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Writing@CSU Writing Guide

Understanding Reliability and Validity

These related research issues ask us to consider whether we are studying what we think we are studying and whether the measures we use are consistent.

Reliability

Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions, formulate theories, or make claims about the [generalizability](#) of their research. In addition to its important role in research, reliability is critical for many parts of our lives, including manufacturing, medicine, and sports.

Reliability is such an important concept that it has been defined in terms of its application to a wide range of activities. For researchers, four key types of reliability are:

Equivalency Reliability

Equivalency reliability is the extent to which two items measure identical concepts at an identical level of difficulty. Equivalency reliability is determined by relating two sets of test scores to one another to highlight the degree of relationship or association. In quantitative studies and particularly in experimental studies, a

correlation coefficient, statistically referred to as r , is used to show the strength of the correlation between a [dependent variable](#) (the subject under study), and one or more [independent variables](#), which are manipulated to determine effects on the dependent variable. An important consideration is that equivalency reliability is concerned with correlational, not causal, relationships.

For example, a researcher studying university English students happened to notice that when some students were studying for finals, their holiday shopping began. Intrigued by this, the researcher attempted to observe how often, or to what degree, these two behaviors co-occurred throughout the academic year. The researcher used the results of the observations to assess the correlation between studying throughout the academic year and shopping for gifts. The researcher concluded there was poor equivalency reliability between the two actions. In other words, studying was not a reliable predictor of shopping for gifts.

Stability Reliability

Stability reliability (sometimes called test, re-test reliability) is the agreement of measuring instruments over time. To determine stability, a measure or test is repeated on the same subjects at a future date. Results are compared and correlated with the initial test to give a measure of stability.

An example of stability reliability would be the method of maintaining weights used by the U.S. Bureau of Standards. Platinum objects of fixed weight (one kilogram, one pound, etc...) are kept locked away. Once a year they are taken out and weighed, allowing scales to be reset so they are "weighing" accurately. Keeping track of how much the scales are off from year to year establishes a stability reliability for these instruments. In this instance, the platinum weights themselves are assumed to have a perfectly fixed stability reliability.

Internal Consistency

Internal consistency is the extent to which tests or procedures assess the same characteristic, skill or quality. It is a measure of the precision between the observers

or of the measuring instruments used in a study. This type of reliability often helps researchers interpret data and predict the value of scores and the limits of the relationship among variables.

For example, a researcher designs a questionnaire to find out about college students' dissatisfaction with a particular textbook. Analyzing the internal consistency of the survey items dealing with dissatisfaction will reveal the extent to which items on the questionnaire focus on the notion of dissatisfaction.

Interrater Reliability

Interrater reliability is the extent to which two or more individuals (coders or raters) agree. Interrater reliability addresses the consistency of the implementation of a rating system.

A test of interrater reliability would be the following scenario: Two or more researchers are observing a high school classroom. The class is discussing a movie that they have just viewed as a group. The researchers have a sliding rating scale (1 being most positive, 5 being most negative) with which they are rating the student's oral responses. Interrater reliability assesses the consistency of how the rating system is implemented. For example, if one researcher gives a "1" to a student response, while another researcher gives a "5," obviously the interrater reliability would be inconsistent. Interrater reliability is dependent upon the ability of two or more individuals to be consistent. Training, education and monitoring skills can enhance interrater reliability.

Related Information: Reliability Example

An example of the importance of reliability is the use of measuring devices in Olympic track and field events. For the vast majority of people, ordinary measuring rulers and their degree of accuracy are reliable enough. However, for an Olympic event, such as the discus throw, the slightest variation in a measuring device -- whether it is a tape, clock, or other device -- could mean the difference between the gold and silver medals. Additionally, it could mean the difference between a new world record and outright failure to qualify for an

event. Olympic measuring devices, then, must be reliable from one throw or race to another and from one competition to another. They must also be reliable when used in different parts of the world, as temperature, air pressure, humidity, interpretation, or other variables might affect their readings.

