



# ONLINE DATA COLLECTION: AN EMPIRICAL ASSESSMENT OF VALIDITY AND RELIABILITY

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## Abstract

*The use of Internet to aid research practice has become more popular in the recent years. In fact, some believe that online data collection may revolutionize many disciplines by allowing for easier data collection, larger samples, and therefore more representative data. However, scholars are skeptical of its usability as well as its practical value. Thus the accuracy and consistency of online data gathering is a significant aspect of research methodology which is known as validity and reliability. Often new researchers are confused with selection and conducting of proper validity type to test their research instrument (questionnaire/survey). This paper explores and describes the validity and reliability of online data gathering and also discusses various forms of validity and reliability tests. The paper also examines the traditional model of reliability and validation of data. Evaluation of online resource is another topic which deal with how online resource is been managed by the operators. We thereby come up with principles and elements that can be used to evaluating data to ascertain the possibility of the data being reliable and valid. The paper briefly outline the processes used traditionally and then bring out how these principles can be presented in the new culture. By its very nature, the Internet appears to be a very promising medium for researchers. As a vehicle for data collection, it promises increased sample size, greater sample diversity, easier access and convenience, lower costs and time investment, and many other appealing features. The use of Internet to aid research practice has become more popular in the recent years. In fact, some believe that Internet surveying and electronic data collection may revolutionize many disciplines by allowing for easier data collection, larger samples, and therefore more representative data. However, others*

*are skeptical of its usability as well as its practical value. The validity and reliability of the scales used in research are important factors that enable the research to yield healthy results. For this reason, it is useful to understand how the reliability and validity of the scales are measured correctly by researchers.*

## **Introduction**

The advent of computers in the realm of social research has represented a huge step forward. Computer-assisted interviewing for online surveys and research has made data-gathering easier, quicker and cheaper. Online research methods are bringing about complex and thorough changes in the field. The most commonly mentioned advantages include a reduction in costs and errors, advanced design features and new elements including audio and video content, and the possibility of using new platforms, such as smartphones and tablets. However, many challenges and issues are yet to be resolved, including sampling strategies, penetration of the Internet, software solutions and start-up costs.

Some of these changes have had unexpected consequences. For example, the simplicity and low cost of online data collection have led to an unprecedented democratization of survey research. Online questionnaire applications are simple, user friendly, accessible to anyone with an Internet connection, and often free of charge. On the one hand they provide researchers with instant and cheap access to powerful design features, a variety of question formats and useful tools (e.g. simple statistical modules and panel management features); on the other hand, they may lead to less robust methodological considerations and to the institutionalization of bad practice (e.g. misrepresentation of convenient samples) (Lee et al., 2008). While online data collections are easy to do because they are cheap and quick, good online surveys are increasingly difficult to carry out due to over-surveying.

With the advancement of information and communication technology, researchers have found new methods of data collection and analysis. This has evolved from telephone surveys, computerized data analysis, and use of cell phones and pagers, to collecting information at random intervals, use of Personal Digital Assistants (or "Palm Pilots"), and use of the Internet

in research. Although the Internet is fast becoming a common fixture in contemporary life in many parts of the world, it remains relatively unused for primary data collection in many research fields.

The aim of the paper is to collect information from a literature review on validity and reliability of online data collection and. It evaluates its pros and cons in terms of research processes and outcomes.

## The Problem

The use of online data collection has risen in popularity over the past decade and reflects ongoing changes in the research process. With the ubiquity of the internet, a new avenue for collecting research became available. Today, internet-based research is common place and online surveys are considered cheaper, faster, and more convenient methods for accessing participants. Indeed, with online opportunities such as Mechanical Turk, researchers have access to samples that are vast, diverse, and motivated to respond to surveys.

Although internet-based research clearly benefits researchers, the validity of the data collected is unclear. Online data collection is assumed to provide anonymity and therefore participants are more likely to respond candidly and genuinely, (Ward&Pond, 2015). It is in the light of the above that this paper accesses the validity and reliability of online data collection.

Others include;

- Poorly chosen distribution channels can lead to biased data, low response rates and a host of other potential issues.
- Participants are less likely to stay fully engaged for a survey of more than 8-10 minutes than with other research methods
- Repeated requests to complete the survey can be perceived by participants as annoying, and can therefore backfire against a business.

