The Measurement and Conceptualization of Curiosity

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ABSTRACT. In this study, the authors tried various methods to measure and conceptualize curiosity. A sample of 369 education students (103 men, 266 women) who were attending universities on the East Coast of the United States completed 5 paper-and-pencil curiosity measures in 1 of their classes. Using confirmatory factor analysis, the authors found that the data best fit a 3-factor curiosity model consisting of cognitive curiosity, physical thrill seeking, and social thrill seeking. These findings supported the development of new instruments that specifically measured those 3 curiosity types, new empirical research predicting meaningful curiosity-related outcomes, and subsequent theory building concerning how and why curiosity is a fundamental part of optimal human functioning.

Key words: curiosity, optimal human functioning, sensation seeking, thrill seeking

“The human being is a curious creature and that is a good thing...” (Gazzaniga, 2005, p. 40).

HUMANKIND’S NATURAL CURIOSITY has been a major impetus behind scientific discovery and the advancement of civilization (Berlyne, 1978; Bjørnø, 2003; Dewey, 1910; Elmikey, 2005; Loewy, 1998). Bruner (1966) proposed that curiosity is so important that it “is essential to the survival not only of the individual but of the species” (p. 115). Gazzaniga (2005) more specifically linked curiosity to the human evolutionary drive to adapt and survive. Thus, through their nature to be ever curious, individuals are motivated to discover new ways to solve salient problems to adapt successfully and continually.

Preliminary research results have indicated that curiosity fosters cognitive, social, emotional, spiritual, and physical development over the lifespan by stimulating exploratory behavior (e.g., Berlyne, 1960; Kashdan & Roberts, 2004;
Loewenstein, 1994). Curiosity has been linked to a wide range of key developmentally relevant tasks ranging from the play and school activities of children (Berlyne, 1960; Rubin, 2005) to the work and leisure activities of adults (Reio, 2003; Reio & Wiswell, 2000). Voss and Keller (1983) stressed that curiosity and the exploratory behavior it elicits are vitally important because these traits help individuals flexibly adapt to changing environmental conditions. Furthermore, curiosity has been acknowledged theoretically and empirically as having an important positive role in developing secure attachments throughout the lifespan (Bowlby, 1988), forming an identity (Erikson, 1968), and becoming a psychologically healthy person (Kashdan & Roberts, 2004; Maslow, 1970).

Litman & Spielberger (2003) stated that curiosity can be “broadly defined as a desire to acquire new [information and] knowledge and [italics added] new sensory experience that motivates exploratory behavior” (p. 75). In other words, curiosity has at least two distinct types: (a) information seeking, or cognitive curiosity, which stimulates information-seeking, exploratory behavior and (b) sensory curiosity, which stimulates sensation-seeking, exploratory behavior. Piaget (1952) maintained that being actively curious is a prerequisite for the construction of knowledge because it motivates the acquisition of new information and the seeking of new stimuli (Ginsburg & Opper, 1988). Piaget referred to both the cognitive and sensory types of curiosity. In his view, experiences gained through the information seeking and sensory types of curiosity and exploratory behavior promoted cognitive development through the construction of new knowledge. Gibson (1988) also stressed that curiosity and the exploratory behaviors it elicited were vital to the fostering of perceptual learning and development. From her ecological perspective, curiosity motivates exploratory action to differentiate among the “ample and structured...layout, surfaces, objects, and events of the world” in the service of obtaining new information about affordances (opportunities for action) in the environment (Gibson & Pick, 2000, p. 11). Gibson implicitly suggested that information-seeking curiosity might help answer questions about affordances related to specific objects or events, whereas sensory curiosity might motivate the spontaneous seeking of new opportunities for action.

With regard to a number of important psychological theoretical perspectives, researchers have largely ignored the potential role and relevance of curiosity in human functioning. Researchers studying sociocognitive, sociocultural, information processing, and expertise theories have said little about curiosity, although, each theory—at least implicitly—acknowledges the importance of motivation in general. Thus, even though curiosity is widely acknowledged as a potentially strong motivator of behavior (Berlyne, 1954, 1978; Kashdan & Roberts, 2004; Piaget, 1952; Reeve, 1989), researchers have little guidance from those four important psychological traditions with regard to how and why curiosity might be

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linked specifically, for example, to levels of efficaciousness, collaborative activity, surface versus deep processing of information, or expertise development, respectively. Researchers who have studied brain science have not addressed curiosity’s neural substrates or how curiosity might be linked to emerging brain systems that influence behavioral activity, including learning. This state of affairs is unfortunate because our understanding of curiosity remains unclear, even with previous research evidence, which has suggested that curiosity might be (a) developmentally vital, (b) an important motive of human behavior, and (c) relevant to most domains of human operation (e.g., educational, occupational, recreational, spiritual; Kashdan & Roberts, 2004; Loewenstein, 1994; Loewy, 1998; Zuckerman, 1994, 2004).

