VOCA TIONAL INTEREST DEVEL OPMENT FROM ADOLESCENCE TO ADULTHOOD: A META-ANALYSIS ON MEAN-LEVEL CHANGE

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THESIS
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ABSTRACT

Interests are among the most widely applied individual difference constructs in education and psychology. Despite their widespread usage, it is not known whether vocational interests undergo mean-level changes with age. If interests do change, in what direction? And do changes vary across age, kinds of interests, and gender? In the current meta-analysis, we aggregate effect sizes from 53 longitudinal studies on mean-level change in vocational interests, containing 98 total samples and 20,927 participants. Meta-analytic regression models were used to assess patterns of change during different age periods spanning early adolescence to middle adulthood. Results showed that mean-level interest scores increase slightly with age ($d = .04$). This age effect primarily involved interest in People orientation ($d = .09$) rather than Things orientation ($d = .00$). Patterns of change also varied across age categories. Mean-level interest scores decreased during early adolescence ($d = -.10$) before increasing throughout late adolescence ($d = .09$). During young adulthood, mean-level interest scores continued to change, but the direction of change varied across kinds of interests. Gender differences associated with occupational stereotypes showed distinct patterns of change across age categories. Gender gaps in Realistic and Social interests widened during early adolescence, but tended to decrease throughout the remainder of adolescence and young adulthood. Overall, findings suggest that vocational interest intensity undergoes meaningful changes from adolescence to adulthood, with theoretical and practical implications concerning the development of vocational interests.

Keywords: vocational interests, continuity and change, lifespan, gender differences, development
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Vocational Interest Development From Adolescence To Adulthood:
A Meta-Analysis On Mean-Level Change

Interests are among the most widely applied individual difference constructs in education and psychology (Chamorro-Premuzic, von Stumm, & Furnham, 2011; Lubinski, 2000; Savickas & Spokane, 1999; Silvia, 2006). The field of educational psychology examines situational interest as the context-specific state that affects motivation and engagement (Renninger & Hidi, 2016); applications include teaching and learning. The field of vocational psychology and organizational psychology examines interests as dispositions. Interests in vocational psychology are used to guide students who are making education- and career-related decisions (Strong, 1943; Holland, 1997); and interests in organizational psychology are related to employment outcomes such as job satisfaction (Spokane, Meir & Catalano, 2000) and performance (Nye, Sue, Rounds & Drasgow, 2012), and career success (Rounds & Su, 2014). Because of their widespread influence on educational and occupational decision-making and performance, it is critical to understand the degree that interests change through the lifespan.

To date, there has only been one meta-analysis of longitudinal studies on continuity and change of vocational interests (Low, Yoon, Roberts, & Rounds, 2005). Low et al.’s meta-analysis focused on rank-order consistency, revealing that individual differences in vocational interests are among the most stable of all psychological constructs. Yet rank-order consistency is but one of two main ways to assess continuity and change. The other, mean-level change, reflects variation in interest intensity levels across time. Mean-level change is independent from rank-order consistency (De Fruyt et al., 2006), and mean-level differences have distinct effects on behavior (Funder & Colvin, 1991). It is not known whether vocational interests undergo mean-
level changes across the lifespan. If patterns do exist, their identification would have important implications for developmental theories (Hidi & Renninger, 2006; Holland, 1997) and the practical usage of interest inventories (Su & Nye, 2015). For example, a previous meta-analysis identified large sex differences in vocational interests corresponding to gender-based occupational stereotypes (Su, Rounds & Armstrong, 2009). These findings explain the gender disparity in STEM fields (Su & Rounds, 2015) and have guided efforts to reduce it (e.g., Ceci & Williams, 2011; Karabenick & Urdan, 2014). However, they also raise questions: When in the life course do these gender differences develop? Do they increase or decrease with age?

Previous longitudinal studies on mean-level changes in vocational interests have been unable to address these questions comprehensively. Existing studies have focused on limited age groups, often across only two time points, and have produced contradictory results. For example, while some studies found that interest intensity generally increases with age (e.g., Tracey, Robbins, & Hofses, 2005; Yang, 2010), others found decreases (e.g., Kuder, 1964; Tracey, 2002) or mixed results across interest categories (e.g., Rottinghaus, Coon, Gaffey & Zytowski, 2007; Lubinski, Benbow, & Ryan; 1995). In this study, we use meta-analysis to aggregate longitudinal research on mean-level changes in vocational interests from adolescence to adulthood. In other words, we explore how people’s average interest intensity in different domains changes from adolescence to adulthood (sufficient data does not exist on change in middle- and late-adulthood). The present study investigates three core questions: (a) How do mean-level vocational interest scores change during different age periods marked by educational transitions? (b) Do the size and direction of changes vary across different types of interests? (c) Are there gender differences in patterns of change?
The Concept and Measurement of Interests

Interests are defined as “trait-like preferences to engage in activities, contexts in which activities occur, or outcomes associated with preferred activities that motivate goal-oriented behaviors and orient individuals toward certain environments” (Rounds & Su, 2014, p. 98). Interests are unique from other trait-like psychological constructs, such as personality traits and cognitive abilities, in that they are always contextualized to something. In other words, interests reflect patterns of motivation for pursuing different activities, outcomes, and environments. Because interests capture motivation—including goals and plans—they are powerful predictors of behavior contextualized to specific environments (Rounds & Su, 2014).

Vocational interests—which focus on occupational and educational contexts—are commonly measured using interest inventories. Interest inventories are organized into different scales which categorize and quantify responses. Holland’s (1958, 1997) hexagonal model is the most commonly used classification system. Holland’s six interest traits are collectively known as RIASEC: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). Realistic interests involve hands-on activities and working with tools. Investigative interests revolve around scientific and mathematical pursuits. Social interests reflect activities involving teamwork, social interaction, and relationship building. Artistic interests utilize creative expression. Enterprising interests revolve around leadership, economic gain, and social influence. Conventional interests involve systematic tasks and defined rules. Two dimensions underlie the RIASEC typology: interests that involve People rather than Things, and Data rather than Ideas (Prediger, 1982). The Person-thing and Data-Ideas interest orientations can be measured directly (e.g., Graziano, Habashi, & Woodcock, 2011) or calculated using different subsets of RIASEC interest scores (e.g., Su, Rounds, & Armstrong, 2009).
Some interest inventories contain other scale formats, such as occupational interest scales, basic interest scales, and general interest scales (Hansen, 1994; Rounds, 1995). These alternative scales can be translated into the standard RIASEC output using established methods from past research (Su et al., 2009). The RIASEC typology therefore provides a framework that can be used to compare results across studies using distinct interest inventories (Rounds & Day, 1999).

**Continuity and Change in Interests**

There are a variety of operational definitions for “continuity” and “change” in psychological constructs. The most common interpretations are rank-order (relative) consistency and mean-level (absolute) change. Both of these perspectives focus on group-level change as opposed to individual-level change (Low et al., 2005). For example, a longitudinal study on mean-level change in Realistic interests would operationally define “change” as an increase or decrease in the entire sample’s average Realistic interest intensity over time. If half of the sample’s Realistic interests increased by two points, while the other half decreased by two points, the sample would appear to have experienced no mean-level change, despite the fact that every individual experienced some degree of change. Rank-order consistency and mean-level change therefore reflect change within groups as a whole, which explains why they offer insight into normative patterns of continuity and change.

Although both mean-level change and rank-order consistency are group-level measures, they can be thought of as independent constructs (Roberts et al., 2006). Mean-level change reflects absolute change: increases or decreases within a group’s interest score intensities, or profile elevations, over time. On the other hand, rank-order consistency describes relative change: the degree to which the relative ordering of individuals’ interest scores within a group remain the same (De Fruyt et al., 2006). It is possible for a single sample to undergo substantial
mean-level change, but have perfect rank-order consistency, and vice-versa. Consider a sample of two individuals, Person A and Person B. At time one, Persons A and B have the following ordering of scores, respectively: Person A (2, 3, 4); Person B (3, 4, 5). If at time two, Person A’s interest scores increase to (4, 5, 6) while Person B’s interest scores increase to (5, 6, 7), the sample’s rank-order consistency would remain perfect, despite the fact that the sample’s mean-level interest scores increased by two points (Roberts et al., 2006). If, on the other hand, Person A’s interest scores increased to (5, 6, 7), while Person B’s interest scores increased to (4, 5, 6), the sample would have zero rank-order consistency, with the same amount of mean-level change. (Roberts et al., 2006). This simple example demonstrates why rank-order consistency and mean-level change are independent group-level measures, each telling only part of a story.

