

# PSY 5090: Psychometric Theory

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Spring 2021

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Office Hours: T 12:15 p.m. - 2:15 p.m.

Class Hours: Tu & Th 11:00 a.m. - 12:15 p.m.

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Class Room: Zoom PID: 865 911 5844

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## Required Text

[1] K.S. Shultz, D.J. Whitney and M.J. Zickar. *Measurement Theory in Action: Case Studies and Exercises*. 2nd Edition. 2013.

## Reading List

A reading list can be found at the end of the syllabus.

## Optional Texts

[1] D. Borsboom. *Measuring the mind: Conceptual issues in contemporary psychometrics*. 2005.

[2] L. Crocker and J. Algina. *Introduction to Classical and Modern Test Theory*. 2006.

## Required Software (Open Source)

[1] R Core Team. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria, 2018. <http://www.r-project.org>.

[2] RStudio Team. *RStudio: Integrated Development Environment for R*. RStudio, Inc. Boston, MA, 2018. <http://www.rstudio.com/>.

## GitHub

This course will use GitHub for file sharing. A free account can be set up by visiting [www.github.com](http://www.github.com). Our course GitHub site is: [https://github.com/orgs/PSY5090/teams/psy5090\\_spring\\_2021](https://github.com/orgs/PSY5090/teams/psy5090_spring_2021)

## Prioritizing Wellness

Having a “normal” life in the face of a global pandemic and political upheaval is impossible, so I encourage you first and foremost to have self-compassion. Even the strongest of us are struggling right now, so we need to take care of ourselves and recognize that none of this is “normal.” We also need to show compassion for others, now more than ever. Thus, the first and most important guiding principle of this course is that we will prioritize physical and mental wellness, both for ourselves and others, above all other things.

## Course Description & Objectives

This course will provide you with an overview of the concepts and issues central to an understanding of classical and modern test theory, and the construction of psychometrically sound measurement instruments. Topics for the course will include an overview of basic statistical concepts, scaling, test construction and scoring algorithms, item analysis, reliability theory and estimation, validity, prediction and classification, analysis of test dimensionality including exploratory and confirmatory factor analysis, test refinement and revision, test bias and fairness, and validity generalization.

The learning objectives of the course are as such:

1. To demonstrate knowledge of the basic elements of modern test theory and development via class discussion, written assignments, and tests.
2. To be able to engage in professional discussions of psychometric theory, to evaluate the body of evidence in support of measures of psychological constructs, and to communicate one's ideas in a clear, concise, and professional manner.
3. To discuss course materials in a helpful and collaborative manner.
4. To assist others in learning the course material by participating in classroom discussion and problem-solving sessions.
5. To demonstrate knowledge of measurement selection, (mis)use, fairness, and bias.

Following completion of the course, you should be able to (1) critically evaluate psychological tests and (2) write a systematic review of measures of a particular psychological construct.

## Class Attendance & Participation

Attendance is required and expected, but I will strive to be *very* flexible to accommodate the challenges and realities of online course delivery, especially considering the current state of the world. That said, you are encouraged to attend class on a regular basis and to be prepared (e.g., having read the requisite chapters and/or articles; having completed problem sets when assigned) to participate in discussions and in-class activities.

For some weeks, there are assigned problem sets. Problem sets should be completed electronically using `RMarkdown` and submitted via `GitHub` as `knitted .HTML` files to the appropriate folder (*n.b.*, I will explain this in class). For any given problem set, it is recognized that you may not always be

able to answer all of the questions or to answer them correctly. The purpose of the problem sets is to challenge you, give you hands-on experience working with real data, and provide you with an opportunity to gain practice without explicit grading. Therefore, I will simply be noting whether you have prepared the problem sets and/or have demonstrated effort. To reiterate, these are not graded efforts; rather they should serve to guide your understanding of important points that we have covered in lecture or through assigned readings, and may benefit you for examinations. When relevant, full answers will be discussed in class, and posted to self-check your work.