Validity

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. While reliability is concerned with the accuracy of the actual measuring instrument or procedure, validity is concerned with the study's success at measuring what the researchers set out to measure.

Researchers should be concerned with both *external* and *internal* validity. External validity refers to the extent to which the results of a study are generalizable or transferable. (Most discussions of external validity focus solely on generalizability; see Campbell and Stanley, 1966. We include a reference here to transferability because many qualitative research studies are not designed to be generalized.)

Internal validity refers to (1) the rigor with which the study was conducted (e.g., the study's design, the care taken to conduct measurements, and decisions concerning what was and wasn't measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore (Huitt, 1998). In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity.

Scholars discuss several types of internal validity. For brief discussions of several types of internal validity, click on the items below:

Face Validity

Face validity is concerned with how a measure or procedure appears. Does it seem like a reasonable way to gain the information the researchers are attempting to obtain? Does it seem well designed? Does it seem as though it will work reliably? Unlike content validity, face validity does not depend on established theories for support (Fink, 1995).

Criterion Related Validity

Criterion related validity, also referred to as instrumental validity, is used to demonstrate the accuracy of a measure or procedure by comparing it with another measure or procedure which has been demonstrated to be valid.

For example, imagine a hands-on driving test has been shown to be an accurate test of driving skills. By comparing the scores on the written driving test with the scores from the hands-on driving test, the written test can be validated by using a criterion related strategy in which the hands-on driving test is compared to the written test.

Construct Validity

Construct validity seeks agreement between a theoretical concept and a specific measuring device or procedure. For example, a researcher inventing a new IQ test might spend a great deal of time attempting to "define" intelligence in order to reach an acceptable level of construct validity.

Construct validity can be broken down into two sub-categories: Convergent validity and discriminate validity. Convergent validity is the actual general agreement among ratings, gathered independently of one another, where measures should be theoretically related. Discriminate validity is the lack of a relationship among measures which theoretically should not be related.

To understand whether a piece of research has construct validity, three steps should be followed. First, the theoretical relationships must be specified. Second, the empirical relationships between the measures of the concepts must be examined. Third, the empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular measure being tested (Carmines & Zeller, p. 23).

Content Validity

Content Validity is based on the extent to which a measurement reflects the specific intended domain of content (Carmines & Zeller, 1991, p.20).

Content validity is illustrated using the following examples: Researchers aim to study mathematical learning and create a survey to test for mathematical skill. If these researchers only tested for multiplication and then drew conclusions from that survey, their study would not show content validity because it excludes other mathematical functions. Although the establishment of content validity for placement-type exams seems relatively straight-forward, the process becomes more complex as it moves into the more abstract domain of socio-cultural studies. For example, a researcher needing to measure an attitude like self-esteem must decide what constitutes a relevant domain of content for that attitude. For socio-cultural studies, content validity forces the researchers to define the very domains they are attempting to study.

Related Information: Validity Example

Many recreational activities of high school students involve driving cars. A researcher, wanting to measure whether recreational activities have a negative effect on grade point average in high school students, might conduct a survey asking how many students drive to school and then attempt to find a correlation between these two factors. Because many students might use their cars for purposes other than or in addition to recreation (e.g., driving to work after school, driving to school rather than walking or taking a bus), this research study might prove invalid. Even if a strong correlation was found between driving and grade point average, driving to school in and of itself would seem to be an invalid measure of recreational activity.

Commentary

The challenges of achieving reliability and validity are among the most difficult faced by researchers. In this section, we offer commentaries on these challenges.

Difficulties of Achieving Reliability

It is important to understand some of the problems concerning reliability which might arise. It would be ideal to reliably measure, every time, exactly those things which we intend to measure. However, researchers can go to great lengths and

make every attempt to ensure accuracy in their studies, and still deal with the inherent difficulties of measuring particular events or behaviors. Sometimes, and particularly in studies of natural settings, the only measuring device available is the researcher's own observations of human interaction or human reaction to varying stimuli. As these methods are ultimately subjective in nature, results may be unreliable and multiple interpretations are possible. Three of these inherent difficulties are quixotic reliability, diachronic reliability and synchronic reliability.