The only published meta-analysis on continuity and change in vocational interests focused on rank-order consistency. Low et al. (2005) quantitatively reviewed 66 longitudinal studies spanning various ages from early adolescence through middle adulthood. Vocational interests were notably stable throughout all age periods, displaying higher rank-order consistency than personality traits (Roberts & Delvecchio, 2000). The rank-order consistency of interests was least stable during adolescence (ages 12-18), then increased substantially during the college years (ages 18-22). Interest stability continued to increase during young adulthood, hitting a peak from ages 25-30. These findings suggest that interests shift around more during adolescence, when many students begin working part-time jobs and taking career-oriented courses, than during young adulthood. Nevertheless, Low et al.‘s results do not provide any information on the direction in which interests change, or the magnitude of changes. This knowledge is critical to advance existing research on interest development, career choice, and employment outcomes.
Vocational Interest Development

Several different theories propose mechanisms for how interests develop including: Holland’s (1997) Theory of Vocational Personalities and Work Environments, the Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994), and the Four-Phase Model of Interest Development (Hidi & Renninger, 2006; Renninger & Hidi, 2016). These three theories differ in their emphases. Holland’s theory is the most general; it broadly describes the process by which interests become more differentiated over time through exposure to and reinforcement from different environments (Holland, 1997). The SCCT, based on Bandura’s (1982) self-efficacy theory, focuses more narrowly on the role of self-efficacy beliefs and outcome expectations. According to the SCCT, interests are more likely to develop and flourish when people view themselves as competent in activities and anticipate positive outcomes from performing them. The SCCT serves as the basis for several career development and behavior models (e.g., Betz, Borgen, & Harmon, 1996; Lent & Brown, 2013) and meta-analytic research has found strong links between self-efficacy beliefs and interests (Rottinghaus, Larson, & Borgen, 2003). However, the SCCT’s emphasis on self-efficacy as the antecedent of interest has not been consistently supported in longitudinal studies (Armstrong & Vogel, 2009; Nauta, Kahn, Angell, J, & Cantarelli, 2002; Tracey, 2002).

Both Holland’s model and the SCCT describe the interest development process at a general level. They have different emphases, but both theories broadly recognize the importance of exposure, ability, and reinforcement in transforming new experience into interest. In contrast, Hidi & Renninger’s (2006; 2016) Four-Phase Model of Interest Development, which focuses primarily on learning in educational contexts, breaks down the process into specific, sequential phases. According to the Four-Phase model, interest begins as a psychological state triggered by
short-term situational changes. Interest is maintained over time through sustained attention in recurring situations, eventually emerging into a predisposition to seek reengagement. In the final phase, interest becomes well-developed, self-regulated, and can persist through frustration and other obstacles (see Expectancy-Value theory for a related perspective on the development of achievement motivation; Eccles, 1983; 2009).

A central premise of the Four-Phase Model is that interests retain the capability to change at each phase through triggering (Hidi & Renninger, 2016). Triggering refers to the process by which interest is directed towards an object of attention. Triggers can come from characteristics of the environment (e.g., the design of a classroom) or from other people (e.g., teachers, parents, or work supervisors). While many triggers lead to increased interest, they can also have the reverse effect. For example, receiving a poor grade on a mathematics test may discourage a student from paying attention in subsequent math classes. The impact of a trigger depends largely on the affective reaction it causes in a person, which varies for people in different interest development phases (Hidi & Renninger, 2016). The same poor grade may motivate a different student, who already has a well-developed interest in math, to pay closer attention in future classes.

The trait-like nature of vocational interests is most consistent with the later phases of interest described in the Four-Phase Model (Hidi & Renninger, 2016). Thus, vocational interest development is likely guided by triggers that affect well-developed interests, rather than situational interests. For example, classroom activities designed to increase interest in school subjects through increasing its relevancy or novelty are less effective for students with more-developed interests (Harackiewicz, Tibbetts, Canning, & Hyde 2014; Hulleman & Harackiewicz, 2009). These students may have already made such connections and can experience boredom
from repetition. Well-developed interests are more likely to be impacted by triggers that help integrate personal identities, basic needs, or values (Eccles, Fredricks, & Epstein, 2015; Krapp, 2005). Social experiences that promote a sense of belongingness can be particularly influential in the development of interests (Bergin, 2016).

**Patterns of Mean-level Change with Age**

How do mean-level interest scores change with age? Does interest intensity (i.e., profile elevation) increase, decrease, or remain constant? Does the direction of change vary across different educational transitions? These questions are not only important for informing developmental theories, they also have significant implications for interventions targeting interests and other non-cognitive abilities, such as motivation (Gaspard et al., 2016; Karabenick, & Urdan, 2014). For example, a nationwide intervention designed to increase students’ motivation to pursue STEM careers could benefit from the knowledge that Investigative vocational interests were generally decreasing during a particular educational period. The intervention could be tailored to address negative stereotypes and social norms associated with Investigative careers to support interest development. Mean-level changes in vocational interests have yet to be assessed through meta-analysis, but primary studies on changes in interests and related constructs, such as motivation and self-efficacy beliefs, yields insights into potential patterns of change.

Mean-level interest scores may increase with age because of the links between interests, experiences, competencies, and self-efficacy beliefs. During adolescence and young adulthood, individuals are increasingly exposed to new ideas, activities, and environments through schooling, extracurricular activities, and entry into the workforce. Although certain negative experiences may prevent exploration of potential interest areas, shared reinforcement processes
generally encourage adolescents and young adults to learn and get better at different tasks. Furthermore, recent research on the brain’s reward circuitry has found that humans are hardwired to seek out new information for interest-driven content (Berridge, 2012; Gruber, Gelman, & Ranganath, 2014). This suggests that individuals are intrinsically motivated to develop their interests (Renninger & Hidi, 2016). Supporting this idea, several primary studies have found that vocational interests generally increase with age (Tracey, Robbins, & Hofsess, 2005; Donnay, Thompson, Morris, & Schaubhut, 2004).

Although humans are hardwired to seek out new interests, the environment may not always provide the necessary support. Numerous studies have found declines in interests and other motivational constructs with age (Renninger & Hidi, 2016; Tracey, 2002; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991; Wigfield & Eccles, 2000). Much of this research has focused on interest in school subjects, especially math and science (Bong, Lee, & Woo, 2015; Frenzel Pekrun, Dicke, & Goetz, 2012). There are several reasons why interest in school subjects may decline with age, such as the increasingly hierarchical nature of instruction, an increased emphasis on grades, pressure from parents, or sensitivity to peer-based social norms (Renninger & Hidi, 2016). These same processes may cause mean-level decreases in vocational interests, particularly Investigative interests which include math- and science-based careers. However, as a whole, vocational interests are broader than interest in school subjects alone.

As evidenced by these divergent findings, there is no clear expectation for the direction of change in overall interest intensity with age. Another possibility is that the direction of change varies during different age periods. Considerable research on personality trait development now supports the idea that different developmental processes occur during early adolescence (i.e., the middle school years, ~ages 11-14), late adolescence (i.e., the high school years, ~ages 14-18),
and emerging adulthood (~ages 18-30). Vocational interests are similar to personality traits in that they reflect relatively enduring attributes that can develop and mature over time (Lent, 2005; Roberts et al., 2006; Rounds & Su, 2014; Tracey & Sodano, 2008). Several theories on personality trait development may also apply to interests, such as the maturity principle (Roberts et al., 2006; Roberts & Mroczek, 2008) and disruption hypothesis (Soto, John, Gosling, & Potter, 2011; Soto & Tackett, 2015).

The maturity principle was one of the main conclusions of a seminal meta-analysis on mean-level changes in personality traits (Roberts et al., 2006). The authors found that during late adolescence and young adulthood, people become more agreeable, conscientious, and emotionally stable—traits associated with social maturity (Roberts & Mroczek, 2008). These positive changes occur rapidly during the transition from late adolescence to emerging adulthood and are associated with age-graded social roles that call for increased responsibility and maturity (e.g., finding a full-time job) (Roberts et al., 2006; Roberts & Mroczek, 2008). Research on mean-level changes in self-esteem and sense of mastery supports this general trajectory, as both of these traits increase normatively during late adolescence and young adulthood (Erol & Orth, 2011).

During early adolescence, development follows a different path: disruption. Opposing the general trend of increasing personality trait maturity, research has found short-term dips in agreeableness, conscientiousness, and emotional stability during the transition from childhood to adolescence (Soto et al., 2011; Soto & Tackett, 2015). These negative changes may be related to the previously discussed research on declining interests (e.g., Lent et al., 2006; Renninger & Hidi, 2016; Tracey, 2002). Research has also shown that peer-based social norms are particularly influential during this time. For example, a recent neurological study found that adolescents were
more likely to “like” photos on social media that had more previous “likes”, and more-liked photos were associated with brain activity in areas linked to reward processing, social cognition, and attention (Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016).

In summary, early adolescence appears to be an exception to the general trend of increasing social maturity, self-esteem, and sense of mastery throughout the early lifespan. If the disruption hypothesis applies to vocational interest intensity, we would expect mean-level interest scores to decrease during the transition from childhood to adolescence (i.e., the middle school years, ages 11-14). After this period, the direction of change seems less clear. If vocational interests follow a similar pattern of change as self-esteem and sense of mastery, they should also increase during late adolescence and young adulthood. The maturity principle from personality trait research also suggests positive changes with age, but these changes may only occur in specific interest categories. This leads to the first research question: How does mean-level interest intensity change during different age periods?

**Different Types of Interests**

Changes in interest intensity may also depend on the interest category in question. Patterns of mean-level change may differ across RIASEC categories, each of which captures different types of activities and environments (Holland, 1997). The person-thing orientation (Prediger, 1982), which underlies the RIASEC hexagon, may be particularly influential. At its core, this dimension explains individual differences in preferences for attending to people or objects (things) in one’s environment. While some individuals prefer work environments filled with social interaction, others enjoy working alone (Graziano et al., 2011).

