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Brief Report

Measuring Epistemic Curiosity in Young Children†

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Epistemic curiosity (EC) is the desire to obtain new knowledge capable of either producing positive experiences of intellectual *interest* (I-type) or of reducing undesirable conditions of informational *deprivation* (D-type). Although researchers acknowledge that there are individual differences in young children's epistemic curiosity, there are no existing measures to assess the I- and D-type constructs of EC in early childhood. The aim of this study was to develop and validate parent-report scales that reliably assessed early expressions of I- and D- type EC in young children. To develop the I/D-Young Children (I/D-YC) scales, 16 potential items were administered to 316 parents of children aged 3 to 8. These items were adaptations of an existing adult self-report measure of EC as well as newly developed items. Confirmatory factor analyses demonstrated that a 10-item 2-factor (5 I-type, 5 D-type) model had the best fit. Construct validity analyses and psychometric data indicated that our newly developed I/D-YC scales are valid and reliable measures of individual differences in early expressions of I- and D-type EC.

Key words: children; epistemic curiosity; I/D model; intellectual exploration; measurement

Epistemic curiosity (EC) is the desire for new information that motivates knowledge acquisition and exploratory behaviour (Berlyne, 1954). EC can stimulate positive feelings of intellectual *interest* associated with the anticipation of learning new knowledge (I-type) or reduce unpleasant experiences of uncertainty, which are associated with feeling *deprived* of information (Berlyne, 1954; Litman, 2005). I-type EC is associated with novelty seeking behaviour and the intrinsic joy of new

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discoveries (Litman, 2008). D-type EC is associated with uncomfortable feelings of perplexity or frustration due to having an incomplete understanding of something or lacking the solution to a specific problem (Litman, 2008; Litman, Crowson, & Kolinski, 2010). I-type EC motivates one to alternate between a diverse selection of novel sources of intellectual stimulation, whereas D-type EC motivates persistent and detailed examination aimed at finding answers to resolve specific unknowns (Litman, 2005; Litman & Mussel, 2013; Mussel, Spengler, Litman, & Schuler, 2012). In academic settings, I- and D-type EC are empirically found to correspond to different types of learning goals (Elliot & Church, 1997; Elliot, McGregor, & Gable, 1999). Both I-type and D-type EC are associated with setting mastery-oriented learning goals (i.e., goals that involve expending energy in order to discover and enjoy new intrinsic interests). However, D-type EC is more strongly and uniquely associated with setting performance-approach oriented learning goals (i.e., extrinsically motivated learning goals associated with effort and persistence) for which the accuracy and relevance of newly acquired knowledge is critical (Litman, 2008; Richards, Litman, & Roberts, 2013).

While the exact origin and developmental course of EC is unclear, the degree to which each type of curiosity is experienced and behaviorally expressed is theorized to vary according to individual differences in relatively stable I- and D- type EC personality traits (Litman, Collins, & Spielberger, 2005). The relevant dispositional tendencies of EC are theorized to begin to manifest in early childhood (Berlyne & Frommer, 1966; Minuchin, 1971; Mittman & Terrell, 1964). Among adults, individual differences in trait I- and D-type EC are assessed using the I/D scales—two 5-item self-report instruments designed to measure levels of the experience and expression of each kind of EC (Litman, 2008). The English versions of these scales have been shown to be reliable and valid indicators of I- and D-type EC (Koo & Choi, 2010; Litman, 2008; Litman et al., 2010), as have translations of the scales in Chinese (Huang, Zhou, Wang, & Zhang, 2010) and German (Litman & Mussel, 2013). However, one major limitation of the existing I/D scales is that they were designed to measure individual differences in the experience and expression of EC exclusively in adults. The content of the items as well as the self-report nature of the scales makes them inappropriate for assessing EC in young children. Consequently, little is known about the levels of these emotional–motivational tendencies earlier in the life span, as presently there is no clear way to reliably and validly track their development.

In order to learn more about these tendencies and their development, researchers require specialized assessment tools for measuring the indicators of early expressions of I- and D-type EC. Such tools should be developed on the basis of a sophisticated understanding of the intellectual development of children during the first few years of life as well as an understanding of the nature, experience and expression of I- and D-type EC. While there are several existing tools that assess expressions of curiosity in children (e.g., Penny & McCann, 1964), no measures have been developed with the expressed purpose of measuring the I- and D-type factors of EC. The aim of this study was to develop and validate a parent-report scale that assesses early expressions of I- and D-type EC in young children.

