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Perspectives on fluid and crystallized intelligence: facets for verbal, numerical, and figural intelligence

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Abstract

Fluid intelligence is often measured with figural tests, whereas crystallized intelligence is often assessed with verbal tests. It is argued that construct-irrelevant figural variance is included in fluid intelligence and construct-irrelevant verbal variance is included in crystallized intelligence. The specification of a content facet comprising verbal, numerical, and figural abilities for fluid and crystallized intelligence would reduce the construct irrelevant variance. This faceted view of fluid and crystallized abilities is regarded as more convincing than a purely hierarchical structure. Although the present approach is partly similar to Guttman's Radex model, no radial partitioning of the tasks is expected. Seven hundred and six German participants aged between 14 and 50 years were tested with the I-S-T 2000, a test comprising verbal, numerical, and figural reasoning tasks, as well as verbal, numerical, and figural knowledge tests. In smallest space analysis, a simplex for fluid and crystallized intelligence emerged as well as a radial or a polar facet for verbal, numerical, and figural content. The faceted structure for fluid and crystallized intelligence was also shown in confirmatory factor analysis and fitted the data more completely than the hierarchical model. The implications for the conceptualization and the assessment of fluid and crystallized intelligence are discussed.

Keywords: Fluid intelligence; Crystallized intelligence; Facet theory; I-S-T 2000

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1. Introduction

The present study examines possibilities for further development of the 'classical' theory of fluid (gf) and crystallized (gc) general intelligence (Cattell, 1963, 1987; Horn, 1988). The intended development is based on the introduction of a facet for verbal, numerical, and figural intelligence. Important parts of this approach were already introduced in the manual for a German intelligence test, the 'Intelligenz-Struktur-Test 2000' (Amthauer, Brocke, Liepmann & Beauducel, 1999), which is a completely revised form of Amthauer's (1971) intelligence test. The revision of the test focussed on the theoretical conception and was largely based on the critique in Brocke, Beauducel and Tasche (1998). Since research concerning the gf–gc theory has mainly been conducted in English-speaking countries, the further theoretical elaboration and the discussion of the present approach should be presented in English, too.

1.1. The measurement of gf and gc

The gf–gc theory is widely used and discussed in current research (e.g. Carroll, 1993; Flanagan, Genshaft & Harrison, 1997; Härnqvist, Gustafsson, Muthén & Nelson, 1994; Lindenberger & Baltes, 1997; Staudinger, Maciel, Smith & Baltes, 1998). It is not easy to define simple scales containing few variables for measuring gf and gc, because the gf and gc factors were defined by large sets of different variables, and even included personality-trait markers in the first studies (e.g. Cattell, 1963; Horn & Cattell, 1966). According to Horn (1988), gc has prominent relationships with verbal knowledge, following instructions, information about the humanities, social and physical sciences, culture in general, as well as problem definition. Horn and Noll (1997) called gc 'acculturation knowledge', expressing the importance of the knowledge domain for the conceptualization of gc. Fluid intelligence appears to operate whenever the sheer perception of complex relations is involved (Cattell, 1987). It spreads over many kinds of relationships: classificatory similarities, causal relations, inductive reasoning, abstract relations in numbers, and inferential relations. According to Horn (1988), good measures of gf are inductive reasoning, concept formation, visual conceptualization, effectiveness in using problem-solving strategies, and numbers reversed memory.

1.2. Problems and conceptual perspectives in current gf–gc measurement

The high generality and variable operationalization of gf and gc has some implications for the theoretical conception of the constructs. Both broader and more specific interpretations of gf and gc are sometimes proposed. The more specific view of gf focuses on different forms of reasoning as primaries for gf (e.g. Carroll, 1993; Flanagan & McGrew, 1997). The more specific view of gc focuses on different forms of knowledge and language aptitudes (Carroll, 1993; Flanagan & McGrew, 1997). The focus on knowledge as a basis of gc is in line with Ackerman's (1996) view of 'intellect-as-knowledge'. However, according to the broader perspective, gf comprises reasoning as well as memory and perceptual speed, whereas gc comprises knowledge and fluency (e.g. Lindenberger & Baltes, 1997). These broader conceptions of gf and gc are surely interesting and well founded (see Hakstian & Cattell, 1978; Horn & Cattell, 1982; Gilardi, Holling & Schmidt, 1983) and have some potential especially for developmental psychology (e.g. Baltes, Lindenberger