Personality and Social Relationships in Adolescence:

A Dynamic Interplay

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Larissa L. Wieczorek

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Members of the doctoral examination board

Chair of the disputation: Prof. Dr. Nale Lehmann-Willenbrock

First dissertation reviewer: Prof. Dr. Jenny Wagner

Second dissertation reviewer: Prof. Dr. Katrin Rentzsch

First disputation reviewer: Prof. Dr. Oliver Lüdtke

Second disputation reviewer: Prof. Dr. Juliane Degner

Danksagung

Man entdeckt keine neuen Erdteile, ohne den Mut zu haben,
alte Küsten aus den Augen zu verlieren.

André Gide

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Summary

The need to belong to someone represents an essential human need across the entire life span. In adolescence (i.e., the age between 10 and the early twenties), social networks undergo fundamental changes and new levels of intimacy are pursued. Thus, the initiation and maintenance of satisfying social relationships represent important developmental tasks for individuals in this age group and are key to well-being. Theoretical and empirical work has long emphasized the close link between personality and social relationships. Given that most studies in this field target adult samples, however, comparably little is known about the way personality relates to social relationships in adolescence. Moreover, the underlying mechanisms and the role of more complex patterns (e.g., interaction effects) within this association remain unclear. Integrating literature from developmental, social relationship, and personality psychological research, this dissertation followed three overall research aims. First, to investigate how personality traits relate to social relationships in adolescence, and, second, to investigate which processes in social interactions can explain this link. Finally, the third goal was to go beyond the study of linear main effects and investigate how personality traits interact with adolescents' social environment and with each other. To address these goals, this dissertation encompasses three preregistered studies, which analyzed cross-sectional and longitudinal data of three different adolescent samples to elucidate the dynamic interplay of personality and social relationships in middle and late adolescence (i.e., the age between 14 and the early twenties).

All three studies examined how adolescents' personality traits relate to their social relationships while focusing on different socio-emotional outcomes located at the micro level (social interactions), meso level (specific relationships), and macro level (all relationships). Making use of experience sampling data and multilevel modeling, Study 1 adopted a micro-level perspective and examined how self- and other-perceptions of real-life social interaction behaviors contribute to the links between adolescent's personality traits (i.e., extraversion, agreeableness, and neuroticism) and momentary satisfaction with social interactions. At the meso level, Study 2 focused on romantic relationships, which become increasingly important in adolescence. Using mixed-effects location scale models, this study investigated how the interplay between neuroticism and romantic relationship variables relates to the level and variability of adolescents' momentary affect. Finally, taking on a macro-level perspective, Study 3 used polynomial regression analyses with an information-theoretic approach for model comparison, investigating how the interplay of neuroticism and extraversion predicts loneliness cross-sectionally and over one year. Going beyond broad trait effects, the first two studies also explored the effects of corresponding, more fine-grained personality facets.

Findings support the relevance of personality for adolescents' social relationships at the micro, meso, and macro level and with respect to short- and long-term (i.e., momentary and one-year) associations. Overall, neuroticism was related to negative socio-emotional outcomes, while extraversion and agreeableness showed positive effects. Looking at underlying mechanisms at the micro level of social interactions, momentary perceptions of more expressive and communal behavior play an important role in the association between adolescents' personality and higher momentary social satisfaction. Furthermore, this dissertation provides evidence for two kinds of more complex patterns characterizing the associations between personality and social relationships in adolescence. First, at the meso level of adolescents' romantic relationships, findings provide initial evidence that neuroticism moderates the association between relationship quality and the variability of momentary positive affect. Second, at the macro-level capturing adolescents' multiple social relationships, exponential, saturating, and interaction effects predicted individual differences in loneliness beyond the main effects of neuroticism and extraversion.

The current dissertation contributes to the literature on personality and social relationships in adolescence in three important ways. First, it integrates, supports, and extends central assumptions from different theoretical models on personality and social relationships. Second, as a methodological contribution, it underlines the relevance of assessing the association between personality and social relationships on different relationship levels and timelines, applying statistical models that reflect non-linear associations and interactions, and distinguishing across personality facets and specific socio-emotional outcomes. Finally, the results of this dissertation highlight the importance of personality and related interpersonal behaviors for adolescents' experiences in social relationships. This knowledge may be used to promote the establishment of satisfying social relationships and consequently improve well-being in adolescence. Nonetheless, to approach causal explanations, social interaction studies that also include experimental manipulations are required. In addition, future research needs to combine short-term with long-term measurements, which track adolescents over longer periods to further deepen our understanding of the dynamic interplay characterizing the association between personality and social relationships in adolescence.

1. Theoretical Background

Forming and maintaining satisfying and lasting social relationships is one of the most fundamental human needs (Baumeister & Leary, 1995a). Already in antiquity, Aristotle characterized the nature of humans as *zoon politikon,* which can be translated as "social being". Modern research defines social relationships as direct, repeated, and dynamic interactions between two individuals which are mentally represented and recognized as a relationship by both interaction partners (Asendorpf et al., 2017a; Hinde, 1979). Today, more than two thousand years after Aristotle's claim, empirical studies have provided robust evidence on the impact of social relationships on well-being. People with satisfying relationships live longer and are generally healthier, happier, and more satisfied with their lives (Chopik, 2017; S. Cohen, 2004; Diener & Seligman, 2002; Goswami, 2012; Hawkley & Cacioppo, 2010). On a daily basis, social relationships can have enhancing effects on well-being through social interactions with both close and distant others (Sandstrom & Dunn, 2014). These positive effects of social relationships are evident in every stage of life (Kahn & Antonucci, 1980), but they are especially influential in adolescence when not only individuals themselves but also their social networks undergo radical changes. The adolescent years (ages 10 to early 20s) mark a time during which many developmental changes occur, including identity exploration and social relationship reorganization (Erikson, 1959; Havighurst, 1948). Specifically, adolescents increasingly individualize from their parents, initiate new relationships with peers, and make their first romantic experiences (Furman & Shaffer, 2003; Rubin et al., 2006). While these changes are a window of opportunity, they can also be stressful and hold the risk for negative experiences such as feelings of uncertainty or rejection (e.g., Bouchey & Furman, 2003; Collins & Steinberg, 2006; Laursen & Hartl, 2013). Therefore, it is important to understand the factors that contribute to individual differences in adolescents' experiences in social relationships.

One such key predictor of social relationships is personality, defined as relatively stable patterns of thinking, feeling, and behavior (Roberts et al., 2006): The close link between personality and social relationships is supported by both theoretical (e.g., Back et al., 2011; Wiggins, 1991) and empirical (e.g., Asendorpf & Wilpers, 1998; Wagner et al., 2014) research. Since most previous research in this field has focused on adulthood, however, comparably little is known about the association between adolescents' personality and their social relationships. Furthermore, literature remains inconclusive concerning possible underlying mechanisms behind this association and has neglected more complex patterns, such as interactions between adolescents' personality and their social environment or between different personality traits.

In the present dissertation, I investigate and discuss the role of personality for social relationships in adolescence. Investigating both cross-sectional and longitudinal associations and a variety of socio-emotional outcomes (i.e., social satisfaction, affect, and loneliness), I conducted three studies that shed light on the dynamic interplay that characterizes the association between adolescents' personality and their social relationships. In the first part of this chapter, I review literature on the particular role of social relationships in adolescence. In the second part, I provide an overview of theories and empirical research on the link between personality and social relationships. Finally, I integrate these concepts and findings from developmental, social relationship, and personality research to carve out gaps in the existing literature and to derive my research questions.

1.1. Social Relationships in Adolescence

Whereas people require supporting relationships throughout the life span (Baumeister & Leary, 1995b; Kahn & Antonucci, 1980), they are especially relevant in adolescence. During the transition from childhood to adulthood, individuals are confronted with biological changes, shifts in their own needs and motivations, and new expectations from society (Dahl et al., 2018; Steinberg, 2005; Suleiman et al., 2017). These changes posit several challenges to the individual (Erikson, 1959; Havighurst, 1948) and are closely intertwined with changes in adolescents' social networks, in which new relationships are pursued and existing ones need to be redefined (Furman & Shaffer, 2003; Rubin et al., 2006). As such, adolescence undeniably represents an eventful chapter of life, making it a particularly compelling period to study social relationships.

In the following, I introduce adolescence as a period of change and build on theoretical perspectives from life-span psychology. On this basis, I identify different types of significant social relationships in adolescence and highlight the relevance of specific socio-emotional outcomes that reflect adolescents' experiences in social relationships.

1.1.1. Adolescence as a Period of Change

Adolescence encompasses a multitude of developmental changes and experiences occurring as part of the transition from childhood to adulthood. The beginning of this transition is marked by the onset of puberty, a period of rapid physiological changes leading to sexual maturation (Dahl et al., 2018; Lehmiller, 2017). Besides the transformation of the body, pubertal hormones and structural and functional changes in the adolescent brain give rise to changes in cognitive, emotional, and motivational processes (Dahl et al., 2018; Suleiman et al., 2017). For example, individuals show considerable improvements in reasoning, information processing, expertise, abstract thinking, and perspective-taking and expand on their executive control

(Crone & Dahl, 2012; Keating, 2004; Kilford et al., 2016; Steinberg, 2005). Additionally, the neural and hormonal changes during adolescence have been associated with the experience of higher emotional intensity and reactivity, while contributing to the development of the ability to regulate affect and arousal (Rosenblum & Lewis, 2003; Steinberg, 2005). Moreover, adolescents show increases in sensation-seeking and risk-taking behavior, greater motivation to seek out rewards, and an enhanced experience of rewards (Crone & Dahl, 2012; Steinberg, 2005). Researchers widely agree that all of these processes contribute to the social reorientation in adolescence, including the orientation toward peers and romantic partners, being more sensitive to acceptance and rejection, and showing an increased capacity to experience feelings of desire, love, connection, and empathy (Blakemore, 2012; Nelson et al., 2005; Rosenblum & Lewis, 2003; Suleiman et al., 2017).

