

Measuring Parent Rated Interest and Deprivation type Curiosity in Swedish Young Children - are they meaningfully distinct?

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Abstract

Background: Proxy ratings of young children's curiosity has the potential to be useful for research in Sweden. One such proxy rating is the parent-rating Interest/Deprivation Young Children scale. This scale has previously only been validated in Dutch samples, where it differentiated curiosity dimensions of interest (joyful exploration) and deprivation (reduction of aversive feelings of not knowing).

Objective: The objective of this study was to investigate internal and construct validity of the Swedish version of the Interest/Deprivation Young Children scale.

Method: A translation of the Interest/Deprivation Young Children scale was conducted and then administered to 266 parents in Sweden, who rated their children (4-6-years old) on 10 items, with 5 items each for subscales of interest and deprivation dimensions of epistemic curiosity. Responses were analyzed using confirmatory factor analysis.

Results: Results indicate acceptable internal reliability for deprivation-curiosity items ($\alpha = 0.78$) and for interest-curiosity items ($\alpha = 0.79$). For the combined scale score alpha was found good ($\alpha = 0.84$). However, confirmatory factor analysis failed to differentiate interest and deprivation dimensions of curiosity.

Conclusions: Item revisions are suggested which could be implemented for further investigations. Also, the possibility of using the I/D-YC total score as a more general measure of child curiosity is argued for. An open question is how other dimensions of curiosity might be more viable for proxy ratings of child curiosity.

Keywords: Early Childhood, Curiosity; Interest/Deprivation-model; Construct-Validity; Parent-rating; Early Childhood Education

Introduction

Children's curiosity is important for many aspects of learning and reliable curiosity measures are needed for empirical investigations. Central for this article is the psychometric testing of the Swedish version of a proxy rating scale intended to capture young children's curiosity.

Curiosity, the desire for information in the absence of external rewards (1), has long been explored in different forms. Perhaps the most widely accepted dimensionalities of curiosity are perceptual (curiosity for sensory stimuli), and epistemic curiosity (curiosity for knowledge and facts) (2), as well as curiosity seen as a more enduring propensity (trait curiosity) (3), or as a result of the environment (state curiosity) (4). A more debated differentiation is whether curiosity should be characterized as a will to reduce uncertainty, or to seek uncertainty (5), echoing back to earlier views of curiosity as a drive to reduce (2) or

to uphold optimal levels of arousal (4,6,7). For instance, epistemic curiosity (EC), has been conceptualized as driven by the need to resolve specific information gaps and reduce aversive feelings of being deprived of specific information (8), but also as motivated by pleasant feelings associated with approaching uncertainty and seeking information as in joyful exploration and discovery (9). A model of trait EC, seeking to reconcile these different views, is the Interest/Deprivation model (I/D-model) proposed by Litman and Jimerson (13). The I/D-model posits that trait EC manifests in both experience, and expression in 1) Interest EC (I-type EC), driven by motivations of interest and positive feelings when openly searching and learning new information (10), and 2) Deprivation EC (D-type EC), driven by need-like motivations and the reduction of negative feelings when experiencing deprivation of specific knowledge (11).

Evidence for the differentiation of I- and D-type dimensions of EC have predominantly come from adult self-report studies, using items from the I-type Epistemic Curiosity scale (12), and the D-type Epistemic Curiosity as a Feeling of Deprivation scale (13). In initial studies, it was observed that these two scales had a high overlap (13,14), and a revised 10-item scale for measuring I- and D- factors that differentiated the most between I- and D-type factors were developed using items from ECS and the CFDS (10). This scale, albeit having high inter-factor correlations, has successfully differentiated between I- and D- type EC in student (10) and non-student adult samples (15), as well as cross-culturally, in a German sample (16). It has also indicated I- and D- type factors in a Chinese sample but required a modification to achieve fit for a two-factor solution (17).

