

Ch. 5: Validity

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Review : Reliability

- History
- Classical Test Score Theory
 - Models of reliability
 - Sources of error
- Estimating Reliability
- Increasing Reliability
- SEM and Confidence Intervals

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Validity

- History
 - Griggs v. Duke Power
 - Ricci v. DeStefano
- Defining Validity
- Four Kinds of Validity
- Reliability vs. Validity
- Validity as Explained Variance

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Griggs v. Duke Power (1971)

- Duke Power company - Coal fired power plant
- 13 people employed as Janitors
- Wanted promotions to next level (coal handler)
- Duke required certain score on IQ test for promotion
- Of 95 employees at power station, 14 were Black, 13 of 14 were janitors
- Legal case: was the IQ test requirement valid or discriminatory?
- Supreme Court decision : “invalid”

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Griggs v. Duke Power - 2

- Supreme court found If a test impacts different ethnic groups disproportionately, the business must demonstrate the test is a “reasonable measure of job performance”
- In scientific terms: tests must be *valid* predictors of specific criteria.

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Disparate Impact

- aka “Adverse Impact”...
- disproportional...
- adverse effect...
- on a protected class...

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Impact

- A negative Effect on
 - Employment or
 - Housing

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Disproportionate

- The proportion of a protected class affected by the behavior is different from a non-protected class
 - 80% rule
- Example
 - 50% of men are hired
 - 45% of women are hired
 - $45/50 = 90\%$

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Protected Classes

- Federal Law:
 - race, color, religion, national origin, age (40+), sex, pregnancy, citizenship, familial status (kids), veterans, genetic status
- California Law:
 - ...disability, sexual orientation, HIV or medical status, political party, victim of domestic violence

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Definitions of Validity

- Agreement between test scores and the thing (construct) it claims to measure
- Many other definitions; some confusing or incompatible with each other
- AREA/NCME (1985, 1999, 2012) “Standards for Educational and Psychological Testing”
- One informal definition: Face Validity
- Three formal definitions: Content, Criterion, Construct

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Face Validity

- Common Sense / Informal Analysis
- “I like mechanics magazines” = you like mechanics magazines.
“I never tell a lie” = you never lie
- Issues:
 - What factors might influence a test-taker’s response?
 - Face validity is not a proper type of validity
 - Quizzes in magazines or on the Internet -- appear “face valid” but usually have low reliability and very low validity

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Does Face Validity Matter?

- Naive view = face validity
- Tests with very little face validity...
 - what does the average test taker feel about the test?
 - motivation?
 - confusion?

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Content Validity

- Do the test questions cover the construct?
- Commonly used in education (achievement/ aptitude testing)
- Example: does an Algebra test contain questions about a wide range of Algebra topics?
- This is a Logical, rather than statistical argument
- Fuzzy definition
- Modern theories consider Content Validity a sub-set of other types of validity

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Content Validity 2

- If a test is supposed to test a specific *Construct*, problems may arise:
- Construct underrepresentation
 - test questions miss important topics
- Construct-irrelevant variance
 - test scores are influenced by outside factors
 - e.g. anxiety, reading comprehension, IQ, etc...

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Content Validity

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Improving on Content Validity

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Norm vs. Criterion

- Norm-referenced test
 - “Hire the top 5% of applicants”
 - Pro - select the best
 - Con - can they do the job?
- Criterion-referenced test
 - “Hire those who can do _____”
 - Pro - they can do the job
 - Con - not selecting the best

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Criterion Validity

- Criterion -- a well defined measure of performance *in the real world*
- Criterion validity -- the correlation between a test score and the specific criterion

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Predictive vs. Concurrent

- Predictive
High School SAT score (predictor) predicts later College GPA (criterion)
- Concurrent
Work samples from mechanics