Development of the I/D-Young Children (I/D-YC) Scales

To develop scales for measuring individual differences in I- and D-type curiosity for young children (I/D-YC), we began by considering past theoretical and empirical work on EC and on early expressions of intellectual exploration in

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young children (Berlyne & Frommer, 1966; Courage, Reynolds, & Richards, 2006; Henderson & Moore, 1979; Keller, Schölmerich, Miranda, & Gauda, 1987; Keller, 1994; Kreitler, Zigler, & Kreitler, 1975; Lansink, Mintz, & Richards, 2000; Maw & Maw, 1966; Minuchin, 1971; Moch, 1987; Penny & McCann, 1964; Penny, 1965). Building on our familiarity with these literatures, we evaluated the content of the items of the existing I- and D-type scales (Litman, 2008) to identify candidates for adaptation, as well as constructed a number of new items for potential inclusion in an I/D-YC item pool.

Adaptations and new items were necessary for three major reasons. First, the existing scale items have limited content validity for young children because the items often refer to expressions of EC that young children will be unlikely to have yet experienced, such as being kept awake all night 'thinking about solutions' to matters self-identified as 'difficult conceptual problems' or taking pleasure in the discussion of 'abstract concepts' with others. Second, the existing scales were designed specifically for self-report rather than the observational reports of parents. Third, the items of the current scale do not explicitly refer to behavioural expressions of I-type (e.g., 'novelty seeking') and D-type (e.g., 'persistent problem solving') EC that are reflective of early forms of intellectual exploration. Building on our knowledge of EC and of early forms of intellectual exploration, we reasoned that expressions of I-type EC may include alternating between novel sources of stimulation, delight in encountering new things or people, and a preference for novelty over making a detailed examination of familiar things. We reasoned that expressions of D-type EC in young children may include focused and sustained attention to and detailed inspection of sources of intellectual stimulation, such as toys or the behaviours of others, or being bothered when something is detected as missing.

Validation of the I/D-YC Scales

To assess the construct validity of the I/D-YC scales, we examined the relationships between scores on each of the I/D scales and scores on four measures of constructs that are relevant to different aspects of early children's intellectual exploration and engagement, namely sensation seeking, shyness, inhibitory control and hyperactivity-inattention. Sensation seeking (SS) is a trait defined by the seeking of varied, novel and complex sensations and experiences (Zuckerman, 2006). Although in adults the relationships between SS and EC is generally weak (Collins, Litman, & Spielberger, 2004; Litman & Spielberger, 2003; Litman et al., 2005; Reio, Petrosko, Wiswell, & Thongsukmag, 2006; Spielberger & Starr, 1994), in children, tendencies to engage in novelty seeking aimed at new sensory experiences may have greater overlap with tendencies to seek out new information for purposes of gaining knowledge (Keller et al., 1987; Kreitler et al., 1975). Given the theoretical connection between SS and novelty seeking, we hypothesized early childhood SS would correlate positively with I-type EC but be either unrelated or only weakly positively related to D-type EC.

Shyness in young children manifests in feelings of distress and withdrawal in the presence of other people and corresponds to lower levels of extraversion and novelty seeking behaviour (Crozier & Birdsey, 2003). Therefore, we hypothesized that scores on the shyness scale would correlate negatively with I-type EC but be either unrelated or very weakly positively related to D-type EC.

Inhibitory control reflects the ability of a child to suppress an explicit or implicit inappropriate response (Enticott, Ogloff, & Bradshaw, 2006). The impulsiveness,

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inattentiveness and overactivity that characterize attention deficit-hyperactivity disorder have been attributed to deficits in inhibitory control (Schacher, Tannock, Marriott, & Logan, 1995). Relatedly, hyperactivity-inattention is characterized by the inability to focus deliberate, conscious attention when completing a task as well as excessive physical movement or restlessness (Goodman, 1997). Given that expressions of D-type curiosity involve engaging significant focus, persistence and cognitive effort to obtain new knowledge, we hypothesized that inhibitory control deficits and hyperactivity-inattention would correlate negatively with D-type EC but be unrelated to I-type EC.

