

**MORE THAN JUST A SIMPLE TWIST OF FATE:
SERENDIPITOUS RELATIONS IN ADOLESCENCE**

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Abstract

Unexpected, non-normative events are key influences on life-span human development. Despite this importance, little is known about how an individual may capitalize on these events by transforming them into opportunities for sustained positive development. In this research, I introduce the concept of *serendipitous relations* – mutually beneficial, adaptive developmental regulations brought about by the time-extended coaction of intentional self-regulatory actions and unexpected non-normative life events. In turn, I hypothesize that use of specific *serendipitous actions* (for instance, identifying an unexpected events as potential opportunities for positive development, or disengaging from prior goals when new goals that derive from unexpected events show promise) leads to such serendipitous relations, which may be especially important sources of positive development during periods of life transition. Using data from one sample of American high-school students and two samples of American students enrolled in post-secondary educational institutions, results from a series of latent variable analyses supported these hypotheses: higher levels of serendipitous actions predicted within-time adaptive development, and interindividual variability in rank order of serendipitous actions predicted interindividual variability in rank order of adaptive development (as indexed by a measure of Positive Youth Development) from the final year of high school into post-secondary educational enrollment. Interpreting these results as preliminary support for the future study of serendipitous relations, I offer suggestions for future research to more fully

explicate potential underlying developmental processes and provide ideas for applying this research to domestic and international interventions.

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My Mom and my Dad taught me to love and to learn and to love learning. They pushed me to climb the big hills, even if it meant shifting down a gear or two. My brothers taught me to teach. If someone asks who I am, I am their brother first, and everything else second. Jackie and Rich Lerner taught me everything that you're about to read. Their lessons of humility, devotion, and tenacity extend beyond the pages of this dissertation. They knew how to push me and how to support me and they changed my life. The other Musketeers, Kristina and Megan, taught me to ask for help. I asked a lot, they always helped, and they will be my friends/family/proofreaders forever.

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And you may find yourself living in a shotgun shack

And you may find yourself in another part of the world

And you may find yourself behind the wheel of a large automobile

And you may find yourself in a beautiful house, with a beautiful wife

And you may ask yourself

Well...How did I get here?

The Talking Heads, 1980

Chapter 1:

PROBLEM STATEMENT

An individual produces his or her own development (Lerner, 1982) through intentional self-regulatory (ISR) actions aimed at achieving goals (Baltes, Lindenberger, & Staudinger, 2006; Freund, Li, & Baltes, 1999). Within the framework of relational developmental systems theory (RDST), these ISR actions, like all developmental processes, involve bidirectional person \leftrightarrow context relations (Lerner, 2006) between all levels of the developmental system (Mistry, in press; Overton & Lerner, 2012). One way to categorize these influences comes from life-span developmental psychology, which studies the mutuality of influences between the individual's actions and three categories of influential life events: age-graded, history-graded, and non-normative (Baltes, Reese, & Lipsitt, 1980).

There are examples in the literature involving individuals' use of ISR to maximize gains and/or minimize losses associated with age-graded events, such as declining personal resources or abilities due to aging (Freund, 2008); history-graded changes in ecological resources, such as globalization, or the emergence of widespread youth-development programs (Larson & Wilson, 2004; Urban, Lewin-Bizan, & Lerner, 2010); or changes associated with non-normative historical events, such as the Great Depression (Elder, 1974, 1980; Elder & Shanahan, 2006). However, there exists little theoretical discussion or empirical evidence delineating the role that ISR may play in capitalizing on non-normative

life events. This purpose of this research, therefore, is to begin to investigate two basic questions involving ISR and non-normative life events.

First, are there distinct ISR processes that enhance the probability of positive outcomes from unexpected non-normative life events? Second, if such ISR-based, mutually beneficial person \leftrightarrow context exchanges – which I term here and later operationalize as *serendipitous relations* – exist, do they vary within individuals across time and/or across individuals within time? To maximize the opportunity to investigate serendipitous relations, I focus the present research on individuals progressing from high school to post-secondary education institutions, which are often characterized by the normativity of unexpected events, e.g., chance meetings, unanticipated experiences, and changes in area of academic focus.

The potential importance of this research

Could the study of serendipitous relations offer new insights into the role of ISR processes in positive development across the life span? If so, why is the progression from high school to post-secondary education a suitable time frame for assessing these processes? There are at least two ways that studying serendipitous relations during this progression would contribute to the self-regulation and life-span literature.

First, as noted earlier, there is a gap in the literature about the role of an individual's ISR in regard to unexpected, non-normative life events¹. Since such

¹ There are certainly other types of unusual life events, and both description and study of these events are absent in the literature. For example, what is the role of ISR in response to *unexpected normative events*, such as winning a lottery? This event is normative in the sense that someone must win the drawing periodically, and certain ISR processes are

events occur frequently and have been cited as an important influence across several literatures (e.g. Bandura, 1982; Delgado & Lynch, 1999; Landes, 1994, Lewis, 1998; Pina e Cunha, Clegg & Mendoca, 2010) it is important to understand the individual's capacity to maximize gains and minimize losses when he or she encounters them. In addition, while most prominent ISR theories include concepts that involve the individual adjusting his or her goal pursuit in light of unexpected setbacks, goal blockage, or diminution of resources (e.g. the compensation and loss-based selection in the Selection, Optimization, and Compensation [SOC] model of ISR; Freund & Baltes, 2002), to my knowledge no ISR theory expressly includes processes where the individual adjusts his or her goal hierarchy due to unexpected successes, emerging goals, or unanticipated gains in resources. Such gains-based variations in goal pursuit might emerge from one's exposure to unexpected non-normative events.

This research represented an initial step in addressing several key issues pertaining to ISR and unexpected non-normative life events. For example, I tested whether specific ISR processes increase the likelihood of encountering these non-normative events during goal pursuits. I also examined if these processes are conceptually and empirically distinct from those detailed in existing theories of ISR. Finally, because of the measurement model I used, I studied the

likely important factors in instantiating the event (e.g., going to the store and purchasing a ticket) as well as promoting positive post-win outcomes (e.g., hiring qualified legal representation or accounting help). Another type of unusual life event could be the *expected non-normative event*; however, this category of event likely only occurs for those adolescents who "score high" on the personal fable component of adolescent egocentrism, or perhaps for narcissistic or solipsistic adults. Unfortunately, an examination of these and other types of unusual life events, and how they relate to an individual's ISR, are outside the scope of the proposed research.

relations between these proposed ISR processes and other intraindividual factors. For example, an individual's capacity to benefit from an unexpected meeting through ISR could also be related to low levels of temperamental rigidity or "functional fixedness" (e.g. Chess & Thomas, 1999; Duncker, 1945; Glucksberg, 1962), which in turn may be associated with higher levels of creativity and social intelligence.

The research on serendipitous relations may bring about a second contribution to the literature: a better understanding of the diverse outcomes that can result from longer-term developmental transitions and the role that ISR may play in these outcomes. Developmental transitions can be fraught with uncertainty (Weiss, Freund, & Wiese, 2012), as individuals interact with a context of unfamiliar affordances and constraints (Brandstädter, 2006; Gibson, 1977). During these periods, individuals may be exposed to a greater level of unexpected non-normative life events. One example of such a transition is the move from high school to a post-secondary educational institution (e.g., Lefkowitz, 2005), where individuals may be tasked with choosing a "major," or focal area of study (Galotti, 1999), selecting engaging and beneficial extracurricular activities (e.g., Busseri et al., 2011), navigating new social situations involving sex-related communication (Lefkowitz & Espinoza-Hernandez, 2007), and appropriately handling alcohol and/or substance use (Padilla-Walker, Nelson, Madsen, & Barry, 2008).

In general, an individual's ISR processes are thought to be important factors in promoting adaptive responses to challenges arising from uncertainty

during periods of transition (e.g., Heckhausen, 2002). There is some evidence that ISR processes may be particularly important in preventing losses during school transitions. For example, a child's action control beliefs can minimize losses due to the stressful middle school transition, which involves unpredictable social, emotional, and educational challenges (Vanlede, Little, & Card, 2006). In addition, a late adolescent's ability to successfully use the ISR actions termed compensatory secondary processes (e.g., goal disengagement, goal rescaling, or lowering aspirations; Heckhausen, Wrosch & Schulz, 2010) after unexpectedly failing a university exam was associated with higher levels of life satisfaction (Tomasik & Salmela-Aro, 2012).

However, uncertainty during transitions does not exclusively involve losses; rather, these periods can also provide unexpected opportunities to maximize gains. For example, a first year university student may unexpectedly find her vocational calling and pursue long-term self-developmental goals because of her required enrollment in a Fine Arts course. Like minimizing losses due to stress or failure, actualizing gains from unexpected events likely requires enacting specific ISR processes at particular periods both during the initial transition and beyond. For instance, the hypothetical first year student might have selected the Fine Arts course because of a passing interest in the topic, and, once unexpectedly enamored, might disengage from prior goals and change majors to maximize her gains. While the existing ISR research is replete with theories and data describing patterns of goal engagement and disengagement (e.g., Wrosch, Scheier, Miller, Schulz, & Carver, 2003) it may not adequately describe the

potentially nuanced and dynamic person \leftrightarrow context relations associated with the unexpectedly emergent goals that may be typical during periods of transition. Thus, an aim of this research was to improve our understanding of the beneficial and ongoing interplay between these ISR processes and these events; that is, exploring serendipitous relations may allow us to understand how individuals *make opportunities* out of unexpected non-normative life events.

In sum, serendipitous relations may be an important but understudied topic in life span human development and are worthy of extended research for at least two reasons. First, we know little about the role of an individual's ISR as it pertains to non-normative life events. Second, serendipitous relations may play an important role in promoting adaptive development during periods of uncertainty, such as major life transitions. Therefore, this research addressed: 1. the appropriate means to best measure the specific ISR processes that may enhance the probability of positive outcomes from non-normative unexpected life events; and 2. the extent to which these ISR processes were associated with adaptive development across a major life transition.

The methods used to address these issues are described briefly below. This research involved two studies. Study 1 addressed a first research question. Study 2 addressed a second research question.

The Present Studies

Study 1 – How can we best measure the specific ISR processes that may enhance the probability of positive outcomes from non-normative unexpected life events?

The goals for Study 1 were to develop an initial measurement model for serendipitous relations, and to test whether specific ISR processes and characteristics of unexpected, non-normative life events were concurrently predictive of adolescents' adaptive development. Accordingly, the first study involved three steps: 1. Factor analysis of a set of items designed to assess characteristics of unexpected, non-normative life events, the ISR processes that may be associated with serendipitous relations, and a factor representing components of positive development; 2. Factorial invariance testing of the resulting structure across three samples of late adolescents; and 3. An assessment of the cross-sectional latent relations among the factors for characteristics of unexpected, non-normative life events, the theoretically-related ISR factors, and a factor representing positive development.

As described in greater detail in Chapter 3, the characteristics of unexpected non-normative life events were operationalized as: 1. the *frequency* of such events, that is, how often they are perceived to occur; 2. the *positivity* of such events, or how positive individuals perceive them to be; and 3. the *influence* of such events, that is, how much they are perceived to influence development.

There were two ISR factors in this research. The first was a factor for the Selection, Optimization, and Compensation (SOC) model (e.g., Baltes et al., 2006). The second was a factor for *serendipitous actions*, which are described later as specific self-regulatory actions hypothesized to enhance the probability of positive outcomes from non-normative unexpected life events. Finally, positive development was operationalized by a factor representing the Five Cs model of

Positive Youth Development (PYD; e.g., Lerner et al., 2005). I hypothesized that, if an invariant model that included these factors could be modeled with these data, higher levels of serendipitous actions in high school would predict higher levels of concurrent PYD, beyond the influence of SOC, as well as the frequency, positivity, and influence of unexpected non-normative events.

Study 2 – Are changes in serendipitous actions associated with adaptive development across a major life transition?

The goal for Study 2 was to assess whether an individual's change in his or her serendipitous actions was associated with adaptive development (as indexed by PYD) across a major life transition (high school to post-secondary educational studies). However, the present data, which were collected at two time points, were not ideally suited to assess the patterns of intraindividual change and interindividual differences in intraindividual change in serendipitous actions and adaptive development necessary to address this developmental question. Nevertheless, it was possible to test a component of this question: whether interindividual variability in rank order for the serendipitous actions factor (which could, in part, derive from differences in intraindividual change), predicted changes in the rank ordering of PYD levels from high school to enrollment in post-secondary education. While such analyses may not be fully sensitive to within-person change, they could lead to a better understanding of the longitudinal relations among these factors, or provide suggestions for future intraindividual research (Selig & Little, 2012).

Therefore, the second study involved using a cross-lagged longitudinal panel model to examine the autoregressive and concurrent associations between ISR actions, serendipitous relations, and positive outcomes in a sample of adolescents assessed once during their final year of high school and again during their enrollment in a post-secondary education institution. I hypothesized that interindividual variability in rank order of serendipitous actions from high school to post-secondary education were predictive of variability in rank order of PYD during the same period, over and above the influence of interindividual variability in SOC, as well as the frequency, positivity, and influence of unexpected, non-normative life events. Findings that supported this hypothesis, while not causal in nature, nor fully sensitive to intraindividual change, would provide an important foundation for future developmental analyses.

This dissertation will be organized into three main sections. First, I will present a literature review, theoretical grounding, and operationalization of serendipitous relations. Next, I will present the method, results, and brief discussions of the two studies described above. Finally, in a general discussion, I will consider implications for the ISR and life-span developmental literatures. In addition, I will suggest future research about serendipitous relations, and potential applications of knowledge about serendipitous relations to promote positive development.

CHAPTER 2:
**SERENDIPTIOUS RELATIONS: AN OPERATIONALIZATION BASED
IN ETYMOLOGY AND DEVELOPMENTAL THEORY**

As he had many nights before, the astronomer and Theatine priest Giuseppe Piazzi spent the early hours of January 1st 1801 cataloging the night sky. When a faint, unexpected pinprick of light appeared through his Palermo telescope, he made note of this “new star.” Over the next few nights he observed this discovery with some excitement. Watching closely, the “star” seemed to be moving slowly across the sky (Hoskin, 1999). Piazzi had serendipitously discovered the first asteroid, which he named Ceres.

The history of science is punctuated by unexpected discoveries like Piazzi’s (Roberts, 1989). The sociologist Robert Merton termed this phenomenon – where the scientist flexibly develops new theory based on observing an unexpected or anomalous event – “the serendipity pattern” (Merton, 1948, 1957, 1968). Serendipity is, of course, not the exclusive province of the scientist. Positive, unexpected events often alter the life course of everyday individuals as well (e.g., Williams, Soeprapto, Like, Touradji, Hess, & Hill, 1998; Plunkett, 2001). However, while coincidental life events captured the attention of some scholars (e.g., Jung, 1973), much of the extant literature on the developmental influence of unexpected life events focuses on the potentially calamitous results of unanticipated cohort effects like the Great Depression (e.g., Elder, 1974, 1980) or “unhappy accidents” like mistakenly knocking on the door of a murderous gang (Bandura, 1982). Fortuitous, unexpected life events have been given short

shrift: stipulated, but not necessarily studied, as potential sources for developmental variation (e.g., Baltes, 1983; Brim & Ryff, 1980).

In this chapter, I attempt to address this gap in the literature by introducing the concept of *serendipitous relations*. A bidirectional, person \leftrightarrow context process (Lerner, 2006) based in relational developmental systems theories (RDST; e.g., Overton, 2006, 2010), serendipitous relations can be defined as *mutually beneficial², adaptive developmental regulations (Brandstädter, 2006) brought about by the time-extended coaction of intentional self-regulatory actions and unexpected non-normative life events*. Throughout this chapter, I will argue that serendipitous relations constitute an important and understudied influence on life-span development that is consistent with and complimentary to various extant theoretical positions.

This chapter has four main sections. First, I trace serendipity's etymology over its relatively brief history. This section highlights the multiple, often-conflicting historical definitions of serendipity and offers some insight into why the concept is currently scarce in the developmental literature. Next, I synthesize

² While serendipitous relations are mutually beneficial, unexpected non-normative events could be beneficial to a person alone or to the context alone. For instance, a thief may by chance notice an unlocked window and rob a home. This unlocked window clearly benefits the thief, and clearly harms the resident. By my definition, the theft was not a serendipitous relation for either party. Unexpected events can also benefit the context to the detriment (or at least the inequitable benefit) of the individual. A clear example of this situation would be the story of Henrietta Lacks. Mrs. Lacks suffered from cervical cancer, and before her death in 1951, doctors took various tissue samples to run standard medical tests. These samples, to the shock of the Johns Hopkins-based researchers, continued to reproduce in the lab setting, and have been vital in many medical projects, including research on cancer and AIDS (for an account of this story, see Skloot, 2010). For Mrs. Lacks and her family, her cells' contributions were not a serendipitous relation; they did not extend her life span and until recently, she was not widely recognized in the medical community. However, for the Johns Hopkins researchers, who benefitted both their careers and the medical field, the gains from Mrs. Lacks' cells *could* arguably be seen as a serendipitous relation.

these definitions and the core concepts of three prominent developmental theories (i.e., RDST, intentional self-regulatory theories, and the life-span developmental perspective) into a three-phase model of serendipitous relations. The second section also includes a description of five intentional self-regulatory (ISR) processes hypothesized to lead to serendipitous relations. In the third section, I briefly discuss how addressing the problematics that may arise from the three-phase model may serve to strengthen the overall concept of serendipitous relations. In the final section, I emphasize two core hypotheses in regard to studying the model I presented of serendipitous relations, and I will discuss how this dissertation begins to address these hypotheses.

Serendipity's Origins and Etymology

To argue that serendipitous relations should be considered important influences on life-span development, I believe that it is important to first explore reasons for the concept's current absence from the literature. Some of the blame lies in serendipity's (that is, the word's) curious origins, which allowed for great variation in its usage over time and among groups (Merton & Barber, 2004). Specifically, as I will illustrate, these usage variations were based on differing definitions of the word, which, in addition to causing confusion among users, were also generally incompatible with the person \leftrightarrow context relations that underlie contemporary developmental science. The one exception, however, may be serendipity's original definition.

The origins of serendipity lie in a letter by the eccentric aristocrat Horace Walpole, written in 1754. Describing his ability to "dip" his hand into a bookshelf

and find precisely the book he was looking for, Walpole related his abilities to those of the “Three Princes of Serendip,” protagonists of an eponymous ancient tale (*Serendip* being an Arabic/Ceylonese word for Sri Lanka; Merton & Barber, 2004). In the story, the Princes deduce the whereabouts of a very specific missing camel, sight unseen, based on their skillful observation of a series of obscure clues. Walpole termed the Princes’ behavior – “always making discoveries, by chance and sagacity” – serendipity (1754). Here, while perhaps unintentionally, Walpole introduces serendipity as a discovery that involves, arguably, the *coaction* of sagacity (or wisdom, an “individual” characteristic) and chance (a “contextual” characteristic). However, as a coined word in a private letter, this definition of serendipity, as well as the word itself, lay dormant for decades.