Of central importance for this study is that Piotrowski, Litman, and Valkenburg (18), additionally provided evidence for I- and D-type EC factors among Dutch children too young for self-reports, by developing the parent rating Interest/Deprivation young children (I/D-YC) scale. But, to the best of my knowledge, no studies have yet tested the scale in other samples. As the I/D-YC has the potential to be a low-cost, up-scalable measure of Swedish children's EC, and the I/D-distinction could be of value in, for example, educational research, the present study sought to investigate the internal and construct validity of a Swedish version of the I/D-YC.

In the sections below, a brief summary of the development of the I/D-YC is provided, followed by the testing of the Swedish I/D-YC, concluded by a discussion both on item and theoretical levels, and suggestions for future research.

The Interest/Deprivation Young Children Scale

The I/D-YC (18) was originally developed using an initial item pool consisting of 20 items, constructed using past research on early behavioral expressions of EC, together with the I/D-model. The item pool was reduced to 16, by omitting problematic items not suitable for parent rating, and then further down to 14 after item-test considerations. The final 10 items were selected after reviewing factor loadings, modification indices, the standardized covariance residual matrix, and chi-square difference tests. Following reliability and confirmatory factor analysis of the 10-item version using 316 ratings from Dutch parents, indicated that both scales had acceptable alphas, ranging between .80 - .85, and acceptable goodness-of-fit indices for I- and D- factors, but needed a modification to achieve this (18).

Method

Sample

The sample consisted of 138 girls and 128 boys (n=266), who were rated by their parents. The children were between 4-6 years old (M= 64.12 months, SD = 6.85 months) and had started preschool at 28 months on average. Recruitment was done via the inclusion in waves two and three in a pre-registered RCT study (19). The children were enrolled in 17 different units within 11 separate preschools, where a unit consisted of 7 to 30 children. As inclusion criteria, children needed to be at least four years of age and a unit had to have at least seven children.

Parents filled in the I/D-YC at home and the response rate was high (94%). The demographic profile of the parents was somewhat skewed toward middle and higher socioeconomic groups, and the vast majority lived in two-parent households. Moreover, 35% of households were multilingual with English, Spanish, Arabic, Kurdish, and Polish being the most common language apart from Swedish. Parents also filled in other questionnaires in addition to the Swedish version of the I/D-YC. The forms were delivered to the parents in sealed envelopes and returned anonymously by them in prepaid envelopes to the university.

Data screening

Missing data consisted of 18 unrated items. Two outliers outside the 1.5 interquartile range consisting of low I-type curiosity, were identified and omitted from further analysis. Additionally, an analysis of straight-lining responses using guidelines from Meade and Craig (20), indicated 5 outliers with 10 identical answers in a row which were removed.

Measures

A translated version of the I/D-YC was used. The original and translated items are listed in table 1. The translation process followed guidelines from Guillemín, Bombardier, and Beaton (21). Forward translations were first conducted by two translators and synthesized. This was then back-translated, and reviewed by a committee that compared it to the original items. This led to a new iteration of the translation process, rendering sufficient agreement between original and back-translated items. Forward translations were conducted by a Ph.D. student associated with the Department of Linguistics, Stockholm University, and by the first author who also performed the synthesis of the translations. Both back-translations were conducted by independent native speakers of English who also were skilled Swedish speakers. The review committee consisted of two linguistic researchers, one psychologist from the Department of Child and Youth studies, and the

author. Pre-testing revealed some comprehension problems, leading to minor additional revisions. Pre-testing also led to adding a Likert scale step due to skewing indications in the I-factor.

The final version of the translated I/D-YC consisted of 10-items with 5-items for I- and D-type

subscales. Likert ratings were between 1-5, where (1) "Almost never", (2) "Sometimes", (3) "Often", (4) "Almost always", and (5) "Always". Summing of the individual item scores yielded subscale scores for I-type and D-type EC. None of the items were reversed in keeping with the original scale.

