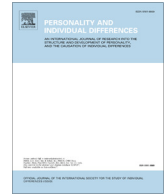




Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Epistemic curiosity and self-regulation



Marco Lauriola^a, Jordan A. Litman^{b,*}, Patrick Mussel^c, Riccardo De Santis^a, Howard M. Crowson^d, Robert R. Hoffman^b

^a Department of Social and Developmental Psychology, Sapienza Università di Roma, Rome, Italy

^b Institute for Human and Machine Cognition, FL, USA

^c Department of Psychology, University of Würzburg, Germany

^d Department of Educational Psychology, University of Oklahoma, USA

ARTICLE INFO

Article history:

Received 26 August 2014

Received in revised form 2 March 2015

Accepted 9 April 2015

Keywords:

Epistemic curiosity

Self-regulation

BIS/BAS

Risk-taking

ABSTRACT

Relationships between Interest (I) and Deprivation (D) type epistemic curiosity (EC) and self-regulation were evaluated in two studies. In Study 1 (Italians, $N = 151$), I-type EC correlated positively with positive outcome-expectancies and risk-taking, but negatively with thinking about negative outcomes. D-type EC correlated positively with emotional restraint, thoughtful evaluation, and concern over negative outcomes and potential risks. In Study 2 (Americans, $N = 218$; Germans, $N = 56$), I-type EC correlated positively with behavioral activation, especially fun seeking, whereas D-type correlated negatively with fun seeking. Neither EC scale correlated significantly with behavioral inhibition. These findings suggest that I-type EC corresponds to fun, carefree and optimistic approaches to learning, while D-type EC reflects greater thoughtfulness and caution regarding knowledge-search.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Broadly recognized as playing an important role in intellectual development, *epistemic curiosity* (EC) is the motive to seek, obtain and make use of new knowledge (Berlyne, 1954; Litman, 2005; Loewenstein, 1994). Individual differences in dispositional tendencies to experience and express EC have been empirically shown to predict setting self-directed learning goals and the attainment of intellectual achievements (Litman, Crowson, & Kolinski, 2010; Richards, Litman, & Roberts, 2013; von Stumm, Hell, & Chamorro-Premuzic, 2011). Research on the nature of individual differences in EC, conducted across a range of ages and cultures, suggest it is experienced and expressed in two correlated, but psychologically distinct ways: (1) a desire for new information anticipated to increase pleasurable feelings of situational *interest* (I-type), and (2) a motive to reduce unpleasant experiences of feeling *deprived* (D-type) of new knowledge (Huang, Zhou, Wang, & Zhang, 2010; Litman & Mussel, 2013; Piotrowski, Litman, & Valkenburg, 2014).

Given I- and D-type EC's shared association with knowledge-seeking, unsurprisingly, scores on measures of EC typically show strong convergence with one another (Mussel, 2010) and with related constructs (Litman, Collins, & Spielberger, 2005).

However, the special nature of EC's role in self-directed learning and intellectual achievement is better elucidated by examining evidence of how I- and D-type EC meaningfully *diverge*: I-type EC involves intellectual exploration aimed at the fun of discovering completely new ideas, while D-type EC reflects an uncomfortably intense "need to know," that energizes and directs seeking specific pieces of information needed to solve for a specific unknown (Litman, 2008). Supportive of the I/D distinction, each type of EC has empirically demonstrated unique associations with different metacognitive judgments, personality traits, affective experiences, self-directed learning goals, and levels of effort expended towards learning.

Consistent with I-type's orientation towards the pleasure of entirely new discoveries, I-type EC predicts state-curiosity reactions when individuals determine they "don't know" something (Litman, Hutchins, & Russon, 2005). It correlates positively with openness, preference for novelty, tolerance of ambiguity and expressions of positive affect, but correlates negatively with negative affective experiences (Litman, 2010; Litman & Mussel, 2013). I-type EC is found positively associated with setting learning goals aimed at achieving personal satisfaction (i.e., Mastery-achievement), but is essentially unrelated to striving for performance-related achievement (Litman, 2008).

In contrast to I-type EC, and in keeping with D-type's orientation towards striving to fill bothersome knowledge-gaps, D-type EC predicts state-curiosity levels when individuals have partial

* Corresponding author.