- Unless an identification verification tool is used, it is impossible to know if the sample providing answers is the right person (i.e. it could be a family member, friend, etc.) or if one person is submitting multiple responses
- Difficulty reaching certain types of participants, such as those who do not have internet access or non-customer samples in niche industries
- Lack of quality random sampling leads to questionable (if any) statistical confidence and margin of error. A topic that is a major challenge the market research industry faces right now.

### **Evaluating On-line Resources**

The internal process can still apply to instruments got through Internet searches. Internal validity processes are not sufficient in and of themselves but fortunately the Internet has established new types of external validity check. (Richard, Michael, 2004) There are users who specialized in reviewing products, materials and websites. Operators comment on their encounter with some products. Some books are also reviewed on amazon.com, sellers and consumers are reviewed on eBay and opinions and technical initiatives are reviewed on slashdot.org, to mention but few. Most Software producers under different open-source licensing methods is reviewed, scrutinized and improved by many people. Eric Raymond expounds and extols this model<sup>2</sup>.

In summary we propose a set of indicators which encapsulate these principles; positive indicators which increase the probability of the information being accurate and negative indicators decrease the probability.

### **Conceptual Overview: Online data Collection Methods**

#### **E-mail-based Surveys**

In this approach an email message with attached questionnaire is sent to targeted respondents. The respondent after answering questions may reply through an email with



attached responses to a surveyor (Van Selm and Jankowski, 2006). An E-mail-based survey has the advantages of speed and low cost with higher response rate than web-based surveys (Elhejaj et al., 2010). This is because; email is a PUSH technology in which the message is sent to the respondent's inbox whereas the Web is a PULL technology in which respondent must be attached to a web page. It should be noted that there must be a predefined list of e-mail addresses of all respondents. As the survey can be e-mailed to many respondents with no cost, email-based surveys are less costly however, situations where manual entry is required for data analysis, cost may get high. Other problems reported are spam/junk mail and internet coverage bias.

Nowadays an email can be sent through an ordinary Short Message Service (SMS). This can be done using email-to-SMS/SMS-to-email gateway which enable the sending and receiving of email using SMS even to low-end mobile devices. The gateway can send/receive only those emails that contain only text. Rich contents such as audio, video cannot be delivered through SMS, because of limited number of characters per SMS. E-mail to SMS services are offered by all mobile operators.

### **Web-based Surveys**

Web-based surveying is an alternate and more advanced version of mail and email-based surveying. Today there are hundreds of web applications that offer a wide range of surveys from simple-to-complex and free-to-commercial survey solutions. These also offer a wide range of question types with more advanced administration options. The cost of the Web-based survey is low if a third party (normally web survey provider) is involved for overall survey conduction (survey preparation, distribution, response collection and analysis). For example, free service providers like Lime survey<sup>1</sup> may reduce the overall cost of a survey.

The Web-based survey is advantageous because of quick response collection and availability of automated analysis tools. So one doesn't need to pay for data entry operators. The major problem of Web-based survey is low response rate due to internet coverage bias (Van Selm and Jankowski, 2006). Also, in some situations the Web-users are not true representatives of the target population.

## Mobile-based Surveys

Mobile-based surveying and data collection is also a popular method used worldwide by government agencies and Non-Governmental Organizations (NGOs). Mobile phones, which are not only voice-based communication device but offer short message services (SMS, instant messaging) and Web-based services and are used extensively. The mobile-based modes are expanding rapidly due to their multi-model capabilities (Couper, 2011). The growing cellular infrastructure and low-cost mobile phones provide an opportunity to change traditional paper-based data collection techniques to pervasive devices like mobiles (Hartung, 2012). The mobile data collection is based on two techniques. It may be either Browser-based or SMS-based. The browser-based data collection needs an internet connection for sending and receiving of data. For examples Magpi<sup>2</sup>, Open-Data-Kit<sup>3</sup> and OpenXdata<sup>4</sup> offer mobile browser-based data collection. In SMS-based data collection an ordinary 160-character-SMS is used. The cost of SMS-based survey is low due to its pervasiveness. The responses are collected very quickly and efficiently. The automated tool for data analysis is also its major advantage (Rittippant et al., 2009). Besides all mentioned advantages; both browser-based and SMS-based data collection have limitations like mobile browser compatibility issues, mobile screen compatibility issues, and slow internet connections, limited number of characters per SMS, age factor, and low literacy rate especially in developing countries.

