Challenges to Using and Interpreting the SATS-36 Instrument:

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Do you like statistics? Do your students like statistics? How do you *know*?

About the SATS Instrument

- Widely-used to measure attitudes toward statistics
- 28-item (Schau, 1992) *Affect,* *Cognitive Competence,* *Value,* and *Difficulty*
- 36-item (Schau, 2003) the above, with *Interest* and *Effort*
- Primarily used with undergraduate, introductory statistics students
- Translated into many languages

Data & Analysis

- Graphs and analysis are based on student data in the SATS data warehouse, collected from 2007-2010
- Students in introductory statistics courses
- Approximately 2300 students across 120 courses
- Missing values excluded from these analyses
- STEM results graph is from internal data collection using adapted instruments for which validity evidence is largely unavailable

Other Challenges

- Neutral option included, coupled with non-standard instructions:
  - "If you have no opinion, choose Neither disagree nor agree."
- Difficulty may depend on type of student/course
  - Example: Engineering students at BYU tend to have higher difficulty scores than for general populations at UNM.
- Negatively worded items use "not" – may be overlooked by students
- Claimed congruence with Expectancy Value Theory (EVT; e.g. Eccles, 1983, 2014)
  - Potential misalignment between SATS constructs and EVT constructs (e.g. Cost)
- Rigid pre/post structure makes longitudinal research (e.g. Kerby & Wroughton, 2017; Millar & White, 2014) difficult at best
- Not appropriate for use with other populations of interest (e.g. Teachers)

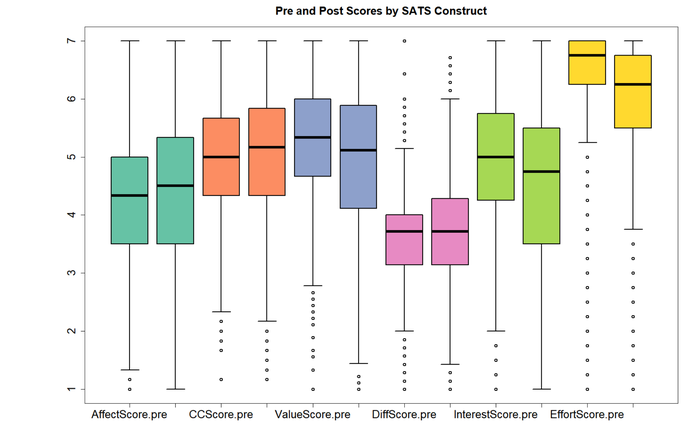


Figure 1. Boxplots showing the Pre (left) and Post (right) scores of students for each SATS construct.

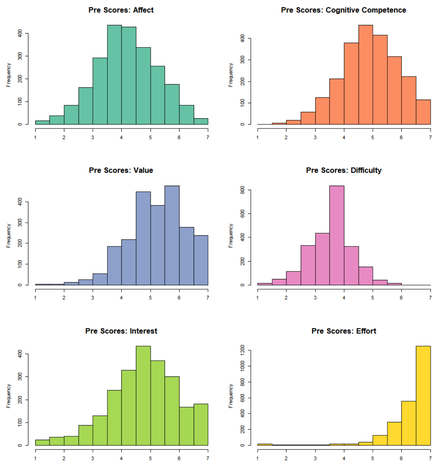


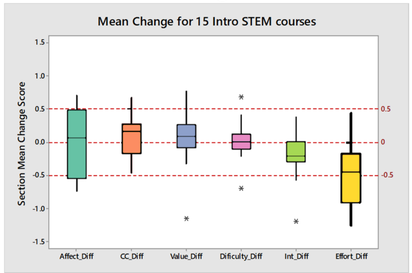
Figure 2. Histograms for student Pre scores for each SATS construct.

Component	Mean Difference	Cohen's d	Interpretation
Affect	0.01	0.01	Small
Cognitive Competence	0.00	0.00	Small
Value	-0.37	-0.39	Medium
Difficulty	-0.06	-0.08	Small
Interest	-0.82	-0.68	Large
Effort	-0.56	-0.65	Large

Table 1. Mean difference (Post-Pre), effect size, and interpretation for each SATS construct.

Figure 3. Mean change scores for 15 sections of introductory STEM courses. These data are from instruments internally adapted for STEM fields. Validity evidence is largely unavailable

STEM Results Using Section Means



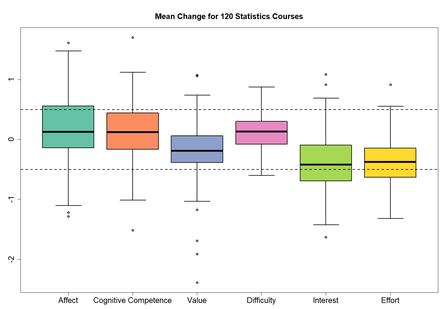


Figure 4. Mean change scores for 120 sections of introductory statistics courses. This figure is modeled on Schau and Emmioğlu's (2012) Figure 3 and exhibits the same pattern.

Changes from Pre to Post

- Changes often absent from Pre to Post (especially *Affect*, *Cognitive Competence,* and *Value*)
  - Does this reflect a true lack of change in the underlying constructs?
  - Or does this reflect an inability for the instrument to detect such changes?
  - Initial development article (Schau et al., 1995) includes only Pre survey
- More variability in Post scores than Pre scores
- Adapted version of SATS to STEM demonstrates similar patterns among scores (see Figures 3 and 4)
- See Figure 1 and Table 1

Interest and *Effort* Scales

- Only four items per construct while the original SATS-28 attitude constructs had no less than 6 items: Affect (6 items), Cognitive Competence (6 items), Value (9 items), and Difficulty (7 items).
  - "More discrete" than the other constructs: possible values for the construct end in .00, .25, .50, .75
  - No negatively-worded items while SATS-28 constructs did include negatively-worded items
- All the Interest items have the word "interest" in them.
  - Example item: *I am interested in learning statistics.* (Schau, 2003, p. 3)
- All the Effort items have the word "plan" in them.
  - Example item: *I plan to complete all my statistics assignments.* (Schau, 2003, p. 3)
- Students who reviewed the Effort items in focus groups (SofIA, STEM Attitudes, 2014 and 2015) indicated that one would tend to strongly agree to all of the items.
- Effort scale tends to exhibit a ceiling effect (especially on Pre), that is the distribution is not symmetric, bounded by 7 (Strongly Agree), and skewed towards 1 (Strongly Disagree) (see Figure 2)
- Students tend to overestimate their effort at the beginning of the semester.

Ways to Address these Challenges

- Understand limitations of SATS when using it or reading reports that use it
- Document validity evidence for your intended uses and question uses that are not supported
- Revisions to SATS? Lots of challenges to address.
- Development of a new instrument? Ongoing project: Surveys of Motivational Attitudes toward Statistics: SOMAS (e.g. Batakci, Bolon, & Bond, 2018; Unfried, Kerby, & Coffin, 2018; Whitaker, Unfried, & Batakci, 2018; Whitaker, Unfried, & Bond, 2019)

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