Note: some problem sets may be completed as part of in-class activities. Otherwise, problem sets should be completed by the Tuesday of any given week. As it is understood in the grading breakdown noted below, problem sets will be reflected in the the “participation” portion of your grade.

You are responsible for obtaining information presented in class from a classmate if you are absent. If you are unable to attend class, please notify me ahead of time if possible or at your earliest convenience, just so that I know you are okay.

## Written Assignments:

During the course of the semester, you will be asked to prepare a written assignment which is a manuscript-length systematic review of measures of a psychological construct of your choosing. This assignment has two parts: a proposal and and a full manuscript. A brief description of both is provided below, with further details are provided at the end of this document.

**Assignment #1: Proposal** — You will be asked to write a short (1,000 word) proposal for a systematic review of a psychological construct. This proposal should be comprised of a) an introduction in which you briefly define and discuss the construct of interest, positioned within the theory to which it pertains, b) provide a high-level overview of your intended literature search strategy, and c) introduce several examples of various measures of this construct and briefly examine the strengths and weaknesses of these existing measures

**Assignment #2: Full Manuscript** — You will be asked to update your proposal by fully elaborating on the procedures and results of your systematic review. This should include a complete introduction in which you fully define and discuss the construct of interest, positioned within the theory to which it pertains, a complete methods section that elaborates on your literature search procedures and the general approach to conducting the systematic review, and a fully fleshed out and comprehensive systematic review the various measures of this construct that articulates and examines the strengths and weaknesses of these existing measures.

All written assignments should be prepared according to APA guidelines (6th edition), prepared electronically in Microsoft Word in Times New Roman 12 with 1 inch margins. All written assignments must be submitted via email. Each assignment is due by 12:00 pm on the date indicated. Late written assignments will be penalized one full letter grade for each day late.

You are welcome to take advantage of the writing services in the Student Success Center; getting feedback benefits writers at all skill levels. Trained writing consultants can help with any writing, multimedia project, or oral presentation. During the one-on-one consultations, you can work on everything from brainstorming and developing ideas to crafting strong sentences and documenting sources. These services do fill up, so please make an appointment. For more information, or to make, change, or cancel an appointment, call 977-3484 or visit <http://www.slu.edu/writingservices.xml>.

## Exams

There will be two take-home examinations – a midterm and a final. For both the midterm and final, exam will be distributed via **GitHub** at 9:30am on Tuesday and are due to me in-person no-later than 10:45am on Thursday. Exam questions will consist of a mix of both problems and short-answer questions. For the problems, make sure to show your work so that partial credit may be assigned. For the short-answer/essay-type questions answers must be complete and readable. Exams can be emailed directly to me.

## Grades

Grades will be determined on the basis of written assignments, midterm, final, and class preparation. The midterm and final are designed to be comprehensive and integrative. There will be no opportunity for “extra credit” to improve grades.

These elements will count as follows:

Component	Weight
Exam 1	25%
Exam 2	25%
Written Assignment 1	10%
Written Assignment 2	25%
Class Attendance/Participation	15%

The following percentage weights and ranges will be used for the calculation of final grades:

Grade	Percentage
A	93-100%
A-	90-92.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	77-79.9%
C	73-76.9%
C-	70-72.9%
D	60-69.9%
F	0-59.9%

## Syllabus Revisions

Other readings or activities may be assigned or substituted throughout the semester. Scheduling may be rearranged to accommodate guest lecturers or other events that may occur. Any changes made will be done as far in advance as possible to allow students the time necessary to prepare for class. The instructor reserves the right to make changes and/or additions to course policies as deemed appropriate.

## University Policies

### Title IX

Saint Louis University and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If you have encountered any form of sexual misconduct (e.g. sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage you to report this to the University. If you speak with a faculty member about an incident of misconduct, that faculty member must notify SLU's Title IX coordinator, Anna R. Kratky (DuBourg Hall, Room 36; [akratky@slu.edu](mailto:akratky@slu.edu); 314-977-3886) and share the basic facts of your experience with her. The Title IX coordinator will then be available to assist you in understanding all of your options and in connecting you with all possible resources on and off campus.