It is commonly said that "adolescence begins in biology and ends in culture" (Smetana et al., 2006, p. 258). Thus, the transition to adulthood as the end of adolescence cannot be captured by a certain level of physical maturation but rather by the adoption and societal recognition of certain social roles and by the rights and responsibilities that come with them (Dahl et al., 2018). Whereas the timeframe for reaching this point of maturation varies substantially across individuals and cultural or historical contexts (Arnett, 2000; Steinberg & Icenogle, 2019), most modern societies confer adult rights and responsibilities (e.g., voting in elections, driving a car, drinking alcohol, signing contracts, being held fully accountable for committed crimes) based on age. For example, individuals living in Germany are treated as adults by law when reaching the age of 18 (*§ 2 BGB Eintritt der Volljährigkeit*, 2022).

In developmental literature (e.g. Clark-Lempers et al., 1991; Collins & Steinberg, 2006; Smetana et al., 2006), adolescence is commonly divided into three periods, namely early adolescence (typically ages 10–13), middle adolescence (typically ages 14–16), and late adolescence (typically ages 17–19). At the same time, the onset of puberty and thus the biologically defined beginning of adolescence varies considerably across individuals (Lehmiller, 2017). Similarly, many authors note that adolescence often continues until age 20 or beyond (Konrad & König, 2018; Sawyer et al., 2018). To account for the lengthened transition between adolescence and adulthood in industrialized countries, Arnett (2000, 2014) even suggested introducing emerging adulthood as an additional developmental phase spanning from ages 18 to 25, where individuals try out different experiences in work and love instead of already settling into long-term adult roles. Consequently, in this dissertation, I use the age-based classifications of adolescence from developmental literature only as an approximate operationalization, while acknowledging that this period in life can expand into the early twenties.

1.1.2. Theoretical Perspectives on Social Relationships in Adolescence

As an overarching developmental framework, *lifespan psychology* (Baltes et al., 2007) considers individual development as a lifelong process that is co-constructed by the interplay between the biological and environmental characteristics of a person. Lifespan psychology captures a number of more specific theories, out of which two are especially relevant in the context of social relationships in adolescence: First, the *convoy model of social relations* (Kahn & Antonucci, 1980) emphasizes that humans require close relationships throughout their life span, yet a person's specific needs for social support change. Second, the *developmental task framework* (Erikson, 1959; Havighurst, 1948) explicitly defines social relationships and related experiences as developmental goals of adolescence.

The Convoy Model of Social Relations

The convoy model of social relations (Kahn & Antonucci, 1980) conceptualizes the individual as part of a dynamic social network (i.e., the social convoy) that accompanies the individual throughout the life span and provides social support. Kahn and Antonucci (1980) define social support as social interactions that include at least one of three key elements: affect (e.g., liking, admiration, love), affirmation (e.g., expressions of agreement or approval), and aid (e.g., money, time, advice). One of the core assumptions of the convoy model of social relations is that a person's need for the amount and kind of social support changes across life. Likewise, the social convoy changes as the individual grows older and life circumstances change, while close relationships with family and peers are assumed to remain a stable component throughout the years for most people. According to the model, correspondence between an individual's need for social support and the quality (e.g., positive, negative), function (e.g., support, affect), and structure (e.g., size, composition) of the social convoy is an important determinant for health and well-being.

Whereas the convoy model of social relations (Kahn & Antonucci, 1980) seems to put an emphasis on adulthood and aging (e.g., Antonucci et al., 2014), it provides a theoretical framework to study social relationships across the entire life span and can be applied to adolescence. As such, a number of implications for the importance and nature of social relationships in adolescence can be derived. First, as adolescents differ from children and adults with respect to individual (e.g., age) and situational (e.g., demands from school and family) properties, they are likely to have unique needs for social support (also see Buhrmester & Furman, 1986; Weiss, 1986). Second, as the model proposes that changes in the social convoy are catalyzed by social role changes (Kahn & Antonucci, 1980), it can be assumed that the social networks of adolescents, who increasingly adopt adult roles, are particularly dynamic. Finally, the convoy model

of social relations proposes that the protective function of social support on well-being is most pronounced when individuals undergo major changes and face stressful times (also see Antonucci et al., 2003). Since the transition from childhood to adulthood represents such a time (e.g., Dahl et al., 2018), the model highlights adolescents' particular need for satisfying social relationships.

The Developmental Task Framework

Another model highlighting the relevance of social relationships in adolescence is the developmental task framework (Havighurst, 1948). In the late forties, Havighurst (1948) proposed that human development can be conceptualized as a movement through stages. Each stage, such as adolescence, is characterized by certain tasks that must be solved. Originally, the developmental task framework has been developed for the educational field as guidance for teachers (according to Eschenbeck & Knauf, 2018). Since then, Havighurst's concept has been adopted by many researchers and modified or extended to apply it to different fields of psychology (e.g. Erikson, 1959; Grob & Jaschinski, 2003; Hutteman et al., 2014; Roisman et al., 2004; Seiffge-Krenke & Gelhaar, 2008). A developmental task is defined as "a task which arises at or about a certain period of life of the individual, successful achievement of which leads to his happiness and to success with later tasks, while failure leads to unhappiness in the individual, disapproval by the society, and difficulty with later tasks" (Havighurst, 1948, p. 2). In adolescence, meeting the following tasks is seen as a prerequisite for successful development in young adulthood as the next stage of life: (1) accept one's body, (2) explore and adopt gender roles, (3) become emotionally and materially independent from parents, (4) form close relationships with peers and romantic partners, (5) learn a profession, (6) prepare for marriage and family life, (7) establish a personal value or ethical system, and (8) take social responsibility (Havighurst, 1948).

In line with lifespan psychology (Baltes et al., 2007), developmental tasks are assumed to result from an interplay of biological changes, age-graded societal expectations, and, individual expectations, norms, and values (Eschenbeck & Knauf, 2018; Havighurst, 1948). Given the prolongation of adolescence as a developmental phase in industrialized countries in the 21st century (Konrad & König, 2018; Sawyer et al., 2018), it has been suggested to slightly redefine the developmental tasks relevant during adolescence. Specifically, certain developmental tasks, such as the choice of a profession or preparation for family life, may only become salient at later stages in life (Roisman et al., 2004; Seiffge-Krenke & Gelhaar, 2008). In contrast, the responsible consumption of media and the choice from a range of leisure activities have emerged as new important tasks in adolescence (Albert et al., 2015; Eschenbeck & Knauf,

2018). Looking at cultural differences, Eschenbeck and Knauf (2018) further explain that while some developmental tasks vary strongly across cultures (e.g., media consumption), others are universal (e.g., social relationships with peers, becoming independent from parents).

Despite these variations in the definition of specific tasks, researchers from different centuries and disciplines largely agree that navigating social relationships represents one essential developmental task area in adolescence (e.g., Grob & Jaschinski, 2003). First, building and shaping relationships with peers and romantic partners and transforming the relationship with parents are both listed as developmental tasks themselves (Havighurst, 1948). Second, social relationships are pivotal to the achievement of many of the other tasks that can be subsumed under identity development (Erikson, 1959, 1968). For example, social relationships with peers of the same and opposite gender provide an important context for adolescents' exploration of gender roles, validation of one's self-concept, and for the examination and acceptance of their (changing) bodies (Furman & Shaffer, 2003; Hurrelmann & Quenzel, 2013; Sullivan, 1953). Moreover, broadening one's social network and peer relationships in particular are an important source of new information that guides the construction of value and norm beliefs (Bukowski et al., 2009; Carstensen, 1995).

1.1.3. Significant Social Relationships in Adolescence

In line with the developmental tasks characterizing adolescence (Havighurst, 1948), parents, peers, and romantic partners complement each other and partly take turns in meeting adolescents' shifting social needs (Buhrmester & Furman, 1986; Weiss, 1986; also see Kahn & Antonucci, 1980). While these relationship types vary in their degree of emotional closeness, temporal stability, and reciprocity in terms of power and support (Laursen & Bukowski, 1997; Neyer et al., 2011), all of them represent significant social relationships in the life of adolescents.

Empirical research widely supports the view of adolescence as a phase of increasing autonomy, in which individuals become more independent of the support of their parents and seek to build meaningful social relationships outside of the family (De Goede, Branje, Delsing, et al., 2009; Laursen & Bukowski, 1997; Rubin et al., 2006; Wagner et al., 2014). In adolescents' relationships with parents, these changes can lead to temporary increases in interpersonal conflict and decreases in closeness (Branje, 2018; De Goede, Branje, & Meeus, 2009; Koepke & Denissen, 2012), although larger national surveys in Germany point to rather harmonious relationships in most families (Albert et al., 2015; Walper et al., 2018).

Whereas adolescents still depend on their parents emotionally and financially, their peer relationships become increasingly close and supportive (Helsen et al., 2000; Rubin et al., 2006;

Smetana et al., 2006). In contrast to family relationships, social interactions with peers are voluntary and potentially threatened by relationship dissolution (Laursen & Bukowski, 1997). Laursen and Bukowski (1997) therefore propose that adolescents are particularly concerned to keep their relationships with peers mutually satisfying. Nonetheless, relationships with both parents and peers remain important sources of social support, that offer complementary social experiences and whose influence affects different areas in adolescents' lives (Collins & Steinberg, 2006; Laursen & Bukowski, 1997). For example, parents provide guidance concerning long-term topics, such as career choices and ethical values, whereas peers are more influential in cultural aspects, such as taste and style (Smetana et al., 2006).