E-mail address: jlitman@ihmc.us (J.A. Litman).

knowledge relevant to an unknown (e.g., “tip-of-the-tongue” responses to questions) and is associated with more intense curiosity-states and more rigorous information-seeking behavior (Litman et al., 2005; Richards et al., 2013). D-type EC tends to correlate as much as or more with conscientiousness than openness, correlates positively with focused attention, impulse-control, and negative affect, but correlates negatively with ambiguity-tolerance, and is essentially unrelated to positive affect (Litman, 2010; Litman & Mussel, 2013; Piotrowski et al., 2014). As to learning goals, D-type EC is more complex than I-type, showing positive correlations with mastery-achievement, performance-achievement, and failure-avoidance, reflecting concern for the accuracy and usability of new knowledge (Koo & Choi, 2010).

1.1. Epistemic curiosity and self-regulation

As detailed in the previous section, research on individual differences in EC suggests that its I- and D-type dimensions each correspond to different underlying processes, different information-seeking activities, and different self-directed learning goals. An important implication of these findings is that I- and D-type EC may also be associated with different *self-regulation* strategies applied towards learning and achievement. Self-regulation in this context refers to the facility with which individuals selectively apply monitoring and control processes to achieving higher levels of knowledge and proficiency (Zimmerman, 2002). Indeed, numerous studies of learning and training, spanning a wide range of domains, have consistently demonstrated that self-regulation is critical not only to acquiring new knowledge and new skills, but to the achievement of high-level expertise (Hoffman et al., 2014).

Moreover, self-regulation not only refers to monitoring and controlling cognitive resources like attention and effort, but also to modulating emotional experiences aroused while learning (Balzarotti, Gross, & John, 2010); self-evaluating progress and formulating expectations about the likelihood of goal-achievement (Nenkov, Inman, & Hulland, 2008); assessment and management of potential risks associated with pursuing one’s goals (de Haan et al., 2011); and valuation of how rewarding new knowledge will be once learned, which may also impact future learning goals (Carver, 2006). At present, the nature of the relationships between the aforementioned self-regulatory factors and I- and D-type EC – the fundamental motives for learning new knowledge – remain largely unexplored. Given independent evidence of the importance of both EC and self-regulation to self-directed learning and achievement, the direction and magnitude of the relationships that may exist between EC and self-regulation begs further consideration.

Previous research suggests that I-type EC is associated with an open, positive approach towards learning, implying a broadly optimistic outlook regarding new discoveries. Additionally, acquiring knowledge capable of satisfying I-type EC places relatively modest demands on the information-seeker; to sate I-type curiosity-states, new information merely needs to be *engaging*, but does not necessarily need to be useful (i.e., factually accurate and/or facilitate understanding), as it does for D-type EC. Although if something expected to be interesting turned out to be dull, this could lead to disappointment (Loewenstein, 1994), the extant theory and research on I-type EC all point to its association with optimistic expectancies about discovery (Maner & Gerend, 2007). Moreover, given that I-type experiences involve seeking new knowledge for the inherent joy of it, as well as greater ambiguity-tolerance, the arousal of I-type states is likely to include expectations that new sources of pleasurable intellectual stimulation may be discovered serendipitously. As such, we would expect I-type EC to involve uninhibited expressions of positive affect, positive outcome-expectancies, little apprehension over potentially

negative outcomes, and an orientation towards having fun while learning.

Like I-type, we might posit that D-type EC also involves optimism regarding knowledge-search; expending time and energy to seek out new information must be preceded by the expectation that one’s efforts will pay off. However, theory and research on the I/D distinction suggest that D-type EC states can only be satisfied by the *right* piece of information – merely discovering *any* new knowledge will simply not suffice (i.e., it is *not* equivalent to Need for Closure; Litman, 2010); to reduce D-type states, the newly learned information must be able to *accurately* resolve an unknown. Moreover, D-type curiosity-states are theorized to resemble a “need-like” condition, involving unpleasant feelings of tension and perplexity, which increase until satisfactorily resolved. This interpretation is consistent with evidence of positive relationships between D-type EC and negative affect (Litman, 2010) and D-type’s association with TOT states (Litman et al., 2005) and the “tingling, torment, [and] turmoil” (Schwartz, Travis, Castro, & Smith, 2000, p.19) that accompany them. Unlike I-type EC, D-type does not orient individuals to learn new things just for the fun of it, but rather underlies wanting to develop a deeper, more meaningful understanding of a subject (Richards et al., 2013).