## Data Collection using Well-Formatted Forms and Browsers

Internet connection and installation of survey application on mobile are mandatory in this type of data collection. The forms can be downloaded from Web-application to a pre-loaded survey application on mobile. In form-based approach, the data can be collected using point-and-click approach with fewer chances of errors. However, this approach has the same inherit problem of internet coverage bias, slow internet connections. The following are a few well-known survey applications used for mobile and tablets.

- 1) Open-Data-Kit5: Open Data Kit is an open-source set of tools for data collection using mobiles and tablets. In Pakistan, ODK is used for data collection by NGOs. In Afghanistan, it was used in 2010 for fraud monitoring in elections. ODK uses forms for data collection on mobile phones, but forms and forms-data are downloaded and uploaded using GPRS/Internet from a user mobile phone (Hartung et al., 2010). Internet coverage bias is likely to occur in ODK-based data collection.
- 2) Magpi / Episurveyor6: Magpi (Ex-Episurveyor) is another well-known browser-based application used for data collection on mobile phones. The Magpi-forms can be downloaded to a pre-loaded Magpi-application on mobile phones. The answers can be sent back to a surveyor using internet or SMS, for which Magpi provides an international GMS modem number. It should be noted that forms cannot be downloaded without GPRS/Internet connection. Only the answers can be sent to the provided GMS modem numbers.
- 3) OpenXdata7: Open data is also open-source software for data collection using low price mobile devices. Open data is an advanced and renamed version of Epihandy8. It uses Openrosa-and-Javarosa9 platform for data collection for J2ME and android-based mobile phones.
- 4) Frontline SMS10: Frontline SMS is an open-source and free SMS management tool. It enables two-way communication using SMS with no need of internet connection. As SMS is available even for low-end mobile devices, therefore Frontline SMS is highly effective and easy way to communicate with a huge number of peoples.

### **Data Collection using SMS**

Short Message Service (SMS), which is considered as the most popular way of communication in developed as well as in developing countries (Rittippant et al., 2009), (Susanto and Goodwin, 2010). SMS is a bi-directional communication service for sending text messages through wireless communication system. It uses GSM 7-bit encoding with maximum capacity of 140 bytes (1120 bits/160 seven-bits characters or 140 characters using eight-bits or

70 characters using sixteen-bits for non-Latin alphabets such as Arabic, Urdu, Chinese, Korean, Japanese languages) (Mahmoud et al., 2010).

SMS-based survey is recommended as a solution to slow, low-response rate and internet coverage problems. SMS-based survey is best alternative to probability Web-based surveys for high response rates (up to 56 % increase in response) (Balabanis et al., 2007). The success indicators for SMS are low-cost and pervasiveness. SMS-based surveys are a best way to collect quick responses (in 3.3 days), which is better than other survey modes (Rittippant et al., 2009).

### **Web-based SMS Services for Data Collection**

SMS is extensively used for alerts, public transport alerts, listening to people opinions in most of the developed countries like Australia, Indonesia, and UK (Susanto and Goodwin, 2010). An inbound strategy invites people on TV, radio or print media while in outbound strategy a list of pre-selected mobile numbers is provided to these third-party survey-providers. Then third-party service providers are responsible for sending SMS invitations, questions and alerts, collect responses and analyze the collected data using statistical tools.

### **Evaluating Technical Data in this new world**

In the bid for students and scholars to take gain of this vast resource without being seen in its traps, new strategies to accessing data have to be adopted. It is important that experienced skilled professionals understands the change in tradition that has taken place and accept creative thinking habits and other structure when using the data. This problem has been recognized previously. Some institutions have tried to address the problem by supporting tutorials to support students identify and evaluate online data. For example the Ohio State University Libraries has a webpage to encourage their students with this.

