

Validity of the Interest- and Deprivation-Type Epistemic Curiosity Model in Germany

Jordan A. Litman¹ and Patrick Mussel²

¹Institute for Human and Machine Cognition, Pensacola, FL, USA

²Department of Psychology, University of Würzburg, Germany

Abstract. Three studies were conducted to evaluate the validity of the interest (I) and deprivation (D) type epistemic curiosity (EC) distinction in three German samples. In Study 1 ($N = 395$) and Study 2 ($N = 191$), responses to German translations of the Epistemic Curiosity Scale and the Curiosity as a Feeling-of-Deprivation Scale were submitted to confirmatory factor analysis. The previously found 10-item 2-factor model (Litman, 2008; Litman, Crowson, & Kolinski, 2010) had the best fit compared to competing models. In Study 1, Study 2, and Study 3 ($N = 249$), the I- and D-type EC scales correlated positively with intellectual stimulation measures, providing evidence of convergent validity. I-type EC correlated with enjoying new discoveries and ideas, whereas D-type EC was associated with persistence and solving problems, providing evidence of discrimination.

Keywords: epistemic curiosity, I-type, D-type, trait-curiosity

Epistemic curiosity (EC) is the desire for new knowledge (Berlyne, 1954, 1978), aimed at stimulating pleasurable feelings of situational *interest* (I-type) or relieving negative affective conditions of feeling *deprived* of knowledge (D-type; Litman, 2005). Individual differences in tendencies to experience and express I- and D-type EC are thought to play an important role in academic goal-setting and learning (Litman, 2008; von Stumm, Hell, & Chamorro-Premuzic, 2011), job-related motivation and performance (Litman, Crowson, & Kolinski, 2010; Mussel, 2012), and overall intellectual development and growth (Kashdan, Rose, & Fincham, 2004; Tamdogon, 2006). As an emotional-motivational state, I-type EC is activated by opportunities for intellectual exploration expected to lead to new discoveries and corresponds to the intrinsic pleasure of learning. D-type EC is theorized to manifest as an uncomfortably intense “need to know,” activated when people find they lack very specific pieces of information needed to solve a problem or complete a knowledge-set (Litman, Hutchins, & Russon, 2005). While both types of EC are associated with knowledge-seeking, because D-type EC is considered to reflect an unsatisfied need-like state, it is hypothesized to be a stronger motive than the I-type EC. Like I-type EC, D-type EC is theorized to be motivated by the intrinsic rewards of new discoveries. However, unlike I-type, the satisfaction of D-type EC also involves extrinsically regulated concerns about the accuracy or fit of new knowledge (Litman, 2008).

Two instruments were recently developed specifically to assess individual differences in I- and D-type EC: Litman and Spielberger's (2003) 10-item Epistemic Curiosity Scale (ECS), and Litman and Jimerson's (2004) 15-item Curiosity as a Feeling-of-Deprivation Scale (CFDS), respectively. Consistent with the theorized distinction between I- and D-type EC, scores on the CFDS are predictive of information-seeking in situations where individuals lack highly specific elements of knowledge, are associated with higher levels of state-curiosity and a greater degree of information-seeking, and correlate positively with measures of negative affect (e.g., anxiety). Also consistent with the I/D distinction, ECS scores correlate with information-seeking in situations where individuals can learn something entirely new, are associated with lower levels of state-curiosity and less information seeking behavior, and are found to be negatively correlated to measures of negative affect (Litman et al., 2005; Litman, 2010).

However, despite these differences, scores on the CFDS and ECS tended to be highly correlated, suggesting that more clearly differentiated I- and D-type measures were needed. In keeping with this view, Litman (2008) and Litman et al. (2010) conducted a series of exploratory and confirmatory factor analyses of responses to the ECS and CFDS items by large samples of college students and working adults. Across all samples, a 2-factor, 10-item I/D model comprising 5 ECS items to assess

the enjoyment of seeking out new ideas, and 5 CFDS focusing on being persistent at solving problems had the best fit of several alternate models tested. Additionally, consistent with hypotheses about the I/D distinction, the two 5-item scales very clearly differentiated in their relationships to negative affect and to intrinsically or extrinsically regulated goals and motives. Moreover, recent research in Beijing, which factored the responses of over 2,600 individuals to Chinese translations of the I- and D-type scales, also found clear evidence of the 2-factor 10-item model (Huang, Zhou, Wang, & Zhang, 2010). Thus, there is strong empirical support for the bifactor 10-item I/D EC model across cultures.