A key part of the transition from childhood to adulthood is learning how to get along with others in school, work, and social settings. Research suggests that people generally become more
socially-oriented during this period. For example, a longitudinal study of 364 White, middle-class children showed that mean-level expressivity increases from ages 13-19 (McHale, Kim, Dotterer, Crouter, & Booth, 2009), although this increase was only significant for boys. Mean-level narcissistic personality traits also decrease with age beginning in adolescence (Roberts, Edmonds, & Grijalva, 2010). Furthermore, the maturity principle is based on mean-level increases in the Big Five traits most associated with social maturity—agreeableness, conscientiousness, and emotional stability (Roberts & Mroczek, 2008). These traits are most closely associated with a Person-orientation, rather than Things (Mount, Barrick, Tippie, Scullen, & Rounds, 2005). Thus, if vocational interests are affected by similar maturation processes, mean-level interest scores involving People (i.e., Social, Artistic, and Enterprising interests) should show greater increases than interests involving Things (i.e., Realistic, Investigative, and Conventional interests). With research question two, we examine this general expectation as well as patterns of change in other RIASEC interests during different age periods.

**Gender Differences**

Gender is an important consideration in interest research as the world of work has historically been divided by gender roles. In a review of research on children’s career development, Watson & McMahon (2005) found that children develop occupational gender stereotypes before kindergarten age; and gendered perceptions about work persist in all elementary school grades. Research has also found that the occupational interests of children, adolescents, and adults are affected by their perceptions of occupations as traditionally masculine or feminine (Weisgram, Bigler, & Liben 2010). A previous meta-analysis found substantial gender differences in mean-level interest scores within RIASEC categories. For example, whereas men display stronger Realistic ($d = 0.84$) interests, women display stronger Social
interests \((d = -0.68)\); negative effect sizes indicate stronger female preferences here) (Su, Rounds, & Armstrong, 2009).

Despite the role of gender in shaping vocational interests, gender differences may decrease with age (Su et al., 2009). Occupational gender norms have changed considerably over the past century as gender equality has become a central issue (Watson & McMahon, 2005). In addition to changing societal norms, age-graded developmental roles may cause gender differences in interests to decrease. The cross-over hypothesis argues that men and women’s personality traits “cross-over” somewhat during adulthood due to normative transitions. Men may become more emotionally nurturing during adulthood as family-life replaces the career as a primary focus, while women may become more dominant and confident during adulthood as children age and childrearing takes up less time (Guttman, 1987; Roberts & Helson, 1997). If the cross-over hypothesis were to apply to interests (Su et al., 2009), men’s Social interests would increase more than women’s, while women’s Realistic interests would increase more than men’s. These differences would likely be most apparent during late adolescence and emerging adulthood, rather than during the disruption period of early adolescence. Research question three tests whether the cross-over hypothesis applies to vocational interests by examining gender differences in patterns of mean-level change.

Other Potential Moderators

Theoretical Framework of Interest Inventory. Different types of vocational interest inventories use different theoretical frameworks to categorize the world of work. Thus, we tested the theoretical framework of interest inventories as a moderator to compare patterns of change across different interest classification systems. The studies included in this meta-analysis used four different theoretical frameworks, including: Holland’s RIASEC format, occupational scales,
basic interest scales, and Kuder’s classification system (Kuder, 1948). Low et al.’s (2005) rank-order meta-analysis did not find any significant differences based on the theoretical framework of interest inventories, so we did not have any direction-specific expectations for this moderator.

**Cohort.** Cohort refers to the year in which a sample was born. Generational cohorts were selected as a potential moderator to assess the degree to which patterns of interest change fluctuate as a result of the normative experiences of individuals born in different time periods. Low et al. (2005) did not find any meaningful relationships between cohort and interest stability, and we did not have any other expectations for cohort.

**Test-retest Interval.** Research on personality trait development shows that time has a positive influence on personality trait change (Roberts et al., 2006). In other words, personality traits change more over longer periods of time; they do not return to a set-point (Roberts & Mroczek., 2008). We therefore expected that interests would exhibit greater change over longer periods of time.
Current Study

The current study aggregates longitudinal data from past primary studies on vocational interests to provide a summary of how interests change from early adolescence (~age 12) through middle adulthood (~age 42). We use meta-analytic regression models to assess patterns of mean-level change across age, interest categories, gender, and other potential moderators. We first assess whether overall interest intensity changes with age, and in what direction. Second, we examine age trends based on the timing of major educational transitions in the United States. These analyses test whether the size and direction of change varies during different educational periods. Third, we investigate patterns of change across different types of interests, independent of age. These models assess whether the size and direction of overall change varies across Holland’s RIASEC typology, Person-Thing, and Data-Ideas interest orientations. Fourth, we examine whether age and interest categories are independent. We use this model to explore how different RIASEC interests change during distinct educational periods. Fifth, on the basis of previous meta-analytic research on gender differences in interests (Su et al., 2009), we test whether gender differences in Realistic and Social interests increase or decrease with age. Finally, we examine the effect of other potential moderating variables, including the theoretical framework of interest inventories, cohort, and retest interval.

Method

Literature review. We used multiple strategies to locate both published and unpublished research, focusing specifically on studies that looked at mean-level changes in interests. We searched abstracts from PsycINFO, Proquest Dissertations and Theses, and ERIC databases using any combinations of words from each of three categories: interests (interest(s), interest trait), career-related (vocational, occupational, career), and methodology (stability, consistency,
continuity, mean-level change(s), longitudinal). This initial search produced 1,970 results, which were all scanned for relevance to the topic. Next, we reviewed the reference list from a previous dissertation on mean-level changes in vocational interests (Low, 2009) and scanned the test manuals of popular interest inventories. Once we had a preliminary list of longitudinal studies, we scanned their reference lists and asked subject matter experts if they were aware of any studies we may have missed.

Inclusion criteria. In order to be included in the meta-analysis, studies needed to meet four criteria: 1) The paper must have reported information about the means and standard deviations of interest scores at two time points, retest interval, sample size, age of sample, and the type of inventory used. 2) The sample for which data was reported must have been defined by a specific mean age (e.g., “18-year-olds”) or age-based description (e.g., “college freshman”) at the first time testing (with a common retest interval). This criterion was necessary because age was our primary basis for examining the continuity of interests across the lifespan. 3) The retest interval must have been one year or greater. This was done to minimize carry over effects between tests. 4) Papers must have been published in English and the research must have been conducted with participants in the U.S. or Canada. These criteria were included because the timing of educational transitions (e.g., beginning high school or graduating college) varies across countries; studies conducted in other countries could confound patterns of age-graded normative interest change in the U.S. and Canada. Fifty-three studies met all of the above criteria and were subsequently included in the meta-analysis (see Table 1 for full list). The 53 studies contained 98 total samples, consisting of 20,927 participants, yielding 529 estimates of change within RIASEC categories.
Study/Variable Characteristics

**Age categories.** We recorded each sample’s age at the first and final time of testing. The majority of studies explicitly reported the mean or median age of their sample. However, some studies only provided age-based descriptive information about their sample (e.g., college freshman). When this was the case, we assigned an initial age to the sample based on the typical age of individuals from that population (e.g., college freshman were recorded as 18 years-old).

We initially set up four age categories that separated the early lifespan based on the normative timing of major educational transitions: the middle school years (ages 11-14), the high school years (ages 14-18), the college years (ages 18-22), and emerging adulthood (ages 22-30). Samples were assigned to an age category based on the midpoint of their age at each time of testing in the longitudinal study. We took this approach to reduce the complexity of our models by taking into account both age and time interval effects, thus increasing power (we test the robustness of alternative specifications below). The age of samples ranged from 11.5 to 23.5 years-old at the first time of testing, and from 12.5 to 53 years-old at the final time of testing.

Several samples had long retest intervals that spanned considerably more time than the age category to which they would be assigned based on their midpoint age. For example, if a sample was 18 years-old at the initial testing and 36-years-old at the conclusion of testing (with a midpoint of 27 years-old), only 8 of the 18 years between testing would be included in the 22-30 age category. In order to account for these samples, we created a separate age category representing late adolescence through middle adulthood (or approximately ages 18-42). We assigned samples to this age category if more than 50% of their retest interval (in years) fell outside of their initially-assigned age category. Altogether, fifteen samples were reassigned through this procedure. The fifteen samples in the late adolescence through middle adulthood age
category were fairly homogenous in age, with an average age of 18.4 years-old at initial testing ($SD = 3.2$ years) and 41.9 years-old at final testing ($SD = 8.7$ years). The mean retest interval for this age category, weighted by sample size, was 25.7 years ($SD = 7.3$ years).

**Gender.** We coded samples of women, men, and mixed-gendered participants separately. We then computed separate effect size estimates for samples comprised of entirely men or women (in addition to overall effect sizes).