**Philosophical and Theoretical Approaches**

Scholars have had varying views of curiosity for millennia (Loewenstein, 1994). Plato claimed that we naturally seek new experiences for the sake of knowing, which we find intrinsically satisfying (Lodge, 1920). Likewise, Aristotle thought that curiosity, or the desire for knowledge, is universal, and that curiosity should be sought for its own sake (Ross, 1975). By contrast, St. Augustine (143) equated curiosity with vanity and whimsy. Psychologists and philosophers in the late 19th and early 20th centuries persisted in distinguishing between the different varieties of curiosity. William James (1890/1950) identified two instinctive types of curiosity. The unnamed first type of curiosity was sensory and involved a combination of excitability and anxiety toward exploring objects in the environment for the purpose of enjoying their novelty. With James’ second type of curiosity—scientific (i.e., cognitive) curiosity—the actual ways humans conceive of objects act as stimuli and sensitize them to knowledge gaps, which, when resolved, result in feelings of pleasure and facilitate the storage of scientific knowledge. James was among the first to suggest that we become sensitive to knowledge gaps and the pleasure of pursuing scientific curiosity at certain ages. Therefore, it would be useful to examine the interaction of curiosity and concomitant knowledge development at different times or perhaps stages of the lifespan.

Dewey (1910), too, claimed that curiosity is a vital component of thinking and noted “curiosity is the only sure guarantee of the acquisition of the primary facts upon which inference must base itself” (p. 31). Dewey described three different types of curiosity (i.e., physical, social, intellectual). Dewey’s physical curiosity, most closely related to James’ (1890/1950) unnamed first type of curiosity, would be a physiological restlessness that he equated to an animal’s tendency to lark about with no particular goal in mind and a child’s endless exploration and testing of the novel properties of objects. He did not consider this type of curiosity to be intellectual per se, but viewed the activities derived by physical curiosity to be essential for consistent intellectual activity. Social curiosity, Dewey’s second type of curiosity, would be activated by social stimuli. This type
can be best illustrated by the child's endless array of "Why?" questions. Although intellectual in a sense, this type of curiosity, Dewey stressed, is simply an attempt to acquire more items of information that are not necessarily rationally connected. Dewey's third type of curiosity, intellectual curiosity, would be aroused when an individual believed there may be more to information or facts than meets the eye. This type of curiosity can be developed into interest in both solving problems and the accumulation of knowledge. Dewey distinguished between curiosity and interest. When information is lacking, curiosity is aroused and can be developed into an enduring interest if the appropriate conditions are present. Thus, psychologists must spark individuals' curiosity if they expect to develop their interest in a particular domain. Dewey cautioned that intellectual curiosity and the motivation to learn could be easily squelched by excessive dogmatism, inflexibility, the obsession with routine, and ambivalence. It is odd that scholars have overlooked Dewey's views about curiosity especially because of his stature in past and present philosophical and educational thinking (Elkind, 1999; Null, 2003; Saito, 2003).

As the twentieth century progressed, many researchers attempted to determine the precise nature of curiosity. During a roughly 25-year period beginning in the early 1950s, Berlyne (e.g., 1954, 1960, 1966, 1978) did much seminal work on curiosity. Because his work was so instrumental in defining the construct and for guiding empirical research, it is difficult to find a research article on curiosity that does not refer to some portion of his theory.

Berlyne (1954) originally distinguished between two types of curiosity: epistemic and perceptual. He defined epistemic curiosity as the kind of curiosity "whose main fruits are knowledge" and perceptual curiosity as the kind of curiosity that "leads to increased perception of stimuli" (p. 180). He conceded, however, that both may be closely related. Berlyne (1960) also introduced two types of exploratory behavior: specific and divergent. A lack of information arouses one's curiosity, and specific exploration ensues. However, the need for stimulus variety (novelty) arouses curiosity, which elicits divergent exploration in both animals and humans. For example, specific curiosity directs one toward information-seeking exploratory behavior for the sake of acquiring an answer to a question. Diverse curiosity sparks explorations of novel stimulation. Specific and diverse curiosity work together to optimize exposure to new learning and stimulation that might have short- and long-term developmental and educational implications (Berlyne, 1978). To date, curiosity research is concerned with specific and divergent types of curiosity (e.g., Litman & Spielberger, 2003), perhaps because of the clearer conceptual delineation between these curiosity types (Loewenstein, 1994).