German Research on I- and D-Type EC

Cross-cultural research is important for the scientific study of curiosity because it clarifies the degree to which patterns and structural relationships in the associated traits are universal (e.g., McCrae et al., 2005). Although, as previously noted, the 10-item 2-factor I/D model has received strong empirical support in the United States and in China, no research has been conducted to investigate the validity of this model in Germany – or for that matter in any other Western non-English-speaking groups. The study of curiosity and exploratory behavior has a long research tradition in Germany, exemplified most notably in several scholarly texts derived from symposiums on curiosity in the 1980s and 1990s (Keller, Schneider, & Henderson, 1994; Voss & Keller, 1983; Görlitz & Wohwill, 1987). This tradition has continued into the 21st century, as evidenced by several new lines of research on EC and its impact on various life outcomes (e.g., Mussel, 2010; Renner, 2006). In order to facilitate further new research on EC in Germany, validation of the most contemporary I/D EC model is a logical and important step.

The present set of studies investigates whether the 10-item 2-factor I/D EC model could be further validated cross-culturally, using German translations of the original measures in studies of three German samples. Study 1 and Study 2 examine the dimensionality of the ECS and CFDS items with confirmatory factor analyses, using methods and procedures from previous research on the English and Chinese versions of these scales (Huang et al., 2010; Litman, 2008; Litman et al., 2010). To assess convergent and divergent validity, we examined correlations with other measures of tendencies to seek cognitive stimulation and the relationships to the Big Five. In Study 3, we examined the relationships between the I- and D-type EC measures and different motives that underlie working on cognitive tasks. As previously noted, I-type EC is hypothesized to be associated with the intrinsic joy of seeking out new ideas, whereas D-type EC is hypothesized to motivate resolving specific unknowns, aimed at acting on a combination of intrinsic and extrinsic motives.

Method

Participants

The participants in Study 1 were 395 (202 women) volunteers from Germany, ranging from 18 to 70 years of age ($M = 30$, $SD = 11.1$); 51% were university students, 49% were employed. The Study 2 participants were 191 (98 women) volunteers, also from Germany, ranging in age from 20 to 67 years ($M = 35$, $SD = 11.7$). There were 18% university students and 82% employed persons. In Study 3, the participants were 250 (168 women) students, ranging in age from 14 to 23 years ($M = 17.6$; $SD = 2.7$).

Instruments

The Epistemic Curiosity Questionnaire consisted of German translations of the 10-item ECS and the 15-item CFDS (Mussel, 2010; Renner, 2006). The ECS includes two 5-item subscales: The ECS-Diversive subscale measures taking pleasure in exploring new ideas (e.g., “I enjoy exploring new ideas”), while the ECS-Specific subscale measures enjoyment in discovering how things work (e.g., “When I see a complicated piece of machinery, I like to ask someone how it works”). The CFDS consists of three 5-item subscales; the first assesses a desire to increase competence (CFDS-Competence) by reducing ignorance (e.g., “I don’t like not knowing things, so I try to learn new information about even the most complex topics.”), the second measures expressions of intolerance (CFDS-Intolerance) for unsolved problems (e.g., “It really gets on my nerves when I know that I’m close to solving a puzzle, but still can’t figure it out.”), and the third inquires about persistence (CFDS-Persistence) in seeking out missing information (e.g., “I can spend hours on a single problem because I just can’t rest without knowing the answer”).

The ECS and CFDS were administered in Study 1 and 2; Study 3 used only the 5-item ECS-Diversive and 5-item CFDS-Persistence subscales.

Need For Cognition (NFC; Cacioppo, Petty, & Kao, 1984; German translation by Bless, Wänke, Bohner, Fellhauer, & Schwarz, 1994) is an 18-item instrument that assesses tendencies to enjoy intellectual stimulation and cognitive activity (e.g., “I prefer my life to be filled with puzzles that I must solve.”). The NFC was administered in all three studies.

The Curiosity and Exploration Inventory (CEI; Kashdan, Rose, & Fincham, 2004; translation by Renner, 2006) is a 7-item measure that includes a 4-item Interest in Exploration subscale (e.g., “Everywhere I go, I am out looking for new things or experiences”), and a 3-item subscale that measures Absorption when engaged in a specific task (e.g., “When I am actively interested in something, it takes a great deal to interrupt me”). The CEI was used in Study 1 only.

Big Five Measures

In Study 1, to assess individual differences in Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, the German version of the NEO-PI-R (Borkenau & Ostendorf, 1993) was administered. In Study 2, these personality variables were measured using the German version of the HEXACO inventory (Ashton & Lee, 2009). In Study 3, only the NEO-PI-R “ideas” facet of Openness was assessed.

Other Measures

Typical Intellectual Engagement (TIE; Goff & Ackerman, 1992; translation by Wilhelm, Schulze, Schmiedek, & Süß, 2003) is an 18-item measure of attraction to intellectually stimulating activities, consisting of three subscales: Reading (5 items; e.g., “I read a great deal”), Contemplation (7 items; e.g., “I like to think about a problem, even if it doesn't affect the result,” and Curiosity (6 items; e.g., “there are few topics that I find boring”). This instrument was administered in Studies 2 and 3.

