Lab 2: Validity

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Before we start

Go to Canvas and download `Lab2.RData`

Load the data into R:
`load("Lab2.RData")`

Skeleton R-script also found on Canvas (`lab2skeletonscript.R`).

Today:

- Classical validity-analysis using the multi-trait multi-method approach.
- Examine convergent and discriminant evidence of validity.
- Whether this approach provides relevant evidence depends on intended interpretations and uses of test-scores.

The multi-trait multi-method (MTMM) matrix:

- Famously presented by Campbell and Fiske (1959).
- Origins in personality (or trait) psychology.
- Involves examining **Convergent** and **Discriminant** evidence of validity.
  - **Convergence:**
    Scores for *same trait* measured by *different methods* should correlate, and correlate sufficiently strongly.
  - **Discrimination:**
    Different traits measured by the *same (or different) method* should not correlate more strongly than the above.
- Hence, a method for providing evidence pertaining to the **relations to other variables** category of the *Standards*.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix. *Psychological Bulletin, 56*(2), pp. 81–105. doi: https://doi.org/10.1037/h0046016

The MTMM matrix:

TABLE 1

A Synthetic Multitrait-Multimethod Matrix

		Method 1			Method 2			Method 3		
	Traits	A_1	B_1	C_1	A_2	B_2	C_2	A_3	B_3	C_3
	A_1	(.89)								
Method 1	B_1	.51	(.89)							
	C_1	.38	.37	(.76)						
	A_2	.57	.22	.09	(.93)					
Method 2	B_2	.22	.57	.10	.68	(.94)				
	C_2	.11	.11	.46	.59	.58	(.84)			
	A_3	.56	.22	.11	.67	.42	.33	(.94)		
Method 3	B_3	.23	.58	.12	.43	.66	.34	.67	(.92)	
	C_3	.11	.11	.45	.34	.32	.58	.58	.60	(.85)

Note.—The validity diagonals are the three sets of italicized values. The reliability diagonals are the three sets of values in parentheses. Each heterotrait-monomethod triangle is enclosed by a solid line. Each heterotrait-heteromethod triangle is enclosed by a broken line.

MTMM explained (convergence):

TABLE 1

A Synthetic Multitrait-Multimethod Matrix

		Method 1			Method 2			Method 3		
	Traits	A_1	B_1	C_1	A_2	B_2	C_2	A_3	B_3	C_3
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Reliability coefficients: Convergence.
The proportion of variance shared between true-scores and observed-scores produced when a trait is measured by way of one specific method.

"Validity coefficients": Convergence.
Heteromethod, monotrait correlations. Correlation between trait-scores produced by means of one method should correlate strongly with those produced using another method.

MTMM explained (discrimination):

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A Synthetic Multitrait-Multimethod Matrix

		Method 1			Method 2			Method 3		
	Traits	A_1	B_1	C_1	A_2	B_2	C_2	A_3	B_3	C_3
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Between-trait, within method correlations (Discrimination):
"Heterotrait-monomethod" correlation coefficients. Correlation between scores on different traits measured using the same method.

Between-trait, between method correlations (Discrimination):
"Heterotrait-heteromethod" correlation coefficients. Correlation between scores on different traits measured using different methods.

C&F's 4 criteria for MTMM validity:

1. Validity diagonal values should be:
   - Statistically significant.
   - Sufficiently strong to be interesting.
2. Validity diagonal values should be higher than values in heterotrait-heteromethod triangles.
3. A variable should correlate higher with different method of measuring the same trait, than with different trait measured with same method.
4. The same pattern of trait-interrelationship should be evident in all heterotrait triangles of both the mono-method and heteromethod blocks.

Criteria #1 = Convergent evidence of validity.
Criteria #2-4 = Discriminant evidence of validity.

Task 1

- Analyze Convergent and Discriminant validity-evidence organized in a MTMM matrix.
  1. Convergence and Discrimination *within* methods.
  2. Convergence and Discrimination *between* methods.
- Data is from MTMM matrices presented in C&F's original article.
- Data is stored in `Lab2.RData`, available on Canvas.

Data-set:

TABLE 2

PERSONALITY TRAITS OF SCHOOL CHILDREN FROM KELLEY'S STUDY
(N=311)

		Peer Ratings				*Association Test*			
		A_1	B_1	C_1	D_1	A_2	B_2	C_2	D_2
Peer Ratings									
Courtesy	A_1	(.82)							
Honesty	B_1	.74	(.80)						
Poise	C_1	.63	.65	(.74)					
School Drive	D_1	.76	.78	.65	(.89)				
Association Test									
Courtesy	A_2	*.13*	.14	.10	.14	(.28)			
Honesty	B_2	.06	*.12*	.16	.08	.27	(.38)		
Poise	C_2	.01	.08	*.10*	.02	.19	.37	(.42)	
School Drive	D_2	.12	.15	.14	*.16*	.27	.32	.18	(.36)

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Reliabilities

"Validity coefficients"

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Discrimination of Constructs within Methods.

Discrimination of Constructs across Methods.

Todays task:

- **Task 1:** Examine the MTMM matrix. Summarize the evidence.
  1. Examine the evidence for convergence and discrimination within the first method.
  2. Examine the evidence for the second method.
  3. Examine the evidence for convergence and discrimination across methods.

- **Task 2:** Disattenuate and re-assess. Pick one of the traits.
  1. Examine the convergent evidence of the two methods after attenuation.
  2. Examine the discriminant evidence within methods following disattenuation.
  3. Examine the discriminant evidence across methods following disattenuation.

MTMM example: Convergence and Discrimination of "Poise".

TABLE 2

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"Disattentuating" correlations

Correlations between scores impacted by reliability ("attenuation").
To get at "true correlation" between traits, correct for attenuation ("disattenuate").

- Let $\rho_{x.y}$ denote true correlation between traits x and y (given perfect reliability).
- ... $r_{x.y}$ the observed correlation between traits x and y.
- ... $r_{x.x}$ and $r_{y.y}$ the reliabilities with which x and y are measured (respectively).

An estimate of the "true" correlation between traits x and y can be obtained by:

$$\rho_{x.y} = \frac{r_{x.y}}{\sqrt{r_{x.x} r_{y.y}}}.$$

MTMM example: Disattenuating correlations

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Disattenuation example:
M1 School-Drive <-> M2 Courtesy