Often coined as a "hallmark of adolescence", the emergence of romantic relationships is considered an important milestone contributing to adolescents' socio-emotional development (Collins, 2003; Furman et al., 2008; Rosenblum & Lewis, 2003). Romantic relationships often evolve in the context of existing relationships with non-romantic peers (Collins & Steinberg, 2006). As friendships, romantic relationships are ongoing, voluntary social interactions that are mutually acknowledged by two individuals, yet they have a peculiar intensity and are often marked by verbal and physical expressions of affection (Collins, 2003). Whereas romantic relationship involvement in adolescence is common (Carver et al., 2003; Connolly & Johnson, 1996; Rubin et al., 2006), there are large interindividual differences in romantic relationship experiences, including individuals who have never entered a romantic relationship during this developmental phase (Gonzalez Avilés et al., 2021).

1.1.4. Significant Experiences in Adolescents' Social Relationships

To meet the complexity of social relationships and related experiences, one helpful approach is to consider social relationships on three different levels (Back et al., 2023; Feld et al., 2007; Hinde, 1979). The *micro level* refers to specific social interactions taking place at a certain time and place and thus underlying situational circumstances. The *meso level* focuses on specific relationships, such as relationships with family, peers, or romantic partners. Finally, the *macro level* subsumes the multiple relationships that are part of a person's social network. Whereas processes at each level are constrained and influenced by processes at other levels (Hinde, 1979), the micro, meso, and macro level each provide important insights into an individual's social relationships. For example, the frequency or duration of social interactions (micro level; e.g., Barrett & Pietromonaco, 1997; Srivastava et al., 2008), the length of a relationship (meso level; e.g., Berscheid et al., 2004), and the size of a person's social network (macro level; e.g., Wagner et al., 2014; Wrzus et al., 2013) entail complementary information.

Besides these rather objective criteria, adolescents' subjective experience at the different levels of their social relationships is of major psychological interest. Given the multitude of social changes (e.g., formation of new and redefinition of existing relationships; Laursen & Bukowski, 1997; Rubin et al., 2006; Wagner et al., 2014), social relationships in adolescence bear the potential for joy and happiness but can also be challenging (e.g., Bouchey & Furman, 2003; Collins & Steinberg, 2006; Laursen & Hartl, 2013). This wide spectrum of adolescents' subjective experiences can be captured by assessing different socio-emotional outcomes. In this dissertation, I focus on interindividual differences in adolescents' *momentary social satisfaction* at the micro level, *momentary affect* at the meso level, and *loneliness* at the macro level. As explained in the following, each of these constructs reflects significant experiences in adolescents' social relationships, yet captures a unique aspect.

Momentary Social Satisfaction

Momentary social satisfaction refers to the cognitive appraisal of a social interaction (for a discussion of the term *satisfaction*, see Diener et al., 2003). As such, momentary social satisfaction offers insights at the micro level of social interactions and reflects how adolescents experience their social relationships in everyday life. Theoretical accounts suggest that, over time, multiple positive or negative social interactions accumulate into more or less satisfying social relationships (Back et al., 2011, 2023; Thibaut & Kelley, 1978). Accordingly, adolescents' experiences of momentary social satisfaction at the micro level are assumed to lay the foundation for their social experiences at the meso and macro level.

Momentary Affect

Momentary affect can be defined as a basic, consciously accessible state with a certain valence that forms the basis for more complex emotions (Ekkekakis, 2013; J. A. Russell, 2003). In a number of seminal experience-sampling studies, Larson and colleagues found that, compared to children and adults, adolescents experience more negative and variable affect (for an overview, see Larson & Sheeber, 2008). Accordingly, adolescence represents a unique age period concerning both individuals' *affect level* (i.e., how negative or positive affect is on average) and their within-person *affect variability* (i.e., how much affect fluctuates across time and situations). Highlighting the particular relevance of romantic relationships for individual differences in adolescents' momentary affect, initial findings suggest that affect variability might be heightened among adolescents with a romantic partner when compared with their single peers (Larson et al., 1980). Moreover, relationship quality likely contributes to individual differences in affect among adolescents who are currently involved in a romantic relationship. First, higher relationship quality has been linked to a number of broader affective outcomes, such as higher

happiness (Demir, 2008) and lower depression (Mirsu-Paun & Oliver, 2017), and may thus relate to higher levels of positive affect in daily life. Second, stressful events such as conflicts, which occur more frequently in relationships with lower quality (see Galliher et al., 2004; Laursen, 1995), may contribute to higher affect variability. Altogether, besides reflecting adolescents' experiences on a day-to-day basis in general, momentary affect can offer insights into adolescents' experiences within the context of romantic relationships and thus at the meso level of specific relationships.

Loneliness

Loneliness describes the distressing feeling that accompanies the perceived discrepancy between the desired and actual quality or quantity of social relationships in general (de Jong Gierveld et al., 2018; Hawkley & Cacioppo, 2010). As such, loneliness offers insights at the macro level referring to adolescents' multiple social relationships. Since adolescents experience a vast amount of changes in their social network, they are considered to be especially prone to feel lonely (Heinrich & Gullone, 2006; Laursen & Hartl, 2013). Based on the conceptualization by Weiss (1973), loneliness can be further separated into the perceived lack of close others, termed *emotional loneliness*, and the perceived lack of feeling as part of a group, termed *social loneliness*. These more specific aspects of loneliness can be either analyzed as separate constructs or subsumed under an overall score of loneliness (D. Russell et al., 1984).

1.2. The Association Between Personality and Social Relationships in Adolescence

How people think, feel, and behave—that is, a person's personality (Roberts et al., 2006) —is closely linked to their social relationships. Specifically, the association between personality and social relationships is reflected in three key goals of personality psychological research, namely *description*, *explanation*, and *prediction* (Back et al., 2023; also see Mõttus et al., 2020). First, interpersonal perceptions and behaviors are indispensable to describe personality. Second, social processes are key to understanding and explaining how personality exerts its influence. Third, considering the social context is required to improve predictions of personality effects on a person's behavior or specific socio-emotional outcomes. Along these lines, several theoretical frameworks emphasize the association between personality and social relationships (e.g., Back et al., 2011; Hofstee et al., 1992; Neyer & Asendorpf, 2001; Wiggins, 1991). Since the majority of theoretical and empirical research on personality and social relationships has focused on adulthood, however, this association is less well understood in adolescence. So far, empirical findings highlight the relevance of personality for individual differences in adolescent's social network structure and their broader experiences in

social relationships with family and peers (e.g., Asendorpf & Wilpers, 1998; Branje et al., 2004; Deventer et al., 2019; Wagner et al., 2014). In contrast, little is known about underlying mechanisms at the micro level and more complex patterns, including interactions between adolescents' personality and their social environment at the meso level and between different personality traits at the macro level.

In the following, I elaborate on the conceptualization of personality in adolescence and introduce theoretical models on the link between personality and social relationships in general. Subsequently, I provide a brief summary of empirical findings on this association and close with a note on the units in which personality is analyzed. This way, I provide a deeper understanding of the theoretical assumptions and current gaps in literature motivating my research aims.

1.2.1. Conceptualization of Personality in Adolescence

The vast majority of previous studies on personality and its correlates have focused on adulthood (Soto & Tackett, 2015). This focus may be rooted in the long-held view according to which personality represents a mature psychological phenomenon (Caspi et al., 2005). In a distinct tradition, developmental psychologists have typically studied the temperament of children, which describes biologically-based individual differences in motoric, emotional, and attentional reactivity and behavior (Caspi & Shiner, 2008; Rothbart, 2007). Typically, temperament is seen as more basic and conceptualized based on a narrower range of individual differences than personality (Caspi & Shiner, 2008; Strelau, 2001). As a time between childhood and adulthood, adolescence has not been comprehensively represented by either research tradition for a long time. Empirical work has, however, challenged the conceptual distinction between child temperament and adult personality and concluded that both concepts have more in common than previously assumed (McCrae et al., 2000; Shiner, 2005). For example, both temperament and personality can also be observed in non-human species (Gosling & John, 1999; Weinstein et al., 2008). Moreover, child temperament and adult personality are both affected by genetic influences and environmental factors (Bouchard & Loehlin, 2001; Emde & Hewitt, 2001; Krueger & Johnson, 2008) and also show both relative stability and change over time (Roberts & Del Vecchio, 2000; Shiner, 2005). In addition to these structural commonalities, temperament can be mapped to personality concepts, indicating a strong overlap in terms of content (Caspi & Shiner, 2008; Shiner & DeYoung, 2013). Accordingly, research converges on the fact that individual differences in adolescence can be conceptualized based on personality.

The Big Five Framework of Personality

It can be confidently said that the Big Five framework is the most established taxonomy to study personality, as shown by its wide use across age groups, nations, and disciplines (e.g., Ozer & Benet-Martínez, 2006; Roberts et al., 2007; Schmitt et al., 2007; Soto et al., 2011). For a long time, however, the search for such a universally accepted taxonomy was one of the great challenges in personality psychology. In 1936, Allport and Odbert identified almost 18,000 terms in an unabridged English dictionary that could be used to distinguish characteristics across different individuals (John et al., 2008). Based on this seminal lexical approach, decades of research using semantic and empirical clustering procedures led to the discovery of five broader traits reflecting personality differences: The "Big Five" (Goldberg, 1990; McCrae & Costa, 1987, 2008).

