Developing a Social-Cognitive Model of Public Engagement with Science & Innovation Policy

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APPROACH

As policymakers increasingly turn to public engagement as a tool to shape policy, identify the need for regulation of scientific research and development, etc., there is a need for more research on *"What forms of engagement work for what purposes? When? Why?"* We have been applying a systematic approach, illustrated by **Figure 1**, that includes:

- Broad consideration of relevant theories
- Narrow manipulation of experimental factors
- Broad examination and interpretation of factor effects, mediators and moderators in light of the initial theories

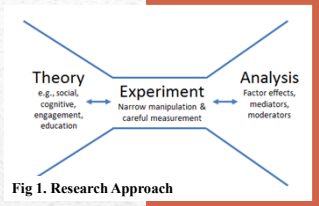

Fig 1. Research Approach

This iterative approach will create the empirical base needed to add detail to a general model of public engagement, illustrated by **Figure 2**, which includes attention to:

- Features of public engagements
- Participant perceptions of those features
- Ways in which people (and groups) engage
- Important moderators (such as participant characteristics) and
- Valued outcomes

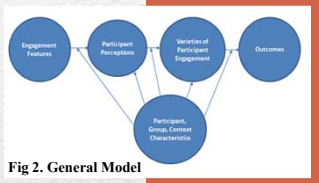

Fig 2. General Model

MEASURES

A major goal and outcome of the project is to develop standardized measures for use in future studies.

Varieties of Participant Engagement (α)

- *Conscientious:* focused, thorough (.82+)
- *Open-minded:* to other perspectives (.70+)
- *Closed-minded:* mind is made up (.72+)
- *Negative:* upset, angry, frustrated (.70+)
- *Creative:* inspired, inventive (.85+)
- *Disinterested:* bored, distracted (.89+)
- *Active learning:* explored, related (.77+)
- *Social:* listened, discussed, asked others (.88+)

Confirmatory Factor Analyses Fit Indices (8-factor model, WLSMV estimator)

Student sample at two time points:
RMSEA=.047,.049; CFI=.967,.969; WRMR=1.097,1.067

Adult resident sample:
RMSEA= .043; CFI= .951; WRMR=1.199

Process Satisfaction & Fairness

"Imagine that thousands of people across America were invited to go through a process similar to that which you have just gone through, in order to give their input on the future of research and development in nanogenomics…and gov't then created policy based on that input." (Government decisions were randomly assigned to be consistent or not with P views)

- Fairness item: "*The process used by the government to make decisions about this issue was fair.*" (Strongly Disagree to Strongly Agree, 6-point scale)

Quality of Input (QI)

At post (and sometimes pre) engagement activities, written student input was coded by independent raters for factors such as global quality; numbers of issues considered, explicit suggestions, and elaborations; and consideration of alternative views.

Study 1 Reliability: Cronbach's α = .67-.94 *; Validity:* QI variables tend relate to each other (rs~.6-.9), word count (r~.6), prior knowledge of nanotechnology (rs ~ .2), negative engagement (closed and annoyed, rs ~ -.2) and, in Study 1, tended to be higher in the critical thinking condition than the explore condition for those initially low in political efficacy.

METHODS

Participants
for all studies are students in Introductory Biology. (*N*s = 150-350)

Science Policy Topic
discussed by students is ethical, legal, and social issues (ELSI) associated with biological applications of nanotechnology.

Time Frame
for each study is 1 semester.

Engagement Components
include activities such as

- Pre-Reflection (survey)
- Lecture on ELSI in science
- Short video introduction to nanotechnology
- Reading assignment
- Responses to ELSI scenarios
- Post-Input (survey)

To date, we have conducted four studies in which we have experimentally varied two major elements of public engagement.

Cognitive elements: Manipulated using varying information formats and assigning different tasks to complete while reading background materials.

Social elements: Manipulated by randomly assigning participants to think about and write responses to ELSI scenarios under individual or group conditions.

Study 1 (Pilot) & Study 2 (Testing)
Used 3 (cognitive) x 2 (social) designs and compared:
Three cognitive conditions:

- "Explore" the background information instructions
- "Matrix note taking" instructions
- "Critical thinking" instructions

Two social conditions:

- Group discussion vs. Individual social context while responding to ELSI scenarios

Studies 3 (Initial) & 4 (Replication, analyses ongoing)
Used a 2 x 2 x 2 x 2 design and compared
Two information presentation conditions:

- Newsletter vs. Pro/Con organization format

Two cognitive conditions

- Critical thinking vs. Explore instructions

Two social conditions

- Group discussion vs. Individual (vs. online in Study 3) social context while responding to ELSI scenarios

SELECTED FINDINGS

Deliberation: It matters *how* it is encouraged

Much has been written about the potential benefits of deliberation (e.g., Barabas, 2004; Chambers, 1996; Farrar et al, 2010; Gastil et al., 2008; Luskin et al., 2002; Muhlberger, et al., 2011; Price et al., 2002; Warren, 1992).

