



Verbal Reasoning & Justification of Scientific Knowledge Beliefs

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Abstract

1374 undergraduates took a shorter version of the verbal-reasoning section of LSAT test and a justification of scientific knowing questionnaire. A principal component analysis yielded three dimensions: Personal Justification (JP), Justification by Authority (JA), and Justification by Multiple Sources (JMS). Whereas students who relied highly on JMS performed better on verbal-reasoning task than their less-relying counterparts, JP had an opposite effect. Implications of the results and validation of the justification of knowing questionnaire are discussed.

Keywords: Epistemic Beliefs, Individual Difference, Justification of Knowledge, Verbal

Reasoning

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Growing evidence suggests that students' beliefs about knowledge and learning, their epistemic beliefs, correlate with their academic performance (Bendixen & Feucht, 2010; Hofer & Pintrich, 2002).

One aspect of academic performance crucial for college students is their verbal-reasoning ability (Alloway and Alloway, 2010). Verbal-reasoning ability is correlated with various cognitive abilities such as reading ability (McBride-Chang & Manis, 1996), working memory capacity (Conway et al., 2003; Kane et al., 2004), and general argumentation abilities (Nippold & Ward-Lonergan, 2010). However, there is relatively less to no research that looked at the role of epistemic beliefs in one's verbal-reasoning ability. One objective of this study is to investigate whether one's domain-specific epistemic beliefs pertinent to scientific knowledge predicts their performance on the verbal-reasoning task. Understanding this relationship opens up new venues to help students master this critical skill. Another objective of this study is to validate the most commonly used questionnaire (Ferguson et al., 2013) that measures reader's justification beliefs about knowing scientific knowledge.

This study examined the relationship between students' justification beliefs specific to science and their verbal-reasoning ability. Additionally, this study tested the validity of the justification for knowing measure through a confirmatory factor analysis.

Method

Participants

One-thousand three-hundred seventy-four undergraduate students from the introduction to psychology courses at a mid-western university participated in the study for course credit as a part of the prescreening process. Data from seventy-one participants were dropped because of incomplete responses ($N=1303$).

Design

The design for this study is a 2 training (audience tutorial vs. control tutorial) x 3 audience prompt (friendly, hostile, vs. mixed audience) between-participants design. The dependent variables are number of argument elements (claims; use of support: additions, copied statements, transformations; otherside information: counters, responses, rebuttals) and audience specific features (denials, pejoratives, 1st person pronouns, 2nd person pronouns).

Materials, Procedure, & Preliminary Data-analysis

Using the online SONA platform, participants, in addition to taking other questionnaires, took a shorter version of the verbal-reasoning section of the Law School Admissions Test (LSAT) and a justification of knowing questionnaire (Ferguson et al., 2013).

Verbal-reasoning Task (VrT). In this shorter version of LSAT, participants read three short passages and answered four multiple-choice questions. The original version has fourteen passages and eighteen questions. Previous studies (e.g., Dandotkar, Magliano, & Britt, 2016) found the shorter version reliably predicted the performance on the original version. A verbal-reasoning score was computed for each participant, which served as the critical dependent measure.

Epistemic-Questionnaire. Participants, in the justification for knowing task, read eighteen items and rated their agreement with them on a 10-point Likert-scale (1=disagree-completely; 10=agree-completely). The items on the questionnaire measured three epistemic dimensions, six items per dimension: Justification by authority (JA), Personal justification (JP); Justification by multiple sources (JMS).

As recommended by Ferguson et al. (2013), a Pearson's correlation was conducted on items specific to each dimension separately to remove items that were unrelated (<1.5) or negatively related to other items in the dimension. Two items specific to JP were removed as a result. A principal component analysis with oblique rotation was conducted on the remaining 16 items, which yielded three factors – JP, JA, & JMS. These 16 items met the Kaiser-Guttman retention criteria of eigenvalues greater than unity and explained 55.89% of sample variation.

For each participant and epistemic dimension (JA, JP, & JMS), an average epistemic score was computed. Participants, for each dimension separately, were categorized as belonging to a high-scored, medium-scored, or low-scored group based on a tertiary split. A confirmatory factor analysis was also conducted to validate the measure. However, the specific details of the analysis are not reported here because of the space constrain. Only the resulting model from this analysis is presented here (See Appendix A). Details of the analysis will be presented at the conference.

Results

Three one-way ANOVAs – one for each, JP, JA, & JMS, dimension – were conducted on participants' verbal-reasoning scores. Participants' level of epistemic belief (high-scored, medium-scored, or low-scored) for each dimension served as the between-subject factor and their verbal-reasoning score served as the dependent measure.

There was a significant effect of JP ($F(2, 1300)=13.52, p=0$), and JMS ($F(2, 1300)=7.06, p=.001$) dimensions but not JA ($F(2, 1300)=2.35, p=.096$). The effect of JA dimension, however, was approaching significance. For JP and JMS dimensions, several post hoc tests with Bonferroni correction were conducted to understand the details of the omnibus effects. These tests revealed the high-scored JMS group scored higher on the verbal-reasoning task than the medium-scored ($p=.015$) and low-scored ($p=0$) groups. For the JP dimension, in contrast, the low-scored group performed better on the verbal-reasoning task than the medium-scored ($p=.041$) and high-scored ($p=.001$) groups. See Table 1 for means and standard errors for each group and dimension.

Table 1. *Average Verbal-reasoning Scores with Standard Errors in Parantheses as a Function of Epistemic Dimension & Group.*

Epistemic Dimension	Group	Verbal-reasoning Score (with SE)
Personal Justification (JP)	Low	1.54 (.05)
	Medium	1.38 (.05)
	High	1.2 (.04)
Justification by Multiple Document Sources (JMS)	Low	1.23 (.04)
	Medium	1.39 (.05)
	High	1.47 (.05)
Justification by Authority (JA)	Low	1.29 (.05)
	Medium	1.34 (.04)
	High	1.44 (.05)

Discussion

These findings suggest that justification of knowing beliefs predicts one's verbal-reasoning ability. Relying on JMS to justify scientific knowledge is positively related to one's verbal-reasoning ability whereas relying on JP is negatively related. With JA, the results are slightly different. Even though there was no effect of this dimension, a trend was noticed where participants who relied moderately on JA performed better on the verbal-reasoning task than their high and low-relying counterparts. Educational implications of the findings are discussed. Additionally, this study validated an epistemic measure, for capturing the justification of knowing beliefs specific to science, that is commonly used in the field of text and discourse.

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APPENDIX A

APPENDIX A: Confirmatory Factor Analytic Output1