The Work Preference Inventory Challenge and Enjoyment Scales (WPI; Amabile, Hill, Hennessey, & Tighe, 1994; German translation by Ohly & Fritz, 2007). The WPI 7-item Enjoyment measure assesses taking intrinsic pleasure in working on various tasks (e.g., “It is important for me to be able to do what I most enjoy”); the 8-item Challenge subscale measures a desire to be intellectually challenged by the tasks in which one is engaged (e.g., “I enjoy tackling problems that are completely new to me”). These instruments were only used in Study 3.

The Goal Orientation Learning scale (VandeWalle, 1997) is a 5-item German instrument that measures being motivated to enhance one's competence by acquiring new skills and mastering new challenges (e.g., “I often look for opportunities to develop new skills and knowledge”). This scale was administered only in Study 3.

Work-Related Curiosity Scale (WRC; Mussel, Spenger, Litman, & Schuler, 2012) is a German instrument that assesses motives regarding information seeking, learning, developing new ideas or solutions, and accomplishing intellectually demanding tasks in the workplace. Based on the responses of participants in the present study, factor analyses revealed two 6-item factors, from which preliminary subscales were developed. The first subscale measures a desire to Develop Ideas (e.g., “I like to develop new strategies”) and the second measures being focused on Solving Problems (e.g., “I am further motivated by difficulties when solving problems”). This scale was administered only in Study 3.

Procedure

In all three studies, participants responded to the study instruments over the internet. In Studies 1 and 2, participants

were recruited by university students in return for course credit; in Study 3, participants responded to the items in the course of an online assessment for occupational choice. Across the studies, subjects covered a diverse range of age, sex, education, and professions that can be considered to be broadly representative of the German population. All subjects participated voluntarily, without compensation.

Study 1 and 2 Results

Psychometric Data and Summary Statistics

Means, *SDs*, *αs*, and correlations for the ECS and CFDS measures are reported in Table 1 for Study 1 and 2. *αs* for all of the EC measures were generally acceptable, with the exception of the CFDS-Competence and CFDS-Intolerance subscales. All of the correlations among the measures were strong and positive, as would be expected given that all of these instruments assessed individual differences in different aspects of EC.

Confirmatory Factor Analytic Strategy

To assess the dimensionality of the EC items, the covariance matrix of responses to the ECS and CFDS items was submitted to confirmatory factor analyses using maximum likelihood estimation. As in related previous research (e.g., Litman, 2008), for each sample, two sets of models were tested: The first consisted of all 25 ECS and CFDS items; the second set included only the ECS-Diversive and CFDS-Persistence items recently identified by Litman (2008; Litman et al., 2010) as the most differentiated measures of I- and D-type EC, respectively.

Three models were evaluated for the first set. The first was a 1-factor model, examined to determine whether the 25 curiosity items were more appropriately conceptualized as comprising a unitary EC construct. The second was a 2-factor I/D model consisting of correlated I- (10 ECS items) and D-type (15 CFDS items) factors. The third model consisted of five correlated factors based on the two ECS and three CFDS subscales. For the second set, only two models were tested: a 10-item single factor model, similar to the 1-factor model for the first set, and a 10-item 2-factor model based on the results of previous research with the English and Chinese ECS and CFDS scales (Huang et al., 2010; Litman, 2008; Litman et al., 2010), with correlated I- (5 ECS-Diversive items) and D-type (5 CFDS-Persistence items) factors.

Several goodness-of-fit (GOF) indices were examined, including chi-square (χ^2), comparative fit index (CFI), non-normed fit index (NNFI), McDonald's centrality fit index (MFI), and root mean square error of approximation (RMSEA). To compare nested models, the parsimony fit index (PFI) was examined; to compare nonnested models,

Table 1. Means, SD, α coefficients, and correlations* between the ECS and CFDS and their subscales in Study 1 ($N = 395$, top row) and Study 2 ($N = 191$, bottom row)

	<i>M</i>	(<i>SD</i>)	α	1	2	3	4	5	6
1. ECS	50.13	(8.19)	.84						
	50.43	(8.81)	.85						
2. ECS-Diversive (5-item I-type scale)	26.14	(4.07)	.77	.87					
	26.40	(4.51)	.81	.86					
3. ECS-Specific	23.99	(5.03)	.73	.92	.60				
	24.03	(5.41)	.76	.91	.57				
4. CFDS	74.90	(10.69)	.83	.69	.60	.60			
	73.43	(11.48)	.85	.68	.58	.62			
5. CFDS-Competence	25.77	(3.89)	.59	.52	.50	.45	.80		
	25.52	(4.04)	.59	.52	.54	.40	.78		
6. CFDS-Intolerance	25.08	(4.22)	.57	.51	.50	.42	.83	.53	
	24.58	(4.36)	.64	.48	.40	.45	.85	.55	
7. CFDS-Persistence (5-item D-Type scale)	23.84	(4.84)	.78	.65	.56	.60	.84	.50	.53
	23.82	(5.35)	.83	.67	.51	.66	.86	.46	.60

Notes. CFDS = Curiosity as a feeling of Deprivation Scale, ECS = Epistemic Curiosity Scale. * r 's, $p < .05$.