To encourage deliberative thinking in Studies 1 and 2, we used explicit instruction in "how to think critically," which resulted in **decreases in positive forms of engagement** and increases in negative forms of engagement.

In Study 3 we made adjustments based on Study 1 and 2 results and implemented less didactic critical thinking "prompts," which **increased positive engagement** during the reading assignment compared to the control condition (no prompts), including increased conscientious engagement that in turn was related to higher subjective knowledge later (Point estimate = .064, 95% CI: .0034 - .1443; replicated in Study 4, point estimate = .081, 95% CI: .0267 - .1832).

Closed-minded engagement affects fairness perceptions

It is important that participants see the process used to obtain the decision as fair, especially if they disagree with the decision, otherwise they may resist rather than accept the policy decision arrived at through public input (Lind et al., 1990; Tyler, 1997).

In Study 2, none of our manipulations were associated with greater process fairness perceptions. However closed-minded engagement was identified as a negative predictor of process fairness (β = -.35, *SE* = .21, see Table below) **when one disagreed** with the decision made by the government (see process fairness measure).

In Study 3, closed-minded engagement negatively predicted fairness perceptions **when pro/cons were listed explicitly** and for persons **high in need for cognition**.

Table: Study 2 Results

Predicting fairness perceptions with closed-minded engagement

Dependent Variable	Predictor	*B*	S.E.	β	*t*	*p*	ΔR^2
Rated fairness of process for creating policy	Agreement with govt. decision (0 = disagree, 1 = agree)	.886	.157	-.347	5.623	<.000	.152**
	Need for cognition	.262	.118	.160	2.214	.028	.024*
F(4,157) = 12.674, *p* < .001	Agreement with govt. decision * Closed-minded engagement	.823	.285	.863	2.892	.004	.040**
	Closed-minded engagement (in disagree = 0 condition, agree = 1)	-.707	.210	-.347	-3.375	.001	.055**
Adj. R^2 = .225***	*Closed-minded engagement (in agree = 0 condition, disagree = -1)*	.116	.200	.057	.581	.562	.002
	Constant	3.589	.111	-	32.278	.000	-

Specific engagement types predict knowledge gains

Theories from educational psychology suggest that deep processing, facilitated by active learning and strategic (very similar to conscientious) engagement enhances learning and achievement (e.g., Carini et al, 2006; Chin & Brown, 2000; Entwistle & McCune, 2004; Minbashian et al., 2004; Prince, 2004; Shell & Husman, 2008; Zhang & Sternberg, 2005). Study 3 (S3) and 4 (S4) results:

We find **subjective learning** is predicted by **conscientious** (S3,S4: β = +.20,+.22, *SE* = .09,.08), **active learning** (S3: β = +.20, *SE* = .08) and **disinterested** (S3: β = -.18, *SE* = .07) as well as **closed** and **open** (S4: *rs*= .14-.15, p <=.05) engagement.

Meanwhile, **objective knowledge** at post-testing is predicted positively by **conscientious** engagement (S4: β = .05, *SE* = .03, p = .055), and **social engagement** (S3: β = .06, *SE* = .02, *p* < .05); and negatively by **angry** (S3: β = -.10, *SE* = .04 , *p* < .05) and **close-minded** engagement (S3: β = -.09, *SE* = .04 , *p* < .05).

EMERGING ISSUES & CONCLUSIONS

Our studies have been conducted under nearly ideal conditions. By working with students considering nanotechnology ELSI issues as part of their coursework, we have been able to *randomly assign* relatively large numbers of participants to experimental conditions and conduct *intensive engagements* over a series of weeks while *closely monitoring* changes in knowledge, attitudes, and levels of engagement throughout the experimental processes. Through these studies we have found:

- **Not all deliberative methods will be successful for all purposes.** Our studies suggest that decreases in engagement can occur with some structured approaches.
- **Type of engagement matters.** There are a variety of ways that participants can engage when involved in a public engagement. Understanding how different design choices impact different forms of cognitive, affective and behavioral engagement can provide direction for refining the effectiveness of engagements.
- **Replication is essential.** Even theoretically seemingly "obvious" results may be highly dependent on the specific conditions under which they are found, or may be moderated by individual differences, making the use of controlled experiments imperative to the development of robust models of public engagement.

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