AAAS Outcome Expectancy for Public Engagement with Science (PES)

Scale for Scientists

What is outcome expectancy? Outcome expectations are considered a key component of Social Cognitive Theory (Bandura, 1986). Defined as a person's judgements about the likely consequences of a given task, positive outcome expectations serve as incentives that promote future behavior (Bandura, 2001). Practically speaking, they guide behavioral choices, as people adopt courses of action that are likely to result in positive outcomes. As such, a scientist's outcome expectations related to outreach would be expected to inform the extent to which they continue to engage with the public as well as the nature of such engagement.

How can you use this scale? Outcome expectations have the potential to predict scientists' continued engagement with PES (Besley, 2014; Besley et al., 2013; Besley, et al., 2015; Dudo & Besley, 2016), and thus are a meaningful construct to science communication. The scale has the potential to measure a range of outcome expectations in relation to prior PES encounters and monitor key factors that keep scientists engaged in PES. The scale also has the potential for scores to improve over time, a key characteristic for researchers and evaluators interested in using the scale to study change in scientists' outcome expectations.

How were the items developed? Twenty-three scientists participated in think aloud interviews to provide response process evidence to support the use of specific survey items (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). Scientists were from a range of disciplines. The discussions of both the logic model and reactions to the scale items during the think aloud yielded valuable and nuanced language describing outcome expectations in scientists' own words. This verbiage was used to create 30 new items, using DeVellis (2016) as a guide. The neutral answer choice was also eliminated. The new response options and the wording of specific items were then tested through a second round of think aloud interviews conducted with a new group of 20 scientists. All had been involved in PES within the past year. The second round of think aloud interviews narrowed down the number of items from 30 to 20 that were intuitive to scientists and yielded a range of rating responses. These items were then administered to a test sample of 341 scientists who had conducted at least one PES activity in the past year.

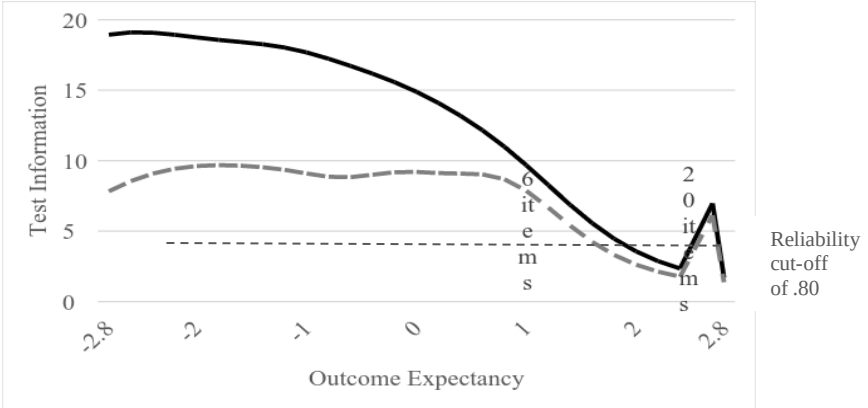
What is the internal structure of the scale? For the purposes of the current study, graded response models were conducted (see Samejima, 1969; 1996) using MPlus 7 (Muthen & Muthen, 1998-2012). Two models were conducted with all 20 items initially. The first model generated estimates for both the slope and location of each item in the model. The second estimated the location only, and held the slope constant (and thus was akin to a Rasch model). The two models were then compared using a likelihood test; results indicated that the default graded response model was the better fit for the data compared to the model that constrained the slope of each item and thus confirmed that items in the model were differently discriminating with regard to outcome expectancy (df=19, p<.05).

For the remaining analysis, the difficulty and discrimination estimates were calculated from the graded response model and then used to determine the items that provided the best measures of outcome expectancy. A high discrimination parameter value means that the probability of a correct response increases more rapidly as the ability (latent trait) increases (An and Yung, 2014). Acceptable discrimination values are greater than 1.0; the discrimination values for items on the Outcome Expectancy for PES scale ranged from 1.19 to 2.19. No items were eliminated based on this criterion.