Building on Cattell's (1957) early work, Berlyne (1960) also acknowledged the possibility of individual differences in curiosity. He noted that Cattell's factor-analytic evidence suggested a "varying in prevailing strength from one individual to another" (p. 282) in his own measure of exploration and in Guilford's (1956) measure of "sensitivity to problems" (p. 282). Berlyne indicated that both con-
structs were closely related to his notion of epistemic or knowledge-seeking curiosity. In an effort to examine possible individual differences in curiosity, other researchers have extended Berlyne's work by developing personality-trait measures of the construct including the Ontario Test of Intrinsic Motivation, Novelty Experiencing Scale, and Academic Curiosity Scale. Researchers developed the State–Trait Personality Inventory and the similar Melbourne Curiosity Inventory to measure curiosity both as an emotional state and as a personality trait (Spielberger & Starr, 1994).

In addition to Berlyne's (1960) specific and diversive curiosity classification, another major line of curiosity research concerns state and trait curiosity (e.g., Boyle, 1983; Loewenstein, 1994). The strength of this approach seems to be its ability to test the possible interactions among state and trait curiosity and daily behavior to foster optimal human functioning. Loewenstein questioned the viability of the state–trait distinction and especially the use of trait curiosity measures because of curiosity's possible susceptibility to social desirability, conflicting results among demographic groups, and measurement problems. He concluded that "perhaps curiosity simply does not exist as a stable, generalized trait... even if trait curiosity were measurable, the practical benefits of such a scale are questionable" (p. 79–80). He strongly favored investigating state curiosity primarily because of its potential practical benefits, such as stimulating learning. Despite Loewenstein's reservations, researchers have continued to use the state–trait distinction (e.g., Kashdan & Roberts, 2004).

In sum, early thinkers from Plato, Aristotle, and St. Augustine to James and Dewey have debated curiosity's possible virtues and vices. Curiosity has been linked positively to cognitive development, learning motivation, attachment, identity formation, personal growth, and perceptual learning and development, yet little information exists as to why and how. Researchers from the sociocognitive, sociocultural, information processing, expertise, and neuropsychological perspectives have had little to say about curiosity's relevance to human thinking and behavior. Part of this seeming scholarly ambivalence might result from the construct's conflicting conceptualizations. James (1890/1950), Dewey (1910), and Piaget (1952) introduced the notion that there are different types of curiosity. Berlyne (1954, 1960) tested and developed the idea that curiosity might be multidimensional. It is unfortunate that even he noted that considerable conceptual overlap might exist among his various conceptualizations (i.e., epistemic, perceptual, specific, diversive curiosity). In addition, he introduced the existence of state and trait curiosity, and the possibility of individual differences in curiosity, but never developed this particular research line sufficiently to guide future research precisely.

Factor-Analytic Investigations

Over the past 40 years, psychological and educational researchers have developed numerous definitions and descriptions, together with a wide range of terms,
to describe curiosity. Terms like *interest*, *intrinsic motivation*, *play*, and *exploration* have often been used interchangeably with curiosity, yet these terms are not the same (Kreitler & Kreitler, 1994). Researchers who have attempted to clarify the construct of curiosity have considered curiosity on a more fundamental level by factor-analyzing trait curiosity measures to ascertain their underlying latent structure (Loewenstein, 1994; Spielberger & Starr, 1994). A factor-analytic approach can be exceptionally useful because the latent structures or dimensions are stable across measurement systems (Gorsuch, 1983; Ho & Au, 2006; Nunnally & Bernstein, 1944), which makes these dimensions less subject to possible variability introduced by diverse definitions and operationalizations.

Factor analytic studies have identified two-, three-, and five-dimensional models of curiosity. Among the two-dimensional conceptualizations are those of Berlyne (1960) and Day (1971; specific and divergent curiosity), Ainley (1987) and Langevin (1971; depth- and breadth-of-interest), and Spielberger and Starr (1994; information and experience seeking). The model by Byman (1993) has three dimensions: information seeking, experience seeking, and physical thrill seeking, whereas Kreitler and Kreitler (1994) suggested five facets: manipulatory, perceptual, conceptual, exploration of the complex or ambiguous, and adjutic-—compliant. Like a number of researchers (e.g., Ainley; Boyle, 1983; Byman, 1993; Litman & Spielberger, 2003; Reio & Wiswell, 2000), in this study, we attributed curiosity’s lack of scholarly acknowledgement, at least in part, to measurement and conceptual issues. Much could be gained from further psychometric examination of the construct.