**Theoretical Framework of Interest Inventory.** About half of the samples (49%) were tested using some form of the Strong Interest Inventory, which has undergone three major revisions since its inception. The Strong Vocational Interest Blank (SVIB) provides scores for 55 occupational scales (Strong, 1938) as well as 23 basic interest scales. The SVIB was revised in 1974, becoming the Strong-Campbell Interest Inventory, before undergoing another major revision in 1994 to its current name, the Strong Interest Inventory (Donnay, 1997). The Kuder Preference Record was the next most commonly utilized interest inventory (some form of the KPR was given to 31% of the samples), followed by the Vocational Preference Inventory (6%), and the UNIACT Inventory (5%).

Although we converted all interest scores into Holland’s (1958) RIASEC categories, we were also interested in investigating patterns of mean-level change across the original theoretical frameworks used by different interest inventories. We sorted inventories based on their theoretical framework. Interest inventories utilized either Holland’s (1958) RIASEC scales (e.g., UNIACT–Revised, see American College Testing Program, 1995), occupational scales (e.g., SVIB, see Strong, 1938), basic interest scales (e.g., OVIS, see D’Costa, Winefordner, Odgers, & Koons, 1970; Project TALENT Interest Inventory, see Flanagan, Dailey, Shaycoft, Gorham, Orr, & Goldberg, 1962), or Kuder’s classification system (e.g., KPR, see Kuder, 1948). There were
also 11 samples for which both basic interest and occupational scale scores were available.

Cohort. We inferred generational cohorts by subtracting the age of participants in a given sample from the year in which the first testing occurred. For studies that did not include specific testing dates, we used publication dates in their place. The generational cohorts of samples varied considerably, ranging from samples born in 1916 to 1996.

Retest Interval. All longitudinal studies included information about the amount of time between assessments. Intervals ranged from 1 to 36 years.

Data Analysis

Effect size computation. We computed effect sizes using raw mean scores and standard deviations for 96% of the studies. For the other 4% of studies, we inferred effect sizes from t-values using the formulas from Morris and Deshon (2002, p. 118). Effect sizes were computed for each sample by subtracting the mean interest scores at final testing from those at initial testing, and then dividing these differences by the standard deviations of raw scores at initial testing.

We chose this metric, known as the single-group, pretest-posttest raw score effect size (Morris & DeShon, 2002), instead of a change-score metric (which divides difference scores by the standard deviations of change scores) for several reasons. First, unlike the change-score metric, the raw score metric does not utilize test-retest correlations (a function of rank-order consistency) in the computation of standardized difference scores. Second, the raw-score metric standardizes each sample’s difference scores using units from the original scale, allowing for direct comparisons to be made across independent samples. Finally, we avoided the change score metric because one cannot accurately estimate the degrees of freedom for the pooled standard deviation when test-retest procedures are utilized (Morris & DeShon, 2002; Roberts et al., 2006).
We first aggregated effect sizes within RIASEC categories. If a single sample yielded multiple effect sizes within one Holland trait, we averaged the various effect sizes into a single estimate of change (e.g., difference scores for the Outdoor and Mechanical scales of the KPR were averaged into a single estimate of change for Realistic interests). There were also several samples with overlapping data from the SVIB occupational scales and SVIB basic interest scales. For these samples, we first aggregated the effect sizes from the original interest scale format into the RIASEC taxonomy so that we had two effect sizes for each RIASEC category. We then averaged the effect sizes from the occupational scales and basic interest scales within each RIASEC category to compute single estimates of change.

After computing effect sizes within RIASEC interest categories, we computed effect sizes along the Person-Thing and Data-Ideas orientations. These two orientations were initially proposed to be bipolar dimensions (Prediger, 1982). However, recent research suggests that they are not bipolar and are better represented from a bivariate perspective (Graziano et al., 2011; Tay, Su, & Rounds, 2011; Woodcock et al., 2013). In other words, an interest in People does not necessarily imply a lack of interest in Things; and similarly, one can be interested in activities that involve both Data and Ideas simultaneously. We computed separate effect sizes for People, Things, Data, and Ideas, using modified formulas from the UNIACT-Revised Edition manual (American College Testing Program, 1995, p. 126), such that:

\[
\begin{align*}
\text{People} &= \frac{(2(S) + (A) + (E))}{4} \\
\text{Things} &= \frac{(2(R) + (I) + (C))}{4} \\
\text{Data} &= \frac{(E) + (C)}{2} \\
\text{Ideas} &= \frac{(I) + (A)}{2}
\end{align*}
\]
Consistent with our lifespan development approach, we then aggregated effect sizes within age categories. The vast majority of studies (98%) only reported data for two time-points, but one study reported data for three time-points (Tracey, Robbins, & Hofsess, 2005). For the study with three time-points, we used the difference between mean interest scores at final and initial testing because this interval completely covered an existing age category. Lastly, we aggregated all effect sizes (denoted by $d$) into a single dataset, along with the other coded variables.

Analytic Approach. We applied Cheung’s (2008) framework to fit random and mixed effects meta-regression models to the dataset using Mplus statistical software (Muthén & Muthén, 1998-2015). Random effects meta-analysis estimates an omnibus effect size as well as the amount of systematic between-study variance, and mixed effects meta-regression attempts to explain the between-study variance using coded moderators. We treated each coded study characteristic as a potential moderator of mean-level change. Because each study contributed multiple effect sizes (i.e., multiple RIASEC categories), we applied two corrections to obtain robust standard errors. First, all analyses were weighted by the inverse sampling variance and the inverse number of effect sizes drawn from each study. Second, we corrected for nonindependence via clustered standard errors.

Our first goal was to assess how mean-level interest scores change during different age periods. We were also interested in the possibility that interest scores undergo continuous patterns of change, such that educational transitions are less impactful. If interest development is responsive to qualitative educational transitions, then our linear model would be unable to detect this trend, and our categorical model would be preferred. Thus, we fit separate meta-regression models treating age as both a categorical and continuous variable. In the continuous model, we
tested the effects of age at the first time of testing while controlling for the effect of retest interval. In the categorical model, we did not control for retest interval because this variable was already included in the computation of age categories, as described earlier.

To investigate our second research question—whether the size and direction of changes varied across interest categories—we fit meta-regression models for RIASEC categories, Person-Thing, and Data-Ideas orientations. These three models tested whether effect sizes varied across different types of interests, independent of the other variables. We also wanted to explore patterns of RIASEC interest change within each age category. Thus, we set up an additional meta-regression model to test for interactions between the age categories and RIASEC categories.

Our third goal was to assess whether patterns of change differed for men and women, focusing specifically on the cross-over hypothesis (Guttman, 1987; Roberts & Helson, 1997). We limited our investigation to Realistic and Social interests to avoid model over-specification and because these two interest categories have the greatest mean-level gender differences (Su et al., 2009). As discussed earlier, the cross-over hypothesis concerns age-related changes in adulthood, after the disruption period of early adolescence (Soto & Tackett, 2015). Thus, we examined gender differences separately within age categories. We explored patterns of change in Realistic and Social interests within the samples that comprised early adolescence (ages 11-14); late adolescence, the college years, and emerging adulthood (ages 14-30); and late adolescence through middle adulthood (ages 18-42). The estimates of change within the 14-30 age category were computed by adding the cumulative effect sizes from the original three age categories that spanned this interval: ages 14-18, 18-22, and 22-30. In summary, the first age category focused on gender differences during the disruption period, while the latter two were different ways of testing the cross-over hypothesis during young adulthood.
We also investigated whether overall effect sizes varied across other potential moderators, including: retest interval, cohort, and the theoretical framework of interest inventories. We tested these moderators using overall effect sizes (i.e., average $d$-values for each sample), rather than within each age and RIASEC category separately, to increase our power to detect significant effects. Furthermore, the probability of making a Type I error would have increased substantially due to the multitude of tests required to test each moderator within each age and RIASEC category separately.

For purposes of analysis, all categorical variables were coded using effects coding. Therefore, we present expected effect size estimates for each category (e.g., the expected effect size for high schoolers), as well as the meta-regression coefficient for the coded moderator (e.g., how much more or less do high schoolers change than the omnibus midpoint). These two statistics convey different, independent information. The expected effect size gives the overall magnitude of the effect, and tests for statistical significance in reference to zero. We report this information in terms of $d$-scores. The meta-regression coefficient gives the coded moderators deviation from the other levels of the moderator, and tests for statistical significance in reference to the midpoint effect size. We report this information in terms of $b$ coefficients. We centered continuous moderators, and due to a large positive skew, retest interval was log transformed to normality. We report estimates of systematic between-study heterogeneity as $\tau$. 

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Results

Study Characteristics

Table 1 displays the study authors, gender(s), number of participants, test-retest interval, age category, cohort, interest measure, theoretical framework, and sample description for each sample included the meta-analysis. Table 2 shows descriptive information for the samples within each age category, weighted by sample size when appropriate. The median test-retest interval was 3.5 years mean; the weighted mean was 6.9 years. The median cohort was born in the 1949. Men comprised 54% of the sample participants; women comprised 39%; and the remaining 7% were mixed-gender. The RIASEC interest trait categories were all studied at similar rates: Investigative was studied the most (93%), while Enterprising and Social were studied the least (87%).