If you wish to speak with a confidential source, you may contact the counselors at the University Counseling Center at 314-977-TALK. To view SLU's sexual misconduct policy and for resources, please visit the following web addresses: [www.slu.edu/here4you](http://www.slu.edu/here4you) and <https://www.slu.edu/general-counsel>.

### Disability Services

Students with a documented disability who wish to request academic accommodations must contact Disability Services to discuss accommodation requests and eligibility requirements. Once successfully registered, the student also must notify the course instructor that they wish to access accommodations in the course.

Please contact Disability Services, located within the Student Success Center, at [Disability\\_services@slu.edu](mailto:Disability_services@slu.edu) or 314.977.3484 to schedule an appointment. Confidentiality will be observed in all inquiries. Once approved, information about the student's eligibility for academic accommodations will be shared with course instructors via email from Disability Services and viewed within Banner via the instructor's course roster.

*Note:* Students who do not have a documented disability but who think they may have one are encouraged to contact Disability Services.

### Academic Integrity

Academic integrity is honest, truthful and responsible conduct in all academic endeavors. The mission of Saint Louis University is "the pursuit of truth for the greater glory of God and for the service of humanity." Accordingly, all acts of falsehood demean and compromise the corporate endeavors of teaching, research, health care, and community service via which SLU embodies its mission. The University strives to prepare students for lives of personal and professional integrity, and therefore regards all breaches of academic integrity as matters of serious concern.

The governing University-level Academic Integrity Policy was adopted in Spring 2015, and can be accessed at: [https://www.slu.edu/provost/policies/academic-and-course/policy\\_academic-integrity\\_6-26-2015.pdf](https://www.slu.edu/provost/policies/academic-and-course/policy_academic-integrity_6-26-2015.pdf).

Additionally, each SLU College, School, and Center has adopted its own academic integrity policies, available on their respective websites. All SLU students are expected to know and abide by these

policies, which detail definitions of violations, processes for reporting violations, sanctions, and appeals. Please direct questions about any facet of academic integrity to your faculty, the chair of the department of your academic program, or the Dean/Director of the College, School or Center in which your program is housed.

## **Student Success Center**

In recognition that people learn in a variety of ways and that learning is influenced by multiple factors (e.g., prior experience, study skills, learning disability), resources to support student success are available on campus. The Student Success Center assists students with academic-related services and is located in the Busch Student Center (Suite, 331). Students can visit <https://www.slu.edu/life-at-slu/student-success-center/> to learn more about tutoring services, university writing services, disability services, and academic coaching.

## **University Writing Services**

Students are encouraged to take advantage of University Writing Services in the Student Success Center; getting feedback benefits writers at all skill levels. Trained writing consultants can help with writing projects, multimedia projects, and oral presentations. University Writing Services offers one-on-one consultations that address everything from brainstorming and developing ideas to crafting strong sentences and documenting sources. For more information, visit <https://www.slu.edu/life-at-slu/student-success-center/> or call the Student Success Center at 314-977-3484.

## **Basic Needs Security**

Students in personal or academic distress and/or who may be specifically experiencing challenges such as securing food or difficulty navigating campus resources, and who believe this may affect their performance in the course, are encouraged to contact the Dean of Students Office ([deanofstudents@slu.edu](mailto:deanofstudents@slu.edu) or 314-977-9378) for support. Furthermore, please notify the instructor if you are comfortable in doing so, as this will enable them to assist you with finding the resources you may need.

## Class Schedule

*Note:* Class schedule for planning purposes only; subject to change.

