INTRODUCTION

The novelist Mark Twain (1835–1910) once said that "time cools, time clarifies; no mood can be maintained quite unaltered through the course of hours." This observation captures an inherent characteristic of mood and affect, namely that rather than representing static entities and persisting dispositions only, states of well-being undergo fluctuations across time. In everyday life, this approach to well-being is likely to be very salient. Conversations often start by asking one another how life is going. Individuals tend to report having so-called good days or bad days, and this judgment often includes an assessment of mood as well as daily experiences, including achievements and failures, joyful events as well as frustrating or sad ones. In other words, subjective well-being is a phenomenon that can be examined from various levels: Individuals differ from one another in terms of their *average levels* of mood and well-being (e.g., Myers & Diener, 1995; Ryff, 1995). Individuals may also differ from one day to the next in how they feel, and in turn individuals may differ from one another with respect to these *fluctuations* in their everyday emotional well-being. Some people report more frequent and more pronounced mood swings than other people.

These anecdotal observations correspond to empirical evidence with mainly young adults about the occurrence of and individual differences in fluctuations in subjective well-being (Eid & Diener, 1999, Watson, Wiese, Vaidya, & Tellegen, 1999) across very short-term time frames, such as hours, and slightly longer ones, such as from day to day or week to week. In addition, there is experimental evidence on a variety of effects of mood on performance that correspond to the implicit view often voiced in everyday life that "having a bad day" entails not only a mood but also performance evaluations across a multitude of a day's challenges and tasks.

Theoretically, subjective well-being (SWB) is portrayed as a multidimensional construct, which includes cognitive evaluations of satisfaction with life in general and particular life domains as well as emotional components indicated by the frequency and intensity of positive and negative affects (Campbell, Converse, & Rodgers, 1976; Diener, 1984; Diener, Suh, Lucas, & Smith, 1999; Lawton, 1983; McGregor & Little, 1998; Ryan & Deci, 2001; see also Ryff, 1989, 1995). SWB is a central concept in lifespan psychology (Baltes & Baltes, 1990; Baltes, Lindenberger, & Staudinger, 2006). The degree of fit between an individual's potential and readiness and the demands of the environment is thought to be reflected in an individuals' average level of subjective well-being: Well-being is higher when the person-environment fit is better (Baltes & Baltes, 1990; Freund & Riediger, 2003; Ryff, 1989). Beyond general questions of person-environment fit, short-term intraindividual variability or fluctuation in well-being is viewed in lifespan developmental psychology as a key indicator of the plasticity and adaptive

capacity of the psychological system (Baltes et al., 2006; Nesselroade, 1991b; Siegler, 1994, 2002; see Section 1.1.1). Age-related differences in observed intraindividual variability point to normative and idiosyncratic changes in the orchestration of behavior and generate questions about the functionality of such fluctuation.

This dissertation focuses on the daily dynamics of two central dimensions of emotional well-being: positive affect (PA) and negative affect (NA). Both components are thought to encompass distinct functions: PA is considered to be a representation of one's level of pleasurable engagement with the environment, whereas NA is thought to represent one's level of general distress (e.g., Watson, Clark, & Tellegen, 1988). The present study addresses three concerns about the (self-reported) experience of PA and NA that have received relatively little attention in the lifespan developmental literature: (a) Age-related differences in the stable as well as the dynamic characteristics of day-to-day affect, (b) trait-like and state-like correlates of affect variability in young and older adults and the predictive value of age over and above personality in predicting affect variability, and (c) age-related differences in the associations between affect variability and cognitive performance. These three issues were examined in the context of a micro-longitudinal study, in which a group of young (20–30 years) and older (70–80 years) adults provided subjective ratings of positive and negative affect and objective cognitive performance measures on a day-to-day basis across up to 45 days.

This dissertation is organized as follows. First, I will give an overview of the central theoretical and empirical work that motivated the current study. In the second chapter, I will outline the three research questions and hypotheses. After a description of the methods in the third part, including a summary of the analytical approach, I will present the results for each of the three research questions about intraindividual variability in positive and negative affect. Finally, I will conclude with a discussion of these findings with respect to previous work and the hypotheses, including an overview of the study's strengths and limitations, and an outlook for future directions of research.

1. THEORETICAL BACKGROUND

This chapter outlines the theoretical and empirical work that motivated the current dissertation and from which research questions and hypotheses were derived. It is divided into three main parts. In the first, the concept of intraindividual variability will be introduced, and its relevance for lifespan psychology in general as well as for the study of emotional well-being in particular. In the second part, patterns and correlates of such intraindividual variability in the specific domains of positive affect and negative affect (PA and NA, respectively) in young and older adults will be reviewed, including a discussion about individual differences in functionality or dysfunctionality of variability in affect. The last section of the chapter reviews the relevant literature pertaining to the coupling of PA and NA and cognitive performance at the level of individuals in everyday life. The question is raised whether or not young and older adults show different patterns of associations consistent with lifespan psychological notions of age-related differences in resource allocation (Baltes, 1987; Baltes et al., 2006; Riediger, Li, & Lindenberger, 2006).

Before beginning the overview of previous theoretical and empirical work, two issues need to be mentioned. The first concerns some definitional clarifications. The terms emotion, affect, and mood are often used interchangeably in the literature. Emotions encompass distinct facial expressions, autonomic changes, adaptive behaviors as well as distinct subjective feeling states. Emotions are characterized by greater arousal levels than moods and affective states, and they tend to be rather short-lived reactions to a specific cause, whereas moods and affective experiences are more enduring and diffuse broad subjective feeling states that are not specifically directed towards any particular object, target, or behavior (e.g., Forgas, 1995; Isen, 1984; Moore & Isen, 1990; Watson, 2000a). In this dissertation, the primary focus is on momentary experiences within the everyday ebb and flow of moods and affective states as representations of emotional well-being. The term emotional well-being will be used to refer to the overall construct, whereas the terms mood states and positive and negative affect will be used interchangeably to refer to the subjective (i.e., self-reported) feeling states that represent specific components of emotional well-being in everyday life (Larsen & Diener, 1992; Watson et al., 1988).

The second issue concerns the meaning and measurement of positive and negative affect. These two terms are currently used in the literature to describe a wide range of positively and negatively valenced emotion and mood adjectives. To date, a debate about the correct rotation, labeling, and substance of these affect domains is still ongoing (e.g., Russell & Carroll, 1999; Watson, 1988b). Researchers adhering to the bipolarity view consider the positive aspects of

mood to be the opposite of negative affective feelings. They argue for the use of the unrotated factors that are typically labeled pleasantness/unpleasantness and arousal (engagement; e.g., Barrett & Russell, 1998; Feldman, 1995; D. P. Green & Salovey, 1999). The pleasantness/unpleasantness dimension tends to be represented by items such as happy and content on the positive side and items such as sad and blue on the negative side. The two poles of the arousal or engagement dimension are represented by items such as quiet and still on one end and items such as aroused and astonished on the other end. The circles in Figure 1.1 characterize this perspective. Proponents of the alternative view suggest the use of varimax rotation on the initial two factor solution, resulting in two independent factors often called positive affect and negative affect (e.g., Tellegen, Watson, & Clark, 1999; Watson & Clark, 1997). In this perspective, positive affect is characterized by items such as active, excited, and strong. Positive affect is considered to represent an affective dimension distinct from negative affect, which is characterized by items such as jittery, hostile, or nervous. This model of affect structure is represented by the squares in Figure 1.1.

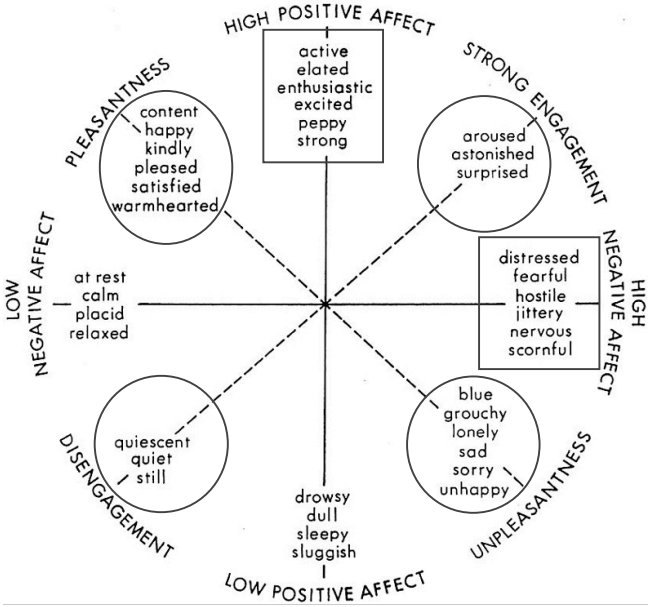

Figure 1.1. The Circumplex Model of Emotion as Proposed by Watson & Tellegen (1985)

Watson and colleagues (1999) renamed Positive Affect (PA) and Negative Affect (NA) into Positive Activation and Negative Activation. As can be seen, in this model, high PA and high NA are proposed as two independent dimensions, whereas pleasantness–unpleasantness represent the endpoints of one bipolar dimension. Items in squares are a selection of those assessed by the Positive and Negative Affect Scale (PANAS; Watson et al., 1980). Items in circles are a selection of those that Larsen, Diener, and colleagues consider to measure hedonic tone better than the PANAS scales, and which lay individuals consider to more adequately capture happiness/unhappiness (cf. Larsen & Diener, 1992; Larsen & Kasimatis, 1991).

In previous work, researchers have used a variety of items to assess the emotional components of well-being, but have often subsumed these under the terms of positive and negative affect. For simplicity of presentation, in the following theoretical overview, the terms positive and negative affect are used to refer to both high and low arousal emotion and mood terms. As will be introduced in the Method chapter, selection of instruments for the assessment of positive and negative affect was carefully guided by the goal to assess a broad range of mood adjectives and to better distinguish between the different dimensions of positive and negative moods. Therefore, a slight differentiation in terminology will be introduced to facilitate presentation of results.

1.1 The Lifespan Study of Intraindividual Variability: A New Look at Emotional Well-Being

Why study intraindividual variability in the first place, and why study it in the context of well-being? In one of his central papers on intraindividual variability, Nesselroade (1988) stated "A person is many values at the same time, some of which are quite temporary" (p. 166). In other words, individuals are characterized by a multitude of features. Some of these features remain rather stable across time and across situations, whereas others are more transitory in nature, fluctuate, or undergo more or less permanent changes, which may occur across various time frames and contexts. Because of this, it is important to study behavior over time so as to adequately capture the potential range of psychological functioning in an individual's repertoire. This is particularly true with respect to subjective appraisals of well-being. Some individuals may, on average, be happier than other individuals (e.g., Myers & Diener, 1995). In this situation, the average level of well-being is considered a trait-like feature that distinguishes one individual from another. On the other hand, apart from a general trait-like level of well-being, some moments or days tend to be happier than other moments or days, suggesting that mood and emotional well-being have quite transitory aspects as well (e.g., Eid & Diener, 1999; Watson et al., 1999). In order to gain a complete understanding of the psychological well-being of an individual, and how individuals differ in terms of well-being, it is necessary to examine both the enduring and the transitory qualities of subjective emotional well-being.

This first section of this chapter is intended to give a historical overview of the conceptual and empirical underpinnings of the phenomenon of intraindividual variability. To better structure this overview, this section is divided into two parts, representing the two main streams of research on variability: The first one is concerned with a developmental or lifespan

psychological perspective, the second one adds to this from a personality and individual difference perspective.

At the outset, it should be mentioned that several taxonomies of intraindividual variability have been advanced several decades ago (Cattell, 1957a; Fiske & Rice, 1955; Wohlwill, 1970). Recently, researchers have proposed extensions or reformulations of these early taxonomies, reflecting the continuing contemporary relevance and interest in the phenomenon and its various facets (Li, Huxhold, & Schmiedek, 2004; Lindenberger & Oertzen, 2006; see Table A1 in Appendix A, for an overview on the different taxonomies). Drawing also upon the early work, Nesselroade (2001) distinguished two types of variability. In his taxonomy, he explicitly acknowledges a developmental perspective on the phenomenon of within-person variability, which is why his perspective is briefly discussed here as representative of the others: The first type of variability is represented in potentially reversible within-person changes (e.g., mood, fluctuation), whereas the second refers to potentially less reversible changes indicative of development (e.g., learning, maturation). The two types are illustrated in Figure 1.2, which is taken from an earlier chapter (Nesselroade, 1991b) that focused on the distinction between variability as fluctuation and variability as change.

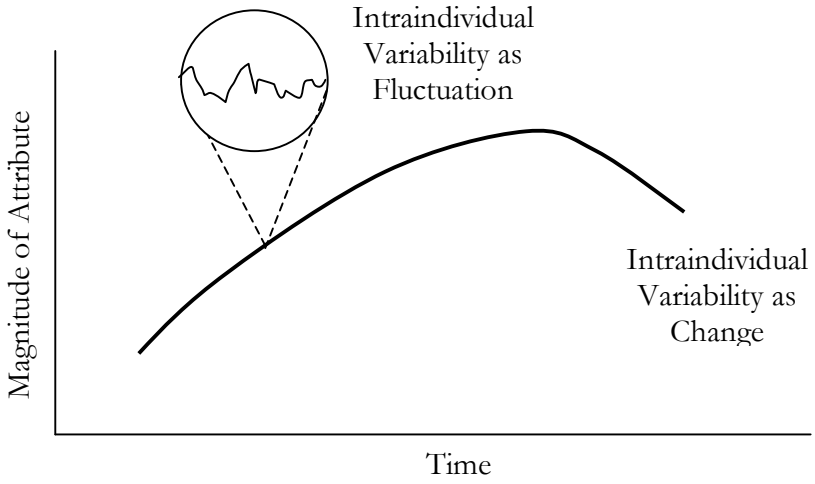

Figure 1.2. Schematic Representation of Intraindividual Variability as Fluctuation and as Change (modified from Nesselroade, 1991b, p. 215)

In the present dissertation, the focus is on intraindividual variability in terms of the first of these two types, namely relatively reversible short-term fluctuations, which Nesselroade (1988)

also referred to as the steady state "hum"[1]. Accordingly, the term intraindividual variability will be used throughout this dissertation as referring to relatively reversible fluctuations, unless otherwise specified. As will be discussed in the Results chapter, the distinction and separation of fluctuation from change is not only conceptually but also methodologically relevant.[2]

1.1.1 Lifespan Propositions Linked to Short-Term Intraindividual Variability

Several central lifespan theoretical propositions bear directly on the concept of intraindividual variability and underline its importance in understanding human development across various time levels (Baltes, 1987; Baltes et al., 2006; Lautrey, 2003; Nesselroade, 1991b). Table 1.1 gives an overview of these concepts and a summary of how they are proposed to link to the study of short-term intraindividual variability.

The proposition of *plasticity* denotes the idea that any given developmental pathway is but one manifestation of a multitude of possible pathways and in its given form a realization of an individuals' potential and his or her specific life contexts. Furthermore, plasticity represents the potentiality of development, and an examination of plasticity should focus both on the potential for malleability as well as its boundary conditions.

In this sense, studying interindividual and age-related differences in plasticity across different time scales is informative about the potentialities as well as the constraints of human behavior and development. Whereas longer time frames (e.g., months, years) allow for the study of variability in the sense of developmental change, variability occurring within individuals across shorter time frames (e.g., days) gives a sense of individual differences in the (range of) short-term plasticity, flexibility and regulative mechanisms but also the vulnerability of the system, offering a new perspective on development and on aging (e.g., Baltes, Reese, & Nesselroade, 1977; Miller, 2002; Nesselroade, 1988, 1991b; L. B. Smith & Thelen, 2003; Thelen, 1992). In child development, for example, fluctuation may indicate mechanisms underlying a transition phase between one level or stage of functioning and another ontogenetically higher one. Siegler (1994, 2002) reviews evidence for systematic intraindividual variability in the development of a number

[1] Cattell (1957b) further differentiated concepts of variability, which are based on temporal covariation. He distinguished between function fluctuant states, and purely fluctuant states. The former are described as states of traits, which form a within-person factor by temporal coupling and are related to individual differences in mean levels of the corresponding trait. The latter, on the other hand, do not form a within-person (i.e., P-technique) factor that is related to a corresponding trait.