Because of our focus on educational transitions, we also examined the educational characteristics of the sample participants in each age category. All sample participants in the 11-14 age category were middle school students (ranging from 5th to 7th graders). Forty-three percent of the participants in the 14-18 age category were high school students at the onset of the study, while the other 53% were 8th graders. In the 18-22 age category, 80% of the participants were college students at study onset (notably, 45% were college freshman), and 20% were high school students. Eighty-eight percent of the 22-30 age category and at least 59% of the 18-42 age category had some type of college education (we could not determine educational attainment rates for the other participants in these two age categories). In summary, the 11-14, 14-18, and 18-22 years-old age categories were well representative of middle school students, high school students, and college students, respectively; and the vast majority of sample participants in the
22-30 and 18-42 years-old age categories were college graduates. There was insufficient data on attrition rates, socio-economic status, and race/ethnicity to include these variables in analyses.

**Do Interests Change?**

When considering our full meta-analytic dataset, we found evidence of a small, positive change in mean-level vocational interest scores \( (d = .04, p < .05) \). This suggests that if a given individual were to take an interest inventory twice over a period of at least one year, their average interest would likely increase slightly, rather than decrease or remain constant. However, there was substantial evidence of between-study heterogeneity \( (\tau = .106, p < .001) \) implying that there are systematic sources of variance in the overall effect size estimate that may be explained by our coded moderators.

**How Do Changes Vary Across Age Categories?**

Treated continuously, age \( (b = -.005) \) and time interval \( (b = .016) \) did not explain between-study heterogeneity \( (p's > .17) \). Therefore, we proceeded to treat age categorically to test for nonlinear effects. Table 3 presents the results of the meta-regression model predicting changes in overall interest intensity by age category. (See also Figure 1 for a graphical representation.) As mentioned, the first four age categories were based on the timing of major educational transitions in the U.S.: the middle school years (ages 11-14), high school years (ages 14-18), college years (ages 18-22), and emerging adulthood (ages 22-30). The fifth age category includes studies with long retest intervals that spanned late adolescence through middle adulthood (~ages 18-42).

The average effect size for this model was .02 \( (p = .23) \). Consistent with the *disruption hypothesis*, we found that mean-level interest scores decreased during the middle school years \( (d = -.10, p < .01) \), and this effect size was significantly lower than the other age categories \( (b = -\)
Put differently, our model implies that interest intensity decreases by approximately $1/10$ of a standard deviation across the middle school years, and this effect size is .12 standard deviations below the overall midpoint, a statistically significant deviation. Interest scores then increased during the high school years ($d = .09, p < .01$), significantly more than the other age categories ($b = .07, p < .01$). During the college years ($d = -.01, p = .91$) and emerging adulthood ($d = .03, p = .21$), interest scores plateaued. Lastly, in the age category representing late adolescence through middle adulthood, there was a statistically significant increase in interest scores ($d = .07, p < .01$) that differed from the other age categories ($b = .05, p < .05$).

With regard to our first research question, the results suggest that interest intensity changes across the lifespan nonlinearly. After decreasing during early adolescence, mean-level interest scores either remain constant or increase slightly throughout the remainder of adolescence and young adulthood. The high school years, spanning late adolescence, were marked by the greatest increases in overall interest intensity. Even with age as an explicit moderator, we still found significant between-study heterogeneity ($\tau = .09, p < .01$).

**How Do Changes Vary Across Interest Categories?**

Table 4 displays the meta-regression models predicting mean-level changes for different interest categories. We fit separate models for RIASEC, Person-Thing, and Data-Ideas interest orientations. In the RIASEC model, the average effect size was .04 ($p < .05$) and there were significant differences across RIASEC categories. Whereas Artistic ($d = .10, p < .01$), Social ($d = .08, p < .05$), and Enterprising ($d = .11, p < .01$) interests increased, Conventional interests decreased ($d = -.07, p < .05$), and Realistic ($d = .04, p = .22$) and Investigative ($d = .00, p = .91$) interests remained constant. The regression coefficients for Artistic ($b = .05, p < .05$) and Enterprising ($b = .07, p < .01$) interests were significantly greater than average, while
Investigative \((b = -.05, p < .05)\) and Conventional \((b = -.12, p < .01)\) effect sizes were significantly lower than average.

These differences are also represented within the results of the Person-Thing model, which provides a binary representation of the data from all six RIASEC categories. The average effect size for this model was \(.04 (p < .05)\), and effect sizes significantly differed across Person-Thing interest orientations. Interests involving People increased over time \((d = .09, p < .01)\), whereas interests involving Things showed no change \((d = .00, p = .99)\). These effect sizes were significantly different from each other \((p < .01)\).

Smaller differences were found within the Data-Ideas model. Interests involving Ideas \((d = .03, p = .06)\) increased slightly over time, while interests involving Data remained constant \((d = .00, p = .87)\). These effect sizes were not significantly different from each other \((p = .24)\). In all three models examining changes across interest categories, we found significant between-study heterogeneity \((\text{For RIASEC, } \tau = .10, p < .01; \text{ for Person-thing, } \tau = .11, p < .01; \text{ for Data-Ideas, } \tau = .11, p < .01)\).

**Are Age and Interest Category Effects Interdependent?**

Table 5 displays the results of a meta-regression model testing for interactions between age and interest categories. We used this model to explore how different RIASEC interests change within each age category. In other words, we examined more specific patterns of interest change within the effect size estimates displayed in Table 3. The average effect size for this model was \(.02 (p = .12)\), and the estimate of between-study heterogeneity was non-significant \((\tau = .02, p = .77)\). This result implies that nearly all (81%) of the systematic between-study heterogeneity could be explained when modeling the interdependence of age and interest category effects. For ease of presentation, we only report expected effect size estimates for this
model involving interactions. The supplementary material contains the coefficients for the full model. Note that not all interaction parameters were statistically significant, and we focus on the model implications most relevant to our hypotheses.

As mentioned, the period of adolescence was marked by two general patterns of change: mean-level interest scores decreased during early adolescence, then increased during late adolescence. This general pattern of change was evident for most RIASEC categories. For example, Conventional interests showed the greatest decline during early adolescence \((d = -0.35, p < .01)\), before shifting in the positive direction during late adolescence \((d = 0.08, p = .08)\). Realistic and Social interests showed similar patterns of change, but there were substantial gender differences within these two domains which are further explored in Table 6. There were two notable exceptions to the pattern. Enterprising interests were the only RIASEC category to increase significantly during early adolescence \((d = 0.23, p < .05)\), and they continued to increase during late adolescence \((d = 0.18, p < .01)\). Additionally, Investigative interests showed little change during both age periods.

Although average interest intensity remained constant during both the college years and emerging adulthood, there were notable differences across RIASEC traits. The interest orientations involving People either increased or remained constant. For example, Artistic \((d = 0.12, p < .01)\) and Social \((d = 0.13, p < .05)\) interests increased significantly during the college years. Artistic interests continued to increase significantly \((d = 0.20, p < .01)\) during emerging adulthood, as did Enterprising interests \((d = 0.10, p < .01)\). In contrast, the interest orientations involving Things either decreased or remained constant. During the college years and emerging adulthood, the majority of the effect sizes for Realistic, Investigative, and Conventional interests were negative, but did not reach statistical significance.
The results from the final age category, covering late adolescence through middle adulthood, generally support those found during the college years and emerging adulthood. Interests involving People, particularly Social \((d = .21, p = .05)\) and Enterprising interests \((d = .09, p < .05)\), were more likely to increase than Interests involving Things. However, there was one notable exception: Investigative interests also increased significantly within this age category \((d = .16, p < .01)\).

In relation to our second research question, the results highlight several important distinctions in patterns of change for different types of interests. When age was not considered, interests involving People (i.e., Artistic, Social, and Enterprising) increased significantly, whereas interests involving Things either decreased (Conventional) or remained constant (Realistic and Investigative). When the age categories were considered, this general pattern was most evident within the three age periods that comprise young adulthood: the college years, emerging adulthood, and late adolescence through middle adulthood. Before adulthood, most interest categories followed a general trend of decreasing during early adolescence, then increasing during late adolescence. Enterprising and Investigative interests were notable exceptions; Enterprising interests increased significantly during both age periods, while Investigate interests showed little change.

**Are There Gender Differences in Patterns of Change?**

As a preliminary test, we examined whether overall interest intensity differed in samples composed entirely of men or women and found that it did not \((b = -.01, p = .62)\), leaving substantial unexplained between-study heterogeneity \((\tau = .11, p < .001)\). The result is consistent with our expectations and previous results indicating interdependent moderator effects. To explore gender differences in this context, we focus on whether age trends in Realistic and Social
interests (i.e., the two interest categories with the largest previously established gender differences) differ for women and men. A major strength of this analysis is that we were able to compare results across samples composed entirely of men or women, rather than the percent of each within samples.

Table 6 displays the meta-regression results, including the differences between effect sizes for women and men. This model allowed us to test the cross-over hypothesis (Guttman, 1987; Roberts & Helson, 1997) during young adulthood, while also examining gender differences during the disruption period of early adolescence (Soto & Tackett, 2015). The average effect for this model was -.11, \((p < .01)\) and the estimate of between-study heterogeneity was non-significant \((\tau = .05, p = .13)\). Because this model only used a subset of the dataset, the between-study variation above is not directly comparable to the previous models. For ease of presentation, we only report expected effect size estimates and difference scores for this model (see supplementary materials for \(b\) coefficients for this model).