Langevin (1971) introduced the breadth- and depth-of-interest curiosity distinction through his exploratory factor-analytic research using five curiosity measures and a sample of 269 children who were 12 years old. These factors seem to be similar to conceptions of specific and divergent curiosity (Spielberger & Starr, 1994), although Loewenstein (1994) argued that the breadth—depth distinction was nothing more than a subdivision of specific curiosity. To our knowledge, this issue has not been addressed by curiosity researchers. Langevin (1976) reexamined his earlier work by studying a combination of 53 teacher education students and 30 individuals who were hospitalized with schizophrenia (N = 83). Although this second protocol was questionable with respect to both his participants and methodologies (e.g., inadequate sample size for factor-analytic work [Kline, 1993]), Langevin concluded that the two curiosity dimensions he found in his previous study were simply artifacts of the measurement forms he used. Both Boyle (1989) and Byman (1993) used that finding to refute the breadth—depth distinction in favor of the state—trait curiosity conceptualization.

Ainley (1987) extended Langevin’s research and corrected the problems associated with his 1976 study by using a much larger sample (N = 227) and by using exploratory factor-analytic procedures. Ainley also used self-report measures and college students (M age = 20 years). She found tenable two- and three-factor solutions, but selected a two-factor solution most closely aligned with
Langevin’s breadth- and depth-of-interest scales. Ainley concluded that Langevin’s (1971) early work was tentatively supportable and that curiosity consisted of two parsimonious factors: breadth- and depth-of-interest. Giambra, Camp, and Grodsky (1992) agreed with Ainley’s two-factor interpretation of curiosity for adults of all ages because the two-factor interpretation facilitated clearer understanding in comparison of different age groups. Boyle (1989), however, strongly criticized Ainley’s empirical support of the breadth–depth distinction. Even so, Boyle might have inappropriately used Ainley’s findings to support a global state–trait conceptualization because she did not use state curiosity measures in her study (Spielberger & Starr, 1994). Similar to Ainley, Spielberger and Starr used university students (sample size not reported) in their exploratory factor-analytic work on the nature of curiosity and described two distinct factors—information seeking and experience seeking.

Byman (1993) reanalyzed Ainley’s (1987) original data through a confirmatory factor analysis (CFA) based on Boyle’s (1989) criticism of Ainley’s interpretation of her exploratory factor-analytic work. After CFA model fitting “to construct a better fitting model statistically than the two-factor one.” Byman declared that Ainley’s data best fit a three-factor model instead of a two-factor model, and he named the new, third factor venturesomeness, or physical thrill seeking (p. 157). Byman concluded that Langevin’s (1971) and Ainley’s depth–breadth distinction was less useful than a global state–trait one and called for new CFA research on an independent set of curiosity data to test this idea further. Reio (1997) noted that Byman’s call had been overlooked and that additional CFA examination of the curiosity construct specifically addressing that issue had not been conducted.

Buck (1999), in his examination of biological affect, proposed that curiosity was a higher-level cognitive affect. In this study, we did not seek to dispute rival conceptualizations of curiosity. Rather, we assumed that most views of curiosity were accurate and complementary, yet incomplete. Building on theory and previous exploratory factor-analytic research of curiosity (e.g., Ainley, 1987; Langevin, 1971, 1976; Olson & Camp, 1984; Spielberger & Starr, 1994), in this study, we aimed to shed light on curiosity’s theorized multidimensionality through confirmatory factor-analytic procedure. Previous exploratory factor analysis (EFA) studies of curiosity have been useful to the field because they have identified possible latent structures underlying the numerous definitions and operationalizations of the curiosity construct (e.g., Ainley, 1987; Olson & Camp, 1984). Overall, the bulk of the EFA study results have specified that adult curiosity consisted of either two or three dimensions (e.g., Langevin, 1971; Spielberger & Starr, 1994). Answering Byman’s (1993) call, the next research step would be to verify these findings through CFA procedure. According to Gorsuch (1983), CFA would allow for testing of a specific, hypothesized factor structure on the basis of strong theoretical evidence or substantial past data that permits the specification of a unique factor resolution. In this study, based on theory and extensive empirical research, we tested
competing one-, two-, and three-factor models of curiosity. We anticipated that more concise, objective information about curiosity’s dimensionality would guide the development of new instruments, empirical research related to predicting meaningful developmental and educational outcomes, and subsequent theory building.