If the activation of D-type EC produces mild to moderately negative experiences, for which mitigation has fairly stringent criteria (i.e., new knowledge cannot merely be interesting, it must facilitate comprehension), then D-type EC may coincide with greater concerns about *potential risks* involved in knowledge-search – i.e., one might expend considerable resources to seek out and make sense of new knowledge, only to fail in the search or subsequent sense-making. Failure means wasted resources, continued uncertainty and sustained negative affect. A greater awareness of the risks associated with expending effort for potentially “useless” information suggests that D-type EC involves *lower* levels of optimism about knowledge-seeking, and more consideration of the risk of negative outcomes. These predictions are highly consistent with previous research that shows D-type EC is associated with setting both performance-oriented and failure-avoidant goals (Litman, 2008), and with concerns about the utility of new knowledge (Koo & Choi, 2010). Further, given recent findings that indicate D-type EC is positively correlated with impulse-control (e.g., Piotrowski et al., 2014), we would also expect D-type EC to be associated with greater deliberation and caution before exerting effort to obtain new information.

Consequently, in regard to self-regulation, we would predict D-type EC to be positively associated with careful evaluation, consideration of negative outcomes, emotional restraint, and prudent assessment of potential risks in knowledge-seeking. However, it is important to note that D-type EC, like I-type, is theorized and empirically shown to reflect an *approach* orientation; thus, any hesitation associated with D-type EC should not result in avoidance, but rather, thoughtful and wary approach. Indeed, previous research on D-type EC has shown it to be associated with more intense curiosity-states and more knowledge-seeking behavior (Litman et al., 2005), suggesting that D-type EC should correspond to drive-like approach, at least once one determines that initiating knowledge-search is warranted.

1.2. The present studies

Previous work on the I/D distinction suggests there may be different self-regulatory strategies uniquely associated with each expression of EC, but these relationships remain unexplored. Thus, the major goal of the present studies was to examine relationships between I- and D-type EC and several self-regulatory processes: emotional regulation, risk assessment, outcome

expectancies, and approach or avoidance of potential rewards. Given that previous research has demonstrated considerable cross-cultural stability in EC as a psychological construct, to further explore the extent to which EC and relevant self-regulatory phenomena are universally experienced and expressed, we examined these relationships in three cultures/languages (Italian, American-English and German) using translations of the I/D EC scales found equivalent to one another by native bilingual speakers in regard to interpretation, factor structure, internal-consistency, and major correlates, even with different “trait-like” rating formats/response ranges (Litman & Mussel, 2013; Litman & Silvia, 2006), along with available translated and validated measures of the aforementioned self-regulatory domains.

In keeping with previous work on the I/D distinction, we hypothesized that I-type EC would correlate positively with optimistic outcome-expectancies, willingness to take risks, and overall approach-orientation, particularly in regard to fun-seeking, but would have little relation to thoughtful evaluation or emotional restraint. In contrast, D-type EC was hypothesized to be associated with deliberation, emotional control, and concern over potential risks. In keeping with past research showing that D-type EC is associated with higher levels of effort and persistence, and has more demanding criteria for satiation, D-type EC was expected to have a stronger relationship to drive-related approach as compared to I-type, and to be either negatively or un-correlated with fun-seeking. As both EC scales assess approach-tendencies, it was hypothesized that the scales would be about equally related to reward-responsiveness, and that neither EC scale would correlate with avoidance.

2. Methods

2.1. Participants

In Study 1, 151 Italian undergraduates ($N = 113$ female; M age = 24.45, $SD = 2.91$) were recruited from psychology courses at University of Rome, Italy. In Study 2, 218 American undergraduates ($N = 167$ female; M age = 20.81, $SD = 2.51$) and 56 German undergraduates ($N = 47$ female; M age = 20.95, $SD = 3.07$) were recruited from psychology and general education classes at University of Oklahoma, USA, and University Würzburg, Germany. Although our participants were “convenience” samples, all of the universities from which they were recruited were public and in large cities, and thus all respondents were considered reasonably representative of young, educated adults from their native cultures. However, all three samples consisted mostly of women (roughly, 77%), and the Italian sample was significantly older than the other two (t 's > 1.96, $p < .05$). Although we had no specific hypotheses concerning gender or age in regard to the I/D distinction, given these differences we conducted exploratory analyses and found no significant correlations.

