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### Revisiting the Conceptualization, Measurement, and Generation of Interest

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## Revisiting the Conceptualization, Measurement, and Generation of Interest

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This article provides an overview of recent interest research, focusing on the conceptualization, measurement, and generation of interest. It includes work that reflects differing theoretical backgrounds, research traditions, domains, and participants. Research on interest needs to be theoretically grounded if it is to be generally applicable and inform practice. Investigators must consider their own research questions, including learners' age and characteristics of the learning context, in relation to the range of conceptualizations in the field. Whereas researchers' questions should drive research on interest, their conceptualization of interest should inform their choice of measures. In addition, research addressing the ways in which interest might be generated and/or supported to develop should be aligned with both the conceptualization and measurement(s) of interest.

All normally functioning persons have a neurological predisposition to seek information and develop interest (Hidi, 2006). Even if they initially have low self-efficacy, lack academic goals for learning, and/or are not able to self-regulate, their interest can develop (see Palmer, 2009; Renninger, 2010). Despite the importance of interest for educational practice, research on interest is presently handicapped by a burgeoning number of articles in which the connections to complementary and relevant research questions are often lacking. This situation is a natural outgrowth of investigations that include seemingly disparate conceptualizations of interest and differences of participant age, disciplinary focus, learning context (in- or out-of-school), and/or measurement and research methods employed.

Referring to psychologists' discussions of learning more than six decades ago, Allport (1946) declared, "One of our greatest defects is our lack of a consistent or adequate theory of interest" (p. 341). This situation has not yet changed, but could. Whereas we do not presently have an adequate theory, there are many theoretically driven conceptualizations

of interest. By considering their similarities and differences, we may come closer to building a coherent theory. In addition, findings from the emerging field of neuroscience allow us for the first time to consider how interest as a theoretical construct could be related to the physiological functioning of humans and may eventually yield a new dimension for theory building.

In this article, we provide an overview of studies and reviews of interest research, focusing on publications in the last decade. We note that researchers' conceptualizations and the questions that drive their research on interest differ. We suggest that, for interest research to be generalizable and inform practice, conceptualizations of interest should determine the selection of measures and interpretations of how interest might be generated and/or supported to develop. We think that next steps in interest research need to be specified in a way that does not confound the measurement of interest and the interpretation of findings. Whereas these recommendations may not result immediately in "a consistent or adequate theory of interest," they should pave the way.

As a psychological variable, interest has a long history. In the late 19th and early 20th centuries, interest was referenced in the work of Baldwin (1897), Dewey (1913), James (1890), Piaget (1940), and Thorndike (1935), among others.

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However, it is only in the last 30 years that studies of interest have begun to be undertaken systematically. Although there have been multiple approaches to describing interest, the literature indicates that there are five characteristics of interest as a motivational variable on which many researchers agree. First, interest is content or object specific (e.g., Chen, Darst, & Pangrazi, 1999; Holland, 1985/1997; Krapp, Hidi, & Renninger, 1992; Silvia, 2006). It refers to an individual's focused attention and/or engagement with particular events and objects. Second, interest involves a particular relation between a person and the environment and is sustained through interaction: The potential for interest is in the genetic makeup of the person, and the content and the environment determine the direction of interest development (e.g., Barron, 2006; Sansone & Thoman, 2005; H. Schiefele, Krapp, Prenzel, Heiland, & Kasten, 1983). Third, interest has both cognitive and affective components, although the relative amount of each may vary depending on the phase of interest (e.g., Ainley, Hidi, & Berndorff, 2002; Harp & Mayer, 1997; Renninger & Wozniak, 1985). Fourth, a person is not always aware of his or her interest during engagement; the learner may not be aware of his or her interest being triggered, and in later phases of interest the learner may be so absorbed that he or she is not metacognitively aware during engagement (e.g., Krapp, 2005; Renninger & Hidi, 2002). Fifth, interest has a physiological/neurological basis; brain activations differ when a learner is and is not engaged with interest (e.g., Hidi, 2006; Kang et al., 2009; Palmer, 2009; Panksepp, 1998). In fact, Hidi (2011) specifically argued that interest is related to the reward circuitry, and thus interest functions as a reward.

Interest is now recognized to be a critical cognitive and affective motivational variable that guides attention (Hidi, 2001; McDaniel, Waddill, Finstad, & Bourg, 2000; Renninger & Wozniak, 1985; Schaffner & Schiefele, 2007; Silvia, 2005), facilitates learning in different content areas (Ainley et al., 2002; Denissen, Zarrett, & Eccles, 2007; Renninger, Ewen, & Lasher, 2002) and for learners of all ages (e.g., Harackiewicz, Barron, Tauer, & Elliot, 2002; Johnson, Alexander, Spencer, Leibham, & Neitzel, 2004; Nolen, 2007; Palmer, 2009), and develops through experience (Azevedo, 2006; Krapp & Lewalter, 2001; Renninger & Hidi, 2002). The way in which interest is generated and/or affects learning has been found to vary depending on whether a person is in an earlier or later phase of interest development (Harackiewicz, Durik, Barron, Linnenbrink, & Tauer, 2008; Hidi & Renninger, 2006; Krapp, 2007; Sansone & Thoman, 2005; U. Schiefele, 2009). For example, the phase of students' interest results in variations in (a) perceptions of autonomy and resulting interest experience across school subjects (Tsai, Kunter, Lüdtke, Trautwien, & Ryan, 2008), (b) receptivity to feedback (Lipstein & Renninger, 2007), (c) the negative effects of lack of feedback (Katz, Assor, Kanat-Maymon, & Bereby-Meyer, 2006), and (d) the effect of methylphenidate (Ritalin) on increasing dopamine production and invigoration of participants (Volkow et al., 2004). Moreover, undergradu-

ates with less interest for mathematics responded positively to task novelty, but those with more interest for mathematics were hampered by novelty (Durik & Harackiewicz, 2007).

Empirical studies have repeatedly shown declines in students' interest for school subject matter as students' levels of schooling increase (e.g., Denissen et al., 2007; Hidi, 2000), although interest of school-age students can develop with support from the tasks and/or the organization of the learning environment (Barron, Kennedy-Martin, Takeuchi, & Fithian, 2009; Frenzel, Goetz, Pekrun, & Watt, 2010; Guthrie et al., 2006; Nolen, 2007; Rotgans & Schmidt, 2011a). Moreover, Krapp and Lewalter's (2001) longitudinal study of business students revealed that although initial interest declined, new interests that represented refinements of the initial interest emerged.

Investigations further suggest that interest has a reciprocal relation to other motivational variables, such as goals (Harackiewicz et al., 2008; Renninger, Bachrach, & Posey, 2008), self-efficacy (Nieswandt, 2007), self-regulation (Sansone, 2009; Sansone, Weir, Harpster, & Morgan, 1992; see Hidi & Ainley, 2008), and achievement value (Frenzel et al., 2010; see Wigfield & Cambria, 2010). Findings also suggest that differences in the structure of domains (e.g., statistics and psychology) may impact interest (Lawless & Kulikowich, 2006).

Given the importance of the role of interest in learning, understanding how interest unfolds and can be supported to develop in and out of school is critical (Barron, 2006; Hofer, 2010; Renninger & Su, in press). In particular, there is a need to consider how interest is conceptualized, measured, and generated. If researchers are not clear that the level, or phase, of interest varies among students, then decisions about how to best support both the generation of interest specific to those with little to no interest and those with more developed interest can be obscured. For example, if researchers focus on developed interest and conceptualize it as a trait, then they may not recognize that students' interests could be nurtured and that lack of interest could be changed and become a future interest with support from others.

Research groups from all over the world are now conducting investigations of interest. The questions addressed and the methods employed are not always aligned and are frequently unrelated. Thinking and research addressing the conceptualization of interest continues to develop, although gaps between the conceptualization of interest and the methods used to study interest are not necessarily recognized (Krapp & Prenzel, 2011). Empirical work frequently does not describe the researchers' conceptualization of interest, and the links between conceptualizations and choices of measures and methods or interventions to generate interest are often not specified.

The following three sections of this article address the conceptualization, measurement, and generation of interest. Articles, chapters, and books on interest published in the last decade were identified using PsycINFO. There were 4,600

search returns in which the term “interest” appeared in the abstract with either of the keywords “motivation” or “learning,” within the range of publication years 2000 to 2010. To include a representative sample of studies, parsimonious selection was then undertaken to include a balance of perspectives related to the conceptualization, measurement, and generation of interest, including those conducted in different domains and with learners of varying ages. Because of their scope and consideration elsewhere, the particular relations between interest and achievement (e.g., Rotgans & Schmidt, 2011b; Wigfield & Cambria, 2010), interest and effort (e.g., Renninger, 2003), and interest and intrinsic motivation (e.g., Hidi, 2000; Hidi & Harackiewicz, 2000; Sansone, 2009; U. Schiefele, 2009) are not highlighted, and differences of interest and gender are referenced but not discussed in detail (e.g., Gardner, 1998; Krapp & Prenzel, 2011; Watt, 2004).

## CONCEPTUALIZATIONS OF INTEREST

In this section of the article, we overview current conceptualizations of interest in terms of their foci: development, emotion, task features/experience, value, or vocational interest. Although all researchers and practitioners have at least an implicit definition of interest, this overview includes only those who have written about the theoretical basis of their perspective. Potential complications of measurement are noted when present, as are next steps in the study of each conceptualization bearing on the generation and development of interest.

### Development

The development of interest has been the focus of the conceptualizations of both Hidi and Renninger (2006) and Krapp (2002, 2007). They have each described interest as being a psychological state and a predisposition to reengage particular disciplinary content over time that develops through the interaction of the person and his or her environment. Hidi and Renninger have focused on the role of interest in learning and development, whereas Krapp has been concerned with the relation between interest and the developing self over time.

*Hidi and Renninger.* Hidi and Renninger (2006) described a Four-Phase Model of Interest Development that extends earlier discussions of situational and individual interest undertaken with Krapp (e.g., Hidi, Renninger, & Krapp, 2004; Krapp et al., 1992). Based on findings from existing empirical studies, the four phases of interest are triggered situational, maintained situational, emerging individual, and well-developed individual interest.