[2] However, although fluctuation itself may be reversible, its characteristics are thought to reflect developmental differences in the adaptive capacity of the psychological system of individuals. Consider, for example, the scenario that older adults show a greater range of fluctuation than do young adults in negative affect but not in positive affect. This difference in short-term variability might be contingent upon the laboratory assessment context of our observations and thus be reversible at the end of the study. At the same time, it could reflect development-related constraints in the regulation of emotions in a novel and stressful context.

of cognitive skills such as memory strategies, conceptual development, and problem-solving skills. This type of variability often precedes a qualitative developmental shift. Van Geert and van Dijk (2002), for example, found that intraindividual variability is a key characteristic of individual differences in language learning in infants. In another short-term longitudinal study, de Weerth, van Geert, and Hoijtink (1999) were able to show that fluctuations in infant behavior such as crying, fussing, and smiling decreases between the ages of 0–5 months to 10–15 months, possibly indicating changes in the mother-infant relationship and in communicative skills.

Table 1.1
Overview of Lifespan Theoretical Propositions Important for the Study of Short-Term Intraindividual Variability

Lifespan Theoretical Proposition	Link to Short-Term Intraindividual Variability
Plasticity	In addition to long-term change, short-term fluctuations represent individual differences in ▪ the malleability/flexibility of the psychological system ▪ the robustness/vulnerability of the system ▪ regulative mechanisms
Multidirectionality	▪ Development is characterized by both stability and change, across different time scales. ▪ Both can only be understood in reference to one another. ▪ Age-related differences at any point in time are both due to differences in interindividual characteristics but also intraindividual variation.
Gains & Losses	▪ Age-related differences in intraindividual variability may be indicative of changes in the gain-loss balance. ▪ Age-related differences in intraindividual variability may not form a uniform pattern across psychological domains, suggesting age-related gains in one domain (e.g., greater adaptive and regulatory capacity) and age-related losses (e.g., e.g., less functional stability) in another.
Contextualism (biological and environmental influences)	▪ Short-term fluctuations are driven by endogenous as well as exogenous factors. ▪ Domain-specific and age-related differences in intraindividual variability need to consider these different influences.

Note. Adapted from Baltes, 1987; Baltes et al., 2006; Nesselroade, 1991b

In old age, variability is often seen more as an indicator of a breakdown in the system or an indicator of decline in functioning (e.g., Li, Aggen, Nesselroade, & Baltes, 2001; Lipsitz, 1995, 2002; Lipsitz & Goldberger, 1992; Vaillancourt & Newell, 2002). Greater week-to-week fluctuations in perceived control was predictive of a greater mortality risk in older adults in the Cornwall Manor Studies (Eizenman, Nesselroade, Featherman, & Rowe, 1997; see also Section 1.3.2 for further discussion of the functional or dysfunctional nature of a great range of variability).

The proposition of *multidirectionality* refers to the idea that development is characterized by patterns of growth and decline across various attributes rather than being characterized primarily by one or the other. This proposition is important in light of a study of intraindividual variability because it acknowledges that individuals are best characterized by ongoing change and stability at any point in time, and hence both qualities should be examined and understood in reference to one another. As one example, examining age-related differences in intraindividual variability in the domain of emotional well-being is thought to enhance present knowledge on factors underlying the relative stability of well-being across the lifespan. The theoretical notion of multidirectionality may also include domain-specific differences in age-related changes in variability: Whereas in some domains of functioning, short-term within-person variability may increase with age, other domains may be best characterized by age-related decline in intraindividual variability (see also Section 1.2.3).

In close association with plasticity and multidirectionality, there is a third lifespan theoretical proposition, namely the notion that ontogenetic development is characterized by both *gains and losses*, and that it is the gain-loss ratio that will evidence diversity both within and across individuals (e.g., Baltes, 1987; J. Smith, 2003). Importantly for intraindividual variability is the idea that the pattern of within-person changes in variability may differ across domains of functioning at any point in time, suggesting gain in some domains and loss in other domains (Martin & Hofer, 2004; Nesselroade, 1991b). For instance, an increase in variability in a particular attribute could represent gain in that it may represent an increase in adaptive and regulatory capacity. An increase in variability in another attribute, however, may be construed as a loss in that it may signify a decrease in the system's functional homeostasis and consistency. Furthermore, domain-specific individual and age-related differences in the range of short-term fluctuations may be indicative of changes in the gain-loss balance and underlying motivations for the allocation of resources into the maintenance of this gain-loss balance. In the context of the lifespan meta-model of selective optimization with compensation (i.e., the SOC-model, Baltes & Baltes, 1990), a micro-level perspective on psychological functioning is useful to enhance understanding of the

processes of resource allocation as well as adaptation. This is particularly true from the standpoint that successful maintenance of psychological functioning in everyday life is an outcome of the successful management of multi-tasking demands, requiring an optimal orchestration of resources and demands across both short-term and long-term time frames (Baltes & Smith, 1999; Baltes et al., 2006).

Last, intraindividual variability (both in its conception as fluctuation and as change) unfolds within a *context*. Lifespan theory focuses on two meta-categories of contexts: biological and environmental influences that each have normative age-graded, normative history-graded, and non-normative aspects (Baltes et al., 1977; Baltes & Smith, 2004). Everyday contexts (e.g., family conflicts and joys, job-related stress and accomplishments, health events) can be viewed as manifestations of these meta-categories. The dialectics of these contextual influences are likely to vary across individuals but also across domains of functioning and across the different time frames under which one wishes to examine intraindividual variability. Different factors are likely to drive variability as fluctuation and variability as change, and these differences might vary further across different domains of psychological functioning. For example, neurophysiologic changes in the brain are thought to underlie the increasingly higher levels of variability in cognitive functioning with age (Li & Lindenberger, 1999). On the other hand, neurological deficits are less likely to underlie individual and age-related differences in variability in affect and mood (e.g., Strauss, MacDonald, Hunter, Moll, & Hultsch, 2002). These may rather be linked to differences in factors that are thought to be rather independent from biological changes, such as life style factors and emotion regulative abilities (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Schulz, 1982; see also Section 1.2.1 for further discussion of this issue with respect to variability in positive versus negative emotional well-being).

In sum, several key concepts of lifespan psychological theory, such as plasticity, multidirectionality, gains and losses, as well as contextualism, represent the theoretical framework and rationale for studying short-term intraindividual variability from a developmental psychological standpoint. As such, intraindividual variability can be linked to long-term change and stability to arrive at a more complete understanding of human development.

1.1.2 Intraindividual Stability and Variability as Central Characteristics of Individuals

Despite the theoretical importance of intraindividual variability for the study of psychological functioning, the prevailing emphasis in psychology has been on stable features that characterize individuals over stimuli, situations, and over time, and distinguish *between* different individuals at any point in time. In this regard, the "big five" personality dimensions, like

intellectual abilities, have all been considered to be stable characteristics of individuals. Tellegen (1988), for example, suggests that variability was considered in many models to reflect "low-traitedness" rather than an interesting characteristic of individuals. Likewise, affect is one aspect of psychological functioning that is thought to be closely related to individual differences in personality (e.g., Costa & McCrae, 1980; Hepburn & Eysenck, 1989; Watson & Clark, 1992). The emphasis on stability and traits rather than change and states has been reflected in study designs. Traditionally, these have, for the most part, consisted of single-occasion, cross-sectional assessment or, when focusing on change, *long-term* longitudinal studies with measurement points spaced at least months if not years apart. Recently, more and more researchers have conducted micro-longitudinal studies that extend a perspective restricted to snapshots of individual functioning to micro-level processes unfolding from moment-to-moment or day-to-day. As Eckenrode and Bolger (1995, p. 80) proposed, "measurement at the daily level affords the researcher with the equivalent of a behavioral science microscope."

In their classical paper on the importance of considering intraindividual variability as a meaningful person characteristic, Fiske and Rice (1955; see also Hoyer, 1974; Yan & Fischer, 2002) define intraindividual variability as the stable and lawful difference between an individual's two responses to the same stimuli in the same situation at two different points in time. They critically raise the problem that for a long time, short-term fluctuations (i.e., microdevelopment) have been merely treated as error of measurement or noise. Interestingly, as early as 1900, Stern (cf. Eid & Diener, 1999) pointed out that there are both stable and variable components to the self. Cattell (1952, 1957a, 1957b, 1966), a contemporary of Fiske and Rice, called for the need to study the "error" in order to understand its association with known influences and hence to no longer represent mere error. A number of authors have repeated Cattell's advice over the last 50 years (Baltes et al., 1977, 2006; Cervone, 2005; Guthke, Beckmann, & Wiedl, 2003; Nesselroade, 1988; Schroots & Yates, 1999). In his classical data-box heuristic, Cattell (1952, 1966) outlined the possible combinations of selecting data along the three dimensions of person, variable, and occasion, together with different covariation techniques (see Figure 1.3; see also Buss, 1971, for an early extension of the model into a developmental framework).

The integration of an idiographic (e.g., intraindividual variation) with a nomothetic (e.g., interindividual differences) approach corresponds to the central tenets of trait-state theories, which argue that both temporal (i.e., state) and dispositional (i.e., trait) features are fundamental to individuals' functioning (Mischel & Shoda, 1995; Nesselroade, 1988; Spielberger, 1972; see Steyer, Schmitt, & Eid, 1999, for review). In sum, in order to understand developmental processes, research designs and theories have to "put the process into developmental processes"

(Nesselroade & Schmidt McCollam, 2000, p. 295). Lifespan researchers have even suggested that intraindividual variability in psychological functioning should be the background or reference frame against which mean level differences ought to be compared to receive a more enriched picture of the complex and multidimensional nature of development and change across the lifespan (Cattell, 1957b; Featherman & Petersen, 1986; Nesselroade & Featherman, 1997). This would allow the researcher to obtain estimates of age-related differences and of change that are unconfounded by intraindividual state fluctuations (Nesselroade, 1988).

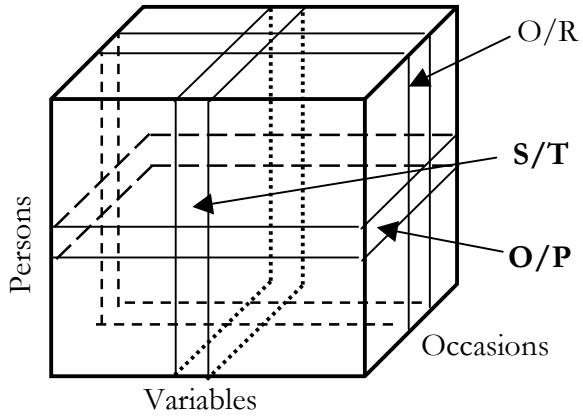

Figure 1.3. Cattell's (1952, 1966) Three-Dimensional Data-Box (Persons × Variables × Occasions)
The study of intraindividual variability is defined on the O/P and S/T slices, because both are characterized by multiple occasions of measurement. O/P (variables × occasions): multiple variables measured over time in one individual; S/T (persons × occasions): multiple persons measured on one variable over time.

The timelessness of these considerations is reflected in a number of recent conceptual-empirical papers bearing on the same topic, both in the domains of lifespan developmental psychology (e.g., Nesselroade & Ram, 2004; Nesselroade & Salthouse, 2004; Nesselroade & Schmidt McCollam, 2000; Salthouse & Berish, 2005; B. R. Williams, Hultsch, Strauss, Hunter, & Tannock, 2005) and personality psychology (e.g., Cervone, 2005; Cervone & Shoda, 1999; Fleeson, 2004; Stone, Shiffman, & DeVries, 1999; Tennen, Affleck, Armeli, & Carney, 2000; Vallacher, Read, and Nowak; 2002). For example, Hooker and McAdams (2003) have proposed a six-foci model of personality across the lifespan that incorporates the mapping of structures (i.e., traits, personal action constructs; between-person variance) with corresponding processes (i.e., states, self-regulation; within-person variance) from a lifespan developmental perspective (see also Mroczek & Spiro, 2003). Fleeson (2001) conceived of traits as representing density distributions of states. Others have considered behavior profiles across different situations to

represent personality signatures (e.g., Kammrath, Mendoza-Denton, & Mischel, 2005; Mischel & Shoda, 1995; see also Diener & Larsen, 1984). Yet another line of work has advocated the differentiation of different aspects of intraindividual variability as instances of interindividual difference characteristics (e.g., *flux, pulse,* and *spin*, see Moskowitz & Zuroff, 2004, 2005).

In addition to previous theoretical work, the last two decades have witnessed an impressive reversal of the relative dearth of empirical research on short-term intraindividual variability. A 1991 special issue in the Journal of Personality (e.g., Tennen, Suls, & Affleck, 1991) on personality and daily experience has recently been updated with a 2005 special issue, reflecting on the potential of idiographic analysis in microgenetic designs and future directions (e.g., Tennen, Affleck, & Armeli, 2005). In part, the increased interest and scientific output is associated with the advent of new measurement tools that have constantly been refined and extended (Brandstätter, 1977; Csikszentmihalyi, Larson, & Prescott, 1977; Fahrenberg, Leonhart, & Foerster, 2002) and statistical methods that facilitate considerations of micro-level processes and dynamic changes in both assessment and analysis (e.g., Bolger, Davis, & Rafaeli, 2003; Raudenbush & Bryk, 2002; Chow, Ram, Boker, Fujita, & Clore, 2005; Nesselroade & Ghisletta, 2003; Nezlek, 2001; Ram, Rabbitt, Stollery, & Nesselroade, 2005; Stone et al., 1999).

Specifically, a growing number of studies investigate short-term fluctuations in *affect, emotions, and stress* (e.g., Birditt, Fingerman, & Almeida, 2005; Carstensen et al., 2000; Eaton & Funder, 2001; Eid & Diener, 1999; Sheldon, Ryan, & Reis, 1996; Watson, 1988a; Watson et al., 1999; see Ferrer & Nesselroade, 2003, for examining affective processes at the dyadic level). In addition, intraindividual variability has also been examined in such diverse domains as *control beliefs* and *competence* (e.g., Eizenman et al., 1997; Musher-Eizenman, Nesselroade, & Schmitz, 2002; M. L. Roberts & Nesselroade, 1986), *self-efficacy* (e.g., Lang, Featherman, & Nesselroade, 1997), *self-esteem* (e.g., Gable & Nezlek, 1998; Kernis, Grannemann, & Mathis, 1991), *cognition* and *sensorimotor functioning* (e.g., Hultsch, McDonald, & Dixon, 2002; Li et al., 2001; B. R. Williams et al., 2005), *infant behavior* (e.g., de Weerth et al., 1999), *coping* (Schwartz, Neale, Marco, Shiffman, & Stone, 1999; Tennen et al., 2000), *chronic pain* and *physical symptoms* (e.g., Larsen & Kasimatis, 1990; Tennen & Affleck, 1996), as well as *cortisol secretion* in depression (e.g., Peeters, Nicolson, & Berkhof, 2004). Even behavioral manifestations of the Big Five personality factors have been investigated with respect to their day-to-day within-person fluctuations (e.g., Borkenau & Ostendorf, 1998; Fleeson, Malanos, & Achille, 2002).

The importance of intraindividual variability as an indicator of individual differences in the integrity of the psychological system has also become clear through research on the predictive utility of within-person variability for interindividual differences in health and mortality. In one

study, the short-term *in*stability (i.e., lability) in addition to lower mean levels of self-esteem was shown to predict risk for depression, rather than the average level of self-esteem by itself (e.g., Gable & Nezlek, 1998; Kernis et al., 1991). Furthermore, in the Cornwall Manor studies, short-term fluctuations in older adults' perceived control, not their average level of control, predicted mortality five years later (Eizenman et al., 1997).