METHOD

Sample

After receiving approval from the sponsoring institution's Institutional Review Board, a large research institute collected the data. Parents were recruited through an online panel that is representative of the Netherlands. This panel has approximately 60,000 individuals who have indicated they are willing to complete questionnaires over the internet for the research institute. Inclusion in the panel is done via random sampling. In May 2012, parents with a child between the ages of 3 and 8 years old were invited to participate in an online survey. As with other traits, we expect that EC will begin to manifest itself around 18–24 months. Given the likely variation in EC onset, combined with other research which has shown that traits are more stable after age 3 (Lewis, 2001), we felt that assessing EC beginning at 3 years of age was appropriate. The upper end of the age range (age 8) was selected because there is an ongoing effort to develop a self-report scale of I- and D-type EC with preadolescent and adolescent children, and self-report measurement is more appropriate with older children. A total of 316 parents completed the online survey (58% mothers). The average age for children in this sample was 5.30 years (SD = 1.44) with slightly more boys than girls (54.7% boys).

Measures

I/D-YC item pool

An initial pool of twenty items (10 I-type, 10 D-type) was developed in English and then translated into Dutch. Translation required several steps. First, two native Dutch speakers, also fluent in English, independently translated all items. A third native Dutch bilingual speaker then merged these translations, resolving any differences in translation. A fourth native Dutch speaker back-translated the items into English. Finally, these back translations were compared to the original versions for equivalency and revised as needed. This translation process ran through several iterations until each item was determined to be an accurate translation of the original.

The face and content validity of our twenty newly developed I/D-YC items were evaluated by colleagues with knowledge in the areas of EC, child development and parent research to ensure that all items were theoretically consistent, developmentally appropriate and reflected behaviours that would be observable by parents. Items that were identified as unclear or problematic for parent-report were either discarded or rewritten, resulting in sixteen items for evaluation. These sixteen items were administered to parents. Parents were asked to indicate how

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frequently their child expresses the characteristics or behaviours described, using the response categories: (1) almost never, (2) sometimes, (3) often and (4) almost always.

Sensation seeking

A five-item measure of sensation seeking was administered to parents. This scale is based upon an existing scale that has been used with children between 6 and 7 years old (Trice, 2010). Items were altered to ensure they were appropriate for parent-report and that they reflected behaviours for a broader age of children (e.g., '*child name* … likes to go as fast as possible, for example, on a bike.'). Response categories were (1) completely not true, (2) not true, (3) a little not true / a little true, (4) true and (5) completely true.

Shyness

The six-item measure of shyness (e.g., 'My child is sometimes shy even around people s/he has known a long time') from the short form of the Children's Behavior Questionnaire (CBQ) was administered to parents (Putnam & Rothbart, 2006). These items were available in a validated Dutch translation of the CBQ (Majdandzic & van den Boom, 2007). Response categories were (1) completely not true, (2) not true, (3) a little not true/a little true, (4) true and (5) completely true.

Inhibitory control

The ten-item measure of inhibitory control (e.g., 'My child loses control more easily than peers') from the Behavior Rating Inventory of Executive Function (BRIEF) was administered to parents (Gioia, Isquith, Guy, & Kenworthy, 2000). These items were available in a validated Dutch translation of the BRIEF (Smidts & Huizinga, 2009). Responses categories were (1) never, (2) sometimes and (3) always. Higher scores indicate greater deficits in inhibitory control.

Hyperactivity-inattention

The five-item measure of hyperactivity-inattention (e.g., 'My child is easily distracted and has trouble staying focused') from the Strengths and Difficulties Questionnaire (SDQ) was administered to parents (Goodman, 1997). These items were available in a validated Dutch translation of the SDQ (van Widenfelt, Goedhart, Treffers, & Goodman, 2003). Response categories were (0) not true, (1) somewhat true and (2) completely true.