During the middle school years, there were significant gender differences in mean-level changes for both Realistic and Social interests. Both boys’ \((d = -.11, p < .01)\) and girls’ \((d = -.28, p < .01)\) Realistic interests decreased, but girls showed a significantly steeper decline than boys’ \((d = -.18, p < .01)\). There was also a significant gender difference in Social interests \((d = .63, p < .01)\), as girls’ Social interests increased slightly \((d = .09, p < .05)\), while boys’ showed a steep decline \((d = -.54, p < .01)\). Both difference scores suggest that gender gaps in vocational interests widen during the disruption period of early adolescence.

The estimates of change within the 14-30 and 18-42 age categories offer two ways of examining the cross-over hypothesis. As mentioned, the 14-30 age category consisted of cumulative effect sizes from the original three age categories spanning this interval: late
adolescence, the college years, and emerging adulthood. The 18-42 age category contained only samples with long-test retest intervals that spanned late adolescence through middle adulthood. The results from both age categories provide some support for the cross-over hypothesis. In Realistic interests, Women’s interest scores increased significantly within both the 14-30 (d = .26, p < .01) and 18-42 age categories (d = .24, p < .01), while men showed little change (for 14-30, d = -.02, p = .91; for 18-42, d = -.11, p = .28). Social interests follow a similar trend: Men’s Social interests increased significantly in the 14-30 age category (d = .29, p < .01) and increased only slightly less in the 18-42 age category (d = .23, p = .05), while women’s Social interests changed little (for 14-30, d = .03, p = .82; for 18-42, d = .07, p = .17). We also tested whether these effect sizes were significantly different for men and women. The only significant difference was in Realistic interest scores in the 18-42 age category (d = .35, p < .01), such that women’s Realistic interests increased more than men’s. However, the other effect sizes tended to be moderate and potentially meaningful in magnitude (differences in trends of approximately d = |.2|).

With regard to research question 3, the results suggest that gender differences in vocational interests follow two distinct patterns of change. During the disruption period of early adolescence, gender differences in Realistic and Social interests widen. After this period, however, gender differences appear to decline. In the two age categories that spanned late adolescence to adulthood, women’s Realistic interests increased, while men’s remained constant. Parallel changes were found in Social interests, as men’s Social interests showed a pattern of increasing, while women’s did not. These results provide some support for the cross-over hypothesis. Nevertheless, the effect sizes in the 14-30 and 18-42 age categories were only significantly different for men and women in one of four comparisons, most likely due to low power for estimating this difference. One potential explanation for this finding is that although
vocational interests associated with the opposite gender increase during young adulthood, interests associated with the same gender remain constant—rather than decreasing. Thus, the gender differences were not large enough to warrant the conclusion that Realistic and Social interests change in different directions for men and women after early adolescence.

**Moderation Analysis**

Next, we investigated whether mean-level changes in interests varied based on the presence of moderators other than age, interest categories, and gender. We addressed this research question using three separate meta-regression models: theoretical framework of interest inventories, cohort, and retest interval. Each model included an effects coded moderator as a predictor of overall interest change.

**Theoretical Framework of Interest Inventory.** Table 7 presents the effects of the theoretical framework used by interest inventories. This model tested whether patterns of change varied across different interest classification systems. We did not have any direction-specific expectations for theoretical framework. Only two deviations were statistically significant. Mean-level interest change was greater than average for theoretical frameworks using Basic interests \( (b = .04, p < .05) \), and lower than average for frameworks using Kuder’s interest scales \( (b = -.04, p < .01) \). Despite these two significant deviations, the differences across theoretical frameworks were relatively small.

**Cohort Effects.** We tested whether effect sizes differed across birth cohorts to assess whether patterns of change varied based on the year in which samples were born. We did not have any direction-specific expectations for this moderator. Cohort had a small, positive relationship with mean-level interest change; the estimated effect of a one year cohort difference
was .002 (p = .06). These results suggest that the vocational interests of younger cohorts increased slightly more than older cohorts, but the effect size was trivial in magnitude.

**Retest Interval.** As mentioned, retest interval was inherently included in the computation of age categories. However, we also examined it separately to investigate the question of whether vocational interests change more over longer periods of time. Research on mean-level changes in personality traits suggests that time has a positive relationship with change (Roberts et al., 2006), so we expected studies with longer retest intervals to show greater changes. Retest interval had a small, positive relationship with change (d = .02, p = .17), but the effect was nonsignificant. Thus, similar to the other moderators in this section, the effect of retest interval was slight.
Discussion

Vocational interests reflect patterns of motivation for pursuing different educational and career-related activities and environments (Rounds & Su, 2014). The current meta-analysis examined mean-level changes in vocational interests from adolescence to adulthood across 98 samples. Findings indicate that interests undergo meaningful changes in different periods of the early lifespan. Patterns of change showed notable variation during age-graded educational periods and across different types of interests. Gender differences were found suggesting that the interests of men and women become more similar with age beginning in late adolescence. We focus the discussion on implications of the present findings for the development of interests and the use of interests in applied settings.

The first research question examined the extent to which changes in interest intensity vary during different age-graded educational periods. Results reveal compelling differences in patterns of change across the five age categories. During early adolescence (i.e., middle school, ages 11-14) mean-level vocational interest scores decreased ($d = -.10; k = 6$). These negative changes are consistent with research showing declines in ability-related beliefs and interest in school subjects during early adolescence (Bong et al., 2015; Frenzel et al., 2012; Wigfield et al., 1991; Wigfield & Eccles, 2002). Based on the accumulation of these research findings, the disruption hypothesis, which originally focused on personality trait development during early adolescence (Soto & Tackett, 2015), can now be extended to interests (Renninger & Hidi, 2016).

In contrast, the period of late adolescence (i.e., high school, ages 14-18) was marked by increases in mean-level interest scores ($d = .09; k = 28$). These positive changes suggest that interest intensity levels recover quickly after the disruption of early adolescence. Mean-level interest scores remained constant during both the college years (ages 18-22; $d = -.01; k = 34$) and
emerging adulthood (ages 22-30; $d = .03; k = 15$). In the final age category, containing samples with long retest intervals (spanning ages 18-42), interest scores increased slightly ($d = .07; k = 15$), suggesting a gradual increase of interests from late adolescence to middle adulthood. In general, these findings suggest that vocational interest intensity undergoes relatively volatile changes during adolescence before gradually leveling out during young adulthood. However, because these findings are based on aggregated scores from all interest categories, they do not distinguish between changes in different types of interests.

The second research question investigated whether the size and direction of changes varied across kinds of interests. We first modeled these changes across all samples ($k = 98$) before examining more specific patterns of change within each age category. Independent of age, the most striking differences were found across the Person-Thing interest orientation (Graziano et al., 2011). Person-oriented interests (Artistic, Social, and Enterprising) increased over time, whereas Things-oriented interests either decreased (Conventional) or remained constant (Realistic and Investigative). Our analysis of the interdependence of age and interest categories revealed that this general pattern of increasing Person-oriented interests was most evident in the three age periods that spanned young adulthood (i.e., ages 18-22, 22-30, and 18-42). Overall, these findings are similar to those outlined by the maturity principle (Roberts & Mroczek, 2008), which explains normative increases in personality traits associated with social maturity during young adulthood (Roberts et al., 2006). During the same age periods, our results indicate that people become more interested in activities and environments that involve helping others (Social), unsystematic creative expression (Artistic), and leading or influencing people (Enterprising). On the other hand, during adolescence most interest categories followed the general trend of decreasing during early adolescence before increasing during late adolescence.
The only exceptions were Investigative and Enterprising interests. Throughout both adolescent age periods, Investigative interests remained constant and Enterprising interests increased.

Most of the effect sizes within each age category were relatively small in magnitude. Although this may seem to suggest that the changes within each interest category are not practically significant, this conclusion requires further examination for two reasons. First, what constitutes a small change in vocational interests? Individual differences in vocational interests are markedly stable throughout adolescence and young adulthood (Low et al., 2005), showing greater stability levels than personality traits (Roberts & DelVecchio, 2000). Thus, even small changes in vocational interest intensity can have a big impact on a variety of consequential decisions, ranging from choosing a college major to deciding on which occupation to pursue. Furthermore, any mean-level change in vocational interests could impact job performance and turnover intention, with implications for personnel selection procedures based on interest assessments (e.g., Nye et al., 2012; Van Iddekinge et al., 2011). A second reason to further examine the magnitude of changes is that the effect sizes were confined to age periods that separated the early lifespan into categories. If we assume that the mean-level changes within each age category are independent, the effect sizes can be summed to provide an estimate of the total amount of change for each interest category from early adolescence to middle adulthood. The total accumulation of positive change ranged from about two-fifths to one-half of a standard deviation in Artistic and Enterprising interests, respectively. In contrast, mean-level Conventional interest scores decreased by about one half of a standard deviation. Such changes can be characterized as medium in magnitude (Cohen, 1992), and are even more noteworthy because they reflect change across entire populations.
With research question three, we compared patterns of change for men and women in Realistic and Social interests. These two interest categories hold the greatest mean-level gender differences, with men having stronger Realistic interests and women have stronger Social interests (Su et al., 2009). How do these gender differences change with age? As shown in Figure 3, results indicate that gender differences follow two distinct patterns of change. During the disruption period of early adolescence, the gender gap widened in both Realistic and Social interests. These changes appear to be the result of large mean-level decreases in boys’ Social interests ($d = -.54$) and girl’s Realistic interests ($d = -.28$). However, beginning in late adolescence these trajectories shifted direction providing some support for the cross-over hypothesis (Guttman, 1987; Roberts & Helson, 1997). In two independent age categories representing late adolescence through middle adulthood, women and men showed mean-level increases in the interest categories typically associated with the opposite gender ($d’s$ ranged from .23 to .29). During young adulthood, women become more interested in Realistic activities that involve the outdoors, using hands to fix things, and the manipulation of tools and machines. On the other hand, men become more interested in Social activities such as teaching, training, and helping others.