Serendipity, the word, was “rediscovered” and appropriated by an insular group of erudite antiquarians and bibliophiles in the late 1870s and early 1880s. They had encountered the word in a published volume of Walpole’s letters (see Merton & Barber, 2004). Among these men, there was much speculation as to serendipity’s exact definition, due in part to its lack of Latin or Greek root. For instance, in 1880, Edward Solly stated that serendipity was used to “express a particular kind of natural cleverness” involving the “the discovery of things that the finder was not in search of.” Rather than the skills required for discovering an unexpected event, Andrew Lang described, one year later, his notions of serendipity: “the luck of falling on just the literary document which one wants at the moment.” Lang’s notion involved the chance and pleasure of the fortuitous timing of such an event. Between these men, therefore, serendipity was alternately

used to describe the characteristics of an individual (e.g., a serendipitous bibliophile) or an “event” in the context (e.g., serendipitously happening upon an unexpected book), rather than their coaction, as Walpole described. Whatever the exact usage, these early users modified serendipity’s meaning, appropriating it to correspond to certain characteristics of a common, yet complex phenomenon in their collecting or reading: the positive discovery of something unexpected.

This pattern – serendipity’s meaning being “refracted” by the behaviors and experiences of its users – continued with the word’s next adopters, a group of well-read scientists and doctors. As intimated earlier, unexpected events – from Piazzzi’s discovery of Ceres to Alexander Fleming’s discovery of penicillin – often drive scientific discovery. Within serendipity’s early community of scientific users, Solly’s “skill conception” was most often emphasized, and in some cases, forwarded as an important foundation for scientific development (Merton & Barber, 2004). For example, Walter Bradford Cannon, known for the “fight or flight” response (1929) and the associated Cannon-Bard theory of emotion, discussed serendipity frequently in his medical school lectures (Barber & Fox, 1958; Merton & Barber, 2004), and exhorted his students to be open to unexpected paths or solutions that may emerge during the course of research.

As more scientists began to use the word, serendipity started to trickle into the common lexicon. As it had through each of its early-user groups, serendipity’s meaning was once more refracted, this time by shared experiences of the general population. Like the collector happening upon a rare book, or the chemist exploring the properties of an accidentally-created compound, everyday

individuals can also be influenced by their ability to “make the most of” unexpected opportunities. However, unlike the early users of the word, the general population does not engage in the specific shared goal pursuits of scientists or antiquarians; every individual does not do research, nor does every individual collect rare books. In the general population, one likely now cites serendipity as an unexpected instance of more diverse occurrences, for example, the selection of a partner or an occupation or a pastime. The lack of a shared reference point from which to consider serendipity as a “skill,” or *specific* “kind of natural cleverness,” may have influenced the current common usage of the word: serendipity is now often a synonym for a lucky, happy accident, and it is therefore clearly more “Lang” than “Solly.”

In many ways, the development of serendipity as a word is not unique. The meaning of words used to describe complex concepts, like love or morality, will vary across time and among users. Further, as once-esoteric or scientific words enter the lexicon, they tend to lose earlier meaning, cachet, and specificity (Merton & Barber, 2004). However, serendipity’s characteristics – its relatively recent coining, unusual provenance, and ability to describe a complex, yet common phenomenon – contributed to the varied and divergent definitions of the word. By the mid-20th century, when serendipity became widely used, these alternating uses may have contributed to its general exclusion from the contemporary developmental literature. In addition, as I will argue in greater detail below, this relative absence may also be based in echoes of the Solly (individual) and Lang (context) split conceptions of serendipity. In contrast, the

bidirectional process that characterizes the concept of serendipitous relations hews more closely to Walpole's original definition.

Antimonies and the Exclusion of Serendipity from Historical Developmental Theory

The idea that serendipity or serendipitous relations may be *either* sagacity *or* chance – or, either an attribute of the individual or a characteristic of the context – is an example of an antimony (Overton, 1998; 2006). In science, antimonies are founded in a fundamental, non-reciprocal split conception of “pure forms” based in a neo-positivist, Cartesian, reductionist worldview (e.g., Overton, 2002). For the majority of its existence, the study of human development “has been the captive” of antimonies (like “nature / nurture” or “mind / body”) based in a reductionist framework (Lerner & Overton, 2008, p. 245). By comparison, RDSTs emphasize mutually reciprocal and constitutive relations between all levels of an integrated developmental system (Lerner, 2006, 2011; Overton, 2006, 2010). Therefore, from an RDST perspective, the isolation of individual and contextual bases for serendipitous relations invites complicated – yet wholly unnecessary – problems that may have made the study of serendipity in developmental science seem unattractive.

While, to my knowledge, no social scientist has explicitly presented a split conception of serendipity in his or her research, a few examples in the literature indicate some evidence of this view. This evidence is often based in descriptions of methodological concerns. For instance, the sociologist Howard Becker highlighted practical and methodological challenges to studying chance events by

describing a study of meteors (1994). In this study, astronomers taped the night sky, using many remote cameras across many days, hoping to catch at least a fleeting glimpse of a rare meteor. Becker, wistfully explaining that such a data collection technique for a sociological study of coincidences was not feasible, wrote that “no one would pay for such an enormous ‘fishing expedition’” (1994, p. 192).

Becker’s sentiments reflect those of psychologist David Krantz, who lamented the absence of chance occurrences from psychological studies (1998). Like Becker, Krantz illustrated what he considered to be fundamental methodological limitations of studying chance events. Arguing that historical research in psychology was based in the “expectation that simple, universal laws of animate behavior could be discovered,” Krantz held that the general methodology of psychology was designed to “allow these laws to be teased out of the complex, indeterminate, often chance-like real world” (Krantz, 1998, p. 93). Psychology’s research paradigm, according to Krantz, resulted in the study of chance events to be “fundamentally unresolvable at the data level,” as it was these chance events themselves that research designers explicitly seek to control (Krantz, 1998).

While addressing different issues, both Becker’s and Krantz’s positions reflect a split, yet more “Lang-like” conception of serendipity. If serendipity is simply a happy accident, like a meteor passing through the night sky, then, as Becker illustrates, collecting data on serendipity’s role in human development would be restrictively costly. If serendipity is simply chance, as Krantz seems to

hold, then the researcher cannot model relationships between serendipity and other factors, as serendipity itself – as chance – would be essentially unpredictable. Clearly, if the measurement of a concept is restrictively costly or scores from the measure bear no predictable relation to criterion behaviors, then the study of the concept would not be productive and the concept would have a limited role in any scientific field.

Examples of serendipity in contemporary, RDST-based literature.

Not all scholars would take the bleak view about the use of the concept of serendipity suggested in Krantz's (1998) analysis. For example, Albert Bandura, in a commentary regarding Krantz's article offered critiques of Krantz's position as well as suggestions for future scholarship on unexpected events (1998). While the prediction of fortuitous events themselves may be beyond the capabilities or auspices of psychology, Bandura noted, psychologists should be able to identify the particular characteristics of individuals who avail themselves of and generally benefit from their occurrence (Bandura, 1998). Further, Bandura argued that fortuitous events were not simply "chance" alone, but rather came about through the sorts of person \leftrightarrow context (Lerner, 2006) bidirectional relations that characterize the RDST approach. That is, Bandura argued that individuals can bring about fortuities through their inquisitive, persistent actions across time (Bandura, 1998). This idea, at face value, closely resembles the concept of serendipitous relations, and provides some theoretical justification for their study. Bandura wrote, seemingly taking an RDST approach on serendipity, that:

Psychology can (also) provide a conceptual scheme for predicting the nature, scope, and strength of the impact that chance encounters will have on human lives. The fact that an initiating event is fortuitous does not mean that the entire trajectory is a random one. Framing fortuitously activated processes of change as ones that are empirically unanalyzable is a prescription for investigatory paralysis (Bandura, 1998, p. 97).

Michael Lewis extends this argument throughout his book *Altering Fate: Why the Past Does not Predict the Future* (1998). Lewis' central thesis is that assuming the dominant, "gradualist," or continuity-based approaches to the study of development (e.g., attachment theory, or the psychoanalytical model) actually obfuscates, rather than clarifies, the developmental processes that the researcher wishes to study. From this lens, he argues, unexpected influential events may "make efforts at prediction seem impossible" (1998, p.7).

In Lewis' opinion, nothing could be further from the truth. In fact, he argues that the individual's attempts at marshaling an adaptive response in the face of unexpected events are an essential and understudied element of an individual's ontogeny. In addition, he argues that applied programs and interventions that foster developing these within-time adaptive responses to the unexpected may be more beneficial than current approaches, which emphasize early intervention. Combining the pragmatic approaches of William James with the foundational concepts of RDST, Lewis summarizes his position by noting that:

Individuals develop in the presence of random events, and lives are more characterized by zigs and zags than by some predetermined, connected, and linear pattern. It is only when we understand how organisms are influenced by their environments *now* and how their ideas that exist *now* for their futures can affect their desires and behaviors that we can understand the nature of development, how we got to be what we are, and how we might go about making a more perfect and just society, both for ourselves and for those less fortunate that we (1998, p.11).

Serendipitous Relations: A Theoretical Grounding and Operationalization

The arguments of both Bandura (1998) and Lewis (1998) indicate that research framed by a RDST approach should be capable of at least describing, and perhaps explaining and optimizing (Baltes, 1987; Baltes, Lindenberger, & Staudinger, 2006), the particular characteristics of the individual-in-context (e.g. Magnusson, 1999; Magnusson & Stattin, 1998) associated with increased benefit from unexpected events. Having invested considerable space in describing the “investigatory paralysis” that may have resulted from a split conception, I will now attempt to justify serendipitous relations as a key feature of life-span human development by offering a theoretical grounding and operationalization of the concept. Once again, I propose that serendipitous relations can be understood as mutually-beneficial, adaptive developmental regulations brought about by the time-extended coaction of intentional self-regulatory actions and unexpected non-normative life events. The following six-point heuristic below provides an

organized theoretical justification for this operationalization, based broadly in RDSTs, action-theoretical intentional self-regulation theories, and life-span human development theories.

1. Relational developmental systems underlie human development

Historical perspectives on human development were generally characterized by a Cartesian reductionist conception of human development (Lerner, 2012; Overton, 2010). While these conceptions persist at varying levels across psychology, much of the work in contemporary developmental science is based in RDSTs (Overton & Lerner, in press), which hold, among other tenets, that multidirectional relations among all levels of the system (e.g., cell, individual, community) influence human development (Lerner, 2002, 2006). From a RDST perspective, therefore, the fundamental units of analysis are measures of person \leftrightarrow context relations, rather than measures of the individual or context alone (Lerner, 2006). In this way, the study of serendipitous relations as a coactive person \leftrightarrow context process is better suited to the predominant metatheoretical position of developmental science than are studies of an “individual’s serendipity” (“sagacity;” a set of skills or behaviors) or the “serendipity of a context” (“chance;” a set of environmental conditions or influences).

2. Within the frame of RDSTs, self-development occurs through intentional self-regulatory processes

In relational developmental systems models, individuals can produce their own development through their action (Lerner, 1982). In this way, a person’s agentic self-development (e.g., Brandstädter, 2006; Brandstädter, Wentura, &

Rothermund, 1999) has long been considered a key influence on the life course (e.g., Heckhausen, 1999; Heckhausen et al., 2010; Lerner & Busch-Rossnagel, 1981). One prevalent metatheoretical position used to study this topic is the action-theoretical model (e.g., Geldhof, Little, & Colombo, 2010), which, appropriately enough, is broadly concerned with the influence of one's actions and control thereof on self-development (e.g., Little, 1998). Action-theoretical perspectives specify that one's self-developmental actions are organized around meaningful developmental goals (Heckhausen et al., 2010). Such goals have a variety of labels in the literature, including personal projects (e.g., Little, Salmela-Aro & Phillips, 2007), goals of intentional self-development (Brandstädter et al., 1999) and personal goals (e.g., Riediger, Freund & Baltes, 2005).

In order to achieve these long-term goals, an individual must strike a balance between his or her strengths or weaknesses and the resources or challenges present in the context. These chosen, organized actions-in-context that further valued goals or purposes are termed *intentional self-regulation* in the literature (ISR; e.g., Lerner, Freund, DeStefanis, & Habermas, 2001; Napolitano et al., 2011). There are many theories that describe intentional self-regulation. For instance, the prominent Selection, Optimization, and Compensation model (SOC; e.g., Baltes & Baltes, 1990; Freund, 2008; Freund & Baltes, 2002) holds that in order to best maximize goal-related gains and minimize goal-related losses, individuals should channel their energies towards a small number of goals (Selection), develop specific strategies to achieve those goals (Optimization), and “bounce back” with new strategies when initial plans fail (Compensation).

Whatever the precise operationalization, research has linked higher levels of ISR actions to a variety of positive within- and across-time outcomes across the life span (e.g., Ebner, Freund, & Baltes, 2006; Freund, 2008; Gestsdóttir & Lerner, 2008; Mischel & Moore, 1973; Mischel, Shoda, & Rodriguez, 1989). Of course, no two “goal pursuits” (or “goal pursuers”) are identical. A variety of factors can influence goal hierarchies, goal strategies, and the likelihood of goal attainment.

3. ISR-based goal pursuits can vary in terms of “linearity” of ISR actions, and this “linearity” is influenced by age- and history-graded life events

When an individual’s goal pursuits occur in a somewhat “linear” fashion, for instance, successfully preparing for a marathon by following a training regimen without incident or complication, he or she could be exhibiting high levels of primary control (Heckhausen et al., 2010), or can be understood as making wise goal selections and choices for goal optimization strategies (Baltes et al., 2006). However, this linearity is not always guaranteed. As Robert Burns famously reminded us, “The best laid schemes o’ mice an’ men / Gang aft agley” (often go awry). The journey towards goal achievement can be circuitous and full of setbacks (Backman & Dixon, 1992; Heckhausen, 1999). An RDST perspective holds that interrelated, “co-constructing” factors at all levels of the developmental system jointly contribute to these branching paths in the life course (Li & Freund, 2005) by constraining or affording the action resources necessary to achieve goals (Brandstädter, 2006).

How do individuals “bounce back” after their best-laid plans go awry?

Various self-regulation theories describe the ways individuals can minimize loss –

and potentially later maximize gains – during diversions or setbacks. One component of this process is described as *compensation* in the aforementioned SOC model (e.g., Baltes et al., 2006). For example, a compensating individual seeking to complete a dissertation may choose to write in a quiet classroom after attempts to be productive at home did not work because of the interference of noisy roommates.

Alternatively, for various reasons, an individual may deem a goal to be unattainable, or that the pursuit of a goal may incur more potential losses than he or she is willing to undertake. In these situations, the individual may disengage from the first goal and instead pursue another goal. According to Brandstädter (2006), portions of this process are deemed *flexible goal adjustment*, while Heckhausen terms components of these actions *compensatory secondary control* strategies (e.g., Schulz & Heckhausen, 1996). Returning to the SOC model, Baltes and colleagues term this type of goal disengagement, and later re-engagement with alternate goals, *loss-based selection* (e.g., Freund & Baltes, 1998).

However, these processes only describe one half of goal “non-linearity.” How are individual plans adjusted, and how do individuals adjust their plans when an unexpected goal emerges due to *gains*? A relative gap in the theoretical literature and theory exists when it comes to detailing these gain-related processes. To my knowledge, no contemporary theory of ISR expressly describes the self-regulatory actions involved when one reorganizes his or her goal structure due to gains, nor does any theory describe the self-regulatory actions involved in identifying or instantiating situations where one *could* select new goals due to

gains. Further, no existing theory of ISR discusses which types of self-regulatory actions may be associated with maximizing gains arising from unexpected events and emergent goals. When it comes to the particular case of serendipitous relations, these latter self-regulatory actions and processes represent the core coactive component of the concept that is assessed at the individual level.

More generally, what kinds of events may bring about non-linearity in ISR actions, whether in response to gains or losses? One way to categorize these influences is to borrow from the foundations of life-span developmental research (e.g., Baltes, Cornelius, & Nesselroade, 1979; Baltes, Reese, & Lipsitt, 1980), which posited three major influences on the life span development: 1. age-graded factors; 2. history-graded factors; and 3. non-normative factors. What follows here is a description of these influences, and their role in shaping an individual's ISR action.

Age-graded Influences

While ISR is considered here to be a systems-based concept, certain influences related to goal non-linearity can be conceptualized as age-graded, or primarily individual-based. For instance, traditional conceptualizations of development proposed that, across the life span, normatively developing individuals are confronted with a series of sequential age-graded developmental tasks requiring the exercise of some sort of self-regulatory capacity to achieve (Erikson, 1968; Havinghurst, 1953). In the recent literature, the clearest instance of this concept involves the study of goals arising from age-graded developmental deadlines (Heckhausen, 2000; Heckhausen & Schulz, 1999). This research often

focuses on goal non-linearity based on losses. For example, one loses the chance of becoming pregnant (barring medical procedures) after menopause; approaching or passing this developmental deadline can greatly affect goal structure and efficacy (Heckhausen, Wrosch, & Fleeson, 2001). Of course, age-graded influences are not entirely individual-based. Societies that are age-stratified reinforce these age-graded influences on ISR actions by providing norms and expectations for timely goal completion. For instance, one may be more likely to experience losses by failing to finish college in one's 20s, or by needing to work past standard retirement age (e.g., Bossé, Aldwin, Levenson, & Ekerdt, 1987).

In addition to age-graded developmental goals, biological and neurocognitive factors also influence goal structure and achievement. These influences could be considered age-graded in the sense that they are biologically-bound to specific physiological or hormonal variations across the life span. In adolescence, for example, the development of the prefrontal cortex (e.g., Paus, 2009) allows for gains through improved metacognitive abilities and planning processes necessary for successful goal pursuit (e.g., Geldhof et al., 2010; Kuhn, 2009). However these gains could be tempered by losses brought about by risky behaviors whose prevalence is potentially exacerbated by adolescents' overall inchoate neurological development (e.g., Chein, Albert, O'Brien, Uckert & Steinberg, 2011; Steinberg, 2008).

At the other end of the life span, elderly individuals generally experience declining fluid, or information-processing cognitive abilities (e.g., McArdle, Ferrer-Carja, Hamagami, & Woodcock, 2002). Given these losses, elderly

individuals may utilize still-stable crystallized cognitive abilities earned through a lifetime of experience (Baltes & Mayer, 2001) to achieve goals after setbacks (Li & Freund, 2005). Whether it is an approaching biological deadline, an organizing prefrontal cortex, or declines in certain cognitive abilities, age-graded factors can affect the linearity of ISR actions and processes.

History-graded influences

History-graded events also influence the linearity of ISR actions and processes. In the case of these life events, losses can perhaps be best conceptualized as historically-bound constraints on goal choice or chances for goal achievement, while gains may be best understood as expanded potential pathways or improved chances. In this way historical processes like an increasingly “globalized” world (Larson & Wilson, 2004) or the Great Depression (Elder, 1974, 1980) alter one’s life course in an “absolute” or probabilistic sense, by instantiating, eliminating, promoting, or minimizing the likelihood of attaining certain goals. For instance, in the late 1800s, a large number of students at American land-grant universities studied agricultural sciences, as many of these students grew up on small farms, and the universities themselves were oriented towards supporting this scholarship (Bonnen, 1998). Today, there are “gains” in academic choice: students come from diverse backgrounds and may pursue disciplines that did not exist in the late 1800s, for example, in computer science or broadcast journalism.