RESULTS

Confirmatory Factor Analysis

In keeping with the data analytic procedures of previous research on the I/D EC model (Litman, 2008), and to facilitate comparability between previous research findings and those of the present study, confirmatory factor analyses using maximum likelihood estimation were conducted to assess the factor structure of the I/D-YC items, with the aim of developing two brief I- and D-type scales that were similar in composition to the existing I/D measures developed for adults. Several goodness of fit (GOF) indices were examined including chi square, comparative fit index (CFI) and root mean square error of approximation (RMSEA).

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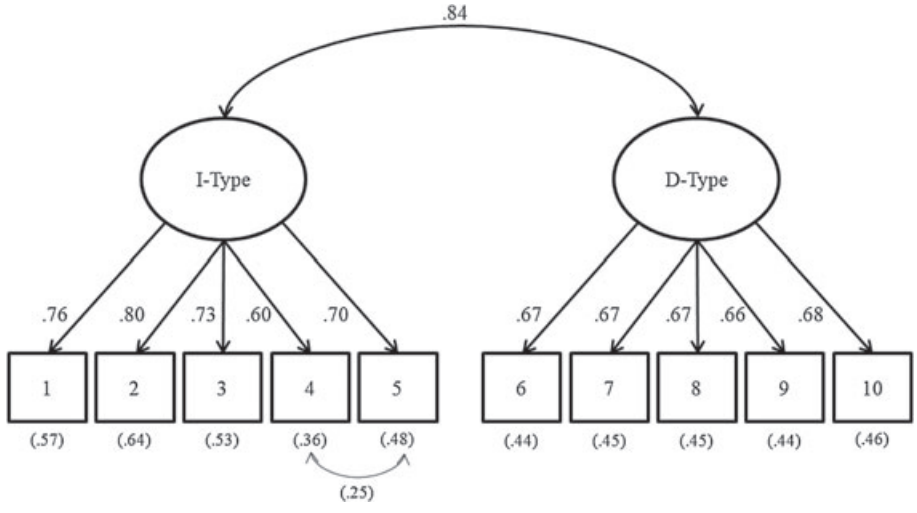
Although a non-significant chi square is desirable, smaller values still indicate superior fit when significant (James, Mulaik, & Brett, 1982). CFI values between .90 and .95 and/or RMSEA values between .05 and .08 indicate acceptable model fit, and CFI values larger than .95 and/or RMSEA values smaller than .05 indicate good model fit (Kline, 2005). To compare the predicted 2-factor model with a one-factor model, the expected cross-validation index (ECVI) was used. For ECVI, lower values indicate superior fit (Hatcher, 1994). There were no missing data.

First, on the basis of low item-test correlations (<.30), two items (one I-type and one D-type) were omitted from further analyses (Comrey, 1988). Responses to the remaining 14 items were submitted to confirmatory factor analysis. Inspection of the



I-Type Items	D-Type Items
1. My child has fun learning about new topics or subjects.	6. When presented with a tough problem, my child focuses all of his/her attention on how to solve it.
2. My child is attracted to new things in his/her environment.	7. My child devotes considerable effort trying to figure out things that are confusing or unclear.
3. My child enjoys talking about topics that are new to him /her.	8. My child is bothered when he/she does not understand something, and tries hard to make sense of it.
4. My child shows visible enjoyment when discovering something new.	9. My child will work for a long time to solve a problem because he/she wants to know the answer.
5. When my child is learning something new, he/she asks many questions about it.	10. My child carefully examines things by turning them around or looking at them from all sides.

Figure 1. Confirmatory Factor Analysis for the I/D-YC.

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Table 1. Means, standard deviations and reliability indices for I-type and D-type scales and construct validity scales

	M (SD)	α
I-type scale	3.18 (.56)	.85
D-type scale	2.58 (.61)	.80
Sensation seeking	2.54 (.74)	.73
Shyness	2.50 (.81)	.83
Inhibitory control	1.60 (.37)	.86
Hyperactivity-inattention	.67 (.51)	.80

SD, standard deviation.