Quixotic reliability refers to the situation where a single manner of observation consistently, yet erroneously, yields the same result. It is often a problem when research appears to be going well. This consistency might seem to suggest that the experiment was demonstrating perfect stability reliability. This, however, would not be the case.

For example, if a measuring device used in an Olympic competition always read 100 meters for every discus throw, this would be an example of an instrument consistently, yet erroneously, yielding the same result. However, quixotic reliability is often more subtle in its occurrences than this. For example, suppose a group of German researchers doing an ethnographic study of American attitudes ask questions and record responses. Parts of their study might produce responses which seem reliable, yet turn out to measure felicitous verbal embellishments required for "correct" social behavior. Asking Americans, "How are you?" for example, would in most cases, elicit the token, "Fine, thanks." However, this response would not accurately represent the mental or physical state of the respondents.

Diachronic reliability refers to the stability of observations over time. It is similar to stability reliability in that it deals with time. While this type of reliability is appropriate to assess features that remain relatively unchanged over time, such as landscape benchmarks or buildings, the same level of reliability is more difficult to achieve with socio-cultural phenomena.

For example, in a follow-up study one year later of reading comprehension in a specific group of school children, diachronic reliability would be hard to achieve. If the test were given to the same subjects a year later, many confounding variables would have impacted the researchers' ability to reproduce the same circumstances

present at the first test. The final results would almost assuredly not reflect the degree of stability sought by the researchers.

Synchronic reliability refers to the similarity of observations within the same time frame; it is not about the similarity of things observed. Synchronic reliability, unlike diachronic reliability, rarely involves observations of identical things. Rather, it concerns itself with particularities of interest to the research.

For example, a researcher studies the actions of a duck's wing in flight and the actions of a hummingbird's wing in flight. Despite the fact that the researcher is studying two distinctly different kinds of wings, the action of the wings and the phenomenon produced is the same.

Annotated Bibliography

American Psychological Association. (1985). *Standards for educational and psychological testing*. Washington, DC: Author.

This work on focuses on reliability, validity and the standards that testers need to achieve in order to ensure accuracy.

Babbie, E.R. & Huitt, R.E. (1979). *The practice of social research 2nd ed.* Belmont, CA: Wadsworth Publishing.

An overview of social research and its applications.

Beauchamp, T. L., Faden, R.R., Wallace, Jr., R.J. & Walters, L. (1982). *Ethical issues in social science research*. Baltimore and London: The Johns Hopkins University Press.

A systematic overview of ethical issues in Social Science Research written by researchers with firsthand familiarity with the situations and problems researchers face in their work. This book raises several questions of how reliability and validity can be affected by ethics.

Borman, K.M. et al. (1986). *Ethnographic and qualitative research design and why it doesn't work. American behavioral scientist 30, 42-57.*

The authors pose questions concerning threats to qualitative research and suggest solutions.

Bowen, K. A. (1996, Oct. 12). The sin of omission -punishable by death to internal validity: An argument for integration of quantitative research methods to strengthen internal validity. Available: <http://trochim.human.cornell.edu/gallery/bowen/hss691.htm>

An entire Web site that examines the merits of integrating qualitative and quantitative research methodologies through triangulation. The author argues that improving the internal validity of social science will be the result of such a union.

Brinberg, D. & McGrath, J.E. (1985). *Validity and the research process*. Beverly Hills: Sage Publications.

The authors investigate validity as value and propose the Validity Network Schema, a process by which researchers can infuse validity into their research.

Bussièrès, J-F. (1996, Oct.12). Reliability and validity of information provided by museum Web sites. Available: <http://www.oise.on.ca/~jfbussieres/issue.html>

This Web page examines the validity of museum Web sites which calls into question the validity of Web-based resources in general. Addresses the issue that all Websites should be examined with skepticism about the validity of the information contained within them.

Campbell, D. T. & Stanley, J.C. (1963). *Experimental and quasi-experimental designs for research*. Boston: Houghton Mifflin.