Despite the different trajectories of change for men and women during young adulthood, the magnitude of these changes does not appear to be large enough to make up for the overall gender differences in Realistic and Social interests. Su et al.’s (2009) meta-analysis found that men have stronger Realistic interests by an effect size of .84, while women have stronger Social interests by an effect size of -.68. In the current meta-analysis, the difference scores in the two age categories spanning young adulthood ranged from .28 to .35 in Realistic interests, and from -.16 to -.26 in Social interests. Even if the upper bound estimates were accurate, the effect sizes
from this meta-analysis would still be less than half the size of the effect sizes from Su et al.’s meta-analysis. Furthermore, the difference scores we found during early adolescence were also notable in magnitude, with effect sizes of -.18 for Realistic interests and .63 for Social interests. Integrating these various findings leads to two conclusions. First, early adolescence appears to be a key period when gender differences in vocational interests develop and increase. Second, although these differences begin to decrease in late adolescence, there are still likely to be moderate to large gender differences in Realistic and Social interests by middle adulthood. Throughout young adulthood, both women and men gain interest in activities typically associated with the opposite gender, but they do not lose interest in activities associated with their own gender.

**Limitations, Future Directions, and Conclusions**

The current meta-analysis adds a new perspective to the study of continuity and change in dispositional traits over time by aggregating effect sizes from longitudinal studies on mean-level change in vocational interests. Because of the group-level data reported by primary studies, the estimates of change from the current study do not provide information about individual differences in the stability of vocational interests. Past research has found that personality trait development varies as a function of individual differences (Mroczek & Spiro, 2003; Roberts et al., 2002; Robins et al., 2001), so this is an important area for future research. We were also unable to provide estimates of change past middle adulthood due to a lack of longitudinal research on the vocational interests of older adults. Research on other dispositional traits, such as personality (Roberts et al., 2006), suggests that interests may continue to change well into middle and later adulthood. Future studies can advance existing knowledge by tracking changes in older adults.
Another limitation to the present meta-analysis is that we needed to categorize the various interest measures used in past research into a single RIASEC typology in order to integrate findings. This process inherently led to a loss of information as more specific interest categories (e.g., occupational scales) needed to be generalized to fit within a RIASEC category. Lastly, the vast majority of samples included in our meta-analytic dataset were composed of individuals with higher than average levels of education. Future longitudinal research should sample from more diverse populations, across ethnicity, race, and socio-economic status.

In conclusion, the current meta-analysis showed that vocational interest intensity undergoes meaningful changes from adolescence to adulthood. The disruption period of early adolescence was marked by widening gender differences and overall decreases in mean-level interest scores. Mean-level interest scores recovered during late adolescence and gender differences began to decrease. Gender differences continued to decrease throughout young adulthood, but the magnitude of these changes was not large enough to offset the gender gap found in previous meta-analytic research. Results also indicate that Person-oriented interests increase throughout young adulthood, while Things-oriented interests remain constant. The overall patterns of change identified in this study provide a new perspective to theories of interest development and have widespread implications for the practical use of interests in educational psychology as well as vocational and organizational psychology.
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Note. *Indicates that study data was found in Campbell (1971). KGIS Kuder General Interest Survey; KOIS Kuder Occupational Interest Survey; KPR Kuder Preference Record; NVII Naval Vocational Interest Inventory; OVIS Ohio Vocational Interest Survey; SCII Strong Campbell Interest Inventory; SII Strong Interest Inventory; SVIB BIS Strong Vocational Interest Blank: Basic Interest Scales; SVIB OCC Strong Vocational Interest Blank: Occupational Scales; TALENT Project Talent Interest Inventory; UNIACT Unisex edition of ACT Interest Inventory. VPI = Vocational Preference Inventory. Basic = Basic Interest Scales. Kuder = Kuder’s 10 interest scales. Occ = Occupational Scales. Occ/Basic = Averaged data from Basic and Occupational scales. RIASEC = Holland’s RIASEC scales.
Table 2. Sample Characteristics Across Age Categories

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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Median</td>
<td>*Mean</td>
<td>1990</td>
<td>1959</td>
<td>48%</td>
</tr>
<tr>
<td>11-14</td>
<td>6</td>
<td>986</td>
<td>1.0</td>
<td>2.9</td>
<td>1990</td>
<td>1959</td>
<td>48%</td>
</tr>
<tr>
<td>14-18</td>
<td>28</td>
<td>10,285</td>
<td>3.0</td>
<td>2.5</td>
<td>1957</td>
<td>1973</td>
<td>43%</td>
</tr>
<tr>
<td>18-22</td>
<td>34</td>
<td>4,724</td>
<td>3.5</td>
<td>2.9</td>
<td>1945</td>
<td>1950</td>
<td>47%</td>
</tr>
<tr>
<td>22-30</td>
<td>15</td>
<td>1,415</td>
<td>8.0</td>
<td>7.7</td>
<td>1947</td>
<td>1948</td>
<td>82%</td>
</tr>
<tr>
<td>18-42</td>
<td>15</td>
<td>3,517</td>
<td>26.0</td>
<td>25.7</td>
<td>1953</td>
<td>1935</td>
<td>86%</td>
</tr>
<tr>
<td>All Samples</td>
<td>98</td>
<td>20,927</td>
<td>3.5</td>
<td>6.9</td>
<td>1949</td>
<td>1959</td>
<td>54%</td>
</tr>
</tbody>
</table>

Note. *Indicates estimate weighted by sample size. Gender percentages do not always add up to 100% because of mixed-gender samples.

Table 3. Mean-Level Changes in Overall Interest Intensity by Age Category

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Effect Size</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d</td>
<td>95% CI</td>
</tr>
<tr>
<td>Average</td>
<td>.02 [-.01,.04]</td>
<td>-0.12 [-.16,.08]</td>
</tr>
<tr>
<td>11-14</td>
<td>-.10 [-.15,.06]</td>
<td>0.07 [.03,.11]</td>
</tr>
<tr>
<td>14-18</td>
<td>.09 [.05,.13]</td>
<td>-.02 [-.09,.05]</td>
</tr>
<tr>
<td>18-22</td>
<td>-.01 [-.09,.08]</td>
<td>0.02 [.03,.06]</td>
</tr>
<tr>
<td>22-30</td>
<td>.03 [.02,.08]</td>
<td>0.05 [.01,.10]</td>
</tr>
<tr>
<td>18-42</td>
<td>.07 [.02,.11]</td>
<td>.09 [.04,.14]</td>
</tr>
<tr>
<td>τ</td>
<td>.09 [.04,.14]</td>
<td></td>
</tr>
</tbody>
</table>

Note. d = the expected effect size in reference to zero. b = each age categories’ deviation from the midpoint effect size. τ = random effect standard deviation in the between-study effect size. 95% CI = 95% random effects confidence intervals.

Table 4. Mean-Level Changes by Interest Category (Independent of Age)

<table>
<thead>
<tr>
<th>Interest Category</th>
<th>Effect Size</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d</td>
<td>95% CI</td>
</tr>
<tr>
<td>Average RIASEC</td>
<td>.04 [.00,.08]</td>
<td>.00 [-.06,.06]</td>
</tr>
<tr>
<td>Realistic</td>
<td>.05 [.03,.12]</td>
<td>.05 [.01,.10]</td>
</tr>
<tr>
<td>Investigative</td>
<td>.00 [.05,.05]</td>
<td>-.05 [-.08,.01]</td>
</tr>
<tr>
<td>Artistic</td>
<td>.10 [.05,.14]</td>
<td>.04 [.02,.10]</td>
</tr>
<tr>
<td>Social</td>
<td>.08 [.01,.15]</td>
<td>.07 [.03,.11]</td>
</tr>
<tr>
<td>Enterprising</td>
<td>.11 [.06,.16]</td>
<td>-.12 [-.16,.07]</td>
</tr>
<tr>
<td>Conventional</td>
<td>-.07 [-.14,.00]</td>
<td>.10 [.05,.15]</td>
</tr>
<tr>
<td>τ</td>
<td>.10 [.05,.15]</td>
<td></td>
</tr>
<tr>
<td>Average Person-thing</td>
<td>.04 [.00,.08]</td>
<td>.04 [.02,.07]</td>
</tr>
<tr>
<td>People</td>
<td>.09 [.04,.13]</td>
<td>-.04 [-.07,.02]</td>
</tr>
<tr>
<td>Things</td>
<td>.00 [-.05,.05]</td>
<td>.11 [.07,.15]</td>
</tr>
<tr>
<td>τ</td>
<td>.11 [.07,.15]</td>
<td></td>
</tr>
<tr>
<td>Average Data-Ideas</td>
<td>.02 [-.02,.05]</td>
<td>-.02 [-.04,.01]</td>
</tr>
<tr>
<td>Data-orientation</td>
<td>.00 [-.04,.05]</td>
<td>.02 [-.01,.04]</td>
</tr>
<tr>
<td>Ideas-orientation</td>
<td>.03 [.00,.07]</td>
<td>.11 [.07,.15]</td>
</tr>
<tr>
<td>τ</td>
<td>.11 [.07,.15]</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. (cont.)