The Big Five Traits. The Big Five traits are neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness (McCrae & Costa, 1987, 2008; Soto & John, 2017). *Neuroticism* characterizes an individual's tendency to feel anxious and easily stressed. *Extraversion* describes the tendency to socially approach others and to enjoy their company. *Openness to experience* covers the tendency to seek intellectual engagement and to be creative. *Agreeableness* is the tendency to act in an altruistic, modest manner. Finally, *conscientiousness* captures the tendency to possess self-discipline and to organize tasks. Although different numbers of traits have been proposed (e.g., Bakan, 1966; DeYoung, 2015; Hogan, 1983; Lee & Ashton, 2004; Schultz & Schultz, 2017; van der Linden et al., 2010), the Big Five framework remains the most accepted and most studied way to conceptualize and measure personality.

Given their relevance for individual differences in interpersonal behavior, extraversion and agreeableness are often called the two traits with the greatest direct relevance for social relationships (McCrae & Costa, 1989; Trapnell & Wiggins, 1990). Furthermore, neuroticism is considered a trait with high relevance for individual differences in a person's perceptions and subjective experience within social contexts (e.g., Denissen & Penke, 2008a, 2008b; Karney & Bradbury, 1995). Therefore, in this dissertation, I focus on the role of neuroticism, extraversion, and agreeableness for adolescents' social relationships.

The Big Five Facets. The Big Five framework (McCrae & Costa, 1987, 2008) assumes that personality is organized hierarchically, such that broad, higher-order traits subsume narrower, lower-order facets (see Markon, 2009; McCrae, 2015). While all facets of one personality trait share a common core, each adds unique aspects (Costa & McCrae, 1995; McCrae, 2015). This way, each of the Big Five traits represents a higher level of abstraction from a wide range of specific thoughts, feelings, and behaviors organized in facets (Costa & McCrae, 1995).

Existing measures of the Big Five personality traits range from the definition of two (Soto & John, 2009), over six (Costa & McCrae, 1992a, 1995), up to nine (Hofstee et al., 1992) facets per trait depending on the specific theoretical conceptualization and questionnaire length.

Aiming for a satisfying compromise between these notions, the Big Five Inventory-2 (Soto & John, 2017) distinguishes among three facets per Big Five trait. This way, the BFI-2 balances bandwidth and fidelity, while keeping the number of items, and thus participant burden, at a reasonable level (Soto & John, 2017). As such, the BFI-2 is well suited to examine the role of neuroticism, extraversion, and agreeableness and their corresponding facets for social relationships in adolescence. In this conceptualization, neuroticism consists of the facets *anxiety* (experiencing anxiety and fear), *depression* (experiencing sadness and low levels of energy), and *volatility* (experiencing volatile mood swings). Extraversion can be divided into the facets *sociability* (being outgoing and talkative), *assertiveness* (being decisive, persuasive, and taking responsibility), and *activity* (experiencing positive emotions and high levels of energy). Finally, agreeableness breaks down into the facets *compassion* (showing concern for others' well-being), *respectfulness* (treating others politely and inhibiting antagonistic impulses), and *trust* (holding positive beliefs about other people).

Empirical Evidence for the Big Five in Adolescence

As Soto and Tackett (2015) highlight in their review, empirical investigations reveal both similarities and differences between the Big Five measured in adolescence and adulthood. Regarding similarities, the Big Five can be reliably measured in adolescence with questionnaires commonly used in adult samples (Brandt et al., 2020; De Fruyt et al., 2000; Israel et al., 2022; Soto et al., 2008). As a second shared feature, empirical findings suggest that the hierarchical structure of personality traits generalizes to adolescence (Soto & John, 2014; Tackett et al., 2008, 2012). Regarding differences between adolescent and adult personality, extant research points to a stronger interrelatedness between single Big Five traits in (early) adolescence (Brandt et al., 2020; Soto et al., 2008; Tackett et al., 2008, 2012). For example, children's and adolescents' levels of agreeableness showed a relatively strong positive covariation with their level of conscientiousness. Importantly, these studies also indicate that, as individuals grow older, personality traits become more differentiated, such that a much cleaner distinction between agreeableness and conscientiousness is possible by mid-adolescence. As a second difference, there is evidence that, in addition to the Big Five traits, a sixth factor capturing motor activity may be required to accurately reflect the personality of young adolescents, which becomes less relevant with psychological maturation (Soto & John, 2014).

To summarize, empirical evidence converges on the fact that the Big Five represents a reliable and valid taxonomy to study personality in adolescence (e.g., Brandt et al., 2020; Shiner, 2005; Soto et al., 2008). At the same time, adolescent personality is still developing (see Caspi & Shiner, 2008; Klimstra et al., 2009) and differs from adult personality in certain aspects (see Soto & Tackett, 2015). Therefore, the continued study of the Big Five personality and its correlates in adolescent samples remains important.

1.2.2. Theoretical Perspectives on Personality and Social Relationships

For a long time, personality psychology has been divided into two schools of thought, with a structural view putting particular emphasis on the description of individual differences in behavior and a process-oriented view that is interested in more dynamic aspects of personality, including its underlying processes and its interplay with the environment (Mischel & Shoda, 1994). Following these distinct research traditions, a number of theoretical perspectives on personality and social relationships have emerged. Representing both the structural and the process-oriented view, I introduce two types of models—circumplex models of interpersonal behavior (Hofstee et al., 1992; Wiggins, 1991) and dynamic models of personality and social relationships (Back et al., 2011; Neyer & Asendorpf, 2001)—in more detail in the following. Arguing that all of them offer complementary approaches advancing our understanding of the association between personality and social relationships, I conclude with an integration of theoretical perspectives.

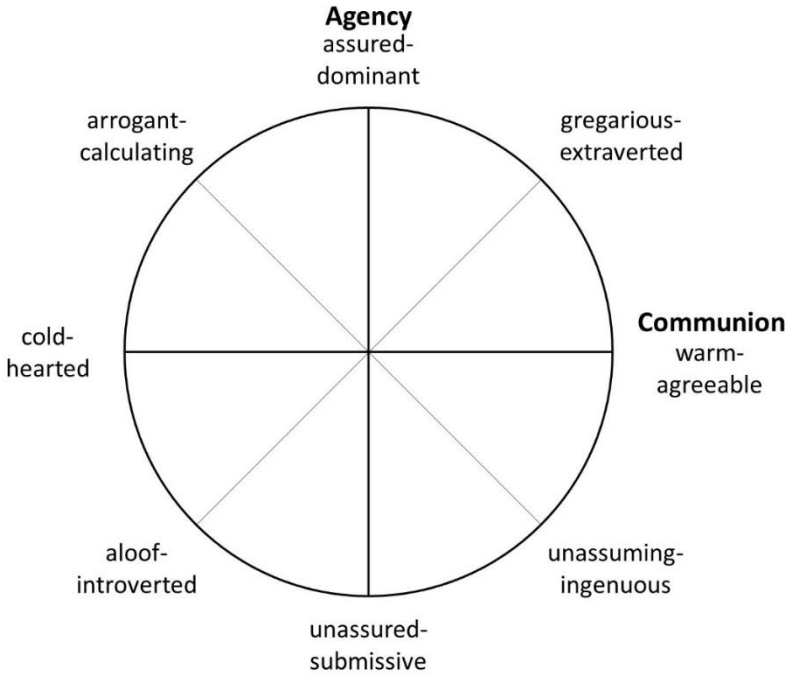
Circumplex Models of Interpersonal Behavior

The origins of circumplex models of interpersonal behavior can be traced back to the work of psychiatrist Harry Stack Sullivan. In his interpersonal theory of psychiatry, Sullivan stated that personality is not limited to the individual, but is best understood within the context of social interactions (Sullivan, 1953). The Berkeley/Kaiser Group (LaForge, 2004; Leary, 1957) then translated Sullivan's ideas into an empirically validated model, the *interpersonal circumplex* (also see Dawood et al., 2018; Strack & Horowitz, 2011). Based on this pioneering work, contemporary interpersonal theory and circumplex models (Bakan, 1966; Pincus & Ansell, 2013; Wiggins, 1991) locate interpersonal perceptions and behaviors within a circular space based on two broad dimensions (see Figure 1). The first dimension, *agency*, reflects a person's motivation and capacity to "get ahead" (Hogan, 1983) and relates to goals of dominance and achievement, and flexibility in behavioral and cognitive domains (Digman, 1997; Hurley, 1998). The second dimension, *communion*, reflects a person's motivation and capacity to "get along" (Hogan, 1982), and relates to goals of nurturance and close relationships, and maintenance in emotional, social, and motivational domains (Digman, 1997; Hurley, 1998).

Whereas it has been posited that extraversion and agreeableness most closely match the two broader dimensions of agency and communion, respectively (Du et al., 2021; McCrae & Costa, 1989), all personality traits of the Big Five framework can be mapped onto the dimensions of the interpersonal circumplex (Ansell & Pincus, 2004; Digman, 1997; Trapnell & Wiggins, 1990; Wiggins & Trapnell, 1996). Accordingly, neuroticism, extraversion, and agreeableness each have implications for agentic and communal interpersonal perceptions and behavior (see Du et al., 2021).

Figure 1

The Interpersonal Circumplex



Note. Interpersonal perceptions and behaviors are represented in a circular space spanning around the two dimensions of agency and communion. Adapted from the work of Wiggins (Wiggins, 1991; Wiggins et al., 1988).