2.2. Study 1 instruments (Italian language)

I- and D-type EC (Litman, Lauriola, & De Santis, 2014, α range = .70–.78.) was assessed with a 5-item I-type scale (“I enjoy exploring new ideas”), and a 5-item D-type scale (“I can spend hours on a single problem because I just can’t rest without knowing the answer”). Respondents indicated on a 4-point trait-scale how frequently they generally felt as each item described (1 = almost never; 4 = almost always).

Emotion Regulation Questionnaire (ERQ; Balzarotti et al., 2010, α range = .72–.84) consists of a Cognitive Reappraisal scale that assesses reinterpreting events to change one’s emotions (“When I want to feel less negative emotion, I change the way I’m thinking

about the situation”), and Expressive Suppression, which measures restraining emotional expression (“When I am feeling negative emotions, I make sure not to express them”). For each item, a 7-point scale was used (1 = strongly disagree; 7 = strongly agree).

Elaboration on Potential Outcomes scales (EPO; Nenkov et al., 2008, α range = .80–.94) assess tendencies to consider positive and negative consequences of one’s behavior through: Generation/Evaluation of potential outcomes (“I try to anticipate as many consequences of my actions as I can”), Positive Outcome Focus (“I keep a positive attitude that things always turn out all right”), and Negative Outcome Focus (“I am often afraid that things might turn out badly”). For each item, respondents used a 7-point scale (1 = strongly disagree; 7 = strongly agree).

RT-18 (de Haan et al., 2011, α range = .74–.80) uses dichotomous-response items to assess Risk-Taking Behavior (“I sometimes like to do things that are a little frightening”) and Risk Assessment (“I usually think about all the facts in details before I make a decision”, reverse scored). Higher scores on both scales reflect stronger tendencies to take risks.

2.3. Study 2 instruments

I/D EC scales: Two translations of the I/D EC sales, one in American-English and one in German, both equivalent to the aforementioned Italian version. The American-English I- and D-type scales (Litman, 2008, α ranges = .82–.88) used the same trait frequency-rating format as the Italian version; the German translation (Litman & Mussel, 2013, α ranges = .77–.83) used a 7-point trait-metric, that assessed how well each item generally described respondents (1 = not very descriptive; 7 = very descriptive).

Behavioral Inhibition Scale/Behavioral Activation Scales (BIS/BAS; Carver & White, 1994, α range = .66–.74; Randler, Baumann, & Horzum, 2014, German version, α range = .45–.77). The BIS measures regulation of avoidance (“I feel worried when I think I have done poorly at something important”) while the BAS measures regulation of appetitive motives and approach. The BAS comprises three subscales that measure Drive (“When I want something I usually go all-out to get it”), Fun Seeking (“I will often do things for no other reason than that they might be fun”), and Reward Responsiveness (“When good things happen to me, it affects me strongly”). Responses to each item were made on a 4-point scale (1 = very false for me; 4 = very true for me.)

2.4. Procedures and data analytic strategies

For each sample, data were collected either individually or in small groups, with completion times of 30–40 min; all procedures complied with regulations regarding privacy and ethical research standards. In keeping with previous research on the I/D distinction, we examined both the zero-order and partial correlations, in order to clarify both shared and unique relations between each EC scale and its correlates. While decisions regarding hypotheses were based primarily on evidence of statistical significance using a conventional $p < .05$, we also considered magnitude and direction of relationships, regardless of significance. As noted previously, no significant correlations were found for age or gender; thus, we conducted all analyses on the total sample for each cultural group.

3. Study 1 results (Italians)

Means, standard deviations, alphas, zero-order and partial correlations between the I-and D-type EC scales, the ERQ, the EPO and the RT-18 scales are reported in Table 1. Alphas were acceptable ($\geq .70$) for all the measures. As expected, the I/D scales correlated positively with one another, although the magnitude

Table 1

Means, standard deviations, alphas, zero-order and partial correlations between the I- and D-type EC scales and measures of self-regulation ($N = 151$; Italians).