New opportunities or challenges present in the context due to history-graded events do not necessarily unilaterally affect one’s development.

Individuals must act to maximize gains and minimize losses from these events. For example, recent research indicates that the utilization of history-graded environmental affordances, like the widespread youth development programs currently present in the United States (Eccles & Gootman, 2002), coactively influences the relations between the types of ISR strategies adolescents use and their positive development (Urban, Lewin-Bizan, & Lerner, 2010). As contextual constraints and affordances to goal achievement are historical and societally bound (Brandstädter, 1990), one can expect that future historical variations in youth development programs, or in any other contextual influence, will impact the linearity of an individual's ISR.

In sum, gains or losses arising from age- or history-graded sources can alter the linearity of goal strivings. While these processes are important influences on life span development, they are not, however, the primary focus of this research.

4. Non-normative life events also influence the linearity of one's ISR processes

While unexpected age- and history- graded events surely influence ISR processes, I contend that serendipitous relations involve unanticipated gains that develop through the idiographic coaction of ISR and unexpected, *non-normative* life events³. In general, non-normative events refer to individual and contextual

³ Unexpected events can of course be age-graded (for instance, early pubertal timing) or history-graded (for instance, change in employment opportunities for American women after the mobilization following the Pearl Harbor attack [e.g. Hernandez, 1993]). However, in contrast to non-normative events, which are more idiosyncratic in nature and thus better suited to the person ← → context foundations of serendipitous relations, age- and history-graded events are generally primarily individual-based or context-based, respectively. Thus,

phenomena that do not occur in a normatively age-graded or history-graded manner (Baltes et al., 1980).

Non-normative life events are important influences on life-span development. Unlike the influence of age-graded factors, which follow a U-shaped pattern of greater influence over early and later parts of life, and history-graded factors, which are thought to be particularly influential during adolescence, Baltes and colleagues (1980) speculated that the influence of non-normative life events increased across the life span. Recalling Werner's orthogenetic principle (1957), which holds that development progresses to states of greater differentiation, Baltes and colleagues argued that non-normative life events show this increase in importance across the life span because the accumulation of varying life experiences, which results in greater and greater heterogenic individuation (1980). That is, as individuals age, their unique non-normative experiences, events, and goals become key influences on their life's narrative (McAdams, 2011; McAdams, Josselson, & Lieblich, 2006).

Given their idiosyncratic nature, goal strivings that emerge from non-normative life events differ from those that arise from normative age-graded influences (e.g., completion of secondary education) or those from history-graded influences (e.g., finding employment during the Great Depression). For goals

while gains may arise from the individual's skilled use of ISR in response to unexpected age-graded or history-graded events, these gains do not specifically reflect examples of serendipitous relations. Rather, the gains that may arise from age- or history-graded unexpected events could be, like serendipitous relations, generally considered as adaptive intentional self-regulatory responses to unexpected changes in the developmental system. The basic contention here is that serendipitous relations, while perhaps involving specific and somewhat uniform self-regulatory actions across individuals, are *essentially idiographic*, rather than common across specific age groups or sociocultural cohorts.

arising from these latter two types of life events, the individual can more readily refer to archetypal individuals (e.g., exemplars in his/her age group or mentors in his/her sociocultural context) or patterns of behavior (e.g., cultural scripts or norms of behavior) as guideposts for ISR actions (Brim & Ryff, 1980). The more idiosyncratic goals emerging from non-normative influences (e.g., regaining motor functioning after an accident or injury) likely require unique, situation-specific suites of ISR actions in order to achieve adaptive outcomes. Given that these life events are, by definition, not normative, the individual lacks the supports or guidance he or she may have for challenges arising from age- or history-graded life events. This absence may result in, as Wrosch and Freund (2001) state, “the relative importance of the individual (being) enhanced for regulating non-normative as opposed to normative developmental challenges” (p. 272).

For example, in the oft-mentioned scenario of winning the lottery, the individual may risk losses if he or she, flush with new wealth, spends unwisely without proper financial advice or behavior. To use a less fanciful example, consider the concept of the incomplete architecture of human development (Baltes, 1997), wherein the importance of the aging individual’s self-regulatory capacities is heightened in part due to insufficient environmental supports for the elderly. Reinforcing this position, research has illustrated the importance of self-regulatory processes in the management of non-normative health problems during adulthood (Wrosch, Heckhausen, & Lachman, 2000), as well as, for example,

disengagement from goals following non-normative retirement age (Robbins, Lee, & Wan, 1994).

While non-normative life events are key influences on life span development, they are comparatively less-studied than age- or history-graded events. When they are discussed, the focus is generally on calamitous or catastrophic events. For example, consider the story of Paul Watkins, as relayed by Bandura (1982). A promising youth who had been elected student body president of his high school, he traveled to California after graduation to meet a friend. Unbeknownst to Watkins, the friend had moved out of his home, and the new tenants were the infamous Manson Family (Watkins & Soledad, 1979). Soon, Watkins became a member of the group, adversely altering his life forever.

Clearly, not every negative non-normative life event is as irreparably catastrophic as knocking on Charles Manson's door. Individuals can enact ISR actions in an attempt to moderate the influence of these life events. For example, recent research has illustrated that, in the face of failing an entrance exam to a university-like setting, individuals who can successfully disengage from this unexpectedly blocked goal have more adaptive levels of functioning over time (Tomasik & Salmela-Aro, 2012). In this example, the individual uses specific ISR disengagement strategies to, at least in the most proximate sense, minimize losses and attempt to maintain functioning in the face of failure. While these processes are important, the overrepresentation of calamitous non-normative life events in the literature (compared to fortuitous and positive non-normative events) results

in a critical theoretical lacuna involving understanding the role of ISR processes in maximizing gains from non-normative events.

5. It is likely that there are specific ISR actions involved in maximizing gains from unexpected non-normative events

To this point, much of this argument could be characterized as “old wine in a new bottle.” The basis for this conceptualization of serendipitous relations lies in an RDST-based life-span human development perspective, and specifically within action-theoretical models of ISR (e.g., Brandstädter, 2006). However, due in part to roots in gerontology (which is generally focused on issues of loss or decline), the life-span human development-based ISR literature (e.g., Baltes et al., 2006; Freund, 2008) is currently lacking a description or explanation of the particular kind of ISR processes that are at the focus of this paper: those actions that may both instantiate and maximize gains from unexpected, non-normative life events. This section attempts to address this point by introducing serendipitous relations as “new wine” in the “old bottles” of RDST, ISR, and life-span developmental theories.

To begin, it seems important to address that non-normative life events may have unique characteristics when it comes to their relations to an individual’s ISR. While ISR actions can serve as means to minimize losses or maximize gains arising from age-graded or history-graded factors, an individual has very little ability to instantiate these influences on the life span. An individual usually cannot will puberty to begin, nor can an individual typically enact geopolitical policy. Non-normative events function differently. From an RDST perspective,

these influences are, by their more idiosyncratic nature, at least partially instantiated by the actions of the individual as they progress across their “thread of life” (Wollheim, 1984). From this perspective, non-normative life events are not simply random chance, but rather have some foundation in an individual’s action. In addition, as illustrated in the prior section, an individual can modulate the influence of non-normative life events through ISR actions, and such actions might be especially important for adaptive functioning given the lack of social supports or guides. Thus, unique among the factors specified in the life span developmental perspective, non-normative life events provide an opportunity to study the *bidirectional coaction of ISR processes and contextual influences*. Recall that this coactive process is consistent with the requirements for the fundamental units of analysis in RDST approaches, as specified in Section 1.

The remainder of this section introduces some ISR processes that might instantiate the non-normative events that may later lead to gains, as well as some ISR processes that may be associated with maximizing potential gains from such events. To frame the introduction of these processes, I will relay a story told by the anthropologist Richard Leakey (2010) in a volume whose focus was on the role of serendipity on scientific discoveries (de Rond & Morely, 2010).

Attempting to disprove the somewhat dismissive claim that “Leakey’s luck” alone lead to the success that he and his family members have had in discovering some of the most important anthropological specimens in history, Richard Leakey describes many of the ISR processes that may instantiate and maximize gains from unexpected non-normative events.

“Leakey’s luck” or serendipitous relations? Two cases where specific self-regulatory actions maximized gains from unexpected events.

According to his son Richard, Louis Leakey’s future seemed foreclosed: he was to be a missionary in Kenya, like his father, and the first step in this process was a theological degree from Cambridge. A severe concussion sustained in a rugby match changed these plans. The prescribed treatment for the injury was a break from studies. During his recuperation, Louis heard of a German paleontological expedition to Tanganyika (part of the current Tanzania) that was in need of a Swahili translator. Louis, being fluent in Swahili and unexpectedly available during his recuperation, applied and was accepted for the position. Soon after arriving, Richard writes, he “became absolutely riveted by the evidence of early life in the form of dinosaurs” (Leakey, 2010). Upon returning to Cambridge, he dropped his theological studies and focused full time on paleontology. An illustrious yet unanticipated career in the field followed thereafter, one full of diligent work and fortuitous discoveries of fossil specimens in East Africa.

While Richard Leakey does not describe the following story in the aforementioned article, his mother, Mary, was involved in a fortuitous discovery herself, and one with a most unusual impetus: elephant dung. In 1976, members of her team were playfully tossing projectiles of this matter when Andrew Hill, face to the ground, noticed strange indentations seemingly frozen in the ancient ash (Ghiglieri & Bilmes, 2000). Hill had discovered a field of prehistoric animal footprints, striking in scale.

One set of these footprints looked vaguely hominid, and Mary, jumping at the potential for a major find, devoted her team to attempt finding more specimens. Two disappointing years later, without a suitable footprint to show for their efforts, Mary instructed the crew to excavate the site and instead look for bones. Ndibo, the crew's maintenance man, cleared away some debris from the field, and, to his shock, uncovered what the team had been looking for all along: a pair of nearly perfect ancient hominid footprints. Ndibo notified Mary, and, upon viewing the area, she ordered the prints to be painstakingly examined (Ghiglieri & Bilmes, 2000). Mary Leakey and her team, beginning by dodging elephant dung, had uncovered groundbreaking evidence of our early ancestors' bipedalism, recasting notions of human evolution (e.g., Hay & Leakey, 1982; Leakey & Harris, 1987).

To return to Richard Leakey's defense of his family's discoveries as being more than simply "Leakey's luck," he writes:

So I think that what people call luck is very much an element or characteristic of being willing to recognize and exploit opportunities. When you see an opportunity, you should definitely take it and accept that there are high risks sometimes in doing so. In a sense, it gets back to what serendipity was supposed to be about when it was coined back in the 1700s, emphasizing the role of sagacity in exploiting accidental occurrences (Leakey, 2010).

Introducing Serendipitous Actions: Five key intentional self-regulatory processes potentially involved in serendipitous relations. I believe

that the Leakeys' stories illustrate instances of serendipitous relations and, as such, provide examples of five key ISR processes that both instantiate and substantiate such beneficial person \leftrightarrow context exchanges. The five ISR key processes, taken together, represent what I will term *serendipitous actions*. These five key processes are: 1. Being intentionally serendipitously oriented; 2. Identifying an unexpected event that may lead to gains; 3. Seizing the moment and beginning to act on those unexpected events; 4. Disengaging from prior goals to further invest resources in emergent goals that provide gains; and finally, 5. Extending investments to more fully transform unexpected events into opportunities for maximum gains. The fact that the Leakeys' stories are divergent in their time frame and scope is not problematic; in fact, such variation should highlight that serendipitous actions may be an integral part of a wide variety of types of serendipitous relations. The five key ISR processes are described in more detail below.

1. Having a serendipitous orientation. The first and most general ISR-based serendipitous action is having some degree of an intentional serendipitous orientation. Using Richard Leakey's words, such an orientation involves "being willing to recognize and exploit opportunities," despite the risks that such behavior may entail. Individuals with a serendipitous orientation *choose* to not "wear blinders," that is, they choose to not be foreclosed in their goal selections, and instead to be open new possibilities, new goals, and new outcomes. Essentially then, individuals with a serendipitous orientation intentionally put themselves in situations where positive unexpected events are more likely to

occur. In addition, those with a more serendipitous orientation select and work towards achieving goals that arise from such unexpected circumstances. These individuals, therefore, also likely have a growth, rather than maintenance orientation (e.g., Freund, Hennecke, & Riediger, 2010; Mustafic & Freund, 2012). In addition, individuals choosing to employ a serendipitous orientation are likely highly agentic, and thus excel at facing the unexpected challenges that emerge across their life span (e.g., Little, 1998, 2002)

The stories of Mary and Louis Leakey illustrate two key complexities inherent to the concept of a serendipitous orientation: 1. It may be more common to be serendipitously oriented during particular periods of the life span, or given particular contextual conditions; and 2. An individual chooses to be serendipitously oriented within the context of goals of greater or lesser abstraction. I describe this first complexity below.

Recall that before the injury, Louis' fate seemed preordained; he was to be a missionary. At this point in his life, it seems Louis was not serendipitously oriented. Importantly, unlike the personality factor "openness to experience" (e.g., McCrae & Costa, 1997), a serendipitous orientation is likely a more plastic individual factor, given its intentionality. That is, during certain periods of life, or given particular contextual conditions, individuals may be more or less likely to choose to engage in goal pursuits that arise from unexpected events. In terms of periods of the life span, it may be that having a serendipitous relation is more likely during adolescence and young adulthood. Louis' status as an unencumbered young student without long-term commitments may have influenced or eased his

choice to act with a serendipitous orientation and be open to unexpected opportunities. In terms of contextual influences, Louis' unexpected head injury allowed him to pause and evaluate his studies. This period of reflection perhaps contributed to his choice to be more serendipitously oriented.

The second key complexity – that an individual chooses to be serendipitously oriented within the context of goals of greater or lesser abstraction – requires a more nuanced discussion. An individual's intentional actions can serve to support various levels of his or her goal hierarchy, progressing from proximal goals to more distal, abstract goals (Freund, 2008). For instance, an adolescent may exercise to achieve the more proximal goal of making a sports team while also serving the more abstract goal of improving physical well-being. Choosing to be serendipitously oriented is a type of intentional action, and therefore can also serve to support various levels of an individual's goal hierarchy. For example, choosing to be serendipitously oriented in academics during the first year of university (that is, enrolling “undecided”) may serve the more proximal goal of increased exposure to new topics, while also serving the more distal, abstract goal of finding a career or area or interest that is personally fulfilling and enjoyable.

While choosing to be serendipitously oriented may affect one's proximal or distal goal pursuits, a serendipitous orientation is itself grounded in a specific goal pursuit that may exist at varying degrees of abstraction. As I will further illustrate in the next section, this grounding can influence the types of unexpected events that an individual encounters and may choose to pursue. For examples of

this phenomenon, consider the Leakey's stories. Louis' injury provided him with an opportunity to pause his unfulfilling theological studies. Choosing to be serendipitously oriented in regard to the abstract goal of finding an enriching career, Louis happened upon the opportunity to travel to Africa, and began his sterling career in paleontology. Mary, on the other hand, choose to be serendipitously oriented in regard to the more specific goal of maximizing scientific return on a promising excavation site in Tanzania. Mary twice decided to pursue the unexpected opportunity to dig for more footprints rather than continue on the original pursuit of unearthing fossil remains. These stories indicate that the degree of abstraction with which one is serendipitously oriented influences the type of opportunities he or she may encounter. Future research should investigate if differing scopes of abstraction for serendipitous relations are more or less adaptive during different periods of the life span, or given different contextual conditions.

2 and 3. Identifying unexpected events and seizing the moment to act on them.

Recall that Horace Walpole's original definition for serendipity involved "chance and sagacity." Where having a serendipitous orientation may increase the likelihood for positive chance events to occur for an individual, the next two serendipitous actions more directly involve a degree of "sagacity," that is, wisdom and skill. Beginning with the first of these processes, it seems obvious that in order to benefit from an unexpected event the individual much first perceive it being potentially laden with gains. Therefore, certain cognitively-based

attentional and pattern-recognition factors may be vital in identifying these events. This discerning process would require the individual to exert attentional focus to detect that the event is unusual and in fact comprised of relevant or desired characteristics (e.g., Colombo, 2001). This process also likely involves related cognitive pattern recognition processes (e.g., Diamond, 1988), where the individual identifies the event as being anomalous and potentially gains-laden. The “sagacity” or skill in this serendipitous action is being attuned to one’s environment and identifying the key, potentially motivating characteristics of unusual event.

Simply recognizing an unusual event as being potentially gains-laden is not enough. An individual must seize the opportunities that they perceive in that unexpected event. This third serendipitous action is a “mirror image” of Baltes and colleagues’ *loss-based selection* (e.g. Freund & Riediger, 2003): instead of selecting new goal based on experienced systemic losses or declines (as is the case with loss-based selection), this third serendipitous action involves the individual instead directing resources towards an unexpected, emergent goal based on the perception of possible systemic gains. In this serendipitous action, the individual therefore makes a “gains-based selection,” that is, he or she determines that the potential gains that could arise from pursuing this unexpectedly emergent goal warrant some initial and provisional investment of resources. During this provisional investment, the individual can then compare the potential for gains arising from the emergent goal to the perceived gains that could arise from the current goal. The extent of how provisional this initial

investment may be likely varies from individual to individual, or circumstance to circumstance. Some instances of “seizing” an unexpected opportunity may result in a “dead end” or mismatch, while others, like the example of Louis Leakey, may be the launching point for serendipitous relations across the life span.

Returning to Mary Leakey’s story, we see the importance of identifying and seizing unexpected opportunities in serendipitous relations. In fact, the story contains several pivotal instances of both serendipitous actions. First, in terms of identifying events, the perceptive dung-dodging team member provided the genesis for the serendipitous relations by identifying the footprints. Next, Ndibo years later, unexpectedly identified the long-sought footprints and restarted the vigorous search. In terms of seizing the opportunities, Mary twice ordered her team to scour the area – first, after the initial discovery of tracks and, second, after Ndibo’s definitive discovery. Wagering that the possibility to find early hominid footprints was sufficiently high, Mary Leakey provisionally invested the resources of her team, comparing the gains that could arise from the footprints’ discovery with the gains from a fossil-focused expedition. As the evidence mounted for the footprints’ importance, Mary and her team began using the fourth and fifth serendipitous actions, described below.

4 and 5. Disengaging from prior goals and extending investments to transform events into opportunities for gains.

Most contemporary ISR theories involve descriptions of the processes of goal disengagement. For instance, accommodative processes described in the work of Brandstädter and colleagues (e.g., Brandstädter & Renner, 1990)

resemble Heckhausen and colleagues' secondary control strivings (Heckhausen et al., 2011). These goal disengagement processes are described as an individual's psychological recalibration or adaptation after hardship or loss. In short, goal disengagement is often described as getting in "flow with the current" (Rothbaum, Weisz, & Snyder, 1982) after one fails at a goal.

This process does not entirely match with the proposed serendipitous action of prior goal disengagement. To review the described serendipitous actions thus far, an individual with a serendipitous orientation may identify potentially gains-laden unexpected events more frequently or efficiently. If he or she deems this newly-identified opportunity as having sufficient potential for maximizing gains, then he or she may seize the opportunity, and make provisional investments.