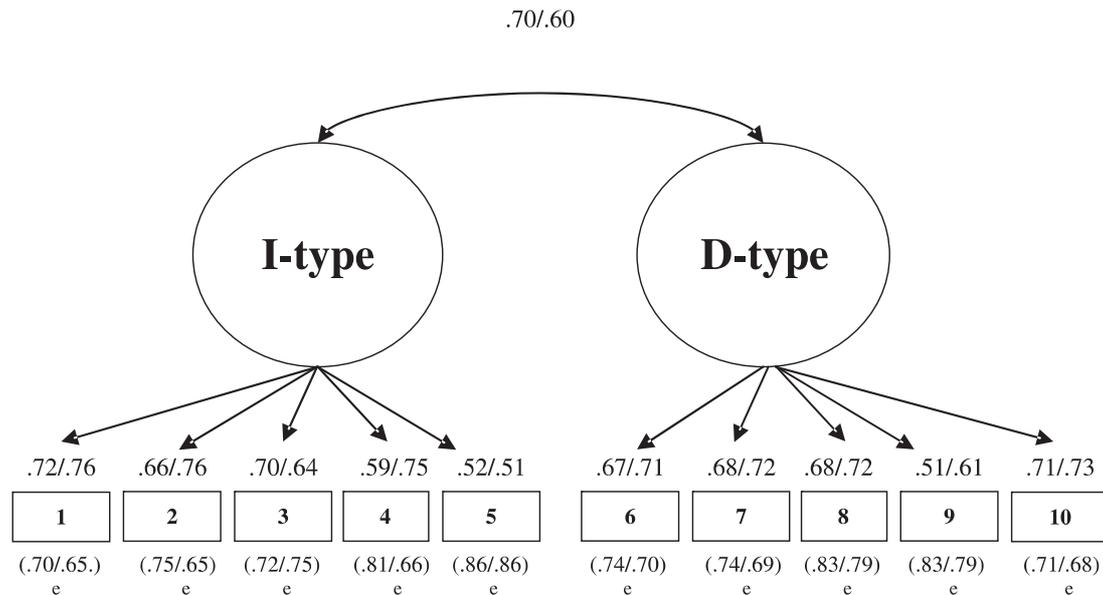
Table 2. Goodness of fit indices (GFI) for five EC models in Study 1 ($N = 395$, top row) and Study 2 ($N = 191$, bottom row)

GFI	Models				
	1A	1B	1C	2A	2B
χ^2 (<i>df</i>)	859.947(275)**	780.341(274)**	626.175(265)**	190.356(35)**	75.898(34)**
	702.846(275)**	636.900(274)**	512.564(265)**	164.087(35)**	38.462(34) <i>ns</i>
CFI	.800	.825	.875	.861	.963
	.741	.780	.850	.805	.993
NNFI	.782	.809	.859	.822	.951
	.712	.780	.830	.749	.991
MFI	.478	.527	.633	.822	.948
	.326	.387	.523	.713	.988
RMSEA[95% CI]	.073[.068–.078]	.069[.063–.074]	.059[.053–.065]	.106[.092–.121]	.056[.039–.073]
	.091[.082–.099]	.084[.075–.092]	.070[.061–.079]	.139[.118–.161]	.026[.000–.060]
PFI	.768	.778	.779	.696	.728
	.677	.695	.726	.623	.727
ECVI [95% CI]	2.442[2.222–2.682]	2.258[2.051–2.486]	1.915[1.736–2.116]	.588[.486–.709]	.302[.297–.377]
	4.309[3.898–4.762]	3.979[3.590–4.406]	3.429[3.100–3.807]	1.087[.983–1.324]	.437[.000–.542]

Notes. 1A = 1-Factor 25-item curiosity model. 1B = 2-Factor 25-item I/D model. 1C = 5-factor 25-item I/D subscale model. 2A = 1-Factor 10-item curiosity model. 2B = 2-Factor 10-item I/D model. ** $p < .001$.

the expected cross-validation index (ECVI) was evaluated. In determining model fitness, a nonsignificant χ^2 is desirable, although smaller values indicate superior fit even when significant (James, Mulaik, & Brett, 1982). Hu and Bentler (1999) suggest that values for MFI $> .90$ and CFI and NNFI $> .95$ indicate close fit. Hu and Bentler (1999) suggest RMSEA $< .06$ indicates close fit, although Browne and Cudeck (1992) consider $< .08$ acceptable. For PFI, James et al. (1982) suggest that values $> .50$ are acceptable, with higher values being desirable. For ECVI, lower values indicate superior fit (Hatcher, 1994).