	<i>M</i>	<i>(SD)</i>	α	Zero-order <i>r</i>		Partial <i>r</i>	
				I-type	D-type	I-type	D-type
I-type EC	15.80	(2.81)	.78				
D-type EC	12.60	(2.96)	.72	.18			
ERQ Cognitive Reappraisal	4.86	(0.96)	.81	.15	.11	.13	.08
ERQ Expressive Suppression	3.04	(1.26)	.76	-.07	.20	-.12	.21
EPO Generation/Evaluation	31.74	(5.85)	.87	.13	.33	.07	.32
EPO Positive Outcome Focus	14.44	(4.07)	.83	.30	-.09	.32	-.16
EPO Negative Outcome Focus	15.94	(5.65)	.89	-.16	.23	-.22	.27
RT-18 Total Scale	21.02	(4.11)	.81	.31	-.09	.34	-.16
RT-18 Risk Taking Behavior	13.25	(2.73)	.80	.40	.02	.41	-.06
RT-18 Risk Assessment	7.77	(2.25)	.75	.08	-.18	.12	-.20

ERQ = Emotion Regulation Questionnaire.
 EPO = Elaboration on Potential Outcomes.
 RT-18 = Risk Taking Questionnaire.
 Partial *r* corresponds to the statistical control of the other EC scale.
 $r \geq .18$ are significant and in bold, $p < .05$.

was lower than typically found (c.f. Litman, 2008). As hypothesized, D-type EC correlated positively with Expressive Suppression and Generation/Evaluation; I-type was not significantly related to either. Consistent with our hypotheses, I-type EC correlated positively with Positive Outcome Focus and negatively with Negative Outcome Focus; the opposite pattern of correlations was found for D-type. Also as hypothesized, I-type EC was positively correlated with Risk Taking, but was not significantly associated with Risk Assessment, although the positive direction suggests less concern with risk. As hypothesized, D-type EC correlated negatively with Risk Assessment, indicating greater concern with risk.

4. Study 2 results (Americans and Germans)

Means, standard deviations, alphas, zero-order and partial correlations between the American-English and German I- and D-type EC scales, with corresponding BIS and BAS translations, are reported in Table 2. Alphas were acceptable for most of the measures, but lower than optimal for the German BAS, particularly Reward Responsiveness. This result mirrors past research, which has found that while the German BIS/BAS are valid and comparable to their English counterparts, their alphas tend to be lower (c.f.,

Table 2

Means, standard deviations, alphas, zero-order and partial correlations between the I- and D-type EC scales, and BIS and BAS for Americans ($N = 218$, left of diagonal) and Germans ($N = 56$, right of diagonal).

	<i>M</i>	<i>(SD)</i>	α	Zero-Order <i>r</i>		Partial <i>r</i>	
				I-Type	D-Type	I-Type	D-Type
I-type EC	14.35/5.43	(3.04/0.90)	.85/.78				
D-type EC	11.14/4.60	(3.05/1.21)	.87/.75	.56/.40			
BIS Total	2.01/3.01	(0.39/0.45)	.71/.79	.10/-.16	.00/.01	.11/-.20	-.04/.13
BAS Total	3.93/3.02	(0.68/0.30)	.87/.69	.38/.39	.04/.16	.40/.36	-.13/-.07
BAS Reward Responsive	1.74/3.26	(0.23/0.36)	.85/.50	.34/.25	.01/.21	.37/.16	-.14/.09
BAS Drive	1.15/2.80	(0.24/0.44)	.71/.57	.24/.13	.09/.09	.23/.09	.00/.02
BAS Fun Seeking	1.61/2.94	(0.23/0.48)	.64/.65	.36/.45	.00/.05	.40/.51	-.17/-.27

BIS = Behavioral Inhibition Scale.
 BAS = Behavioral Activation Scale.
 Partial *r* corresponds to the statistical control of the other EC scale.
 For American-English scales, $r \geq .14$ are significant and in bold, $p < .05$; for German scales, $r \geq .27$ are significant and in bold, $p < .05$.