They described the development of either a new or an existing interest as initiated when something catches the attention of a learner, a process called triggering (Dewey, 1913;

Hidi & Baird, 1986). The triggering process may be fleeting but can also allow interest to develop and yield maintained situational interest. Once interest is maintained, repeated engagement can be either self-initiated or promoted by the environment, leading to the development of first an emerging and then a well-developed individual interest. An important but often overlooked aspect of the model is that although situational interest represents the early phases of interest development, there are multiple possibilities for the person with a more developed individual interest to experience related situational interest (Bergin, 1999; Renninger & Hidi, 2002).

Phases in the development of interest are considered to be sequential and distinct and to represent a form of cumulative, progressive development in cases where interest is supported and sustained, either through the efforts of others or because of challenges or opportunities (Harackiewicz et al., 2008; Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Krapp & Lewalter, 2001; Nolen, 2007; Renninger & Hidi, 2002). However, interest may also fluctuate or fall off (Bergin, 1999; Renninger & Lipstein, 2006). The length and character of a given phase is influenced by individual experience, temperament, and genetic predisposition, as well as the learner's environment (Nolen, 2007; Renninger & Leckrone, 1991; Renninger & Riley, in press; Tsai et al., 2008).

Hidi and Renninger (2006) described each phase of interest as characterized by varying amounts of affect, knowledge, and value. Although the very earliest phases of interest might be considered to be an emotion and to have minimal knowledge requirements (Hidi, 2006; Reeve, Jang, Hardre, & Omura, 2002), Hidi and Renninger suggested that for interest to develop, knowledge and value, in addition to affect, need to be present. More specifically, they argued that although affect continues to be important, as interest develops and deepens, knowledge and value develop concurrently (Renninger & Hidi, 2002; Renninger & Riley, in press). Consequently, from this perspective the measurement of interest in later phases of interest development needs to account for knowledge and value as well as for feelings.

Precise measurements that can distinguish among the four phases of interest have not yet been developed. Constructing such measures is difficult because of the changing and individual nature of the relation among affect, value, and knowledge that is the presumed basis of movement between phases of interest. To inform practice, next steps for study of the model should address (a) when and how triggers work, (b) how movement between phases of interest occurs, and (c) what phase of interest is realistic and optimal for individual learners to obtain.

*Krapp.* Krapp's (2003, 2005, 2007) Educational-Psychological Conceptualization of interest is focused on the relation between interest and the person's growing awareness of self and need for integration of the self and his or her activity. In describing the individual's identification with interest, Krapp (e.g., 2007) pointed to the central role

of feelings and value in development and the role of “self-intentionality” of goal setting consistent with these (Krapp & Prenzel, 2011). He theorized the presence of three stages of development that parallel those identified by Hidi and Renninger (2006)—emerging situational, stabilized situational, and individual interest—and emphasized the relative stability of the stages of this sequence and relation to current activity (Krapp & Prenzel, 2011). He argued that although it is possible to learn something new without being aware, learning is more likely to occur if the learning process is personally significant (Krapp, 2003).

Krapp (2005, 2007) has suggested that interest development occurs through either conscious cognitive processes or less conscious or subconscious factors. However, he has also maintained that the affective and cognitive components of interest are two distinct systems that tend to act independently. Krapp (2007) posited that there are two levels of experience that serve as a control system for development and are primarily guided by emotions: the biological self and self-regulation that includes the forms of decision making with respect to future goals. Krapp (2002, 2005) also has made specific links between his work on interest and self-determination theory (Ryan & Deci, 2009). He connected the development of interest with psychological needs, suggesting that when psychological needs such as autonomy, competence, and social relatedness are satisfied, interest is generated.

Krapp and Prenzel (2011) described the need for effective measures that allow identification of both cognitive and affective components of interest. It is not clear what the implications of separating the physiological functioning (biological self) from goal generation are in this conceptualization, given that according to neuroscientific findings goal generation is inherently related to the brain’s reward mechanisms (Ernst & Spear, 2009). Next steps in the development of the Educational-Psychological Conceptualization of interest may include (a) investigating the possibility of a reciprocal relation among psychological needs and other motivational variables including interest as suggested by Hidi and Renninger (2006), and (b) accounting for fluctuations in interest once interest and identity are integrated.

## Emotion

Theoretical frameworks that focus on the state of interest as an emotion appear in the work of M. Ainley (2007; Ainley & Ainley, 2011) and Silvia (2006). Although each involves appraisals, Ainley’s work centers on interest and other emotional responses during interaction with a task, whereas Silvia is concerned with the source of the emotional response in a person’s engagement with the task.

*Ainley.* Ainley’s (2007; Ainley & Ainley, 2011) studies have addressed appraisal processes during the state of interest and their outcomes. She described interest as having

an important effect on both affective and cognitive functioning, although she focused on interest as an affective experience that can support learning. She described the experience of interest as related to choices and decisions made during task engagement as well as the disposition students bring to tasks.

Focusing on what she terms the “micro level” of students’ affective experience, she and her colleagues tracked the range and the temporal sequence of students’ experiences during engagement using the Between the Lines software that they developed (Ainley et al., 2002). Their findings suggest that (a) the state of interest is a key component of engagement and that (b) mood, disposition, and situation combine to influence students’ affective reactions to tasks. For example, individual interest was found to predict anticipated interest and to promote on-task engagement (e.g., Ainley, Corrigan, & Richardson, 2005; Ainley et al., 2002). More recently, Ainley and Ainley (2011) used data from the PISA international study of science achievement to suggest that value is a strong predictor of students’ enjoyment of science and that enjoyment mediates the predictive effects of value in learning science.

Understanding the longer term implications of a learner’s emotional state could be important for practice. Open questions for this conceptualization of interest include (a) whether interest as a psychological state remains the same when assessed over time, (b) what the impact of the prior state of interest on current engagement is, and (c) how the intensity and valence of affect changes with the development of interest.

*Silvia.* Following the work of Berlyne (1960) and focusing specially on perceptual appraisal in the arts, Silvia (2006, 2010) argued that interest is generated by collative variables such as novelty, unfamiliarity and complexity. In his *Psychology of Constructive Capriciousness* (Silvia, 2001), he distinguished between *interest* and *interests*. Interest was described as a basic emotion like happiness, fear, or anger that resides in an individual, whereas interests are defined as self-sustaining motives that lead people to engage idiosyncratically with objects and ideas for their own sake. Silvia also suggested that interest serves longer term goals of adaptation, such as cultivating knowledge and promoting diversified skills and experience and that interest develops through a process of magnification: repeated experience with qualitatively similar input. He described the process of magnification as initiating interest development.

In his research program, Silvia (2003, 2005; Turner & Silvia, 2006) measured and manipulated appraisals and ratings of interest for stimuli varying from random polygons to visual art and poetry. Findings from this work support his hypotheses that collative variables induce interest. For example, he found that novelty was a powerful trigger for interest. Furthermore, he and Turner (Turner & Silvia, 2006) argued that the emotion of interest is distinct from the emotion of

enjoyment. Specifically, Turner and Silvia (2006) examined the situational interest<sup>1</sup> of individuals looking at “disturbing” and at “calming” paintings and concluded that interest and pleasantness were essentially unrelated. They reported that disturbing pictures could be highly interesting but unpleasant, whereas calming pictures were highly pleasant but uninteresting.

Findings from this line of work are important because they suggest that measurement of enjoyment is not a proxy for interest, an issue that receives further discussion later in this article. However, the specific measurements associated with appraisals of collative variables that are the focus of this conceptualization of interest are unlikely to be directly applicable to educational practice because these measures are restricted to visual triggers. Further development of this conceptualization might be informed by neuroscientific research that suggests that (a) brain activation in response to interest may occur without conscious cognitive evaluation and (b) supports the distinction between interest and enjoyment (Berridge, Robinson, & Aldridge, 2009; Ernst & Spears, 2009).

### Task Features/Environment

Mayer (2005, 2008) and Sansone (e.g., 2009) have each addressed the experience of interest in their conceptualizations of interest. Mayer has focused more specifically on the features of tasks, particularly new media, whereas Sansone has been concerned with the motivation and activity of the participant as both contributing to and impacting interest.

*Mayer.* In his recent work, Mayer (2005, 2008) formulated a cognitive theory of multimedia learning in which he contended that meaningful learning can occur only if the learner attends to relevant stimuli and that the simultaneous presentation of visual and verbal materials is an optimal condition for learning. Findings indicate that highly interesting details, also termed seductive details, take processing capacity away from the learning of core materials (e.g., Mayer, Griffith, Jurkowitz, & Rothman, 2008).

Mayer’s earlier work drew on Kintsch’s (1981) distinction between cognitive and emotional interest. Harp and Mayer (1997) suggested that sources of “emotional interest” (entertaining text and illustrations) could be distinguished from “sources of cognitive interest” (adding support for structural understanding) and that interest elicited by sources, such as processing coherent text (cognitive interest), promoted a sense of positive affect about passages that led to increased learning. Schraw and Lehman (2001) have since pointed out that the distinction between emotional and cognitive interest has not been tested empirically and has links to situational

and individual interest have not been made. Furthermore, Hidi (2006) argued that both cognitive and affective systems may be involved to varying degrees in the processing of texts.

The implications of optimal conditions for presenting materials to learners are clearly relevant to practice. Next steps for research on this conceptualization may include developing measures that would allow testing whether emotional and cognitive interest are distinct, and describing (a) learner’s changing needs in their work with verbal and visual materials over time and (b) the role of prior states of interest on present engagement with verbal and visual materials.

*Sansone.* In their Self-Regulation of Motivation model, Sansone and her colleagues (e.g., Sansone & Harackiewicz, 1996; Sansone & Smith, 2000; Sansone & Thoman, 2005) highlighted the role of interest experience in addition to goal-defined experience in the process of self-regulation. An extension of the work on “flow” (Csikszentmihalyi, 1975) and on situational interest (see Hidi, 2001), interest experience was described as including both affect and cognition and as evolving in the interaction of the goals of undergraduate students, their activity, and features of the environment (e.g., Sansone & Thoman, 2005).

