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Epistemic curiosity and related constructs: Lacking evidence of discriminant validity

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ABSTRACT

Epistemic curiosity, the "desire for knowledge that motivates individuals to learn new ideas, eliminate information-gaps, and solve intellectual problems" (Litman, 2008), has been identified as a crucial variable in different areas and stages of life. However, several constructs have been proposed that might be highly similar regarding construct domain, but are based on different theoretical positions and were investigated under different labels. Three of these constructs, namely need for cognition, typical intellectual engagement, and openness for ideas, were investigated regarding discriminant validity. Based on two studies with 395 and 191 participants, no evidence of discriminant validity could be found. Especially, correlations within several measures of curiosity, interpreted as convergent validity, had mean correlations of .60 and .59 for the two studies, respectively. Correlations between curiosity measures and the related constructs need for cognition, typical intellectual engagement, and openness for ideas, interpreted as discriminant validity, were virtually identical (.59 and .57, respectively). Furthermore, exploratory factor analysis indicated that one factor explained the variance of the investigated constructs reasonably well. It is concluded that integrating the body of research that has been built around these constructs might stimulate future research on epistemic curiosity.

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1. Introduction

Epistemic curiosity has been identified as a crucial variable in different areas and stages of life. Examples include the role of curiosity in facilitating cognitive development (Sternberg, 1994; Tamdogon, 2006), school and academic learning (Day, 1982), development of interpersonal closeness (Kashdan & Roberts, 2004), personal growth (Kashdan, Rose, & Fincham, 2004), and job performance (Mussel, 2010). Correspondingly, several attempts have been made in order to describe and explain the content and latent structure of the construct, its nomological net as well as underlying mechanisms (e.g. Litman, 2005). However, beyond the research that centered on curiosity, several constructs have been proposed that might be highly similar regarding construct domain, but have been investigated under different labels. Based on a review of the literature, three constructs were identified which exhibit highly similar definitions compared to definitions of curiosity, but were developed in different areas and on different theoretical positions: need for cognition (Cacioppo & Petty, 1982), typical intellectual engagement (Goff & Ackerman, 1992), and openness for ideas (Costa & McCrae, 1992). The purpose of the present study is to investigate whether these constructs exhibit sufficient discriminant validity in order to justify their coexistence under different labels. Therefore, based on two studies, discriminant validity was investigated in regard to four different measures of epistemic curiosity. Recent concepts of curiosity and their 63 measurement are briefly reviewed; subsequently, the aforementioned constructs are linked conceptually and empirically to curiosity.

Epistemic curiosity (EC) can be defined as "desire for knowledge that motivates individuals to learn new ideas, eliminate information-gaps, and solve intellectual problems" (Litman, 2008; see Berlyne (1960) and Loewenstein (1994)). Based on Berlyne's seminal work, two dimensions of epistemic curiosity can be distinguished which were labeled specific and diverse. Specific curiosity refers to the desire for certain pieces of information, and is initiated by so called collative variables, such as novelty, complexity, or ambiguity. Diverse curiosity was first described as being motivated by feelings of boredom or a desire for stimulus variation. In contrast to Berlyne's focus on motivational states, Day (1969) rather considered diverse curiosity as individual difference in dispositional tendencies to engage in exploration. Consequently, diverse curiosity was regarded as desire for new, exciting or amusing stimuli (Day, 1971). Litman and Spielberger (2003) developed a measure of specific and diverse epistemic curiosity, finding the two dimensions highly correlated (.56). A second recently developed measure of epistemic curiosity is the Curiosity and Exploration Inventory (Kashdan et al., 2004), including two subscales that assess interest in exploration of new things and levels of absorption when engaged in curiosity (similar to Csikszentmihalyi's (1990) concept

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of flow). Kashdan et al. found that both subscales of the Curiosity and Exploration Inventory correlated positively with other measures of trait curiosity (M r = .57).