### Week 01, 01/25 - 01/29 Review Syllabus & Overview of Course

- Textbook Readings *N/A*
- Assigned Readings
- Problem Set *N/A*
- Written Assignment *N/A*

### Week 02, 02/01 - 02/05 Course Introduction & General Overview

- Textbook Readings *N/A*
- Assigned Readings Sackett; Schwartz
- Problem Set *N/A*
- Written Assignment *N/A*

### Week 03, 02/08 - 02/12 Introduction to Measurement Theory

- Textbook Readings Chapter 1
- Assigned Readings Clark; Comrey
- Problem Set *N/A*
- Written Assignment *N/A*

### Week 04, 02/15 - 02/19 Test Preparation & Specification

- Textbook Readings Chapters 4, 12, & 15
- Assigned Readings *N/A*
- Problem Set *N/A*
- Written Assignment *N/A*

### Week 05, 02/22 - 02/26 Statistics for Psychological Measurement

- Textbook Readings Chapter 2
- Assigned Readings *N/A*
- Problem Set *N/A*
- Written Assignment *N/A*

### Week 06, 03/01 - 03/05 Psychological Scaling

- Textbook Readings Chapter 3
- Assigned Readings Smith; Smith; Vogt
- Problem Set Problem Set “A”
- Written Assignment Assignment #1

### **Week 07, 03/08 - 03/12 Classical Test Theory and Reliability**

- **No Class Thursday**
- **Textbook Readings** Chapters 5 & 6
- **Assigned Readings** Cortina
- **Problem Set** *N/A*
- **Written Assignment** *N/A*

### **Week 08, 03/15 - 03/19**

- Midterm Exam Week

### **Week 09, 03/22 - 03/26 Validity**

- **Textbook Readings** Chapters 7, 8, & 9
- **Assigned Readings** Campbell; Foster; Haynes; Landy; Messick
- **Problem Set** Problem Set “B”
- **Written Assignment** *N/A*

### **Week 10, 03/29 - 04/02 Test Bias, Fairness, & Equivalence**

- **Textbook Readings** Chapter 11
- **Assigned Readings** Livingston
- **Problem Set** Problem Set “C”
- **Written Assignment** *N/A*

### **Week 11, 04/05 - 04/09 Item Analysis & Scoring Tests**

- **Textbook Readings** Chapters 13 & 14
- **Assigned Readings** Cicchetti; Hunsley; Worthington
- **Problem Set** Problem Set “D”
- **Written Assignment** *N/A*

### **Week 12, 04/12 - 04/16 Exploratory Factor Analysis**

- **Textbook Readings** Chapter 18
- **Assigned Readings** Costello; Floyd; Reiss
- **Problem Set** *N/A*
- **Written Assignment** *N/A*

### **Week 13, 04/19 - 04/23 Confirmatory Factor Analysis**

- **Textbook Readings** Chapter 18
- **Assigned Readings** Schmitt
- **Problem Set** Problem Set “E”
- **Written Assignment** *N/A*



**Week 14, 04/26 - 04/30 Validity Generalization**

- **Textbook Readings** Chapter 10
- **Assigned Readings** Schmidt
- **Problem Set** Problem Set “F”
- **Written Assignment** *N/A*

**Week 15, 05/03 - 05/07 Item Response Theory**

- **Textbook Readings** Chapters 20 & 21
- **Assigned Readings** *N/A*
- **Problem Set** *N/A*
- **Written Assignment** Assignment #2

**Week 16, 05/10 - 05/14**

- Final Exam Week

## Overview of Written Assignments

### Assignment #1: Proposal

Throughout the semester, you will be writing a systematic review of measures of a psychological construct. This first assignment will constitute the “proposal” for this larger project, which will facilitate my ability to give you feedback on the direction you take in constructing your full manuscript. This first assignment will thus be comprised of a 1,000 proposal in which you a) briefly define and discuss the construct of interest, positioned within the theory to which it pertains, b) provide a high-level overview of your intended literature search strategy, and c) introduce several examples of various measures of this construct and briefly examine the strengths and weaknesses of these existing measures.

