constructed.

Indeed, a nagging problem in the measurement of all forms of media use remains that of identifying a meaningful common scale unit. The choice of time, e.g., minutes or hours, is more of a convenience than a psychologically or semantically meaningful decision. When you watch TV, you watch programs, not minutes. When you go on the Internet, you are targeting web sites, games or a friend, not minutes. Perhaps a new measure of Internet use should consider what sites where visited. This would allow respondents to recall content rather than time. In addition, equating 15 minutes of reading with 15 minutes of TV viewing ignores the differences in complexity of these two behaviors. Nonetheless, until time can somehow be refined in measurement schemes, it remains the most common index of use.

Limitations

Like self report methods, e-tracking has some limitations. To begin, there are an undetermined portion of users who share computers and/or access to the Internet from multiple computers, and/or multiple user handles. Though this has the potential to inflate or deflate usage figures, the problem can be largely alleviated by pre-tracking surveys that ask about computer use habits and handles. This information can be used to screen out certain subjects (e.g., those who use multiple machines) and/or data (e.g., coming from handles not belonging to the participant of interest). In the present study, steps were taken to obtain such information. During recruiting, subjects were asked if their Internet access was confined to their home or dorm, to which almost all said "yes." In addition, logs were checked for multiple screen names, which did not appear to be a problem. Nevertheless, we recognize that subjects could conceivably have used the Internet in another location (e.g., checking email at a friend's house), which would introduce some error into the time estimates obtained through their e-tracking logs.

A second potential problem stems from the coding of use information. With self-report measures, the subjective category interpretations of participants determines how their uses are classified. With coding, the coding scheme and coders determine this, which may result in slight discrepancies. In addition, our coding scheme did not allow for overlapping categories—coders were told to place each activity in the log into the single category that best captured it, whereas users may have counted certain activities (e.g., looking at discussion boards on a sports site) as two or more uses. This problem would only apply to a small subset of uses, and based on our coder agreement we would

argue that most activities clearly fit into one single category that both users and coders would agree on.

A final problem that we will address here is the lack of male participants in this study. Though invitations went out to a group of students split evenly between males and females, males seemed less willing to participate. The reasons for this are not clear, but it may have something to do with the privacy invasion concerns introduced by e-tracking. Since males have been shown to be heavier consumers of socially undesirable content such as porn, it may be more difficult to get their consent to do e-tracking.

Future Directions

Despite its problems, e-tracking has much to offer to the research community. This paper merely introduces how e-track can inform researchers of time spent engaging in various computer and Internet activities. E-track software can also be used to examine patterns of use, types of use (e.g., communication, information), specific web sites visited, how those sites were surfed, how much time computer users spend on individual web pages, and more. Further, research also should consider how socially desirable activities such as information seeking and socially undesirable behaviors such as viewing pornography and gambling differ by data collection method. Given the abundance of commercially available spyware today, the method of e-tracking is now more accessible than ever before, and computer-mediated communication scholars should take advantage of it. Internet use is far more complex than traditional media use—it encompasses a host of activities, many of which occur for a very short duration of time. Users of these media are also much more active than traditional media users. To better gauge how the

multitude of functions of computers are being used, the methods used to measure them need to be more “active” as well, which e-tracking certainly seems to be.

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Table 1

INTERNET AND COMPUTER USE YESTERDAY IN HOURS
(n = 50)

	Online Survey	Diary	E-Track	*F*
Web for school	.86	.93	.24	8.30*
Web for news	.16	.36	.03	3.19*
Web for shopping	.19	.38	.16	2.29
Web for sports info	.16	.22	.03	3.06
Web for finances	.07	.22	.02	2.14
Web for computer info	.08	.45	.02	5.32*
Web for entertainment	.35	.46	.07	3.88*
Web for hobbies	.22	.42	.04	4.64*
Web for travel	.08	.08	.02	2.05
Web for porn	.04	.22	.03	1.53
Online chat	.02	.04	.00	.68
Instant Messenger	2.22	2.00	2.28	.46
Discussion Boards	.07	.01	.00	8.00*
E-Mail	.53	1.04	.51	5.20*
General Software	1.05	.80	.68	1.16
File sharing	.76	.56	.34	2.92
Online video games	.23	.21	.09	.86
Offline video games	.25	.20	.19	.07

*Significant at the $p < .05$ level.

Appendix A: Sample Coding Sheet

Session #	Start Time	End Time	Total Time	Activity Description	Activity Type

Activity Type Codes

Communication variables

1. chat room use
2. discussion board use
3. instant messenger use
4. email use

Web Use variables

5. banking/finance site
6. computer/technology site
7. education site
8. entertainment site
9. news site
10. online gaming
11. porn site
12. recreation/hobby site
13. shopping site
14. sports site
15. travel site

Other Use variables

16. music listening
17. non-online game playing
18. file sharing software
19. general software use

Other Activity codes

98. other type of web site
99. other non-web activity

Appendix B: Sample E-track Log Page