GFI indices are reported in Table 2; χ^2 were significant for all five models, with the exception of the 10-item 2-factor model (2B) for Study 2. GFI for all Set 1 models indicated poor fit, with the exception of RMSEA for the 5-factor 25-item model for Study 1. For Set 2, the 1-factor model had poor fit for both samples, whereas the fit was significantly better for the 2-factor I/D model in both groups ($\Delta\chi^2 = 115$ in Study 1 and $\Delta\chi^2 = 126$ in Study 2, both $p = .00$). Additionally, the 10-item 2-factor I/D model had the lowest χ^2 and ECVI of all five models, which indicated superior fit in comparison to all other tested models (Hu & Bentler 1999).



German Translation

1. Es macht mir Spaß, neue Ideen zu verfolgen.
2. Ich finde es faszinierend, Neues zu lernen.
3. Es macht mir Spaß, etwas über Themen zu lernen, mit denen ich nicht vertraut bin.
4. Wenn ich etwas Neues kennen lerne, möchte ich gerne mehr darüber herausfinden.
5. Es macht mir Spaß, abstrakte Ideen zu diskutieren
6. Konzeptuelle Probleme halten mich wach, bis ich die Lösung gefunden habe.
7. Wenn ich mich mit einem Problem beschäftige, kann ich nicht ruhen, bis ich die Lösung habe.
8. Es frustriert mich, wenn ich etwas nicht lösen kann, so dass ich umso härter an der Lösung arbeite
9. Ich kann lange über einem Problem brüten.
10. Ich arbeite wie verrückt an Problemen, die gelöst werden müssen.

English Translation

1. I enjoy exploring new ideas.
2. I find it fascinating to learn new information.
3. I enjoy learning about subjects that are unfamiliar to me.
4. When I learn something new, would like to find out more about it.
5. I enjoy discussing abstract concepts.
6. Difficult conceptual problems can keep me awake all night thinking about solutions.
7. I can spend hours on a single problem because I just can't rest without knowing the answer.
8. I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it.
9. I brood for a long time in an attempt to solve some fundamental problem.
10. I work like a fiend at problems that I feel must be solved

Figure 1. Diagram of the 10-item 2-factor I/D EC model for Study 1 ($N = 395$, left of diagonal) and Study 2 ($N = 191$, right of diagonal).

Thus, consistent with previous research findings for the English and Chinese EC scales (Huang et al., 2010; Litman, 2008; Litman et al., 2010), the five items that comprised the ECS-Diversive subscale were the best I-type EC measures, while the five CFDS-Persistence subscale items were found to be the best measures of D-type EC for the German versions as well. Figure 1 displays the 10-item 2-factor I/D model, and reports coefficients for the two samples. For both samples, the two curiosity factors were strongly correlated (Study 1, $r = .70$; Study 2, $r = .60$), and all factor loadings were significant ($p < .001$), ranging from .51 to .76.

Convergent and Divergent Validity Data

Zero order and partial correlations between the two 5-item I- and D-type EC scales and the other measures of intellectual stimulation for Study 1 are reported in Table 3. Each partial correlation between I-type EC and the other measures reflects the statistical controlling of D-type EC, while

the variance accounted for by I-type EC was partialled out of each correlation between D-type EC and the other scales. Partialing out the overlapping variance between the I- and D-type measures reveals the unique relationship between each EC scale and the other measures. The nature of the differences between the two curiosity types becomes clearer. Consistent with the findings of past research, positive correlations were found for I- and D-type EC with the CEI total scale (Litman & Silvia, 2006). However, an interesting divergence was found for the correlations with the CEI subscales: The CEI-Experience scale, which assesses interest in seeking out new experiences, was more highly correlated with I-type EC, whereas CEI-Absorption, which reflects becoming immersed in a particular task, was more strongly associated with D-type EC; these differences were further emphasized by the partial correlations. These results are consistent with the view that I-type is more strongly related to novelty-seeking, whereas D-type involves being immersed in, and working perseveringly on, specific problems. Both I- and D-type EC correlated positively with NFC, which is consistent with the view that all three mea-

Table 3. Zero order and partial correlations* between the 5-item I-type and 5-item D-type EC measures and other intellectual stimulation measures for Study 1 ($N = 395$)