TABLE 1. Original and translated I/D-YC items

Item	Swedish translation	English translation
Q1	Mitt barn har roligt när hen lär sig om nya teman, ämnen och saker.	My child has fun learning about new topics and subjects
Q3	Mitt barn lockas av och är intresserat av nya saker och föremål i hens miljö.	My child enjoys talking about topics that are new to him/her
Q5	Mitt barn tycker om att prata om sådana ämnen som är helt nya för hen	My child enjoys talking about topics that are new to him/her
Q7	Mitt barn visar tydlig uppskattning och glädje när hen upptäcker något nytt	My child shows visible enjoyment when discovering something new
Q9	När mitt barn lär sig något nytt ställer hen många frågor om det	When my child is learning something new, he/she asks many questions about it
Q2	När mitt barn får ett svårt problem, fokuserar mitt barn all sin uppmärksamhet på hur hen kan lösa problemet	When presented with a tough problem my child focuses all of his/her attention on how to solve it
Q4	Mitt barn lägger betydande energi på att förstå saker som är förvirrande eller oklara	My child devotes considerable effort trying to figure out things that are confusing or unclear
Q6	Mitt barn blir besvärat när hen inte förstår något och försöker då intensivt att göra det begripligt och förståeligt	My child is bothered when he/she does not understand something, and tries hard to make sense of it
Q8	Mitt barn kommer att arbeta länge för att lösa ett problem därför att hen vill veta svaret	My child will work for a long time to solve a problem because he/she wants to know the answer
Q10	Mitt barn tittar noga på saker och undersöker dem genom att vrida och vända på dem och titta på dem från olika håll.	My child carefully examines thing by turning them around or looking at them from all sides

Blue section = I-type EC. White section = D-type EC. Item numbers reflects orders as administered in the parent rating

Statistical methods

Statistical analyses were conducted using R (22), with libraries lavaan (23), and psych (24). Descriptive measures included means, standard deviations, and skewness. Reliability measures included Cronbach's alphas, mean inter-item correlations, and corrected item-total correlations. Thresholds for alphas and mean inter-item correlations followed guidelines from Clark & Watson (25), where $\alpha \geq 0.8$ is acceptable, and mean inter-item correlations should fall between 0.15-0.50. Thresholds for corrected item-total correlations followed Hair et al (26), with values over 0.5 indicating good reliability.

A confirmatory factor analysis (CFA), was conducted. This analysis used diagonally weighted least squares as the estimator due to the initial screenings of response frequencies indicating non-normality in I-type EC, and that simulation studies suggest that diagonally weighted least squares have sufficient robustness of estimates when data are ordinal and skewed (27). Note that, although polychoric correlations were chosen for the item correlation matrix due to ordinality and skewness, reliability indices are reported using Pearson correlations due to ease of interpretation and because

ordinal reliability indices could be more hypothetical (28). Several goodness of fit indices and corresponding thresholds were calculated, including chi-square (χ^2), comparative fit index (CFI), root mean square error (RMSEA), Tucker Lewis index (TLI), the standardized root mean square residual (SRMR), as well as the expected cross-validation index (ECVI). Non-significant chi-square values are desirable, but large sample sizes often influence chi-square to reject the model (29). The comparative fit index (CFI), and Tucker Lewis index (TLI), indicate good fit with values above 0.95 (30). The root mean square error (RMSEA) has been suggested to show an acceptable fit below 0.08 (31), or more conservatively below 0.06 (30). The standardized root mean residual (SRMR), indicates good fit if values are below 0.08 (30), or below 0.05 if using more conservative thresholds (32,33). The expected cross-validation index (ECVI), becomes useful when comparing nested models, where better fit is indicated with lower values (34).

Results

Means, standard deviations, alpha coefficients with 95% confidence intervals, mean inter-item

correlations, corrected item-total correlations, and polychoric correlations between items are reported in table 2. Frequencies for subscale scores are reported in Figure 1. The results are reported for the total sample as there were significant albeit small differences between sexes (boys = 19.9, girls = 20.8) in I-type curiosity, $t(252.82) = -2.3, p = .022$, with no difference in D-type curiosity, $t(262) = .14, p = .9$. SES did not significantly predict any I/D-YC subscale scores. Means were higher in I-type than D-type indicating negative skewness (-0.75).

Cronbach's alphas for both subscales were borderline acceptable with 95% CI [0.74-0.83]. The mean inter-item correlations and corrected item-total correlations were for both scales acceptable with 95% CI [0.42-0.43], and [0.638-0.646] respectively. For the total score (summed subscale scores), alpha was found to be good with 95% CI [0.81-0.87].