Table 2. Pearson zero-order and partial correlations between I-type and D-type scales and validation constructs

I-type			D-type		
	r	Partial *r*		*r*	Partial *r*
Sensation seeking	.13*	.00	Sensation seeking	.18*	.13*
Shyness	−.33*	−.30*	Shyness	−.16*	.10
Inhibitory control	−.10	.07	Inhibitory control	−.21*	−.20*
Hyperactivity-inattention	−.09	.08	Hyperactivity-inattention	−.21*	−.21*

Each partial correlation between the I-type scale and a given construct validity measure controls for D-type scores; the partial correlations between the D-type scale and the validity measures control for I-type scores.
*$p < .05$

factor loadings, standardized residual covariance matrix, modification indices and chi square difference tests suggested that four additional items be removed[1]. This resulted in a 10-item 2-factor model. This 2-factor model resulted in acceptable fit, χ^2 (DF = 33, N = 316) = 82.75, $p < .001$, CFI = .96, RMSEA = .07, ECVI = .40. A 1-factor model resulted in poor fit, χ^2 (DF = 35, N = 316) = 148.95, $p < .001$, CFI = .91, RMSEA = .10, ECVI = .60. The 2-factor model had a lower ECVI, indicative of better fit. Estimates for the inter-factor correlation, factor loadings and error path coefficients for the 10-item 2-factor model are presented in Figure 1. As with the existing self-report measure of I- and D-type EC (Litman, 2008), the two I/D-YC factors were highly correlated ($r = .84$); all factor loadings were strong and significant, ranging from .60 to .80.

Construct Validity

Means, standard deviations and internal consistency statistics are reported in Table 1. The resulting I-type scale and D-type scale demonstrated acceptable internal consistency. No significant relationships with age or differences by gender were found for either scale. Pearson correlations between the I- and D-type scales and the measures of sensation seeking, shyness, inhibitory control and hyperactivity-inattention are reported in Table 2. In the table, partial correlations between I-type EC and a given construct validity measure reflect the statistical controlling of D-type EC scores while the partial correlations between D-type EC and the validity measures reflect controlling for I-type EC. By partialing out the overlapping variance between the I- and D-type measures, the unique relationship

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between each scale and the other measures is revealed, and the nature of the differences between the two curiosity types is clarified (Litman, 2008; Litman et al., 2010; Litman & Mussel, 2013).

Zero-order correlations indicated a small but significant positive relationship between sensation seeking and both I- and D-type EC. While we expected that the relationship would be more pronounced between I-type EC and sensation seeking, partial correlations indicate that the relationship with I-type EC is due primarily to overlap with the D-type EC scale. Scores for both scales were significantly negatively related to shyness according to the zero-order correlations. Consistent with our hypotheses, partial correlations revealed that the relationship was due primarily to overlap with I-type EC and that shyness was unrelated to D-type EC. Lastly, as hypothesized, both the zero-order and partial correlations indicated that inhibitory control deficits and hyperactivity-inattention were negatively associated with D-type EC and uncorrelated with I-type EC.

DISCUSSION

The aim of this study was to develop and validate a new measure of I- and D- type EC constructs in young children (I/D-YC). Given that existing measures have been developed exclusively for adults (Litman, 2008), the development of the I/D-YC scales represents an important contribution to the literature. In developing the I/D-YC scales, it was important to ensure they were theoretically informed, demonstrated content validity and were appropriate for parental report. To meet these goals, we adapted items from the original I/D scales (Litman, 2008) as well as developed a new pool of items. These items were tested with parents of young children aged 3–8 years old. Confirmatory factor analysis resulted in a 10-item I/D-YC measure, consisting of a 5-item I-type scale and a 5-item D-type scale.

Validation analyses indicated that the I/D-YC scales had acceptable psychometric properties. Cronbach's alpha for both I- and D-type scales indicated that both scales were internally consistent. Construct validity data for the I/D-YC scales were also satisfactory. Partial correlations indicated that I- and D-type EC are distinguishable from one another. Children with greater I-type EC were less likely to exhibit shyness while children with greater D-type EC demonstrated improved inhibitory control and less hyperactivity-inattention. Somewhat unexpectedly, a weak positive association between D-type EC and sensation seeking was found, whereas I-type EC, on the other hand, was unassociated with sensation seeking. Based on previous research as well as our theoretical understanding of the relevant constructs, we expected essentially the opposite outcome. It is likely that the lack of association between I-type EC and sensation seeking reflects the particular items that were used to measure sensation seeking. While measures of sensation seeking that are typically used with adults (e.g., Zuckerman, 2006) include many items that describe a preference for novel or adventurous experiences across a range of intensity, the parent-report version used here focused mainly upon thrilling and potentially frightening experiences (e.g., going fast on a bicycle; enjoying scary things like spiders and monsters). An attraction to the emotional thrills stimulated by these kinds of sensory-perceptual experiences, and the pleasure associated with their subsequent reduction, may share some developmental overlap in early childhood with experiences of intellectual tension in the face of uncertainty and the rewarding reduction of that tension when new knowledge is gathered, which are processes associated with D-type curiosity (Litman et al., 2005).