	<i>M</i>	<i>(SD)</i>	α	I-Type		D-Type	
CEI	34.67	(5.07)	.66	.64	.47	.58	.36
CEI-Exploration	20.44	(3.42)	.65	.68	.57	.46	.15
CEI-Absorption	14.23	(2.83)	.51	.33	.09	.49	.38
NFC	83.79	(13.37)	.85	.72	.58	.58	.31
Openness	222.50	(26.54)	.86	.45	.42	.20	-.06
Fantasy	35.46	(7.81)	.76	.08	.13	-.06	-.12
Esthetics	37.89	(8.86)	.79	.23	.23	-.07	-.07
Feelings	40.50	(7.04)	.76	.22	.17	.14	-.02
Actions	34.57	(5.92)	.59	.37	.39	.09	-.15
Ideas	37.81	(7.27)	.75	.65	.54	.45	.15
Values	36.27	(5.31)	.43	.18	.17	.07	-.03

Notes. CEI = Curiosity and Exploration Inventory, NFC = Need For Cognition. In each column, the *rs* listed corresponds to zero order *r* and the second is the partial *r* (other EC scale controlled). * $r > .10$ are significant and in **bold**, $p < .05$.

Table 4. Zero order and partial correlations between the 5-item I-type and 5-item D-type EC measures and the NEO scales for Study 1 ($N = 395$)

	<i>M</i>	<i>(SD)</i>	α	I-Type		D-Type	
Neuroticism	168.24	(35.18)	.92	-.24	-.23	-.09	.05
Anxiety	29.97	(8.75)	.83	-.19	-.19	-.05	.06
Angry Hostility	26.85	(7.34)	.72	-.14	-.14	-.05	.03
Depression	24.87	(8.49)	.83	-.18	-.19	-.03	.08
Self-Consciousness	29.35	(7.21)	.70	-.22	-.26	-.01	.14
Impulsiveness	32.44	(6.62)	.60	-.01	.06	-.10	-.11
Vulnerability	24.77	(7.10)	.80	-.39	-.31	-.24	-.03
Extraversion	225.84	(28.80)	.89	.36	.31	.19	-.01
Warmth	42.33	(6.39)	.76	.35	.32	.17	-.03
Gregariousness	37.28	(7.74)	.76	.12	.12	.03	-.04
Assertiveness	34.13	(7.25)	.77	.31	.27	.15	-.02
Activity	37.25	(6.43)	.68	.35	.25	.26	.09
Excitement-Seeking	34.01	(7.56)	.59	.15	.12	.09	.02
Positive Emotions	40.84	(7.52)	.76	.20	.18	.09	-.02
Agreeableness	222.10	(26.71)	.88	.14	.17	.00	-.10
Trust	36.82	(7.03)	.76	.20	.25	-.02	-.17
Straightforwardness	35.56	(6.81)	.63	.04	.08	-.04	-.08
Altruism	43.38	(6.16)	.75	.23	.19	.13	.00
Compliance	33.43	(6.33)	.61	.00	.03	.04	-.05
Modesty	33.81	(6.80)	.71	-.04	-.02	-.03	-.01
Tender-Mindedness	39.10	(5.73)	.59	.15	.17	.02	-.08
Conscientiousness	235.96	(29.81)	.91	.31	.10	.42	.31
Competence	41.37	(5.65)	.69	.39	.27	.31	.13
Order	37.17	(6.68)	.66	.01	-.10	.17	.20
Dutifulness	44.48	(6.55)	.76	.29	.13	.34	.22
Achievement	38.99	(6.42)	.70	.45	.23	.52	.37
Self-Discipline	39.94	(8.06)	.84	.22	.06	.31	.23
Deliberation	34.02	(7.14)	.77	.05	-.07	.20	.20

Notes. In each column, the *rs* listed corresponds to zero order *r* and the second is the partial *r* (other EC scale controlled). $r > .10$ are significant and in **bold**, $p < .05$.

Table 5. Zero order and partial correlations between the 5-item I-type and 5-item D-type EC measures, intellectual stimulation measures, and the HEXACO Big Five scales for Study 2 ($N = 191$)

	<i>M</i>	(<i>SD</i>)	α	I-Type		D-Type	
TIE	81.70	(13.77)	.79	.52	.40	.41	.19
TIE-Reading	21.63	(7.53)	.85	.16	.15	.05	-.03
TIE-Contemplate	35.48	(6.00)	.69	.61	.47	.51	.28
TIE-Curious	24.58	(5.34)	.63	.42	.28	.39	.22
NFC	83.97	(14.03)	.86	.62	.44	.67	.52
Openness	47.07	(8.81)	.68	.49	.42	.27	.03
Conscientiousness	49.56	(7.81)	.72	.29	.10	.42	.33
Extraversion	50.78	(7.58)	.71	.45	.41	.22	-.01
Agreeableness	42.88	(8.06)	.69	.04	.14	-.15	-.19
Neuroticism	39.76	(9.92)	.81	-.12	-.17	.04	.12

Notes. TIE = Typical Intellectual Engagement. NFC = Need For Cognition. In each column, the r 's listed corresponds to zero order r and the second is the partial r (other EC scale controlled). $r > .15$ are significant and in **bold**, $p < .05$.