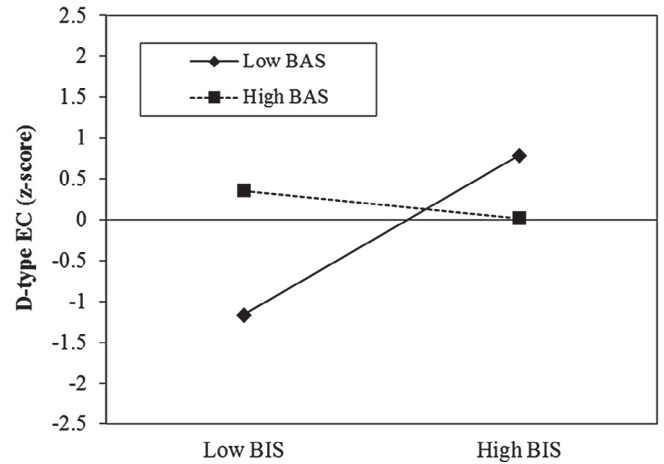


Fig. 1. Plot of the interaction of BIS and BAS on D-type EC for Americans ($N = 218$). BIS = Behavioral Inhibition Scale, BAS = Behavioral Activation Scale.

Randler et al., 2014). In both samples, as hypothesized, neither EC scale correlated significantly with BIS. As expected, I-type EC correlated positively with total BAS for both samples. Correlations with the BAS subscales were significant for Americans, but not Germans, although the direction was as expected. As hypothesized, for both samples, I-type EC correlated positively with Fun Seeking and Reward Seeking for both samples, whereas D-type EC correlated negatively. Although D-type EC's negative relationship with Fun Seeking was as expected, the magnitude and direction of relationships with the other BAS subscales was unexpected, and the lack of any relationship with Drive was contrary to our hypothesis.

Given mixed support for our hypotheses, in keeping with the Joint Subsystems Hypothesis (Corr, 2004), we explored whether BIS-BAS interaction effects might elucidate the nature of the relationships among these constructs. Separate multiple regressions were computed for each EC scale; although no significant interactions were found in the German sample, a significant BIS-BAS interaction effect was found for D-type EC for the Americans ($\beta = -0.57$, $SE = 0.20$, $t = -2.83$, $p < .01$). As illustrated in Fig. 1, highest levels of D-type EC were associated with Low BAS + High BIS, while lowest levels corresponded to Low BAS + Low BIS, suggesting that greater punishment-sensitivity and impulse-control contribute jointly to D-type EC.

Finally, given differences in sample size and scaling between the German and American-English EC measures, we conducted z-tests (Preacher, 2002) to determine whether the correlations differed significantly in magnitude; only the partial correlations

between I-type and BIS significantly differed ($z = 2.04$; $p < .05$). However, this finding is difficult to interpret, given that both correlations were nonsignificant. It is interesting to note that German BIS/BAS means were all significantly higher than their English counterparts (t 's > 1.96 , $p < .05$). As these means were similar in magnitude to those reported previously for each cultural group (Carver & White, 1994; Randler et al., 2014), this may suggest cultural differences worth exploring in future research (also see Leone, Perugini, Bagozzi, Pierro, & Mannetti, 2001 regarding BIS/BAS scores across cultures).

5. General discussion

The present studies examined relationships between I- and D-type EC and several aspects of self-regulation. In Study 1 (Italians), D-type EC correlated positively with Expressive Suppression and Generation/Evaluation, whereas I-type was unrelated to either, indicating that, as hypothesized, D-type EC involves emotional-control and deliberation. I-type EC correlated positively with positive outcome-focus and willingness to take risks but negatively with negative outcome-focus, consistent with our hypothesis that I-type involves optimism about new discoveries. As expected, for D-type EC, the opposite pattern of correlations with outcome-focus and Risk Assessment emerged, suggesting that D-type involves concern over potential negative consequences due to incorrectly comprehending/applying knowledge. One important implication of these findings is that I-type EC underlies *carefree* intellectual exploration, whereas D-type EC orients individuals to apply cognitive resources *judiciously*. In future research, it may be worthwhile to examine whether I- and D-type EC differentially predict resource expenditure when knowledge-seeking is experimentally constrained (e.g., place limits on question-asking).

