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Deconstructing intellectual curiosity

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ABSTRACT

Scales of Need for Cognition (NFC), Typical Intellectual Engagement (TIE), and Epistemic Curiosity (EC) measure intellectual curiosity (IC). These scales correlate strongly and have been factor-analyzed individually but not together. Here $N = 396$ (143 males) undergraduates completed measures of NFC, TIE, and EC. Six factors, labeled *Intellectual Avoidance*, *Deprivation*, *Problem Solving*, *Abstract Thinking*, *Reading*, and *Wide Interest*, were identified. TIE is the broadest scale, measuring all factors except *Deprivation*; NFC measures *Intellectual Avoidance* and *Problem Solving*, plus *Abstract Thinking* and *Deprivation* to a lesser degree; and EC largely measures *Deprivation*. Moreover, *Reading* may not fit in the IC domain; higher-order factor analysis indicated that, whereas items measuring *Reading* loaded more strongly on their first-order factor, items measuring the other factors strongly loaded on a general factor of IC. These results are significant for understanding the contents of these scales, and for future scale development.

1. Introduction

Human curiosity is a topic of current research interest, and has been applied to predicting job performance (Mussel, 2013b), academic achievement (von Stumm, Hell, & Chamorro-Premuzic, 2011), and exploratory behavior (Litman, Hutchins, & Russon, 2005). Loewenstein (1994) identified two 'waves' of research: the first in the 1950s and '60s addressed the psychological foundations of curiosity and the second in the '70s and '80s concerned its measurement and dimensionality. Given this revival, we may label current interest as the 'third wave' of curiosity research.

Berlyne (1950, 1954) provided an early, influential account of curiosity, distinguishing perceptual curiosity (the desire for sensory experience) from Epistemic Curiosity (EC; the desire for knowledge). The Epistemic Curiosity Scale (Litman, 2008) is the most current scale of EC, measuring 'interest' (I-type) and 'deprivation' (D-type) factors. EC has been related to feeling-of-knowing and exploratory behavior (Litman et al., 2005), ambiguity tolerance, and need for closure (Litman, 2010).

Researchers (Mussel, 2010, 2013a; von Stumm et al., 2011) have identified measures developed separately from EC but which address similar constructs, specifically, Need for Cognition (NFC) and Typical Intellectual Engagement (TIE). Cohen, Stotland, and Wolfe (1955) defined NFC as a person's need to make sense of his or her experiential world. Cacioppo and Petty (1982) adopted the term, but defined it as 'the tendency for an individual to engage in and enjoy thinking' (p. 116). NFC has been applied in many areas, including marketing, behavioral medicine, and education (Cacioppo, Petty, Feinstein, & Jarvis, 1996).

Cacioppo and Petty (1982) developed a 34-item NFC measure, later condensed to 18-items (Cacioppo, Petty, & Kao, 1984). While a single factor has routinely been extracted from either scale (Cacioppo et al., 1996), a number of studies have reported multiple factors. For the 34-item scale, Tanaka, Panter, and Winborne (1988) identified three factors, but used an uncommon true–false response scale, making their results difficult to compare with past research (Cacioppo et al., 1996). Bors, Vigneau, and Lalande (2006) argued that negatively-worded items created spurious factors in their study—when these items were positively re-worded, a single factor emerged. However, Furnham and Thorne (2013) created a positively-worded form of the 34-item NFC scale and reported three factors: 'need for cognitive challenge', 'need for knowledge and understanding', and 'enjoyment of cognitive effort'.

For the 18-item scale (Cacioppo et al., 1984), Sadowski (1993) reported a single factor in a sample of undergraduates ($N = 1218$). However, two considerations suggest a possible second factor: the first principal component accounted for 30.92% of the variance, while a second accounted for an additional 8.95%; and the second eigenvalue of 1.61 substantially exceeds the cutoff suggested by Horn's (1965) parallel roots analysis to indicate a second factor. Additionally, Davis, Severy, Kraus, and Whitaker (1993), using a sample of 230 undergraduates, reported two factors for the NFC 18-item scale, representing 'enjoyment of cognitive activity', and 'preference for problem solving'—possibly the putative second factor in Sadowski (1993)'s dataset. However, Furnham and Thorne (2013) concluded that a positively re-worded 18-item scale contained one factor, essentially the 'need for cognitive challenge' factor of the full scale. Thus, although both scales contain a

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major factor appropriately labeled 'Need for Cognition', the 18-item scale may contain a second factor, and the 34-item scale possibly a third.

Conceptually similar to EC and NFC, TIE was defined by Goff and Ackerman (1992) as 'a personality trait hypothesized to relate to typical vs. maximal intellectual performance' (p. 539). Ackerman's PPIK theory (intelligence-as-Personality, -Process, -Interests and -Knowledge) extends Cattell's investment theory of intelligence (1943, 1971) by formally incorporating personality variables such as TIE (Ackerman, 1996). TIE is thus a composite measure, located between intelligence and personality.

The TIE scale contains 59 items relating to intellectual activity (Goff & Ackerman, 1992). Although much research treats TIE as a unitary construct (Chamorro-Premuzic, Furnham, & Ackerman, 2006; von Stumm et al., 2011), factor analyses have suggested three (Ackerman & Goff, 1994), four (Dellenbach & Zimprich, 2008) and five (Arteche, Chamorro-Premuzic, Ackerman, & Furnham, 2009; Ferguson, 1999) factors. Arteche et al. (2009) labeled the five factors 'reading and information seeking', 'intellectual avoidance', 'directed complex problem solving', 'abstract thinking', and 'intellectual pursuits as a primary focus.' TIE has been of particular interest for education, where it has been used to argue that intellectual curiosity predicts variance in academic success beyond what is explained by intelligence and effort (von Stumm et al., 2011).