1.2 Patterns of Within-Person Fluctuations in Affect in Young and Older Adults

After a definition of the concept of intraindividual variability from a lifespan psychological and individual difference perspective in the previous chapter, this section is intended to more specifically highlight empirical findings about patterns of variability in positive and negative affect in young and older adults. For structural clarity, the section is divided into four main parts, and empirical findings on age-related differences are highlighted if available in the literature. The first part focuses on variability in PA and NA across different time scales, showing that affect is not only a stable but also a variable phenomenon. The next section provides evidence for intraindividual variability in affect as a stable and systematic individual difference characteristic. Third, a brief overview is given of how within-person analyses can provide new insights into the debate on the structure of self-reported affect and mood. Finally, expectations about and initial evidence on age-related differences in the magnitude of variability will be reviewed. Despite a plethora of research on variability in affect, there are still open questions about age-related differences. Some of these questions are addressed in the present thesis.

1.2.1 Fluctuation in Emotional Well-Being Within and Across Days in Young and Older Adults

A central tenet of this thesis is that the affective components of well-being can be considered at two levels: as a relatively enduring disposition and as a relatively short-term reaction to daily events and physiological oscillations[3]. Studies on age-related differences and changes in well-being as a disposition have been rather numerous (e.g., Mroczek & Kolarz, 1998; Kunzmann, Little, & Smith, 2000). On the other hand, albeit the conceptual as well as

[3] In the present dissertation, 'short-term' versus 'long-term' are used to contrast relative differences in time frames. Long-term is used to refer to time periods of months and years, whereas short-term is used to refer to time periods of daily assessment. For instance, as opposed to a startle response, such as surprise, which may best be captured at a millisecond moment-to-moment level, the unit of a day is comparably long-term.

methodological interest in short-term fluctuations from a lifespan psychological perspective, only very few studies have begun to consider age-related differences in well-being as a short-term phenomenon in terms of intraindividual fluctuation. Most of what is known about these short-term dynamics of emotional well-being is derived from studies with young adults and a few studies on older adult samples, but studies have not encompassed samples consisting of individuals of different ages.

One of the earliest endeavors to understanding everyday mood and well-being was conducted by Wessman and Ricks (1966). Apart from the question of how people generally differ in terms of reported levels of happiness, they already focused on day-to-day variations in happy and unhappy mood within individuals. Two young adult samples participated each over a period of six weeks (i.e., 42 successive days), completing a questionnaire each night before bed. The authors found that, on average, participants felt "pretty good", but showed great interindividual differences in intraindividual variability patterns (operationalized as the within-person standard deviation across the study period). In this study, no regularity of these variability patterns could be observed, however.

This finding stands in marked contrast to other research in which a seven-day cycle of daily mood variability was reported on the basis of spectral analysis of daily variability data (Larsen & Kasimatis, 1990), as well as using other dynamical modeling techniques such as a damped oscillator model (Chow et al., 2005). Furthermore, based on the results of confirmatory factor analyses and estimated reliability coefficients for several emotion subscales, Eid & Diener (1999) showed that intraindividual variability in affect is not just random and unsystematic, but represented a distinct feature of individual's emotional experience (see also Yasuda, Lawrenz, van Whitlook, Lubin, & Lei, 2004).

In general, affect has been shown to vary in young and in older adults, not only from day to day, but also over the course of a single day (mirroring circadian rhythms), as well as on a weekly basis and also by season (Kleban, Lawton, Nesselroade, & Parmelee, 1992; Lawton, Parmelee, Katz, & Nesselroade, 1996; see Watson et al., 1999, for review of findings on young adults). A very parsimonious time frame in examining fluctuations in affect over the course of a day was used in a series of studies by Watson et al. (1999; see also Clark, Watson, & Leeka, 1989), all of which were conducted with college students rating their momentary or their daily mood either once or several times a day (every two waking hours) across periods of one to seven weeks. Patterns of within-day fluctuation of momentary positive affect (PA) and negative affect (NA) were quite different. Positive affect tended to "ebb and flow with the daily tide of events, whereas NA crashes upon us in times of trouble only to disappear just as quickly when the storm

is over" (Clark & Watson, 1988, p. 305). Specifically, after starting low, PA continually rose until a first peak approximately three hours after getting up, reached its maximum at about eight hours post rising, and then declined. Watson et al. (1999) also reported that PA and body temperature showed the same diurnal pattern of variation. NA, on the other hand, showed little such variation and remained relatively unchanged at intermediate levels.

These characteristic patterns of variability in PA versus variability in NA are mirrored by the finding that across various time-levels, positive mood shows greater variability than negative mood (e.g., Eid & Diener, 1999). This pattern could be replicated in two studies by Kleban, Lawton, and colleagues (Kleban et al., 1992; Lawton et al., 1996), who investigated daily affect variation over 30 days in three groups of older adults (M = 82.8 years): those with no psychiatric diagnosis, minor depressives, and major depressives. In general, Kleban et al. (1992) reported that there was little variability in either positive or negative affect scores, but in comparison, participants were more variable in their positive affect than in their negative affect (see also Lawton, Kleban, Dean, Rajagopal, & Parmelee, 1992; Shifren & Hooker, 1995; Shifren, Hooker, Wood, & Nesselroade, 1997).

Taken together, the divergent and characteristic variability of positive versus negative affect lends support to propositions that both affect systems may represent the subjective experience level of two distinct underlying (evolutionarily) adaptive systems of approach and withdrawal: The Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS; cf. Gable, Reis, & Elliot, 2000). In this regard, PA is thought to represent the subjective component of one's daily joy in life and energy in order to cope with the day's challenges, with its highest level around midday, the period in which it is most likely needed. NA is considered to serve as the emergency system, ready to jump in when sudden circumstances require it, but otherwise remaining relatively stable and unaffected by the circadian rhythms of the PA- and other bodily systems. Overall, in light of the above findings, it becomes evident that traditional studies on affect and well-being, treating the construct as a rather stable phenomenon or one that only changes over long-term periods, have not captured the dynamic dimension of affective experience that appear to characterize the daily lives of young and older adults and possible age-related differences in subjective well-being (Eid & Diener, 1999).

1.2.2 Intraindividual Variability in Positive and Negative Affect Represents a Systematic Individual Difference Characteristic

It is generally assumed that individuals differ in the degree to which their moods vary across time and that mood variability is a stable characteristic of the individual, which signifies a

pattern of emotional reactivity that differs between people (Larsen, 1987; McConville & Cooper, 1999; Wessman & Ricks, 1966).[4] Several studies have shown, for example, that variability in positive mood tends to be significantly and positively related to variability in negative moods (e.g., r = .49 in McConville & Cooper, 1999). One important study to underline the status of intraindividual variability in mood as a stable interindividual difference characteristic was conducted by Penner, Shiffman, Paty, & Fritzsche (1994). Using a sample of 54 adults ranging in age from 25 to 62 years (M = 40.1 years), the authors examined intraindividual variability in mood ratings sampled several times across 12–14 days using an in situ experience sampling method. Analyses reported in the cited study are based on mood ratings that were prompted by random signals throughout participants' waking hours, resulting in 75–100 assessments for each individual. Upon signaling, participants rated their current mood on 11 positive and negative affect items (e.g., happy, frustrated, calm, tired) and provided information on their current location and activity.

Using the coefficient of variation as the measure of variability that statistically controls for proportional associations between mean level and intraindividual standard deviation, the temporal and cross-situational stability and the internal consistency of mood variability was examined, with findings underlining the status of mood variability as a systematic individual difference variable: Mood variability for each item was temporally stable as indicated by significant positive correlations between the variability estimated for odd-numbered and even-numbered days (r range = .61 to .88) as well as significant positive correlations between variability computed for the first five and the last five days (r range = .31 to .64, only for one word, the correlation of r = .23 was not significant). In addition, comparing situations in which individuals reported eating versus those in which they reported working, variability estimates were correlated significantly positively for all but one item with r ranging from .30 to .67. Considering the coefficients of variation as participants' "responses" to each item, internal consistency was examined using Cronbach's alpha. Across all items, the coefficient alpha was .84, and it was .66 and .71 for the positive and negative items considered separately, respectively. Individual differences in diversity of activities as well as in response styles (i.e., individual differences in using response alternatives) could not explain these high alphas. The pattern of results indicates that intraindividual fluctuations in ratings of positive and negative affect and mood follow a systematic pattern that is reasonably stable across time and contexts and can thus be used to distinguish individuals from one another – over and above mean level differences.

[4] Rather than examining intraindividual variability merely across time, researchers interested in individual differences and personality have also proposed the concept of metatraits, which refers to systematic individual differences in a general tendency to show variability versus stability in responding to the different items on a trait scale (e.g., Baumeister, 1991).

Intraindividual time-series data can also be used to examine individual differences in affect structure. Such data can be used to investigate whether the between-person structure replicates on a within-person level – or in other words, whether the assumption of ergodicity in factor structures between the between-person and the within-person level of analysis holds (Molenaar, Huizenga, & Nesselroade, 2003; see also Cattell, 1957b; Schmitz, 2000). In general, positive and negative affect, particularly when considered on both high and lower arousal levels (i.e., including pleasantness items), tend to be largely independent over longer time frames. It has been suggested, however, that both the type of affect descriptors as well as the time frame across which ratings are made play an important role in resolving part of the debate on the structure of self-reported affect (Diener & Emmons, 1985; Watson, 1988b; see Russell & Carroll, 1999, for review). Specifically, whereas it may be possible to have both frequent episodes of high positive as well as of high negative affect across a period of weeks or months, many would agree that it is quite unlikely that individuals report being very happy and very sad at the same moment in time. This suggests that momentary ratings of mood should be characterized by a substantial negative correlation between aggregates of positive and negative affect.

At an empirical level, within-person analyses indicate that intraindividual structures of positive and negative affect differ significantly across individuals and not all individuals' affective structure is best represented by a two-factor structure. In other words, some individuals experience their emotions to rise and fall together, whereas others have more differentiated emotional lives – a pattern found both in samples of young and in samples of older adults (e.g., Eid & Diener, 1999; Kleban et al., 1992; Larsen & Cutler, 1996; Lawton et al., 1996; Ram, Odgers, Mikels, Carstensen, & Nesselroade, 2004; Shifren & Hooker, 1995; Shifren et al., 1997; Watson, 1988a; Zevon & Tellegen, 1982). Apart from examining the concurrent covariation, the potential for self-regulatory mechanisms has been considered by examining lagged effects of daily affective experiences from one day to the next across 70 days in a study on 12 older individuals with Parkinson's disease (M = 68.75 years, range = 59–81) conducted by Shifren et al. (1997; see also Kim & Nesselroade, 2003). Dynamical factor analysis yielded a great deal of between-subjects diversity of structural and lagged relationships in PA and NA. For example, yesterday's emotional experiences had an effect on today's overall well-being only for some individuals and not for others.

Despite the converging evidence in these separate studies of young and older adults about the diversity of within-person affect structures, these studies differ, among other things, in their use of affect measures as well as time frames sampled. The multitude of within-person structures found for self-reported affect suggests that there are substantial individual differences in how

individuals' go about handling affective experiences of very different valence. In addition, this pattern opens up new questions on whether there are systematic age-related differences in structures that are linked with individual differences in adaptive functioning. Theory-building on the function of different affect structures between individuals of different ages is only beginning. In an experience sampling study by Carstensen and colleagues (2000), for example, 184 participants aged 18 through 94, with an average age of 55.0 years (*SD* = 20.4) were signaled five times a day across one week (35 occasions) to indicate their momentary affect. Older adults' emotional experiences emerged as more complex than those of younger age groups, as indicated by a significant positive correlation between age and the number of eigenvalues larger than 1.0, which were derived on the basis of each participant's correlation matrix of emotion ratings for all 35 occasions. Complexity was also related to less frequent and less intense NA and lower levels of neuroticism and thus appeared to be an additional positive characteristic of older adults' emotional lives. These findings are in accordance with the work of Ong and Bergeman (2004), who also showed greater affect complexity (despite using a slightly different operationalization of complexity) to be predicted by adaptive interindividual difference factors (see also Linville, 1985, for related work on self-complexity).

Apart from the notion of complexity, an interesting idea is that the concurrent experience of both positive and negative affective states requires some form of integration of both affective tones into a coherent subjective affective state. For example, individual and age-related differences in affect structures could be examined from the perspective that the concurrent regulation of both positive and negative emotions represents one instance of dual-tasking in everyday life. Albeit not from a developmental or lifespan perspective, but rather focusing on young adults, Zautra and colleagues have advocated the Dynamic Model of Affect. This model describes how the association between positive and negative affect varies as a function of the information processing demands of a given context (Davis, Zautra, & Smith, 2004; Zautra, Berkhof, & Nicolson, 2002). The model suggests that during non-stressful times, individuals can afford the independent processing of positive and negative stimuli, and this may even be beneficial for the sake of maximizing the amount of information one extracts from the environment. The picture changes during stressful situations that bring about uncertainty and therefore increase processing demands. In such contexts, the resource-demanding independent processing of positive and negative stimuli may be given up for a less demanding processing strategy, in which the two affect domains are considered on a bipolar continuum in order to free up resources to deal with the stressful context.

The model's underlying assumptions with regard to the cognitive costs of information processing of valenced information and or emotion regulation will be discussed further in the context of the coupling of affect and cognitive performance in young and older adults (Section 1.4). However, the dual-task metaphor appears to be useful for a more complete understanding of the functional value of differences in affect structures in different age groups.

1.2.3 Age-Related Differences in Intraindividual Variability in Emotional Well-Being

Two scenarios about age-related differences in the range of intraindividual variability can be found in the literature: The first scenario proposes that aging should be characterized by *increasing* lability and hence intraindividual variability of the psychological system. Nesselroade (1988) suggested, for example, that with increasing levels of illness, adulthood and old age should be characterized by an increase in intraindividual variability. Other driving factors for this augmentation are seen in increases in frailty as well as neurological changes (i.e., inconsistency in central nervous system functioning) that impair the robustness of the system (e.g., Li & Lindenberger, 1999; Lipsitz, 2002; R. West, Murphy, Armilio, Craik, & Stuss, 2002a). The second scenario advocates the opposite direction of age-related differences and changes, suggesting the self- related and emotional processes in late life may be more efficiently regulated than in young adulthood, possibly due to a cumulated experience of self-regulation across a multitude of self-relevant life events. As a consequence, one may find a *decrease* in variability in such domains across the lifespan (e.g., Birditt et al., 2005; Lawton, 2001; Carstensen, Isaacovitz, & Charles, 1999).

In part, the two different proposals are derived from different domains of psychological functioning (see Table 1.2). The study of developmental aspects and lifespan changes in intraindividual variability and dynamics has received conceptual and empirical attention particularly in the area of cognitive development during childhood as well as in research on cognitive aging (e.g., Hultsch & MacDonald, 2004; Li & Lindenberger, 1999; Li, Lindenberger, Hommel, Aschersleben, Prinz, & Baltes, 2004; Siegler, 1994, 2002). In contrast, variability in emotional well-being has been mainly studied in young adults. Age group comparisons in the magnitude and correlates of affect variability are necessary, however, in cumulative theory building on the developmental implications of the short-term dynamics of psychological functioning in general and in emotional experience in particular.

Furthermore, the factors driving variability differ in both perspectives. Whereas the 'increase-perspective' focuses on biological antecedent factors that may be most central in explaining age-related shifts in the range of variability in cognition, the 'decrease-perspective'

considers more psychological factors as antecedents for short-term variability in affect and its ontogenetic changes. In the realm of emotion and emotional well-being, biological factors may not be irrelevant, but insufficient, making psycho-social explanations essential candidates for a complete exploration of changes in affect fluctuation during adulthood.