Sansone (2009) summarized findings from their experimental work as suggesting that although the anticipation of interest may lead to engagement, persistence depends on the quality of the interest experience. Individuals have been found to actively regulate their engagement and to influence their interest experience as a way to sustain motivation. They do this by shaping initial choices, self-regulatory strategies, persistence, and reengagement. Sansone and Thoman (2005) also noted that the nature of engagement affects the experience of interest and may be a goal in itself and that the process of self-regulating interest can delay or derail the outcomes that motivated initial engagement. They further noted that the interest experience itself can be a goal, one that may enhance and/or conflict with other goals such as achievement outcomes. Not surprisingly, differences in students’ initial interest for a task such as computing has also been found to affect their ability to work with additional information as well as their resulting interest experience (Sansone, Fraughton, Zachary, Butner, & Heiner, 2011).

Given that this conceptualization is based on studies of undergraduate participants, there are questions about how applicable the findings are for younger students. For example, it is important to find out how the process of self-regulating interest develops and at what age self-generation might be expected to occur. Further study to investigate changes in the interest experience with the development of interest would also be useful.

### Value

U. Schiefele (2001, 2009) and Eccles, Wigfield, and their colleagues (e.g., Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006) have conceptualized interest in terms of

<sup>1</sup>Although Turner and Silvia (2006) did not refer to their focus of investigation as situational interest, in the terminology used by most interest researchers, they have investigated situational interest.

value, in addition to feelings. U. Schiefele has concerned himself with the impact of interest on learning, whereas Eccles, Wigfield, and their colleagues have focused on expectancies.

*U. Schiefele.* In his consideration of the relation among situational interest, individual interest, and intrinsic motivation, U. Schiefele (2001, 2009) defined individual interest as a “set of valence beliefs.” He noted that beliefs are constructs that require continuous cognitive processing and suggested that when individual interest is activated, it directly impacts intrinsic motivation.

U. Schiefele (2009) distinguished between triggered and maintained situational interest as described in the Four Phase Model; however, he also suggested that interest ranges from being a singular focus of engagement, such as reading an intriguing text, to being a relatively enduring “value belief,” such as having an interest for disciplinary content (e.g., physics). U. Schiefele’s (2009) perspective is informed by findings from his and his colleagues’ Study Interest Questionnaire, which demonstrated that feelings (the respondents’ involvement with content), value (the importance of content), and intrinsic character (the choice to participate with the content) are associated and are not independent factors (U. Schiefele, Krapp, Wild, & Winteler, 1993). U. Schiefele, similarly to Krapp, considers the role of feelings and value to be distinct from knowledge and cognition in development. Unlike Krapp, however, U. Schiefele does not link the development of interest to a control system or to the psychological needs described by self-determination theory.

It is not clear how intrinsic motivation can be measured independently of interest. In addition, more information about interest being a belief is needed, given that beliefs are cognitive constructs and neuroscientific findings suggest that interest has neurological roots (e.g., Kang et al., 2009). Furthermore, if interest is a belief that can be developed, it could be important for practice to identify when and under what conditions this belief begins to develop.

*Eccles, Wigfield, and colleagues.* Eccles and Wigfield’s and their colleagues’ studies have focused on task interest as one of the major components of expectancy-value theory (e.g., Eccles et al., 1983; Wigfield et al., 2006). Their comprehensive research program has examined the influence of value for activity on motivation for achieving in school.

Wigfield et al. (2006) summarized findings from this research program as indicating that interest (defined as how much the respondent likes the activity) differentiates first, followed by the other components: utility (how useful the respondent finds the activity) and attainment value (how important the activity is for the respondent personally). They reported that elementary-school-age children could be expected to distinguish between activities based on interest and utility, whereas following Grade 5, students distinguished between activities based on interest, utility, and attainment value. Of importance to this conceptualization is the relation

among the task components; thus, interest value is considered to be “one type of value and must be considered in relation to other types of values in thinking about its relation to children’s engagement in different activities” (Wigfield & Cambria, 2010, p. 4).

Findings from expectancy-value theory have significantly contributed to identifying issues critical to matching learners to effective learning environments. In studies of the “stage-fit” of the student to the social environment of the school, home, and community, the match between the learner and the environment has been found to influence students’ motivation to succeed (e.g., Eccles & Midgley, 1989; see Wigfield et al., 2006, for a review). Systematic changes in the environment such as the inclusion of situationally interesting hands-on activities have been found to result in increases in comprehension and increased longer term motivation and reading comprehension (Guthrie et al., 2006). However, Guthrie et al. (2006) also reported that motivation was found to mediate the impact of these activities, underscoring the need to fit the environment to the learner. In their review, Wigfield and Cambria (2010) described decline in interest, ability perceptions, and achievement value among elementary and high school students as related to the quality of the learning environment.

Because studies of interest in the expectancy-value framework are focused on self-reported liking of a discipline/activity and the role of the environment as a support or constraint on these feelings, task interest focuses on feelings and does not include an assessment of knowledge. However, as Sansone (2009) noted, the “degree of interest” in this model is only one source of value; it is analyzed together with the assessment of importance, utility, and cost, to describe task value or expectancy value.

Current research in the field suggesting that positive emotions may not be adequate for explaining the motivating power of interest (Berridge et al., 2009; Ernst & Spear, 2009; Turner & Silvia, 2006) could raise questions for those who chose to use the single rating of liking as a measure of task interest. Further development of this conceptualization might include within- and between-participant studies using multiple measures, as suggested by Wigfield and Cambria (2010).

### Vocational Interest

Vocational interest is not a construct that is typically referenced in motivation research (Ainley, 2010; Krapp, 2007). Holland’s (1985/1997; see also Armstrong, Allison, & Rounds, 2008) theory of interest types is focused on interest in terms of a person’s current capacities and their potential links to occupations. J. M. Alexander, Johnson and their colleagues’ (e.g., J. M. Alexander, Johnson, Leibham, & Kelley, 2008) conceptual interest is similar to that of Holland, although it focused on young children and the implications of interest in particular types of activities for future engagements such as school, instead of occupations.

Lent, Brown, and Hackett's (1994) social cognitive career theory (SCCT) represents an extension of Holland's work to career counseling.

*Holland.* Holland's (1985/1997; see also Armstrong et al., 2008) conceptualization of interest focuses on the present skills and abilities of an individual and the relation between these and occupations (majors, training programs, etc.). Through extensive research, six characteristics have been identified that could be related to the requirements of different occupations. These include the skills and abilities of being realistic, investigative, artistic, social, enterprising, and conventional (RIASEC). RIASEC characteristics reflect both the individual and the potential work environment, described as being composed of those who successfully work together and who share attitudes and values.

Learners' RIASEC characteristics might be expected to map onto later phases of interest development. Although congruence between a person's RIASEC characteristics and their work environment has been found to result in success and satisfaction, measurement of interest based on this type of inventory gauges only the presence or absence of interest at the time of measurement. This conceptualization of interest does not address whether and how interest develops, nor does it address how an interest that does not already exist might be supported to develop.

*J. M. Alexander, Johnson, and colleagues.* Studies of conceptual interest that have focused on young children (J. M. Alexander et al., 2008), also termed "extremely intense interest" (DeLoache, Simcock, & Macari, 2007), have paralleled discussions of vocational interest. In these investigations, categories of interests with which children engage have been identified, for example, conceptual, socio-dramatic, creative arts, constructive/building, sports/dance, games with rules, literacy arts, skill, outside/physical activity, TV/radio, play with others (J. M. Alexander et al., 2008). Children are typically typed as having one or another conceptual interest and then the implications of different types of interests are considered in relation to the structure of knowledge, learning, and/or school transitions (e.g., DeLoache et al., 2007; Johnson et al., 2004). Rather than interest emerging in the interaction of the person and the environment, DeLoache et al. (2007) specifically suggested that extremely intense interest originates with the child and does not appear to be influenced by others.

Like measurement of vocational interests, measurement of conceptual interests focuses on interests that presently exist rather than how interest might be generated or supported to further develop. In fact, if interest is not understood to emerge in the interaction of the person and the environment, any conclusions about educational implications are difficult to identify. Further consideration for this conceptualization might include exploring both the age- and experience-related

development of conceptual interests within and between individuals.

*Lent, Brown, and Hackett.* Although focused on occupational choice, Lent, Brown, and Hackett (1994) described the building blocks of career development as including self-efficacy beliefs about the ability to succeed, outcome expectations or beliefs about performance in particular contexts, and personal goals. They described interest development as determined by the individual's perceptions of his or her own competence, or ability to succeed.

On one hand, their work suggests that if underrepresented minorities or women in science, technology, engineering, or mathematics do not think that they can pursue an occupation, they will not have an interest in pursuing it (Lent 2005). On the other hand, their work also suggests that faulty self-efficacy beliefs or outcome expectations can be modified through environmental support for successful experience (Brown & Lent, 1996). This conceptualization of interest points to the potential for interest both to develop and be supported to develop, although it also casts the lack of particular interests (e.g., women who do not have an interest in engineering) as deficits. Coordination of this line of research with questions addressed by conceptualizations of interest that focus on vocational interest (e.g., Holland, 1985/1997) and that focus on development of interest (e.g., Hidi & Renninger, 2006) could be beneficial.

## Summary

Each of the conceptualizations of interest overviewed focuses on a different aspect of the way in which individuals engage with particular content. Whereas the conceptualizations are grouped in terms of their emphasis on development, emotion, task features/environment, value, and vocational interest, there are also other ways to refer to them. Some, like Hidi and Renninger's, Krapp's, and U. Schiefele's, focus on the development of interest as unfolding through interactions with the environment. Others are concerned with how the environment is (a) perceived (Silvia; Lent, Brown, & Hackett), (b) responded to (Ainley), or (c) constructed (Mayer). Yet others have pointed to (a) the perceived value (Eccles, Wigfield, and colleagues) and the experience and activity needed for interested engagement (Sansone), or (b) the possibilities provided by developed interests (Holland; J. M. Alexander and colleagues).

The conceptualizations also vary in the extent to which affect, knowledge, and value are the focus of inquiry, although all acknowledge the role of affect, or feelings, as a component of interest. Knowledge and value as components of interest are included in the conceptualizations of Hidi and Renninger; Ainley; Silvia; Mayer; Sansone; Holland; J. M. Alexander, Johnson, and colleagues; and Lent, Brown, and Hackett. Finally, affect and value as established through

cognitive evaluation are the focus of Krapp; U. Schiefele; and Eccles, Wigfield, and their colleagues.

## MEASUREMENT OF INTEREST

Because conceptualizations of interest vary, they have different implications for how interest should be measured, and on what to focus if the goal is to support interest to develop. How interest is assessed reflects at least implicit assumptions about the conceptualization of interest. Use of self-report questions, for example, can provide information about the perceived experience and should only be used with care to assess the earliest phases of interest development because a respondent may not be aware of the triggering process.