An overview of experimental research that includes pre-experimental designs, controls for internal validity, and tables listing sources of invalidity in quasi-experimental designs. Reference list and examples.

Carmines, E. G. & Zeller, R.A. (1991). *Reliability and validity assessment*. Newbury Park: Sage Publications.

An introduction to research methodology that includes classical test theory, validity, and methods of assessing reliability.

Carroll, K. M. (1995). Methodological issues and problems in the assessment of substance use. *Psychological Assessment*, Sep. 7 n3, 349-58.

Discusses methodological issues in research involving the assessment of substance abuse. Introduces strategies for avoiding problems with the reliability and validity of methods.

Connelly, F. M. & Clandinin, D.J. (1990). Stories of experience and narrative inquiry. *Educational Researcher* 19:5, 2-12.

A survey of narrative inquiry that outlines criteria, methods, and writing forms. It includes a discussion of risks and dangers in narrative studies, as well as a research agenda for curricula and classroom studies.

De Witt, P.E. (1995, July 3). On a screen near you: Cyberporn. *Time*, 38-45.

This is an exhaustive Carnegie Mellon study of online pornography by Marty Rimm, electrical engineering student.

Fink, A., ed. (1995). *The survey Handbook*, v.1. Thousand Oaks, CA: Sage.

A guide to survey; this is the first in a series referred to as the "survey kit". It includes bibliographical references. Addresses survey design, analysis, reporting surveys and how to measure the validity and reliability of surveys.

Fink, A., ed. (1995). *How to measure survey reliability and validity* v. 7. Thousand Oaks, CA: Sage.

This volume seeks to select and apply reliability criteria and select and apply validity criteria. The fundamental principles of scaling and scoring are considered.

Godwin, M. (1995, July). JournoPorn, dissection of the *Time* article. Available: <http://www.hotwired.com>

A detailed critique of *Time* magazine's *Cyberporn*, outlining flaws of methodology as well as exploring the underlying assumptions of the article.

Hambleton, R.K. & Zaal, J.N., eds. (1991). *Advances in educational and psychological testing*. Boston: Kluwer Academic.

Information on the concepts of reliability and validity in psychology and education.

Harnish, D.L. (1992). Human judgment and the logic of evidence: A critical examination of research methods in special education transition literature. In D.L. Harnish et al. eds., *Selected readings in transition*.

This article investigates threats to validity in special education research.

Haynes, N. M. (1995). How skewed is 'the bell curve'? *Book Product Reviews*. 1-24.

This paper claims that R.J. Herrnstein and C. Murray's *The Bell Curve: Intelligence and Class Structure in American Life* does not have scientific merit and claims that the bell curve is an unreliable measure of intelligence.

Healey, J. F. (1993). *Statistics: A tool for social research, 3rd ed.* Belmont: Wadsworth Publishing.

Inferential statistics, measures of association, and multivariate techniques in statistical analysis for social scientists are addressed.

Helberg, C. (1996, Oct.12). Pitfalls of data analysis (or how to avoid lies and damned lies). Available: <http://maddog/fammed.wisc.edu/pitfalls/>

A discussion of things researchers often overlook in their data analysis and how statistics are often used to skew reliability and validity for the researchers purposes.

Hoffman, D. L. and Novak, T.P. (1995, July). A detailed critique of the *Time* article: Cyberporn. Available: <http://www.hotwired.com>

A methodological critique of the *Time* article that uncovers some of the fundamental flaws in the statistics and the conclusions made by De Witt.

Huitt, William G. (1998). *Internal and External Validity*. <http://www.valdosta.peachnet.edu/~whuitt/psy702/intro/valdgn.html>

A Web document addressing key issues of external and internal validity.

Jones, J. E. & Bearley, W.L. (1996, Oct 12). Reliability and validity of training instruments. *Organizational Universe Systems*. Available: <http://ous.usa.net/relval.htm>

The authors discuss the reliability and validity of training design in a business setting. Basic terms are defined and examples provided.