A process is recommended for evaluating online data quality. (Richard, Michael, 2004) Sadly, there no accepted method assuring that any particular reference is valid and reliable; but nor was there any such guarantee in the pre-Internet world. Rather than offering a prescriptive formula for evaluating on-line information validity, we hereby come up with principles and elements that can be used to evaluating data to ascertain the possibility of the data being



reliable and valid. We will briefly outline the processes used traditionally and then bring out how these principles can be presented in the new culture.

### **Validity and reliability of data (Traditional Processes)**

There are external process and internal process for guaranteeing the validity and reliability of data.

The external processes that professionals stand on to ensure the qualities of printed technical data are:

- Peer review for journals or conference proceedings. After the material has been written it is tendered to accepted experts in the fields who mentioned on the superior of the work and reveal any crucial omissions or mistakes that they have noticed. In this case, multiple reviewers are involved. (Possibly two or three)
- The Technical magazines bring in editors who are capable in the field: These editors study the material and also cross-check with other sources, normally only best magazines survive market forces; thus financial essentials enforces a degree of quality assurance.
- Colleague or mentors are asked for assessments of the quality of information. Capable professional colleagues supply a source of verification.
- Technical writers make important efforts to ensure the data in engineering catalogs and data books is correct and valuable. Certain catalogs have a reputation for the high quality of their technical advice such as Omega's Instrumentation Catalog and HP's Measurement catalog.

All of the above mechanisms come down to some form of peer review process, enforced by the desire to maintain reputation and financial by essentials.

Data got from online searches may not have been subject to any of the external processes of validity assurance. However peer reviewed materials are still available, as indicated earlier, these often are hidden behind membership or financial incapability. There are also internal processes which readers use to maintain quality.

- Agreement with known standards in the specific technical area and with current technical understanding in general
- Style of writing. An objective professional writing style is one indicator of the writer's background and one indicator of validity.
- Congruence with other known high-quality technological references.
- Reference to other known high-quality technological references

other words, data that is unreliable, irreproducible, or invalid, leading to the wrong conclusions and actions.

The term “survey” reflects a range of research objectives – target populations and sampling frames, recruitment strategies, survey instrument designs, survey administration methods, data processing, and statistical adjustment –to ensure a high-quality survey process and outcome. Given the wide range of options in conducting a survey, it is imperative for the consumer/reader of survey findings to understand the potential for bias as well as the strategies and techniques used for reducing bias, so that appropriate conclusions can be drawn from the data.

Good surveys produce accurate data and critical information, providing salient windows into the core of the topic under exploration. Conversely, bad surveys produce flawed data. In other words, data that are unreliable, irreproducible, or invalid, leading to the wrong conclusions and actions.

There are many elements involved in survey design that affect the quality of data that comes out of a survey – the time and effort it takes for survey respondents to complete a survey, order of questions, number of points on the rating scale, order of question-answer options – to name a few. So, what are the key factors to consider creating surveys that gather high-quality data? While validity and reliability are commonly discussed in the field of psychometrics, it is often assumed that they are present without validation. But we need to be sure that the answer to the question, “Is the data that comes out of this survey reliable and valid to use?” is yes. This is to avoid drawing the wrong conclusions, particularly when stakes are high such as survey

results impacting one's promotion decision or an investment decision on where to spend time and money for improvement.

What are survey reliability and validity? Do they mean the same thing? Even though it is not uncommon to see these two words used interchangeably, they are two very different concepts in the data research field. How are they different? Why does it matter to know the difference?

### **Surey reliability vs. Survey validity**

Validity and reliability are two key factors to consider when developing and testing any survey instrument for use in gathering data. Attention to these considerations helps to ensure the quality of your survey instrument and the data collected for analysis and use.

Imagine that you are designing the [employee engagement survey](#), and you consider asking the question

### **Validity**

Although there is much debating going on about validity and an entire study can be written about it validity is foremost on the mind of those developing measures and that genuine scientific measurement is foremost in the minds of those who seek valid outcomes from assessment.

Validity can be seen as the core of any form of assessment that is trustworthy and accurate. Validity explains how well the collected data covers the actual area of investigation (Ghuri and Gronhaug, 2005). Validity basically means "measure what is intended to be measured" (Field, 2005). Types of validity include; face validity, content validity, construct validity, criterion validity and reliability.

Validity refers to the essential truthfulness of a piece of data. By asserting validity, the researcher is asserting that the data actually measure or reflect the specific phenomenon claimed. Scientific history is full of examples of research findings that were discredited because they were lacking in validity.