As is the case in the measurement of many motivational variables, there are no established or agreed-upon methods for measuring interest and its development (see Murphy & Alexander, 2000). The lack of clear-cut guidelines reflects the challenge of assessing feeling, values, and knowledge as they develop, given that these are not directly observable. Some measures of interest, moreover, may include components that could alternately be regarded as antecedents or as outcomes, suggesting that the empirical relation is tautological.

Interest assessments in recent conference sessions range from self-ratings of interest versus boredom and/or intrinsic value, self-reporting of emotions including interest, the coupling of participant observation and in-depth interviews, to a survey designed to tap different components of interest. In the following section, various methods used in interest research are reviewed and their implications are considered.

### Self-Reports

Whether interviews or surveys, self-report measures require participants to rate or comment on the level of interest that they experience in a given situation. Self-report items vary from those that simply ask about interest (e.g., How interested are you in mathematics?) to those that ask about more complex components of interest (e.g., How likely are you to do a mathematics problem that is not assigned by the teacher?). Surveys (paper-and-pencil or online) may include forced choice, Likert ratings, and/or open-ended items. Interviews may be either structured or semistructured and may or may not also include tasks. The content of the items used to assess interest varies, as does the structure (the number, frequency, and validity of the items used).

As Frenzel, Dicke, Pekrun, and Goetz (2009) noted, the large number of empirical studies that have explored interest based on self-reporting suggest that researchers feel confident that these data can appropriately assess interest. However, there can be several potential complications in using this type of measurement. In the section that follows, we

discuss the content and structure of self-reports and point to some of these potential complications.

*The content of self-reports.* Ideally, the content of items researchers select to assess interest is consistent with their theoretical perspectives, content validated, and informed by prior research findings. However, the content of items selected to assess interest in self-reports tends to vary significantly. Researchers may conflate the affective and cognitive components of interest in their assessments (Krapp & Prenzel, 2011), address only the affective component, focus on the momentary psychological state of interest without considering further reengagement, or consider one component of interest such as affect (e.g., liking) in relation to other variables (e.g., expectancy value; Wigfield & Cambria, 2010).

When researchers consider the affective component central to general interest, the items they select address feelings (e.g., P. A. Alexander, Jetton, & Kulikowich, 1995; Tobias, 1994) and/or value (e.g., Chen et al., 1999; Linnenbrink-Garcia, et al., 2010; U. Schiefele et al., 1993). Those who also considered knowledge to be a component of interest, on the other hand, employed items that assess feelings, knowledge, and value (e.g., Haüssler & Hoffmann, 2002;<sup>2</sup> Renninger et al., 2002). However, sometimes the items researchers have selected are not aligned with the researchers' own working conceptualization of interest, which affects the data that are collected and their interpretation. For example, if a researcher's measure of interest is assessed based on liking alone, interpretation of data collected on the basis of these data cannot be interpreted as necessarily reflecting more developed interest (see Renninger & Su, in press). In other instances, the contents of the items researchers select for study may not be appropriate for other researchers' use and need to be recognized as such.

Frenzel et al. (2009) argued for the validation of item content based on age-group studied because of conceptual shifts they observed in their study of adolescents' mathematics interest. They found that younger students' answers to items used to assess mathematics interest were more related to affective experiences and expression of value, whereas older students' answers frequently expressed their concerns with thirst for knowledge and autonomy related to dealing with mathematics. These findings have serious implications for the use of quantitative self-measures of interest with participants of different ages more generally. That is, in order to guard against measurement variance, researchers must be assured that participants across age groups interpret items of a scale in a conceptually similar manner.

<sup>2</sup>Haüssler and Hoffmann's study was an investigation of the relation between interest, self-concept, and achievement in physics classes. They reported their findings as "results in the affective domain"; however, the items assess knowledge as well as feeling and value.

As previously discussed, another potential complication for the content of items in self-reports is the need to reflect on emerging findings. Although interest and enjoyment tend to be associated with positive affect and are correlated (e.g., Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000), evidence from both neuroscience and interest research suggests that measuring interest solely on the basis of positive feelings (e.g., liking, enjoyment) may not be appropriate (Berridge et al., 2009; Ernst & Spear, 2009; Harackiewicz et al., 2002; Turner & Silvia, 2006). Other researchers also have cautioned that negative affect may be associated with the experience of interest especially in the earlier phases of interest development (Ainley, 2007; Bergin, 1999; Hidi & Harackiewicz, 2000) and that in later phases of interest, negative affect (e.g., frustration) can be overcome by the focus that accompanies well-developed individual interest (Kim, Lee, & Bong, 2009; Renninger, 2000).

*Structure of self-reports.* In addition to varying by content, self-reports differ in the number of items employed and the frequency with which they are presented. For example, P. A. Alexander and Murphy (1998) measured student interest in the domain of educational psychology with a 7-point rating scale that tapped students' rating of interest (liking) for each of 26 topics. Information from this type of assessment clearly differs from studies that coupled Likert ratings of knowledge, feelings, and activity with open-ended items to gauge participation (Renninger et al., 2002), or used in-depth open-ended interviews that last 4 hr in order to determine interest (Fink, 1998).

Ainley and Patrick (2006) argued that even a single item may be sufficient for identifying the state of interest as an emotion (e.g., following the reading of text with a Likert rating of level of activation from bored to interested; see also discussions in Calder & Staw, 1975; Reeve, 1989). By itself, a single item provides a basis for classifying interest relative to others; however, it does not provide additional information about the nature and extent of present engagement or likelihood of reengagement. For purposes of understanding the relation of interest and other motivational variables, or understanding the trajectory of interest development, multiple sets of items provide more information, as do multiple sources of input, such as interviews with participants and parents (McHale, Kim, Dotterer, Crouter, & Booth, 2009; see also Organization for Economic Co-Operation and Development, 2007; Renninger et al., 2008).

In-depth retrospective interviews with individuals, for example, have proven to be a rich source of case material on interest in specific populations. Examples include Fink's (1998) study of accomplished people with dyslexia, Gisbert's (1998) study of women mathematicians, and Barron's (2006) study of adolescents' work with new media. Assessment of interest in each case was based on the researcher's judgment.

Surveys also have been used to gauge changes in interest over time when interest is not developed and the partici-

pant group is large and/or not previously studied. Items are sometimes repeated as part of pre- and postintervention assessments, or during the course of a particular task. Haüssler and Hoffmann (2002), for example, administered their survey of 21 items to study three dimensions of interest (individual interest for the domain of physics, interest in the topic, and interest in the activity with the topic) at three time points. Data from each allowed tracking of change in the various types of interest.

Building on the earlier work of U. Schiefele and Csikszentmihalyi (1994), experience sampling methods have been employed to track activity over time. For example, Krapp and Lewalter (2001) employed questionnaires and experience-sampling procedures to study the interest of business students. Their study was conducted over 2 years of vocational training; experience sampling was undertaken using programmable pocket calculators into which participants typed their responses. In-depth interviews also were conducted with participants at the end of each year of schooling, serving to further anchor the information gathered. Shernoff, Csikszentmihalyi, Schneider, and Steele Shernoff (2003; see also Shernoff, 2010) also employed experience-sampling methods to explore relations among concentration, situational interest, enjoyment, and flow, and based on the richness and range of data collected, they were also able to theorize about disengagement and its relation to the challenge of activity and needed skills.

## Behavioral Measures

The most common behavioral measure used in interest research is a combination of observation, ethnography, and/or use of video and may include participant observation in which the researcher has a role and is engaged as a participant while observing. Recently, in a study of middle school mathematics students, Renninger, Aragaki, and Ainley (2010) reported that a self-report survey that included open-ended questions and participant observation provided different insights into the students' interest. Whereas the survey data described students' perceptions of their engagements, observational data provided further information that the students were not yet in a position to realize about themselves (e.g., they were not consistent in their use of strategies and/or they repeatedly engaged one but not another type of mathematics question). Other forms of behavioral measures include online measures. Examples of these types of studies of interest follow.

*Observation/Ethnography/Video.* Sources of observational data range from institutional data about undergraduate psychology students' course reenrollments (e.g., Harackiewicz et al., 2002) to video footage of participation that allows microanalysis of adolescents' work with the mathematics and science in representational design (Azevedo, 2006) and chronicling the forms of environmental supports for middle-school-age students engaging new media

(Barron et al., 2009). Observation has also been coupled with self-reporting to understand the context of the learning environment such as the museum or the classroom. For example, Falk and Adelman (2003) coupled entry–exit interviews with unobtrusive tracking of individual visitors to an aquarium, measuring interest with self-report items and coupling this information with observations about the nature and quality of interactions with various exhibit components.

In classroom research, Nolen (2007) gathered information from primary school children about their interest for writing using self-report data and coupled these data with both observations and artifacts. By studying children in two classrooms longitudinally, she was positioned to describe pedagogical variations that contributed to and/or hampered the children's developing interest for writing. Similarly, Pressick-Kilborn and Walker (2002) used field notes kept by both the teacher and her students as data sources on interest development of individual fifth graders in science class. These data were coupled with informal interviews during lessons and semistructured interviews with selected students at three time points. Furthermore, some but not all of the interactions were audio- or videotaped to allow mapping of individual trajectories of interest development.

*Online measures.* To date, there has been limited use of the online environment as a tool for collecting behavioral measures of interest, although a few studies have made use of its potential for archiving what is essentially another form of observational data. As noted earlier, Ainley and her colleagues (e.g., Ainley, Hidi, & Berndorff, 2002; Graham, Tisher, Ainley, & Kennedy, 2008) have used the Between the Lines software to capture participants' responses during their work with tasks. This method allows study of change in affective responses during engagement and allows archiving of other complementary information such as participants' choice of text, perseverance, and goals.

In their study of mathematics teachers' interest for and learning from online professional development, Renninger, Cai, Lewis, Adams, and Ernest (2011) coupled a number of different online measures with self-reports to assess teachers' interest for mathematics and participation in online professional development. Their online measures included forced-choice and open-ended pre- and postworkshop self-reports, assessment of online contributions to discussions and blogs, and logfile analysis. They also conducted phone interviews with a subsample of the participants. Findings from the study indicated that there were different reasons for participation and, importantly, that participation alone could not be used as an assessment of interest.