Aiming for an integration of the Big Five framework and circumplex models, the *Abridged Big Five Dimensional Circumplex* (AB5C) model by Hofstee et al. (1992) classifies interpersonal perceptions and behaviors within 10 specific circumplexes, each of them based on the combination of two Big Five traits. This way, the AB5C combines the advantages of two taxonomies: First, it covers the full range of traits from the Big Five framework (Costa & McCrae, 1992b). Second, it accounts for the fact that most interpersonal perceptions and behaviors can be assigned to more than one personality trait (Wiggins, 1980). For example, Eysenck and Eysenck (1985) have proposed that neuroticism and extraversion interact, such that reactions to social stimuli of people with high neuroticism differ significantly depending on

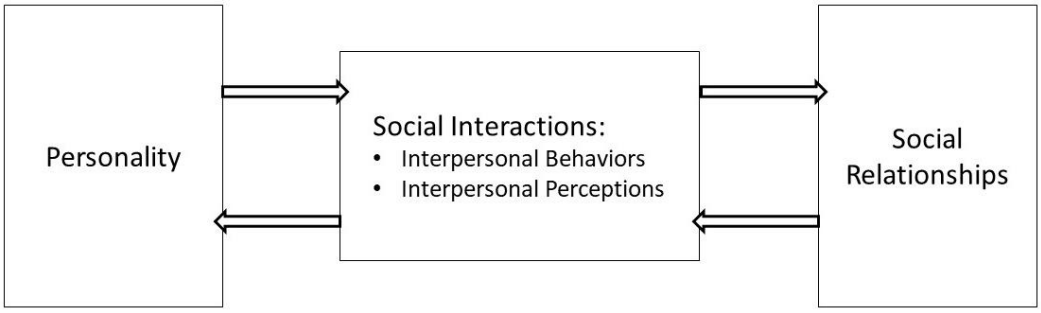
their level of extraversion (i.e., being intro- or extraverted). Along these lines, the neuroticism-extraversion circumplex (Hofstee et al., 1992) illustrates that the interpersonal implications of neuroticism vary depending on a person's level of extraversion: Typical behavior of individuals with higher neuroticism and lower extraversion is characterized as anxious, self-critical, and shy. In contrast, the model describes people with higher neuroticism and higher extraversion as high-strung, excitable, and talkative. Thus, by assigning interpersonal behaviors and perceptions to the interplay between two personality traits, the AB5C highlights the need to study the role of interactions between personality traits for social relationships (see Judge & Erez, 2007).

Dynamic Models of Personality and Social Relationships

Dynamic models on personality and social relationships emphasize that personality does not only shape people's interpersonal perceptions and behaviors but that the social environment also feeds back into a person's personality. This overarching view is advocated by the *dynamic-interactional paradigm*, which suggests that personality traits and social relationships co-develop over time and reciprocally interact with each other (Caspi, 1998; Magnusson, 1990; Neyer & Asendorpf, 2001). Along these lines, Back et al.'s (2011) framework for analyzing the complex dynamics of personality and social relationships—the *PERSOC* framework—proposes that personality traits and social relationships can mutually influence each other and that social interactions mediate this association (see Figure 2). For example, people with higher agreeableness may be more satisfied with their social relationships because they act more friendly during social interactions and perceive more friendly reactions from their interaction partners (Berry & Hansen, 2000; Cuperman & Ickes, 2009; Rau et al., 2020). Consequently, investigating perceptions and behaviors in daily social interactions is key to understanding the processes linking personality and social relationships.

Figure 2

The Mediating Role of Social Interactions



Note. According to the framework for analyzing the complex dynamics of personality and social relationships (PERSOC; Back et al., 2011), personality and social relationships can mutually influence each other, and social interactions function as mediators within this interplay.

A second implication that derives from the dynamic-interactional paradigm is that people differ from each other in their reactions to certain social cues or situations (Magnusson, 1990; Neyer & Asendorpf, 2001). That is, the interplay between a person's personality and their social environment translates into certain behaviors or psychological states. For example, it has been argued that neuroticism moderates a person's affective reactions to social cues, such that individuals with higher neuroticism react with more negative affect to social stressors, such as being criticized or rejected (Denissen & Penke, 2008b; Holmes, 2002). Therefore, investigating how personality and social relationships interact is crucial for understanding individual differences in socio-emotional outcomes.

Integration of Theoretical Perspectives

As described above, circumplex models of interpersonal behavior (Hofstee et al., 1992; Wiggins, 1980) and dynamic models on personality and social relationships (Back et al., 2011; Neyer & Asendorpf, 2001) have in common that they suggest a close link between personality and social relationships. Yet, they elaborate on different aspects of this association that complement each other in a descriptive, explanatory, and predictive manner (see Mõttus et al., 2020). As such, I build on an integration of both theoretical perspectives to investigate the association between personality and social relationships in adolescence.

As a first shared point, both model types highlight the relevance of social interactions for investigating the association between personality and social relationships. Specifically, circumplex models highlight the interpersonal implications of personality and offer a detailed, yet parsimonious description of interpersonal behaviors (Wiggins, 1991; Wiggins et al., 1988; also see Back, 2021; Dawood et al., 2018). Among the dynamic models, the PERSOC framework (Back et al., 2011) goes one step further and identifies processes in social interactions (i.e., interpersonal behaviors and perceptions) as mediators between personality and social relationships. This way, PERSOC provides a theoretical conceptualization to explain the mechanisms underlying the association between personality and social relationships. Taken together, both theoretical perspectives emphasize the need to investigate specific perceptions and behaviors within social interactions.

As a second shared point, both circumplex models of interpersonal behavior and dynamic models on personality and social relationships emphasize the need to move beyond simple associations between personality and socio-emotional outcomes, yet center on distinct aspects. Most clearly, the dynamic-interactional paradigm elaborates on the fact that personality dynamically interacts with an individual's social environment (Neyer & Asendorpf, 2001) and

moderates the association between social cues and socio-emotional outcomes (Denissen & Penke, 2008b). The AB5C model (Hofstee et al., 1992), in contrast, focuses on the fact that individual differences in interpersonal perceptions and behaviors can best be described by assigning them to combinations of two Big Five traits. This way, it suggests that personality traits interact with each other, although this prediction is not explicitly formulated in the model (see Judge & Erez, 2007). Together, the two perspectives highlight interactions between, first, personality and the social environment, and second, different personality traits. This way, they form a theoretical scaffolding to make predictions from personality on socio-emotional outcomes that are more complex and potentially a more accurate reflection of reality (Chaplin, 1997; Mõttus et al., 2020).

Finally, as an overarching methodological implication, the integration of both theoretical perspectives suggests that studying the association between personality and social relationships requires considering different timelines (see Back et al., 2023). Specifically, associations between personality and social relationships can be described at a cross-sectional level, as it is typically done in circumplex models (Hofstee et al., 1992; Wiggins, 1980). In contrast, explanatory processes and predictive effects that are outlined in dynamic models on personality and social relationships (Back et al., 2011; Neyer & Asendorpf, 2001), refer to longitudinal associations. These include short-term links capturing social interactions on a momentary or daily level and long-term links capturing a person's social life across several months or years. Besides considering the association between personality and social relationships on different relationship levels (i.e., micro, meso, and macro), it is thus important to investigate it with respect to different timelines (i.e., short- and long-term) to obtain an integrative picture.

1.2.3. Empirical Findings on Personality and Social Relationships

In line with theoretical concepts (e.g., Denissen & Penke, 2008b; McCrae & Costa, 1989), previous research emphasizes the impact of neuroticism, extraversion, and agreeableness on social relationships, whereas empirical evidence for the effects of openness and conscientiousness is less pronounced or more mixed (Harris & Vazire, 2016; Mund et al., 2016; Ozer & Benet-Martínez, 2006). In the following, I briefly summarize empirical findings on the association between each trait and social relationships in adolescence in general, before turning to the role of personality for the three specific outcomes of this dissertation (i.e., momentary social satisfaction, momentary affect, and loneliness).

Personality and Social Relationships in Adolescence

Neuroticism in adolescence has been linked with increases in insecurity (Deventer et al., 2019; Parker et al., 2012) and lower levels of emotional closeness (Wagner et al., 2014) in

different types of relationships (e.g., parents and peers). Moreover, adolescents with higher neuroticism tend to perceive more conflict in their social relationships (Borghuis et al., 2020), and to be less liked and popular among classmates (van der Linden et al., 2010). Extraversion in adolescence has been positively linked with the eased formation of new relationships (Asendorpf & Wilpers, 1998; Harris et al., 2017; Klimstra et al., 2013; Selfhout et al., 2010; Wagner et al., 2014) and with higher levels of emotional closeness across different relationship types (Harris et al., 2017; Wagner et al., 2014). In addition, adolescents with higher extraversion tend to perceive more support from their peers (Asendorpf & Van Aken, 2003) and to be more liked and popular among their classmates (Lösch & Rentzsch, 2018; van der Linden et al., 2010). Finally, agreeableness in adolescence has been related to declines in insecurity (Deventer et al., 2019; Parker et al., 2012), higher levels of emotional closeness and relationship stability (Branje et al., 2004; Wagner et al., 2014), and fewer conflicts in social relationships (Asendorpf & Wilpers, 1998; Deventer et al., 2019; Parker et al., 2012). Moreover, adolescents with higher agreeableness seem to exchange more social support with family members (Asendorpf & Van Aken, 2003; Branje et al., 2004), and to be more liked by their classmates and selected as friends (Lösch & Rentzsch, 2018; Selfhout et al., 2010; van der Linden et al., 2010).

