# Further Development and Psychometric Analysis of the Student Survey of Motivational Attitudes Toward Statistics

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#### Introduction

• Attitudes matter in education!<sup>1</sup>

• We need to understand **statistics and data science attitudes** to understand how to help students succeed in the data deluge.

• Current instruments exhibit flaws, or are nonexistent.<sup>2</sup>

#### Student Survey of Motivational Attitudes Towards Statistics

MASDER:

Motivational Attitudes in Statistics and Data Science Education Research • 3-year NSF IUSE grant (Oct '20 - Sept '23)

• Develop 6 instruments evaluating student and instructor attitudes toward statistics and data science, and the learning environment

• Conduct nationally-representative sample of students and instructors

• This presentation focused on the *Student Survey of Motivational Attitudes Towards Statistics (S-SOMAS)* 

# Methodology: The S-SOMAS

**Theoretical Construct** Attainment Value Cost and Benefits  $\bullet$ Academic Self-Concept **Goal Orientation** Expectancy Value Difficulty \_ Utility Value Interest and Enjoyment -

- Survey contains 88 items and 8 constructs developed under Expectancy-Value Theory (EVT)
  - Students responded on a 7-point Likert scale
- Analysis on Pilot 2 data
  - Revisions to item and constructs after each administration of the survey
  - All analyses conducted in R-Studio

#### Item

- You must work hard to understand statistics.
- No one in my career field uses statistics
- I am interested in learning more about statistics.

# Methodology

Attainment Value

- How important learning statistics is to one's personal identity.
- Attainment value is a traditionally difficult construct to measure
- Similar approaches were made for all items in other constructs in the survey

Item Code	Item
Attain 1	If I did poorly in a statistics course, I would be disappointed in myself.
Attain 2	Doing well in statistics is important to my sense of self.
Attain 3	If I am unable to interpret statistical results, I feel insecure.
Attain 4	I feel anxious at the thought of learning statistics.
Attain 5	I would feel proud of myself if someone told me that I am good at statistics.
Attain 6	I would feel satisfied if I were able to help a friend with statistics.
Attain 7	Understanding statistics makes me feel good about myself.
Attain 8	I feel defeated when a statistical problem takes longer than expected.
Attain 9	Learning statistics is very important to me.
Attain 10	If I do poorly in statistics, I get frustrated.
Attain 11	Understanding statistics gives me a sense of satisfaction.
Attain 12	I would feel good about myself if my peers came to me for statistical advice.
Attain 13	I would feel valued if someone wanted my help in understanding statistics.

# Methodology: Administration & Data Cleaning



- Administered to 3114 undergraduates at 41 universities across the United States in Fall 2021
- Multiple imputation was performed to impute 87 missing values

• Final sample size of 2535 out of a possible 4503 students

• Final response rate of 56.3%

### Methodology: Analyses



Results

#### EFA

Item Code	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Item Rating
Attain 1					0.565				Unremarkable
Attain 2									Problem
Attain 3									Problem
Attain 4		-0.678							Problem
Attain 5					0.614				Unremarkable
Attain 6					0.523				Unremarkable
Attain 7	0.440				0.436				Problem
Attain 8									Problem
Attain 9	0.748								Unremarkable
Attain 10					0.525				Unremarkable
Attain 11	0.544								Unremarkable
Attain 12					0.526				Unremarkable
Attain 13					0.550				Unremarkable

# Results: IRT

Attain 3, 4, 8 and 10 show clear deviations

Wright Map with Thurstonian Thresholds for Attainment Value



Wright Map with Thurstonian Thresholds for Attainment Value



# Results: IRT (Cont.)

Removed Attain 4, but Attain 3, 8 and 10 are still issues

Wright Map with Thurstonian Thresholds for Attainment Value



Wright Map with Thurstonian Thresholds for Attainment Value



# Results: IRT (Cont.)



	Item Code	Item Rating
	Attain 1	Unremarkable
	Attain 2	Unremarkable
	Attain 3	Problem
	Attain 4	Problem
	Attain 5	Unremarkable
	Attain 6	Unremarkable
es ratings	Attain 7	Unremarkable
	Attain 8	Problem
	Attain 9	Problem
	Attain 10	Problem
	Attain 11	Unremarkable
	Attain 12	Unremarkable
	Attain 13	Unremarkable