If during the course of these initial investments the individual further perceives the unexpected opportunity may in fact provide gains over-and-above the perceived gains or his or her earlier-specified, "pre-opportunity" goal pursuit, then he or she may fully disengage from that prior goal. The individual thereby selectively invests energies in the emergent goal, as he or she identifies it as best chance for shaping positive development. Again, the serendipitous action of prior goal disengagement differs from many of those in the cotemporary ISR literature primarily in that the disengagement occurs because the individual perceives greater gains from the emergent goal, rather than he or she perceiving greater losses from the prior goal.

The fifth serendipitous action is most consistent with existing ISR theories. After disengaging from that prior goal, the individual then enacts standard ISR processes in order to best assure that he or she can extract maximal gains from the now-focal opportunity. Where this action may vary somewhat with extant ISR constructs is that, upon extending the investment in emergent goal, the individual may “accrue” unexpected gains along the way, given the unanticipated nature of the serendipitous relation. Thus, the individual must perceive when he or she has indeed achieved maximal (or at least adaptive, or desired) gains from the unexpected event, rather than cutting this process short of this point.

These final two proposed serendipitous actions, that is, disengaging from a prior goal after investing in an unexpected opportunity, and extending one’s investments to maximize the potential benefit from these opportunities, can be illustrated in the stories of both Leakeys. Louis’ story is most clear-cut: once he decided, rather rapidly, that he was suited for a career in anthropology and paleontology, he disengaged from his prior goal of studying theology, and then invested untold hours across his life to achieve maximum gains from his career choice. Mary also illustrated these skills in her story. Once clear footprints were unearthed by Ndibo, she cast away her temporary goal of finding skeletal specimens and devoted her team to painstakingly searching for and excavating the hominid footprints. Both Leakeys extended their investments to achieve maximal gains.

Summary. In this section, I proposed that there may be five key ISR processes, termed serendipitous actions, that represent the individual’s coactive

component of serendipitous relations: 1. Having a serendipitous orientation; 2. Identifying unexpected events that may lead to gains; 3. Seizing the moment and beginning to act; 4. Disengaging from prior goals; and finally, 5. Extending investments through standard ISR processes. The variation in the Leakeys' stories, both in scope and time frame, provide some evidence for why these ISR processes may inform the study of various types of serendipitous relations.

For instance, while I have described these processes in a fairly linear way, that is, one process building upon the last, it is likely that these processes are often recursive within the same goal striving. For instance, Mary's story represents several repeated processes, made possible by frustrating periods punctuated with further unexpected events. In addition, each of these processes, and the whole of the serendipitous relation, may vary by length, given the individual and the circumstance. For instance, Louis seems to have relatively quickly used the first four described processes, while Mary and her team spent considerably more time between the initial dodging of elephant dung and the full disengagement from skeletal excavations. These problematics are further discussed later in the chapter. However, in sum, serendipitous actions may represent the individual component of various types of serendipitous relations.

6. Serendipitous relations can be described using a three-phase model of coacting serendipitous actions and unexpected events

In this section, I will present a three phase model of serendipitous relations. This model illustrates the time-extended coaction of serendipitous actions and unexpected, non-normative life events. This model also builds from

the content of the prior five sections. To review, Section 1 laid theoretical groundwork, arguing that serendipitous relations should be best understood as a person \leftrightarrow context relation, rather than an individual skill or contextual affordance alone. In Section 2, I briefly reviewed the ISR literature, and discussed contemporary notions of how an individual's goal-related actions can inform his or her development. Maintaining an RDST-based perspective, in Section 3, I reviewed how two key influences posited by the life-span developmental perspective – age- and history-graded events – can shape an individual's ISR effectiveness and linearity. In Section 4, I discussed how unexpected non-normative life events can influence an individual's ISR. In Section Five, I described five potentially-important ISR processes – serendipitous actions – for maximizing gains from non-normative events. In the next section, I will synthesize ideas about an individual's exposure to unexpected events and his or her serendipitous actions and into a three-phase model of serendipitous relations. This model, termed the *Unexposed, Uncovering, and Unlocking (or 3U) Model of Serendipitous Relations*, is briefly described below. Figure 1 portrays a typical instantiation of this model.

 Insert Figure 1 about here

3U Phase One: Unexposed. The first phase, “Unexposed,” occurs before an individual's exposure to an unexpected non-normative life event. In this phase, individuals are actively working towards their earlier-defined goals. While some

individuals with a less-serendipitous orientation may continue to work on earlier goals without distraction, individuals with a more serendipitous orientation may “keep one eye open” for unexpected events that may serve to maximize gains. These unexpected events may already exist in the context, waiting to be found, or they may be a yet-to-be-instantiated product of the individual’s current ISR strivings.

While serendipitous relations are mutually beneficial for the person and his or her context, remaining in the unexposed phase is not necessarily maladaptive. For example, an individual may commit to a particular goal, such as being the first family member to earn a university degree. Through adversity, he or she may persevere (Duckworth, 2007) and earn the degree while ignoring alternate and potentially adaptive pathways, like dropping out to become an entrepreneur. However, earning a university degree is still an important achievement and, especially for “first-generation” graduates, often leads to positive developmental outcomes (e.g., Pascarella, Pierson, Wolniak, & Terenzini, 2004). In other cases, however, remaining in the unexposed phase and not pursuing alternate pathways suggested by unexpected events might result in personal regret, even *Sehnsucht* (Schiebe, Freund, & Baltes, 2007) or intense longing.

Despite some instances where progressing may not be adaptive, the unexposed phase is still an essential first step for serendipitous relations. The individual’s ISR actions during their prior-goal strivings set the stage, and in some cases, may instantiate unexpected events that may lead to serendipitous

relations. As Bandura notes, “People can make chance happen by pursuing an active lifestyle that increases the number of fortuitous encounters they are likely to experience” (1998, p. 98). These ideas are also consistent with Lewis’ (1997) conception of the role of “fate” in human development. In sum, therefore, when an individual’s active goal pursuit, serendipitous orientation, and an unexpected, well-suited event coact, the individual is likely to progress from the unexposed phase and into the uncovering phase.

3U Phase Two: Uncovering. The second phase of serendipitous relations, termed “Uncovering,” involves the individual’s provisional ISR investments after exposure to (or perception of) an unexpected event. During the uncovering phase, therefore, the individual identifies the gains that may arise from opportunities that the unexpected event may bring. As such, it primarily involves two of the five serendipitous actions described above: identifying unexpected events, and seizing the moment and beginning to act on those unexpected opportunities.

An individual begins the uncovering phase after identifying an unexpected event that is perceived to be potentially gains-laden. After such identification, the individual can choose whether or not to act on the opportunities that this event presents. Seizing a potential opportunity involves provisional resource investments in the goal. These provisional investments may involve attempts to, for instance, understand the required steps, time investment, or necessary sacrifices for achieving the emergent goal. These provisional goal investments, I argue, likely exist in tandem with contemporaneous investments in earlier-specified goals. Thus, these provisional and parallel investments may provide the

individual with an opportunity to assess and compare both the “fit” and potential for maximization of gains between the original and emergent goals.

The uncovering phase, like each of the phases in this model, can be recursive. That is, an individual can identify an unexpected event, and for a variety of reasons, decide not to seize that event. Thus, he or she moves back into the “Unexposed” phase pending perception of, or exposure to, another unexpected event. In addition, an individual can seize the event, make provisional investments, and decide against pursuing the emergent goal. In addition, the uncovering phase may vary in length across individuals and situations, as evidenced in the Leakeys’ stories. Regardless of the time length or the potential recursiveness, the uncovering phase, like the unexposed phase, is a necessary step towards serendipitous relations.

3U Phase Three: Unlocking. The third phase of serendipitous relations, termed “Unlocking,” involves the individual intentionally shifting his or her primary goal focus away from the prior goal and towards the emergent goal in an attempt to capitalize on the unexpected opportunity. In this phase, therefore, an individual moves from provisional investments in the unexpected opportunity to more definite or focal investments, in an attempt to unlock the opportunities’ potential gains. As such, this phase primarily involves the final two serendipitous actions described earlier: disengaging from prior goals, given potential future gains, and extending goal investments, in an attempt to maximize gains from unexpected opportunities.

The unlocking phase begins when the individual makes a conscious choice to disengage from prior goals – and more fully engage in the emergent goal – in order to maximize the probability of success from the unexpected opportunity. Again, this process reflects something of a “gains-based selection,” that is, the individual orients his or her goal resources (e.g., time, effort, energy; Freund, 2008) towards the emergent goal and away from the prior goal, because of the perception of comparatively greater possible systemic gains. After this more definitive engagement with the emergent goal, the individual then must employ time-extended ISR processes to maximize his or her chances for gains. These particular ISR processes are similar, conceptually, as they are both processes an individual uses to achieve goals that do not have a serendipitous origin. For instance, using the SOC framework (e.g., Freund, 2008), the individual could engage in a variety of Optimization and Compensation strategies across the course of the goal process until he or she is satisfied with the gains earned from the emergent goal.

The length and intensity of this extended investment likely varies by individuals, by situations, and by their coaction. That is, the unlocking phase of serendipitous relations may last decades, as illustrated by Louis Leakey, or it may last for a far briefer period of time. In addition, some emergent goals may require minimal investment to achieve maximal gains. Whatever the duration or the intensity of the investment, the unlocking phase is a critical final step in any serendipitous relation.

A Description of “Serendipitous Relations Lost and Serendipitous Relations Gained” From the Literature: The Case of the Floppy-Eared Rabbits

To further illustrate the 3U model of serendipitous relations, and how serendipitous relations can be related to positive functioning and development, I will analyze a famous example from the literature: the story of Dr. Lewis Thomas, Dr. Aaron Kellner, and the floppy-eared rabbits. To begin, I will summarize this story, which was originally told by Barber and Fox (1958):

In the 1950s, prominent medical researchers Lewis Thomas and Aaron Kellner were exploring treatments for cardiac and blood vessel lesions associated with rheumatic fever. Injecting compound after compound on their test subjects – rabbits – the researchers noted that upon injecting the enzyme papain, their rabbits' ears immediately became floppy, rather than rigid. Kellner was focused on exploring the research question at hand. He drove ahead with different enzymes, considering the newly-floppy ears “flamboyant” and interesting, at best. Thomas, on the other hand, switched his research focus mid-stream. He “chased it like crazy,” spending untold hours consulting the literature, replicating the finding, and examining the rabbit's ears under a microscope (Barber & Fox, 1958). After years of on-and-off again research, his finding – that under certain conditions, cartilage was reactive, rather than remaining essentially inert – recast common medical notions and proved far more productive than his first research path.

While Dr. Kellner made important contributions over the course of his career (for example, by helping to create a reliable blood supply system for the

New York region), he did not engage in serendipitous relations after observing the floppy-eared rabbits. Instead, it was Dr. Thomas who, through his serendipitous actions, maximized his gains from this unexpected event. Where these men diverge is easily discernible using the 3U model of serendipitous relations.

In the Unexposed stage, both Kellner and Thomas were embedded within a laboratory context, with access to rabbits and access to enzymes. They were both highly-trained biological researchers, and both were exploring the same research question. Both observed the newly-floppy rabbit ears after injecting papain. Where the men may have differed is in their serendipitous orientations. Thomas reported being exposed to the concept of serendipity by his medical school instructor, the aforementioned Walter Bradford Cannon (Barber & Fox, 1958). Cannon's lectures, which emphasized the role of serendipity in science, may have "primed the pump" for Thomas' serendipitous orientation. On the other hand, Dr. Kellner appeared "locked into" his original research goal. In his interview, he expressed some ambivalence about the role unexpected findings in research. He said, describing some of these challenges:

Should you boil or freeze, filter or centrifuge? These are the kinds of crossroads you come to all the time...It's always possible to do four, five, or six things, and you have to choose between them...How do you decide? (Barber & Fox, 1958, p. 136).

When it comes to the Uncovering phase, both men observed the change in the rabbits' ears, but it was Thomas alone who identified the floppy ears as a potential opportunity. Identifying the ears as a potential source for gains led

Thomas to provisionally invest goal resources in the opportunity. He repeated the phenomenon, and later took ear specimens to the microscope for evaluation.

Kellner, on the other hand, focused on the original goal (Barber & Fox, 1958). He did not identify the floppy ears as being helpful to his research, and so he did not provisionally invest in them.

Finally, Thomas continued developing this serendipitous relation through the serendipitous actions associated with the Unlocking stage, which involved several years of on-and-off research. He determined that investing goal resources in exploring the cause of the floppy ears might be more beneficial than his prior work. Thus, he disengaged from this prior goal. Finally, in order to unlock the maximum potential gains from this unusual and unexpected opportunity, Thomas extended his investment, “chased” the riddle of the floppy ears “like crazy,” and after some time, made an important contribution to biology by expanding our understanding of the reactivity of cartilage. Therefore, Dr. Thomas’ serendipitous actions helped lead to this serendipitous relation. Table 1 compares the differences in the three phases of serendipitous relations between Dr. Thomas and Dr. Kellner, as well as Mary and Louis Leakey.

Insert Table 1 about here

Addressing Problematics in the 3U Model of Serendipitous Relations

There is likely great variety in serendipitous relations. For instance, I would argue that the unexpected onset of a career trajectory, the chance meeting

of a romantic partner on a train, or being rejected from a first-choice university and yet excelling at and enjoying one's second choice institution could all be considered such relations. In each of these examples, one could describe the required serendipitous actions for the scenario, and fit the process to the 3U model of serendipitous relations described above. As serendipitous relations, each of these examples would be, on balance, unexpected, positive, and significant.

However, the unexpected events that may catalyze these serendipitous relations might not share these characteristics. For instance, these events may be rare or common. They may be initially experienced as negative, positive, or neutral. Finally, the events may be immediately significant or only significant after some actions and/or some period of time. In this section, I will argue that these complicating characteristics of unexpected events should not undermine the present conceptualization of serendipitous relations, but could rather help to support it. In so doing, I will introduce several problematics and related hypotheses that represent possibilities for future empirical research.

Variations in levels of exposure to gains-laden unexpected events. In some part instantiated by the individual's action, an unexpected event is the catalyst of any serendipitous relation. However, different contexts likely provide different levels of these instantiating unexpected events. Within certain sociocultural contexts, an individual with a serendipitous orientation might move somewhat easily from a context with fewer potential unexpected opportunities (e.g., the small, rural town) to one with that may have more of these potential opportunities

(e.g., the “big city”). Other sociocultural contexts may limit this mobility, often with deleterious effects (e.g., Breen & Jonsson, 2005).

If an individual is embedded within a context that constrains his or her access to gains-laden unexpected events, this situation does not preclude the individual from engaging in serendipitous relations. In these unfortunate circumstances, the individual might remain in the unexposed phase for an extended time, and may perhaps only move into the uncovering phase after a tenacious searching process or after encountering particularly rare or fortuitous event. Similarly, an individual embedded within a context rich with potential unexpected opportunities is not guaranteed serendipitous relations. For these individuals, serendipitous relations may often terminate before a transition to the unlocking phase; that is, the individual may repeatedly identify and provisionally invest in unexpected opportunities, but later disengage from that process when he or she perceives a greater chance for gains from another unexpected event.

Variations in “positivity” of unexpected events. Serendipitous relations are mutually beneficial for the person and his or her context. However, the unexpected events that begin these relations might not always present themselves as immediately positive. That is, an individual can also engage in serendipitous relations when the unexpected event is at first negative. How might this variation in “positivity” affect serendipitous relations across the 3U model?

When the unexpected event is quite positive, it likely shortens and simplifies the uncovering and unlocking phases. That is, when such an event

occurs, and the individual identifies it, he or she may disengage from prior goals quickly, and the required investments to achieve maximal gains from this unexpected positive event might in fact be rather minimal. Conversely, these kinds of serendipitous relations may have lengthened unexposed stages, as the individual might “wait” for the perfect unexpected event to act, all the while still being serendipitously oriented. An example of event that may precipitate such a serendipitous relation could be unexpectedly meeting an individual who, impressed with your conversation, offers you your “dream job.”

On the other hand, when the unexpected event begins as negative, the uncovering and unlocking phases may be comparatively longer or “more costly” in terms of goal resources. Here, the individual must first identify the negative event as having some potential for gains, which might be a difficult and lengthy process. Next, the provisional investment in the emergent goal may be tentative or limited, given the losses the individual may have endured from the unexpected event itself. Finally, if he or she progresses from the uncovering phase into the unlocking phase, any residual negative elements of the unexpected event may delay or complicate prior goal disengagement as well as extended goal investment.

An example of serendipitous relations initiated by a negative event could be developing a successful entrepreneurial business after having been laid off. Given the variation in unexpected events across the life span, the potential of both positive and negative unexpected events to both instantiate serendipitous relations

could be a useful avenue for future research. However, this issue is not addressed directly in the present research.

Variations in when unexpected events are perceived to be significant.

Serendipitous relations are proposed to be key influences on life span human development. Therefore, the unexpected events that initiate such relations, like the relations themselves, are considered to be significant. However, not every instantiating unexpected event is immediately perceived this way. I believe that there are at least two distinct types of serendipitous relations that begin with seemingly “insignificant” unexpected non-normative life events.

The first variation is what I would call the “delayed” serendipitous relation. Here, the individual is presented with a potentially meaningful unexpected event, but for a variety of reasons, he or she does not immediately identify it a significant opportunity for gains, and/or does not allocate provisional resources towards exploring the event’s feasibility. Luckily for the individual, the gains from this event are not strictly time-bound, and after some period of time, he or she begins the uncovering and transitions into the unlocking phase. There may be several reasons for delayed serendipitous relations. Most simply, the individual may “miss” the event when it is first observable. Another reason for the delay may be temperamental; that is, rigid (as opposed to flexible) individuals might delay serendipitous relations, giving their tendency to feel discomfort or stress in breaking patterns or habits (e.g., Chess & Thomas, 1984; 1996; Thomas & Chess, 1977). In addition, if they do engage in serendipitous relations, individuals who are less serendipitously oriented may do so in a tentative and

delayed manner. An example of such a “delayed” serendipitous relation would be a youth who applies to a local, regional campus of a state university, only to be unexpectedly accepted into the more prestigious, main campus location. Because of his or her temperamental reticence to leave home, or his or her failure to identify the main campus as an opportunity, the serendipitous relation may be delayed until a year later, when the youth decides to transfer to the main campus and later excels.

The second variation is what I would call “indirect” serendipitous relations. Elements of this concept are based in McAdams’ life story model of identity (e.g., McAdams, 1988; McAdams & Cox, 2010), where the individual develops his or her identity through constructing a meaningful life narrative out of a complicated and sometimes chaotic series of experiences. An indirect serendipitous relation involves the narrative-constructing individual ascribing significance to an unexpected event that served to help instantiate serendipitous relations, while also describing that event as being somewhat insignificant at the moment of its instancing.

An example of such a serendipitous relation would be buying a box of academic texts at a yard sale, and months later finding a very influential book for one’s research. Here, the individual might recount this portion of his or her life narrative by stating, “Looking back, if I hadn’t bought that dusty box of books, I wouldn’t be here today.”