Research demonstrates that measures of EC, NFC and TIE overlap extensively, shown by strong inter-correlations, substantial shared variance in factor analysis, and similar patterns of association with personality variables. Using German translations of the EC, NFC, and TIE, Mussel (2010) reported strong correlations between all curiosity measures in two samples, ranging from .52 for EC-Deprivation and TIE, to .74 for EC-Deprivation and NFC, while Woo, Harms, and Kuncel (2007) reported $r = .78$ between TIE and NFC. Mussel (2010) also subjected total scores of five curiosity scales to exploratory factor analysis, and reported that one factor explained 67% of the variance. Additionally, Woo et al. (2007) observed very similar associations for NFC and TIE with Five Factor Model (FFM) variables and Autonomous Regulation in Learning measures. However, Mussel (2010) cautioned that the scales may not be identical, as TIE correlated more strongly with Gc than did NFC on account of its 'reading' factor. Therefore, despite strong overlap, these scales may also be meaningfully different, highlighting the need to integrate these measures within a broad framework (Mussel, 2010).

Recently, (Mussel, 2013a) outlined such a framework, which not only incorporates existing measures of intellectual curiosity (IC) but also points in new directions. This framework proposes that two dimensions encompass Intellect: Process and Operations. 'Process' refers to consecutive phases in performing an action, and has subcomponents labeled Seek (a desire for new intellectual challenges) and Conquer (a desire to master current domains of knowledge). 'Operations' reflects a person's preference for engaging in different intellectual activities, labeled Think, Learn, and Create. These operations were developed as counterparts to aspects of intelligence theory, where 'Think' parallels fluid intelligence, 'Learn' parallels crystallised intelligence, and 'Create' parallels creativity. When combined these two dimensions produce six facets which span the conceptual space of Intellect: Seek Think, Seek Learn, Seek Create, and Conquer Think, Conquer Learn, Conquer Create. Mussel (2013a) locates TIE, NFC and EC—plus several other curiosity measures—within this framework. TIE, NFC and I-type curiosity most closely resemble the Seek Think facet, while D-type curiosity was associated with the Conquer Think facet.

Two specifics should be noted about Mussel's (2013a) approach. First, while he measured I-type and D-type EC separately, he treated TIE and NFC as unitary constructs, leaving unanswered the associations between TIE and NFC at the factor level. Second, the TIE scale administered was substantially truncated. The 18-item German version (Wilhelm, Schulze, Schmiedek, & Süß, 2003) was used, which has three factors: 'intellectual curiosity', 'contemplation', and 'reading'. However, Mussel (2013a) excluded five 'reading' items, concluding that 'reading' could not be incorporated into the Intellect framework at this stage. This 13-item measure is perhaps somewhat different from the 59-item version, which contains up to five distinct factors; a significant point, because 'reading' is perhaps what distinguishes TIE from other measures such as NFC, and is the main cause of TIE's closer association with Gc (Mussel, 2010).

It is important to examine more closely the relationships between EC, NFC, and TIE. Mussel's (2013a) approach implies that these measures are subsumed by a higher-order factor termed 'Intellect', as others have suggested (Tanaka et al., 1988). However, he also noted that the relations between facets, and between facets and a possible higher-order factor, remain unclear. To our knowledge, no study has compared the content of these measures at the factor level using the same dataset. Moreover, if these measures are not importantly different, findings across these constructs could be integrated, allowing the full significance of the Intellect domain to be appreciated.

The present exploratory study has factor analyzed the items from EC, NFC, and TIE. It addressed three research questions:

(1) How many factors exist in the general domain occupied by TIE, NFC, and EC?
(2) Do all these factors load substantially onto a higher-order factor?
(3) Which factors do each scale measure?

2. Method

2.1. Participants

Participants were mostly first-year undergraduate psychology students from the University of Adelaide, who received course credit for their involvement. All were informed only that the study aimed to investigate the relationship between IC and academic performance. Data were collected on two occasions: 225 responses from May-to-October 2012 within an earlier study (Powell & Nettelbeck, 2014), and another 176 from April-to-June 2014. Means and standard deviations for all measures were very similar for both datasets. Five incomplete cases were excluded, leaving $N = 396$ (253 females), with mean age 20.2 ($SD = 3.92$ yrs) for the final analysis.

2.2. Measures

2.2.1. Epistemic Curiosity (EC)

The 10-item Epistemic Curiosity Scale measures interest (I) and deprivation (D) factors for EC. Responses were on a 4-point Likert-type scale (1 = "almost never" to 4 = "almost always"). Higher scores indicate higher EC. Litman (2008) has reported acceptable internal consistency reliability (I-type: $\alpha = .82$; D-type: $\alpha = .76$), with a correlation $r = .47$ between the two factors, together with evidence that I-type curiosity relates to intrinsic motivation, whereas D-type curiosity relates to extrinsic motivation (Litman, Crowson, & Kolinski, 2010).

2.2.2. Need for Cognition (NFC)

Cacioppo et al. (1984) developed the 18-item NFC scale as an efficient measure for engagement in effortful thought. Despite having less evidence of dimensionality than the 34-item version, the 18-item scale was deemed sufficient for two reasons: (1) most researchers have used the 18-item scale, making results from this analysis relevant to more studies; and (2) of the 16 NFC items excluded by the short form, seven are identical with items in the TIE scale, and an eighth has a close conceptual parallel. Given that the TIE scale was also administered here, using the NFC short form eliminated some redundant questions and shortened administration times.

Responses were on a 9-point Likert-type scale (−4 = "very strong disagreement" to +4 = "very strong agreement"). Higher scores