Table 6. Zero order and partial correlations between the 5-item I-type and 5-item D-type EC measures and other intellectual stimulation and curiosity measures for Study 3 ($N = 249$)

	<i>M</i>	(<i>SD</i>)	α	I-Type		D-Type	
I-Type	24.31	(4.30)	.75				
D-Type	19.80	(5.63)	.80	.37			
TIE	75.44	(15.42)	.82	.56	.49	.36	.20
TIE-Reading	20.92	(9.23)	.93	.29	.27	.12	.01
TIE-Contemplate	32.50	(5.55)	.63	.55	.47	.45	.31
TIE-Curious	21.92	(5.63)	.67	.51	.44	.35	.20
NFC	74.52	(13.03)	.83	.57	.47	.58	.49
WRC	51.26	(10.13)	.85	.64	.56	.66	.59
WRC-Solve Problems	23.86	(5.90)	.81	.50	.36	.67	.60
WRC-Develop Ideas	27.40	(5.24)	.73	.68	.61	.51	.38
WPI-Challenge	29.25	(5.61)	.73	.58	.48	.61	.52
WPI-Enjoy	42.02	(5.41)	.65	.51	.44	.33	.17
Openness-Ideas	34.55	(7.13)	.72	.64	.57	.39	.21
Goal Orientation-Learning	22.85	(4.32)	.75	.63	.55	.53	.41

Notes. TIE = Typical Intellectual Engagement, NFC = Need For Cognition. WPI = Work Preference Inventory. In each column, the r 's listed corresponds to zero order r and the second is the partial r (other EC scale controlled). $r > .11$ are significant and in **bold**, $p < .05$.

asures assess desires for intellectual stimulation. The pattern of correlations with the Openness scale and its facet measures was somewhat contrary to expectations, but not inconsistent with the theorized I/D distinction. While I-type EC correlated positively with all of the Openness facets, particularly the Ideas facet, D-type EC was only weakly related to Openness, with the exception of Ideas. After controlling for I-type EC, we discovered that the few significant associations found between D-type EC and the Openness facets were negative in sign, again with the exception of Ideas. These findings suggest that I-type EC involves imagination, being open to new experiences, and taking pleasure in abstract ideas, but they also suggest that such tendencies are unrelated to D-type EC, possibly because D-type lends itself more to intellectual rigor than imaginative flights of fancy.

Zero order and partial correlations between I- and D-type EC and the other Big Five measures for Study 1 are reported in Table 4. I-type EC was negatively correlated with nearly all of the Neuroticism measures. Given that I-type EC involves expressions of positive affect, these results were expected. After controlling for I-type EC, we found D-type EC to be positively associated with Self-consciousness, possibly because the arousal of D-type EC is associated with concerns over the accuracy and relevance of newly gathered information. The negative association with Impulsiveness may indicate that D-type EC involves thoughtful deliberation rather than jumping to conclusions (Litman, 2010). I-type EC correlated positively with all Extraversion facets and with several Agreeableness facets, presumably because of the overlap in positive affect among these instruments. By contrast, D-type EC was either weak-

ly or uncorrelated with any Extraversion measures and, after controlling for I-type EC, had small negative correlations with the Agreeableness facets. I-type EC had very small positive correlations with several Conscientiousness facets, and one negative correlation with Order, after controlling for D-type EC, while D-type EC had small to moderately strong positive correlations with all of the Conscientiousness measures, particularly Achievement, both with and without partialing out I-type EC. These findings are consistent with the view that D-type EC is associated with greater effort and persistence expended toward gathering information as compared to I-type EC (Litman et al., 2005; Litman, 2008; Litman et al., 2010).

Table 5 reports the zero order and partial correlations between I- and D-type EC, intellectual stimulation, and the HEXACO measures for Study 2. I-type EC had small to moderately strong positive correlations with all of the TIE scales, especially Contemplate, most likely because it assesses taking pleasure in new ideas. D-type EC also correlated positively with TIE, with the exception of Reading, which was unexpected. As in Study 1, both I- and D-type EC correlated positively with NFC. Generally consistent with the correlations found for the NEO measures, I-type EC was positively associated with Openness and Extraversion, and negatively correlated with Neuroticism. After partialing out I-type EC, D-type EC correlated positively with Conscientiousness and negatively with Agreeableness.