Sansone et al. (2011) also combined self-report measures with behavioral measures in their study of the role of interest experience in undergraduates' learning of programming. They used online surveys with a control group and two interest-experience conditions (online and offline) to examine anticipated interest for beginner-level learning, and

its relation to participants' patterns of engagement (total frequency of accessing an optional example and exercise links; incidental recognition of words appearing on those pages), and patterns in self-reported interest for learning.

Another format being developed to assess interest online without directly involving self-reports is Ely, Ainley, and Pearce's (2010) My Interest Now for Engagement (MINE) tool. Developed for use with troubled adolescents who would not seriously complete traditional self-report measures, MINE is an "interactive and playful" environment. It provides respondents with a pool of 60 potential interests from which to select and through interaction also collects information about the cognitive and affective dimensions of interest experience. Preliminary findings supported the validity of the MINE tool and indicated that it allows participants to explore, trigger, and discover new interests.

### Neuroscientific Methods

Knutson and Wimmer (2007) asserted that techniques that can visualize neural activity are revolutionizing psychology. Neural imaging such as functional magnetic resonance imaging (fMRI) allows researchers to track changes in the deep regions in the brain by recording changes in blood oxygenation and indicating increased brain activity. Specifying brain regions that respond to interest is in its infancy. However, researchers have begun to make connections between reward mechanisms and interest.

An important study emerging from this literature is that of Kang et al. (2009). Although their work refers to what they examined as "curiosity" rather than "early phases of situational interest," their findings bear equally on early phases of interest and curiosity, as both are characterized by an internally driven search for novelty (Quintanilha, 2010). Using fMRI measures while individuals were reading trivia questions, Kang et al. (2009) found that participants' level of curiosity correlated with activity in a brain region (caudate) previously associated with anticipated rewards, suggesting that the presence of interest is associated with the activation of brain reward systems.

In another study, Kim et al. (2009) investigated the interactive effects of task interest and competence on brain activation during negative feedback. The findings indicated that interest played a buffering role against the potential detrimental effects of negative feedback. Of interest, this kind of buffering has been mentioned by interest researchers using measures other than brain activation as well (Katz et al., 2006; Tsai et al., 2008).

### Summary

Self-reporting is the most common form of interest measure employed, and the structure, content, and use of these reports have implications for what is assessed as well as how findings from such studies are interpreted.

Although it is not possible to specify which measure(s) should be used by researchers to assess interest in their studies, we suggest that they need to be aware of the options, the utility of triangulating methods, and the importance of aligning the methods they use with their intended conceptualization. It also appears that a key issue for researchers to consider is how others have assessed the same types of questions they are posing even if the disciplinary content or age-group varies.

## GENERATION OF INTEREST

One of the most critical questions in education concerns how interest can be generated. As Hidi and Harackiewicz (2000) observed, educational research needs to address how to motivate the academically unmotivated, and thus, support for the development of interest is essential. The section that follows provides an overview of studies that have focused on the generation of interest, sometimes termed “sources of interest.” This work extends studies of text-based interest that were undertaken in the mid-1980s that demonstrated that readers were interested in texts that included unusual, incongruent, surprising, or novel ideas they found important, could identify with, and/or that described actions and feelings (see Hidi & Berndorff, 2001, for a review). Its application has included involving learners in activity and modifying activities to increase engagement (Dunst & Raab, 2006). Researchers have now identified a wide range of activities and tasks that contribute to interest development, in addition to investigating self-generation of interest in situations where individuals modify a task or activity to trigger and/or increase their own interest.

### Activities and Tasks

Mitchell’s (1993) study in mathematics classrooms was the first to demonstrate how one could distinguish between activities that trigger situational interest and those that can maintain it. He found that group work and interaction with puzzles and computers were likely to trigger adolescents’ situational interest, whereas meaningfulness (personal relevance of the content) and involvement (the extent to which students are active participants) tended to be sources of maintained—that is, longer lasting—situational interest. Extending Mitchell’s work, Palmer (2004), for example, reported that student interest in his high school science classes was generated by novelty, meaningfulness, and involvement. In a subsequent publication, Palmer (2009) concluded that although novelty was the main source of situational interest, choice, physical activity, and social involvement also supported the generation of interest.

Chen et al. (1999) and Chen, Darst, and Pangrazi (2001) also used Mitchell’s work as a basis for their study of the cognitive demands of learners’ experiences in physical edu-

cation classes. They found that increased cognitive demand was related to learners’ experiencing a sense of novelty, challenge, high attention demands, and exploration and resulted in increased situational interest. These findings are consistent with those from studies of novel contexts, such as a webquest application in mathematics (Halat, 2008) and a web-based Global Ed simulation in social studies (Gehlbach et al., 2008). Both of these technological investigations resulted in the initial triggering of interest and maintained interest over time, findings corroborating a central role for novelty in learners making connections to content.

The potential of the structure, setting, facilitation, and selection of activities and tasks to generate interest has also been examined. Nolen (2007), for example, concluded that instruction that allowed students to interact with each other around the content to be learned contributed to the development of interest. Similarly, using the classroom as the unit of analysis, Cobb and Hodge (2004) documented the way in which providing opportunities for students to assume roles as data analysts needing to prepare arguments for a broader audience supported the development of classroom-level interest. Addressing the processes involved in facilitating the generation of interest, Thoman, Sansone, and Pasupathi (2007) summarized a series of studies that indicate the importance of the quality of interaction (eye contact, verbalization) on the experience and generation of interest. Boscolo, Ariasi, Del Favero, and Ballarin (2011) reported that the feature of tasks that contributed to the generation of interest were genre rather than text based in a reading-to-write activity that included three types of writing tasks.

Working in groups has also been studied as a context for facilitating the development of new interests. In their study of secondary vocational and undergraduate students, Boekaerts and Minnaert (2003) and Minnaert, Boekaerts, and DeBra-bander (2007) argued that situational interest was jointly and uniquely linked to the students’ psychological needs for autonomy, competence, and social relatedness. Situational interest and social relatedness could be predicted at each of the three stages of group work, although the roles of competence and autonomy as triggers for interest varied according to the stage of the task. Students’ feelings of competence during the early orientation stages of group work predicted situational interest and students’ need for autonomy predicted situational interest during execution and closing of the project (Boekaerts & Minnaert, 2003; Minnaert et al., 2007). In a related study, Hidi, Weiss, Berndorff, and Nolan (1998) reported that being assigned the role (goal) of group expert and given the opportunity to demonstrate knowledge to the group during a science museum visit was a powerful motivator of interest, especially for boys. The children in the target group happily spent up to 10 min trying to become “experts” and in some cases had to be coaxed into moving on from one exhibit to another, whereas the children who did not receive this intervention tended to spend less than 1 min with any given exhibit.

In the studies reviewed so far, the generation of interest was primarily organized or designed by other individuals (or groups): parents, teachers, or peers who have an assumed role in interest development, given that they created the learning environment, designed the tasks, provided instruction and information, and so forth. Opportunity to engage with others provides support for interest development and allows engagement with potential interests to be modeled and negotiated (Barron et al., 2009; Pressick-Kilborn & Walker, 2002). In this regard, the role of parents' (Dunst & Raab, 2006) and the teacher's (Long & Murphy, 2005) own interest for the content and its contribution to their students' interest for this same content cannot be overlooked.

Currently, cross-cultural studies of interest have begun to suggest the importance of not overgeneralizing findings about the generation of interest. For example, Lillemyr, Sobstad, Marder, and Flowerday (2010) examined cultural profiles among Aboriginal, Navajo, and Sauri student groups on interest in play, learning preference, self-concept, and motivational orientation. Whereas social relatedness was central for the motivation of all students, indigenous students tended to favor more traditional, teacher-directed concepts of play and learning as opposed to more autonomous activity. Ainley and Ainley (2011) also reported that the composition of students' science interest in the PISA assessments varies across countries with different historical and cultural traditions. It appears that comparing results collected on groups with similar demographic profiles may be appropriate, but comparison of groups that differ based on demographics may not be.

### Self-Generation of Interest

When learners seek and make use of resources in order to engage particular content, they are said to self-generate, or trigger, their own interest. Sansone and her colleagues' (e.g., Sansone et al., 1992) studies were the first to address the self-generation of interest. They found that undergraduates were able to recognize boredom and were positioned by both age and experience to make initially uninteresting tasks interesting (e.g., redefining the task as an opportunity to learn). More recently, they have also suggested that when individuals with less rather than more prior interest used a strategy to make a task interesting for themselves, this was predictive of their continued engagement (Sansone, 2009).

Azevedo (2006) reported that interest is more likely to be self-generated when learners have time, flexibility, and feelings of competence. Several other studies suggest that students may also self-generate interest if tasks are not challenging enough and/or the learning environment supports them to self-regulate their activity. Meyer and Turner (2002), for example, reported that a middle-school-age student intentionally increased the challenges of a writing assignment to make it more interesting by writing more than the one required sentence. Their findings are similar to Kunter, Baumert, and

Koeller (2007), who also reported that the opportunity to self-regulate activity supports and sustains interest.

In a series of studies, Hulleman et al. (2008; see also Hulleman & Harackiewicz, 2009) also have suggested that students can be supported to self-generate interest if they are required to reflect on task value. In their studies, the assignment to self-generate explanations of value for semester-long courses led students to make connections between their own lives and what they would be learning in the course. This resulted in the triggering of interest that became self-generated.

### Summary

Educational research addressing the generation of interest has focused on the potential to use activities and tasks to support the development of interest. The importance of novelty, challenge, and the role of others emerged as significant features of these activities and tasks. Moreover, the findings suggest that educators can provide students with goals such as assuming the role of the expert and participating as part of a group or in a community as supports for students' interest.

Differences in the disciplinary content and the wide range of age groups on which studies of interest generation draw should be noted. Although caution is needed to recognize that there are differences of cultural context (e.g., Ainley & Ainley, 2011), considering links among studies addressing the generation of interest is also needed. Often studies of the generation of interest build on research from a specific disciplinary domain and/or one participant group. Given the relatively recent effort to systematically study the generation of interest and the need to determine how the interest of all learners might be developed, researchers should be encouraged to consider all available data across domains and with varying age groups in addressing their research questions. For example, a study of group work in mathematics could be usefully informed by middle-school-age students' work in cooperative groups in at a science museum. Considering the generation of interest across domains and age groups should enable interest research to advance and be more generalizable.

