Intelligence 38 (2010) 582–595

Contents lists available at ScienceDirect

Intelligence

Rugby versus Soccer in South Africa: Content familiarity contributes to cross-cultural differences in cognitive test scores ☆

Maike Malda [a,*], Fons J.R. van de Vijver [a,b], Q. Michael Temane [b]

[a] Tilburg University, the Netherlands
[b] North-West University, South Africa

ARTICLE INFO

Article history:
Received 16 July 2009
Received in revised form 24 July 2010
Accepted 28 July 2010
Available online 21 August 2010

Keywords:
Cognition
Culture
Spearman's Hypothesis
Content familiarity
Validity
South Africa

ABSTRACT

In this study, cross-cultural differences in cognitive test scores are hypothesized to depend on a test's cultural complexity (Cultural Complexity Hypothesis: CCH), here conceptualized as its content familiarity, rather than on its cognitive complexity (Spearman's Hypothesis: SH). The content familiarity of tests assessing short-term memory, attention, working memory, and figural and verbal fluid reasoning, was manipulated by constructing test versions with an item content derived from either Afrikaans or Tswana culture in South Africa. Both test versions were administered to children of both cultures. The sample consisted of 161 urban Afrikaans, 181 urban, and 159 rural Tswana children ($M_{age} = 9.37$ years). Children generally performed best on the test version that was designed for their own group, particularly on the cognitively and culturally complex working memory and figural fluid reasoning tests. This relation between content familiarity and cognitive test performance supports CCH and disconfirms SH.

Cross-cultural differences in cognitive test scores are not well understood (Fagan & Holland, 2002, 2007, 2009; Helms-Lorenz, Van de Vijver, & Poortinga, 2003; Sternberg et al., 2002). Where do they come from and why are they larger for some tests than for others? Spearman's Hypothesis (SH) relates these cross-cultural differences to the cognitive complexity of tests; differences are larger for tests with a higher cognitive complexity (Jensen, 1985, 1998). SH attributes this pattern to cross-cultural differences in the underlying general cognitive ability on which tests with a higher cognitive complexity more strongly rely. However, score differences between cultures can also be caused by test bias or by cultural differences in valued and therefore trained strategies to solve certain cognitive tasks (Bridgeman & Buttram, 1975; Montie & Fagan, 1988). In line with the option of test bias, Helms-Lorenz et al. (2003) state that a test's cognitive complexity could be confounded with its cultural complexity (which can cause test bias) and the latter may largely explain cross-cultural score differences. A test's cultural complexity refers to the extent to which specific cultural knowledge is required to perform well on this test, such as declarative (factual) knowledge and procedural knowledge (i.e., knowledge on cultural practices, such as sports or celebrations) that is shared in a particular culture. The extent to which test content (e.g., concepts, drawings) is more familiar to one of several compared cultural groups is a reflection of cultural complexity. In order to disentangle the influence of cultural and cognitive complexity on test performance, the present study examines the effect of content familiarity on the performance on tests of different cognitive complexity. More specifically, we address the role of content familiarity in tests measuring (the cognitively complex ability

☆ We thank Ansie Kitching and Dipuo for their help during the pilot study. Our gratitude goes to Abegale, Andrea, Anita, Corlene, Hester, Ina-Mari, Kefilwe, Keitumetse, Kelebogile, Liesl, Lorato, Marguerite, Marichelle, Maryke, Masego, Myrtle, Segametsi, Sharlott, Surita, Tsholofelo, Victoria, and Vidette for administering the cognitive tests to the children. We would like to thank the principals and teachers of the participating schools for their interest and enthusiasm in our study. Last but not least, we thank all participating children.

* Corresponding author. Department of Psychology, Tilburg University, PO box 90153, 5000 LE Tilburg, the Netherlands. Tel.: +31 0 13 4662526.
E-mail address: maikemalda@gmail.com (M. Malda).

0160-2896/$ – see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.intell.2010.07.004

of) fluid reasoning and tests measuring (the less complex, though related abilities of) short-term memory, attention, and working memory (Carroll, 1993; McGrew, 2005). For each of these tests, two test versions were developed in which the content familiarity of the items was maximized for either Afrikaans or Tswana school-age children in South Africa. Both versions were administered to children of both groups.

1. Cultural complexity

Successful performance on a test with a high cultural complexity requires specific cultural knowledge (Helms-Lorenz et al., 2003). This knowledge is stored in a semantic network in memory, which can be viewed as a system of nodes (cultural elements) with links (associations) between them. This network is comparable to the system of cognitive elements required for cognitive skill acquisition (see Anderson, 1982). For people who are familiar with the culture in which a test is developed, this semantic network has a well defined structure of strong and weak links, which means that relevant associations are readily made between the content of the test and their knowledge. This network facilitates the successful completion of the test. People from a different culture do not have this well developed semantic network associated with the content of this particular test, because they may not know the cultural elements or their associations; as a consequence, they have difficulty to perform well. The level of cultural complexity of a test then refers to the extent to which an elaborate and automated semantic network of cultural information is required to perform well. Cultural complexity is conceptualized in the present study as the extent to which test content is more familiar to one of the compared groups.