To summarize, neuroticism has been primarily associated with negative socio-emotional outcomes. In contrast, both extraversion and agreeableness have shown largely positive effects on adolescents' social relationships, although they differ in their specific functions: Whereas extraversion may be particularly relevant for the extension of adolescents' social network by actively making new friends, agreeableness seems to be key for the maintenance of positive relationships (Selfhout et al., 2010; Wagner et al., 2014). Therefore, neuroticism, extraversion, and agreeableness all have strong implications for adolescents' social relationships, while each trait's contribution likely varies across the three socio-emotional outcomes relevant in this dissertation (i.e., momentary social satisfaction, momentary affect, and loneliness). The following sections provide a more detailed overview of research on these specific associations and highlight current gaps in the literature.

Personality and Momentary Social Satisfaction

Since previous empirical studies on personality and social relationships in adolescence focused on broader socio-emotional outcomes within and across different relationship types (i.e., at the meso and macro level; e.g., Asendorpf & Wilpers, 1998; Parker et al., 2012), little is known about how personality manifests in adolescents' momentary social satisfaction (i.e., at the micro level). Research investigating momentary happiness among adult participants (Mueller et al., 2019; Sun et al., 2017; Wilt et al., 2012) suggest that the negative effects of

neuroticism and the positive effects of extraversion and agreeableness are also reflected in people's experience of social interactions. Whether this finding generalizes to momentary social satisfaction in adolescence, however, remains an open question.

Another open question refers to the underlying mechanisms that explain how personality relates to momentary social satisfaction. In line with the PERSOC framework (Back et al., 2011), findings from previous studies using adult samples suggest a mediating role of perceptions of interpersonal behaviors as they relate to both personality and an individual's social experience (e.g., Caughlin et al., 2000; Geukes et al., 2017; McNulty, 2008). Moreover, previous research suggests differences across personality traits, such that perceptions relating to neuroticism are mainly based on cognitive processes, perceptions relating to extraversion on a person's behavior, and perceptions relating to agreeableness on both (McCrae & Costa, 1989). For example, neuroticism has been related to more negative perceptions during romantic partners' problem-solving discussions in the laboratory (McNulty, 2008), a negative interpretation bias in hypothetical scenarios on ambiguous situations with the romantic partner (Finn et al., 2013), and with more negative perceptions during social interactions of unacquainted triads in the laboratory (Morse et al., 2015). In contrast, extraversion has been related to more sociable, friendly, and self-revealing behavior in studies investigating daily social interactions of university students (Breil et al., 2019; Geukes et al., 2017; Wilson et al., 2015) or interactions of unacquainted triads in the laboratory (Morse et al., 2015). Finally, agreeableness has been related to the tendency to perceive more positive characteristics in other people (Cuperman & Ickes, 2009; Rau et al., 2020) and to more expressive, modest, and attentive behavior in social interactions of university students in daily life (Geukes et al., 2017) or in the laboratory (Back et al., 2009; Berry & Hansen, 2000).

In conclusion, previous research on social interactions in adulthood highlights the relevance of personality for individual differences in momentary social satisfaction and perceptions of interpersonal behaviors. Whereas these studies point to differences among neuroticism, extraversion, and agreeableness, the specific perceptions that mediate each trait's link with momentary social satisfaction remain unknown. Accordingly, more research is needed to elucidate the mechanisms underlying the association between personality traits and momentary social satisfaction in adolescence.

Personality and Momentary Affect

Among the Big Five, neuroticism represents the trait with the strongest implications for a person's affective experiences (Barlow et al., 2014; Denissen & Penke, 2008b; Soto & John,

2017). Along these lines, a number of diary and experience-sampling studies using adult samples provide empirical support for the association between neuroticism and individual differences in momentary affect. Findings indicate that—within and outside social contexts—people with higher neuroticism experience lower levels of positive affect, higher levels of negative affect, and higher affect variability (e.g., Eid & Diener, 1999; Geukes et al., 2017; Kuppens et al., 2007; Miller et al., 2009). So far, there are only two experience-sampling studies based on Dutch adolescent samples, which show that neuroticism relates to higher levels of momentary negative affect (Borghuis et al., 2020) and lower levels of positive affect and higher affect variability (Reitsema et al., 2022) in adolescence, too.

Within the context of specific relationships (i.e., at the meso level), previous research using adult samples provides initial evidence that neuroticism moderates the association between romantic relationship variables and momentary affect in addition to its main effects. First, the momentary affect of adolescents with higher neuroticism may be more closely associated with social threats and insecurities relating to one's partner, as suggested by Denissen and Penke's (2008a) finding that neuroticism moderates affective responses to imagined social and non-social threats, indicating that individuals with higher neuroticism were more sensitive to social stressors. Second, Mueller et al. (2019) found in an experience-sampling study on social interactions that neuroticism moderated affective responses to different types of interaction partners, such that people with higher neuroticism felt less happy when interacting with their romantic partner compared to other interaction partners. As a possible interpretation, Mueller et al. (2019) suggest that individuals higher in neuroticism may feel particularly insecure in ambiguous situations involving their partner. Third, in another experience-sampling study based on older (ages 67 to 93) romantic couples, Mueller et al. (2021) found that the momentary positive affect of individuals with higher neuroticism was more closely coupled to their partners' momentary positive affect. This finding provides initial evidence that romantic partners with higher neuroticism are also more sensitive to social cues with positive valence. Altogether, the three studies suggest that neuroticism moderates the association between romantic relationship variables and momentary affect. Whether these findings generalize to adolescence, a period where romantic relationships take on a particular role for affective experiences (Larson et al., 1980; Mirsu-Paun & Oliver, 2017), remains an open question.

Personality and Loneliness

A recent meta-analysis by Buecker et al. (2020) suggests that, among the Big Five personality traits, neuroticism and extraversion are the strongest predictors of loneliness perceived

across a person's relationships (i.e., at the macro level). Based on both cross-sectional and longitudinal studies, the meta-analysis of Buecker et al. found that higher neuroticism and lower extraversion related to higher levels of loneliness at baseline and up to 17 years later. Although most of the studies included in the meta-analysis used adult samples, similar associations were observed in adolescence (Asendorpf & Van Aken, 2003; Vanhalst et al., 2012). Furthermore, initial evidence suggests that the negative association between extraversion and loneliness was more pronounced in younger age groups (Buecker et al., 2020; Vanhalst et al., 2013). Hence, extraversion might be particularly relevant for loneliness in adolescence. Regarding the more specific aspects of loneliness, findings of the meta-analysis by Buecker et al. (2020) indicated that extraversion is more strongly associated with social loneliness. Neuroticism, on the other hand, seems to relate to emotional and social loneliness equally. Despite this strong evidence for the predictive effects of extraversion and neuroticism for loneliness in adolescence and other age groups, only few studies have investigated how personality traits relate to prospective changes in loneliness. In one rare study tracking young adults across two measurement points (1995 and 2010), Mund and Neyer (2016) found that only higher neuroticism, but not extraversion, predicted increases in loneliness across 15 years. Corresponding studies examining the role of personality traits for changes in loneliness during adolescence are yet to be conducted (cf., Vanhalst et al., 2013).

Standing in stark contrast to early theoretical notions on interactions between neuroticism and extraversion (Eysenck & Eysenck, 1985; Hofstee et al., 1992), extant studies have exclusively examined linear main effects of personality traits on loneliness. Consequently, two kinds of more complex patterns remain unexplored: First, the effects of neuroticism and extraversion might represent non-linear effects, wherein the strength of the association between each trait and loneliness varies across trait levels. For example, the effect of neuroticism could be exponential, such that being modestly or very low in neuroticism might not make much of a difference for loneliness, whereas adolescents with very high neuroticism are at much higher risk to experience loneliness than those with fairly high neuroticism. Second, the respective effects of neuroticism and extraversion could interact. For example, the effects of both traits could reinforce each other, such that the positive association between neuroticism and loneliness is even stronger for adolescents with lower extraversion. Whereas no previous study has tested such effects with respect to loneliness, initial support comes from research on subjective well-being: In a few studies using adult samples, the interaction between neuroticism and extraversion predicted individual differences in subjective well-being beyond the main effects of both traits (Hotard et al., 1989; Lynn & Steel, 2006; Morris et al., 2015). To understand the

potential differential role of neuroticism and extraversion for adolescents' loneliness, and the interplay between both personality traits, however, more research is needed.

1.2.4. Towards Higher Resolution: The Relevance of Personality Facets

Typically, personality psychological research—including research on the Big Five (McCrae & Costa, 1987, 2008)—studies individual differences based on overall scores of higher-order traits, such as neuroticism, extraversion, and agreeableness. The clear advantage of analyzing such broader traits is that individual differences in personality can be summarized within a manageable and easily communicable number of dimensions (Mõttus et al., 2020). Personality facets can, however, make an important contribution to advancing the descriptive, explanatory, and predictive power of personality (see Mõttus et al., 2020): First, they allow for more detailed descriptions of personality and its correlates. Second, it has been proposed that facets can help to get closer to concrete, causal explanations regarding the way personality exerts its effects on psychological outcomes because they define more specific behaviors, thoughts, and feelings than the overall scores of traits do (McCrae, 2015; Mõttus, 2016; Mõttus et al., 2020). Finally, a number of researchers have concluded that the analysis of facet scores appears to be particularly useful when predicting and investigating associations between personality and social relationships (Mueller et al., 2019; Mund & Neyer, 2014): Compared to broader traits, personality facets can be better linked to specific socio-emotional outcomes or specific cues of the social environment. To date, however, very little is known about the association between personality facets and social relationships in both adolescence and other age groups, which is why it remains an important topic for investigation.

