

Girls' Interest in Nature and Science Scale (GINSS)

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In support of a summative evaluation of *SciGirls* Season Three, Multimedia Research developed a scale to assess preteen girls' interest in nature and science. The work was sponsored by Twin Cities Public Television under National Science Foundation Grant No. 1323713.¹ *SciGirls* Season Three multimedia focused on nature topics experienced through the science inquiry protocols of citizen science projects.² As part of a suite of data collection instruments for the evaluation with fifth-grade girls,³ Multimedia Research developed, piloted, validated and implemented the Girls' Interest in Nature and Science Scale (GINSS): A nine-statement Likert scale constructed to reveal girls' strength of interest in nature and science activities. Researchers are encouraged to use this scale to extend its application; please let us know how you use the scale.

Scale Psychometrics

Inspired by an early draft of the Cornell Lab of Ornithology's DEVISE project's Adult Interest in Science and Nature Scale (now just Science Scale⁴), an initial item pool was reviewed by *SciGirls* staff and grant advisors. In a pilot study, nine statements were randomly presented as part of a larger online survey to a total sample of 212 fifth-grade girls from nationally distributed classes in Sacramento, CA; Austin, TX; Bethlehem, GA; Miami, FL; Jacksonville, FL; Kenly, NC, and Bryn Mawr, PA. Half of the sample were 10 years old and half were 11 years old. The sample was homogeneous in age and gender to match the intended *SciGirls* summative evaluation sample. The participant sample was ethnically diverse but such background information was not individually recorded for the pilot study.

Descriptive statistics. The statements were presented in random order for each respondent with five response categories: strongly disagree (1), disagree, not sure, agree, strongly agree (5). Table 1 presents descriptive statistics for the scale statements, ordered by mean rating.

Table 1. Descriptive Statistics

Items in GINSS	Mean	Median	Std Dev
1. It's fun to do science activities	4.17	4	0.88
2. It's fun to collect things from outdoors	4.11	4	0.95
3. I like to hear about new discoveries in science	3.96	4	0.99
4. I want to understand how things in nature work	3.93	4	0.95
5. I like to identify things in nature	3.76	4	1.06
6. I like to observe birds, butterflies, bugs or other things in nature	3.61	4	1.17
7. I enjoy watching nature shows	3.50	4	1.16
8. I enjoy reading about science	3.32	3	1.11
9. I like talking about science topics with others	3.20	3	1.16
Total Scale	3.72	3.78	0.71

Reliability. If the scale statements have a strong relationship to the intended scale construct of interest, then the statements will have a strong relationship to each other. To assess the homogeneity of items within the scale, the most commonly used statistic for internal consistency reliability is Cronbach’s alpha; whereas ordinal (polychoric) alpha is more appropriate for these data because it has been shown to estimate reliability more accurately for Likert-type ordinal (not continuous) response formats.⁵

Polychoric alpha coefficients are presented in Table 2. The total scale reliability coefficient is .88. The large (> .8) individual item and total scale coefficients are appropriate for research purposes⁶ and “very good” as rated by DeVillis⁷. DeVillis also suggests that “a scale with an alpha of .85 is probably perfectly adequate for use in a study comparing groups with respect to the construct being measured” (p. 110). All nine statements contribute positively to scale reliability and were retained in the scale used in the summative evaluation.

Table 2. Polychoric Reliability

Items in GINSS	Polychoric reliability if item dropped
1. It’s fun to do science activities	0.88
2. It’s fun to collect things from outdoors	0.87
3. I like to hear about new discoveries in science	0.87
4. I want to understand how things in nature work	0.87
5. I like to identify things in nature	0.87
6. I like to observe birds, butterflies, bugs or other things in nature	0.87
7. I enjoy watching nature shows	0.87
8. I enjoy reading about science	0.88
9. I like talking about science topics with others	0.88
Total Scale	0.88

Exploratory Factor Analysis. Through exploratory factor analysis, the goal is to assess how well the scale scores of the pilot girls reflect a single common dimension of interest in nature and science or reflect multiple dimensions. It was determined if the data were suitable for factor analysis by looking at several measures of sampling adequacy.⁸ KMO (Kaiser-Meyer-Olkin) index equaled a “meritorious” .86, above the acceptable value of .5; Bartlett’s test was highly significant ($\chi^2 (212) = 867.95, p < .00001$); and the majority of inter-item correlations were greater than .3. Thus, factor analysis was appropriate for the data set.