Despite the unusual nature of this serendipitous relation, the 3U model still appears to be adequate to describe the process. Instead of the considering first

reading the important book as the instantiating unexpected event, the individual instead retrospectively locates that event as the purchasing of the dusty box of books. Therefore, the unexposed phase may be longer and perhaps more convoluted in these types of serendipitous relations, but the individual still uncovers and unlocks the gains that may arise from that event after he or she identifies the opportunity. In addition, given McAdams' theory, when an individual retrospectively recounts the events that led up to an unexpected opportunity, he or she may attempt to "make sense" of the serendipitous relation as a whole by trying to understand the actions that lead to its instancing. Thus, the description of these serendipitous relations may emphasize the indirect nature of the unexpected opportunity. Unfortunately, while understanding the role of personal narrative in serendipitous relations may be an important and interesting topic, it is also outside of the purview of this dissertation.

The 3U Model and the present research. I believe that the 3U Model of Serendipitous Relations may represent a frame for a broad program of research that would explore the role of an individual's action in maximizing gains from unexpected, non-normative life events. As implied in my discussion of these problematics, this model is quite complex, and may be characterized by significant interindividual differences within or across time and intraindividual change across development. Adequately testing this model would require a programmatic body of research with varying research designs, measurement timings, and sampling characteristics. As introduced in the following section, and described in greater detail in Chapter 3, the data collected for the present research

should be considered an initial step in this research. While it may not directly test the usefulness of each component of the 3U Model, the present research does allow for preliminary evaluation of a general measurement model for serendipitous relations across a longitudinal sample of late adolescents.

Towards the Systematic Study of Serendipitous Relations: Core Hypotheses and Initial Plans for Research

As defined earlier, serendipitous relations are considered mutually beneficial, adaptive developmental regulations brought about by the time-extended coaction of serendipitous actions and unexpected non-normative life events. This operationalization informs two key hypotheses, each of which will be initially explored in this dissertation.

First, and most broadly, I hypothesize that timely use of serendipitous actions improves one's chances to engage in serendipitous relations. Thus, I hypothesize that use of serendipitous actions may be associated with a greater number of, and greater gains from, unexpected events. This hypothesis was initially explored in the subsequent studies included in this dissertation. Results supporting this hypothesis might suggest that serendipitous actions could represent an important and understudied aspect of an individual's ISR.

The second core hypothesis is that serendipitous relations may be key determinants for an individual's success and positive development during periods of life transition. Periods of life transition are fraught with uncertainty; skills that were once useful may no longer apply, old goals may dissolve or diminish in importance and, importantly for this research, new goals may emerge in

unexpected ways. Individuals who can make opportunities out of these unexpected events through serendipitous actions will, I hypothesize, achieve greater adaptive developmental regulations with their contexts. This hypothesis was also initially explored in this dissertation.

The Present Research

In this chapter, I presented a theoretical basis for understanding serendipitous relations as key influences on life-span human development. Basing this argument in relational developmental systems and intentional self-regulation theories, as well as in the life-span developmental perspective, I proposed that specific serendipitous actions serve to increase the likelihood of one's exposure to unexpected opportunities, as well as the ability to uncover their potential and later unlock to maximize gains. When an individual progresses through these three phases, he or she engages in a serendipitous relation, and, I argue, this increases the likelihood for his or her positive functioning and development. I further hypothesized that serendipitous relations may be especially relevant during periods of life transition.

These hypotheses underlie the two overarching research questions for this dissertation. First, are the ISR processes – here termed serendipitous actions – that are associated with adaptive development given unexpected non-normative events, and, if so, how can these actions be best modeled? Second, controlling for indices of intentional self-regulation and characteristics of non-normative life events, are changes in serendipitous actions associated with changes in adaptive development across the transition from high school to a post-secondary

institution? These research questions should provide necessary initial insight into the study of serendipitous relations and will be examined across two studies.

Study 1 addressed the first research question in three steps: 1. Factor analysis of a new series of items designed to assess serendipitous actions and characteristics of unexpected, non-normative life events, respectively; 2. Factorial invariance testing of the resulting structure across three samples of late adolescents; and 3. An initial, cross-sectional SEM of the above-stipulated model of serendipitous relations.

The nature of the data used in this research, described in detail in Chapter 3, were not ideal for studying intraindividual change and interindividual differences in intraindividual change in serendipitous actions and adaptive development necessary to address the second question. Therefore, Study 2 preliminarily addressed the second research question through a cross-lagged longitudinal panel analysis that examined the predictive associations between interindividual variability in the rank order of serendipitous relations and interindividual variability in the rank order of PYD from high school to post-secondary education, controlling for participant sex as well as interindividual variability in the rank order of SOC and the frequency, positivity, and influence of unexpected, non-normative life events. While such analyses may not fully address the research question at hand, they provide an initial first step and could serve to elucidate the longitudinal relations among these factors, or provide suggestions for future research that may be capable of assessing intraindividual change (Selig & Little, 2012).

Thus, taken together, these studies are broadly aimed at providing a valid and reliable measurement model and, as well, initial empirical support for the theoretical model of serendipitous relations. Following the discussion of these studies and the explication of the findings, I will discuss implications for work in applied settings and offer suggestions for future research involving serendipitous relations.

CHAPTER 3:
THE RELATIONS BETWEEN SERENDIPITOUS ACTIONS AND
POSITIVE DEVELOPMENT DURING HIGH SCHOOL AND POST-
SECONDARY EDUCATION

This research involved two studies. The goal of the first study was to provide initial convergent validity and reliability for this measurement model. Accordingly, the first study involved developing a measurement model for serendipitous relations, testing the invariance of the parameters of this model across three samples of late adolescents, and assessing a cross-sectional latent structural equation model (SEM) among the resulting constructs.

The goals of the second study were to assess whether changes in serendipitous actions were predictive of changes in PYD from high school to post-secondary enrollment. As noted in Chapter 2, the data for this research were collected at two time points and were not conducive to studies of intraindividual change and interindividual differences in intraindividual change. However, these data could provide information on the relations between the variability in interindividual rank order between serendipitous actions and PYD, which is a useful preliminary step for future developmental research. Therefore, the second study involved testing a longitudinal cross-lagged SEM of these relations to ascertain whether interindividual variability in rank order of serendipitous actions across the transition from high school to post-secondary education predicted interindividual variability in rank order of PYD over the same period.

As indicated in Chapter 2, I hypothesized that use of serendipitous actions leads to higher levels of positive development from unexpected, non-normative events. In addition, I hypothesized that serendipitous relations are key sources of positive development during periods of transition. Therefore, given the goals of these studies, I predicted that if an invariant measurement model fit these data, serendipitous actions would be cross-sectionally predictive of PYD for high school students. In addition, I predicted that interindividual variability in rank order of serendipitous relations would be predictive of interindividual variability in rank order of PYD from high school to enrollment in post-secondary studies. In other words, I predicted that as individuals improved their relative standing against the sample in serendipitous actions, they would also improve their relative standing in PYD during this important life transition.

The data for this research came from two sources. A portion of the data were collected as a part of the 4-H Study of PYD, a longitudinal study of over 7,000 youth in the United States that began in 2002 with the study of fifth graders and continued through 2012 with the collection of data from individuals one-year-post secondary school (e.g., Lerner et al., 2011). In particular, these data were drawn from adolescents participating in the Grade 12 (or Wave 8) and/or “Grade 13” (post-secondary or Wave 9) portions of the larger study. I present here the features of the methodology that pertain to the goals of the proposed research; full details of the method of the 4-H Study can be found in other publications (e.g., Lerner et al., 2005; Lerner et al., 2010).

Additional data were collected from participants in the Correlates of Positive Youth Development, or C-PYD study, which was conducted in 2012. The C-PYD study was designed, in part, to cross-sectionally assess the associations between serendipitous actions and positive development among undergraduates at Tufts University.

Study 1: Modeling Serendipitous Actions and Serendipitous Relations

Participants

The first sample, hereafter the *high school senior* (or *HS*) sample ($n = 707$), was comprised of Grade 12 participants in the larger 4-H Study. This sample was 68.5% female with a mean age of 17.74 years ($SD = .83$ years). The ethnic background of this sample was: 75.0% White/European American, 4.8% Latino/a, 3.7% Black or African American, 3.7% Asian or Pacific Islander, and 1.3% other. In addition, 11.3% of youth did not have complete information about their ethnic background(s).

The second sample, hereafter the *post-secondary*, or *PS* sample ($n = 461$), was comprised of individuals who participated in the ninth wave of the 4-H Study and were currently enrolled in a post-secondary educational institution. The majority of participants were enrolled at a four-year university (82.4%), while smaller percentages were enrolled in two-year, community, or junior colleges (16.5%) or trade schools (1.1%). Participants' average age was 20.15 years ($SD = .98$ years). The participants were 71.4% female. The ethnic background was 76.8% White/European American; 3.5% Latino/a, 4.1% Black or African American, 2.6% Asian or Pacific Islander, 1.8% other, with 9.3% of respondents

missing data. Since both the HS and PS samples were derived from the larger 4-H Study, 229 participants provided data in both samples.

The third sample, termed *post-secondary comparison*, or the *PSC* sample, consisted of 196 undergraduate students, ages 18 to 25 ($M = 20.4$ years; 69% female) who participated in the C-PYD study. The ethnic background for these participants was 68.5% White/European American; 12.5% Asian/Asian American; 6.6% Hispanic/Latino; 3.0% Asian Indian/Indian-American; 2.5% Black or African American; 5.6% multiethnic; and 1.0% other.

Procedure

Since the participants from the HS and PS samples represented only a small portion of the larger 4-H Study, I present here only the features of the procedure that pertain to this portion of data collection. Full details of the procedure of the early waves of the 4-H Study can be found in prior publications (e.g., Lerner et al., 2005; Lerner et al., 2010). To collect data from these samples, members of the research team contacted youth who had participated during earlier waves and invited them to complete an online questionnaire, which included various indices of positive development and constructs relevant to this research. The questionnaire took approximately 45 minutes to complete.

Participants from the PSC sample were recruited through posters on a university campus and through social media websites (e.g., Facebook). Individuals were invited to complete an online questionnaire that included indices

of positive development and constructs relevant to this research. This questionnaire took approximately 30 minutes to complete.⁴

Measures

Serendipitous relations are defined as mutually beneficial, adaptive developmental regulations (Brandstädter, 2006) brought about by the time-extended coaction of intentional self-regulatory actions and unexpected non-normative life events. Therefore, in this research, I included items that would assess the quality of adaptive developmental regulations (or positive development), the levels of serendipitous actions, and the characteristics of unexpected non-normative life events. Serendipitous actions are based in action-theoretical conceptions of ISR, which have been linked to adaptive development across the life span (e.g., Baltes et al., 2006; Li & Freund, 2005; Napolitano et al., 2011). Accordingly, I included indices of this construct, to ascertain whether serendipitous relations accounts for a significant proportion of the variance in adaptive developmental regulations over and above ISR. Each category of measures is described below.

Positive Youth Development – Adaptive developmental regulations were indexed by measures based in the Lerner and Lerner PYD model (e.g., Bowers et al., 2011; Lerner et al., 2005, 2010). In this literature, PYD is operationalized by the Five Cs (Eccles & Gootman, 2002; Roth & Brooks-Gunn, 2003):

Competence, Confidence, Character, Connection, and Caring. Items used to calculate these Cs come from several well-validated and well-known scales.

⁴ The questionnaires were not identical across the HS/PS and PSC groups. Several items varied in their number, scoring format, and response options. These variations are described in the measures section.

Across the first eight waves of the 4-H Study, the original format and content of these items was retained; that is, PYD items were characterized by a variety of formats and scoring ranges. The HS sample derived from the eighth wave of 4-H Study data collection and responded to these original item formats. The full details of the substance and psychometric characteristics of these items can be found in several publications (e.g. Bowers et al, 2010). However, in the PS and PSC sample, all PYD items were recoded as Likert-type items, and scored on a 1 (low) to 5 (high) format. To facilitate invariance testing, responses to PYD items for the HS sample were recoded on a 1 to 5 scale.

The 4-H Study includes 78 items to measure the 5Cs. Modeling the parameters of each of these items, along with those for the other constructs of interest, would have resulted in an unduly complex model. Therefore, I modeled PYD as a single latent factor with five parceled indicators, each representing one of the “Cs.” This modeling strategy was based on recent research (Geldhof et al., in press), which proposed a pragmatic “short form” approach (e.g., Widaman, Little, Preacher, & Sawalani, 2011) to modeling PYD. Each parceled indicator was comprised of six to eight items representing each of the “Cs” of PYD. The mean, standard deviation, and n for these items are presented in Table 2.

 Insert Table 2 about here

Serendipitous Actions –At the onset of this research, there were no extant measures that explicitly assessed the intentional self-regulatory actions associated

with promoting positive development given unexpected, non-normative life events. Therefore, I assessed these actions using a series of new items.

The HS sample represented the initial piloting of these items, and therefore had different item content and format compared to the other samples. In the HS sample, serendipitous actions were assessed by two items. Each item had four response options and was arrayed in a format adopted from the Self-Perception Profile work of Harter and colleagues (e.g. Harter, 1985). Participants were instructed to select which of two “people” they were “more like,” and the extent to which he or she resembled that “person” (e.g., “Really like me,” or “Sort of like me”). For these items, individuals who reported high values strongly endorsed using serendipitous actions. An example response endorsing serendipitous actions read “I’m able to take advantage of chance events in my life (such as meeting a mentor, or hearing about an exciting job).”

In the PS and PSC samples, serendipitous actions were measured by five indicators: three new items along with the original two. The five indicators assessed the five serendipitous actions described in Chapter 2. The format of these items differed from the format of the HS sample items. Participants read a description of a person endorsing serendipitous actions and were instructed to select how similar they were to this person. Scoring options were arrayed in a Likert-type format, with responses for these items ranged from 1= *not at all like me* to 5= *exactly like me*. For these items, individuals who reported high values were hypothesized to endorse using serendipitous actions. An example item read “Sometimes, I change my long-term goals when a more positive, unexpected

opportunity comes about.” Fewer than 2% of participants in the PS and PSC samples responded “not at all like me” to these items, therefore, these responses were collapsed and the data were analyzed with four response options. The mean, standard deviation, and n for these items are presented in Table 2. The full text of these items for the HS sample can be found in Table 3.

 Insert Table 3 about here

Characteristics of Unexpected Non-normative Life Events – There were no extant measures for the various dimensions of unexpected non-normative life events pertinent to this research. Therefore, I modeled these dimensions using nine new items that were hypothesized to correspond to three factors: *Frequency* (or levels of exposure to such events; Items 1-3), *Positivity* (or how positive such events tend to be; Items 4-6), and *Influence* (or how meaningful such events tend to be; Items 7-9).

Respondents from each group completed data on these nine items. Each item was arrayed in a Likert-type format. For Items 1-3, participants were instructed to report how often, in the past thirty days, they were exposed to unexpected meetings, experiences, or learning opportunities. Each item was scored from 1 = *never* to 5 = *several times a week*. An individual reporting high values on these items indicated that he or she perceived a high frequency of unexpected events in daily life. For Items 4-6, participants were instructed to report how positive unexpected meetings, experiences, or learning opportunities

were for them in the last thirty days. Each item was scored from 1 = *negative* to 5 = *positive*. An individual reporting high values on these items indicated that unexpected events in his or her life were generally positive. For Items 7-9, participants were instructed to report how much unexpected meetings, experiences, or learning opportunities changed their “relationships, schedules, interests, attitudes, or goals” in the last thirty days. Each item was scored from 1 = *negatively* to 5 = *positively*.⁵ An individual who reported high values for these items indicated that unexpected events were important influences on his or her life. The mean, standard deviation, and *n* for these items are presented in Table 2. The full text of these items can be found in Table 3.

Intentional self-regulation (ISR) – Levels of serendipitous actions should be related to, but distinct from, general, global levels of ISR. To measure general ISR, I used a subset of items from the SOC questionnaire (Freund & Baltes, 2002). While the full SOC questionnaire contains 24 items, a reduced nine-item version has been identified as an adequate measure of ISR in adolescence (e.g., Gestsdóttir & Lerner, 2007; Zimmerman, Phelps, & Lerner, 2007). Each of the nine items was dichotomous: participants are asked to indicate which of two people they are most similar, Person A or Person B. A sample item is, *Person A: I concentrate all my energy on a few things OR Person B: I divide my energy among many things*. Responses were coded such that SOC-endorsing responses are given a 1 and non-SOC responses are given a 0. The mean, standard deviation,

⁵ Items 4 – 9 also included the response option “Does not apply.” This response is neither positive nor negative (nor neutral), nor is it significantly influential or insignificant. Therefore, these responses were recoded as missing.

and n for these items are presented in Table 2. For these data, the mean value represents the proportion of individuals reporting SOC-endorsing responses.

Additional variables – Participant sex was included as a covariate to assess potential differences between males and females in the associations of interest.

Analyses

The general goal for Study 1 was to develop a measurement model for serendipitous relations suitable for research involving high school and post-secondary students. An invariant, well-fitting model would provide preliminary support for this goal. The research had several analytical steps. First, I developed a baseline, two-group (three-sample) Confirmatory Factor Analysis (CFA) model that included factors for serendipitous actions, characteristics of unexpected, non-normative life events, SOC, and PYD. Using the standardized factor loadings from this model, I next calculated the reliability of each factor, in terms of coefficient ω (e.g., McDonald, 1999). I then tested for loading (weak) and intercept (strong) invariance across the three groups. Finally, to begin testing the hypotheses presented in Chapter 2, I examined the latent correlations among the resulting factors using a cross-sectional SEM.

Model fit for each analysis was gauged by root mean square error of approximation (RMSEA) 90% confidence interval, Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) values. Cutoffs for acceptable fit were CFI and TLI values $> .90$ and RMSEA confidence interval $< .08$ (e.g., Marsh, Hau, & Wen, 2004). Relative fit values were calculated in reference to an alternative null

model, which provides more accurate assessments when compared to the default null model in Mplus (e.g., Widaman & Thompson, 2003). The criterion for invariance testing was $\Delta CFI < .01$ per invariance step, as suggested by Cheung and Rensvold (2002). Below, I present a more detailed description of each analysis in this study.

Baseline two-group CFA – The first step in this research involved fitting a configurally invariant two-group CFA. The first group included the 4-H-derived HS and PS samples, while the second group included only the PSC sample. The dichotomous SOC indicators were treated as categorical. Therefore, I implemented the CFA using a robust weighted least-squares estimator (WLSMV) in Mplus 7.0. For a multigroup CFA, this software requires an identical data structure across groups. These data do not fit this requirement: the first group included both a high school and post-secondary-attending sample drawn from the 4-H Study, while the second group included only the post-secondary-attending PSC sample.

Therefore, to test this model, I inputted randomly-generated data to populate an identical data structure for the PSC group with “phantom indicators.” This process drew from suggestions in recent research involving residual centering (Geldhof, Pornprasertmanit, Schoemann, & Little, 2013). Modeling these data required fully freeing the covariances of each randomly-generated indicator, fixing each indicator’s loadings on a single latent factor to zero, and fixing these factors’ means, variances, and correlations to zero.