**Method**

**Participants**

The participants in this study were 103 men and 266 women, who were 18 to 60 years old ($M_{age} = 26.81; SD = 6.76$). We recruited the participants from education classes on three East Coast campuses in the United States. Forty-eight of the participants were 18 to 20 years old; 256 were 21 to 29 years old; 43 were 30 to 39 years old; 18 were 40 to 49 years old; and 4 were 50 to 60 years old. We conducted 1 (research variables) x 3 (campus group) analyses of variance and found no statistically significant differences on the research variables, $F$s (12, 356) < 1.77, $p$s > .05. On the basis of this evidence, we combined the samples to increase statistical power (Cohen, Cohen, West, & Aiken, 2003).

**Instrumentation**

For this study, we selected five curiosity instruments with strong psychometric properties. These specific measures (11 subscales) represent the range of major theoretical operationalizations of curiosity used to measure adult curiosity (Ainley, 1987; Olson & Camp, 1984). We used the Melbourne Curiosity Inventory (MCI; Naylor, 1981), the State–Trait Personality Inventory (STPI; Spielberger et al., 1980), the Sensation Seeking Scale (SSS; Zuckerman, 1979), the Novelty Experiencing Scale (NES; Pearson, 1970), and the Academic Curiosity Scale (ACS; Vidler & Rawan, 1974). Each of these measures is a self-report, pencil-and-paper questionnaire, which Ainley (1987) recommended. The Cronbach’s alphas ranged between .62 and .93 for the 11 subscales.

The MCI has one 20-item state ($\alpha = .87$) and one 20-item trait ($\alpha = .93$) curiosity subscale with an additive, 4-point Likert-type scale ($1 = almost never; 4 = almost always$). The STPI has additive, 4-point Likert-type ($1 = not at all; 4 = very much so$) 10-item state ($\alpha = .79$) and trait ($\alpha = .83$) curiosity subscales and 10-question anger and anxiety subscales that we did not use in this research. Both the MCI and STPI are considered measures of information seeking, which is the cognitive type of curiosity. The NES has four additive 20-item subscales, which include two subscales representing cognitive curiosity (internal cognitive [ICT; $\alpha = .76$], external cognitive [ECT; $\alpha = .82$]) and two subscales representing sensory curiosity (internal sensation [IST; $\alpha = .67$], external sensation [EST; $\alpha = .88$]). Prospective respondents circle either like or dislike to indicate whether they like the activity described by the item statement.
With sensation seeking, one seeks novel sensations and changing experiences more often simply for the experience. The SSS, on which respondents circle A or B to indicate agreement, consists of four additive 10-item subscales measuring four dimensions of sensation seeking: thrill-and-adventure seeking (TAST; \( \alpha = .78 \)), disinhibition (DIST; \( \alpha = .76 \)), boredom susceptibility (BST; \( \alpha = .74 \)), and experience seeking (ESTSS; \( \alpha = .62 \)). The ACS (\( \alpha = .88 \)), which is another cognitive curiosity measure consisting of 45 questions (respondents circle T or F to indicate agreement), is summed to find one curiosity score. Thus, the MCI, STPI, NES, ACS, and SSS are essentially trait measures of curiosity, in which only the MCI and STPI include a state curiosity subscale. We did not include the state measures in our subsequent analyses to afford comparison with previous personality trait research (e.g., Ainley, 1987; Byman, 1993; Spielberger & Starr, 1994).

**Procedure**

We administered the selected curiosity measures with a demographic survey to all 369 participants during their education classes as part of an extra credit activity. All students participated on the condition of anonymity. According to the guidance of the institutional review board, we first explained the purpose of the study to each participant. Next, we distributed the measures. The average administration time was 35 min per individual.

**Results**

The analysis had two major steps that led to the development of a final CFA model. First, we performed modeling on 11 curiosity variables, which resulted in a CFA model that was adequate, but not theoretically parsimonious or conceptually satisfying. The limitations of the model suggested the deletion of two variables, which resulted in the analysis of nine variables. An analysis of these variables yielded the final CFA model that was theoretically defensible and a close fit to the data.