The exploratory factor analysis utilized the software FACTOR⁹ and followed tested recommendations for the most appropriate procedure in applied research to examine dimensionality underlying Likert-scored items. For ordinal scales, parallel analysis using minimum rank factor analysis and polychoric correlations have been shown to outperform other analyses.^{10,11}

High factor loadings on each item in a one-factor model were produced (Table 3). Costello and Osborne¹² recommend that “5 or more strongly loading items (.50 or better) are desirable and indicate a solid factor” (p. 5). The proportion of common variance explained by the unidimensional model is 70%. Parallel analysis also advised a one-factor solution. Thus, the scale scores reflect a single common dimension of interest in nature and science for fifth-grade girls.

Table 3. Factor Loadings

Items in GINSS	Factor 1 Loading
1. It’s fun to do science activities	0.60
2. It’s fun to collect things from outdoors	0.73
3. I like to hear about new discoveries in science	0.64
4. I want to understand how things in nature work	0.70
5. I like to identify things in nature	0.72
6. I like to observe birds, butterflies, bugs or other things in nature	0.74
7. I enjoy watching nature shows	0.72
8. I enjoy reading about science	0.64
9. I like talking about science topics with others	0.60

Scale Application. Given the reliability and single factor results of the pilot study, a composite score of the GINSS was appropriate to use in the summative evaluation of *SciGirls* Season Three. The evaluation implemented the scale in an online survey to establish the equivalency of a two groups (treatment, control) prior to an intervention. For the evaluation sample of 98 fifth-grade girls, high scale reliability (polychoric alpha = .87) was obtained. Scale scores did not differ by group, by age, or by self-reported status as minority (n = 37) or non-minority (n = 61).

¹ Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

² See <http://goo.gl/VTN73b> for *SciGirls* Season Three episodes. See pbskids.org/scigirls/games for *SciGirls* Season Three games: *Creature Features* and *Rule the Roost*.

³ See www.informalscience.org or <http://www.tpt.org/science/evaluations/> for full evaluation report

⁴ See www.birds.cornell.edu/citscitoolkit/evaluation/instruments

⁵ Gaderman, A.M., Guhn, M., & Zumbo, B. D. (2102). Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. *Practical Assessment, Research & Evaluation, 17*(3), 1- 13. Retrieved from <http://pareonline.net/pdf/v17n3.pdf>.

⁶ Nunnally, J.C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.

⁷ DeVillis, R. F. (2012). *Scale Development: Theory and Applications* (3rd ed. Vol. 26). Thousand Oaks, CA: Sage Publications.

⁸ Dziuban, C. D., & Shirkey, E.C., (1974). When is a correlation matrix appropriate for factor analysis? Some decision rules. *Psychological Bulletin, 81*, 358-361. <http://dx.doi.org/10.1037/h0036316>

⁹ Lorenzo-Seva, U., & Ferrando, P.J. (2006). FACTOR: A computer program to fit the exploratory factor analysis model. *Behavior Research Methods, 38* (1), 88-91. <http://dx.doi.org/10.3758/BF03192753>

¹⁰ Timmerman, M. E., & Lorenzo-Seva, U. (2011). Dimensionality assessment of ordered polytomous items with parallel analysis. *Psychological Methods, 16*(2), 209–20. <http://dx.doi.org/10.1037/a0023353>

¹¹ Baglin, J. (2014). Improving Your Exploratory Factor Analysis for Ordinal Data: A Demonstration Using FACTOR. *Practical Assessment, Research & Evaluation, 19*(5). Retrieved from <http://pareonline.net/getvn.asp?v=19&n=5>.

¹² Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation, 10*(7). Retrieved from <http://pareonline.net/getvn.asp?v=10&n=7>