Table 1.2
Overview of Two Scenarios about the Association of Intraindividual Variability and Age

Proposals about Intraindividual Variability and Age	Domains for Which Empirical Evidence for Proposal is Available
Increase in Intraindividual Variability With Age: e.g., due to biological decline and reflecting health-related losses in the system	Cognitive and sensorimotor performance *e.g., Li et al. (2001), Nesselroade & Salthouse (2004), R. West et al. (2002a), B. R. Williams et al. (2005)* Physiological parameters (e.g., heart rate) *e.g., Lipsitz (2002)*
Decrease in Intraindividual Variability With Age: e.g., increased capacity for regulation of self and emotions and a possible reflection of a positive gain (due to the crystallization of experience)	Self-perceptions *Charles & Pasupathi (2003)* Emotional well-being: Positive and Negative Affect: *Preliminary Evidence from Carstensen et al. (2000), Larson et al. (1980)*

In his review on emotion and aging more than two decades ago, Schulz (1982, 1985) suggested that older adults (without specifying which age range exactly he was referring to) should have reduced lability and should therefore experience fewer mood swings as a function of being "more set in their ways" (p. 533). Indeed, external factors driving variability in affect, such as daily routines, but also internal factors, such as identity and personality formation, are likely to differ between young and older adults. Adolescence and young adulthood are often described as periods during which a multitude of social, biological and psychological changes occur (e.g., identity formation and the search for autonomy; Erikson, 1968; Larson, Csikszentmihalyi, & Graef, 1980). On the other hand, late adulthood and older age should be characterized by a rather stable sense of self and daily routines that are more highly regulated than younger adults' based on age-related differences in developmental tasks (e.g., Charles & Pasupathi, 2003; Schulz, 1982, 1985). Older adults often report a greater preference for routines than younger adults (cf. Bouisson, 2002; Kastenbaum, 1981). In this perspective a certain degree of routinization has been considered adaptive at all ages, and in particular in older adulthood as a means of

conserving resources by enhancing predictability and preventing stress-related expenses of resources resulting from novel situations (but see Bouisson & Swendsen, 2003 and Reich & Zautra, 1991, for the potentially maladaptive implications of routinization in older adults). These previous findings would suggest that the everyday lives of older adults should be characterized by a less pronounced up and down of affective self-reports than younger adults' lives.

Prior to setting the stage for an overview of initial empirical evidence on age-related differences in the magnitude of short-term intraindividual variability in positive and negative affect, findings on age-related differences and changes in trait-level well-being and emotional functioning will be outlined. This is in line with Nesselroade's (1988; Nesselroade & Ford, 1985) reminder that mean levels as well as variability should be examined in reference to each other.

Age-Related Differences in Average Levels of Well-Being and Emotional Functioning

Theoretical and empirical research on age and emotions suggests that in the realm of emotion, the loss theme that dominates many lay opinions about older age inadequately describes the empirical evidence (e.g., Birditt & Fingerman, 2003; Blanchard-Fields, 1998; Isaacovitz & Smith, 2003; Labouvie-Vief, 1998; Lawton, Kleban, Rajagopal, et al., 1992; Mroczek & Kolarz, 1998; Neiss & Almeida, 2004). Rather, the pattern of age-related differences found across emotional functions (i.e., reactivity, regulation) and across different response systems (subjective, autonomic) corroborates that many aspects of emotional functioning are preserved or even improved with age. For example, understanding of the complexity of emotions and the ability to integrate emotional information in cognitive (e.g., problem-solving) tasks shows improvements with age (Blanchard-Fields, 1998; Labouvie-Vief, DeVoe, & Bulka, 1989). Cross-sectional and some longitudinal evidence has examined self-reports of frequency of positive and negative affect, self-reports and physiological parameters of emotional intensity, as well as self-reported and behavioral emotion regulation. Main findings pertaining to each domain will be summarized in the following paragraphs (see Table 1.3 for an overview)[5].

[5] A different and more detailed summary of the literature has been undertaken by Levenson (2000; see Appendix A, Table A3). For the present study, however, Table 1.3 is sufficient in giving a brief summarized overview of the main findings on emotion and age.

Table 1.3
Overview of Empirical Findings on Age-Related Differences in Emotional Functioning

Emotional Functioning Across Different Response Systems	Direction of Age-Related Differences [a, b]
Frequency of Self-Reported Affect	(Inconsistent findings across studies)
Positive Affect	O = Y or O > Y, only one study found O < Y
Negative Affect	O = Y or O < Y, no evidence for O > Y!
Intensity/Reactivity of Emotional Experience	
Self-Report	O < Y
Physiological Parameters	Autonomic activity: O < Y; Heart Rate: O = Y
Emotional Control/Regulation	
Self-Report	O > Y
Behavior (Physiological Parameters)	O = Y (very limited empirical evidence)

Notes. a) O = Older Adults, Y = Young Adults. b) Summary of pattern of findings is mainly based on cross-sectional studies. There are a few longitudinal studies that have examined the frequency of self-reported affect.

Self-reported frequency of positive and negative affect. In general, younger and older adults tend not to differ in the frequency of reported negative affect (Costa, Zonderman, McCrae, Cornoni-Huntley, Locke, & Barbano, 1987; Kunzmann et al., 2000; Stacey & Gatz, 1991). In those studies that found evidence for change in negative affect, it was (minor) age-related decline in average frequency of negative affect, particularly when controlling for functional health (e.g., Charles, Reynolds, & Gatz, 2001; Gross, Carstensen, Tsai, Skorpen, & Hsu, 1997; Kunzmann et al., 2000; Mroczek & Kolarz, 1998). The frequency of experiencing positive affect, however, exhibits a more inconsistent picture. Some studies did not find evidence for long-term longitudinal change in positive affect with age (e.g., over nine years, Costa et al., 1987), and no significant correlation between age and the frequency of self-reported affect emerged in an experience sampling study of Carstensen and colleagues (2000). On the other hand, in a cross-sectional sample of individuals aged 25 to 74, Mroczek and Kolarz (1998) found greater frequency of positive affect in older than younger adults. Similarly, Kunzmann et al. (2000) reported that cross-sectionally, there was a positive relationship between age and positive affect after controlling for functional health in a sample of older adults aged 75 to 104, even though subgroup analyses (young old versus the oldest old) yielded evidence for a decline in positive affect in the oldest group (see also Isaacovitz & Smith, 2003; J. Smith, Borchelt, Maier, & Jopp, 2002). Lastly, evidence for a negative association between age and positive affect over 14 years in adults aged 65 and older

comes from Stacey and Gatz (1991; see also Charles et al., 2001, who also found longitudinal decline in positive affect in older adults beyond age 67). Despite the apparent inconsistencies in findings across studies, no empirical evidence supports the contention that later adulthood can be portrayed by more frequent experiences of negative affect than young adulthood.

Intensity of emotional experiences. Mixed findings have also emerged with regard to the second feature of emotional experience, namely emotional intensity/reactivity. Empirical evidence suggests that subjective appraisals of intensity need to be distinguished from objective indicators of intensity (i.e., physiological indicators of arousal) and that age-related differences in emotional reactivity are not unitary across different response systems (i.e., self-report, physiological parameters; e.g., D. P. Smith, Hillman, & Duley, 2005). Some studies indicate that old and very old adults report less intensity for both PA and NA than do younger adults (e.g., Diener, Sandvik, & Larsen, 1985; Lawton, Kleban, Rajagopal, et al., 1992), whereas others have reported age-related decreases in self-reported affect intensity only for negative emotions (e.g., Barrick, Hutchinson, & Deckers, 1989). A study by Kunzmann and Grühn (2005) showed that physiological arousal patterns do not differ between young and older adults in domains that are particularly salient to older adults (see also Levenson, Carstensen, Friesen, & Ekman, 1991). However, there appears to be evidence for an age-related reduction in levels of arousal with respect to cardiovascular responses during the re-experience of emotional salient events from participants' past (Levenson et al., 1991), which is consistent with age differences in self-reported excitability (Lawton, Kleban, Rajagopal, et al., 1992). The dampening of cardio-vascular responses may facilitate regulation of strong emotional reactions, and may contribute to the self-perceived maintenance or improvement in emotional control with age. This view would also be in line with theoretical propositions of the aging process as one of habituation (Kastenbaum, 1981) and suggestions that the accumulation of experiences with emotional situations may lead to hedonic adaptation (Frederick & Loewenstein, 1999) as one particular habituation process. Given such a reduction in sensitivity, emotional well-being may be best represented in terms of a restricted range of short-term intraindividual fluctuation in older adults, whereas a greater range of variability should best represent subjective well-being in young adulthood.

Emotion regulation. Emotion regulation is one aspect of general self-regulation (Carver & Scheier, 1999). Individuals do not just passively wait and see as their emotions come and go, but actively attempt to influence which emotions they experience when and how (Gross & Levenson, 1997; Larsen, 2000a, 2000b). From a theoretical point of view, lifespan theory suggests that as available resources like energy and time change across the lifespan, life-management processes of selection, optimization, and compensation become increasingly necessary in order to successfully

adapt to changing life contexts (SOC; Baltes & Baltes, 1990; Freund & Baltes, 2000). As a result, lifespan theory predicts an age-related shift in motivational and goal systems from a growth-oriented perspective towards a focus on maintenance (e.g., of well-being) and prevention of loss (e.g., prevention of negative emotions and interpersonal stress; Baltes et al., 2006; Ebner, Freund, & Baltes, in press). As a specific example, Socioemotional Selectivity Theory (e.g., Carstensen, 1995; Carstensen et al., 1999) contends that as a function of diminished future time perspective, older adults are increasingly motivated to regulate their emotions in the service of maximizing positive and minimizing negative emotional experiences. According to the theory and empirical evidence, older adults actively shape their social networks in a way that reflects an increased focus on emotionally close others at the expense of acquaintances. In this context, the shift in motivation and goal focus particularly in the domain of social relationships may provide for self-maintenance and predictability of the emotional implications of one's social interactions (Carstensen, 1995; Charles & Pasupathi, 2003). In addition, these selection processes in the social domain may be regarded as a strategy of antecedent-focused emotion regulation as described in Gross' (1998) process model of emotion regulation (see also Carstensen, Fung, & Charles, 2003; John & Gross, 2004). As a consequence, one's equilibrium level of subjective emotional experience should be relatively unperturbed and thus characterized by less short-term fluctuation around it in older than in younger adults.

From an empirical perspective, emotion regulation has been studied mainly by self-report. Older adults generally report having greater emotional control than younger and middle-aged adults (e.g., Gross et al., 1997; Lawton, 2001; Lawton, Kleban, Rajagopal, et al., 1992; Mroczek, 2001; but see also Bäckman & Molander, 1991, for finding evidence on age-related declines in the ability to cope with emotionally arousing situations as a function of declines in cognitive capacities). Kunzmann, Kupperbusch, and Levenson (2005) examined physiological indicators of emotions in a cross-sectional study and found evidence consistent with the idea that the capacity to voluntarily suppress or amplify emotions remains intact but does not necessarily improve with age. On the other hand, Diehl, Coyle, and Labouvie-Vief (1996) report findings suggesting that older adults are better at impulse control when faced with stressors.

In sum, both external as well as internal factors possibly driving variability in affective experience are thought to differ between young and older adults. Daily life should evince greater levels of routinization in later than early adulthood. Older adults have an accumulated experience in dealing with emotional situations, they have a more elaborate understanding of the complexity of emotions, are more motivated to focus on emotions and to regulate them, and there is some evidence for a diminished subjective intensity and autonomic and cardio-vascular reactivity.

Taken together, this may result in a preserved or even improved ability to voluntarily regulate emotional responses. Patterns of day-to-day fluctuation in self-reported PA and NA are proposed to differ between young and older adults as a reflection of these differences in life contexts and emotional functioning (see Figure 1.4 for a summary overview of the theoretical expectations).

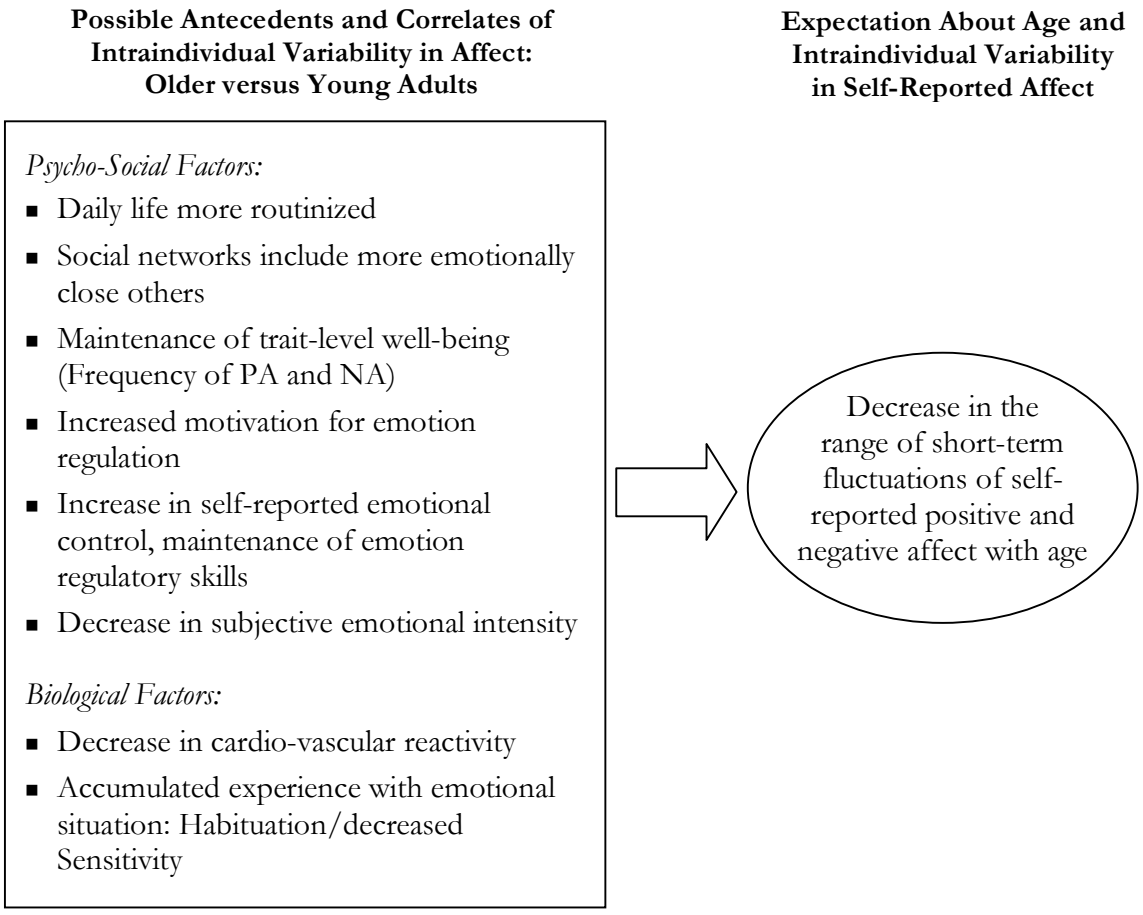

Figure 1.4. Schematic Overview of Age-Related Differences in the Antecedents of Intraindividual Variability in Affect and the Association Between Variability in Affect and Age

The present study was not designed to test the two scenarios about age and variability (i.e., increase versus decrease) and the different propositions regarding age and emotion regulation, physiological reactivity, and daily routines against each other. Nonetheless, previous theoretical and empirical work related to these propositions was used to derive expectations about the presence and the direction of age-related differences in patterns of intraindividual variability in self-reports of positive and negative affect, which are consistent with the perspective

that in the domain of affect, intraindividual variability should decrease with age[6]. The availability of day-to-day assessments on self-reported PA and NA made it possible to examine the latter prediction in the present dissertation study. The following section will review the limited empirical evidence bearing on this issue.

Empirical Evidence on Age-Related Differences in Variability in Affect

Two studies have specifically compared multiple age groups in their daily affective experiences. In the first (Carstensen et al., 2000), the sample included 184 participants aged 18 through 94, with an average age of 55.0 years ($SD = 20.4$). Hence, despite the apparent participation of some adults in advanced ages, the findings are largely based on middle-aged and young-old adults. Markers of PA and NA were measured by a self-developed questionnaire that covered both the activation and the hedonic tone dimensions of affective experience. Participants rated their affect five times a day across one week (35 occasions). At each occasion they indicated the degree to which they currently experienced each affect. Because variability and mean level information are often related, the core findings regarding mean levels of self-reported affect will be reviewed prior to presenting the findings on age differences in variability: Age was unrelated to the average frequency and intensity of positive affect, but a curvilinear relationship between age and the average frequency of negative affect emerged, suggesting a decrease in negative affect frequency until age 60 and a ceased decrease from then onwards. Thus, these findings are only somewhat consistent with results that have emerged from cross-sectional and long-term longitudinal studies on average levels of PA and NA (see previous section).