***Cultural Anthropology Methods Journal*. (1996, Oct. 12). Available: <http://www.lawrence.edu/~bradleyc/cam.html>**

An online journal containing articles on the practical application of research methods when conducting qualitative and quantitative research. Reliability and validity are addressed throughout.

Kirk, J. & Miller, M. M. (1986). *Reliability and validity in qualitative research*. Beverly Hills: Sage Publications.

This text describes objectivity in qualitative research by focusing on the issues of validity and reliability in terms of their limitations and applicability in the social and natural sciences.

Krakower, J. & Niwa, S. (1985). *An assessment of validity and reliability of the institutional performance survey*. Boulder, CO: National center for higher education management systems.

Educational surveys and higher education research and the effectiveness of organization.

Lauer, J. M. & Asher, J.W. (1988). *Composition Research*. New York: Oxford University Press.

A discussion of empirical designs in the context of composition research as a whole.

Laurent, J. et al. (1992, Mar.) Review of validity research on the stanford-binet intelligence scale: 4th Ed. *Psychological Assessment*. 102-112.

This paper looks at the results of construct and criterion- related validity studies to determine if the SB:FE is a valid measure of intelligence.

LeCompte, M. D., Millroy, W.L., & Preissle, J. eds. (1992). *The handbook of qualitative research in education*. San Diego: Academic Press.

A compilation of the range of methodological and theoretical qualitative inquiry in the human sciences and education research. Numerous contributing authors apply their expertise to discussing a wide variety of issues pertaining to educational and humanities research as well as suggestions about how to deal with problems when conducting research.

McDowell, I. & Newell, C. (1987). *Measuring health: A guide to rating scales and questionnaires*. New York: Oxford University Press.

This gives a variety of examples of health measurement techniques and scales and discusses the validity and reliability of important health measures.

Meeks, B. (1995, July). Muckraker: How *Time* failed. Available: <http://www.hotwired.com>

A step-by-step outline of the events which took place during the researching, writing, and negotiating of the *Time* article of 3 July, 1995 titled: *On A Screen Near You: Cyberporn*.

Merriam, S. B. (1995). What can you tell from an N of 1?: Issues of validity and reliability in qualitative research. *Journal of Lifelong Learning v4*, 51-60.

Addresses issues of validity and reliability in qualitative research for education. Discusses philosophical assumptions underlying the concepts of internal validity, reliability, and external validity or generalizability. Presents strategies for ensuring rigor and trustworthiness when conducting qualitative research.

Morris, L.L, Fitzgibbon, C.T., & Lindheim, E. (1987). How to measure performance and use tests. In J.L. Herman (Ed.), *Program evaluation kit (2nd ed.)*. Newbury Park, CA: Sage.

Discussion of reliability and validity as it pertyains to measuring students' performance.

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(From Yang et al. bibliography--unavailable as of this writing.)

Russ-Eft, D. F. (1980). Validity and reliability in survey research. *American Institutes for Research in the Behavioral Sciences August*, 227 151.

An investigation of validity and reliability in survey research with and overview of the concepts of reliability and validity. Specific procedures for measuring sources of error are suggested as well as general suggestions for improving the reliability and validity of survey data. A extensive annotated bibliography is provided.

Ryser, G. R. (1994). Developing reliable and valid authentic assessments for the classroom: Is it possible? *Journal of Secondary Gifted Education Fall, v6 n1, 62-66.*

Defines the meanings of reliability and validity as they apply to standardized measures of classroom assessment. This article defines reliability as scorability and stability and validity is seen as students' ability to use knowledge authentically in the field.

Schmidt, W., et al. (1982). Validity as a variable: Can the same certification test be valid for all students? *Institute for Research on Teaching July, ED 227 151.*

A technical report that presents specific criteria for judging content, instructional and curricular validity as related to certification tests in education.

Scholfield, P. (1995). *Quantifying language. A researcher's and teacher's guide to gathering language data and reducing it to figures.* Bristol: Multilingual Matters.