In Study 2 (Americans, Germans), as hypothesized, neither I- nor D-type EC correlated with BIS. I-type EC correlated positively with Fun Seeking, further demonstrating that I-type EC involves exploring new information for the intrinsic joy of it. By contrast, D-type EC showed small negative correlations with Fun Seeking, suggesting D-type might motivate *eschewing* information deemed frivolous in nature. This finding is consistent with past research that suggests D-type EC orients individuals to seek knowledge expected to be *useful* for resolving unknowns. However, the lack of positive correlations between D-type and Drive or Reward Responsiveness was unexpected. Possibly, these BAS dimensions involve impulsivity (Smillie, Jackson, & Dalgleish, 2006), which is at odds with D-type's association with impulse-control. Additionally, these BAS items emphasize intense positive affect (e.g., "excited", "energized"), which may be unrelated to D-type experiences. Consistent with this interpretation, we found that impulse-control and punishment-sensitivity (i.e., Low BAS + High BIS) interacted to jointly influence D-type experiences (Corr, 2004). An important implication of these findings is that while the (uncomfortable) arousal associated with D-type states might be more intense relative to I-type, activation of D-type EC might not quite reflect "drive-like" experiences as previously hypothesized – at least not in a single "burst" – but might be more precisely understood as prolonged, moderately intense emotional-motivational states that underlie *sustained intellectual activity and concentration*. Beginning in early childhood, controlling impulsivity when distressed is important for sustaining attention and for the development of conscientiousness (Eisenberg, Duckworth, Spinrad, & Valiente, 2014) – all of which correspond to D-type EC.

5.1. Cultural similarities and differences in EC

Besides being one of the first studies to investigate relationships between EC and self-regulation, this study is also novel in that it

was cross-cultural. Two themes seemingly shared across cultures was that I-type reflected a carefree approach to learning, while D-type involved thoughtfulness and caution. Of course, these interpretations should be considered tentative, given that not all aspects of the study could be fully examined cross-culturally due to limitations in available validated translations for all measures. Despite these caveats, the results of the present studies should still hold considerable value for scholars and practitioners in that they identify potentially important themes in EC and self-regulation, as well suggest potential differences between American and German approach/avoidance tendencies.

5.2. Limitations and future research

First, different measures of self-regulation were used in Study 1 and Study 2; to elucidate our results' meaningfulness, it will be important to conduct further cross-cultural investigations of EC and self-regulation. Second, although our participants were disproportionately composed of women. As gender was uncorrelated with EC, we do consider this to be a major drawback, although in future research it would be preferable to examine these phenomena with a more even gender-distribution. Third, there were several weaknesses in our German sample (e.g., small N , different trait-rating for EC scales). However, as the direction of relationships between the German measures was generally consistent with hypotheses, these data still offer further evidence of the universality of the I/D distinction, but should be interpreted cautiously. Finally, the relevant constructs were examined outside of "real-world" contexts (e.g., classrooms, jobsite-training sessions). Follow-up research in this vein may better inform educators of ways to structure learning-environments such that individuals may more effectively apply their time, energy and ability to intellectual achievement.

References

- Balzarotti, S., Gross, J. J., & John, O. P. (2010). An Italian adaptation of the emotion regulation questionnaire. *European Journal of Psychological Assessment, 26*, 61–67.
- Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45*, 180–191.
- Carver, C. S. (2006). Approach, avoidance, and the self-regulation of affect and action. *Motivation, 30*, 105–110.
- Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67*, 319–333.
- Corr, J. P. (2004). Reinforcement sensitivity theory and personality. *Neuroscience and Biobehavioral Reviews, 28*, 317–332.
- de Haan, L., Kuipers, E., Kuersten, Y., van Laar, M., Olivier, B., & Verster, J. C. (2011). The RT-18: A new screening tool to assess young adult risk-taking behavior. *International Journal of General Medicine, 4*, 575–584.
- Eisenberg, N., Duckworth, A. L., Spinrad, T. L., & Valiente, C. (2014). Conscientiousness: Origins in childhood? *Developmental Psychology, 50*, 1331–1349.
- Hoffman, R. R., Ward, P., DiBello, L., Feltovich, P. J., Fiore, S. M., & Andrews, D. (2014). *Accelerated expertise: Training for high proficiency in a complex world*. Boca Raton, FL: CRC Press.
- Huang, D., Zhou, L., Wang, M., & Zhang, J. (2010). *Gender difference in motives of knowledge searching: Measurement invariance and factor mean comparison of the interest/deprivation epistemic curiosity*, Unpublished paper presented at IEEE 2nd Symposium on Web Society. China: Beijing.
- Koo, D.-M., & Choi, Y.-Y. (2010). Knowledge search and people with high epistemic curiosity. *Computers in Human Behavior, 26*, 12–22.
- Leone, L., Perugini, M., Bagozzi, R. P., Pierro, A., & Mannetti, L. (2001). Construct validity and generalizability of the Carver-White behavioural inhibition system/behavioural activation system scales. *European Journal of Personality, 15*, 373–390.
- Litman, J. A. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition and Emotion, 19*, 793–814.
- Litman, J. A. (2008). Interest and deprivation dimensions of epistemic curiosity. *Personality and Individual Differences, 44*, 1585–1595.
- Litman, J. A. (2010). Relationships between measures of I- and D-type curiosity, ambiguity tolerance, and need for closure: An initial test of the wanting-liking model of information-seeking. *Personality and Individual Differences, 48*, 397–402.

