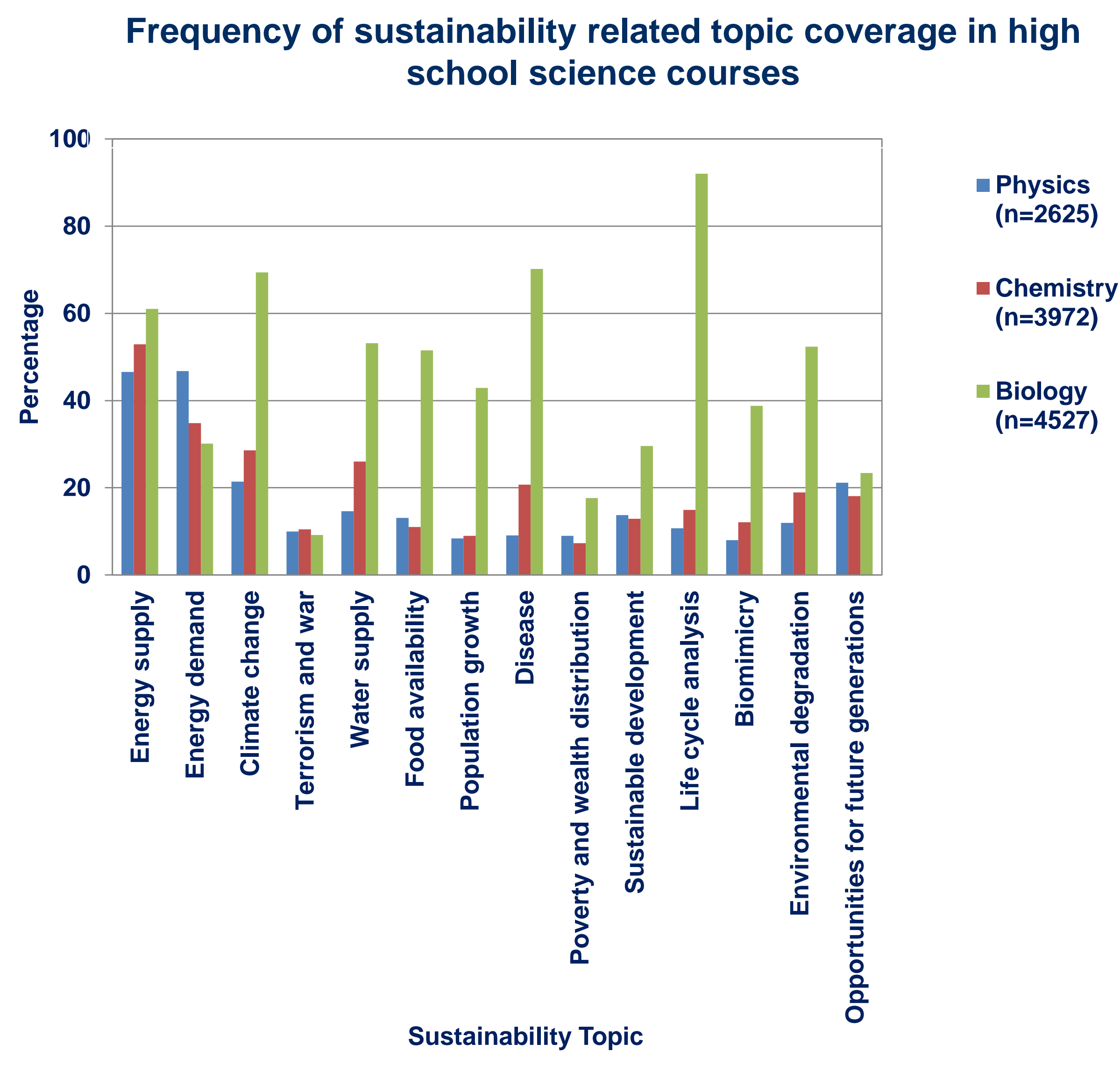


Sustainability in Physics Education: Science Agency Beliefs and Physics Identity

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How frequently are sustainability topics included in physics courses compared to other science courses?



How does inclusion of sustainability in physics courses affect students' science agency beliefs?