In addition to diverse and specific curiosity, Litman and Jimerson (2004) recently introduced the dimension of curiosity as a feeling of deprivation. This dimension refers to rather unpleasant and aversive feelings of uncertainty which accompany curiosity, such as being annoyed at not knowing the answer to a question. As such, the affective tone differs from the rather positive connotations of specific and diverse curiosity, such as joy, interest, stimulation, or heightened arousal. Despite these conceptual differences, Litman and Silvia (2006) found measures of curiosity as a feeling of deprivation and of specific and diverse curiosity to be highly correlated (.62) and having salient loadings on the same factor when factor analyzed. Therefore, while recent refinements in conceptualization have improved theoretical understanding of the construct curiosity (e.g. Litman, 2005), these concepts still share large portions of variance, presumably due to a higher order factor they have in common. In sum, epistemic curiosity can be seen as a well defined construct, with a structure of highly correlated dimensions, for which validated measures have been developed.

Independently of these approaches and based on different theoretical background, a number of constructs have been proposed that share crucial aspects with epistemic curiosity regarding their content and definition. Three of these are need for cognition, typical intellectual engagement, and openness for ideas. Need for cognition was first introduced by Cacioppo and Petty (1982) and was defined as "an individual's tendency to engage in and enjoy effortful cognitive activity" (Cacioppo, Petty, Feinstein, & Jarvis, 1996, p. 197). Contrarily, people scoring low on need for cognition are viewed as cognitive misers. The construct was conceived as an intrinsic motivational tendency that develops in the course of involvements with cognitive endeavors. Concerning curiosity, need for cognition shares much of what Litman and Jimerson (2004) called curiosity as a feeling of interest, even though the focus is rather on thinking, problem solving or reasoning, compared to learning and obtaining new knowledge. A 34-item measure of need for cognition (Cacioppo & Petty, 1982) as well as an 18-item short form (Cacioppo, Petty, & Kao, 1984) was developed, that has been applied in hundreds of studies, mainly in social, personality, developmental, and cognitive psychology. Kashdan et al. found need for cognition to be positively correlated with epistemic curiosity, assessed with the Curiosity and Exploration Inventory (M r = .48). Similarly, Olson, Camp, and Fuller (1984) report positive correlations with trait curiosity of .68 as assessed via the Academic Curiosity Scale (Vidler & Rawan, 1974), of .55 with the Melbourne Trait Curiosity Scale (Naylor, 1981), and .67 with the Trait State Personality Inventory (Spielberger, 1979).

The construct typical intellectual engagement was proposed by Goff and Ackerman (1992). Defined as "personality construct that represents an individual's aversion or attraction to tasks that are intellectually taxing" (Ackerman, Kanfer, & Goff, 1995, p. 276), it shares much of the problem solving and thinking activities with curiosity and need for cognition. However, its theoretical background is rather in research on intelligence. As such, typical intellectual engagement was distinguished from cognitive abilities in that it assesses typical, compared to maximum performance. Even though one of the sub-dimensions of typical intellectual engagement, namely reading (e.g. "I read a great deal" and "When I was a child I read every book in the house", Ackerman & Goff, 1994, p. 151) taps into a slightly different direction, as it concerns very specific and observable behaviors (namely reading), compared to preferences and appraisals regarding thinking and learning, the overall score of the 59-item typical intellectual engagement scale (Goff & Ackerman, 1992) was found to be highly correlated with need for cognition (.78, Woo, Harms, & Kuncel, 2007).

Finally, the construct openness to experience, one factor in the five factor model of personality, which was developed on grounds of the lexical approach, has much in common with curiosity. Peterson and Seligman (2004) recently even equated curiosity with openness to experience. However, given the large heterogeneity of openness to experience (Digman, 1990), curiosity is rather reflected in aspects that have been described as inquiring intellect (Fiske, 1949), intelligence (Borgatta, 1964; Cattell, 1957), or intellectance (Hogan, 1986). Based on Costa and McCrae's work (1985, 1992), curiosity seems to be most closely associated with the facet openness to ideas, including aspects of being open minded, engaging in unconventional thoughts, and solving problems and thinking as an end in itself. Based on the eight item subscale of the NEO PI-R (Costa & McCrae, 1992), openness for ideas correlates positively with need for cognition (.78, Berzonsky & Sullivan, 1992). Even though not reporting results on a facet level, Kashdan et al. (2004) found positive correlations of openness to experience with epistemic curiosity (M r = .50). Similarly, Goff and Ackerman (1992) found a correlation of .65 between openness to experiences and typical intellectual engagement; based on construct validity evidence, Rocklin (1994) proposed that these two are essentially identical.