For instance, thermometer is an example of a valid instrument that produces valid data. The height reached by the fluid in an accurate thermometer is a valid and appropriate measurement of air temperature. Similarly, the movement of a membrane in a barometer is an appropriate and valid way to determine barometric pressure. A ruler can be a valid way to measure length. So also, is a bathroom scale which is a valid measure of weight.

Nothing has helped researchers to understand the importance of attending to validity as much as performance assessment. Intuitively, we all know that words from the horse's mouth are more believable than words related by the horse's trainer. Similarly, a piece of actual student writing has more validity than a score obtained on the language section of a standardized multiple-choice exam. A performance by the school band is a better indicator of students' ability to execute a musical piece than are the students' grades in band.

However, even given the deserved popularity of performance and portfolio assessments, these types of data are not exempt from concerns regarding validity. For example, how should we react to the use of a written lab report as a means to assess student understanding of the scientific method? Should a lab report written in standard English be accepted as a valid indicator of a student's understanding of science?

Suppose you answered yes. Would you still accept that lab report as a valid indicator if you learned that the student lacked fluency in English? Probably not. This is because the English-language proficiency needed to complete the report introduced what scientists call an intervening and confounding variable. In the case of assessing the proficiency in science of a student with limited English proficiency, the written aspect of the report intervenes and thereby confounds the accuracy of the assessment. Intervening and confounding variables are factors that get in the way of valid assessment. This is why when conducting online research and collecting data for action research, it is important to ask: Are there any factors or intervening variables that should cause me to distrust these data?

## **Reliability**

Reliability concerns the extent to which a measurement of a phenomenon provides stable and consistent result (Carmines and Zeller, 1979). Reliability is also concerned with



repeatability. For example, a scale or test is said to be reliable if repeat measurement made by it under constant conditions will give the same result (Moser and Kalton, 1989).

Reliability is a different but no less important concept. Reliability relates to researchers' claims regarding the accuracy of their data. Reliability problems in education often arise when researchers overstate the importance of data drawn from too small or too restricted a sample. For example, imagine

A banker telling his manager that customers love their bank and their services. When the manager asked how, the banker responds defensively by saying his conclusion was based on hard data. Data that was specifically from the banks online AGM. If the manager claims that all those who attended the AGM were shareholders and as such, a fraction of the bank's customers, the conclusion of the banker can be said to be unreliable. This is true. Claiming that such a small and select sample accurately represented the views of a total population stretches the credibility of the assertion well beyond reasonableness.

To enhance the reliability of an online research data, you need to continually ask yourself these questions when planning data collection:

- Is this information an accurate representation of reality?
- Can I think of any reasons to be suspicious of its accuracy?

Testing for reliability is important as it refers to the consistency across the parts of a measuring instrument (Huck, 2007). A scale is said to have high internal consistency reliability if the items of a scale "hang together" and measure the same construct (Huck, 2007, Robinson, 2009). The most commonly used internal consistency measure is the Cronbach Alpha coefficient. It is viewed as the most appropriate measure of reliability when making use of Likert scales (Robinson, 2009). No absolute rules exist for internal consistencies, however most agree on a minimum internal consistency coefficient of .70 (Whitley, 2002).

For an exploratory or pilot study, it is suggested that reliability should be equal to or above 0.60 (Straub et al., 2004). Hinton et al. (2004) have suggested four cut-off points for reliability, which includes excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70) and low reliability (0.50 and below) (Hinton et al., 2004).

Although reliability is important for study, it is not sufficient unless combined with validity. In other words, for a test to be reliable, it also needs to be valid (Wilson, 2010).

A test is seen as being reliable when it can be used by a number of different researchers under stable conditions, with consistent results and the results not varying. Reliability reflects consistency and replicability over time. Furthermore, reliability is seen as the degree to which a test is free from measurement errors, since the more measurement errors occur the less reliable the test.

The more errors found in an assessment the greater its unreliability, and vice versa. Reliability is a very important factor in assessment, and is presented as an aspect contributing to validity and not opposed to validity.