### CONCLUSIONS

In this article we have suggested that differences among conceptualizations of interest have implications for how interest should be measured and on what to focus in order to support interest to develop. Although no unequivocal conclusions can be made about the primacy of particular conceptualizations, measurements, or methods of generating interest, this article should provide readers with a better understanding of their options for conducting interest research that will contribute to building what Allport might have considered an "adequate" theory of interest.

We have suggested that researchers need to align their measures with their theoretical framework in reporting

findings. We have urged researchers to consider findings from others working with similar measures, and also those who are addressing similar questions with other measures, varying disciplinary domains, and/or with different age groups. Building an adequate theory involves drawing on all existing information, its similarities, and differences.

For research to inform practice, the questions of practice—those addressing how interest can be generated and sustained for learners who have little interest and for those whose interest is already well developed—need to be seriously and systematically addressed. Information about how interest is triggered and then sustained in earlier and later phases of interest needs to be understood, as does information about how shifts between earlier and later phases of interest take place and why fluctuations in interest occur.

To date, many conceptualizations of interest are not developmental in the sense that they do not detail change between earlier and later phases of interest development. Instead, they focus on issues that can be related to one or another phase of interest and/or that apply to all phases in the development of interest, although whether information gathered is specific to an earlier or a later phase of interest is not assessed. Those conceptualizations of interest that have addressed change have tended to do so using the distinction between situational and individual interest that forms the basis of the Four-Phase Model.

There is a need to develop models that predict the strengths and needs of learners based on age-related development as well. Qualitative data suggest that all typically functioning learners can develop interest at any age. Given findings suggesting disciplinary difference between domains (e.g. hierarchical, vertical organization), age-related differences in self-representation, or identity, it would be particularly useful to track the development of interest in different types of disciplines.

To date, findings from research undertaken from the perspective of different conceptualizations strongly suggest that interest can be nurtured and supported to develop through interactions with others and/or the design of the learning environment. Interest appears to have enabled learners of varying ages, across disciplines both in and out of school contexts, to make the types of connections to content that result in learning. Moreover, in studies that have tracked interest over time, or controlled for its presence, interest has been found to be a mediator of learning, and reciprocally related to self-efficacy, goal setting, and the ability to self-regulate. These findings are provocative and suggest that interest is a variable that needs to be better understood. Interest research is just beginning to provide information that can be useful to practice. However, knowing that interest has a reciprocal relation to self-regulation, for example, does not enable the educator to know how to support self-regulation to develop. Existing findings need to be further nuanced, considered in relation to each other, and used to identify principles that can be tested and refined. This would pave the way to an adequate theory.

In summary, interest researchers appear poised to significantly impact understanding of interest and its role in learning and, in turn, its possibilities for practice. However, if research on interest is to be generally applicable and inform practice, there is a need for it to be theoretically grounded. Investigators need to consider their own research questions, including learners' age and characteristics of the learning context, in relation to the range of conceptualizations in the field. Although researchers' questions should drive research on interest, their conceptualization of interest should inform their choice of measures. In addition, research addressing the ways in which interest might be generated and/or supported to develop should be aligned with both the conceptualization and measurement of interest.

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## REFERENCES

- Ainley, M. (2007). Being and feeling interested: Transient state, mood, and disposition. In P. Schutz (Ed.), *Emotion in education* (pp. 141–157). New York, NY: Academic Press.
- Ainley, M. (2010). Interest in the dynamics of task behavior: Processes that link person and task in effective learning. In T. C. Urdan & S. A. Karabenick (Eds.), *The decade ahead: Theoretical perspectives on motivation and achievement Volume 16A: Advances in motivation and achievement* (pp. 235–264) Bingley, UK: Emerald.
- Ainley, M., & Ainley, J. (2011). Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about sciences. *Contemporary Educational Psychology*, 36(1), 4–12.
- Ainley, M., Corrigan, M., & Richardson, N. (2005). Students, tasks, and emotions: Identifying the contribution of emotions to students' reading of popular culture and popular science texts. *Learning and Instruction*, 15, 433–447.
- Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology*, 94, 545–561.
- Ainley, M., & Patrick, L. (2006). Measuring self-regulated learning processes through tracking patterns of student interaction with achievement activities. *Educational Psychology Review*, 18, 267–286.
- Alexander, J. M., Johnson, K. E., Leibham, M. E., & Kelley, K. (2008). The development of conceptual interests in young children. *Cognitive Development*, 23, 324–334.
- Alexander, P. A., Jetton, T. L., & Kulikowich, J. M. (1995). Interrelationship of knowledge, interest, and recall: Assessing a model of domain learning. *Journal of Educational Psychology*, 87, 559–575.
- Alexander, P. A., & Murphy, P. K. (1998). Profiling the differences in students' knowledge, interest, and strategic processing. *Journal of Educational Psychology*, 90, 435–447.
- Allport, G. W. (1946). Effect: A secondary principle of learning. *Psychological Review*, 53, 335–347.

- Armstrong, P. I., Allison, P., & Rounds, J. (2008). Development and initial validation of brief public domain RIASEC marker scales. *Journal of Vocational Behavior*, 73, 287–299.
- Azevedo, F. S. (2006). Personal excursions: Investigating the dynamics of student engagement. *International Journal of Computers for Mathematical Learning*, 11, 57–98.
- Baldwin, J.M. (1897). The psychology of social organization. *Psychology Review*, 4, 482–515.
- Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development*, 49, 193–224.
- Barron, B., Kennedy-Martin, C., Takeuchi, L., & Fithian, R. (2009). Parents as learning partners in the development of technological fluency. *International Journal of Learning and Media*, 1, 55–77.
- Bergin, D. (1999). Influences on classroom interest. *Educational Psychologist*, 34, 87–98.
- Berlyne, D. (1960). *Conflict, arousal, and curiosity*. New York, NY: McGraw-Hill.
- Berridge, K. C., Robinson, T. E., & Aldridge, J. W. (2009). Dissecting components of reward: “Liking,” “wanting,” and learning. *Current Opinion in Pharmacology*, 9(1), 65–73.
- Boekaerts, M., & Minnaert, A. (2003). Measuring behavioral change processes during an ongoing innovation program: Scope and limits. In E. DeCorte, L. Verschaffel, N. Entwistle, & J. Merriënboer (Eds.), *Powerful learning environments* (pp. 71–87). New York, NY: Pergamon.
- Boscolo, P., Ariasi, N., Del Favero, L., & Ballarin, C. (2011). Interest in an expository text: How does it flow from reading to writing? *Learning and Instruction*, 21(3), 467–480.
- Brown, S., & Lent, R. (1996). A social cognitive framework for career choice counseling. *The Career Development Quarterly*, 44, 355–367.
- Calder, B. J., & Staw, B. M. (1975). Self-perception of intrinsic and extrinsic motivation. *Journal of Personality and Social Psychology*, 31, 599–605.
- Chen, A., Darst, P. W., & Pangrazi, R. P. (1999). What constitutes situational interest? Validating a construct in physical education. *Measurement in Physical Education and Exercise Science*, 3, 157–180.
- Chen, A., Darst, P. W., & Pangrazi, R. P. (2001). An examination of situational interest and its sources. *British Journal of Educational Psychology*, 71, 383–400.
- Cobb, P., & Hodge, L. (2004, June). *An initial contribution to the development of a design theory of mathematical interests: The case of statistical data analysis*. Paper presented as part of the symposium Design Theories of Interest, Motivation, and Engagement for the Learning Sciences, Sixth International Conference of the Learning Sciences, Santa Monica, CA.
- Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety: Experiencing flow in work and play*. San Francisco, CA: Jossey-Bass.
- DeLoache, J. S., Simcock, G., & Macari, S. (2007). Planes, trains, automobiles—and tea sets: Extremely intense interests in very young children. *Developmental Psychology*, 43, 1579–1586.
- Denissen, J. H., Zarrett, N. R., & Eccles, J. S. (2007). “I like to do it, I’m able, and I know I am”: Longitudinal couplings between domain-specific achievement, self-concept, and interest. *Child Development*, 78, 430–447.
- Dewey, J. (1913). *Interest and effort in education*. Boston, MA: Riverside.
- Dunst, C. J., & Raab, M. (2006). *Influence of child interests on variations in child behavior and functioning*. Ashville, NC: Winterberry.
- Durik, A., & Harackiewicz, J. M. (2007). Different strokes for different folks: How individual interest moderates the effects of situational factors on task interest. *Journal of Educational Psychology*, 99, 597–610.
- Eccles, J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J., & Midgley, C. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). San Francisco, CA: Freeman.
- Eccles, J. P., & Midgley, C. (1989). State/environment fit: Developmentally appropriate classrooms for early adolescents. In R. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol. 3, pp. 139–181). New York, NY: Guilford.
- Ely, B. M. W., Ainley, M., & Pearce, J. (2010, September). *A new method for identifying dimensions of interest: MINE*. Paper presented at the International Conference on Motivation, Porto, Portugal.
- Ernst, M., & Spear, L.P. (2009). Reward systems. In M. de Haan & M. R. Gunnar (Eds.), *Handbook of developmental social neuroscience* (pp. 324–341). New York, NY: Guilford.
- Falk, J. H., & Adelman, L. M. (2003). Investigating the impact of prior knowledge and interest on aquarium visitor learning. *Journal of Research in Science Teaching*, 40, 163–176.
- Fink, R. (1998). Interest, gender, and literacy development in successful dyslexics. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.), *Interest and learning: Proceedings of the Seon Conference on Interest and Gender* (pp. 402–408). Kiel, Germany: IPN.
- Frenzel, A. C., Dicke, A. L., Pekrun, R., & Goetz, T. (2009, August). *Development of mathematics interest in adolescence: Quantitative and qualitative insights*. Paper presented at the meeting of the European Association on Learning and Instruction, Amsterdam, The Netherlands.
- Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence*, 20, 507–537.
- Gardner, P. L. (1998). The development of males’ and females’ interests in science and technology. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.), *Interest and learning: Proceedings of the Seon conference on interest and gender* (pp. 41–57). Kiel, Germany: IPN.
- Gehlbach, H., Brown, S. W., Ioannou, A., Boyer, M. A., Hudson, N., Niv-Solomon, A., . . . Janik, L. (2008). Increasing interest in social studies: Social perspective taking and self-efficacy in stimulating simulations. *Contemporary Educational Psychology*, 33, 894–914.
- Gisbert, K. (1998). Individual interest in mathematics and female gender identity: Biographical case studies. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.), *Interest and learning: Proceedings of the Seon conference on interest and gender* (pp. 387–401). Kiel, Germany: IPN.
- Graham, J., Tisher, R., Ainley, M., & Kennedy, G. (2008). Staying with the text: The contribution of gender, achievement orientations, and interest to students’ performance on a literacy task. *Educational Psychology*, 28, 757–776.
- Gutherie, J. T., Wigfield, A., Humenick, N. H., Perencevich, K. C., Taboada, A., & Barbosa, P. (2006). Influences of stimulating tasks on reading motivation and comprehension. *Journal of Educational Research*, 99, 232–247.
- Halat, E. (2008). The effect of designing webquests on the motivation of pre-service elementary school teachers. *International Journal of Mathematical Education in Science and Technology*, 39, 793–802.
- Harackiewicz, J. M., Barron, K. E., Tauer, J. M., Carter, S. M., & Elliot, A. J. (2000). Short-term and long-term consequences of achievement goals: Predicting interest and performance over time. *Journal of Educational Psychology*, 92, 316–330.
- Harackiewicz, J. M., Barron, K. E., Tauer, J. M., & Elliot, A. J. (2002) Predicting success in college: A longitudinal study of achievement goals and ability measures as predictors of interest and performance from freshman year through graduation. *Journal of Educational Psychology*, 94, 562–575.
- Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, 100(1), 105–122.
- Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology*, 89(1), 92–102.
- Häussler, P., & Hoffmann, L. (2002). An intervention study to enhance girls’ interest, self-concept, and achievement in physics classes. *Journal of Research in Science Teaching*, 39, 870–888.