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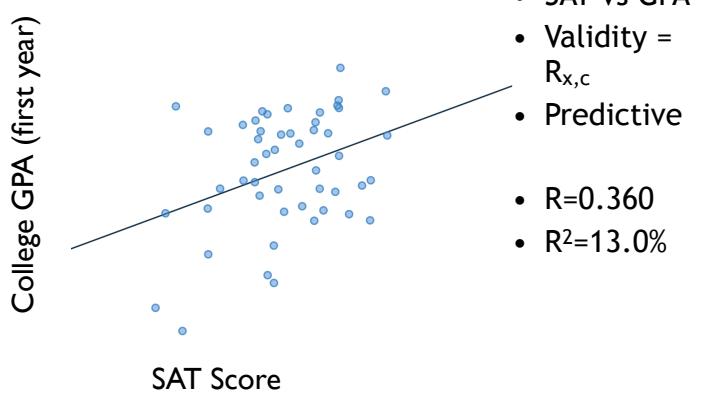
Measuring Validity

- General: relationship between test and what it's supposed to be measuring
- Specific: Pearson product-moment correlation (r) between Test Score (X) and criterion (Y)

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Criterion Validity Example



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How much Validity?

- Validity is often lower than you'd want
- $r > 0.60$ is rare
- $r = 0.40$ or lower is common
- $r^2 = \%$ of variance explained
 - $r = .60$ means just 36% of variation in the criterion scores explained by the predictor score (means 64% is not explained)
 - $r = .40$ means 16% of variance explained (84% not)

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Evaluating Validity Coefficients

- Validity depends on the cause of the correlations
- And on the meaning of the criterion
- If the reason for the relationship changes, validity may change as well.
- Examples:
 - Different *subjects*
 - Different *situation*
 - Different *criterion*

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Problems with Criterion Validity

- “what is the criteria?”
- Some criteria are obvious and sensible: E.g. using SAT to predict college GPA
- For many constructs, it’s not clear: E.g. intelligence. IQ test used to predict _____?
- Without a *specific* criterion, you can’t calculate criterion validity!

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Construct Validity

- Construct = theoretical entity. In soft sciences, usually not directly observable or measurable.
- Solution -- the world is complicated. In Psychology (as in other sciences) things can exist even if they aren’t easy to measure.
- Method -- collect evidence for the construct via multiple **methods**, multiple **sources**, multiple **subjects**

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Construct Evidence

- **Convergent Evidence** – data from multiple sources all tend to point to the same conclusion.
- **Divergent Evidence (aka Discriminant Evidence)** – evidence that a Construct is not the same as another

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Construct Validity Example

- Construct: Insomnia
- Convergent correlations - R should be strong (either positive or negative)
 - # of hours slept
 - tired feeling
 - another test of insomnia
- Divergent correlations - R should be weak (close to zero)
 - age
 - IQ

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Construct Validity Example

| | An old test of insomnia | # of hours slept | Feeling Tired | IQ | Age |
|--|-------------------------|------------------|---------------|-----------|-----------|
| Correlation between your test of insomnia and... | ✓ | ✓ | ✓ | none | none |
| Which kind of Construct validity? | Convergent | Convergent | Convergent | Divergent | Divergent |

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The Love Test

- Rubin (1970)’s Love Scale
- From Literature, created 198 items on Likert scale
- Result: a “Love” scale and a “Liking” scale
- Love scale had 3 factors: attachment, caring, intimacy
- Convergent evidence:
 - lovers vs. friends
 - eye contact
- Divergent evidence:
 - possible to love someone w/o liking them



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All Validity is Construct Validity?

- Modern theory: only one type of validity -- Construct validity
- Other types of validity are just sub-types of Construct validity.

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Ricci v. DeStefano (2009)

- Written and Oral test for promotion to firefighter Captain position in Newhaven CT
- Pass rate: Whites 64%, African Americans 38%, Hispanics 38%
- Scoring rule: only top scores eligible
- None of the African Americans would get promotion
- City, worried about Disparate Impact, denied promotions to everyone
- 18 White employees filed suit against the city
- Question: was this the right action to take?

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Ricci v. DeStefano 2

- Supreme court decision:
- Found City *did the wrong thing*
- Race-based action can be taken only if "demonstrate a strong basis in evidence that, had it not taken the action, it would have been liable under the disparate-impact statute"
- Tests are discriminatory:
 - if they are not valid for the job.
 - Not just because *protected classes* get different results.