1.3. Research Desiderata

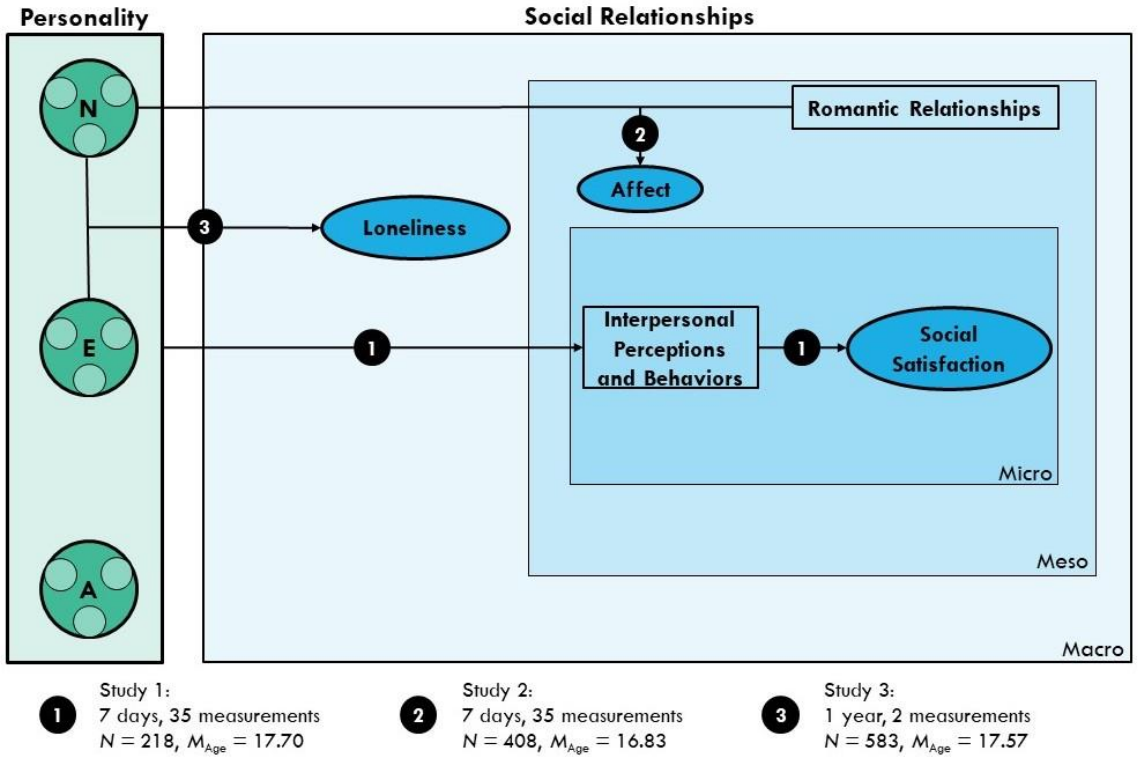
This dissertation aims to elucidate the complex and dynamic interplay of personality traits and social relationships in adolescence. Adolescence is a period of rapid change (Dahl et al., 2018; Steinberg, 2005; Suleiman et al., 2017), in which social relationships transform and gain unique significance (Havighurst, 1948; Laursen & Bukowski, 1997; Rubin et al., 2006). Whereas theoretical and empirical research agree that personality is key to the explanation of individual differences ins social relationships (e.g., Back et al., 2009; Neyer & Asendorpf, 2001; Wagner et al., 2014; Wiggins, 1991), the research presented above reveals four central research gaps refering to the age of adolescence, underlying mechanisms, more complex patterns, and research on personality facets.

First, regarding the role of personality for social relationships in general, adolescence is an understudied age group. This stand in stark contrast to a much larger body of research on the

association between personality and social relationships that has been conducted based on adults samples (e.g., Cuperman & Ickes, 2009; Donnellan et al., 2004; Geukes et al., 2017; Mueller et al., 2019; Mund et al., 2016). Since empirical findings suggest that both personality (e.g., Soto & Tackett, 2015) and social relationships (Kahn & Antonucci, 1980; Laursen & Bukowski, 1997) partly differ between adolescence and adulthood, findings from research using adult samples cannot easily be generalized. Accordingly, the aim of the three studies making up this dissertation is to investigate how personality traits relate to social relationships in adolescence (first research quesiton). In doing so, I focus on three socio-emotional outcomes located at different levels of social relationships (see Figure 3 for an overview). At the micro level, Study 1 examines how neuroticism, extraversion, and agreeableness relate to momentary social satisfaction in adolescents' daily life. At the meso level, Study 2 investigates associations between adolescents' neuroticism and their level and variability of momentary affect in the context of romantic relationships. Finally, at the macro level, Study 3 examines the cross-sectional and longitudinal links of neuroticism and extraversion with loneliness.

Figure 3

Schematic Study Overview



Note. N = Neuroticism, E = Extraversion, A = Agreeableness. Each of these personality traits subsumes three narrower personality facets (see Soto & John, 2017). The association between personality and social relationships in adolescence is studied at the micro level (social interactions), meso level (specific relationships), and macro level (all relationships of a person) and regarding different socio-emotional outcomes.

Second, the mechanisms linking personality and social relationships are only poorly understood. Dynamic-transactional concepts, such as the PERSOC framework (Back et al., 2011), state that personality traits relate to individual differences in social relationships via mediating social interactions. Along these lines, previous research has shown that neuroticism, extraversion, and agreeableness predict individual differences in interpersonal perceptions and behaviors (e.g., Breil et al., 2019; Geukes et al., 2017; McNulty, 2008), but leaves open how this relates to individual differences in a person's social relationships. Accordingly, the second goal of this dissertation was to investigate which processes in social interactions can explain the link between personality traits and social satisfaction. To this end, Study 1 zooms into adolescents' social interactions and explores which perceived interaction behaviors mediate the association between adolescents' personality traits and their momentary social satisfaction (second research question).

Third, research has almost solely focused on linear associations between personality and social relationships. There is much reason to assume, however, that personality effects are more complex. More specifically, the dynamic-interpersonal paradigm emphasizes that people differ from each other in the way they react to their social environment (Denissen & Penke, 2008b; Magnusson, 1990). Along with this, previous studies using adult samples show that people with higher neuroticism react more strongly to both negative and positive social cues (e.g., Denissen & Penke, 2008a; Mueller et al., 2021). Furthermore, theory suggests that personality traits interactively shape interpersonal behavior (Eysenck & Eysenck, 1985; Hofstee et al., 1992) and initial research provides evidence for interactions between extraversion and neuroticism in the context of well-being (e.g., Hotard et al., 1989; Morris et al., 2015). Going beyond the study of linear main effects, the third goal of this dissertation was to investigate how personality traits interact with adolescents' social environment and with each other (third research question). Addressing this goal, Study 2 examines how neuroticism moderates the association between romantic relationship variables (i.e., relationship involvement and relationship quality) and adolescents' momentary affect. Study 3 then investigates how non-linear effects and interactions between extraversion and neuroticism predict individual differences in loneliness.

Finally, most previous studies on personality and social relationships were directed at broader traits and have neglected the role of personality facets. Recently, however, a number of researchers have highlighted the need for facet-specific research (Mõttus, 2016; Mõttus et al., 2020), particularly when studying associations between personality and social relationships

(Mueller et al., 2019; Mund & Neyer, 2014). Consequently, Study 1 and Study 2 of this dissertation investigate the facets scores of personality traits in addition to the overall scores in an exploratory manner.

To address these research gaps, this dissertation encompasses three preregistered studies, in which I analyze correlational cross-sectional and longitudinal data of adolescent samples from three different original studies. For an integrative picture, I investigate personality-social relationship associations on different relationship levels (i.e., micro, meso, macro) and timelines (i.e., short-term and long-term). Moreover, by considering social relationships within different contexts (i.e., social relationships in general and romantic relationships specifically) and a range of socio-emotional outcomes (i.e., momentary social satisfaction, momentary affect, and loneliness), the three studies of this dissertation shed light on the dynamic interplay of adolescent personality and social relationships from a variety of perspectives. To account for the complexity of this interplay, I use a diverse set of statistical approaches, including multi-level mediation, polynomial regression analysis, and mixed-effects location scale modeling. In the following, I briefly summarize the scope of all three studies.

1.3.1. Study 1

Adapting a micro-level perspective on the association between personality and social relationships in adolescence, the purpose of Study 1 was twofold: one, the aim was to test whether associations between personality (i.e., neuroticism, extraversion, and agreeableness) and satisfaction with momentary social interactions previously reported for adults generalize to adolescents; two, the aim was to identify perceptions of social interaction behaviors that can (partly) explain these associations in real-life contexts. Thus, Study 1 provides a direct test of the theoretically derived mediating role of social interactions within the association between personality and social relationships (Back et al., 2011). In line with research on broader relationship outcomes (e.g., Asendorpf & Wilpers, 1998; Parker et al., 2012; Wilson et al., 2015) and on momentary happiness in social interactions of adults (e.g., Mueller et al., 2019), I expected that lower neuroticism, higher extraversion, and higher agreeableness would predict higher satisfaction with social interactions in adolescence. Due to the different conceptual relevance of neuroticism, extraversion, and agreeableness for emotional-cognitive processes and social behavior (McCrae & Costa, 1989; Wiggins, 1991), I further expected that different perceptions (i.e., adolescents' perceptions of their own behavior and their interaction partner's behavior) would mediate the association between each trait and adolescents' momentary social satisfaction.