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There are several important goals for future research with the I/D-YC scales. Most notably, it is important to replicate these findings in a different sample, to further evaluate the reliability and validity of the newly developed I/D-YC scales and to provide additional empirical evidence to support the argument that EC reflects a personality trait. In keeping with these goals, we are currently conducting a longitudinal study of the development of I/D-YC in a new sample of young children, which will enable us to further assess the reliability and predictive validity of the new measure (e.g., predicting attentional skills, cognitive ability and creativity) as well as potentially provide a wealth of new information for researchers interested in studying early expressions of intellectual inquisitiveness and their development over time. In order to bolster the argument that EC reflects a personality trait, future research should also examine the divergence and convergence of EC with constructs such as motivational orientation and temperament. Lastly, research on ways to assess the emergence of I- and D-type EC in children younger than 3 years old, as well as research testing the suitability of these scales for children older than 8 years old, would be a worthwhile next step.

CONCLUSION

Researchers agree that there are individual differences in young children's EC (Berlyne, 1954; Berlyne & Frommer, 1966); however, no measures have been developed to assess the individual differences in the development of I- and D-type EC in early childhood. This study addresses this gap with the development of valid and reliable I/D-YC scales. Given the relatively short length of the scales combined with their ease of administration, we hope that researchers interested in young children's intellectual exploration will find these scales to be a useful set of assessment tools to facilitate their research.

We encourage researchers to investigate the extent to which I- and D-type EC differentially predicts the depth and scope of children's cognitive processing and related cognitive skills, as well as their intrinsic and extrinsic academic motivations, building on studies of the relationships between I- and D-type EC and these factors in adults (e.g., Litman, 2008; Richards et al., 2013). In particular, it will be interesting to unpack the relationship between EC and goal orientation. Earlier on, we noted that research indicates that D-type EC is more strongly associated with performance-approach oriented learning goals. Performance-oriented children frequently attempt to avoid failure and the unfavourable judgments that may accompany this failure. From the perspective of D-type curiosity, it may not be that children are trying to avoid failure per se but rather are driven by a strong desire to solve information gaps by obtaining objectively accurate and relevant knowledge. This expression of D-type EC is distinct from that of the I-type variant which (in adults) appears to orient individuals more towards information expected to stimulate pleasure but may not have the practical ability to solve a problem or improve one's comprehension of something complex. A more careful investigation of I- and D-type EC in conjunction with academic behaviours may provide a more nuanced explanation of these behaviours than goal orientation offers. Similarly, it will be important to examine relationships between the development of I- and D-type EC in children and their ability to identify and attempt to resolve discrepancies in their knowledge (Litman et al., 2005). And lastly, in order to better understand the development and expression of trait I- and D-type EC in children, it will be important to examine the relationships between scores

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on the I/D-YC scales and measures of childhood temperament, particularly as it pertains to aspects of temperament that involve the regulation of attention, behavioural approach, persistence and positive versus negative affect (Rothbart, 1981; Rothbart & Bates, 2006), all of which may be critical to the experience of EC and the expression of information seeking behaviour in young children.

Note

1. Because of space constraints, we only present information on the final set of 10 items. For readers interested in a complete listing of all tested items, as well as factor loadings and other relevant psychometric data, a report can be found online at www.ccam-ascor.nl.