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4 Kinds of Validity

| | Description | Notes | Statistic(s) |
|------------------|---|---|--|
| Face | do items "look" valid? | informal, improper, non-scientific | none |
| Content | do test questions cover the topic? | logic & expert judgement | none |
| Criterion | does the test predict a specific outcome? | requires a well-defined criterion | Pearson's R (correlation) between Test and Criterion |
| Construct | does the test measure what it claims | modern theory: all validity is Construct validity | Convergent and Divergent correlations (Pearson's R) |

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Reliability vs. Validity

- Validity coefficient is the correlation between a test and the criterion
- We know that *Test Measurements* and *Criterion Measurements* are unreliable
- The maximum validity is the square root of the product of their individual reliabilities.

$$r_{12max} = \sqrt{r_{11}r_{12}}$$

- If the tests have low reliability, validity can be hidden

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Reliability vs. Validity : Example

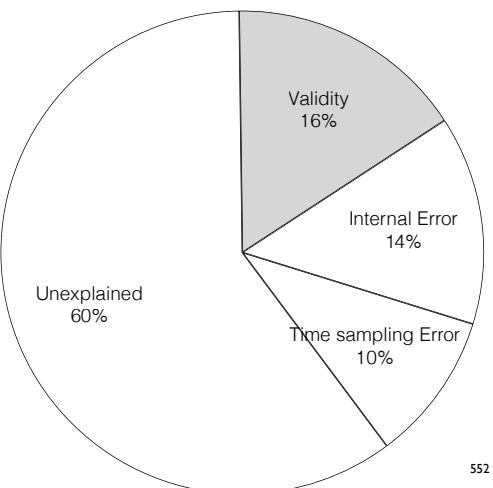
| Reliability of Test | Reliability of Criterion | |
|---------------------|--------------------------|----------------------|
| | | Maximum Validity (r) |
| CES-D | DSM-V Depression | |
| 1 | 1 | 1 |
| 0.8 | 1 | 0.89 |
| 0.6 | 1 | 0.77 |
| 0.4 | 1 | 0.63 |
| 0.2 | 1 | 0.45 |
| 1 | 0.5 | 0.71 |
| 0.8 | 0.5 | 0.63 |
| 0.6 | 0.5 | 0.55 |
| 0.4 | 0.5 | 0.45 |
| 0.2 | 0.5 | 0.32 |

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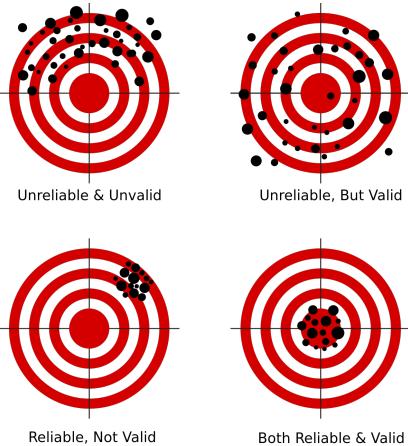
Variance: Reliability & Validity

- Variance in test scores can be divided into different portions
- In this example, only 16% is useful (validly predicts criterion)
- Other sources of error are known or unknown



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Reliability vs. Validity



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Reliability or Validity Part 1

| Procedure | Reliability or Validity | What kind? |
|---|-------------------------|------------|
| Correlation of IQ scores with ability to handle 30 tons of coal per day | | |
| Correlation between SAT scores taken in Junior vs. Senior year of High School | | |
| Having a committee review a high school history exam to make sure the questions cover all required topics | | |
| Correlation between scores on two different versions of a Final Exam | | |

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Reliability or Validity Part 2

| Procedure | Reliability or Validity | What kind? |
|--|-------------------------|------------|
| Showing that your new measure of Anxiety correlates with an old measure of Anxiety, and does not correlate with IQ | | |
| Showing that everyone in your research lab can rate "grumpy" expressions the same way | | |
| Looking at a question about depression and deciding that it measures depression. | | |
| Showing that questions on your test all correlate strongly with each other | | |

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Ch. 5 - Part 2

Review

- Reliability : easier to define and calculate. A property of the Test itself.
- Validity : harder to define, not inherent to the test, depends on the way *the test results are used*.