**Analysis of 11 Variables**

We measured the participants in the study \((N = 369)\) on 11 personality scales. Before administering the CFA, we performed exploratory factor analysis. This method consisted of a principal component analysis, followed by rotation of factors that had eigenvalues greater than 1.00. Three factors emerged, which we rotated using the direct oblimin solution. We used loadings on the three factors to guide the construction of the CFA model, which we performed using EQS version 5.6 structural equation modeling software (Bentler, 1995).

Table 1 shows the hypothesized model. Directed by previous research results, the asterisks indicate the theorized statistically significant coefficients. We predicted that the three hypothesized factors would covary with one another.
(i.e., F1 and F2, F1 and F3, and F2 and F3 would all correlate, signifying an oblique-factor model).

We used maximum likelihood estimation on the covariance matrix calculated from interrelating participant responses. We rejected the independence model that tested the hypothesis that the variables were uncorrelated with one another, $\chi^2(55, N = 369) = 1609.33, p < .001$. A chi-square test of the model was statistically significant, $\chi^2(40, N = 369) = 194.83, p < .001$. The Bentler comparative fit index (CFI) was .90, and the Steiger–Lind Root Mean Error of Approximation (RMSEA) was .10. Both results were adequate, but marginal (Hu & Bentler, 1999). Therefore, we performed post hoc modifications in an attempt to find a better fitting model.

Results of the Wald test indicated that fit would improve if we dropped the path from Factor 3 and the variable DIST. Furthermore, the Lagrange Multiplier test for adding parameters indicated an improvement with the addition of paths from Factor 2 to variable IST and from Factor 3 to variable EST. With these modifications, the revised model had improved fit indexes: CFI = .92, RMSEA = .092. A chi-square test of the model was statistically significant, $\chi^2(39, N = 369) = 160.80, p < .001$. Because we nested the original model within the second model, we performed a chi-square of the difference in fit between the two models (Byrne, 1994). The change in fit was statistically significant, $\chi^2(1) = 34.03, p < .001$.

Examination of the Wald test for model 2 revealed that dropping paths would not improve the fit, but adding two paths would be beneficial. The paths were Fac-

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| MCI      |          |          |          |
| STPI     |          |          |          |

*Note. N = 369. EST = external sensation; ICT = internal cognitive; IST = internal sensation; ECT = external cognitive; DIST = disinhibition; BST = boredom susceptibility; TAST = thrill-and-adventure seeking; ESTSS = experience seeking; ACS = academic curiosity scale; MCI = Melbourne Curiosity Inventory; STPI = State-Trait Personality Inventory.
tor 2 to EST and Factor 3 to IST. After these modifications, model 3 had improved fit indexes: CFI = .94, RMSEA = .08. A chi-square test of the model was statistically significant, $\chi^2(37, N = 369) = 129.22, p < .001$. A chi-square of the difference in fit between models 2 and 3 revealed that the change in fit was statistically significant, $\chi^2(2) = 31.58, p < .001$. Table 2 shows standardized coefficients for model 3.

Despite the fact that the third model with 11 variables met minimum statistical criteria for adequacy of fit, it was not parsimonious. Particularly problematic were two variables: IST and EST. IST was related to all three factors, with a low coefficient in all cases. EST also had coefficients on the three factors—one moderate and two low. The low relative internal consistencies (.67 and .62, respectively) may have limited the utility of these variables for CFA work (Henson, 2001). In addition, the cross-loadings of the coefficients on the factors associated with the scales suggested a lack of conceptual clarity as previously noted by Ainley (1987) and Reio & Wiswell (2000). We thus dropped the variables IST and EST and modeled the remaining nine variables in the second stage of the data analysis.

**Analysis of the Nine Variables**

Table 3 shows the hypothesized model. The data set consisted of the same participants measured in the previously described model ($N = 369$). We per-

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<th>TABLE 2. Coefficients of 11 Variables on Three Curiosity Factors for Confirmatory Factor Analysis Model 3</th>
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*Note. N = 369. Factor correlations were: F1–F2 = .207; F1–F3 = .498; F2–F3 = −.169. EST = external sensation; ICT = internal cognitive; IST = internal sensation; ECT = external cognitive; DIST = disinhibition; BST = boredom susceptibility; TAST = thrill-and-adventure seeking; ESTSS = experience seeking; ACS = academic curiosity scale; MCI = Melbourne Curiosity Inventory; STPI = State–Trait Personality Inventory.*
formed exploratory factor analysis on nine personality scales. We followed principal component analysis by rotation of factors. The first three eigenvalues were 3.08, 2.22, and 0.97, respectively. Although the last value did not exceed 1.00, we retained three factors for rotation using the direct oblimin solution. We used loadings on the three factors to guide the construction of the CFA model.