### **Establishing Validity and Reliability**

To appreciate the concepts of validity and reliability and how you might establish them, consider how you would behave as a judge who is deliberating on a criminal matter. Lawyers for both sides would argue their cases as persuasively as possible. Your task as a judge is to determine which of the arguments to believe. In deciding if a lawyer had “proven his/her case,” you would probably ask these questions regarding validity: Are these claims credible? Can I truly believe this evidence to be what these witnesses and lawyers say it does? To determine the reliability of the evidence, you would ask questions such as these about the accuracy of the witnesses' recollections and testimony: Can I trust the accuracy of their eyes and ears? Could time or emotions have played a trick on their memories?

So how do legal “researchers” defense lawyers and prosecutors convince a judge of the essential truth and accuracy (validity and reliability) of their cases? They do it through corroboration and impeachment. When they want the jury to believe what one of their witnesses said, they bring in other independent witnesses. If an additional witness corroborates everything the first witness said, it increases the confidence a judge will have in the initial testimony. The more independent pieces of evidence a lawyer can place before a judge, the more the judge will trust the truthfulness and accuracy of the claims. Conversely, if lawyers

want the judge to doubt the truth and accuracy (validity and reliability) of the other side, they try to impeach challenge the credibility of the testimony of the other side, by entering into evidence alternative or irreconcilable reports on the same phenomenon from several independent sources.

### **SOME INFORMATIVE ONLINE SEARCH**

People who are trying to get data online on one-time pad cryptography may possibly come across some inconsistent data. Since the one-time pad is a preferred deal of cryptographic snake-oil salesmen (c.f. [www.topsecretcrypto.com/](http://www.topsecretcrypto.com/) or [www.vadiumtech.com/](http://www.vadiumtech.com/)), the significant of being able to attract valid data on this topic is crucial not only to students, but also to on the ground experts.

Looking at the first site found ([www.vidwest.com/otp](http://www.vidwest.com/otp)) which gives a freeware one-time pad software package, including links to various notable sites that if carried out can alert a careful reader the unrealistic of a real-world accomplishment of a digital one-time pad. On the hand, most of the links are no longer good or difficult to go along with. Generally, if one is not observant might be misguided by this site. Even as the site looks credible according to internal indicators, the data it shares on the site itself is scanty and possibly vague. The strategy to getting credible data in this case, is to carry on with the links as well as the page.

Another website is ([world.std.com/~frani/crypto/one-time-pad.html](http://world.std.com/~frani/crypto/one-time-pad.html)) it provides good details, (Richard, Michael, 2004) and also misleading, deliberation of one-time pads. The description of how to carry out one on a system is well open; however it holds that the key can be generated by a cryptographically strong pseudo-random number generator. This site can be specifically hard to notice as faulty, since it is well articulated and informative, except as noted.

However, the site has no external references or citations, and therefore must be suspect. It is also authored by an individual, with no obvious expertise or educational reputation to protect. Looking at the 3rd site (<http://www.aspheute.com/english/20010924.asp>), this assumption shows Unbreakable write-ups Using One Time Pads. It shows code and dialog establishing how to use one-time pads using a pseudo-random number generator, this time with no saving

modification. However, the site deprecates the freely agreed secret writing benchmark in favor of the one-time pad. It has also been established that this site could be hard to differentiate from the authorized sources, more importantly since it came to be a write-up that is online occasionally.

## Conclusion

Data collection over the Internet has many potential benefits. Unfortunately, it also has many potential problems. Properly used, Internet-based data collection can generate large samples, be a solution to funding problems, ease logistics, and eliminate data entry. However, problems can arise during any phase of the research. With careful planning, many issues can be avoided altogether. While not all inclusive, this study presents many of the issues encountered while conducting Internet-based data collection.

Advantages of Internet-based research have allowed us to dream a little bigger and pursue projects and research questions we would never have considered. Who would want to collect data in six cities in three states without formal funding? The Internet and some "creative budgeting" allowed the two of us to put the finishing touch on a project that had been two years in the making but confined to the available student pool for data collection. However, we will not discard the paper-and-pencil format either. For some projects, the inclusion of electronic data collection is not only unnecessary but also impractical. It can add unnecessary costs, time commitments, and headaches when used for smaller samples that are easily available. Conducting Internet-based research remains a decision that the researcher must weigh carefully.

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