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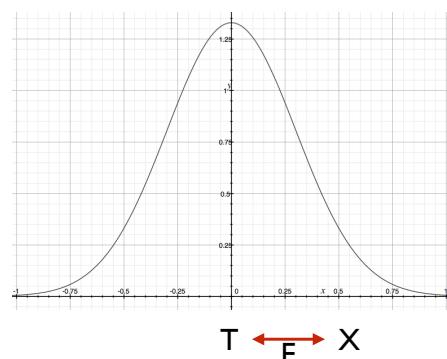
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Classical Test-Score Theory

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- T = True Score
- X = Observed
- E = Error
- $X = T+E$
- $E = X-T$



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4 Kinds of Reliability

| | Description | Name | Statistic |
|----------------------|------------------------------|------------------------------------|--|
| Time Sampling | 1 test given two times | test-retest reliability | correlation between scores at two times |
| Item Sampling | 2 different tests given once | Alternate or Parallel forms | correlation between scores on 2 versions |
| Internal Consistency | One test, multiple items | Split Half or internal reliability | Cronbach's Alpha |
| Observer Differences | One test w/ 2+ observers | inter-observer reliability | Kappa |

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4 Kinds of Validity

| | Description | Notes | Statistic(s) |
|-----------|---|---|--|
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| Criterion | does the test predict a specific outcome? | requires a well-defined criterion | Pearson's R (correlation) between Test and Criterion |
| Construct | does the test measure what it claims | modern theory: all validity is Construct validity | Convergent and Divergent correlations (Pearson's R) |

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Disparate Impact

- aka "Adverse Impact"...
 - disproportional...
 - adverse effect...
 - on a protected class...

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How much validity do you need?

- Clinical Significance
 - Effect Size of Benefits
 - vs Cost and Harm
- Examples:
 - an inexpensive test which can detect 1% of cancers (validity $r^2=1\%$)
 - a written test for airline pilots to detect who is unsafe (validity $r^2=93\%$)
- Answer: it depends

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4 Kinds of Validity

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Constructs, Factors, Facets

- Constructs may be “high” or “low” (also called “top” or “bottom”)
- Top-level constructs are made of smaller constructs
- aka Factors, Facets, Dimensions, Domains, Codes, Types...

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Construct: Anxiety

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Convergent Validity

- Multiple factors within a construct or multiple measures of a construct
- All correlate with each other strongly

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Divergent Validity

- Other factors (not part of a construct)
- Should have low to zero correlation
- What about negative correlations?

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Exercise 3: Literature Review

- Types of articles
- Searching in PsycInfo
- Other Sources

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Types of Articles

- Original Research (aka “Empirical Study”)
 - the most common type: the author(s) run an experiment, collect data, analyze it, and write up their conclusions
- Review (aka “Literature Review”)
 - not to confused with a “Book Review” or “Peer Review”
 - provides a summary of a topic or field of research
 - reads other articles
 - does NOT do any original research

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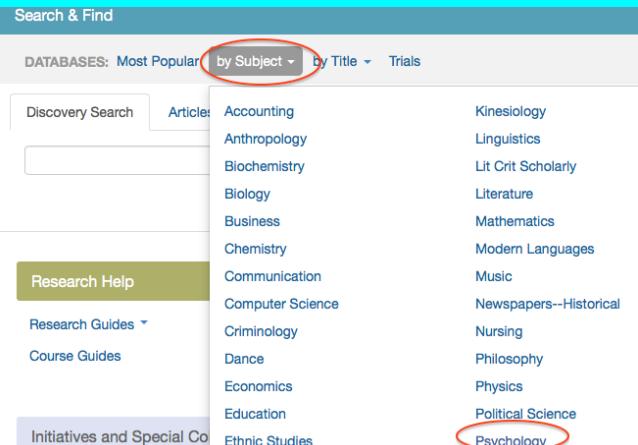
Types of Articles

- Meta Analysis
 - a type of literature review that also does some statistical research
 - re-analyzes other research
- *These are complicated and not suitable for the class project; please don't pick a meta-analysis for your review article(s)*