When investigating the item-correlation matrix, within subscale item correlations were in general of high magnitude. However, correlations with the same magnitude were also found between items from the two subscales as seen in the correlation matrix below.

TABLE 2. Means, Standard Deviations, Internal Consistency Reliability Indexes based on Pearson correlations, and Polychoric Correlations Among Curiosity Items

Sub Scale	M	SD	α	95% CI α	M Inter Item r	M CIT	Q1	Q3	Q5	Q7	Q9	Q2	Q4	Q6	Q8	Q10	
I-type	20.35	3.30	0.77	0.73-0.82	0.41	0.65	Q1	1									
							Q3	0.55	1								
							Q5	0.43	0.49	1							
							Q7	0.53	0.56	0.44	1						
							Q9	0.36	0.47	0.66	0.49	1					
D-type	15.83	3.93	0.76	0.71-0.81	0.39	0.64	Q2	0.36	0.43	0.45	0.35	0.32	1				
							Q4	0.35	0.44	0.56	0.43	0.41	0.50	1			
							Q6	0.22	0.21	0.36	0.18	0.34	0.35	0.46	1		
							Q8	0.31	0.28	0.52	0.34	0.52	0.59	0.49	0.47	1	
							Q10	0.24	0.38	0.43	0.41	0.56	0.37	0.36	0.34	0.50	1
Total	36.15	6.32	0.85	0.82-0.87	0.36	0.55											

N=253 for the I/D-YC. M = mean score, SD = standard deviation, 95% CI = 95% confidence interval, M CIT = mean corrected item-total correlation. Total = summed subscale scores.

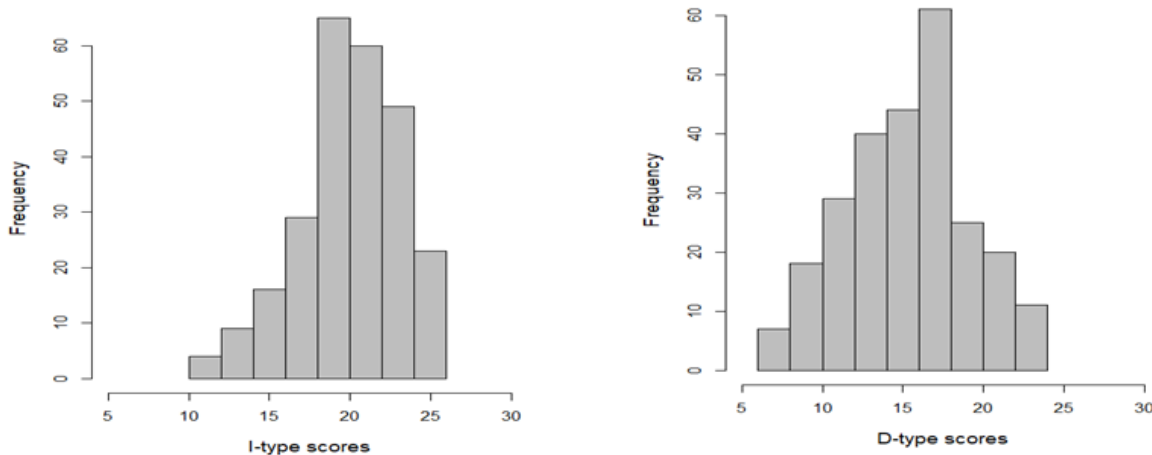


FIGURE 1. I- and D-type scale score frequencies

Confirmatory Factor analysis

Results of the CFA are reported in table 3. The CFA's in this study tested the fitness toward four models: 1) a one-factor solution 2) a two-factor solution without any model modifications, 3) a two-factor solution containing original modifications in keeping with the original Piotrowski et.al (2014)

study, and 4) a two-factor solution containing modifications as indicated by our analysis.