- Hidi, S. (2000). An interest researcher's perspective: The effects of extrinsic and intrinsic factors on motivation. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 311–342). New York, NY: Academic Press.
- Hidi, S. (2001). Interest, reading and learning: Theoretical and practical considerations. *Educational Psychology Review*, *13*, 191–210.
- Hidi, S. (2006). Interest: A motivational variable with a difference. *Educational Research Review*, *7*, 323–350.
- Hidi, S. (2011). Linking neuroscientific research to interest research: Theoretical and empirical considerations. In P. A. O'Keefe & I. Plante (Chairs), *Developments in interest theory and research*. Symposium conducted at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Hidi, S., & Ainley, M. (2008). Interest and self-regulation: Relationships between two variables that influence learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and application* (pp. 77–109). Mahwah, NJ: Erlbaum.
- Hidi, S., & Baird, W. (1986). Interestingness—A neglected variable in discourse processing. *Cognitive Science*, *10*, 179–194.
- Hidi, S., & Berndorff, D. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review*, *13*, 191–209.
- Hidi, S., & Harackiewicz, J. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research*, *70*, 151–179.
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest Development. *Educational Psychologist*, *41*, 111–127.
- Hidi, S., Renninger, K. A., & Krapp, A. (2004). Interest, a motivational variable that combines affective and cognitive functioning. In D. Y. Dai & R. J. Sternberg (Eds.), *Motivation, emotion, and cognition: Integrative perspectives on intellectual functioning and development* (pp. 89–115). Mahwah, NJ: Erlbaum.
- Hidi, S., Weiss, J., Berndorff, D., & Nolan, J. (1998). The role of gender, instruction and a cooperative learning technique in science education across formal and informal settings. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.), *Interest and learning: Proceedings of the Seon conference on interest and gender* (pp. 215–227). Kiel, Germany: IPN.
- Hofer, M. (2010). Adolescents' development of individual interests: A product of multiple goal regulation? *Educational Psychologist*, *45*, 149–166.
- Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments*. Englewood Cliffs, NJ: Prentice Hall. (Original work published 1985)
- Hulleman, C. S., Durik, A. M., Schweigert, S. A., & Harackiewicz, J. M. (2008). Task values, achievement goals, and interest: An integrative analysis. *Journal of Educational Psychology*, *100*, 398–416.
- Hulleman, C., & Harackiewicz, J. (2009). Promoting interest and performance in high school science classes. *Science*, *326*, 1410–1412.
- James, W. (1890). *The principles of psychology*. London: Macmillan.
- Johnson, K. E., Alexander, J. M., Spencer, S., Leibham, M. E., & Neitzel, C. (2004). Factors associated with the early emergence of intense interests within conceptual domains. *Cognitive Development*, *19*, 325–343.
- Kang, M. J., Hsu, M., Krajbich, I., Loewenstein, G., McClure, S., Tao-yi Wang, J., & Camerer, C. (2009). The wick in the candle of learning: Epistemic curiosity activates reward circuitry and enhances memory. *Psychological Science*, *20*, 963–973.
- Katz, I., Assor, A., Kanat-Maymon, Y., & Bereby-Meyer, Y. (2006). Interest as a motivational resource: Feedback and gender matter, but interest makes the difference. *Social Psychology of Education*, *9*, 27–42.
- Kim, S., Lee, M. J., & Bong, M. (2009, April). *fMRI study on the effects of task interest and perceived competence during negative feedback processing*. Paper presented at the Meetings of the American Educational Research Association, San Diego, CA.
- Kintsch, W. (1981). Aspects of text comprehension. *Psychology Bulletin*, *35*, 777–787.
- Knutson, B., & Wimmer, G. E. (2007). Reward: Neural circuitry for social valuation. In E. Harmon-Jones & P. Winkielman (Eds.), *Social neuroscience: Integrating biological and psychological explanations of social behavior* (pp. 157–175). New York, NY: Guilford.
- Krapp, A. (2002). An educational–psychological theory of interest and its relation to SDT. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 405–427). New York, NY: University of Rochester Press.
- Krapp, A. (2003). Interest and human development: An educational–psychological perspective. In L. Smith, C. Rogers, & P. Tomlinson (Eds.), *Development and motivation: Joint perspectives* (pp. 57–84). *British Journal of Educational Psychology Monograph Series*, *2* (Series II).
- Krapp, A. (2005). Basic needs and the development of interest and intrinsic motivational orientations. *Learning and Instruction*, *12*, 383–409.
- Krapp, A. (2007). An educational–psychological conceptualization of interest. *International Journal of Educational and Vocational Guidance*, *7*, 5–21.
- Krapp, A., Hidi, S., & Renninger, K. A. (1992). Interest, learning, and development. In K. A. Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 3–25). Hillsdale, NJ: Erlbaum.
- Krapp, A., & Lewalter, D. (2001). Development of interests and interest-based motivational orientations: A longitudinal study in vocational school and work settings. In S. Volet & S. Järvelä (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications* (pp. 209–232). New York, NY: Elsevier.
- Krapp, A., & Prenzel, M. (2011). Research on interest in science: Theories, methods, and findings. *International Journal of Science Education*, *33*, 27–50.
- Kunter, M., Baumert, J., & Koller, O. (2007). Effective classroom management and the development of subject-related interest. *Learning and Instruction*, *17*, 494–509.
- Lawless, K. A., & Kulikowich, J. M. (2006). Domain knowledge and individual interest: The effects of academic level and specialization in statistics and psychology. *Contemporary Educational Psychology*, *31*, 30–43.
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, *45*, 79–122.
- Lent, R. W., Brown, S. D., Sheu, H-B., Schmidt, J., Brenner, B. R., Gloster, C. S., ... Treistman, D. (2005). Social cognitive predictors of academic interests and goals in engineering: Utility for women and students at historically black universities. *Journal of Counseling Psychology*, *52*, 84–92.
- Lillemyr, O. F., Sobstad, F., Mader, K., & Flowerday, T. (2010). A multicultural perspective on play and learning in primary school. *European Early Childhood Education Research Journal*, *18*, 243–267.
- Linnenbrink-Garcia, L., Durik, A. M., Conley, A. M., Barron, K. E., Tauer, J. M., Karabenick, S. A., & Harackiewicz, J. M. (2010). Measuring situational interest in academic domains. *Educational and Psychological Measurement*, *70*, 647–671.
- Lipstein, R., & Renninger, K. A. (2007). "Putting things into words": 12–15-year-old students' interest for writing. In P. Boscolo & S. Hidi (Eds.), *Motivation and writing: Research and school practice* (pp. 113–140). New York, NY: Kluwer Academic/Plenum Press.
- Long, J. R., & Murphy, P. K. (2005, April). Connecting through the content: The responsiveness of teacher and student interest in a required course. In T. Flowerday (Chair), *New directions in the study of interest and engagement*. Symposium conducted at the meeting of the American Educational Research Association. Montreal, Canada.
- Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 31–48). New York, NY: Cambridge University Press.