Weak and Strong Invariance – The next steps for Study 1 involved incrementally testing for weak (loading) and strong (intercept) invariance across time and across groups. The binary nature of the SOC data required an alternate parameterization for invariance testing. I used the procedure illustrated by Millsap and Yun-Tien (2004). This parameterization involved establishing a marker indicator for the SOC factor in each group, freeing all non-marker item covariances, freeing all SOC factor means, and equating item thresholds across groups, and was introduced during the configural invariance stage.

Analysis of Latent Relations – The final step of Study 1 involved examining the patterns of latent relations among the resulting factors in a cross-sectional SEM analysis. The factors included in this analysis were derived from the most restrictive invariance test model with acceptable fit. Should levels of serendipitous relations predict levels of PYD over and above the influence of SOC, these findings would provide preliminary support for the theoretical model of serendipitous relations described in Chapter 2.

Results

The purposes of this study were to develop a measurement model based in the theoretically-specified components of serendipitous relations, test whether the parameters of this model are invariant across three samples of late adolescents, and describe the patterns of cross-sectional relations among the resulting factors. An invariant model that corresponds to the hypothesized theoretical model would provide initial support for the study of serendipitous relations. In addition, such a model would suggest the potential utility of this empirical approach for studying

serendipitous relations among individuals enrolled in high school or in post-secondary educational institutions. The results for this study are presented in three sections.

Baseline two-group CFA –I first examined the factor structure of a two-group model that included factors for frequency, positivity, and influence of unexpected non-normative life events, serendipitous actions, SOC, and PYD. To control for potential gender differences, each latent factor was regressed on participant sex. There were several additional parameters in this and in subsequent models. The frequency, positivity, and influence of unexpected non-normative factors each included one item referencing an unexpected event, one item referencing an unexpected meeting, and one item referencing unexpectedly learning something. The residuals of these items were freed to correlate across factors. Second, where applicable, I freely estimated the correlation of indicators' residuals across time.

An initial model produced poor fit ($\chi^2 (df=1631) = 2175.287, p < .001$; RMSEA 90% CI = [.021, .027]; CFI: .90; TLI: .86). Modification indices suggested that model misfit was due, in part, to a correlation between the competence and confidence indicators of PYD, which has also been described in prior research (e.g., Bowers et al., 2010). A revised model produced acceptable fit ($\chi^2 (df=1625) = 2087.956, p < .001$; RMSEA 90% CI [.019, .025]; CFI: .94; TLI: .93) after freely estimating the correlations between the competence and confidence indicators in each group. The final model included, as hypothesized, factors for frequency, positivity, and influence of unexpected non-normative life

events, serendipitous actions, SOC, and PYD. In each group, each factor was characterized by acceptable reliability ($\omega > .70$), except for the HS serendipitous actions factor ($\omega = .60$)⁶. Table 4 displays item factor loadings and standard errors for each group, while Table 5 provides the ω reliability estimates for each factor in each group.

 Insert Tables 4 & 5 about here

Weak and Strong Invariance – I next tested for weak invariance by fixing the indicator loadings across samples. This model passed the invariance criterion (Δ CFI = -.002) and displayed acceptable model fit (χ^2 (df =1666) = 2117.079, $p < .001$; RMSEA 90% CI [.019, .025]; CFI: .94; TLI: .93). I then tested strong invariance by fixing indicator intercepts across samples. This model also passed the invariance criterion (Δ CFI = .008) and displayed acceptable model fit (χ^2 (df =1691) = 2202.511, $p < .001$; RMSEA 90% CI [.020, .026]; CFI: .93; TLI: .92). Thus, the factors for frequency, positivity, and influence of unexpected non-normative life events, serendipitous actions, SOC, and PYD were invariant across these groups. Table 6 provides iterative model fit statistics for each step of invariance testing.

⁶ One reason that the reliability of the two-item HS serendipitous actions factor was low may be due to the way in which ω is calculated, which provides lower reliability estimates for scales with few items (e.g., McDonald, 1999). For instance, the serendipitous actions factors in the PS and PSC samples were identified by five indicators (including the two present in the HS sample) and were characterized by good reliability ($\omega = .88$ and $.87$, respectively). Due to the preliminary nature of this work, I proceeded with using the HS serendipitous relations factor in these latent analyses.

Insert Table 6 about here

As hypothesized, the factors in the strong invariant model were characterized by a general pattern of significant, positive intercorrelation. There were several exceptions to this pattern. First, factors for PS SOC and PYD were non-significantly correlated with HS factors for unexpected events' frequency, positivity, and influence. In addition, HS SOC and PS positivity, as well as PS SOC and PS frequency were non-significantly correlated. Finally, in the PSC sample, frequency was non-significantly correlated with SOC and serendipitous actions, while influence was non-significantly correlated with SOC. A full listing of the latent correlations from the strong invariance model for each group is presented in Table 7.

Insert Table 7 about here

Cross-sectional SEM – The final step for this study involved evaluating a cross-sectional SEM using data from the HS sample. This analysis provided an initial assessment of the direction and strength of the associations between the above-described latent factors, and served as a preliminary test of the validity of the theoretical model of serendipitous relations as well as the soundness of these indicators to test that model for this sample. After specifying an initial model, I pruned non-significant regression parameters and tested for significant differences

in model fit using Mplus' *difftest* option (p for all Δ single df tests $< .001$). I recalculated relative model fit indices based on values provided by a HS-sample specific alternative null model.

In these analyses, PYD was initially regressed on serendipitous actions, SOC, and frequency, positivity, and influence of unexpected non-normative factors, with participant sex as a full covariate. This initial model produced acceptable fit (χ^2 ($df = 271$) = 575.644, $p < .001$; RMSEA 90% CI [.031, .039]; CFI: .91; TLI: .90). After iteratively pruning non-significant regression coefficients across two steps, the final model included three significant concurrent predictors of PYD: serendipitous actions (standardized $\beta = .364$, $p < .001$), SOC (standardized $\beta = .412$, $p < .001$), and positivity of unexpected non-normative life events (standardized $\beta = .258$, $p < .001$). The fit for this final model was also acceptable (χ^2 ($df = 273$) = 575.620, $p < .001$; RMSEA 90% CI [.031, .038]; CFI: .91; TLI: .90). Table 8 provides the removed predictors, fit statistics, and χ^2 difference test values for each iterative step in these analyses.

 Insert Table 8 about here

Summary

In these samples, factors for serendipitous actions, SOC, the frequency, positivity, and influence of unexpected non-normative life events, and PYD were invariant across time and across groups. These findings provide preliminary support for this empirical approach to assessing these factors for adolescents

enrolled in high school and post-secondary institutions. A cross-sectional SEM of high-school attending youth also provided preliminary support for my hypotheses: use of serendipitous actions, over and above levels of SOC, predicted higher levels of participants' PYD. In addition, higher levels of PYD could also be predicted by heightened levels of positive, unexpected events during high school. These results are further discussed in Chapter 4.

Study 2:

Assessing the Relations between Rank Order Variability in Serendipitous Relations and Rank Order Variability in PYD in the Transition to Post-secondary Education

The goal for Study 2 was to assess whether an individual's change in his or her serendipitous actions was associated with adaptive development (as indexed by PYD) across a major life transition (high school to post-secondary studies). As noted earlier, these data, which were collected over two times of measurement, were not ideally suited to address this question. However, a cross-lagged panel design can determine whether interindividual variability in rank order for serendipitous actions predicted changes in rank order of PYD from high school to enrollment in post-secondary education. Since interindividual variability in rank order can be, in part, influenced by interindividual differences in intraindividual change, and useful information for future developmental research can be gleaned from this methodological approach, these analyses served as an initial attempt to address the goals of this research. Therefore, the research question for these analyses was: does interindividual variability in the rank order

of serendipitous actions across this transition predict interindividual variability in the rank order of levels of PYD, controlling for variability in the rank order of SOC, and the frequency, positivity, and influence of unexpected, non-normative life events?

Participants and Measures

This longitudinal research included participants from the HS and PS samples only ($n = 939$), as the PSC sample was comprised of exclusively post-secondary-attending individuals. Demographic information about these participants can be found in Study 1. The measures for the serendipitous actions, SOC, PYD, and frequency, positivity, and influence factors for Study 2 are identical to those listed in Study 1.

Analyses

The analyses for Study 2 involved iteratively developing a parsimonious cross-lagged panel SEM to test whether interindividual variability in the rank order of PYD levels from high school to post-secondary educational enrollment was predicted by interindividual variability in the rank order of serendipitous actions, controlling for levels of rank order stability in SOC and the characteristics (frequency, positivity, and influence) of non-normative life events. The parameters of this model were based on the earlier-described strong invariant model. The initial model regressed PS PYD on all within-time PS and across-time HS factors, included autoregressive parameters for each factor, and included participant sex as a full covariate. Following this initial model, I pruned non-significant predictors, and tested for significant differences in model fit using

Mplus' *diffest* option (a significant difference in model fit was defined as $p < .001$ for each single *df* test). Model was fit was calculated in reference to an HS/HE sample alternate null model. I also report the significance and strength of the autoregressive parameters, which provide an indication of the factors' rank order stability in the transition from high school to the post-secondary education setting.

In addition, I also tested whether the potential predictive relations between high school levels of serendipitous actions, SOC, and the characteristics of non-normative life events (frequency, positivity, and influence) and the change in the rank order of PYD were moderated by measurement time lag. Variability in the time elapsed between measurement occasions is a key and often overlooked source of variation in developmental analyses (e.g., Selig, Preacher, & Little, 2012). One way to assess time-lag-as-moderator involves investigating whether the effects of a predictor at Time 1 (in this case, during high school) on the outcome in Time 2 (in this case, change in the rank order of PYD by post-secondary-education enrollment) differ depending on variations in the time elapsed between measurement occasions. For these data, mean time lag between measurement occasions was 25.83 months ($SD = 3.0$ months). Information about the analyses involved in testing for time-lag-as-moderator for this research can be found in Appendix 1, Section A.

Results

The initial cross-lagged panel model included all HS and PS factors (as identified in the strong invariant model) as predictors of PS PYD, as well as

autoregressive parameters, and was characterized by acceptable fit (χ^2 (df =1286) = 1742.837, $p < .001$; RMSEA 90% CI [.017, .022]; CFI: .93; TLI: .92). Several regression parameters of this initial model were non-significant predictors of PS PYD. I pruned these parameters across nine iterations, resulting in a final parsimonious model that included only within-time PS serendipitous actions (standardized $\beta = .340$, $p < .001$) and the autoregressive across-time HS PYD (standardized $\beta = .540$, $p < .001$) as significant predictors of PS PYD, controlling for participant sex. The final model was also characterized by acceptable fit (χ^2 (df =1295) = 1754.183, $p < .001$; RMSEA 90% CI [.017, .022]; CFI: .93; TLI: .92). Table 9 provides the removed predictors, fit statistics, and χ^2 difference test values for each iterative step in these analyses.

Insert Table 9 about here

The autoregressive parameters of this final model indicated a pattern of positive rank order stability for the predictors in this model, albeit to different degrees. Positive rank order stability occurs when the rank order at a first time point significantly predicts similar rank order in the same variable at a subsequent time point (Baltes, Reese, & Nesselroade, 1988). As discussed in greater detail in a later section of this dissertation, these values should be interpreted with caution, as they may not be fully reflective of underlying intraindividual change across times of measurement. For these samples, the rank order of the frequency, positivity, and influence of unexpected non-normative life events were

moderately stable (standardized $\beta = .479, .420, .301$, respectively, p for each $< .001$), as was the rank order of serendipitous actions (standardized $\beta = .575, p < .001$). Rank order levels of SOC, by comparison, were very stable (standardized $\beta = .853, p < .001$).

Time-lag-as moderator analyses

Across a series of analyses, I investigated whether differences in the time elapsed between measurement occasions moderated the predictive rank order variability relations explored in the above-described cross-lagged panel design. For these samples, each lag-moderated factor was non-significantly associated with variability in PYD rank order from high school to secondary-education enrollment. Full details on these results can be found in Appendix 1, Section B.

Summary

Results from the cross-lag panel model supported my hypothesis. Variability in rank order in serendipitous actions from high school to post-secondary educational enrollment predicted variability in rank order of PYD across the same period. In other words, as individuals in this sample improved their relative standing in serendipitous actions, they improved their relative standing in PYD across this major life transition. In addition, each factor in this model was characterized by significant rank order stability, especially in the case of SOC. Finally, as discussed in greater detail in Appendix 1, time lag between measurement occasions did not significantly moderate the associations between HS predictors and variability in rank order of PYD.

CHAPTER 4:
DISCUSSION:
THE PRESENT AND THE FUTURE OF THE STUDY OF
SERENDIPITOUS RELATIONS

Some paths in life are planned well in advance. Other paths may come about unexpectedly. Because either path involves setting goals and attempting to achieve them, individuals employ various ISR actions to chart their course and maximize their chances for success. While the actions associated with the “planned route” have been described extensively in the ISR literature (e.g., Baltes et al., 2006; Freund, 2008; Napolitano et al., 2011), no extant model explicitly describes the self-regulatory actions that one employs to maximize gains from unexpected, non-normative life events. The work in this dissertation represents some initial steps towards addressing this theoretical and empirical lacuna by introducing and preliminarily assessing the concepts of serendipitous actions and serendipitous relations in samples of American high school and post-secondary students.

Thus, the empirical work in this dissertation represented an initial “proof of concept” for the future study of serendipitous relations and for the applicability of newly-developed measures to assess this concept. The two studies that comprised this research assessed two key hypotheses for serendipitous relations:

1. Use of ISR-based serendipitous actions would lead to mutually-beneficial serendipitous relations between person and context;
2. Engaging in serendipitous

relations may be important for adaptive development during periods of life transition, such as the move from high school to post-secondary education.

I will discuss these findings and their implications in three steps. First, I will review and interpret the findings from Studies 1 and 2. Next I will describe the limitations of this research, and offer suggestions on how future work may address these limitations. I will conclude by offering the general implications and “take-home messages” of the present research, and offer suggestions for future research and applied work.

Study 1

In Study 1, I tested the psychometric properties of a new series of items designed to assess components of a serendipitous relation through invariance testing across three groups. In addition, using the resulting factor structure, I examined the relations between serendipitous actions and positive development in a cross-sectional SEM using a sample of high-school students. Accordingly, the purposes of Study 1 were to explore the utility of this particular empirical approach and, as well, to preliminarily assess the validity of the hypothesis that use of serendipitous actions leads to positive development through serendipitous relations.

As expected, a model with factors for frequency, positivity, and influence of unexpected non-normative life events, serendipitous actions, SOC, and PYD fit well and displayed configural invariance across the three groups. In addition, further testing illustrated that these data displayed both weak (indicator loading) and strong (indicator intercept) invariance. Achieving measurement invariance

across groups was an important finding of this research, and suggests that, at least for these samples of American high school and post-secondary students, this approach to assessing the characteristics of serendipitous relations may be psychometrically reliable. While future work will likely include refinements and revisions to the new items, these invariant models provide a strong foundation for this empirical approach.

In addition to being invariant within the present data set, these models generally displayed expected patterns of positive latent intercorrelation. For example, serendipitous actions and SOC were correlated with each other, and as well with levels of PYD. However, it is important to note that there were several factors in the strong invariance model that were non-significantly correlated. Overall, these non-significant correlations generally fell into two patterns: 1. Weak relations between the frequency, positivity, and exposure factors with SOC within time; and 2. Weak relations between the frequency, positivity, and exposure factors with the SOC and PYD factors across time. Why might these factors be non-significantly correlated? The first pattern of non-significant correlations can be addressed by the concepts described in the 3U model of serendipitous relations. While SOC actions may be necessary to “unlock” the potential of an unexpected non-normative event through extended goal investments, they may not be associated with these events’ frequency (the “unaware” stage), nor with individuals’ perceptions of their positive potential (the “uncovering” stage). Given the patterns of correlation in these data, one’s

serendipitous actions may instead be associated with increased frequency, positivity, and influence of such events within time.

The second category of non-significant correlations can also be addressed using the 3U model of serendipitous relations. As described in Chapter 2, some individuals may be frequently exposed to a wide variety of unexpected, non-normative events that may have varying degrees of potential positivity or influence on their lives. With notable exceptions (e.g., knocking on the door of the Manson Family gang), it seems reasonable that a “snapshot” assessment of these characteristics during a particular month of one’s life span might be non-significantly associated with their positive development or one’s ISR during a “snapshot” taken two years later. The importance of thoughtful measurement timing for future research on this topic is described later in this discussion (see Lerner, Schwartz, & Phelps 2009 for a discussion of this issue).

Study 1 also involved a preliminary assessment of the serendipitous relations model. Results from a cross-sectional SEM of high school students indicated that there were three significant predictors of PYD, controlling for participant sex: serendipitous actions, SOC, and the positivity of unexpected, non-normative life events. These results illustrate that, consistent with my hypothesis, higher levels of serendipitous actions were associated with higher levels of PYD beyond the influence of SOC. This finding suggests that high school levels of serendipitous actions and SOC, while conceptually and empirically related, may be distinct skills associated with non-overlapping portions of the variance in within-time levels of positive development.

In addition, these results highlighted the cross-sectional link between positive, unexpected events and positive development. That is, controlling for the influence of individuals' serendipitous and SOC-related ISR actions, very positive unexpected events, meetings, and learning opportunities were predictive of positive development. One interpretation of this finding is that if one reports an overall positivity to his or her unexpected meetings, experiences, and learning, then they might report higher overall life satisfaction, which is likely associated with indices of positive development. In other words, he or she may be thriving through a series of (in this case unexpected) mutually beneficial, person \leftrightarrow context relations brought about, in part, by the "good fortune" of their mostly-positive encounters with chance events. While positivity was a significant main effect predictor of PYD for high school students in this sample, future research should explore whether this relation is moderated by one's serendipitous actions; that is, whether one's effective use of serendipitous actions can increase the positivity of these unexpected events through "uncovering" some of these events' potential.

In contrast, levels of frequency and influence of unexpected events were not significant predictors of positive development. For frequency, this finding suggests that, at least for this sample, the number of unexpected events is not predictive of one's positive development in high school. One reason for "frequency's" non-significance may be that a serendipitous relation could begin from a single, isolated, unexpected non-normative event. Another interpretation could be that use of serendipitous actions moderates the relationship between the

frequency of non-normative life events and their influence on positive development. In other words, one may be surrounded by unexpected opportunities, but without serendipitous actions, these potential paths may remain unexplored. Future work should examine this potential moderating effect.

Finally, the non-significance of the influence of non-normative events on the prediction of PYD could also be interpreted in terms of a potential moderating effect. For example, it seems reasonable that this relationship (influence of non-normative events predicting PYD) could be moderated by the event's positivity, such that extremely influential events are generally associated with PYD when the events also tend to be positive. On the other hand, very influential, very negative non-normative life events, like knocking on the door of the Manson Family, are likely detrimental to PYD. Future research should also test this potential moderation and, as well, the potential moderation between the influence of non-normative events and serendipitous actions on PYD. That is, while individuals may perceive an unexpected event to be influential, it may become more so through effective use of serendipitous actions.

Taken together, the main findings of Study 1 – that the data can be invariantly modeled across three groups, and that these models displayed the hypothesized patterns of correlation and predictive relations between the factors – provide preliminary support for the concepts described in Chapter 2 and for the utility of these items to measure those concepts. These findings represented only a first step in researching serendipitous relations. Potential improvements in future

research, as well as the limitations of Study 1, are addressed later in this discussion.