Note. \(d\) = the expected effect size in reference to zero. \(b\) = each interest categories’ deviation from the midpoint effect size. \(\tau\) = random effect standard deviation in the between-study effect size. 95% CI = 95% random effects confidence intervals.

Table 5. Mean-Level Changes in RIASEC Interests by Age Category

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Interest Category</th>
<th>(d)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-14 (Early Adolescence)</td>
<td>Realistic</td>
<td>-.20</td>
<td>[-.32, -.08]</td>
</tr>
<tr>
<td></td>
<td>Investigative</td>
<td>-.05</td>
<td>[-.20, .10]</td>
</tr>
<tr>
<td></td>
<td>Artistic</td>
<td>.00</td>
<td>[-.10, .10]</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>-.23</td>
<td>[-.62, .16]</td>
</tr>
<tr>
<td></td>
<td>Enterprising</td>
<td>.23</td>
<td>[.04, .42]</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>-.35</td>
<td>[-.48, -.22]</td>
</tr>
<tr>
<td>14-18 (Late Adolescence)</td>
<td>Realistic</td>
<td>.16</td>
<td>[.10, .22]</td>
</tr>
<tr>
<td></td>
<td>Investigative</td>
<td>.01</td>
<td>[-.20, .10]</td>
</tr>
<tr>
<td></td>
<td>Artistic</td>
<td>.09</td>
<td>[.00, .17]</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>.09</td>
<td>[.00, .17]</td>
</tr>
<tr>
<td></td>
<td>Enterprising</td>
<td>.18</td>
<td>[.12, .24]</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>.08</td>
<td>[-.01, .17]</td>
</tr>
<tr>
<td>18-22 (College Years)</td>
<td>Realistic</td>
<td>.01</td>
<td>[-.13, .14]</td>
</tr>
<tr>
<td></td>
<td>Investigative</td>
<td>-.12</td>
<td>[-.24, .00]</td>
</tr>
<tr>
<td></td>
<td>Artistic</td>
<td>.12</td>
<td>[.04, .20]</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>.13</td>
<td>[.03, .23]</td>
</tr>
<tr>
<td></td>
<td>Enterprising</td>
<td>.03</td>
<td>[-.08, .14]</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>-.19</td>
<td>[-.30, -.08]</td>
</tr>
<tr>
<td>22-30 (Emerging Adulthood)</td>
<td>Realistic</td>
<td>-.05</td>
<td>[-.17, .06]</td>
</tr>
<tr>
<td></td>
<td>Investigative</td>
<td>.06</td>
<td>[-.10, .22]</td>
</tr>
<tr>
<td></td>
<td>Artistic</td>
<td>.20</td>
<td>[.09, .31]</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>.02</td>
<td>[-.09, .13]</td>
</tr>
<tr>
<td></td>
<td>Enterprising</td>
<td>.10</td>
<td>[.04, .17]</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>-.09</td>
<td>[-.23, .05]</td>
</tr>
<tr>
<td>18-42 (Late Adolescence to Middle Adulthood)</td>
<td>Realistic</td>
<td>-.08</td>
<td>[-.30, .15]</td>
</tr>
<tr>
<td></td>
<td>Investigative</td>
<td>.16</td>
<td>[.09, .23]</td>
</tr>
<tr>
<td></td>
<td>Artistic</td>
<td>.11</td>
<td>[.05, .26]</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>.21</td>
<td>[.00, .42]</td>
</tr>
<tr>
<td></td>
<td>Enterprising</td>
<td>.09</td>
<td>[.01, .17]</td>
</tr>
<tr>
<td></td>
<td>Conventional</td>
<td>-.06</td>
<td>[-.13, .00]</td>
</tr>
</tbody>
</table>

\(\tau\) = random effect standard deviation in the between-study effect size. 95% CI = 95% random effects confidence intervals.
### Table 6. Mean-Level Changes in Realistic & Social Interests by Gender

<table>
<thead>
<tr>
<th>Interest Category</th>
<th>Age Category</th>
<th>Women</th>
<th>95% CI</th>
<th>Men</th>
<th>95% CI</th>
<th>Difference</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realistic</td>
<td>11-14</td>
<td>-.28</td>
<td>[-.40, -.16]</td>
<td>-.11</td>
<td>[-.15, -.06]</td>
<td>-.18</td>
<td>[-.30, -.05]</td>
</tr>
<tr>
<td></td>
<td>14-30*</td>
<td>.26</td>
<td>[.10, .42]</td>
<td>-.02</td>
<td>[-.29, .26]</td>
<td>.28</td>
<td>[-.04, .59]</td>
</tr>
<tr>
<td></td>
<td>18-42</td>
<td>.24</td>
<td>[.22, .26]</td>
<td>-.11</td>
<td>[-.31, .09]</td>
<td>.35</td>
<td>[.15, .55]</td>
</tr>
<tr>
<td>Social</td>
<td>11-14</td>
<td>.09</td>
<td>[.02, .16]</td>
<td>-.54</td>
<td>[-.84, -.23]</td>
<td>.63</td>
<td>[.31, .94]</td>
</tr>
<tr>
<td></td>
<td>14-30*</td>
<td>.03</td>
<td>[-.22, .27]</td>
<td>.29</td>
<td>[.08, .49]</td>
<td>-.26</td>
<td>[-.57, .05]</td>
</tr>
<tr>
<td></td>
<td>18-42</td>
<td>.07</td>
<td>[-.03, .17]</td>
<td>.23</td>
<td>[.00, .46]</td>
<td>-.16</td>
<td>[-.41, .10]</td>
</tr>
</tbody>
</table>

Note. *14-30 represents the cumulative effect size from the three age categories spanning this interval (14-18, 18-22, 22-30). $d =$ the expected effect size in reference to zero. $\tau =$ random effect standard deviation in the between-study effect size. 95% CI = 95% random effects confidence intervals. Difference scores computed by subtracting men effect sizes from women. The average $d$-value for this model was -.11, 95% CI = [-.16, .06]. The random effect standard deviation in the between-study effect size, $\tau$, was .05, 95% CI = [.01, .12].

### Table 7. Mean-Level Interest Change by Theoretical Framework of Interest Inventory

<table>
<thead>
<tr>
<th>Test Format</th>
<th>Effect Size</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$d$</td>
<td>95% CI</td>
</tr>
<tr>
<td>Average $d$</td>
<td>.04</td>
<td>[.01, .07]</td>
</tr>
<tr>
<td>RIASEC</td>
<td>.05</td>
<td>[-.05, .16]</td>
</tr>
<tr>
<td>Occupational</td>
<td>.02</td>
<td>[.04, .12]</td>
</tr>
<tr>
<td>Basic</td>
<td>.04</td>
<td>[.01, .09]</td>
</tr>
<tr>
<td>Occupational/Basic Avg.</td>
<td>.04</td>
<td>[.04, .03]</td>
</tr>
<tr>
<td>Kuder</td>
<td>-.01</td>
<td>[.04, .16]</td>
</tr>
</tbody>
</table>

Note. $d =$ the expected effect size in reference to zero. $b =$ each effect sizes’ deviation from the midpoint effect size. $\tau =$ random effect standard deviation in the between-study effect size. 95% CI = 95% random effects confidence intervals.
FIGURES

Figure 1. *Meta-Analytic Regression Models for Age Categories, RIASEC Interests, Person-Thing, and Data-Ideas Interest Orientations.*

Note. Solid lines represent the midpoint effect for each model. Dots indicate each moderators’ deviations from the midpoint effect.
REFERENCES


*Cisney, H. N. (1944).* The stability of vocational interest scores during the high school period. (Doctoral Dissertation, University of Michigan, Ann Arbor). Retrieved from ProQuest Dissertations and Theses.


Roberts, B. W., Edmonds, G., & Grijalva, E. (2010). It is developmental me, not Generation Me: developmental changes are more important than generational changes in Narcissism—Commentary on Trzesniewski & Donnellan (2010). *Perspectives on Psychological Science, 5*(1), 97-102.


*Note.* * Indicates that study was included in meta-analytic dataset.