Regression model predicting science agency beliefs with sustainability-related topics in high school physics

Parameters	Estim.	Sig.	SE
INTERCEPT	1.79	***	0.06
Controls			
Academic Achievement Index - Math	0.25	**	0.10
Science/engineering hobbies/activities	0.09	***	0.02
Read/watched science/engineering programs	0.13	***	0.01
Family interest in science as career	0.66	***	0.04
Family did not support interest in science	-0.26	***	0.04
High School Physics Sustainability Topics			
Energy supply	0.12	**	0.04
Sustainable development	0.15	*	0.07
Life cycle analysis	-0.16	*	0.12
Bio-mimicry	-0.33	***	0.09
Adjusted R²	0.27		

*: p<0.05, **: p<0.01, ***: p<0.001

How does inclusion of sustainability in physics courses affect students' physics identity?

Regression model predicting physics identity proxy with sustainability-related topics in high school physics

Parameters	Estim.	Sig.	SE
INTERCEPT	0.62	***	0.11
Controls			
Gender (0=Male, 1=Female)	-0.38	***	0.05
Academic Achievement Index - Science	1.53	***	0.22
Academic Achievement Index - Math	0.45	*	0.21
Academic Achievement Index - English	-0.82	***	0.20
Tinkered with things (e.g. motors)	0.06	**	0.02
Science/engineering hobbies/activities	0.16	***	0.02
Read/watched science/engineering programs	0.06	***	0.02
Family interest in science as hobby	0.17	**	0.06
Family interest in science as career	0.38	***	0.05
Family interest in tutoring for science	-0.19	**	0.07
Family interest in math as career	0.17	***	0.05
Family interest in passing math	-0.13	*	0.05
High School Physics Sustainability Topics			
Energy supply	0.16	**	0.05
Food availability	0.25	*	0.13
Bio-mimicry	-0.37	**	0.13
Providing opportunities for future generations	0.16	*	0.07
Adjusted R²	0.29		

*: p<0.05, **: p<0.01, ***: p<0.001

DATA COLLECTION AND METHODS

- Sustainability and Gender in Engineering (SaGE) survey Fall 2011 (NSF Grant Number 1036617) (<http://stem.fiu.edu/sage>)
- Students from both STEM and non-STEM majors (n = 6772)
- Stratified random sample
- Controls tested:
 - ✓ Race
 - ✓ Ethnicity
 - ✓ Gender
 - ✓ Academic Achievement Index (AAI)
 - ✓ Family support of science and mathematics
 - ✓ Parental education level
 - ✓ Extracurricular STEM activities
- Maximum allowed chance of Type I error fixed at 5% (p< .05)
- Models tested using R [4] with multiple regression and backward elimination yielded:

SCIENCE AGENCY BELIEF ~ AAI + EXTRA STEM ACTIVITIES + FAMILY INTEREST + SUSTAINABILITY

PHYSICS IDENTITY ~ AAI + GENDER + EXTRA STEM ACTIVITIES + FAMILY INTEREST + SUSTAINABILITY

RESULTS

- Energy demand covered more in physics (47%) than in chemistry (35%) and biology (30%)
- Energy supply covered less in physics (47%) than in both chemistry (53%) and biology (61%)
- All other sustainability topics covered more in other courses than in physics
- Positive relationships for STEM activities and family interest on science agency beliefs
- Positive relationships for science AAI, STEM activities, and family interest on physics identity
- Positive relationship for energy supply in both models (p< 0.01)
- Biology-related sustainability topics only predictors that had negative relationships