We used maximum likelihood estimation on the covariance matrix calculated from interrelating participant responses. We rejected the independence model that tested the hypothesis that the variables were uncorrelated with one another, $\chi^2(36, N = 369) = 1232.33, p < .001$. A chi-square test of the model was statistically significant, $\chi^2(24, N = 369) = 64.99, p < .001$. The CFI was .97, and the RMSEA was .07, each indicated a close-fitting model (Hu & Bentler, 1999). Neither the Wald test nor the Lagrange Multiplier test indicated any benefit from deleting or adding paths to the model. Table 4 shows standardized coefficients and factor intercorrelations for the CFA model of nine variables. None of the variables loaded on more than one factor. Thus, the CFA solution was both close fitting and parsimonious.

Overall, the confirmatory analyses suggested that curiosity is not a unitary construct—as the data best fit an oblique three-factor model: Factor 1 (cognitive curiosity), Factor 2 (physical thrill seeking), and Factor 3 (social thrill seeking). We labeled the third factor social thrill seeking, because it was most consistent with Zuckerman’s (1979, 1994) hypothesis—that we seek intense and varied sensations through not only physical activities, but also through people and social activities that can involve risk. In contrast to Byman (1993), we did not support labeling this third factor experience seeking or stimulation seeking, because these labels are incomplete.
TABLE 4. Confirmatory Factor Analysis Standardized Coefficients of Nine Variables on Three Curiosity Factors

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Note. N = 369. Factor correlations were: F1–F2 = .208; F1–F3 = −.159; F2–F3 = .496. EST = external sensation; ICT = internal cognitive; ECT = external cognitive; DIST = disinhibition; BST = boredom susceptibility; TAST = thrill-and-adventure seeking; ACS = academic curiosity scale; MCI = Melbourne Curiosity Inventory; STPI = State–Trait Personality Inventory.

Social thrill seeking more clearly follows Zuckerman’s (1994) theoretical and empirical work that this type of curiosity (disinhibition, boredom susceptibility) is expressed primarily through social or interpersonal activities on behalf of the sensations or possible thrills produced when engaging in such activities. Figure 1 shows the path diagram summarizing the final CFA for the nine variables.

Discussion

These confirmatory factor-analytic results supported previous research results (e.g., Berlyne, 1954; Dewey, 1910; James, 1890/1950) and empirical research results (e.g., Ainley, 1987; Litman & Spielberger, 2003), which suggested the existence of cognitive and sensory types of curiosity. These data also supported the three-factor interpretation of curiosity represented by one cognitive curiosity factor and two sensory curiosity factors. Thus, we found no evidence of a single, general curiosity factor that was first predicted by Berlyne (1966) and later partially supported by Langevin (1976).

The cognitive curiosity factor (Factor 1) is consistent with a great deal of previous research results (e.g., Giambra et al., 1992; Olson & Camp, 1984; Spielberger & Starr, 1994); thus, we found that information-seeking curiosity is a robust, independent dimension of curiosity, as we expected. Items from some of the variables that loaded on this factor included, “I like searching for answers” and “I like thinking a lot about a new idea.”
The identification of two sensory factors—physical thrill seeking (Factor 2) and social thrill seeking (Factor 3)—that are not independent ($r = .496$) is consistent with Byman's (1993) initial CFA findings, although the correlation is stronger in this study. We did not encounter difficulty with the EST subscale as Byman reported, although the internal sensation subscales of the NES and the experience seeking subscales of the SSS were problematic. These problems might reflect the conceptual ambiguities noted by Ainley (1987) and Byman.