In light of these conceptual and empirical similarities, the purpose of the present study is to investigate whether the three constructs need for cognition, typical intellectual engagement, and openness for ideas possess discriminant validity to established constructs of curiosity, namely diverse and specific epistemic curiosity and curiosity as a feeling of deficit. Such evidence seems necessary in order to justify the use of different labels and, correspondingly, separate research accumulation and theory development. The present research extends previous correlational studies by using factor-analysis and computing convergent and discriminant validities. Therefore, in two studies, several different measures of curiosity were included together with the constructs discussed above. Regarding the factor-analytic approach, a prerequisite of discriminant validity would be that the factor structure across all variables would be characterized by more than one factor. Regarding convergent and discriminant validities, correlations between different measures of curiosity can be interpreted as convergent validity; in order to establish discriminant validity, correlations between measures of curiosity on one hand and measures of different constructs, namely need for cognition, typical intellectual engagement, and openness for ideas, on the other should be significantly lower, compared to convergent validities.

2. Study 1

2.1. Sample

Data were collected on a total of 395 participants, who participated voluntarily in the present research. Participants were recruited by one of 40 peers as part of university course work in Germany. On average, participants were 30 years old (SD = 11.1, range: 18–70), 51% were female. Regarding their education, the majority had a university-entrance diploma (82%), while some had secondary school (16%) as highest education. Only 5% had no prior job experience, 35% up to 2 years, 24% up to 5, and 31% more than 5 years. At the point of time when participating in this study, 51% were university students, 49% were employed. Post hoc power analyses revealed β = .99 for a medium correlation of .30 (Cohen, 1988); correlations of .12 and larger are found with power of β > .80.

2.2. Measures

Diverse and specific curiosity were assessed with the 10 item Epistemic Curiosity Scale developed by Litman and Spielberger

Table 1
Convergent and discriminant validity (upper part) and construct validity (lower part) of curiosity and related constructs for Study 1 (first coefficient) and Study 2 (second coefficient, behind the slash).

	1	2	3	4	5	6	7
1. Diverse curiosity	*.76/.80*	.80/.74	.91	.80/.70	.93/.75	.87	/.65
2. Specific curiosity	.60/.57	*.73/.74*	.70	.78/.78	.81/.84	.76	/.67
3. Curiosity and exploration	.64	.48	*.65*	.89	.79	.66	
4. Curiosity as a feeling of deficit	.63/.58	.60/.62	.65	*.82/.85*	.72/.73	.64	/.56
5. Need for cognition	.74/.62	.63/.67	.59	.60/.62	*.84/.86*	.87	/.75
6. Openness to ideas	.65	.56	.46	.50	.68	*.74*	
7. Typical intellectual engagement	/.52	/.52		/.46	/.62		*/.79*
Fluid intelligence	/.00	/.19		/.14	/.16		/.11
Crystalline intelligence	/−.09	/−.08		/.03	/.07		/.20
Openness[a]	.32/.49	.05/.29	.19	.17/.36	.28/.38	.39	/.54
Conscientiousness	.31/.29	.33/.25	.55	.48/.41	.38/.38	.21	/.28
Extraversion	.36/.45	.15/.27	.35	.21/.26	.27/.42	.25	/.27
Agreeableness	.14/.11	.11/.09	.13	.07/−.03	.08/−.15	.03	/.04
Neuroticism/Emotionality	−.24/−.12	−.25/−.15	−.29	−.05/.11	−.31/−.16	−.24	/−.07

Note: Italian indices in the diagonal are reliabilities; above the diagonal, correlations are corrected for attenuation.
[a] In order to maintain comparability, openness to ideas-items were excluded from the openness scale in Study 1; for Study 1, $|r| > .13$ are significant at $p \leqslant .01$; for Study 2, $|r| > .19$ are significant at $p \leqslant .01$.