Study 2

Study 2 represented a preliminary longitudinal extension of the work presented Study 1. The goal of Study 2 was to explore whether adolescents' increased use of serendipitous actions during the post-secondary education transition predicted their increased levels of PYD. The above-described data were not ideally suitable for analyzing intraindividual change and interindividual differences in intraindividual change in these factors necessary for fully addressing this goal. Therefore, I assessed whether interindividual variability in rank order for serendipitous actions across the transition to post-secondary education was predictive of interindividual variability in rank order of PYD, controlling for such variability in SOC, frequency, positivity, and influence, as well as for participant sex. Since interindividual variability or stability in rank order can occur, in part, through the influence of intraindividual change, and the findings from such panel models are useful for future developmental research, these analyses represented a first attempt addressing the goals of this research. In order to assess these interindividual differences, I developed a parsimonious cross-lagged panel design that regressed post-secondary PYD on all post-secondary and high school predictors. This model also included autoregressive parameters, which provided an indication of rank-order stability for each factor across the transition.

Interpreting these results

Before discussing the results of this analysis, it is important to note that interpreting developmental change from rank-order stability analyses should be done with great caution. While interindividual differences in the rank order of a construct at a later time are often influenced by cumulative differences in intraindividual change in that construct, there are circumstances where interpreting rank order stability as developmental change may obfuscate underlying patterns of intraindividual change (Baltes, Reese, & Nesselrode, 1977, 1988). Since intraindividual change can occur at different levels and in different directions across individuals, opposite trajectories in intraindividual change across a time period for two individuals can “cancel each other out,” resulting in no discernible interindividual differences in the mean and standard deviation a construct, and, perhaps, the false impression of uniform intraindividual change (see Lerner, 2002, for examples of such structures). In other words, while a strong autoregressive coefficient could imply relatively uniform intraindividual change for a sample across a time period, it could also occur if a similar number of males decrease and females increase their scores of a variable across measurement occasions. Therefore, it is important to stress that these results only reflect patterns of interindividual differences in rank order across time, rather than patterns of intraindividual change that may be driving these interindividual differences in rank order over time.

These analyses included three types of regression parameters: 1. Autoregressive parameters; 2. Within-time regression parameters; and 3. Across-

time non-autoregressive regression parameters. How was each type of regression parameter interpreted in this research? As discussed above, autoregressive parameters can be considered estimates of interindividual rank-order stability. If this coefficient is positive and significant, then it was interpreted that rank order on this construct in high school predicted a similar standing in rank order on the construct during post-secondary education.

Within-time regression parameters in this research were interpreted in terms of predicted interindividual variability in rank order. In other words, if this parameter was significant and positive, then it implied that positive changes in PYD rank order from high school to post-secondary education were predicted by positive changes in rank order for the predictor across the same time period.

Again, while intraindividual change often influences interindividual differences at a later point, a significant and positive within-time regression parameter did not necessarily imply a commensurate relationship between intraindividual change in the predictor and interindividual differences in PYD rank order from high school to post-secondary education enrollment. Finally, across-time non-autoregressive regression parameters were interpreted in the following way: if this coefficient was positive and significant, then a relatively high standing in rank order for a predictor during high school predicted positive changes in the rank order of PYD from high school to post-secondary education enrollment.

Cross-lagged panel model results

The results from the cross-lagged panel analyses provided preliminary support for the second key hypothesis of this research. Variability in rank order

of serendipitous actions across the transition to post-secondary education predicted variability in the rank order of PYD over the same time period. This finding can be interpreted such that when an individual improved his or her relative standing in serendipitous actions, he or she also tended to improve his or her relative standing in PYD across this important life transition. In addition, post-secondary levels of PYD were also significantly predicted by the autoregressive PYD component. This finding can be interpreted as significant rank order stability in PYD, such that a relatively high standing in PYD during high school predicted a similar standing in PYD rank order during post-secondary education. For these samples, there were no other significant predictors of rank order variability in PYD.

The non-significance for rank order variability for SOC in predicting rank order variability in PYD was unexpected. Recent literature suggested that effective use of SOC actions is associated with adaptive development for adolescents (e.g., Bowers et al., 2011; Gestsdóttir et al., 2010; Napolitano et al., 2011). To this end, the strong invariance CFA model (which does not include autoregressive parameters) did include a positive and significant correlation between SOC and PYD for the post-secondary sample. While SOC actions were associated with within-time thriving for post-secondary students, the high levels of interindividual rank-order stability in the SOC factor likely limited its potential to predict interindividual variability in PYD rank order. I believe that the SOC factor exhibited this high stability for at least two reasons.

First, the dichotomous, forced-choice nature of the questionnaire may have limited variability in response patterns. Had the items included additional response options, perhaps more subtle patterns of variance may have emerged. Second, there may have been endogeneity issues with this sample: participants in this sample – individuals who graduated from high school and attended a post-secondary institution – could generally report consistently high levels of SOC. These individuals may have internalized the importance of consistent use of SOC strategies, and might have consistently used these goal-related actions to achieve the important milestone of enrollment in post-secondary studies. Similarly, individuals who precipitously declined in SOC rank order across the transition to post-secondary education may have dropped out or suspended their studies, and thus were not included in this sample.

Rank-order variability in the frequency, positivity, and influence of non-normative events factors were also non-significant predictors of commensurate variability in PYD rank order. I interpret this finding as a longitudinal extension of the findings from the cross-sectional SEM involving the characteristics of non-normative life events. In those prior analyses, positivity was a significant main effect predictor of PYD, while frequency and influence were non-significant main effect predictors. I hypothesized that the cross-sectional predictive influence of the frequency, positivity, and influence of non-normative events may be moderated by one's serendipitous actions, such that these serendipitous actions may transform a perceived positive and influential non-normative event into a source for long-term adaptive development.

I believe that the same interpretation (potential moderation by serendipitous actions) may hold for these rank-order variability analyses. To use a hypothetical example, imagine a first year student from a rural village newly enrolled at a university in a metropolitan city. In the first week of her studies, she is exposed to an increase in opportunities to join clubs or organizations. With an interest in law, she joins a mock trial club. Leaving a meeting one evening, she stumbles upon a student group that develops robotics. She finds this new work challenging and engaging, and soon leaves the mock trial group and devotes her time to building robots, outworking her peers and pursuing unexpected opportunities in robotics design. Years later, she successfully manages a robotics company.

The hypothetical student was exposed to a greater frequency of potentially-transformative activities during university enrollment (rank order variability in the frequency of potentially positive non-normative events), but her exposure to the robotics club alone did not promote her positive development. Instead she increased her use of serendipitous actions, compared to her peers' changes in these actions over the same period (rank order variability), and maximized gains from her exposure to the robotics club, thus promoting her positive development (rank order variability in PYD). While future research should involve collecting data suitable for analyzing intraindividual change and interindividual differences in intraindividual change with respect to these phenomena, this hypothesis of moderated predictive rank order variability should be explored in future work involving these data.

Finally, both across-time non-autoregressive regression parameters and lag-moderated effects were non-significant predictors of variability in PYD rank order. The non-significance of the across-time non-autoregressive regression parameters illustrated that, for these data, rank order in serendipitous actions, SOC, and the frequency, positivity, and influence of non-normative events during high school was not predictive of interindividual lag order variability in standing in PYD during post-secondary education. The non-significant lag-moderated parameters illustrated that differences in time elapsed between high school and post-secondary measurement occasion did not moderate the relations between high school predictors and changes in PYD rank order during post-secondary education. I believe that these results are related, and likely derive in part from the two-year lag between measurement occasions, which may have attenuated potential across-time relations of this kind. As discussed in the next section, future research should schedule measurement timing in a more theoretically-driven manner.

In sum, however, the findings from Study 2 provided preliminary support for the second key hypothesis in this research by illustrating that variability in the rank order of serendipitous actions across the transition to post-secondary education predicted variability in the rank order of PYD over the same time period for this sample. While this finding should be further explored with other longitudinal samples, it suggests that engaging in serendipitous relations (through use of serendipitous actions) may be a key influence on positive development

during the major life transition of moving from high school to post-secondary studies for the individuals in these samples.

Limitations and Future Directions

While these results provided initial support for the usefulness of future study of serendipitous relations, the results were also characterized by several limitations. In this section, I will discuss these issues first in terms of limitations in this work's samples and, next, in terms of their methodological limitations. Finally, I will offer some suggestions for future work.

Sample limitations

For several reasons, particular care should be taken in generalizing these findings to all post-secondary students or to broader groups. First, the sample was predominately White/ European American. While the American university system is characterized by a disproportionately low amount of non-White/European American students, the ethnic characteristics of this sample do limit generalizability across groups. Relatedly, some research has identified cultural differences in children's perceived control and self-regulatory action (e.g., Grob, Little, Wanner, Wearing, & Euronet, 1996). Most notably for this research, prior work described differences in perception of the role of luck in academic success between Japanese and Western students (Karasawa, Little, Miyashita, Mashima, & Azuma, 1997). Future work should explore the extent to which the concepts of serendipity, serendipitous relations, and serendipitous actions are translatable across cultural settings.

Second, this sample was likely not ideal for the study of serendipitous relations during the transition from high school to post-secondary education because many of the post-secondary sample respondents were likely in their second year of post-secondary studies (due to the average measurement time lag being approximately two years). Serendipitous relations may occur at a greater frequency during the immediate onset of a transition, when an individual may be exposed to a greater number of potentially positive and influential unexpected non-normative life events by virtue of their inchoate understanding of the resources in the context. In other words, it may be advantageous for future serendipitous relations research to purposively focus on those periods in the life span when the individual does not yet know what to “expect” from his or her context. The two-year lag between measurement occasions for this sample limits the ability to assess serendipitous relations that may take place during the beginning of the transition to post-secondary education.

Future work should also explore the role of serendipitous relations for individuals across periods the life span and in diverse settings. In terms of future life-span analyses, I believe that serendipitous relations may be more likely to be sources of positive development for adolescents, especially those embedded in supportive, resource-rich ecological contexts. During adulthood in Western cultures, individuals often engage in normative life tasks such as buying a house or raising a family (Heckhausen, Wrosch, & Schulz, 2010), and thus often pursue goals with an orientation towards maintaining functioning and/or minimizing loss (Ebner, Freund, & Baltes, 2006). Adolescence, on the other hand, is a period of

interaction with new individuals, contexts, and situations (Steinberg, 2011) and may be particularly populated by opportunities for gains, those unexpected “floppy-eared rabbits” that have the potential for altering the life course (Napolitano et al., 2011). If an adolescent fails to act and capitalize on these unexpected events, and instead doggedly pursues an earlier, potentially mismatched goal, he or she may run the risk of foreclosing on potential alternative expressions of identity development and thus limit his or her positive developmental potential (Marcia, 1966, 1980; Napolitano, Bowers, Gestsdóttir, Depping, von Eye, & Chase, 2011). Therefore, given their orientation towards gains (Ebner, Freund, & Baltes, 2006), adolescents and young adults may be uniquely suited to capitalize on unexpected opportunities and engage in serendipitous relations. While the studies in this dissertation do not include comparison samples of children, adults, or the elderly, future work should incorporate the role of serendipitous relations in the positive development of individuals across the life span.

As suggested earlier, there may be great variation in the ways that individuals from diverse contexts undertake serendipitous relations, if the concept is in fact salient across cultures. For instance, it could be maladaptive for individuals from resource-restricted environments or aged individuals with diminished personal resources to pursue unexpected opportunities in the same ways that the relatively privileged, resource-rich individuals in this sample do. This is not to say that serendipitous relations are out of the reach of these individuals, but rather that the exact processes to achieve maximal gains from

unexpected, non-normative events may vary widely across contexts and across the life span. For example, one hypothesis may be that the serendipitous relations in highly-resourced contexts may require a “filtering” approach, where one sorts out the best opportunities from those with a lesser chance for success or lower gains potential. On the other hand, serendipitous relations in resource-restricted environments may require a “scouring” approach, searching for the few unexpected opportunities that may be present in the context.

In other words, the means for serendipitous relations may be different across the life span and for individuals with differential access to resources; however, the ends may be the same – adaptive developmental regulations arising from the coaction of unexpected, non-normative events and intentional self-regulatory action. For this reason, exploring variations in serendipitous relations across these groups may be of vital importance to promoting social justice in a globalizing world whose inhabitants are increasingly connected, increasingly marginalized, and have increasingly expanded life spans.

Methodological limitations

A key limitation in this research was that it did not fully adequately address intraindividual change and interindividual differences in intraindividual change for PYD, serendipitous actions, SOC, and the frequency, positivity, and influence of non-normative events. Instead, the studies only addressed interindividual components of these processes, namely cross-sectional predictive relations and associations between interindividual rank order variability across time. Thus, while the results presented here did provide preliminary support for

the hypotheses of this research, they may obscure potential underlying patterns of within-person change. Since the theory of change in the 3U model of serendipitous relations is described as explicitly intraindividual— an individual encounters an unexpected opportunity and utilizes unique ISR actions to maximize his or her chances for gains from that event – future work should test this concept, perhaps through person-centered approaches such as *p*-technique (Cattell & Williams, 1953; Molenaar & Nesselroade, 2009).

Future research may also benefit the study of serendipitous relations through using observational or experimental paradigms to ascertain short-term, micro-level processes potentially associated with maximizing gains from unexpected events. Another approach could be utilizing daily-diary data collection techniques, or through intensive and purposive sampling during periods of transition. Whatever the precise technique, future research should employ a variety of methodologies to further ascertain the developmental nature of serendipitous actions and serendipitous relations.

Potential topics for future research

The present research focused on providing a theoretical grounding and initial empirical proof-of-concept for the study of serendipitous relations. Future work grounded in qualitative approaches may enrich these findings and refine the concepts presented in this dissertation. For example, interviews or thematic assessments of memoirs or autobiographical statements could elucidate two topics briefly discussed in the introduction: 1. Serendipitous relations in-the-moment are associated with one's narrative recollections of unexpected, positive inflection

points in one's life; and 2. Serendipitous relations may be related to the concept of *Sehnsucht*; that is, the choice to pursue one unexpected opportunity, however beneficial it may be or may have become, could be precluded by one's foreclosure on a persistent orientation to one's life longing.

An examination of individuals' narrative recollection of unexpected inflection points in their lives may support the serendipitous actions described in the 3U Model, suggest key serendipitous actions not specified in this work or, alternatively, illustrate alternate pathways to serendipitous relations. In addition, consistent with the "life story" research of McAdams (e.g., McAdams, 2011; McAdams, Josselson, & Lieblich, 2006), this future qualitative work could examine how between- and within-person variations regarding how individuals narrate their engagement in serendipitous relations may be associated with variation in identity and identity development. For example, how do individuals who recount their serendipitous relations in terms of their agentic actions differ from those who describe these relations in terms of the vagaries of chance?

A second area where qualitative work may benefit the study of serendipitous relations relates to the concept of *Sehnsucht* (Schiebe, Freund, & Baltes, 2007), or intense life-longings. As elaborated in theoretical discussions of the SOC model (e.g., Baltes, et al., 2006; Freund, 2008) individuals have limited resources and must choose to pursue one or a small number of goals from a pool of all other potential goals. In this dissertation, I have argued that an individual's timely use of specific serendipitous actions transform unexpected, non-normative events into opportunities for positive development; thus, in serendipitous

relations, the individual chooses to invest his or her limited resources in one unexpected opportunity rather than, hypothetically, in all other opportunities. This choice introduces a complexity: even if a serendipitous relation is mutually-beneficial for person and context, it represents an investment of resources that may have been better-used on a prior or future opportunity. Thus, qualitative analysis of memoirs or autobiographical statements could illustrate the types of serendipitous relations that still result in individuals feelings of *Sehnsucht*, or, alternatively, the characteristics of individuals who engage in serendipitous relations but still long to have taken an alternative path.

Conclusions and Implications

The overarching goal of this dissertation was an attempt to understand how an individual's intentional actions and unexpected, non-normative events coact to create serendipitous sources of positive development. In the second chapter, I described a model of this process, termed the 3U model of serendipitous relations, where an individual uses specific serendipitous self-regulatory actions to identify, explore, and capitalize on unexpected opportunities for positive development. Using this model as a foundation, I hypothesized that use of these serendipitous actions would lead to serendipitous relations between person and context. I also hypothesized that serendipitous relations would be important sources of positive development for individuals progressing through life transitions.

The results of a series of latent variable analyses served to provide preliminary support for these hypotheses. Using a cross-sectional sample of

American high school and post-secondary enrolled students, results indicated that higher levels of serendipitous actions were associated with higher levels of adaptive development, as indexed by PYD, in high school. In addition, results from longitudinal cross-lagged panel model analyses, that used sample of American high school and post-secondary students, indicated that variability in the rank order of serendipitous actions from high school to post-secondary education was associated with variability in the rank order of PYD across the same important life transition. Taken together, these findings suggested that serendipitous actions may be important and understudied means for individuals to promote their own positive development.

These findings represented only an initial “proof of concept” of the study of serendipitous relations, and should be improved upon in future work. Truly assessing the role of serendipitous relations across the life span will require employing a variety of methodological techniques, collecting data from a wide range of diverse samples, and collaborating with colleagues both interdisciplinarily and across various developmental foci. For instance, while I devoted some time to describing the serendipity’s etymology, future work would benefit from extended collaboration with scholars in philosophy or the humanities to consider refinement of the concepts formulated in the present research. In addition, I believe that serendipitous relations may be an important lens through which to study career development. Future work should integrate the concepts of serendipitous actions and relations into the existing research on the role of chance events or happenstance in vocational development (e.g., Hirschi, 2010;

Krumboltz, 2009). Finally, consistent with a key hypothesis of this work, future research should examine the ways serendipitous actions may promote adaptive development during periods of transition or uncertainty across the life span. For example, future research could examine the role of serendipitous actions during the transition to the workforce, during a period of unexpected employment, or when an individual begins retirement.