Poor fit was revealed for the one-factor solution, with $\chi^2 = 168 (P < 0,01, df=35, N=258)$, RMSEA = 0.122, CFI = 0.931, TLI=0.911, SRMR= 0.076 and with an ECVI = 0.79. When testing a 2-factor solution without modifications, poor fit was revealed, and only marginally improving ($\chi^2 = 149.8$,

P = 0.000 < 0,05, df=34, N=258), with RMSEA (0.112) still showing values above threshold levels, and CFI (0.943) and TLI (0.925) below threshold levels.

When following the original study model modification including one error correlation between Q7_I (“My child shows visible enjoyment when discovering something new”) and Q9_I (“When my child is learning something new, he/she asks many questions about it”), poor fit was observed, with $\chi^2 = 147$ (P < 0,01, df=33, N=258), RMSEA = 0.116, CFI = 0.943, TLI=0.922, SRMR= 0.068 and with an ECVI = 0.76. When proceeding with implementing modification indices as indicated by our analysis, with one error term correlation between Q1_I and Q3_I,

the analysis did not render a good model fit towards the theorized two-factor model with $\chi^2 = 131$ (P < 0,01, df=33, N=258), RMSEA = 0.108, CFI = 0.949, TLI=0.931, SRMR= 0.065 and with an ECVI = 0.69). CFI = 0.943, TLI=0.922, SRMR= 0.068 and with an ECVI = 0.76. When proceeding with implementing modification indices as indicated by our analysis, with one error term correlation between Q1_I and Q3_I, the analysis did not render a good model fit towards the theorized two-factor model with $\chi^2 = 131$ (P < 0,01, df=33, N=258), RMSEA = 0.108, CFI = 0.949, TLI=0.931, SRMR= 0.065 and with an ECVI = 0.69).

TABLE 3. Goodness of fit indices for one and two-factor models

Fit index	One-factor model	Two factor model	Two factor model ^A	Two factor model ^B	Thresholds
	DWLS (robust)	DWLS (robust)	DWLS (robust)	DWLS (robust)	
RMSEA	0.122	0.112	0.116	0.108	RMSEA < 0.06
CFI	0.931	0,943	0.943	0.949	CFI ≥ .95
χ^2 (df)	168.615(35)***	143.461(34)**	147,64(33)***	130.942(33)***	p < 0.05
TLI	0.911	0,925	0.922	0.931	TLI ≥ 0.95
SRMR	0.076	0.069	0.068	0.065	SRMR < 0.08
ECVI	0.79	0.73	0.76	0.69	Lower is better

Confirmatory factor analysis fit indices (estimator=DWLS) and cut-off's as cited by (30,35). ^A Inclusion of one correlated error as in the original validation. ^BIncluding one correlated error as per highest indicated modification index, **p < 0.01, *** p < 0.001.

Discussion

The analysis showed acceptable internal consistency of the subscales, with small differences between sexes, but failed to confirm I- and D- type EC factors, as earlier shown by Piotrowski et al (1). The item correlation matrix indicated broader issues with I- and D-type item cross-loadings, thus showing that there was too much overlap to render a clear two-factor solution, which was the case even when including modifications according to the original study and as indicated by the analysis of this study. Although translation errors could have led to these results, the accordance between the forward and backward translations was considered good, which makes it unlikely as the primary cause.

When investigating at item level, modification indices and the item correlation matrix identified localized areas of strain with high correlations between items Q9_I and Q10_D, and Q4_I and Q5_D. A possible reason for the high correlation between Q9_I and Q10_D is that they both could be interpreted as containing aspects of encountering something new and specific, and not making any of the I-and D-type characteristics sufficiently clear.

There was also a high overlap between Q5_I and Q4_D. Here, Q4_D could be perceived as the child joyfully trying to understand something new (as in Q5_I), as parents might conceive joyful exploration as also involving feelings of confusion. Moreover, when considering that Q4_D also correlates highly with four other I-items, it further indicates that the aversive dimension of not knowing might not be perceived clearly enough by respondents for this item. The need to more clearly associate positive or negative feelings connected to exploratory behaviors becomes even more evident when considering the items that differentiated the most between I and D factors, which are Q1_I (mean correlation = .29) and Q6_D (mean correlation = .26), explicitly make the affective dimension clear (Q1_I: “My child has fun...”, Q6_D: “My child is bothered...”).