(2003, German translation by Renner (2006)). Additionally, the seven item Curiosity and Exploration Inventory (Kashdan et al., 2004, German translation by Renner (2006)) was used. As the three item sub-dimension *absorption* showed rather unsatisfactory reliability ($\alpha = .52$), an overall score was computed ($\alpha = .65$). However, reliability is still somewhat lower compared to Kashdan et al. (between .72 and .80, for five samples); as such, results regarding this scale should be interpreted with caution. Curiosity as a feeling of deprivation was measured by 15 items translated from Litman and Jimerson (2004). Assessing need for cognition, the 18 item short version developed by Cacioppo, Petty and Kao (1984, German translation adapted from Bless, Wänke, Bohner, Fellhauer, and Schwarz (1994)) was used. For assessment of personality variables according to the five factor model (including openness for ideas) the German version of the NEO-PI-R (Borkenau & Ostendorf, 1993) was applied. Reliability estimates for the aforementioned scales can be found in the diagonal of Table 1. For each cell, indices before the slash are from Study 1, behind the slash from Study 2 (see below). Except for Curiosity and Exploration Inventory, all reliabilities were comparable with reports from the literature.

3. Results

Bivariate correlation between curiosity, need for cognition, and openness for ideas can be found in Table 1. Coefficients above the diagonal are adjusted for attenuation. As can be seen, all measures are positively correlated (M $r = .60$; adjusted $r = .80$). If correlations within the four curiosity scales are treated as convergent validities, and correlations between these four scales on one hand and the two scales need for cognition and openness for ideas on the other as discriminant validities, discriminant validity could not be established (.60 vs. .59). Correspondingly, convergent and discriminant validities adjusted for attenuation were almost identical (.81 vs. .77). Regarding external construct validity similar albeit not identical patterns of correlation could be observed. Specifically, compared to the other scales, specific curiosity was uncorrelated with openness (excluding the openness for ideas facet), openness for ideas was less correlated with conscientiousness (especially compared to the curiosity and exploration scale and curiosity as a feeling of deficit), and curiosity as a feeling of deficit was uncorrelated with neuroticism. As such, while some variance proportions remain unshared by the six measures, this holds true for the constructs labeled as curiosity as well as for those being treated under different labels.

Finally, the six variables were subjected to exploratory factor analysis. Based on parallel analysis (Watkins, 2000), visual inspection of the eigenvalues (4.0; 0.6; 0.5; 0.3; 0.3; 0.3) and Kaiser Gutman criterion, one factor is to be extracted which explains 67% of the variance. All variables had factor loadings between .78 and .87, respectively. Across the six variables, coefficient alpha was .82.

4. Study 2

4.1. Sample

Data were collected on a total of 191 participants, who participated voluntarily in the present research. Similar to Study 1, participants were recruited by one of 15 peers as part of university course work in Germany. On average, participants were 35 years old (SD = 11.7, range: 20–67), 51% were female. Regarding their education, the majority had a university-entrance diploma (79%), 14% had secondary school as highest education. Participants had on average 10 years of job experience (SD = 8.8), only 1% reported to have no prior job experience. At the point of time when participating in this study, 15% were university students, 82% were employed. Post hoc power analyses revealed $\beta = .99$ for a medium correlation of .30 (Cohen, 1988); correlations of .18 and larger are found with power of $\beta > .80$.

4.2. Measures

Diverse and specific epistemic curiosity, curiosity as a feeling of deficit, and need for cognition were measured analogous to Study 1. Additionally, the German 18 item scale for the assessment of typical intellectual engagement (Wilhelm, Schulze, Schmiedek, & Süß, 2003) was administered. Reliability estimates for these scales are displayed in the diagonal of Table 1 behind the slash, respectively. To investigate construct validity, the HEXACO-60 inventory (Ashton & Lee, 2009) was used, excluding the honesty-humility factor. Reliabilities were .69 (openness to experience), .72 (conscientiousness), .71 (extraversion), .50 (agreeableness), and .81 (emotionality). Finally, indicators of fluid and crystalline intelligence were applied. Fluid intelligence was measured by two sub-tasks assessing numerical ($\alpha = .68$, 10 items) and figural ($\alpha = .49$, 10 items) reasoning (S & F Personalpsychologie, 2004). Crystalline intelligence was measured via the 25 item vocabulary test ($\alpha = .84$; S & F Personalpsychologie, 2009).