- Mayer, R. E. (2008). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. *American Psychologist*, 63, 760–769.
- Mayer, R. E., Griffith, E., Jurkowitz, I. T. N., & Rothman, D. (2008). Increased interestingness of extraneous details in a multimedia science presentation leads to decreased learning. *Journal of Experimental Psychology: Applied*, 14, 329–339.
- McDaniel, M. A., Waddill, P. J., Finstad, K., & Bourg, T. (2000). The effects of text-based interest on attention and recall. *Journal of Educational Psychology*, 92, 492–502.
- McHale, S. M., Kim, J. Y., Dotterer, A. M., Crouter, A. C., & Booth, A. (2009). The development of gendered interests and personality qualities from middle childhood through adolescence: A biosocial analysis. *Child Development*, 80, 482–495.
- Meyer, D. K., & Turner, J. C. (2002). Discovering emotion in classroom motivation research. *Educational Psychologist* 37, 107–114.
- Minnaert, A., Boekaerts, M., & DeBrabander, C. (2007). Autonomy, competence, and social relatedness in task interest within project-based education. *Psychological Reports*, 101, 574–586.
- Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology*, 85, 424–436.
- Murphy, P. K., & Alexander, P. A. (2000). A motivated exploration of motivation terminology. *Contemporary Educational Psychology*, 25, 3–53.
- Nieswandt, M. (2007). Student affect and conceptual understanding in learning chemistry. *Journal of Research in Science Teaching*, 44, 908–937.
- Nolen, S. B. (2007). Young children's motivation to read and write: Development in social contexts. *Cognition and Instruction*, 25, 219–270.
- Organization for Economic Co-Operation and Development. (2007). *PISA 2006: Science competencies for tomorrow's world: Volume 1: Analysis*. Paris, France: OECD.
- Palmer, D. H. (2004). Situational interest and the attitudes towards science of primary teacher education students. *International Journal of Science Education*, 26, 895–908.
- Palmer, D. H. (2009). Student interest generated during an inquiry skills lesson. *Journal of Research in Science Teaching*, 46, 147–165.
- Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotion*. New York, NY: Oxford University Press.
- Piaget, J. (1940). The mental development of the child. In D. Elkind (Ed.), *Six psychological studies* (pp. 3–73). New York, NY: Random House.
- Pressick-Killborn, K., & Walker, R. (2002). The social construction of interest in a learning community. In D. M. McInerney & S. Van Etten (Eds.), *Research on sociocultural influences on motivation and learning: Vol. 2* (pp. 153–182). Greenwich, CT: Information Age.
- Quintanilha, A. (2010, September). *Promoting curiosity and understanding risk*. Keynote address presented at the International Conference on Motivation, Porto, Portugal.
- Reeve, J. (1989). The interest-enjoyment distinction in intrinsic motivation. *Motivation and Emotion*, 13, 83–103.
- Reeve, J., Jang, H., Hardre, P., & Omura, M. (2002). Providing a rationale in an autonomy-supportive way as a strategy to motivate others during an uninteresting activity. *Motivation and Emotion*, 26, 183–207.
- Renninger, K. A. (2000). Individual interest and its implications for understanding intrinsic motivation. In C. Sansone and J. M. Harackiewicz (Eds.), *Intrinsic motivation: Controversies and new directions* (pp. 373–404). San Diego, CA: Academic.
- Renninger, K. A. (2003). Effort and interest. In J. Guthrie (Gen. Ed.), *The encyclopedia of education* (2nd ed., pp. 704–707). New York, NY: Macmillan.
- Renninger, K. A. (2010). Working with and cultivating interest, self-efficacy, and self-regulation. In D. Preiss & R. Sternberg (Eds.), *Innovations in educational psychology: Perspectives on learning, teaching and human development* (pp. 107–138). New York, NY: Springer.
- Renninger, K. A., Aragaki, W. S. N., & Ainley, M. (2010, September). *Identifying the phase of student interest in mathematics for a study of classroom practices for at-risk students*. Paper presented at the International Conference on Motivation, Porto, Portugal.
- Renninger, K. A., Bachrach, J. E., & Posey, S. K. E. (2008). Learner interest and achievement motivation. In M. L. Maehr, S. Karabenick, & T. Urdan (Eds.), *Social psychological perspectives Volume 15: Advances in motivation and achievement*. (pp. 461–491). Bingley, UK: Emerald.
- Renninger, K. A., Cai, M., Lewis, M., Adams, M., & Ernst, K. (2011). Motivation and learning in an online, unmoderated, mathematics workshop for teachers. *Educational Technology, Research and Development*, 59, 229–247.
- Renninger, K. A., Ewen, E., & Lasher, A. K. (2002). Individual interest as context in expository text and mathematical word problems. *Learning and Instruction*, 12, 467–491.
- Renninger, K. A., & Hidi, S. (2002). Student interest and achievement: Developmental issues raised by a case study. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation* (pp. 173–195). New York, NY: Academic Press.
- Renninger, K. A., & Leckrone, T. G. (1991). Continuity in young children's actions: A consideration of interest and temperament. In L. Oppenheimer & J. Valsiner (Eds.), *The origins of action: Interdisciplinary and international perspectives* (pp. 205–238). New York, NY: Springer-Verlag.
- Renninger, K. A., & Lipstein, R. (2006). Come si sviluppa l'interesse per la scrittura; Cosa vogliono gli studenti e di cosa hanno bisogno? [Developing interest for writing: What do students want and what do students need?] *Età Evolutiva*, 84, 65–83.
- Renninger, K. A., & Riley, K., (in press). Interest, cognition, and the case of L\_\_\_ and science. In S. Kreitler (Ed.), *Cognition and motivation: Forging an interdisciplinary perspective*. New York, NY: Cambridge University Press.
- Renninger, K. A., & Su, S. (in press). Interest and its development. In R. Ryan (Ed.), *Oxford handbook of motivation*. New York, NY: Oxford University Press.
- Renninger, K. A., & Wozniak, R. (1985). Effect of interest on attentional shift, recognition, and recall in young children. *Developmental Psychology*, 21, 624–632.
- Rotgans, J. I., & Schmidt, H. G. (2011a). The role of teachers in facilitating situational interest in an active-learning classroom. *Teaching and Teacher Education: An International Journal of Research and Studies*, 27(1), 37–42.
- Rotgans, J. I., & Schmidt, H. G. (2011b). Situational interest and academic achievement in the active-learning classroom. *Learning and Instruction*, 21(1), 58–67.
- Ryan, R. M., & Deci, E. L. (2009). Promoting self-determined school engagement: Motivation, learning, and well-being. In K. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 171–196). New York, NY: Routledge.
- Sansone, C. (2009). What's interest got to do with it?: Potential trade-offs in the self-regulation of motivation. In J. P. Forgas, R. Baumeister, & D. Tice (Eds.), *Psychology of self-regulation: Cognitive, affective, and motivational processes* (pp. 35–51). New York, NY: Psychology Press.
- Sansone, C., Fraughton, T. B., Zachary, J. L., Butner, J., & Heiner, C., (2011). Self-regulation of motivation when learning online: The importance of who, why and how. *Educational Technology, Research and Development*, 59, 199–212.
- Sansone, C., & Harackiewicz, J. M. (1996). "I don't feel like it: The function of interest in self-regulation. In L. Martin & A. Tesser (Eds.), *Striving and feeling: Interactions between goals and affect* (pp. 203–228). Hillsdale, NJ: Erlbaum.
- Sansone, C., & Smith, J.L. (2000). Interest and self-regulation: The relation between having to and wanting to. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation: The search for optimal motivation and performance* (pp. 342–371). New York, NY: Academic Press.
- Sansone, C., & Thoman, D.B. (2005). Interest as the missing motivator in self-regulation. *European Psychologist*, 10, 175–186.

- Sansone, C., Weir, C., Harpster, L., & Morgan, C. (1992). Once a boring task always a boring task? Interest as a self-regulatory mechanism. *Journal of Personality and Social Psychology*, *63*, 379–390.
- Schaeffner, E., & Schiefele, U. (2007). The effect of experimental manipulation of student motivation on the situational representation of text. *Learning and Instruction*, *17*, 755–772.
- Schiefele, H., Krapp, A., Prenzel, M., Heiland, A., & Kasten, H. (1983). *Principles of an educational theory of interest*. Munich, Germany: Seminar für Empirische Pädagogik und Pädagogische Psychologies der Universität München.
- Schiefele, U. (2001). The role of interest in motivation and learning. In J. M. Collis & S. Messick (Eds.), *Intelligence and personality: Bridging the gap in theory and measurement* (pp. 163–194). Mahwah, NJ: Erlbaum.
- Schiefele, U. (2009). Situational and individual interest. In K. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 197–222). New York, NY: Routledge.
- Schiefele, U., & Csikszentmihalyi, M. (1994). Interest and the quality of experience in classrooms. *European Journal of Psychology of Education*, *9*, 251–270.
- Schiefele, U., Krapp, A., Wild, K-P., & Winteler, A. (1993). Eine neue Version des Fragebogens zum Studieninteresse (FSI). Untersuchungen zur Reliabilität und Validität [A new version of the Study Interest Questionnaire (SIQ)]. *Diagnostica*, *39*, 335–351.
- Schraw, G., & Lehman, S. (2001). Situational interest: A review of the literature and directions for future research. *Educational Psychology Review*, *13*, 211–224.
- Shernoff, D. J. (2010). Engagement in after-school programs as a predictor of social competence and academic performance. *American Journal of Community Psychology*, *45*, 325–327.
- Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Steele Shernoff, E. (2003). Student engagement in high school classrooms from the perspective of flow theory. *School Psychology Quarterly*, *18*, 158–176.
- Silvia, P. J. (2003). Self-efficacy and interest: Experimental studies of optimal incompetence. *Journal of Vocational Behavior*, *62*, 237–249.
- Silvia, P. J. (2005). What is interesting? Exploring the appraisal structure of interest. *Emotion*, *5*, 89–102.
- Silvia, P. J. (2006). *Exploring the psychology of interest*. New York, NY: Oxford University Press.
- Silvia, P. J. (2010). Confusion and interest: The role of knowledge emotions in aesthetic experience. *Psychology of Aesthetics, Creativity, and the Arts*, *4*, 75–80.
- Thoman, D. B., Sansone, C., & Pasupathi, M. (2007). Talking about interest: Exploring the role of social interaction for regulating motivation and the interest experience. *Journal of Happiness Studies*, *8*, 335–370.
- Thorndike, E. L. (1935). The interests of adults. I. The permanence of interests. *Journal of Educational Psychology*, *26*, 401–410.
- Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of Educational Research*, *64*, 37–54.
- Tsai, Y. M., Kunter, M., Lüdtke, O., Trautwein, U., & Ryan, R. M. (2008). What makes lessons interesting? The role of situational and individual factors in three school subjects. *Journal of Educational Psychology*, *100*, 460–472.
- Turner, S. A., Jr., & Silvia, P. J. (2006). Must things be pleasant? A test of competing appraisal structures. *Emotion*, *6*, 670–674.
- Volkow, N. D., Wang, G.-J., Fowler, J. S., Telang, F., Maynard, L., Logan, J., ... Swanson, J. M. (2004). Evidence that methylphenidate enhances the saliency of a mathematical task by increasing dopamine in the Human brain. *American Journal of Psychiatry*, *161*, 1–8.
- Watt, H. M. G. (2004). Development of adolescents' self-perceptions, values, and task perceptions according to gender and domain in 7th- through 11th-grade Australian students. *Child Development*, *75*, 1556–1574.
- Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review*, *30*, 1–35.
- Wigfield, A., Eccles, J., Schiefele, U., Roeser, R., & Davis-Kean, P. (2006). Development of achievement motivation. In R. Lerner & W. Damon (Series Eds.) and N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 933–1002). New York, NY: Wiley.