When considering the result of this study at a theoretical level, high overlaps between I- and D-factors, and somewhat weak goodness of fit indices for two-factor solutions are consistently evident, with model modifications also needed for some (17,18), to render a sufficient two-factor fit. Thus, it is not surprising that what seems to be inherent

difficulties in capturing I- and D-type EC dimensions also extend to other studies of the I/D model. Furthermore, the overlaps might also become amplified with the use of proxy ratings as may be the case with the current study. Moreover, if I- and D-type EC dimensions are highly overlapping, the question arises of how meaningful it is to separate them. Indeed, one study (14) raised the issue of practical meaningfulness in separating them but also referred to the different correlates found for I- and D-factors, as reasons to view them as separate. Still, other researchers have argued that only D-type EC should be viewed as curiosity per se and that I-type EC should be seen as reflecting interest (36), a standpoint related to the debate on how interest differs from curiosity (5,37–42). Moreover, other curiosity dimensions may be more optimal for proxy reports. Notably, one child study (43) did an exploratory factor analysis on data from different behavioral tests of curiosity and rendered curiosity factors of manipulatory curiosity, perceptual curiosity, conceptual curiosity, curiosity about the complex, and adjustive-reactive curiosity, which may prove to be more favorable for proxy ratings of child curiosity. Nevertheless, considering that the internal consistency in the Swedish version of the I/D-YC, when combining both subscales was good and that I- and D- factors were highly overlapping, it is fully conceivable that the I/D-YC combined scale result broadly captures important perspectives of children's trait EC. This, in turn, suggests that the Swedish I/D-YC total score may be utilized as a proxy rating measure when the aim is to investigate child EC more generally.

When looking at broader issues with proxy rating children's EC, one such may lie in the high contextual dependency of curiosity. Curiosity is found to be triggered by contextual stimuli having novelty, complexity, ambiguity, challenge, and uncertainty (4), or surprise and confounded evidence (for a review see (44)). Therefore, differing opportunities for parents to see their children in such curiosity-provoking circumstances may lead to either over or underestimations of their children's curiosity. It is also conceivable that parents with fewer opportunities to observe their children behaving curiously may respond in a more rote fashion due to questions being cognitively taxing, via the retrieval of more distant memories (36, 37). Although this was addressed to some degree via the removal of straight-lining responses, the energy costs involved with responding might still have affected motivation to provide thoughtful answers. Other ways to address the issue of the contextual sensitivity of curiosity is to use larger sample sizes and/or control for parents' opportunities to observe their children in curiosity-evoking contexts. Yet, another validity issue for

proxy ratings of EC is that parents may interpret non-curiosity-related behaviors as being curiosity-driven. For example, when a child asks "Is that a coin?", it may be attributed to curiosity (the desire to know if it is a coin) but also to the desire to use it to buy candy.

Future directions

When considering the issues raised by this study, a revised version of the Swedish I/D-YC, with more clearly stated affective markers in the items, may differentiate better between I- and D- factors. Moreover, how respondents comprehend items, and how their conceptual grasp of epistemic curiosity affects responses can be further investigated via cognitive interviewing. Furthermore, an open question is how proxy ratings based on other curiosity dimensions would perform in comparison to the I/D-YC. Nevertheless, the internal validity of the I/D-YC, when seen as one unitary scale, was good, raising possibilities for it to be used as a more global measure of child epistemic trait curiosity. For this to be further established, convergent validity studies need to be conducted. Overall, due to the high utility of proxy rating child curiosity, developing a valid measure of this kind, which this article hopes to stimulate, will no doubt find wide use in child and education research.

Conflict of interest

The author declared no conflicts of interest.

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Ethical approval

All participating adults and parents of participating children have signed an informed consent form allowing for project members to publish results on the group level. No analyses of individual children have been performed and individual scores cannot be released, not even to parents. All data is coded and depersonalized. All data is kept in accordance with the regulations of data handling from the Swedish Research Council. The project was reviewed and ethically approved by The Regional Ethics Board DNR nr: 2015/1664–31/5, DNR nr: 2018/171-32.

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