IMPLICATIONS

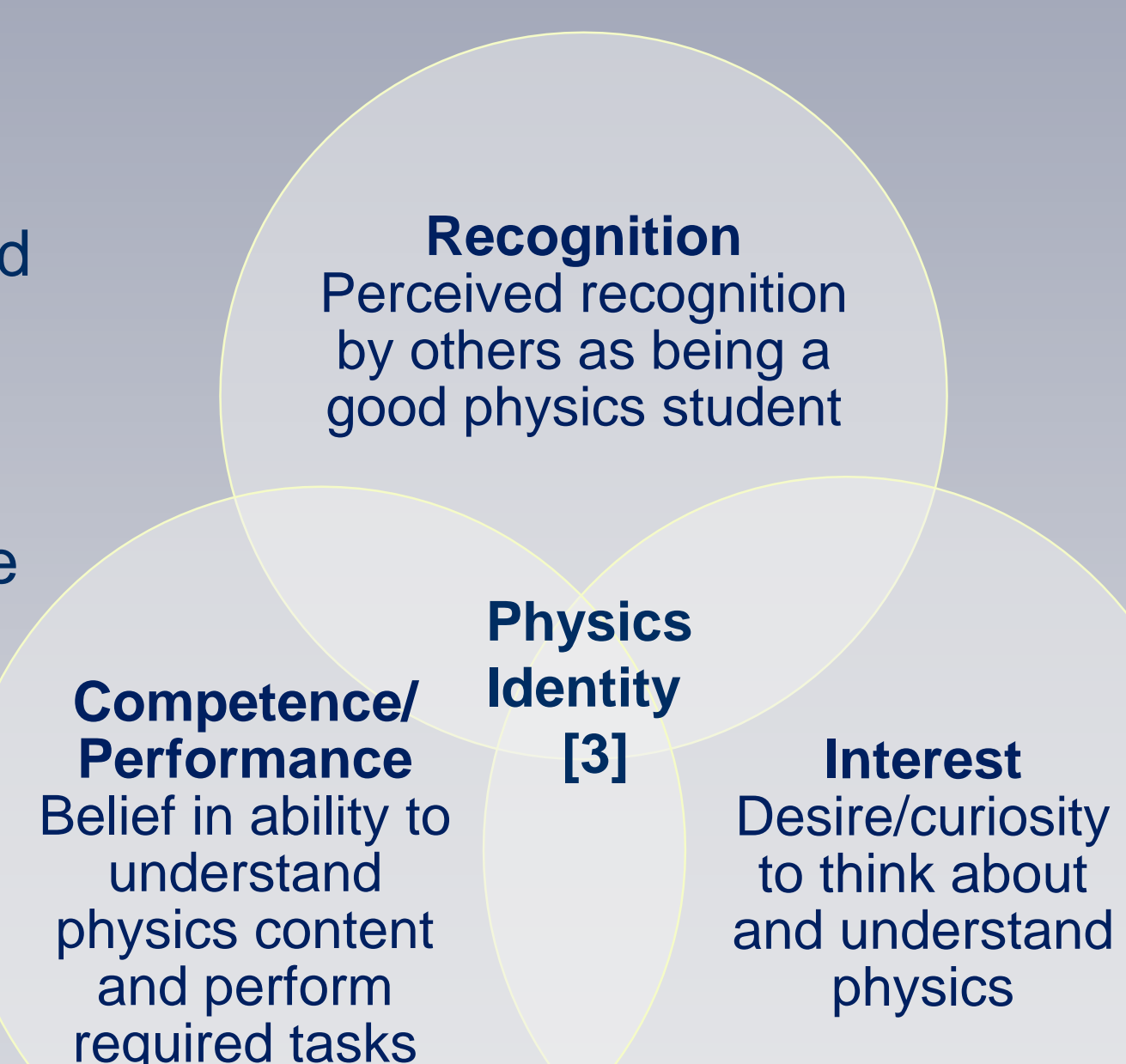
- Our "agency belief" hypothesis: If acquiring knowledge about sustainability science can provide a path to help students believe they can positively impact the world they live, then they are more likely to study science, hopefully physics!

BACKGROUND

WHAT ARE SCIENCE AGENCY BELIEFS?

- Belief that knowledge about science can promote sense of ability to positively affect the world
- Preparation to act on injustice in ones world is known as "critical subject agency"
- Here we focus on "critical science agency" as the belief, that is the perception of oneself, as being able to affect the world through science knowledge [1]

WHAT IS PHYSICS IDENTITY?



"The greatest shortcoming of the human race is our inability to understand the exponential function." [2]

References

- [1] S. Basu, A. Barton, N. Clairmont, and D. Locke, *Cultural Studies of Science Education* 4, 345-371 (2009).
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- [4] R Core Team (2014). *R: A language and environment for statistical computing*, R Foundation for Statistical Computing



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