A guide to categorizing, measuring, testing, and assessing aspects of language. A source for language-related practitioners and researchers in conjunction with other resources on research methods and statistics. Questions of reliability, and validity are also explored.

Scriven, M. (1993). *Hard-Won Lessons in Program Evaluation.* San Francisco: Jossey-Bass Publishers.

A common sense approach for evaluating the validity of various educational programs and how to address specific issues facing evaluators.

Shou, P. (1993, Jan.). The singer loomis inventory of personality: A review and critique. [Paper presented at the Annual Meeting of the Southwest Educational Research Association.]

Evidence for reliability and validity are reviewed. A summary evaluation suggests that SLIP (developed by two Jungian analysts to allow examination of personality from the perspective of Jung's typology) appears to be a useful tool for educators and counselors.

Sutton, L.R. (1992). *Community college teacher evaluation instrument: A reliability and validity study*. Diss. Colorado State University.

Studies of reliability and validity in occupational and educational research.

Thompson, B. & Daniel, L.G. (1996, Oct.). Seminal readings on reliability and validity: A "hit parade" bibliography. *Educational and psychological measurement v. 56, 741-745*.

Editorial board members of *Educational and Psychological Measurement* generated bibliography of definitive publications of measurement research. Many articles are directly related to reliability and validity.

Thompson, E. Y., et al. (1995). *Overview of qualitative research*. Diss. Colorado State University.

A discussion of strengths and weaknesses of qualitative research and its evolution and adaptation. Appendices and annotated bibliography.

Traver, C. et al. (1995). *Case Study*. Diss. Colorado State University.

This presentation gives an overview of case study research, providing definitions and a brief history and explanation of how to design research.

Trochim, William M. K. (1996) External validity. (. Available: <http://trochim.human.cornell.edu/kb/EXTERVAL.htm>

A comprehensive treatment of external validity found in William Trochim's online text about research methods and issues.

Trochim, William M. K. (1996) Introduction to validity. (. Available: <http://trochim.human.cornell.edu/kb/INTROVAL.htm>

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A comprehensive treatment of reliability found in William Trochim's online text about research methods and issues.

Validity. (1996, Oct. 12). Available: <http://vislab-www.nps.navy.mil/~haga/validity.html>

A source for definitions of various forms and types of reliability and validity.

Vinsonhaler, J. F., et al. (1983, July). Improving diagnostic reliability in reading through training. *Institute for Research on Teaching* ED 237 934.

This technical report investigates the practical application of a program intended to improve the diagnoses of reading deficient students. Here, reliability is assumed and a pragmatic answer to a specific educational problem is suggested as a result.

Wentland, E. J. & Smith, K.W. (1993). *Survey responses: An evaluation of their validity*. San Diego: Academic Press.

This book looks at the factors affecting response validity (or the accuracy of self-reports in surveys) and provides several examples with varying accuracy levels.

Wiget, A. (1996). Father Juan Greyrobe: Reconstructing tradition histories, and the reliability and validity of uncorroborated oral tradition. *Ethnohistory* 43:3, 459-482.

This paper presents a convincing argument for the validity of oral histories in ethnographic research where at least some of the evidence can be corroborated through written records.

Yang, G. H., et al. (1995). *Experimental and quasi-experimental educational research*. Diss. Colorado State University.

This discussion defines experimentation and considers the rhetorical issues and advantages and disadvantages of experimental research. Annotated bibliography.

Yarroch, W. L. (1991, Sept.). The Implications of content versus validity on science tests. *Journal of Research in Science Teaching*, 619-629.

The use of content validity as the primary assurance of the measurement accuracy for science assessment examinations is questioned. An alternative accuracy measure, item validity, is proposed to look at qualitative comparisons between different factors.

Yin, R. K. (1989). *Case study research: Design and methods*. London: Sage Publications.

This book discusses the design process of case study research, including collection of evidence, composing the case study report, and designing single and multiple case studies.

Related Links

Internal Validity Tutorial.

An interactive tutorial on internal validity.

<http://server.bmod.athabascau.ca/html/Validity/index.shtml>

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