Both sensory curiosity factors are associated with risk. Zuckerman's (1994) sensation seeking included an element of risk; that is, one may be willing to take
a chance for the sake of intentionally engaging in sensation-seeking experiences. Zuckerman noted that the sensation seeker “underestimates or accepts risk as the price for the reward provided by the sensation or experience itself. . . . [but few seek to] maximize risk for its own sake” (p. 27). Physical thrill seeking (Factor 2) suggested the seeking of sensations and experiences and the willingness to take physical risks for their own sake. We were not surprised by the evidence that the EST subscale loaded highly on this factor because many of the items (“Climbing to the top of a high rugged mountain” and “Diving from a board 50 feet above the water”) are similar to the thrill-and-adventure subscale of the SSS (“I often wish I could be a mountain climber” and “I would like to try parachute jumping”). Social thrill seeking (Factor 3) illustrated the willingness to take social or interpersonal risks for the sake of experiencing new and divergent social sensation and experiences through social drinking, partying, and premarital sexual experimentation, and through activities that might be illegal or taboo. The disinhibition subscale of the SSS loading attained marker variable status (Kline, 1993) on this factor (e.g., “I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional, or illegal”). The more modest loading of the boredom susceptibility subscale on this factor (e.g., “I can’t stand watching a movie that I’ve seen before”) suggested that boredom as an aversive state might motivate or intensify the seeking of new social sensations and experiences as Zuckerman (1994) predicted, however more conventionally and with much less likely risk. Furthermore, the small, but statistically and possibly theoretically significant, positive relationship between the cognitive and physical thrill-seeking factors indicated that information seeking and physical thrill seeking overlap to some degree, which partially supported Shoham, Rose, and Kahle’s (1998) path-analytic work in which thrill-and-adventure seeking and cognitive curiosity arousal positively influenced the intention to participate in risky sports. Being intellectually curious about an intense physical activity like a sport (e.g., jai alai, squash) might motivate one to try it for the first time, whereas staying with the activity or sport might be more a function of one’s desire for satisfying sensory experiences. Thus, both types of curiosity might jointly facilitate engagement in such an activity. Last, the negative relationship between Factors 1 and 3 signified that information-seeking curiosity might present salient information that might weakly deter activities related to social unconventionality and risk taking. Both of the exciting aforementioned possibilities warrant future research.

Our research results are limited to the exploration of the research variables among a convenience sample of education students attending universities on the East Coast of the United States. The results may have varied if the groups of participants had different gender, ethnic, and socioeconomic compositions; however, the results are consistent with previous factor-analytic results of curiosity (e.g., Ainley, 1987; Byman, 1993; Olson & Camp, 1984). In addition, we measured the research variables through self-reports. As recommended by Podsakoff, MacKenzie, Lee, & Podsakoff (2003), we protected participants’ anonymity to reduce the
possibility of social desirability and acquiescence response sets, which are major sources of measurement error. We reduced evaluation apprehension by assuring respondents that there were no right or wrong answers, and we altered the order of the measures in the test battery at each site. Despite following these procedures, however, our results should be applied cautiously to similar research samples only.

Like Spielberger and Starr (1994), we consider this study to be an extension of, and complementary to, previous research results, which suggested that there are a number of distinct curiosity types. Our findings, based on the first CFA of adult curiosity measures with an independent sample, indicated that a three-factor interpretation of curiosity may provide an appropriate classification system for the construct. In addition to an intuitive appeal, our results empirically supported the notion that individuals express curiosity through information seeking (cognitive) and physical and social thrill seeking behaviors. Thus, humans are motivated by a combination for the need to answer questions in their daily lives and the need for new, diverse, intense, and complex physical and social sensations and experiences.

With our refined knowledge about curiosity’s conceptualization, scholars could begin to devise new psychometrically rigorous measurement tools associated with each type of curiosity that would guide productive new empirical research and theory building. For example, these new tools could be used in experimental studies in which the three kinds of curiosity could be manipulated to test their possible respective roles in children’s play, classroom learning, and academic achievement, or engagement in sports and extracurricular activities (e.g., debate, student government). We also could investigate the idea that social thrill seeking might be positive and useful developmentally in certain contexts (e.g., adolescent identity formation; Lightfoot, 1997), especially if the activity is not illegal or unnecessarily risky. Perhaps a refined social-thrill-seeking measure might address the positive possibilities of such behavior. Longitudinal studies could be designed with these three curiosity types in mind to examine how and why they might change and interact with human functioning over the lifespan. Piagetian, sociocultural, and information processing theory could be informed through exploring the three types of curiosity and their specific influences on cognitive development. The promising role of curiosity with regard to developing healthy attachments, forming an identity, growing optimally, and learning perceptually could be further clarified as well. Another productive extension of this research might be to observe actual curiosity-related behaviors related to the three identified curiosity dimensions and how they predict exploratory behavior and learning to corroborate these preliminary findings. This additional investigation is critical if the field of psychology is to move beyond this study to strongly acknowledge the significance of curiosity as a key ingredient of development (e.g., cognitive, social, emotional, spiritual, physical) and learning through new theory building, empirical validation, and meaningful application.
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