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Table 1

A comparison of the serendipitous relations of Dr. Lewis Thomas, Dr. Aaron Kellner, Louis Leakey, and Mary Leakey (from Barber & Fox, 1958 and Leakey, 2010)

Serendipitous action	Serendipitous relations phase	Dr. Kellner	Dr. Thomas	Louis Leakey	Mary Leakey
Serendipitous orientation	Unexposed	Not in this case	Yes	Yes, after injury	Yes
Identification of unexpected event	Uncovering	Yes	Yes	Yes	Yes
Provisional investment of resources	Uncovering	No, continued to work on prior goal	Yes, investigated ears	Yes, but very briefly	Yes, at two time points
Prior goal disengagement	Unlocking	No, continued to work on prior goal	Yes, dropped earlier research	Yes, quit theological studies	Yes, searched for footprints
Extended investment of resources	Unlocking	No, not on emergent goal	Yes, over several years	Yes, over career	Yes, in footprint dig
Outcome	----	No discovery due to floppy ears	Important scientific contribution due to floppy ears	Influential career	Important discovery

*Based on Barber and Fox (1958) and Leakey (2010)

Note: ISR = Intentional self-regulation

Table 2

Means, standard deviations, and number of participants for all items in each sample

<i>Item</i>	HS <i>M</i>	HS <i>SD</i>	HS <i>n</i>	PS <i>M</i>	PS <i>SD</i>	PS <i>n</i>	PSC <i>M</i>	PSC <i>SD</i>	PSC <i>n</i>
Freq. 1	2.94	1.23	696	3.04	1.21	444	3.30	1.01	158
Freq. 2	3.14	1.15	693	3.24	1.11	444	3.25	1.02	157
Freq. 3	3.64	1.22	693	3.59	1.17	443	3.78	1.11	157
Pos. 1	3.99	0.96	602	4.13	0.84	397	4.39	0.74	152
Pos. 2	3.83	1.07	649	3.97	1.03	414	4.18	1.02	152
Pos. 3	4.07	0.96	656	4.24	0.90	423	4.46	0.77	155
Inf. 1	3.65	0.92	600	3.68	0.84	393	3.67	0.77	150
Inf. 2	3.62	1.01	647	3.70	0.95	412	3.67	0.90	151
Inf. 3	3.78	0.96	655	3.89	0.86	423	3.83	0.88	152
S.Act 1	3.19	0.82	685	2.91	0.78	432	2.77	0.89	155
S.Act 2	3.05	0.87	681	2.89	0.77	434	2.52	0.92	157
S.Act 3	---	---	---	2.77	0.79	434	2.60	0.82	156
S.Act 4	---	---	---	2.62	0.80	431	2.24	0.77	155
S.Act 5	---	---	---	2.78	0.85	436	2.62	0.86	154
SOC 3	.666	.051	681	0.81	0.40	438	0.79	0.41	154
SOC 5	.627	.050	681	0.66	0.48	434	0.48	0.50	152
SOC 7	.383	.058	676	0.66	0.48	433	0.69	0.46	150
SOC 8	.639	.048	673	0.72	0.45	434	0.60	0.49	154
SOC 10	.802	.046	672	0.83	0.37	434	0.76	0.43	152
SOC 13	.463	.052	677	0.54	0.50	436	0.41	0.49	152
SOC 15	.620	.052	672	0.81	0.39	433	0.77	0.42	151
SOC 17	.527	.058	675	0.82	0.38	431	0.83	0.38	152
SOC 18	.289	.061	667	0.61	0.48	436	0.54	0.50	151
Competence	.450	.037	691	3.58	0.62	442	3.32	0.61	168
Confidence	.591	.033	690	4.00	0.63	443	3.82	0.57	172
Character	.546	.036	700	3.65	0.58	442	3.63	0.56	180
Caring	.401	.041	699	4.29	0.62	441	4.08	0.68	166
Connection	.650	.033	670	3.97	0.56	443	3.80	0.56	170

Table 3

Full text of the serendipitous actions, frequency, positivity, and influence items for the HS sample

<i>Item Text</i>	<i>Scale</i>	<i>Dimension</i>
In the past 30 days how often have you...		
Met a person you had not anticipated meeting?	Never – Once a week	Frequency
Had an experience you had not expected to have?	Never – Once a week	Frequency
Learned something you had not planned to learn?	Never – Once a week	Frequency
In the past 30 days how positive was:		
Meeting a person you had not anticipated meeting?	Does not apply; Negative – Positive	Positivity
Having an experience you had not expected to have?	Does not apply; Negative – Positive	Positivity
Learning something you had not planned to learn?	Does not apply; Negative – Positive	Positivity
In the past 30 days how much did you change your relationships, schedules, interests, attitudes, or goals based upon:		
Meeting a person you had not anticipated meeting?	Does not apply; Negatively – Positively	Influence
Having an experience you had not expected to have?	Does not apply; Negatively – Positively	Influence
Learning something you had not planned to learn?	Does not apply; Negatively – Positively	Influence
Fill in only one box for each pair of sentences		
Some teenagers are able to take advantage of chance events in life (such as meeting a mentor, or hearing about an exciting job).		
OR	<i>Sort of true for me – Really true for me</i>	Orientation
Other teenagers sometimes miss these opportunities while focused on other things.		
Some teenagers find it hard to invest time and energy in opportunities coming from chance events.		
OR	<i>Sort of true for me – Really true for me</i>	Orientation
Other teenagers often use chance events to improve parts of their lives.		

Table 4
Standardized item loadings and standard errors for all indicators in each sample

<i>Item</i>	<i>HS Loading</i>	<i>HS S.E.</i>	<i>PS Loading</i>	<i>PS S.E.</i>	<i>PSC Loading</i>	<i>PSC S.E.</i>
Freq. 1	.812	.039	.732	.041	.725	.063
Freq. 2	.831	.038	.864	.035	.884	.065
Freq. 3	.734	.045	.868	.041	.750	.077
Pos. 1	.743	.034	.662	.041	.537	.078
Pos. 2	.676	.036	.676	.041	.786	.071
Pos. 3	.735	.037	.703	.043	.740	.069
Inf. 1	.709	.033	.717	.037	.637	.070
Inf. 2	.773	.033	.826	.030	.744	.065
Inf. 3	.859	.034	.803	.035	.937	.068
S.Act 1	.675	.023	.760	.036	.830	.064
S.Act 2	.640	.022	.772	.034	.756	.064
S.Act 3	---	---	.530	.049	.425	.078
S.Act 4	---	---	.711	.041	.670	.076
S.Act 5	---	---	.622	.045	.553	.069
SOC 3	.666	.051	.751	.067	.480	.127
SOC 5	.627	.050	.551	.071	.499	.113
SOC 7	.383	.058	.364	.077	.244*	.128
SOC 8	.639	.048	.724	.064	.702	.092
SOC 10	.802	.046	.704	.067	.612	.111
SOC 13	.463	.052	.557	.064	.262**	.115
SOC 15	.620	.052	.623	.069	.723	.099
SOC 17	.527	.058	.621	.067	.807	.094
SOC 18	.289	.061	.456	.071	.279**	.120
Competence	.450	.037	.499	.046	.309***	.097
Confidence	.591	.033	.549	.041	.401	.085
Character	.546	.036	.568	.045	.547	.087
Caring	.401	.041	.280	.055	.265***	.095
Connection	.650	.033	.750	.035	.537	.084

* = $p > .05$; ** = $p < .05$; *** = $p < .01$

Table 5

Factor reliability estimates, as calculated by ω , for each factor in each sample

Factor	Sample		
	HS	PS	PSC
Frequency	.84	.86	.83
Positivity	.76	.72	.73
Influence	.83	.83	.82
Ser. Actions	.60	.88	.87
SOC	.92	.93	.90
PYD	.76	.76	.83

Table 6
*Fit statistics for configural, weak, and strong invariance models using HS, PS,
 and PSC data*

Test	MFF χ^2	df	CFI	NNFI	Change CFI
Alternative null	9521.059	1930			
Configural invariance	2087.956	1625	0.939	0.928	
Weak invariance	2117.079	1666	0.941	0.931	-0.002
Strong invariance	2202.511	1691	0.933	0.923	0.008

Table 7

Standardized latent correlations among all factors in strong invariance model for the HS, PS, and PSC samples

Factor	1	2	3	4	5	6	7	8	9	10	11	12
1. HS Freq.	1											
2. HS Pos.	.396 ^{***}	1										
3. HS Inf.	.299 ^{***}	.679 ^{***}	1									
4. HS Ser. Act.	.301 ^{***}	.463 ^{***}	.404 ^{***}	1								
5. HS SOC	.173 ^{**}	.220 ^{***}	.289 ^{***}	.573 ^{***}	1							
6. HS PYD	.234 ^{***}	.524 ^{***}	.458 ^{***}	.737 ^{***}	.679 ^{***}	1						
7. PS Freq.	.477 ^{***}	.277 ^{***}	.170 [*]	.374 ^{***}	.112	.190 [*]	1					
8. PS Pos.	.200 [*]	.485 ^{***}	.330 ^{***}	.369 ^{***}	.060	.501 ^{***}	.456 ^{***}	1				
9. PS Inf.	.212 [*]	.410 ^{***}	.329 ^{***}	.283 ^{**}	.127	.453 ^{***}	.391 ^{***}	.766 ^{***}	1			
10. PS Ser. Act.	.219 ^{**}	.249 ^{**}	.191 [*]	.548 ^{***}	.244 ^{**}	.432 ^{***}	.385 ^{***}	.471 ^{***}	.427 ^{***}	1		
11. PS SOC	.008	.163	.184	.481 ^{***}	.658 ^{***}	.591 ^{***}	.093	.183 ^{**}	.199 ^{**}	.330 ^{***}	1	
12. PS PYD	.128	.209 [*]	.147	.589 ^{***}	.463 ^{***}	.766 ^{***}	.231 ^{***}	.500 ^{***}	.437 ^{***}	.580 ^{***}	.529 ^{***}	1

PSC Sample

Factor	1	2	3	4	5	6
1. PSC Freq.	1					
2. PSC Pos.	.485 ^{***}	1				
3. PSC Inf.	.223 [*]	.586 ^{***}	1			
4. PSC Ser. Act.	.177	.361 ^{***}	.333 ^{***}	1		
5. PSC SOC	-.071	.276 [*]	.089	.418 ^{***}	1	
6. PSC PYD	.272 [*]	.474 ^{***}	.302 ^{**}	.422 ^{***}	.615 ^{***}	1

$p < .001 = ***$, $p < .01 = **$, $p < .05 = *$

Table 8

Iterative model fit and single df χ^2 difference test values for HS sample cross-sectional SEM

Iteration	Beta removed	df	χ^2	$\Delta\chi^2 p$ value
Initial	†	271	575.644	***
1	HE Inf.	272	575.586	.660
2	HS Freq. † †	273	575.620	.103

† Initial model predictors of HS PYD included: HS SOC, HS serendipitous actions, HS frequency, HS positivity, and HS influence.

† † Final model predictors of HS PYD included: HS SOC, HS serendipitous actions, and HS positivity

Table 9

Iterative model fit and single df χ^2 difference test values for cross-lagged panel SEM

Iteration	β removed	df	χ^2	$\Delta\chi^2 p$ value
Initial	†	1286	1742.837	***
1	PS Freq.	1287	1742.680	.995
2	HS Serend. Act.	1288	1742.592	.317
3	PS Inf.	1289	1742.987	.317
4	HS Freq.	1290	1741.709	.853
5	HS SOC	1291	1740.940	.647
6	PS SOC	1292	1739.701	.285
7	HS Inf.	1293	1740.708	.271
8	PS Pos.	1294	1742.930	.056
9	HS Pos. † †	1295	1754.183	.009

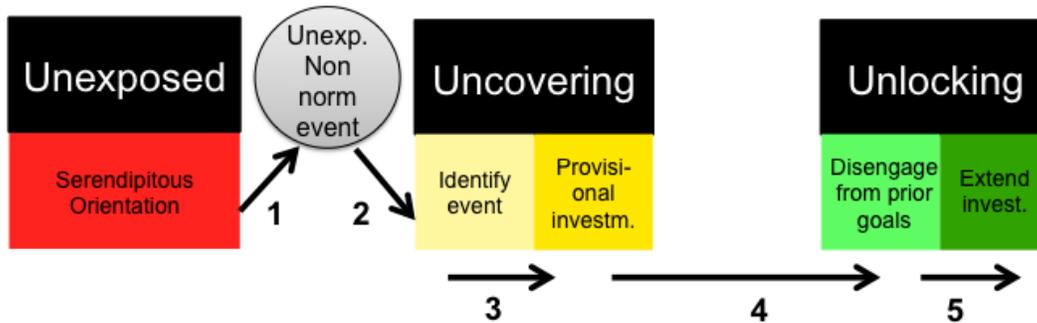
† Initial model predictors of PS PYD included: HS PYD, HS SOC, HS serendipitous actions, HS frequency, HS positivity, HS influence, PS SOC, PS serendipitous actions, PS frequency, PS positivity, and PS influence.

† † Final model predictors of PS PYD included: HS PYD and PS serendipitous actions

Figure 1

A description of a typically progressing serendipitous relation, as organized in the “3U” model

Typical progression of “3U” model of serendipitous relations



1. A serendipitously oriented individual increases his or her likelihood to encounter positive, unexpected non-normative events
2. Such an event occurs
3. The individual identifies that event as being potentially gains-laden, and makes provisional investments in the emergent goal
4. These provisional investments return greater gains than prior investments; the individual disengages from prior goals
5. To unlock the maximum potential gains from the goal, the individual extends ISR investments

Appendix 1, Section A

Time-lag-as-moderator analyses

Time-lag-as-moderator analyses involved regressing an outcome on interaction terms. At the time of this writing, concurrently modeling several interaction terms in Mplus is a computationally intensive task. Therefore, before undertaking these analyses using latent models, I conducted a probe of these moderation terms using ordinary least squares (OLS) regression. Rather than developing a parsimonious OLS regression model, the goal for this probe was instead to efficiently identify promising lag-moderated effects for later investigation using latent approaches. Using SPSS 21, I created scale scores for each factor in the strong invariant model, and then created interaction terms using HS predictor scale scores and participants' time lag values. I then regressed PS PYD on the interaction terms and their constituent HS and PS scales as main effects, in addition to also regressing on participant sex and time lag. Following this initial model, I iteratively pruned non-significant predictors from subsequent models.

Since OLS regression assumes perfect reliability of indicators, the parameters for this probe were necessarily going to be biased (e.g., Busemeyer & Jones, 1983). This inherent limitation in OLS regression required an alternate, more conservative criterion for identifying potentially promising lag-moderated factors. To account for this bias, I established the cutoff for pruning parameters in the OLS regression at $p < .25$. This conservative cutoff served to identify interactive effects that had any potential to be significant predictors as factors in a

latent model. If any lag-moderated effects remained in the final model, they were included in latent analyses.

If an interaction term (or terms) passed this criterion, it was (or they were) added to a model identical to the initial cross-lagged panel design, with the additional main effect parameter of time lag. After this initial model, I pruned non-significant terms until a final, parsimonious model was achieved. I modeled lag-moderated predictor(s) using the *xwith* command in Mplus. Models with interaction terms cannot be estimated using a least-squares-based approach; therefore, the latent models used a robust maximum likelihood estimator (MLR) and utilized a Monte Carlo integration algorithm with 500 integration points.

Models calculated in this way do not provide the standard relative fit indices used in prior analyses. Differences in model fit between pruned models were tested in terms of Δ Satorra-Bentler scaled χ^2 (1988; $p < .001$ for significantly different models), as calculated through the models' log-likelihood values.

Appendix 1, Section B

Time-lag-as-moderator results

As indicated above, testing for moderating time lag effects using latent analyses was contingent upon identifying promising lag-moderated effects in a probe based in OLS regression using a conservative cutoff for significance ($p < .25$). The initial model included 19 predictors: 11 HS and PS predictors as main effects, six interaction effects, and main effects for time lag and participant sex.

Over several iterations, I pruned non-significant ($p > .25$) predictors of PS PYD. The final parsimonious model included eight significant predictors: the HS serendipitous actions time-lag predictor (SAxL; standardized $\beta = -.707$, $p = .144$) HS serendipitous actions (standardized $\beta = .598$, $p = .172$), HS PYD (standardized $\beta = .433$, $p < .001$), PS serendipitous actions (standardized $\beta = .181$, $p = .003$), PS influence (standardized $\beta = .192$, $p = .001$), PS SOC (standardized $\beta = .154$, $p = .009$), participant sex (standardized $\beta = .148$, $p = .007$), and time lag (standardized $\beta = .287$, $p = .237$). Since SAxL met the specified criterion, it was assessed using latent analyses. Table 10 provides the removed predictors, their p values, and the adjusted R^2 for each iterative step in these analyses.

 Insert Table 10 about here

Time lag as moderator – Latent modeling

The latent time-lag analyses were based in the initial model of the cross-lag panel analyses, which had acceptable fit ($\chi^2_{(df=1286)} = 1742.837$, $p < .001$;

RMSEA 90% Confidence Interval = .017 – .022; CFI: .93; TLI: .92). This first model, included the additional SAxL term as in the earlier described parameters produced an AIC = 26492.254, and log-likelihood = -13002.127, and included several non-significant predictors of PS PYD. I iteratively pruned these non-significant predictors, and tested for significant differences in model fit by assessing Δ Satorra-Bentler scaled χ^2 ($p < .001$).

SAxL was pruned in the fourth iteration of these analyses. The lag-moderated term's removal did not result in significant differences in model fit, as calculated by Satorra-Bentler scaled χ^2 ($p = .543$). As in the final cross-lagged panel model, the final model for these analyses included within-time PS serendipitous actions ($\beta = .412, p = .001$) and across-time HS PYD ($\beta = .646, p < .001$) as predictors of PS PYD. These results, coupled with the findings from the OLS probe, suggest that time lag does not moderate the relations between PS PYD and the HS predictors in this sample. Table 11 provides the removed predictors and Satorra-Bentler scaled χ^2 difference test p values for each iterative step in these analyses.

 Insert Table 11 about here

Table 10
Pruned parameters, p values, and model fit information for OLS regression probe iterations

Iteration	β removed	<i>p</i> value	Adjusted R²
Initial	†	***	.41
1	HS PYD x L	.979	.41
2	PS Pos.	.961	.42
3	HS Pos. x L	.883	.42
4	HS SOC x L	.827	.42
5	HS SOC	.520	.43
6	HS Pos.	.565	.43
7	HS Inf. x L	.373	.43
8	HS Inf.	.649	.43
9	HS. Freq. x L	.374	.45
10	HS Freq.	.548	.45
11	PS Freq.	.380	.45

† Initial model predictors of PS PYD included: HS PYD, HS SOC, HS serendipitous actions, HS frequency, HS positivity, HS influence, PS SOC, PS serendipitous actions, PS frequency, PS positivity, and PS influence; lag-moderated interaction terms for HS PYD, HS SOC, HS serendipitous actions, HS frequency, HS positivity, HS influence; and main effects for participant sex and time lag

† † Final model predictors of PS PYD included: HS PYD, HS serendipitous actions, PS SOC, PS serendipitous actions, PS influence, the lag-moderated interaction terms for HS serendipitous actions, and main effects for participant sex and time lag

Table 11
Satorra-Bentler scaled χ^2 difference test p values for iterations of time-lag latent analyses

Iteration	β removed	Δ Satorra-Bentler scaled χ^2 p value
Initial	†	
1	HS Pos.	*
2	PS Pos.	.963
3	SAXL	.545
4	HS Ser. Act.	.596
5	PS Inf.	.454
6	PS Freq.	.458
7	HS Freq.	.495
8	HS Inf.	.594
9	Lag	.064
10	HS SOC	.004
11	PS SOC	.055
12	PS Ser. Act. † †	<.001

† Initial model predictors of PS PYD included: HS PYD, HS SOC, HS serendipitous actions, HS frequency, HS positivity, HS influence, PS SOC, PS serendipitous actions, PS frequency, PS positivity, and PS influence; lag-moderated interaction term for serendipitous actions (SAXL); and main effects for participant sex and time lag

† † Fails Δ Satorra-Bentler scaled χ^2 test; Final model predictors of PS PYD included: HS PYD and PS serendipitous actions

* The exact value (which approaches 1) is not provided because Mplus rounds the log-likelihood values in the output to three decimal places