- Litman, J. A., Collins, R. P., & Spielberger, C. D. (2005). The measurement of sensory curiosity. *Personality and Individual Differences*, 39, 1123–1133.
- Litman, J. A., Crowson, H. M., & Kolinski, K. (2010). Validity of the interest- and deprivation-type epistemic curiosity distinction in non-students. *Personality and Individual Differences*, 49, 531–536.
- Litman, J. A., Hutchins, T. L., & Russon, R. K. (2005). Epistemic curiosity, feeling-of-knowing, and exploratory behaviour. *Cognition and Emotion*, 19, 559–582.
- Litman, J. A., Lauriola, M., & De Santis, R. (2014). *Individual differences in epistemic curiosity in Italy*. FL: Institute for Human and Machine Cognition (manuscript under review).
- Litman, J. A., & Mussel, P. (2013). Development and validation of German translations of interest- and deprivation-type epistemic curiosity scales. *Journal of Individual Differences*, 34, 59–68.
- Litman, J. A., & Silvia, P. J. (2006). The latent structure of trait curiosity: Evidence for interest and deprivation curiosity dimensions. *Journal of Personality Assessment*, 86, 318–328.
- Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin*, 116, 75–98.
- Maner, J. K., & Gerend, M. A. (2007). Motivationally selective risk judgments: Do fear and curiosity boost the boons or the banes? *Organizational Behavior and Human Decision Processes*, 103, 256–267.
- Mussel, P. (2010). Epistemic curiosity and related constructs: Lacking evidence of discriminant validity. *Personality and Individual Differences*, 49, 506–510.
- Nenkov, G. Y., Inman, J. J., & Hulland, J. (2008). Considering the future: The conceptualization and measurement of elaboration on potential outcomes. *Journal of Consumer Research*, 35, 126–141.
- Piotrowski, J. T., Litman, J. A., & Valkenburg, P. (2014). Measuring epistemic curiosity in young children. *Infant and Child Development*, 23, 542–553.
- Preacher, K. J. (2002, May). *Calculation for the test of the difference between two independent correlation coefficients (Computer software)*. <<http://quantpsy.org>>.
- Randler, C., Baumann, V. P., & Horzum, M. B. (2014). Morningness–eveningness, big five and the BIS/BAS inventory. *Personality and Individual Differences*, 66, 64–67.
- Richards, J. B., Litman, J. A., & Roberts, D. H. (2013). Performance characteristics of measurement instruments of epistemic curiosity in third-year medical students. *Medical Science Educator*, 23, 355–363.
- Schwartz, B. L., Travis, D. M., Castro, A. M., & Smith, S. M. (2000). The phenomenology of real and illusory tip-of-the-tongue states. *Memory & Cognition*, 28, 18–27.
- Smillie, L. D., Jackson, C. J., & Dalgleish, L. I. (2006). Conceptual distinctions between Carver and White's (1994) BAS scales: A reward-reactivity versus trait impulsivity perspective. *Personality and Individual Differences*, 40, 1039–1050.
- von Stumm, S., Hell, B., & Chamorro-Premuzic, T. (2011). Curiosity predicts academic performance. The hungry mind: Intellectual curiosity as third pillar of academic performance. *Perspectives on Psychological Science*, 6(6), 574–588.
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41, 64–70.