Study 3 Results

Table 6 reports zero order and partial correlations between the I- and D-type EC and the intellectual stimulation measures for Study 3. I-type ($M = 14.6$, $SD = 3.31$) and D-type EC ($M = 12.90$, $SD = 3.35$) both had acceptable internal consistency ($\alpha = .74$, $\alpha = .80$, respectively) and correlated positively ($r = .37$). As found in Study 2, I-type EC was moderately positively correlated with the TIE measures, especially Contemplate, while D-type EC had smaller correlations with these scales, and was uncorrelated with Reading, after partialing out the overlapping variance of I-type EC. Also, as previously found, both curiosity scales correlated positively and strongly with NFC.

While both I- and D-type EC were about equally strongly correlated with WRC, the magnitude diverged for the subscales. I-type EC correlated more highly with Develop Ideas, whereas D-type EC was more strongly associated with Solving Problems. Although this finding is quite consistent with the hypothesized differences between I- and D-type curiosity, these correlations should be interpreted cautiously given that the WRC measures used in this study were only preliminary. Both EC measures were also about equally correlated with WPI-challenge. However, not surprisingly, I-type EC was much more strongly associated with WPI-Enjoyment. Both I- and D-type EC correlated positively with Ideas and Goal Oriented Learning.

General Discussion

The present series of studies examines the validity of the 10-item, 2-factor I/D EC model in a German sample using German translations of the items. Consistent with previous findings for the English and Chinese versions of the I- and D-type EC scales, confirmatory factor analyses indicated that a 2-factor I/D model comprising the 5-item ECS-Diverse and 5-item CFDS-Persistence items had the best fit compared to several competing models. Across studies, the I- and D-type curiosity scales were positively associated with the NFC and TIE scales, providing evidence of convergent validity (Mussel, 2010).

Discrimination between I- and D-type EC was evidenced on the basis of different correlations with most of the other instruments. I-type EC, which measures tendencies to enjoy new discoveries, was more strongly related to CEI-Experience, WRC-Develop Ideas, and WPI Enjoyment. D-type EC, which involves concentrating on solving specific problems, was more strongly associated with CEI-Absorption and WRC-Solving Problems. Consistent with the view that I-type EC involves experiences of positive affect and pleasure in learning new ideas, I-type EC correlated positively with Openness and Extraversion, but negatively with Neuroticism. By contrast, D-type EC was positively associated with Conscientiousness, which supports the view that D-type curiosity involves high levels of persistence (Litman et al., 2005; Litman, 2008; Litman et al., 2010). These findings suggest that I-type EC involves imagination, being open to new experiences, and taking pleasure in abstract ideas, but they also suggest that such tendencies are unrelated to D-type EC, possibly because D-type lends itself more to intellectual rigor than imaginative flights of fancy. I-type EC had very small positive correlations with several Conscientiousness facets, and one negative correlation with Order, while D-type EC had small to moderately strong positive correlations with all of the Conscientiousness measures, particularly Achievement. These findings are consistent with the view that D-type EC is associated with greater effort and persistence expended toward gathering information as compared to I-type EC (Litman et al., 2005; Litman, 2008; Litman et al., 2010).

With regard to the broader personality realm, the finding that I-type EC was more positively related to both Openness (especially the Ideas facet) and Extraversion, while D-type EC was more strongly related to Conscientiousness, is also quite consistent with previous research findings suggesting that I-type EC involves a general preference for novelty and ambiguity, whereas D-type EC reflects an intense intolerance for ambiguity or uncertainty that motivates working hard and persistent to gather of specific and correct answers (Litman, 2010). However, while the divergence between the I- and D-type EC measures in their relationships with Openness and Conscientiousness is generally consistent with the theoretical I/D model, it may also

indicate a limitation of the D-type scale: Nearly all of the D-type scale items emphasize high persistence in problem-solving behavior over other forms of knowledge-seeking. While problem-solving does indeed involve seeking out new information (i.e., the unknown solution to a problem), it could also be energized by other motives such as one's work ethic, which may contribute to the overlap between D-type scale scores and Consciousnesses and minimize its relationship to Openness. In future research, it will be important to more deeply examine the extent to which D-type underlies problem-solving aimed at learning an unknown and improving one's understanding as opposed to other motives.

These studies demonstrate that conclusions about the nature and assessment of I- and D-type curiosity can be generalized to the German culture. Additionally, these findings may be generalized to student and nonstudent populations, given that both participated in the present studies. Thus, the results of the present study provide further evidence for the validity of the I/D model, and they provide additional data on the reliability and construct validity of two brief I- and D-type scales identified as the best measures of these constructs in past research (Litman, 2008; Litman et al., 2010). In future research it will be important to further examine the validity of the I/D model in other cultures and languages in order to further assess its universality.

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Jordan A. Litman

Institute for Human and Machine Cognition
 40 South Alcaniz Street
 Pensacola, FL 32502
 USA
 E-mail drjlitman@gmail.edu