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					Attain 1	Unremarkable
					Attain 2	Unremarkable
Start with all i	Start with all items				Attain 3	Problem
	Model 1		Model 3		Attain 4	Problem
Chi-Squared	5688.359		355.460		Attain 5	Unremarkable
Degrees of Freedom	65.000		20.000		Attain 6	Unremarkable
CFI	0.892	Remove Attain 3, 4, 8, 9 and 10	0.991	Leads to item ratings	Attain 7	Unremarkable
TLI	0.870		0.988		Attain 8	Problem
SRMR	0.123		0.044		Attain 9	Problem
RMSEA	0.185		0.081		Attain 10	Problem
90% Upper RMSEA	0.189		0.089		Attain 11	Unremarkable
					Attain 12	Unremarkable
					Attain 13	Unremarkable

## Results:

# A Holistic View

- Attain 3, 4 and 8 were problems in every analysis.
- Six items were unremarkable through all three analyses.
- Attain 3 and 4 are removed due to obvious deviations from our attainment definition
- Attain 8 seems related to attainment value in a theoretical sense.

Item Code	EFA Ratings	<b>CFA Ratings</b>	IRT Ratings	Final Decision
Attain 1	Unremarkable	Unremarkable	Unremarkable	Keep
Attain 2	Problem	Unremarkable	Unremarkable	Keep
Attain 3	Problem	Problem	Problem	Drop
Attain 4	Problem	Problem	Problem	Drop
Attain 5	Unremarkable	Unremarkable	Unremarkable	Keep
Attain 6	Unremarkable	Unremarkable	Unremarkable	Keep
Attain 7	Problem	Unremarkable	Unremarkable	Keep
Attain 8	Problem	Problem	Problem	Keep
Attain 9	Unremarkable	Problem	Problem	Keep
Attain 10	Unremarkable	Problem	Problem	Keep
Attain 11	Unremarkable	Unremarkable	Unremarkable	Keep
Attain 12	Unremarkable	Unremarkable	Unremarkable	Keep
Attain 13	Unremarkable	Unremarkable	Unremarkable	Keep

## Discussion: Psychometric Properties

• As demonstrated by attainment, we are seeing strong psychometric properties for the constructs on S-SOMAS. This supplies empirical support for our survey design.

• This puts us in good shape for continued survey development.

#### Future Work

• MASDER - other surveys under development

<u>Surveys of Motivational Attitudes toward...</u>

	Student Instrument	Instructor Instrument	Environment Inventory
Statistics	S-SOMAS	I-SOMAS	E-SOMAS
Data Science	S-SOMADS	I-SOMADS	E-SOMADS



Please Join Us for our Next Steps: MASDER Survey Administration



#### Fall 2022 Survey Administration

- Administer S-SOMAS pre/post semester
- Administer I-SOMAS to all instructors giving S-SOMAS
- Administer pilot S-SOMADS
- Gift card incentive for participation!

#### **Survey Development Opportunities**

- Serve as a Subject Matter Expert (SME), rating each item before administration
- Participate in an instructor focus group about survey items

We need BROAD REPRESENTATION from faculty teaching statistics and data science! <u>Click here to fill out the interest form</u>

Find more information at our website! <u>http://SDSAttitudes.com</u>

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#### References

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# Appendix

# Introduction: Expectancy-Value Theory (EVT)



#### Objectives of the Current Study



## Methodology: Descriptive Statistics

Table of counts and Percentages of student gender

• Median age of 19 years old

• 32.74% first generation

	Man	Woman	I prefer to self-identify	I prefer not to answer	Missing	Total
Counts	887	1552	35	25	36	2535
Percents	34.99%	61.22%	1.38%	0.99%	1.42%	100%

#### Table of counts and Percentages of student year in college

	High School Student	First Year	Second Year	Third Year	Fourth Year	Five+ Years	Graduate Student	Part-time student	Other	Missing	Total
Counts	17	793	693	574	227	69	57	38	30	37	2535
Percents	0.67%	31.28%	27.34%	22.64%	8.95%	2.72%	2.25%	1.50%	1.18%	1.46%	100%

#### Limitations

• Demographics of universities do not necessarily align with the national population.

• Survey length may have some influence on student responses.

• Not all students chose to take the survey.