2. Cognitive abilities in the present study

Short-term memory is described as "the ability to apprehend and maintain awareness of elements of information in the immediate situation" (McGrew, 2005, p. 153). Controlled attention is defined as "the capacity to maintain and hold relevant information in the face of interference or distraction" (Swanson, 2008, p. 582). Working memory is "a system for the simultaneous processing and storage of information" (Oberauer, Süß, Schulze, Wilhelm, & Wittmann, 2000, p. 1018). The assignment of attention to the contents of short-term memory creates working memory (Schweizer & Moosbrugger, 2004; Swanson, 2008). Fluid reasoning is defined as "the use of deliberate and controlled mental operations to solve novel, 'on-the-spot' problems (i.e., tasks that cannot be performed automatically)" (McGrew, 2005, p. 151).

Some researchers state that short-term memory and working memory cannot be differentiated in children (Hutton & Towse, 2001); however, others have shown that they are already distinguishable from six years of age (Gathercole, Pickering, Ambridge, & Wearing, 2004; Swanson, 2008). Working memory capacity and fluid reasoning are strongly related (Süß, Oberauer, Wittmann, Wilhelm, & Schulze, 2002), though distinguishable (Ackerman, Beier, & Boyle, 2005). Conway, Cowan, Bunting, Therriault, and Minkoff (2002) indicated that rather complex tasks such as working memory tasks do not rely on automated routines, similar to fluid reasoning tasks. Working memory and reasoning tasks share a demand for controlled attention. Both working memory and attention play a role in fluid reasoning (Unsworth & Engle, 2005); they have a direct relationship with fluid reasoning and the relation between attention and fluid reasoning is mediated by working memory as well (Schweizer & Moosbrugger, 2004). The cognitive structure underlying fluid reasoning abilities that is compatible with these findings is shown in Fig. 1. Short-term memory and attention have both direct and indirect relations with fluid reasoning. Working memory plays a mediating role. Going from left to right in Fig. 1, the abilities become cognitively more complex.

3. Cognitive versus cultural complexity

Relatively small cross-cultural differences have been found in attention and short-term memory, larger differences in working memory, and the largest differences have been reported in fluid reasoning. How can this patterning be explained? One explanation, known as Spearman's Hypothesis (SH), holds that tasks with a higher cognitive complexity show larger cross-cultural score differences, mainly because of assumed cross-cultural differences in the underlying general cognitive ability on which such tasks strongly rely (Jensen, 1985, 1998). Fluid reasoning tasks produce the largest cross-cultural differences because of their large cognitive complexity when compared to attention, short-term memory, and working memory tasks (Carroll, 1993). Jensen has conducted many studies that supported SH, ranging from batteries of reaction time tasks in which cognitive complexity was varied by increasing the number of response alternatives (Jensen, 1993) to broad cognitive batteries involving a range of cognitive abilities (reviews can be found in Jensen, 1985, 1998). Both Spearman and Jensen focused on IQ differences between Blacks and Whites in the United States; other researchers, testing SH among other groups in other contexts, using various cognitive tests, also found support for the hypothesis (e.g., Hartmann, Kruuse, & Nyborg, 2007; Lynn & Owen, 1994; Rushton, 2002; Te Nijenhuis, Evers, & Mur, 2000; Te Nijenhuis, Tolboom, Resing, & Bleichrodt, 2004; Te Nijenhuis & Van der Flier, 1997, 2003, 2004, 2005).

SH has met with both statistical and conceptual criticism. The adequacy of widely employed statistical procedures to test the hypothesis has been questioned. Multigroup confirmatory factor analysis has been proposed as a statistically more rigorous procedure for testing SH than Jensen's method of correlated vectors; a re-analysis of two data sets that were supportive of SH when analyzed by Jensen's method failed to meet basic requirements of cross-cultural comparability in a multigroup confirmatory factor analysis (see Dolan, Roorda, & Wicherts, 2004). Also, Wicherts and Dolan (2010) found that the allegedly small cultural bias reported by Te Nijenhuis et al. (2004) appeared to be more substantial when re-analyzing their data by including a test for the equality of measurement intercepts over groups. In a similar vein, Wicherts and Johnson (2009) provided statistical arguments against the procedures used by Rushton (2002; see also Rushton, Bons, Vernon, & Cvorovic, 2007) to draw conclusions about the nature of group differences in cognitive abilities in terms of SH and the heritability of these differences.