Examples of systematic reviews of measures of psychological constructs to begin guiding your efforts can be found in the following works:

Chambers, J. A., Alder, E. M., Hoddinott, P., & McInnes, R. J. (2007). A systematic review of measures assessing mothers’ knowledge, attitudes, confidence and satisfaction towards breastfeeding. *Breastfeeding Review*

Francoeur, V., Paillé, P., Yuriev, A., & Boiral, O. (2019). The Measurement of Green Workplace Behaviors: A Systematic Review. *Organization & Environment*

Francis, D. B., Hall, M. G., Noar, S. M., Ribisl, K. M., & Brewer, N. T. (2017). Systematic review of measures used in pictorial cigarette pack warning experiments. *Nicotine & Tobacco Research*

Smith, K. G., & Corkum, P. (2007). Systematic review of measures used to diagnose attention-deficit/hyperactivity disorder in research on preschool children. *Topics in Early Childhood Special Education*

For this assignment, you should begin by identifying an existing psychological construct that is of interest to you (e.g., one that is the focus on your thesis; one that is commonly studied in your laboratory), and for which there exists multiple different (perhaps competing) measures. With respect to choosing constructs and their associated measures, you may wish to limit the scope of your review to exclusively self-reported, trait-like characteristics (e.g., relatively stable and enduring attitudes, values, normal personality facets, etc.), other-reports, or interview protocols. Depending on the scope of the literature, it may make more sense to take a broader view of all possible ways in which this construct has been measured (e.g., if only a handful of measures exist). Regardless of the chosen strategy, I would strongly recommend that you focus your efforts on public domain instruments, rather than on proprietary instruments (e.g., those which must be purchased from a for profit test publisher).

### Assignment #2: Full Manuscript

The purpose of this assignment is to integrate the feedback from assignment #1 to fully elaborate on the proposal you initially submitted by conducting a complete, manuscript-length (i.e., no more than 25 pages; see below) systematic review of measures of a psychological construct. This final paper should include a complete introduction that defines the construct of interest, and grounds this construct within a particular theoretical traditions. The introduction should problematize your work, by making clear why this review is needed, what goals will be accomplished by conducting

this review, and what “gaps” in our understanding of this construct/its measurement are “filled” with this work. Following the introduction, please include a methods section that clearly and transparently outlines the specific procedures followed for conducting the systematic review (e.g., literature search strategies; article screening, etc.). Next, the results section should constitute the “bulk” of this effort, and should report on the state of the literature with respect to the measurement of one’s chosen construct of interest. In reporting your results, make sure to elaborate on any notable (e.g., less-than-desirable, for a specific purpose) psychometric issues (e.g., low reliability; poor validity evidence; overlapping/confounded/proliferated constructs; incomplete content domain coverage, etc.). Finally, your discussion section should summarize the results of your systematic review, and address how the various “gaps” that you have identified in our understanding of this construct have been addressed by this effort. You should also speculate as to the limitations of your work, and speak to various opportunities for future research to result from your findings.

General Guidelines:

1. Please use Times New Roman 12 font size with 1 inch margins. Begin with a title page complete with running head and abstract per APA style (6th edition).
2. Please make liberal use of headings in the introduction (and throughout the entire manuscript) to, for example, label the sections in which you define your construct and the theory from which it derives and to justify the contributions of your systematic review to the literature.
3. The methods section should be constructed per usual, with an eye towards fully elaborating on the approach you have used to systematically obtain all measures of a given construct.
4. Make sure to reference relevant “best practices” for test development procedures and guidelines, as we have discussed in class and seen through assigned readings.
5. Make sure to include an APA style reference section.
6. Please limit your final work to no more than 25 manuscript pages (i.e., exclusive of title page, abstract, references, tables, figures, appendices, etc.). As a rough guide, you should aim for an approximately 5-page introduction, a 5-page methods section, a 10-page “results” section that reports on the results of your review, and a 5-page discussion section.
7. Take advantage of tables and appendices, where relevant.
8. Both papers (i.e., the proposal and the full manuscript) are due by 12:00 pm on the date listed above, and as noted in the syllabus. Papers should be emailed to me. Late papers will be penalized 1 letter grade each 24-hour period they are late.