With respect to intraindividual variability, age was positively correlated with stability of desirable states. In other words, older adults tended to be more stable in their high positive states

[6] Across relatively longer time periods, such as retrospective summary ratings across several days, older adults should report less variability in the frequency as well as the intensity with which they experience positive and negative affect from one time period to the next. Across smaller time frames, such as from one daily moment to a next day's momentary assessment, older adults should report less variability in intensity of positive and negative affect than young adults.

Frequency and intensity of emotional experience are regarded as providing distinct information on the subjective appraisal of well-being (Schimmack & Diener, 1997). Diener, Sandvik, and Pavot (1991), for example, have shown that happiness is best described in terms of frequent positive affect rather than high intensity affect. It should be kept in mind, however, that different methods and designs of assessing self-reported affect are more or less restricted to only one of the two aspects of affective experience: In the standard assessment of self-reported positive and negative affect, individuals tend to be asked to retrospectively rate the *frequency* of experiencing a given list of affect markers across the past week or more commonly the past 24 months. In addition, it would also be possible to ask individuals to rate the average intensity with which they have experienced various affect descriptors.

On the other hand, experience sampling studies tend to ask participants to rate their *momentary* affective experience, which by definition requires an assessment of *intensity* because for any given moment, a rating of frequency is impossible. In the present dissertation, day-to-day assessments of the momentary intensity of affect were available. Therefore, the hypothesis regarding an age-related decrease in variability of affective experience pertains to the aspect of intensity rather than frequency in this study.

(i.e., days on which positive affect was higher than usual) and more likely to maintain low negative states (i.e., days on which negative affect was lower than usual). The authors interpreted this as being indicative of better regulation of emotions in older as opposed to younger adults. Furthermore, it could be shown that the better emotion-regulative abilities of older adults in moving more quickly from highly negative to low negative states, in addition to age per se, accounted for the age difference in frequency of NA (with older adults reporting less frequent NA than younger adults).

Interestingly, however, no positive correlation between age and stability of affect states in general (i.e., regardless of how desirable or undesirable) was found. The authors classified the affect scores at each occasion as either higher, equivalent to, or lower than an individual's idiosyncratic mean across all sampling occasions. They then computed a Phi correlation between these categorical states, analogous to a cross-lagged correlation, and found evidence for small but significant age-related increases in positive affect stability, but no significant age-stability relationship for negative affect. This led the authors to conclude that there was no clear evidence for age-related stability in affective states in general. This conclusion warrants replication, however, (a) across different time frames, in particular those that do not confound within-day and between-day variability, (b) using standard ways of operationalizing intraindividual variability such as the intraindividual standard deviation or the coefficient of variation, and (c) using samples that include a greater number of individuals in the older adulthood groups.

The main emphasis in the other study was not primarily to compare the range of mood variability between different age groups, but rather on the emotional lives of adolescents (Larson et al., 1980). A group of 75 high-school students (spanning all four high-school grades, specific ages not reported in the text) and a group of 107 adults spanning a wide age range (19–65 years, mean age not reported in the text) provided ratings of their current mood several times a day across one week, resulting in 35–70 self-reports of affect for each person. Momentary affect was assessed with a series of adjective pairs (e.g., sad-happy) covering both the activation and the valence aspect of emotional experience. The relevant finding from this study was that the adolescent group reported a greater range of variability in affect than the adult group.

Even though these two studies provide an initial glimpse into possible age-related differences in patterns of short-term fluctuations of self-reported affect and mood, several issues arise that warrant attention: First, both studies have sampled affect several times a day across a one week period, mixing up both within-day and between-day variability. This confounds the different potential sources of variability (i.e., circadian rhythms may be more important for fluctuation within a day, whereas daily events may be more central for fluctuation across days).

Second, the mixed within- and across day design further makes it difficult to tease apart whether a decrease in short-term fluctuations in self-reported affect would be observed both on a very short (i.e., within-day) as well as a slightly more extended time frame (i.e., day-to-day) separately. Third, the number of individuals in advanced older age (i.e., beyond age 60–70) was limited in both samples, and particularly in the second reported study by Larson and colleagues (1980), the 'adult' comparison group was very heterogeneous in age, spanning from young to later adulthood. Thus, findings from these studies only permit tentative conclusions about the pattern of variability in later adulthood (i.e., the ages beyond 65). The last point concerns the selection of affect items. Both studies have attempted to cover a broader range of affect adjectives, but neither has used a standard affect questionnaire such as the PANAS (Watson et al., 1988), which has been employed widely in micro-longitudinal studies on affect in young adults. This strategy impedes the opportunity to compare the age-comparative findings with the majority of previous research. In addition, in the Larson et al. (1980) study, positive and negative mood dimensions were collapsed into a hedonic tone index, making it difficult to draw conclusions for each affect domain separately.

Three features of the design of the present dissertation attempt to address the issues of time period, age range, and measurement instrument. Self-reports of affect were sampled across a single time frame (day-to-day) and an extended period (45 sessions). A group of young (20–30 years) and a group of older adults (70–80 years) participated, ensuring sufficient representation of older adults in their later adulthood years. A standard affect questionnaire was used as well as additional items ensuring both the comparability with the majority of previous findings and a sufficient representation of activation and valence in mood assessment.

1.3 Individual Differences Beyond Age: Trait-Like and State-Like Correlates of Affect Variability

This section addresses the second focus of the present dissertation. It reviews the role of correlates of variability in PA and NA beyond age. Empirical examinations of the factors driving fluctuations in positive and negative emotional experience have taken two main routes. The first has focused on trait-like dispositions (e.g., personality factors), whereas the second has focused on the role of time-varying, state-like variables (e.g., daily events, stress). As an additional theme, implications emerging from findings on the relationship between trait-like factors and variability in affect for the inquiry on the functional versus dysfunctional nature of high levels of affect

fluctuation are considered. The last part addresses age-related differences in patterns of associations between affect variability and the trait-like as well as the state-like correlates.

Even though the present dissertation considers intraindividual variability from a lifespan developmental perspective, age per se may not be the force driving individual differences in patterns of short-term fluctuations of self-reported affect (e.g., Wohlwill, 1970). In terms of antecedents, correlates, and consequences of variability in affective experiences, empirical evidence comes both from trait-like and from state-like variables. The covariation with and predictive utility of short-term fluctuation in affect for other domains of psychological adjustment and functioning on the level of trait-like variables is one way of examining the functional respective dysfunctional implications of high or low levels of variability. On the other hand, researchers have sought to identify primarily state-like or time-varying phenomena that may be driving fluctuations in affect, such as the daily ebb and flow of internal (i.e., physiological) processes as well as external events (i.e., hassles and uplifts). The outlined conceptual importance of variability for a lifespan psychological perspective notwithstanding, the overwhelming amount of evidence of both perspectives stems from studies with young adults, with few studies replicating findings in samples of older adults, and a dearth of studies including samples of different ages, which would allow for conclusions about age-related differences in the antecedents, correlates, and consequences of affective variability. Such information, however, would be highly valuable in furthering understanding of the developmental functions of high versus low levels of variability in the domain of emotional well-being.

1.3.1 Trait-Like Correlates of Variability in Positive and Negative Affect

Even though the primary focus in the present dissertation is on age-related differences in affect variability, other correlates have been examined much more frequently in the literature and shall be reviewed here in brief. Specifically, the main trait-like correlates considered have been personality constructs such as extraversion and neuroticism. These two show strong relationships with trait-like positive and negative affect (Costa & McCrae, 1980; Diener, 1984; Isaacovitz & Smith, 2003; Larsen & Ketelaar, 1991; Watson & Clark, 1992) and were thus prime candidates for linking them to individual differences in variability in positive and negative affect. Another individual difference construct that has been examined as a trait-like correlate of affect fluctuation is affect intensity. This section will highlight the main findings with respect to these trait-like correlates obtained from studies with young adults.

A relatively large number of studies report the relationship between trait affect and personality variables. Extraversion and neuroticism are regarded to be the central personality

variables predisposing individuals to experience positive and negative affect. Extraversion is known to be related to higher levels of positive affect and neuroticism to be related to higher levels of negative affect in all age groups (e.g., Costa & McCrae, 1980; Diener, 1984; Gross, Sutton, & Ketelaar, 1998; Isaacovitz & Smith, 2003; Larsen & Ketelaar, 1991; Watson & Clark, 1992). In addition, some studies have shown that there are cross-over effects that are stronger for the negative personality and affect dimensions, indicating that neuroticism is somewhat related to trait positive affect, whereas extraversion bears little relevance for trait negative affect (cf. David, Green, Martin, & Suls, 1997). Overall, from knowing a person's traits one apparently has some knowledge of how happy or unhappy that person tends to be on average. In contrast, relatively few studies have investigated the association between classical personality variables and variability in PA and NA (see Eid & Diener, 1999, for an overview). It has been suggested that variability should be related to personality traits related to emotional lability (i.e., neuroticism). H. J. Eysenck and Eysenck (1985) expected, for example, that „choleric" temperaments should be tied to variability in mood. In particular, they suggested extraversion to be related to variability in positive mood and neuroticism to be related to variability in negative mood.

The limited available evidence on the association between personality and affect variability is inconsistent across studies, however, and converges mainly on the finding that neuroticism appears to be the most important predictor of variability in mood, particularly in negative mood. For example, D. G. Williams (1990) reviewed six studies and concluded that the only significant relationship found is that between neuroticism and variability in negative mood, a finding that is also corroborated by McConville and Cooper (1999), who report a significant relationship only between neuroticism and psychotism with variability in negative ($r = .29$ and .30, respectively; both ps $< .01$) but not positive mood. In an early study, Bolger and Schilling (1991) found individuals high in self-reported neuroticism to display greater exposure and reactivity to daily stressors than low-neuroticism individuals, indicating that neuroticism is associated with intraindividual variability in negative mood/distress (for review, see Suls & Martin, 2005; see also Eaton & Funder, 2001; Murray, Allen, & Trinder, 2002; Velting & Liebert, 1997). Hepburn and Eysenck (1989) found significant associations between fluctuations in positive mood and extraversion as well as between fluctuations in negative mood and neuroticism and extraversion. Others find no clear relationships between big five personality factors and mood variability (Howarth & Zumbo, 1989; Kardum, 1999; McConville & Cooper, 1992; Wessman & Ricks, 1966).

In a relatively recent and careful examination of the relationship between personality traits and mood variability, Eid and Diener (1999) note that existing studies on the relationship

between personality variables and affect variability are limited because they are mostly constrained to the two broad personality factors of extraversion and neuroticism as captured in Eysenck's Personality Inventory, although openness to experience, agreeableness, and conscientiousness have also been shown to be related to trait affect. Furthermore, affect has been operationalized mainly with mood-like adjectives, thereby neglecting other important aspects of emotional experience (e.g., joy, happiness) that are characteristic of people's everyday well-being. To address these shortcomings, Eid and Diener (1999) investigated the convergent and discriminant validity of short-term variability in a broader range of emotions with regard to personality factors based on the Big Five personality factors (NEO-FFI). Consistent with the studies reported above, personality variables only accounted for a relatively small portion of the variance in affect variability (5.0%, see below). Of all the broad personality factors investigated, Eid and Diener (1999) found neuroticism to be the strongest personality factor associated variability in affect. In particular, at the zero-order level, variability in all negative and one positive emotion were significantly related to neuroticism, with *r*s ranging from .20 (love) to .49 (sadness). Second, extraversion was positively related only to variability in joy ($r = .25$) and negatively to variability in sadness ($r = -.21$). Openness and conscientiousness were unrelated to variability in mood, agreeableness was only related reliably to fluctuations in anger ($r = -.18$).

The particular relevance of neuroticism for variability in affect and emotions was supported in multiple regression analyses, in which the influence of affect mean levels was controlled first: Neuroticism still had an influence for six out of seven affect categories, whereas extraversion explained a significant amount of variance only with regard to variability in fear and anger. Overall, the mean variables (i.e., mean level of affect across assessment period) accounted for the majority of variance in variability, before other personality variables were entered into the regression model. The coefficients of determination for mean level scores ranged from 0.06 for love to 0.48 for shame. Mean levels and personality factors together accounted for only 52.0% of the explained variance of variability, but particularly for variability in positive emotions, up to 80.0% of the variance remained unexplained by mean level and personality factors. Personality alone (after mean levels) accounted only for up 5.0% of the variance in variability, over and above mean levels of affect.

One important addition to these studies needs to be made, however. Apart from mere magnitude of affect variability, a recent study investigated the role of individual difference variables, including the Big Five, for rate of affect change (Hemenover, 2003). Rate of affect change over 20 minutes following a positive, negative or neutral mood induction using film clips in 262 young adults could be predicted by the Big Five and other trait interindividual difference

variables. In greater detail, individuals whose positive affect declined slowly whereas their negative affect dropped quickly over the 20-minute period, could be characterized as being extraverts, emotionally stable as well as having high negative mood regulation expectancies. Those individuals whose negative mood exhibited slow decline while their positive affect showed rapid rates of decay in the prescribed time interval were more likely to be introverted, neurotic and to have lower negative mood regulation expectancies.

Apart from Big Five personality traits, individual differences in affect intensity are theoretically linked to fluctuations in self-reported affect: Affect intensity denotes the regularity with which people experience extremely positive and extremely negative moods and to what extent they vary between these two extreme poles (Larsen, Diener, & Emmons, 1985)[7]. Using spectral analysis, Larsen (1987; see also Kardum, 1999) was able to show that people high in affect intensity, as measured by self-report, displayed daily mood experience patterns characterized by frequent changes in their day-to-day emotional experiences over two and three months, whereas the opposite held for participants low in affect intensity.

In conclusion, classical personality factors such as the Big Five appear to be only weakly related to variability in positive and negative mood, even though they show strong relationships with trait affect. In other words, from knowing a person's traits one may know something about a person's average level of well-being but not much about how variable a person's experience of well-being is. In part, these differences in strength of association may be due to differences in reliability between measures of central tendency and measures of dispersion (e.g., Schmiedek, 2006). These differences notwithstanding, it is possible that psychological processes underlying stability and change in affect may be different (R. J. Davidson, 1998). Whereas findings are somewhat inconsistent across studies (most likely based on differences in the time-sampling of mood and the assessment of personality variables), converging evidence suggests that the strongest relationship can be found between higher levels of neuroticism and greater variability in negative mood, but the amount of variance explained is rather small (e.g., up to 5.0%, Eid & Diener, 1999). Thus, there seems to be potential for gaining additional insights by adopting a lifespan developmental perspective that considers the role of age in addition to personality factors in explaining individual differences in variability of affect.

[7] In this sense, affect intensity is considered to be a trait with implications for subjective emotional experience regardless of valence. Exemplar items from the Affect Intensity Measure (Larsen & Diener, 1987) include statements such as "When I'm happy I feel very energetic", "When I solve a small problem I feel euphoric", "Seeing a picture of some violent car accident in a newspaper makes me feel sick to my stomach", and "Calm and cool could easily describe me (reverse scored)". It should be noted that this general affect intensity construct is thus measured differently than computing intensity scores for positive affect and negative affect separately based on item-specific intensity ratings such as those obtained in experience sampling studies of affect ("Right now, how much do you experience each of the following emotions?", summing up intensity ratings across items for each affect dimension).

1.3.2 The Functional Nature of High versus Low Variability in Daily Affect

From a functional perspective, the value of intraindividual variability as an individual difference characteristic has been seen in its utility to predict other interindividual differences, not only to obtain information on who varies and who does not, but also in order to provide information on the functional or dysfunctional nature of variability itself. Two opposing perspectives have been articulated in the literature, the dysfunctionality and the functionality perspectives. Whereas the first considers high levels of variability to be dysfunctional, the latter discusses high levels of variability as a functional and adaptive feature (see Table 1.4 for overview). Underlying both assumptions is the notion that there may be an optimal level of intraindividual variability that is likely to differ across contexts and functional domains (see Martin & Hofer, 2004, for a short review).

High Levels of Variability as an Indicator of Psychological Dysfunctionality

In the early typology of intraindividual variability, Fiske and Rice (1955) proposed an adaptive type of variability, which they considered to be present when in fact either two objectively different stimuli trigger different responses or when the situational context has changed from one time to the next. The focus with this type of variability is on the adaptive implications of response differences, namely whether it is too small (indicating a possible failure to flexibly adapt to changing environmental and individual conditions) or too large (indicating an overreaction). In this context, response variability is distinguished from behavioral rigidity, indicating that depending on the domain under study, variability may be adaptive (in order to prevent boredom or to react to changing situational demands) or maladaptive (when accuracy is needed).