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Searching PsycInfo



DATABASES: Most Popular by Subject ▾ by Title ▾ Trials

Discovery Search Articles

Research Help

Research Guides ▾ Course Guides

Initiatives and Special Co

Accounting Kinesiology
Anthropology Linguistics
Biochemistry Lit Crit Scholarly
Biology Literature
Business Mathematics
Chemistry Modern Languages
Communication Music
Computer Science Newspapers--Historical
Criminology Nursing
Dance Philosophy
Economics Physics
Education Political Science
Ethnic Studies Psychology

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Searching PsycInfo

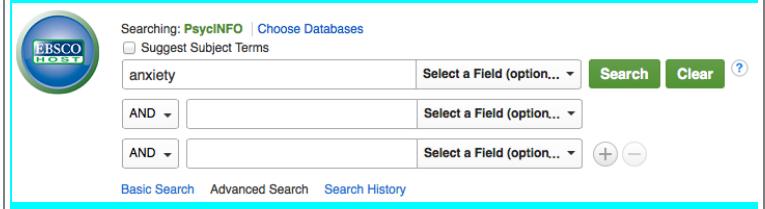
Psychology Databases

Most Useful

| Database | Show database descriptions |
|----------------------|----------------------------|
| PsycINFO | Info |
| Biological Abstracts | Info |
| PubMed @ CSUSM | Info |
| Google Scholar CSUSM | Info |

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Search : Anxiety



EBSCO HOST

Searching: PsycINFO | Choose Databases

Suggest Subject Terms

anxiety Select a Field (option...)

AND Select a Field (option...)

AND Select a Field (option...)

Basic Search Advanced Search Search History

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Anxiety Results

Search Results: 1 - 10 of 245,450

1. The contribution of **anxiety** sensitivity to obsessions in a naturalistic treatment setting.



Academic Journal

Kaczkurkin, Antonia N.; Fitzgerald, Hayley; Tyler, Jeremy; 661-673. Publisher: Springer; [Journal Article]

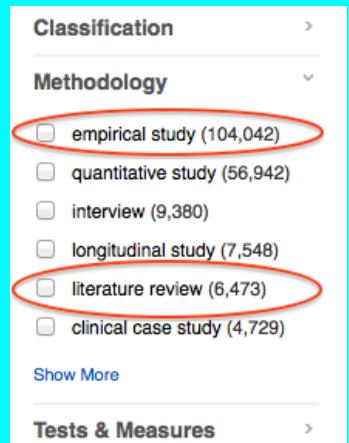
Subjects: Anxiety Disorders; Internalization; Obsessive Compulsive Disorders; Psychopathology; Women; Female

Get It! Get It! at CSUSM

2. Paternal **anxiety** in relation to toddler **anxiety**: T

Type of Publication

- Methodology
- Empirical Study
 - aka Original Study
- Literature Review
 - aka Review



Classification

Methodology

empirical study (104,042)

quantitative study (56,942)

interview (9,380)

longitudinal study (7,548)

literature review (6,473)

clinical case study (4,729)