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REFERENCES

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45*, 180–191. doi:10.1111/j.2044-8295.1954.tb01243.x

Berlyne, D. E., & Frommer, F. D. (1966). Some determinants of the incidence and content of children's questions. *Child Development*, *37*(1), 177–189. doi:10.2307/1126438

Collins, R. P., Litman, J. A., & Spielberger, C. D. (2004). The measurement of perceptual curiosity. *Personality and Individual Differences*, *36*(5), 1127–1141. doi:10.1016/S0191-8869(03)00205-8

Comrey, A. L. (1988). Factor-analytic methods of scale development in personality and clinical psychology. *Journal of Consulting and Clinical Psychology, 56*, 754–761. doi:10.1037/0022-006X.56.5.754

Courage, M. L., Reynolds, G. D., & Richards, J. E. (2006). Infants' attention to patterned stimuli: Developmental change from 3 to 12 months of age. *Child Development*, *77*(3), 680–695. doi:10.1111/j.1467-8624.2006.00897.x

Crozier, R. W., & Birdsey, N. (2003). Shyness, sensation seeking and birth-order position. *Personality and Individual Differences*, *35*(1), 127–134. doi:10.1016/S0191-8869(02)00146-0

Elliot, A. J., & Church, M. A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology, 72*, 218–232. doi:10.1037/0022-3514.72.1.218

Elliot, A. J., McGregor, H. A., & Gable, S. (1999). Achievement goals, study strategies, and exam performance: A mediational analysis. *Journal of Educational Psychology, 91*(3), 549–563. doi:10.1037/0022-0663.91.3.549

Enticott, P. G., Ogloff, J. R. P., & Bradshaw, J. L. (2006). Associations between laboratory measures of executive inhibitory control and self-reported impulsivity. *Personality and Individual Differences*, *41*, 285–294. doi:10.1016/j.paid.2006.01.011

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). Behavior rating inventory of executive function (BRIEF): Professional manual. Lutz, FL: Psychological Assessment Resources.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, *38*, 581–586. doi:10.1111/j.1469-7610.1997.tb01545.x

Hatcher, L. (1994). A step-by-step approach to using the SAS system for factor analysis and structural equation modeling. Cary, NC: SAS Institute.
Henderson, B., & Moore, S. G. (1979). Measuring exploratory behavior in young children: A factor-analytic study. *Developmental Psychology, 15*(2), 113–119. doi:10.1037/0012-1649.15.2.113
Huang, D., Zhou, M., Wang, L., & Zhang, J. (2010). Gender difference in motives of knowledge searching: Measurement invariance and factor mean comparison of the interest/deprivation epistemic curiosity. *2010 IEEE 2nd Symposium on Web Society Conference Proceedings*, Beijing, China. 258–263. doi:10.1109/SWS.2010.5607444
James, L. R., Mulaik, S. A., & Brett, J. M. (1982). Causal analysis: Assumptions, models, and data. Beverly Hills, CA: Sage.
Keller, H. (1994). A developmental analysis of exploration styles. In H. Keller, K. Schneider & B. Henderson (Eds.), Curiosity and exploration (pp. 199–212). Germany: Springer Berlin Heidelberg. doi:10.1007/978-3-642-77132-3_11
Keller, H., Schölmerich, A., Miranda, D., & Gauda, G. (1987). The development of exploratory behavior in the first four years of life. In D. Görlitz, & J. F. Wohlwill (Eds.), Curiosity, imagination, and play: On the development of spontaneous cognitive and motivational processes (pp. 126–150) Hillsdale, NJ.
Kline, R. B. (2005). Principles and practice of structural equation modeling (2nd ed.). New York, NY: The Guilford Press.
Koo, D., & Choi, Y. (2010). Knowledge search and people with high epistemic curiosity. *Computers in Human Behavior, 26*(1), 12–22. doi:10.1016/j.chb.2009.08.013
Kreitler, S., Zigler, E., & Kreitler, H. (1975). The nature of curiosity in children. *Journal of School Psychology, 13*(3), 185–200. doi:10.1016/0022-4405(75)90002-3
Lansink, J. M., Mintz, S., & Richards, J. E. (2000). The distribution of infant attention during object examination. *Developmental Science*, *3*, 163–170. doi:10.1111/1467-7687.00109
Lewis, M. (2001). Issues in the study of personality development. *Psychological Inquiry, 12*, 67–83. doi:10.1207/S15327965PLI1202_02
Litman, J. A. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition & Emotion*, *19*(6), 793–814. doi:10.1080/02699930 541000101
Litman, J. A. (2008). Interest and deprivation factors of epistemic curiosity. *Personality and Individual Differences*, *44*(7), 1585–1595. doi:10.1016/j.paid.2008.01.014
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*(2), 59–68. doi:10.1027/1614-0001/a000100
Litman, J. A., & Spielberger, C. D. (2003). Measuring epistemic curiosity and its diversive and specific components. *Journal of Personality Assessment*, *80*(1), 75–86. doi:10.1207/s15327752jpa8001_16
Litman, J. A., Collins, R. P., & Spielberger, C. D. (2005). The nature and measurement of sensory curiosity. *Personality and Individual Differences*, *39*(6), 1123–1133. doi:10.1016/j.paid.2005.05.001
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*(5), 531–536. doi:10.1016/j.paid.2010.05.021
Majdandzic, M., & van den Boom, D. C. (2007). Multimethod longitudinal assessment of temperament in early childhood. *Journal of Personality, 75*, 121–168. doi:10.1111/j.1467-6494.2006.00435.x
Maw, W. H., & Maw, E. W. (1966). Children's curiosity and parental attitudes. *Journal of Marriage and Family, 28*(3), 343–345.
Minuchin, P. (1971). Correlates of curiosity and exploratory behavior in preschool disadvantaged children. *Child Development*, *42*(3), 939–950.
Mittman, L. R., & Terrell, G. (1964). An experimental study of curiosity in children. *Child Development*, *35*(3), 851–855.
Moch, M. (1987). Asking questions: An expression of epistemological curiosity in children. In D. Görlitz, & J. F. Wohlwill (Eds.), Curiosity, imagination, and play (pp. 198–211). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Mussel, P., Spengler, M., Litman, J. A., & Schuler, H. (2012). Development and validation of the German work-related curiosity scale. *European Journal of Psychological Assessment*, *28*(2), 109–117. doi:10.1027/1015-5759/a000098