Only a few years later, Cattell (1957a, 1957b) reviewed early studies on personality correlates of variability in mood, attitudes and various types of cognitive performance, suggesting that greater variability across domains tended to be related to rather maladaptive personality traits such as low ego strength, low emotional stability, and personality integration in general – and it tended to be higher for individuals in pathological conditions (e.g., epilepsy) rather than healthy subjects (see also Burton, Hultsch, Strauss, & Hunter, 2002; Hultsch et al., 2002). This perspective is also advocated by Rowe and Kahn (1997), who concluded that elevated levels of intraindividual variability across various attributes might be considered a risk factor for impending death in older adults.

To date, the aging literature is still dominated by the view that variability is negative. Returning to the line of thought initiated by Fiske and Rice (1955), greater levels of

intraindividual variability may not unequivocally indicate malfunctioning, however. For example, there may be a desirable amount of normal, regular and hence predictable variation within certain limits and around an optimal level of functioning. On the other hand, irregular variability patterns or variability that exceeds desirable limits could represent the incapacity of the system to self-regulate emotions, cognitions and behavior around a rather stable and desirable mean level (Wessman & Ricks, 1966).

Table 1.4
Overview of Two Perspectives on the Functional Value of High Levels of Variability

High Levels of Short-Term Intraindividual Variability Indicating Individual Differences in	
Positive Psychological Functioning	*Psychological Malfunctioning*
▪ Adaptive flexibility to environmental demands ▪ Effective regulation of personal living environments ▪ Personality equilibrium ▪ Effective coping following stressful event or other perturbation of psychological system ▪ Behavioral diversity (i.e., in strategy selection) characterizing a developmental transition or learning of a new task	▪ Disequilibrium, lability of the system ▪ Increasing levels of illness ▪ Neurological changes in the brain ▪ Lack of processing robustness

Thus, whether or not intraindividual variability is adaptive likely depends upon the specific context or domain of functioning considered, on the developmental context, and on other individual differences (Martin & Hofer, 2004). In light of the negative perspective, greater intraindividual variability indicates a general systemic instability, a hallmark of aging that signals a general system breakdown (Nesselroade, 1991a; Schroots & Yates, 1999). For example, in the cognitive aging literature, greater variability has been discussed as a lack of fidelity or processing robustness, reflecting a compromised neurobiological system (e.g., Li & Lindenberger, 1999; Li et al., 2004; Lindenberger & Oertzen, 2006). Consistent with this, variability in cognitive performance was found to be greater among low-functioning than high-functioning individuals, to be grater among demented as opposed to cognitively healthy older adults, and has thus been interpreted as one indicator of cognitive (pathological) aging (e.g., Burton et al., 2002; Li et al., 2001; Ram et al., 2005; Strauss et al., 2002). Greater variability is related to poorer outcomes in

other domains as well. For instance, among older adults, greater week-to-week fluctuation in control beliefs predicted mortality five years later – aggregated weekly means of control beliefs did not (Eizenman et al., 1997). Among young adults, intraindividual variability in self-esteem is predictive of risk for depression (Gable & Nezlek, 1998; Kernis et al., 1991).

Overall, greater variability is thought to be generally maladaptive when it occurs around high levels of optimal functioning and hence in contexts in which maximum performance has been achieved and great precision is warranted. In these contexts, variability tends to be characterized by a pattern of deviations from optimal (i.e., maximum) performance and hence lapses of performance accuracy (Martin & Hofer, 2004). This could both be driven by a cognitive system that does not function optimally, but also by motivational lapses or fluctuations in other subjective states (e.g., stress, sleep; R. West et al., 2002a). In the physiological domain, on the other hand, a *loss* of complexity in patterns of heart rate variability and blood pressure variability in young versus older adults has been discussed as a potential indicator for the onset of specific decline trajectories and as biomarkers of cardiovascular aging (i.e., highly complex variability may be good; Lipsitz, 1995, 2002; Lipsitz & Goldberger, 1992; Thaler, 2002; Vaillancourt & Newell, 2002).

Concerning affect and mood, an optimal level (i.e., set-point) of well-being is thought to exist together with an optimal range of oscillations around it, differing across individuals (e.g., Headey & Wearing, 1989) and differing within individuals across different facets of well-being (Diener, Lucas, & Scollon, 2006). Deviations from this normal range of fluctuation could be either functional or dysfunctional. As discussed in the next section, greater fluctuations particularly in negative mood are associated with higher levels of neuroticism. In other work, mood variability in general has been considered as an aspect of possible psychological disequilibrium in adolescents (Larson et al., 1980) and as a risk factor for bipolar disorder (e.g., Depue, Slater, Wolfstetter-Kausch, Klein, Goperud, & Farr, 1981; Gottschalk, Bauer, & Whybrow, 1995).

With respect to the functional value of within-person fluctuations in affect, there are some studies with young but very few with older or with young and older adults. Findings converge on the notion that variability in negative affect tends to be related with poorer outcomes, whereas variability in positive affect tends to be inconsistently related to both poorer and adaptive outcomes. For example, Lawton et al. (1996) examined the nature of daily affect variation among three groups of older adults, namely healthy, major depressives, and minor depressives (M = 82.8 years), based on affect ratings obtained daily across 30 days. They showed that the major depression group not only showed the lowest average level of positive affect and

the highest level of negative affect, but also exhibited significantly less total variability in PA than both other groups. In this sample then, depressivity was associated with a diminished magnitude of positive affect fluctuation. This could be interpreted as a loss in depressed individuals' capacity to react to various positive stimuli and events in their everyday environment. For NA, major and minor depression groups had significantly greater overall NA variability and greater variability in the specific negative affects than the healthy group. Consistent with these findings, Burton et al. (2002) reported a positive association between variability in negative affect and number of stressors as well as mean levels of stress reported weekly across 10 weeks in a sample of adults ranging in age from 18 to 50.

Last, some studies have begun to shed light on the functional nature of short-term fluctuations in affect not only by examining its associations with psychological adjustment but also with other domains of functioning such as cognitive performance (Strauss et al., 2002). In this study, the authors compared a total of 45 healthy older adults, older adults with arthritis, and a group of demented older adults aged 57 to 87 on cognitive and physical measures, as well as on self-reported affect and control beliefs. The cognitive tasks included two reaction time tasks and two more complex recognition memory tasks. The physical measures included a 360-degree turn assessing balance/gait, finger dexterity, blood pressure, as well as peak expiratory flow. Affect was measured with the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), and control belief items were taken from Eizenman et al. (1997), including items for competence and control beliefs. Data collection stretched over four repeated measurement occasions spaced one week apart. Intraindividual variability in all domains was operationalized as the intraindividual standard deviation (ISD) as well as the coefficient of variation (CV) that was computed by dividing each participant's SD by their own mean score. The analysis of cross-domain linkages between intraindividual variability and average levels revealed that greater inconsistency in self-reported positive affect was related to slower but more accurate average cognitive performance across the different cognitive measures. With respect to negative affect, individuals exhibiting greater inconsistency in negative affect showed poorer cognitive performance, with group differences in the exact pattern of relation between accuracy and speed in performance and negative affect fluctuation. These results converge to some degree with those from the Lawton et al. (1996) study on the association between depressivity and affect fluctuation: fluctuations in negative affect tended to be linked with negative outcomes in terms of generally poorer cognitive performance, whereas fluctuations in positive affect were associated with both positive (i.e., more accurate) and negative (i.e., being slower) outcomes in the cognitive domain.

High Levels of Variability as an Indicator of Positive Psychological Functioning

Particularly in light of the inconsistent findings regarding the functional or dysfunctional implications of greater variability in positive affect, it is important to stress that fluctuation does not always mean a decrease from optimal functioning (Cattell, 1957b). In some contexts and functional domains, greater variability may even be beneficial. For instance, greater intraperson variability may be indicative of a general developmental transition and thus illustrate the overall system's inherent dynamics. Specifically, greater variability in cognitive performance during childhood is associated with greater movement towards a higher level of functioning (Siegler, 1994, 2002), and in general, in the context of learning a new task or skill, variability may initially signal that an individual is trying out different strategies before deciding on which one appears to be most promising in light of the task demands (Allaire & Marsiske, 2005; Li et al., 2004; Ram et al., 2005). Asendorpf (1992), for example, suggested that in some domains, intraindividual variability might be high in infancy, decrease in middle adulthood, and then increase again in very old age. Furthermore, the capacity to flexibly adapt to changing environmental and individual conditions, characterized by intraperson fluctuations rather than rigid, stable behavior, has been discussed as the 'adaptive' type of intraindividual variability in the classification by Fiske and Rice (1955; see also Nesselroade & Featherman, 1991).

In some contexts, greater intraindividual variability in aspects of emotional well-being, including a dynamical oscillation between positive and negative affect, can also be indicative of successful coping with a stressful life event (e.g., Stroebe & Schut, 1999). In a study with 19 recently bereaved older adult widows (M = 72.2 years, range = 57–82 years), emotional and psychological functioning was assessed every day for three months. Using a dynamical systems approach, Bisconti, Bergeman, and Boker (2004) were able to show that mood variability could be modeled as a linear oscillator model. Specifically, directly following bereavement, participants' reported low levels of well-being, but there was a significant improvement across the 3-month assessment period. In addition, variability in well-being showed a dampening over time, indicating that the magnitude of mood swings decreased as time since bereavement was passing. Even though this study did not examine whether individual differences in such dampening were predictive of more or less successful coping and adjustment at the end of the 3-month period, it elegantly tested theoretical assumptions from the coping literature on dynamical processes and suggested that a consideration of variability in context is warranted and greater levels of variability may be functional and even expected in certain contexts.

1.3.3 State-Like Correlates of Variability in Positive and Negative Affect

Alternative to the explanatory role of trait-like correlates, studies have frequently investigated the association of environmental influences such as daily events thought to be one of the driving forces of state-dependent fluctuations around individual's dispositional level of emotional experience (e.g., Headey & Wearing, 1989; Almeida, Charles, Neiss, & Rowe, 2006). This work has its complementary part in studies that have investigated the role of major life events for trait-level well-being and life satisfaction. Headey and Wearing (1989), for example, outlined a dynamic equilibrium model of well-being and life events in which they propose that individuals have a homeostatic equilibrium level of well-being and an equilibrium level of life events, and only upon departures of life events from their equilibrium level, changes in subjective well-being should occur. They present empirical support for this thesis based on a four-wave panel study with initially 942 individuals (ages 18–65). Likewise, minor daily events are thought to play a prominent role for daily experiences of mood, particularly when they are severe (i.e., greater deviations from equilibrium level; e.g., Stone & Neale, 1984).

Consistent with the dynamic equilibrium model, and in extending it to minor daily events, Almeida and colleagues (2005) recently examined the interplay of environmental and genetic influences in explaining variation in affective distress using data from 210 adult twin pairs (M = 43.4 years, SD = 11.8, range = 25–74 years) that were part of the National Study of Daily Events (NSDE). In this study, individuals were telephoned every night for eight consecutive days and provided self-reports of daily stress and stressor occurrence (among other variables). In addition, ratings of global affective distress across different time frames (past month, past week) were obtained. Using a standard additive genetic model of family resemblance, the authors were able to show that more global reports of affective distress and affective distress reported on stressor-free days were determined by genetic and environmental factors, whereas variation in affective distress across days with stressors were most strongly related to environmental factors.

From a micro-level, intraindividual difference perspective, the emphasis is on the association between daily stress and health indicators (e.g., pain) as opposed to major life events and daily affect or depression (Bolger, DeLongis, Kessler, & Schilling, 1989; Clark & Watson, 1988; Gable et al., 2000; Nezlek & Gable, 2001; Nezlek & Plesko, 2001; van Eck, Nicolson, & Berkhof, 1998; Watson, 1988a). Daily events, as opposed to major life events, are described as minor daily hassles and uplifts, such as a stressful social interaction, a bad grade in a test returned that day, a compliment received from a close friend, a health symptom. According to stress theories, it is these mundane events, and particularly their cumulative occurrence, which should bear their toll on health and well-being outcomes rather than major life events alone (see Kanner,

Coyne, Schaefer, & Lazarus, 1981, for review). The impact of such minor daily events is also expected to depend on the type of event, and there is evidence that interpersonal stressors show much stronger and more persisting relations to daily mood than other daily events (e.g., Bolger et al., 1989; Clark & Watson, 1988).

Theoretically, these hassles and uplifts should be differentially related to PA and NA and individual differences in variability, corroborating the notion that positive and negative affect represent two distinct behavioral systems of approach and withdrawal (e.g., Almeida, 2005; Bolger & Schilling, 1991; Clark & Watson, 1988; Kanner et al., 1981; Zautra, 2003). In addition, because negative influences have been shown to be dominant (e.g., Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Taylor, 1991), cross-over effects may be more prominent for negative events such that negative events related both to daily negative and positive moods, whereas positive events may be only related to daily positive mood. In fact, a large body of research indicates quite consistently that positive daily events tend to be more strongly related to positive affect, with the opposite pattern being true for negative daily events and negative emotions (e.g., Bolger et al., 1989; Clark & Watson, 1988; Gable et al., 2000; Nezlek & Gable, 2001; Nezlek & Plesko, 2001; Vittengl & Holt, 1998; Stone & Neale, 1984). In terms of affective cross-over effects, David et al. (1997) were able to show that desirable events were mainly related to daily positive mood (aggregated across eight nightly assessments), whereas undesirable events were significantly related to average daily negative and positive mood. Furthermore, positive and negative emotions tend not only to be differentially correlated to positive versus negative events, but also to different types of events. In a classical earlier study, Watson (1988a) had 80 young adults rate their daily positive and negative affect and their daily events over six to eight weeks. PA was more strongly related to social activities and physical exercise, whereas NA showed associations with perceived stress. Interestingly though, health complaints were related to variability in both PA and NA (see also Bolger et al., 1989; Clark & Watson, 1988; Emmons, 1991; van Eck et al., 1998; Vittengl & Holt, 1998). In general, the differential coupling between daily hassles and uplifts and types of activities with daily PA and NA are consistent with the notion that the PA system represents the subjective representation of a behavioral system of approach and pleasurable engagement with the environment, whereas the NA system is representative of behavioral withdrawal and distress. It is also noteworthy, that the relationship between events and daily mood could be shown to hold even after accounting for the relationship between personality and daily mood (David et al., 1997).

Given the theoretical propositions about age-related differences in patterns of mood fluctuations, the question remains whether the strength of the relationship between daily events

and daily mood differs between young and older adults. Age-related differences in the pattern of association between daily contexts and daily emotional well-being could be informative about the processes underlying age-related differences in mean levels and variability of affect.

1.3.4 Age-Related Differences in Trait-Like and State-Like Correlates of Affect Variability

Despite the strong conceptual interest in the phenomenon of intraindividual variability for theory building in lifespan psychology on the one hand and a growing body of research on emotion and aging, we have not come very far in understanding the functional nature of short-term variability in self-reported affect in different age groups. Based on the converging evidence on the association of variability in negative affect with poorer outcomes in terms of psychological adjustment and performance (see above), and given the functional role of negative affect as a representation of a behavioral emergency system (Elliot & Thrash, 2002), it is likely that variability in negative affect is related to poorer psychological adjustment (in terms of broader well-being and personality) in both young and older adults. However, even in younger adults, the pattern is less clear with respect to positive affect variability (see above). It is possible that variability in positive affect is linked to better psychological adjustment in young adults because it reflects an adequate reaction to one's diverse daily routines and thus a healthy sensitivity to environmental rewards and pleasantries of life (see Larson et al., 1980; Larson, Moneta, Richards, & Wilson, 2002). In older adults, to the contrary, greater variability in positive affect may reflect hypersensitivity and an inability to orchestrate one's emotional and cognitive resources. Therefore, it could be related to poorer adjustment within the group of older adults. Due to a lack of previous work in this area, these propositions remain speculative and in the present dissertation, an initial attempt will be made at exploring this issue further.