5. Results

All correlation coefficients can be found in Table 1 (coefficients behind the slash are from Study 2). On average, the five scales assessing curiosity, need for cognition, and typical intellectual engagement correlated .58. Based on coefficients adjusted for attenuation, which can again be found above the diagonal, average correlations are .72. Analogous to Study 1, correlation coefficients were divided into convergent (i.e. within the three curiosity scales; .59) and discriminant (i.e. between curiosity scales on one hand and need for cognition and typical intellectual engagement on the other, .57) validities. Again, results failed to support discriminant validity. Based on adjusted correlations, convergent and discriminant validities were .74 and .70, respectively. Regarding construct validity, minor differences were found. As would have been predicted from theory, typical intellectual engagement showed somewhat higher correlations with crystalline intelligence. Based on a post hoc detail analysis of sub-dimensions of typical intellectual engagement, it was shown that this effect was solely due to reading (.30). Regarding the personality variables of the five factor model, results were similar to Study 1. Also, an exploratory factor analysis of the five variables replicated a one factor solution (eigenvalues were 3.3; 0.6; 0.4; 0.4; 0.3), explaining 67% of the variance. All factor loadings were between .76 and .87. Across the five variables, coefficient alpha was .87.

6. Discussion

The purpose of the present study was to investigate whether the three constructs need for cognition, typical intellectual engagement, and openness for ideas possess discriminant validity regarding several constructs from the curiosity domain. Based on convergent and discriminant validities, exploratory factor analysis, and construct validity, evidence of discriminant validity could not be established. Adjusted for attenuation, average correlations between several curiosity measures and measures of these three constructs were .77 in Study 1 and .70 in Study 2. As such, between 49% and 59% of the variance were shared. Furthermore, shared variance will likely be even higher, as the results were corrected for unreliability only, implicitly assuming that all measures possess perfect construct validity (Hunter & Schmidt, 2004).

However, these results should not be misconceived in terms of equivalence of the investigated constructs. Despite variance proportions that can be attributed to less than perfect construct validity, it is likely that, on a construct level, differences exist. One example might be the sub-dimension *reading* from the typical intellectual engagement scale. In accordance with the predictions of Goff and Ackerman (1992), typical intellectual engagement was significantly correlated with crystalline, but not with fluid intelligence. This effect was not observed for any other variable, and a post hoc analysis indicated that the sub-dimension *reading* accounted for these differences. As already discussed, this sub-dimension concerns very specific and observable behaviors (namely reading), compared to preferences and appraisals regarding thinking and learning. Therefore, equivalence of the constructs under investigation is not postulated. However, the results do indicate that differences between the constructs need for cognition, typical intellectual engagement, and openness for ideas on one hand and several curiosity measures on the other are not larger than those within the curiosity scales.

As one anonymous reviewer pointed out, additional constructs might exist which lack discriminant validity, such as intrinsic motivation to learn. Based on definition of epistemic curiosity ("desire for knowledge that motivates individuals to learn new ideas, eliminate information-gaps, and solve intellectual problems"; Litman, 2008), this is more than likely, even though both constructs have specific, non-shared aspects, such as problem solving and thinking on side of epistemic curiosity, and persistence and self-determination on side of intrinsic motivation to learn. Nonetheless, investigating discriminant validity of intrinsic motivation to learn with regard to epistemic curiosity, as well as to need for cognition, typical intellectual engagement, and openness for ideas, seems an interesting issue for future research. Furthermore, as the study was conducted with a German-speaking sample, future research has to show whether the results generalize to the English versions of the personality measures and to samples from different countries and cultures.

In sum, given the lack of discriminant validity of the constructs need for cognition, typical engagement, and openness to ideas with regard to epistemic curiosity, it is recommended that these concepts are integrated in future studies and theory development. For these constructs, hundreds of studies have been published, focusing on quite different subjects and criteria. Integrating these results might stimulate future research on epistemic curiosity.

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