Penny, R. K. (1965). Reactive curiosity and manifest anxiety in children. *Child Development*, *36*, 697–702.

Penny, R. K., & McCann, B. (1964). The children's reactivity curiosity scale. *Psychological Reports*, *15*, 323–334.

Putnam, S. P., & Rothbart, M. K. (2006). Development of short and very short forms of the children's behavior questionnaire. *Journal of Personality Assessment*, *87*(1), 103–113. doi:10.1207/s15327752jpa8701_09

Reio, T. G., Petrosko, J. M., Wiswell, A. K., & Thongsukmag, J. (2006). The measurement and conceptualization of curiosity. *The Journal of Genetic Psychology*, *167*(2), 117–135. doi:10.3200/GNTP.167.2.117-135

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.

Rothbart, M. K. (1981). Measurement of temperament in infancy. *Child Development*, *52*, 569–578.

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In Damon, W., & R. Lerner (Eds.), Handbook of child psychology (6th ed., pp. 99–166). New York: Wiley.

Schacher, R., Tannock, R., Marriott, M., & Logan, G. (1995). Deficient inhibitory control in attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology*, *23*(4), 411. doi:10.1007/BF01447206

Smidts, D., & Huizinga, M. (2009). BRIEF executieve functies gedragsvragenlijst: Handleiding. Amsterdam: Hogrefe Uitgevers.

Spielberger, C. D., & Starr, L. M. (1994). Curiosity and exploratory behavior. In H. F. O'Neil Jr, & M. Drillings (Eds.), Motivation: Theory and Research (pp. 221–243). New Jersey: Lawrence Erlbaum.

Trice, A. D. (2010). Sensation-seeking and video choice in second grade children. *Personality and Individual Differences*, *49*(8), 1007–1010. doi:10.1016/j.paid.2010.07.005

van Widenfelt, B. M., Goedhart, A. W., Treffers, P. D. A., & Goodman, R. (2003). Dutch version of the strengths and difficulties questionnaire (SDQ). *European Child & Adolescent Psychiatry*, *12*, 281–289. doi:10.1007/s00787-003-0341-3

Zuckerman, M. (2006). Biosocial bases of sensation seeking. In T. Canli (Ed.), Biology of personality and individual differences (pp. 37–59). New York: The Guildford Press.

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