With regard to age-related differences in the state-like correlates of affect variability, such as the relationship between daily mood and daily events, two general theoretical hypotheses have been advanced in the literature. These propositions have mainly focused on age-related differences in reactivity to stressors (i.e., negative events), but may be helpful in considering positive events as well: one perspective suggests that older adults should be less reactive to stress based on the notion that the cumulative repetitive experience of negative affect across the lifespan leads to dampening and habituation effects and that individuals become increasingly effective in dealing with their emotions (e.g., Carstensen, 1995; Diehl et al., 1996; Schulz, 1982; cf. Mroczek & Almeida, 2004). A similar perspective can be extended to the relationship between positive events and positive affect, because the dampening should equally hold for different types of affective valence.

The contrary perspective posits that age should be positively related to stress reactivity. Proponents of this perspective argue for a sensitization rather than dampening effect as a function of the repeated experience of negative stimuli, which is related to changes in brain structures mediating the subjective experience of negative affect. This process has also been labeled "kindling" and has been observed with respect to anxiety, depressive episodes and pain among others (cf. Mroczek & Almeida, 2004; see also Uchino, Holt-Lunstad, Bloor, & Campo, 2005).

Unfortunately, the empirical basis that could help to clarify which of the two propositions, if any, holds in which individuals under which conditions, is scarce. In the National Study of Daily Events (NSDE), 1,012 individuals ranging in age from 25 to 74 years were telephoned every night for eight consecutive days and provided self-reports of daily stress and daily negative affect (Mroczek & Almeida, 2004). In essence, multilevel modeling analyses of the NSDE data, which allow for simultaneous estimation of within-person associations and between-person differences therein, yielded support for the second perspective: Older adults showed stronger positive relationships between daily stress and daily negative affect than younger adults. The question remains open, however, whether older adults are also more reactive to positive daily events as reflected in a stronger positive relationship between daily positive events and daily positive affect. Unfortunately, most studies on daily mood, including the one by Mroczek and Almeida (2004), are biased in focus toward the negative such as negative affect, depressivity, and stress, rather than capturing the positive facets of everyday life as well.

So far, I have reviewed the literature that is relevant for the first two research questions on age differences in intraindividual variability in emotional well-being and on trait-like and state-like correlates of variability in emotional well-being. The next section will give an overview of the theoretical and empirical work related to the third focus of this dissertation, namely the within-person association between daily affect and daily cognitive performance in young and older adults.

1.4 The Coupling of Affect and Cognitive Performance Within Individuals: A Sample Case of Dual-Tasking in Everyday Life

Considering that most of what we experience in our daily lives is colored by some affective tone (Watson, 2000a, referred to this as a continuous 'affective stream' that characterizes waking consciousness throughout the day), either positive or negative, and that cognitions are also involved in most of what we do, it is not surprising that psychologists have

long asked the question about how emotions (and other subjective states) and cognition are interrelated. Historically, emotions and affects were seen as debilitating parties when it came to rational cognition, as exemplified in the old cliché of 'the heart versus the head' (e.g., Darwin, 1872, cf. Oatley, 2001). Since then, the perspective has broadened to include functional conceptions of emotional experiences, which examine more closely the specific interactions between certain types of emotion and affect with certain kinds of cognitive tasks.

Studies on emotion-cognition linkages have mainly been restricted to cross-sectional, laboratory experiments of between-person differences in young adult samples. They can be grouped into two broad research strands: The first group is interested in studying how mood states affect the processing and memory of valenced material and how mood affects decision making and social judgments (e.g., Bless, 2003, for review; Clore, Schwarz, & Conway, 1994; Fiedler, 1990; Forgas, 1995). One of the most-studied effects in this tradition is the mood-congruency effect in memory, namely that people tend to have better memory for positive stimuli in positive mood states and better memory for negative material during negative emotional experiences (e.g., Bower, 1981; see also Isen, 1990). Bower (1981) proposed an associative network theory to account for this effect, according to which emotions function as memory units that are associated with co-occurring events. Upon activation, retrieval of events associated with a given emotion is facilitated.

The second line of research is interested in the implications of positive and negative moods for basic cognitive processes such as memory, attention, and creativity in tasks, in which the focus is not necessarily on valenced material or social cognition (e.g., Matthews et al., 2002). This research tradition is two-fold. On the one hand, there is work that has been guided by the distinct functions of positive and negative affect described below, from which hypotheses were derived about the cognitive implications of certain mood states and thus the beneficial and detrimental effects certain affects should have on certain cognitive tasks (e.g., creativity versus elaborative processing). Several researchers have also attempted to highlight the possible neurobiological underpinnings of the emotion-cognition relationship, focusing on brain regions important for emotional experience that are also of utmost importance to cognitive performance (e.g., the amygdala; Dolan, 2002; Gray, 2001; Gray, Braver, & Raichle, 2002), or on neurotransmitters such as dopamine and its mediating role in the influence of positive affect as a feeling state associated with reward-related contexts on creative problem solving and memory (Ashby, Isen, & Turken, 1999; Wacker, Chavanon, & Stemmler, 2006; Wittmann, Schott, Guderian, Frey, Heinze, & Düzel, 2005).

On a different level of analysis the association between affect and cognition has been conceptualized as a resource allocation problem, emphasizing the view that emotions have deleterious effects on cognition due to a resource allocation competition. In the context of the present dissertation, the regulation of emotions and performance on a cognitive task were considered within a theoretical dual-task framework.

The field of emotion-cognition relationships is thus very broad. Within the framework of this dissertation, the focus is on the second research strand, which is interested in the facilitative versus detrimental effects of positive and negative affect for certain cognitive tasks. In addition, because one major interest in the present study is on the role of age in the emotion-cognition interplay, theoretical notions of resource allocation competition and dual-tasking provide a useful theoretical framework to be incorporated in propositions about age-related differences in cross-domain coupling. The next sections will briefly review the general functions of positive and negative affect, and the specific implications of both for various cognitive processes. The last section will highlight theoretical propositions about age-related differences in the relationship between affect and cognitive performance derived from existing theories and summarize some initial empirical evidence.

1.4.1 Functions of Positive and Negative Affect: Benefits and Costs for Cognition

Emotions and affective states serve crucial functions as sources of information both for the person experiencing them as well as communicative tools in social interactions (Schwarz, 1990). According to a prominent theory on the origins of positive and negative affect, mood states reflect a monitoring system of progress or discrepancy in relation to goal values (Carver & Scheier, 1990). Furthermore, positive and negative emotions are considered to be expressions of very distinct underlying behavioral adaptive systems with different neurochemistry and different neurobiological functions (e.g., R. J. Davidson, 1999; Panksepp, 1998). Positive affect and emotions are reflective of the behavioral approach system. This means that in circumstances of positive affect, individuals' thoughts, feelings, and behaviors are goal- and involvement-oriented (Elliot & Thrash, 2002). Positive emotions signal that things are going as they ought to, that one can relax and that one's goals are met (Carver, 2003; Carver & Scheier, 1990; Frijda, 1986; Schwarz, 1990), they foster individual growth and skill acquisition (Fredrickson, 1998), and diminish or undo the cardiovascular effects of negative emotions (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Brainigan, & Tugade, 2000). Happiness, defined as the frequent experience of positive affect, is related to adaptive characteristics such as self-confidence and

optimism, activity and energy, positive social relationships, and superior performance on some cognitive tasks (Lyubomirsky, King, & Diener, 2005).

Negative affect, on the other hand, is a representation of the behavioral inhibition system (Elliot & Thrash, 2002), serving as general information that things are not going well, and that action needs to be taken (e.g., Schwarz, 1990). It has been said to reduce attentional scope and action tendencies (e.g., Broadbent, 1971; Easterbrook, 1959), but at the same time, negative stimuli are thought to mobilize physiological, cognitive, and social resources to a greater extent than do positive emotions (Taylor, 1991).

Different theoretical and empirical research perspectives have emerged to examine potential benefits and costs of emotions for cognitive performance. The first perspective was guided by the general functional roles of two broad classes of emotion and affect, namely positive and negative affect. This tradition incorporated the idea that different affective qualities can both have different implications for cognition, ranging from benefits to costs. The second perspective was narrower, focusing almost exclusively on costs associated with the experience of certain negative emotional-affective states. This second perspective, however, was guided by general conceptions of gains and losses and resource allocation that are central to lifespan psychological research (Baltes et al., 2006). Each perspective will be presented next.

The Functional Perspective: Emotions Can Be Beneficial or Detrimental for Cognition

Given these distinct general functions of positive versus negative affect, distinct implications for cognition have been proposed and empirically tested as well, considering various time scales over which the relationship between emotion and cognition can evolve. One example for a longer time perspective is the broaden-and-build model of positive emotions advanced by Fredrickson (1998). In this model, she proposes that positive emotions foster a broadening of momentary thought-action repertoires. According to the theory, such momentary broadening, over time, builds personal, social, physical, and intellectual resources and skills that enhance positive functioning and well-being in turn and enable the individual to be prepared for future challenges (Fredrickson & Joiner, 2002; see also Ashby et al., 1999; Isen, 1999).

Other theoretical and empirical approaches have focused specifically on the short-term effects of affective states and cognition. In terms of the benefits of emotion and affect for cognition, negative mood has been found to enhance effortful, analytical processing in complex tasks (for review, see Bless, 2003), a strategy that particularly works in novel tasks that require renewed processing and analysis because one cannot rely on previous strategies. On the other hand, this strategy proves to be inefficient in familiar tasks. Positive affect can enhance creative

problem-solving and flexible interpretation of material (e.g., Isen, 1999), which is consistent with the broadening-function of positive affect in Fredrickson's (1998) model. In a recent review article, Lyubomirsky et al. (2005) concluded that happy individuals outperform those in a sad mood on familiar tasks that allow them to rely on previous experiences rather than drawing on energy and resources anew (a strategy associated with negative affect). Some findings also indicate that happy individuals are capable of more effortful processing in novel and complex tasks when there are cues about the importance of the study or cues indicating that participants will be made accountable for their decisions (Lyubomirsky et al., 2005). Similarly, Isen (1999) has argued that people in happy moods show poor cognitive performance primarily in tasks that are considered boring.

In sum, to date, a theory integrating these different findings is missing and empirical evidence suggests that the functional implications of affect for cognition are strongly dependent on the type of affect or emotion as well as the type of cognitive performance one investigates.

The Resource Allocation Perspective: Emotion and Cognition Compete for Similar Resources

Apart from the conceptual perspective that positive and negative emotions may have both beneficial as well as detrimental effects for cognition, another class of theories of the association of emotion and cognition have invoked cross-domain competition in the allocation of resources as indirect causes of coupling, thereby focusing primarily on negative emotional states (see Table 1.5). These theories converge on the idea that the concurrent regulation of emotions and cognitive performance draws upon a similar pool of basic cognitive attentional and working memory resources (i.e., attention, working memory). In the context of the present dissertation, the successful regulation of emotions and cognitive performance is considered as one instance of dual-tasking in everyday life that requires the individual to allocate these common resources to both tasks (see also Navon, 1984; Navon & Gopher, 1979, for early conceptual work on dual-task performance and the idea of resource competition). As a consequence, performance in certain cognitive tasks may be impaired as resources are taxed by the emotional domain rather than being fully available to facilitate maximum performance. In their processing efficiency theory, for example, M. W. Eysenck and Calvo (1992) focus on the negative effect of anxiety on working memory and general cognitive performance. The general assumption of their theory is that (state) anxiety triggers worry and ruminating thoughts that intrude with working memory performance in competition for similar resources as those required by short-term storage and processing of material (see also Morris & Liebert, 1969). This idea is in accordance with the resource allocation theory advanced by Ellis and Ashbrook (1988). The latter acknowledged

primarily sad and depressed mood rather than anxiety, but advocated a similar mechanism of the coupling, in that the authors suggested that task-irrelevant thoughts associated with the depressed mood would induce attentional interference and thus divert resources away from the cognitive task.

Emotion regulation does not only entail the down-regulation of negative affect, but may in certain situations also encompass the up-regulation of negative affect and the down-regulation of positive affect (Parrott, 1993). Even though most individuals would most likely prefer feeling happy than unhappy, very elevated levels of positive affect may be dysfunctional as well. In the context of general self-regulation, Schwarzer (1998), for instance, suggested there is a need of a "time-out" of optimism in goal pursuit, and that not at all stages of a given behavior (i.e., performance on a task, pursuit of a goal), the same level of an emotional experience may be equally helpful. It is thus not surprising, that cognitive costs have not only been associated with negative affect. Positive affect has been found to be related to less accurate, as well as less logical and more superficial, heuristic-driven, and stereotypical judgment-making and information-processing (e.g., Bodenhausen, Kramer, & Süsser, 1994; Forgas & Fiedler, 1996), a strategy that may be dysfunctional in certain novel task contexts. In addition, there is also evidence that not only negative affect (including anxiety and depression) but positive affect as well may lead to a decrease in memory performance by increasing task-irrelevant thoughts and self-focused rumination and thus siphoning off cognitive resources (Joormann, 2005; Lyubomirsky, Tucker, Caldwell, & Berg, 1999; Nolen-Hoeksema, 1998; Seibert & Ellis, 1991), particularly as task difficulty increases (e.g., Ellis, Moore, Varner, Ottaway, and Becker, 1997; Ellis, Thomas, & Rodriguez, 1984; MacLeod, 1996; see also Klein & Boals, 2001, for the presentation of similar ideas and findings regarding the relationship of life event stress and working memory capacity). For instance, in two experiments with 90 young adults, Seibert and Ellis (1991) induced participants into happy, neutral, and sad mood states and then asked them to complete a memory task. In Study 1, participants then had to recall and list thoughts experienced during task completion. In Study 2, participants reported thoughts concurrently with task performance in a "think-aloud" procedure. In both studies, participants later on rated their thoughts in terms of irrelevance, defined as thoughts that did not facilitate successful task performance. Results suggested that both happy and sad mood induction led to a greater number of task-irrelevant thoughts as compared with individuals in the neutral condition. Furthermore, the proportion of task-irrelevant thoughts was negatively correlated with memory performance.

Table 1.5
Overview of Theoretical Models on the Resource Allocation Perspective in Emotion–Cognition Coupling (Ordered by General Proposed Mechanism)

Authors	Name of Theoretical Model	Type of Affect/Mood Considered	Summary of Propositions
Emotion Regulation has Cognitive Costs			
Hasher & Zacks (1979)*	Attentional Capacity Model	Stress/Depression	Effortful memory processes may be vulnerable for the effects of other processes that require cognitive resources, such as stress and depression.
Isen (1984)	Mood Repair Model	Negative mood	Mood-repair processes/emotion regulation use attentional resources that can no longer be allocated to concurrent cognitive tasks.
Richards & Gross (2000)*	Cognitive Costs of Emotion Regulation	Mainly negative mood, but positive mood is theoretically included in model	This process is particularly strong for very demanding regulation strategies (e.g., response-focused suppression versus antecedent-focused reappraisal).
Emotional States Lead to Irrelevant Thoughts			
Ellis & Ashbrook (1988)	Resource Allocation Theory	Sad/Depressed mood states, later extended to positive mood	Emotional states lead to task-irrelevant thoughts, thus affecting the amount of attentional capacity that can be allocated to a criterion (e.g., cognitive) task.
M. W. Eysenck & Calvo (1992) Early related ideas also from Hamilton (1975)	Processing Efficiency Theory	Anxiety	Anxiety leads to worry, which can have both attentional interference as well as motivational effects on cognitive performance
Self-Regulation Diminishes (Depletes) Ego Strength			
Baumeister et al. (1998) & Schmeichel et al. (2003) Early related ideas also from Kahneman (1973)	Ego Depletion Theory	Positive and negative affect/mood	Acts of volition draw upon a limited resource of energy/strength. Self-regulation of one response (e.g., emotion regulation) may exert an influence on the regulation of a concurrent response (e.g., performance in a difficult cognitive task one would prefer giving up on) by drawing on this strength and thereby temporarily reducing it.