**Grading:** For both papers (i.e., the proposal and the full manuscript), the overall score assigned will be a percentage.

## Reading List

- Babyak, M. A., and S. B. Green. 2010. “Confirmatory Factor Analysis: An Introduction for Psychosomatic Medicine Researchers.” *Psychosomatic Medicine* 72: 587–97.
- Campbell, D. P., and D. W. Fiske. 1959. “Convergent and Discriminant Validity in the Multitrait—Multimethod Matrix.” *Psychological Bulletin* 56: 81–105.
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- Clark, L. A., and D. Watson. 1995. “Constructing Validity: Basic Issues in Objective Scale Development.” *Psychological Assessment* 7: 309–19.
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- Comrey, A. L. 1988. “Factor-Analytic Methods of Scale Development in Personality and Clinical Psychology.” *Journal of Consulting and Clinical Psychology* 56: 754–61.
- Cortina, J. M. 1993. “What Is Coefficient Alpha? An Examination of Theory and Applications.” *Journal of Applied Psychology* 78: 98–104.
- Costello, A. B., and J. W. Osborne. 2005. “Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis.” *Practical Assessment, Research and* 10 (7): 1–9.
- Cronbach, L. J., and P. E. Meehl. 1955. “Construct Validity in Psychological Tests.” *Psychological Bulletin* 52: 281–302.
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- Flora, D. B., and P. J. Curran. 2004. “An Empirical Evaluation of Alternative Methods of Estimation for Confirmatory Factor Analysis with Ordinal Data.” *Psychological Methods* 9 (4): 466–91.
- Floyd, F. J., and K. Widaman. 1995. “Factor Analysis in the Development and Refinement of Clinical Assessment Instruments.” *Psychological Assessment* 7: 286–99.
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- Guadagnoli, E., and W. F. Velicer. 1988. “Relation of Sample Size to the Stability of Component Patterns.” *Psychological Bulletin* 103 (2): 265–75.

- Haynes, S. N., D. C. S. Richard, and E. S. Kubany. 1995. "Content Validity in Psychological Assessment: A Functional Approach to Concepts and Methods." *Psychological Assessment* 7: 238–47.
- Henry, B., T. E. Moffitt, A. Caspi, J. Langley, and P. A. Silva. 1994. "On the "Remembrance of Things Past": A Longitudinal Evaluation of the Retrospective Method." *Psychological Assessment* 6: 92–101.
- Holmbeck, G. N. 1997. "Toward Terminological, Conceptual, and Statistical Clarity in the Study of Mediators and Moderators: Examples from the Child-Clinical and Pediatric Psychology Literatures." *Journal of Consulting and Clinical Psychology* 65 (4): 599–610.
- Hunsley, J., and G. J. Meyer. 2003. "The Incremental Validity of Psychological Testing and Assessment: Conceptual, Methodological, and Statistical Issues." *Psychological Assessment* 15: 446–55.
- Kraemer, H. C., E. Stice, A. Kazdin, D. Offord, and D. Kupfer. 2001. "How Do Risk Factors Work Together? Mediators, Moderators, and Independent, Overlapping, and Proxy Factors." *The American Journal of Psychiatry* 158: 848–56.
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- Likert, R. 1932. "A Technique for the Measurement of Attitudes." *Archives of Psychology* 140: 1–55.
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- Miller, M. B. 1995. "Coefficient Alpha: A Basic Introduction from the Perspectives of Classical Test Theory and Structural Equation Modeling." *Structural Equation Modeling* 2 (3): 255–73.
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- Westen, D., and J. Weinberger. 2004. "When Clinical Description Becomes Statistical Prediction." *American Psychologist* 59: 595–613.
- Worthington, R. L., and T. A. Whittaker. 2006. "Scale Development Research: A Content Analysis and Recommendations for Best Practices." *The Counseling Psychologist* 34 (6): 806–38.