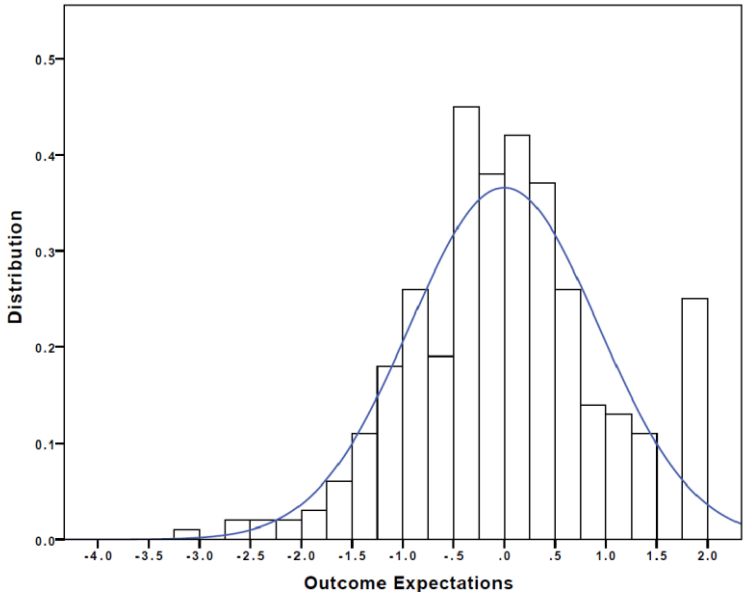
The Item Characteristic Curves (ICCs) were then explored for the 20 items to determine whether each item provided acceptable discrimination. Items were retained if they had a distinct peak for at least five of the six response options on the scale. Fourteen items were eliminated because they did not meet this criteria. The final scale includes 6 items; means, standard deviations, and estimated parameters for each are presented below.

			Thresholds					
	Mean	**SD**	1	2	3	4	5	**Discrimination**
My most recent PES activity gave me insight into the concerns that people have about science.	4.36	1.29	-3.26	-1.76	-0.94	0.11	0.90	1.86
I felt enlightened by ideas shared by participants at my most recent PES event.	4.48	1.21	-2.62	-1.78	-1.05	-0.02	0.81	2.61
My most recent PES activity gave me a better understanding of how people think about the kinds of work that scientists do.	4.66	1.11	-2.78	-2.14	-1.40	-0.25	0.76	2.42
My most recent PES activity helped participants connect science to their everyday lives.	5.05	1.04	-3.90	-3.13	-2.11	-0.96	0.34	1.46
My most recent PES activity provided me with an opportunity to learn from the broader community.	4.60	1.23	-2.22	-1.80	-1.20	-0.20	0.71	2.79
As a result of my most recent PES activity, I believe that participants will make more informed decisions using science.	4.68	1.06	-3.29	-2.50	-1.79	-0.24	0.97	1.71

The results from the initial graded response model reduced the scale to 6 items that had classically adequate reliability for those with outcome expectation scores that range from -3 to 2.2 standard deviations from the mean (see figure at right). The means and standard deviations for each individual item are shown in at right, along with their threshold and discrimination parameters.



The mean Outcome Expectancy for PES score for the sample was 4.64 (*SD*=.89), with a range of 1.17 to 6.00. These results indicate that scientists had moderately positive outcome expectancy for PES overall. The distribution of scores indicates that the scale detected a broad range of outcome expectancy among scientists. The distribution of scores overall is presented in the figure to the right. Compared to the ideal normal distribution curve on the graph, scores on the Outcome Expectancy for PES were slightly overrepresented on the lower side of the graph, were fewer than expected in the moderate positive range, and the highest scores were well above the level expected.



For more details on the analysis, see:
Peterman, K., Robertson Evia, J., Cloyd, E., & Besley, J. (2017) Assessing Public Engagement Outcomes by the Use of an Outcome Expectations Scale for Scientists. Science Communication, 39(6), 782-797. https://doi.org/10.1177/1075547017738018

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