Show More

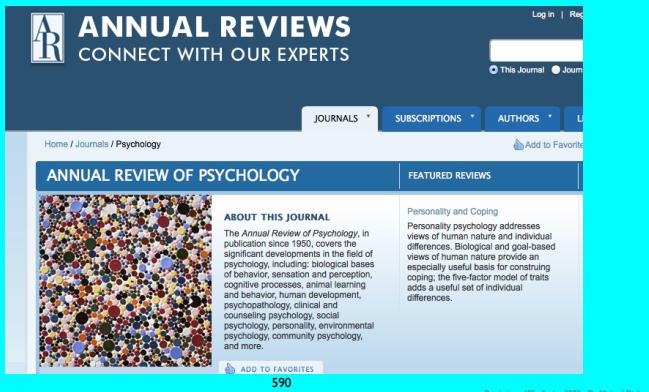
Tests & Measures

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Other Sources

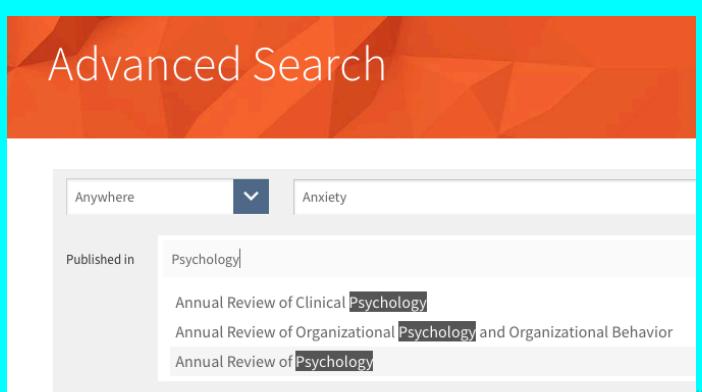
- Some journals specialize in *Review* articles
- <https://annualreviews.org>



The screenshot shows the homepage of the Annual Review of Psychology journal. The header features the journal's logo and the text 'ANNUAL REVIEWS' and 'CONNECT WITH OUR EXPERTS'. Below the header, there are tabs for 'JOURNALS', 'SUBSCRIPTIONS', 'AUTHORS', and 'ABOUT'. The main content area is titled 'ANNUAL REVIEW OF PSYCHOLOGY' and includes a 'FEATURED REVIEWS' section. A sidebar on the left is titled 'ABOUT THIS JOURNAL' and contains a colorful abstract image of numerous small circles in various colors. The footer includes a 'Psychology 402 - Spring 2022 - Dr. Michael Dahr' link.

Searching AnnualReviews.org

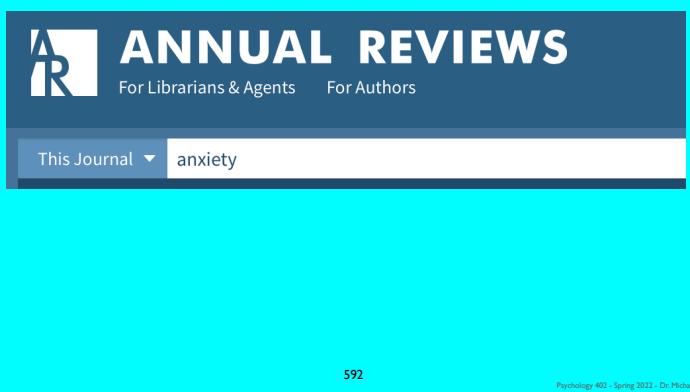
- Advanced Search - search only in *Annual Review of Psychology*



The screenshot shows the 'Advanced Search' interface on AnnualReviews.org. The search bar has 'Anywhere' selected and the term 'Anxiety' entered. Below the search bar, there is a dropdown menu set to 'Published in' and a list of psychology sub-fields: 'Psychology', 'Annual Review of Clinical Psychology', 'Annual Review of Organizational Psychology and Organizational Behavior', and 'Annual Review of Psychology'. The footer includes a 'Psychology 402 - Spring 2022 - Dr. Michael Dahr' link.

Searching AnnualReviews.org

- Choose the journal first, then search only in *This Journal*



The screenshot shows the homepage of the Annual Reviews journal. The header features the journal's logo and the text 'ANNUAL REVIEWS' and 'For Librarians & Agents' and 'For Authors'. Below the header, there are tabs for 'This Journal' and 'anxiety'. The footer includes a 'Psychology 402 - Spring 2022 - Dr. Michael Dahr' link.

Review Assignment

- Exercise 3 on website now

Exercise 3 FAQ

- Q: am I stuck with this construct and articles for my Project Proposal? A: No, you can change your mind later
- Q: Can I study the relationship between Gender and Test Anxiety? A: No, those are 2 separate constructs. Please pick only a single construct
- Q: I can't download the PDF for the AnnualReviews article. A: use the DOI (see instructions on website)

Exercise 3 FAQ

- Q: I'm having trouble finding a good definition of my construct with multiple factors.
- A: that's the hardest part of the assignment. You may need to search a few Review articles until you find it.
- Q: talk about the cheeseburger analogy please
- A: ...