Notes. * = Asterix denotes theoretical models or empirical tests of them that include an explicit lifespan perspective (at least to some extent).
Studies are grouped according to the overall underlying mechanism proposed to drive the emotion-cognition coupling. Within each category, studies are grouped in alphabetical order of authorship. Empirical tests of models have been conducted with induced rather than naturally occurring mood.

Another way in which positive and negative emotions can interfere with cognitive performance is by decreasing attentional capacity, specifically in effortful tasks (Hasher & Zacks, 1979). The Affect Infusion Model (AIM) proposed by Forgas (1995), differentiates between four types of processing strategies with regard to making social judgments, each depending on a combination of amount of effort expenditure (high, low) and the nature of the task (open and constructive, i.e., requiring the transformation of information into new solutions; closed and reconstructive, i.e., having an intuitively apparent solution as a starting point). According to this model, the "infusion" of mood into cognitive performance is most likely to occur in the context of open, constructive tasks (i.e., tasks that require more elaborated processing). Furthermore, emotions in general have been found to suppress performance in deductive reasoning and planning tasks by diminishing working memory resources and by affecting executive functioning directly (Oaksford, Morris, Grainger, & Williams, 1996; Phillips, Bull, Adams, & Fraser, 2002; Spies, Hesse, & Hummitzsch, 1996).

Finally, Richards and Gross (2000; see also Forgas, 2002; Forgas & Ciarrochi, 2002) have recently investigated the impact of emotion regulation on memory performance in young adults. People are thought to continuously engage in emotion-regulation and mood management in order to maximize overall well-being (Gross & Levenson, 1997) or to more generally keep their levels of subjective emotional experience within a given threshold (Forgas & Ciarrochi, 2002). Isen (1984) already advocated the notion that mood-repair processes associated with negative emotional states, often cognitive in nature (e.g., distraction, re-evaluation), take away resources needed for other cognitive tasks. Richards and Gross (2000), however, were able to show that at least some emotion regulatory strategies (i.e., response-focused suppression, but not antecedent-focused reappraisal) impaired memory performance in younger adults. Furthermore in line with the claim of cognitive costs of emotion regulation is the idea of ego depletion advocated by Baumeister and his colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998; see also Kahneman, 1973). According to these researchers, a general resource akin to energy or strength is available to the self. This resource is expended in situations (i.e., 'ego depletion') that require the change, overriding or otherwise the regulation of responses across a variety of tasks, including in the face of emotional stimuli. In fact, Schmeichel, Vohs, and Baumeister (2003, Experiment 2) were able to show that in a sample of 37 undergraduates, prior emotion regulation (i.e., suppression of internal and external emotional reactions to a film clip intended to induce negative mood) led to decrements in performance in a set of cognitive tasks, particularly in more complex tasks of cognitive extrapolation that required executive control, and

to a lesser extent in a relatively simple test of vocabulary, general knowledge, and mathematical ability in multiple-choice format.

Despite the fact that the theoretical models outlined above put forth hypotheses that would be best tested on the within-individual level, the studies reviewed have clearly been limited to the largest part to classical single-occasion, between-person designs. Furthermore, rather than studying naturally occurring affective experiences, most studies have manipulated baseline mood levels by mood-induction procedures. In contrast, half a century ago, Cattell (1957a, 1957b) reviewed initial evidence that within-person variability in performance of various cognitive tasks may be related to states such as fatigue and personality factors of distractibility and daydreaming. In addition, he reasoned that upon the availability of questionnaires sensitive enough to assess momentary variations in a multitude of subjective states, "a new realm of meaningful experiment will open up in the study of moods, fatigue states, biological cycles, and malergies affecting everyday performance" (Cattell, 1957b, p. 685). More recently, and in trying to explain the processes underlying intraindividual fluctuations in cognitive performance, several authors have suggested that in part, trial-to-trial variability in working memory performance could be driven by lapses of executive control and the ability to resist interference (Duncan, Emslie, & Williams, 1996; Schmiedek, Li, Smith, Huxhold, Röcke, & Lindenberger, 2006; Spieler, Balota, & Faust, 1996; R. West, 2001; R. West et al., 2002a).

In sum, acknowledging the dynamical nature of affect and the distinction between the different levels of analysis (i.e., between-person versus within-person), appears to be a long-discussed but yet to be achieved natural extension of previous work to study the interrelationship between the domains of affect/emotion and cognition on a micro-genetic level to learn more about the everyday dynamics of affect and cognition. In the words of Thagard & Nerb (2002) in a recent special issue on dynamical systems perspectives in the area of self and personality, "affect is a natural subject for a dynamical theory that emphasizes the flow of thought and the complex interactions of emotion and cognition" (p. 274).

1.4.2 Does the Cost/Benefit Ratio in the Emotion-Cognition Coupling Differ for Certain Subgroups?

In light of the available theoretical as well as empirical evidence on the cognitive costs associated with emotion regulation, the question is whether there would be individual differences in the way emotions may be coupled with cognitive performance. The central question in the present thesis was whether there would be reliable age-related differences. In an overview of the necessity to consider both stable as well as changing characteristics of individuals within a

developmental psychology perspective, Nesselroade (1988) had already suggested to examine how [emotional] states influence performance in intelligence tests in order to promote a more complete understanding of age-related differences in maximum performance under optimal testing conditions.

From the resource allocation perspective, it is possible that such costs may adversely impact individuals with a relatively restricted cognitive resource pool, or individuals for whom emotion regulation is a very salient goal, with unintended sacrifices of cognitive resources necessary for a given critical task (i.e., older adults, see Table 1.6), or a combination of the two. As outlined in Section 1.1.1, trade-offs between different domains of psychological functioning are a major emphasis in lifespan theoretical notions of selective allocation of resources to one goal-domain (e.g., maintenance or maximization of well-being) over other domains (e.g., maximum cognitive performance in a given test of abilities). In line with these ideas, some of the theoretical accounts touched upon above have taken age as an additional factor in the emotion-cognition link into consideration. Hasher and Zacks (1979; see also Ellis & Ashbrook, 1988), for example, proposed that in old age, attentional interference induced by the experience of emotions might be particularly deleterious due to additional age-related biological and neurological changes that entail a reduction in attentional capacities already. In a similar vein, individuals high in depression may be particularly prone to attentional and inhibitory deficits associated with rumination (see also Joormann, 2005; Unsworth, Heitz, & Engle, 2005). Despite the relevance of a resource allocation perspective for a lifespan psychological approach to the cross-domain coupling of emotion and cognition, little empirical research has been devoted to the question of how age-related differences in average (i.e., trait-like) levels of functioning in both domains translate into processes of prioritization and resource unfolding spontaneously in everyday life.

Table 1.6
Overview of Potential Age-Related Differences in Emotion-Cognition Coupling

Functional Domain	Young Adults	Older Adults
Cognitive Capacity	Relatively intact	Reduced with respect to fluid intelligence (e.g., attention, inhibition)
Emotion regulation	Motivationally less salient	Motivationally highly salient
Emotion-Cognition Coupling in Everyday Life	Relatively weak	Relatively stronger and characterized by impaired cognitive performance

One research tradition that has received relatively vivid attention in recent years, has examined age-related differences in the processing of emotional stimuli in a variety of tasks, including memory, attention, and problem-solving. This type of research is mainly rooted in sociocognitive theories of emotional and cognitive development that have considered the interplay between these two domains at different ages (e.g., Blanchard-Fields, 1998; Carstensen et al., 1999; Labouvie-Vief, Hakim-Larson, DeVoe, & Schoeberlein, 1989). These theories converge on the notion that whereas many aspects of cognition show patterns of decline with age, the salience of emotions and emotional functioning is maintained or increased during adulthood. As a consequence, performance in cognitive and problem-solving tasks that rely on emotions is actually improved or at least maintained in older ages, possibly due to an increased ability to integrate emotional information into information processing tasks (for review, see Blanchard-Fields, 1998; Carstensen & Mikels, 2005; Isaacovitz, Charles, & Carstensen, 2000).

On the other hand, the resource allocation perspective would predict that in those cognitive tasks that require processing of *non*-emotional information, concurrent emotion-regulation and an increased focus on the processing of emotion-relevant information might impair performance in older adults disproportionately in comparison to young adults. Whereas the role of emotion for basic cognitive processes have repeatedly been demonstrated in young adults, there is little empirical research on the relationship between emotion (in the broadest sense) and cognition in older adults, and even less on age-related differences in this association.

In general, two specific emotional states or symptoms have attracted attention in the literature: Both depression and anxiety were shown to be inversely related to performance in a variety of tests, including general mental status, memory, psychomotor speed, and reasoning in samples of older adults who were in the so-called Third Age (i.e., maximum age 80–85 years; e.g., depression: La Rue, Swan, & Carmelli, 1995; anxiety: Wetherell, Reynolds, Gatz, & Pedersen, 2002). The available studies also provide some evidence consistent with the idea that older adults are more vulnerable to the cognitive costs of emotion than young adults.

For example, in a study examining the relationship between age, anxiety and divided attention both in the cognitive and the motor domain (Hogan, 2003), 78 young adults (M = 18.8 years, SD = 1.9) and 92 older adults (M =70.1 years, SD = 7.1) first provided self-reports of state-level and trait-level anxiety and then engaged in a number of cognitive as well as motor tasks (e.g., word-comparison, a pursuit-rotor task). In addition, performance on each task occurred both under selective and divided attention conditions. Across individuals, greater levels of anxiety were related to poorer cognitive (but not motor) performance in older but not younger adults. Deptula, Singh, and Pomara (1993) also reported significant correlations between self-

reported negative affect and depression and verbal memory in elderly but not in young adults (see also Andreoletti, Veratti, & Lachman, 2006). A study by Bäckman and Molander (1991) examined performance of young and older skilled mini-golf players both during training (low arousal condition) and competition (high-arousal condition). Even though both age groups evinced an increase in heart rate and subjective anxiety, younger adults improved their performance from training to competition, whereas older adults' performance deteriorated during competitive play.

One of the few studies to investigate age differences in the effects of both negative *and positive* induced mood (as opposed to a mere focus on such specific states as anxiety or depression) on a cognitive task relevant for the present thesis was conducted by Phillips, Smith, and Gilhooly (2002). Their young sample included 19 to 37 year-olds (M = 23.0 years; SD =5.24; n = 48), and the older sample was between 53 and 80 years of age (M = 67.0 years; SD = 6.65; n = 48). Mood induction occurred through film clips in addition to music, and then participants engaged in the Tower of London task (TOL), an executive control task that assesses planning performance. Executive control is one aspect of working memory, and performance on the task has been found to be related particularly to visuospatial working memory performance. Findings revealed that detrimental effects on task performance (in terms of number of excess moves, number of trials out of three solved in the minimum possible moves, and time taken to plan moves) were quite similar among young and old adults with respect to induced *positive* mood (hence supporting the findings by Oaksford et al., 1996), but older adults were more profoundly affected by *negative* mood than young adults.

The authors discussed their findings with respect to three theoretical ideas. First, both positive and negative mood may have posed an extra load on working memory capacity, which was particularly harmful for older adults, whose working memory capacity is already reduced in comparison to younger adults. Second, positive mood has been shown to be related to less effortful processing, particularly when a task is experienced as boring and unpleasant. Because older adults have been shown to engage in even more heuristic processing than younger adults (Klaczynski & Robinson, 2000), such motivational factors may have increased the effect of positive mood on planning in older adults. And third, the authors recur to findings of greater emotional control and self-regulation in old age, which may occur at the expense of other ongoing demands, for example cognitive performance (see Richards & Gross, 2000) – at least in contexts that involve unemotional stimuli.

Finally, research on age-related differences in source monitoring and recall has also yielded evidence consistent with the idea that older adults' greater focus on affective rather than perceptual information may be one reason for age-related deficits in monitoring and

retrospectively recalling the source of a particular information (Hashtroudi, Johnson, Vnek, & Ferguson, 1994). Others have found only memory anxiety rather than global state anxiety to be more adversely related to memory performance in older than younger adults (H. A. Davidson, Dixon, & Hultsch, 1991), whereas some studies did not find a disproportional vulnerability of emotion on cognition for older as opposed to younger or middle-aged adults at all (Arbuckle, Gold, & Andres, 1986; La Rue & D'Elia, 1985).

In sum, the theoretical and empirical evidence outlined above appears to converge on the general idea that one cannot simply say that when feeling well people also perform well, and when they feel bad, their performance goes downhill also. Positive and negative emotions can both enhance and impair concurrent cognitive performance in both young and older adults. Several theoretical propositions have been formulated on the interplay of affect/emotion and cognition, which hinge on the assumption that emotional experience can have a cognitive load that may interfere with performance on a criterion cognitive task. The present dissertation proposes to consider emotion regulation and cognitive performance from within a dual-task framework. Age-related differences in the prioritization of goals and the availability of resources may affect the ease of and the motivation for particular resource allocation patterns, thus processes of emotion regulation may take a larger toll on one's regulatory and cognitive resources and hence on concurrently executed cognitive performance in older than younger age. Considering the developmental trajectories of the well-being-cognition interplay with respect to naturally occurring day-to-day emotions is warranted to better understand cross-domain relationships and allocation of resources as they unfold in everyday life.

Despite that fact that the theories on emotion-cognition interrelations propose a relationship between momentary affective states and information processing or other cognitive activities to occur for any given individual, empirical evidence so far is largely restricted to between-person studies. In addition, there is limited age-comparative evidence, particular with respect to positive mood states (versus anxiety and depression), which has examined whether age-related changes in motivation, affective competencies and in cognitive abilities lead to age-related differences in the association between affect and cognitive performance.

Within-person evidence is only slowly emerging, and findings are inconsistent across these few studies. Some report moderate within-person associations between aspects of self-reported affect and mood and cognition, while others do not find evidence for within-person coupling, or they only find it between previous day affect and current day cognition (e.g., Ong, Allaire, & Stawski, 2004, Sliwinski, Hofer, & Smyth, 2004; Stawski, Wasylyshyn, & Sliwinski, 2004). Using a single item of current affect (happy–unhappy), Salthouse & Berish (2005), for

example, found that on average, affect and reaction time performance were uncorrelated within individuals (but the authors note that across individuals, the association differed in magnitude and direction, indicating a complex picture of within-person cross-domain associations). One reason for this inconsistency may be that the studies differ in the sampling of number of participants, number of assessment times, selection of measures for affect and cognitive performance. Few of them have gone beyond stress as indicators of daily well-being, or have systematically included both young and older adults.

In general, caution should be exercised when deriving conclusions about intraindividual associations (i.e., relationships at the level of single individuals) on the basis of interindividual (i.e., between-person) correlations at any one point in time (Lindenberger & Oertzen, 2006; Molenaar et al., 2003; W. S. Robinson, 1950; Schmitz, 2000). The finding that happy individuals process cognitive information differently from individuals who are less happy cannot simply be taken as evidence that for any given individual, a happier moment in time is one characterized by a certain processing strategy different from a less happy moment in time. Theoretical assumptions of intraindividual processes cannot simply be substituted with interindividual differences without testing whether certain formal conditions such as equivalence of variances of within-person and within-person variation and sample homogeneity (Molenaar et al., 2003). Already Cattell (1957b) highlighted this issue by outlining two empirical examples, one demonstrating a converging structure across between-person and within-person levels, and one that demonstrates lack of such convergence. Thus, with regard to the coupling of daily variability in affect and cognition, the aim of the present dissertation was to examine whether mood states are related to cognitive performance within individuals, and whether in line with dual-task accounts of emotion-cognition relationships, older adults would show a stronger association than young adults. In an exploratory fashion, we further explored whether personality factors such as extraversion and neuroticism may moderate the coupling pattern. Particularly neuroticism tends to be related to greater levels of negative affect, worry and rumination tendencies (e.g., Costa & McCrae, 1980; Nolen-Hoeksema, 1998; J. E. Roberts, Gilboa, & Gotlib, 1998), and the dual-task perspective of emotion-cognition interplay would predict that individuals who score higher on measures of neuroticism might be more vulnerable to the cognitive costs of emotion regulation than individuals lower in neuroticism. A recent study has also shown neuroticism to be positively related to intraindividual variability in reaction time performance (M. D. Robinson & Tamir, 2005), and may thus function as a moderator of the coupling between affect and cognition at several levels of analysis.