To test these hypotheses, I used self-report questionnaires and experience-sampling data from two adolescent samples ($N_{overall}$ = 218; M_{age} = 17.70) that are part of the SELFIE study (Wagner et al., 2021). All analyses accounted for the nested data structure (i.e. measurements nested within individuals) and were repeated in both samples as robustness analyses of results. Despite the diversity in possible social interaction behaviors, an established system for classification is lacking (for initial conceptual integrations based on adult samples, see Geukes et al., 2017; Leising & Bleidorn, 2011). Thus, in the first step, I conducted an exploratory factor analysis to form indices of adolescents' perceptions of their own and the other person's interaction behavior. In a second step, I used these indices to analyze the interplay between the participants' personality traits, their perceptions of social interaction behaviors, and their momentary social satisfaction via multilevel regression and mediation models (see Preacher et al., 2010, 2011). By distinguishing associations across personality facets in addition to trait scores and by differentiating between social perceptions concerning the self and the interaction partner, the findings offer insights with a new level of detail.

1.3.2. Study 2

Focusing on adolescents' romantic relationships, Study 2 aims at investigating how neuroticism and different aspects of romantic relationships (i.e., relationship involvement and relationship quality) jointly predict interindividual differences in adolescents' momentary affect. First, based on research that was mainly established using young adult samples (e.g. Borghuis et al., 2020; Eid & Diener, 1999; Geukes et al., 2017), I expected that adolescents with higher neuroticism experience lower levels of positive affect, higher levels of negative affect, and higher affect variability. Second, given the lack of previous findings, I made no prediction regarding the association between relationship involvement and individual differences in adolescents' average affect levels but expected based on initial evidence (see Larson et al., 1980) that adolescents in a current relationship experience higher affect variability than their single peers. Looking at individual differences among adolescents involved in a romantic relationship, I further expect that higher relationship quality is associated with higher levels of positive affect, lower levels of negative affect, and higher affect variability (see Galliher et al., 2004; Mirsu-Paun & Oliver, 2017). Finally, based on the heightened responsiveness of individuals with higher neuroticism to social cues (Denissen & Penke, 2008a; Mueller et al., 2021), I expected that neuroticism reinforces each of the associations between romantic relationship variables (i.e., relationship involvement and relationship quality) and adolescents' affect level and variability.

To test these hypotheses, I used combined data from the SELFIE (Wagner et al., 2021) and SchoCo (https://osf.io/r5gjx/) studies ($N_{overall}$ = 408; M_{age} = 16.83), which were collected using self-report questionnaires and experience sampling. To account for the nested data structure (i.e., measurements nested within individuals) and to simultaneously model individual differences in adolescents' level and variability of momentary affect, I used mixed-effects location scale models (Hedeker et al., 2009; McNeish, 2021). In line with the conceptualization of positive and negative affect as separate constructs (Watson & Clark, 1997), I analyzed both measures of adolescents' momentary affect in a parallel manner. Since Study 1 highlighted the distinct roles of personality facets in the context of adolescents' daily social interactions, I examined the effects of the facet scores of neuroticism in addition to the effect of the overall score. Altogether, Study 2 takes a first step towards combining personality psychological research with research on affective experiences in the context of adolescent romantic relationships.

1.3.3. Study 3

Finally, Study 3 addresses the lack of research beyond linear main effects by investigating how non-linear effects and interactions of extraversion and neuroticism predict adolescents' loneliness. Turning to a macro-perspective, I drew on one-year longitudinal data from two samples ($N_{overall}$ = 583; M_{age} = 17.57) from the SELFIE (Wagner et al., 2021) and pairfam (Brüderl et al., 2020) studies. To examine the non-linear and interaction effects, I use polynomial regression analyses with an information-theoretic approach for model comparison (Burnham & Anderson, 2002; Humberg et al., 2019). Specifically, I defined six competing hypotheses that are based on theoretical notions (Eysenck & Eysenck, 1985; Hofstee et al., 1992; Hotard et al., 1989) and empirical findings on linear effects (Buecker et al., 2020), which can be grouped into three categories: First, the *linear main effects hypothesis* predicts that lower extraversion and higher neuroticism are linearly related to higher loneliness. Second, hypotheses grouped under the *monotonous non-linear effects hypothesis* capture the possibility that the effect of extraversion is saturating and the effect of neuroticism is exponential. Finally, the *mutual dependence hypothesis* reflects scenarios in which the effects of extraversion and neuroticism compensate each other (i.e., negative interaction) or mutually reinforce each other (i.e., positive interaction). To test and compare the six alternative hypotheses, I translated each of them into a polynomial regression model and evaluated their empirical evidence.

By conducting separate analyses of the SELFIE and pairfam data, I made use of the different strengths each data set offers (e.g., nuanced measures versus sample size). In addition, the separate analysis of the two data sets allowed identifying which findings are consistent across both adolescent samples. In doing so, I considered both cross-sectional and longitudinal

associations between personality and an overall-score of loneliness. In addition, I explored whether the specific interplay of extraversion and neuroticism differs between emotional and social loneliness (Weiss, 1973). This way, the results of this study contribute to a more nuanced and integrative understanding of the way personality relates to loneliness in adolescence.

2. What Makes for a Pleasant Social Experience in Adolescence? The Role of Perceived Social Interaction Behavior in Associations Between Personality Traits and Momentary Social Satisfaction

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Abstract

Whereas theory and research agree that social interactions are central mediators of the associations between personality traits and relationship outcomes, less is known about the mechanisms involved. This is particularly evident when looking at adolescence, when social networks restructure and expand. Drawing on experience sampling data from two adolescent samples (overall $N > 200$), we examined which self- and other-perceptions of real-life social interaction behaviors contribute to the links between personality traits (i.e., extraversion, agreeableness, and neuroticism) and momentary satisfaction with social interactions. Multilevel exploratory factor analyses revealed that most social perceptions could be represented by two factors, labeled *expressive* and *communal* behavior. As hypothesized, we found that higher extraversion and agreeableness and lower neuroticism predicted greater social satisfaction. These associations were mediated by perceptions of more expressive and communal behavior in the case of agreeableness and extraversion and perceptions of less expressive behavior in the case of neuroticism. Contrary to our expectations, the results were the same no matter whether self- or other-perceptions were used as mediators. We discuss how our results provide information about the co-development of personality traits and social relationships from a microlevel perspective and outline directions for future research on perceived social interaction behavior.

Keywords: real-life social interactions, personality, adolescence, experience sampling

What Makes for a Pleasant Social Experience in Adolescence? The Role of Perceived Social Interaction Behavior in Associations Between Personality Traits and Momentary Social Satisfaction

Whereas social relationships represent an essential human need across the entire lifespan (Baumeister & Leary, 1995; Kahn & Antonucci, 1980), building and maintaining social relationships is of particular interest in late adolescence when relationships outside the family and a new level of intimacy are pursued (Rubin et al., 2006). A growing body of research has shown that personality—defined as a set of relatively enduring patterns of thoughts, feelings, and behaviors (Roberts et al., 2006)—is related to relationship quality (e.g., Asendorpf & Wilpers, 1998; Parker et al., 2012; Wagner et al., 2014). Among the Big Five personality traits, high extraversion, high agreeableness, and low neuroticism have consistently appeared as predictors of positive relationship experiences (Harris & Vazire, 2016; Mund et al., 2016). Theory and research generally agree that these macrolevel associations between personality traits and relationship outcomes are mediated by daily social interactions (e.g., Back et al., 2011; Baumeister & Leary, 1995; Caughlin et al., 2000), yet the underlying microlevel mechanisms are not well understood. Moreover, because studies on social interaction dynamics have tended to target young adults or people in older age groups (e.g., Chui et al., 2014; Mueller et al., 2019; Sun et al., 2017), it is unclear whether existing findings apply to the reality of adolescent life (e.g., unique developmental tasks and related social network characteristics; Aquilino, 2006; Rubin et al., 2006).

To address this research gap, the current paper uses experience sampling method (ESM) data from two adolescent samples and aims to test for whether associations between personality traits and satisfaction with social interactions generalize to adolescents and to identify social interaction behaviors and perceptions that explain these associations in real-life contexts at the microlevel. With this study, we hope to move this research field forward in four important ways: First, our study is the first to examine personality traits and social interactions in adolescents. Second, forming empirically derived indices from a wide range of naturally occurring perceived social interaction behaviors assessed in an ESM design provides new insights into the perceptions involved in social interactions in everyday life. Third, we aim to shed light on the mediating role of these interpersonal perceptions in the associations between personality and social satisfaction. Finally, we aim to provide a new level of detail to this interplay by distinguishing associations across personality traits vs. facets and by differentiating between social perceptions concerning the self and the interaction partner. In the following, we draw on the rich body of literature on associations between personality traits and social relationship outcomes on the

macrolevel to make inferences about corresponding, but less empirically tested and, thus, less understood microlevel associations and processes in social interactions.

The Interplay Between Personality Traits and Social Satisfaction in Late Adolescence

The belongingness hypothesis (Baumeister & Leary, 1995) states that the need to belong to someone and have frequent pleasant interactions has evolved as a result of evolutionary selection. A satisfying social relationship—defined as direct, repeated, and dynamic interactions between two individuals—which is mentally represented and recognized as a relationship by both interaction partners (Asendorpf & Banse, 2000; Hinde, 1979), has an enhancing effect on well-being and health (Cohen, 2004; Diener & Seligman, 2002). In late adolescence, strong social ties might be particularly crucial because individuals and their social networks both experience radical changes: The graduation from school marks the end of childhood (or the beginning of emerging adulthood) and a time of personality maturation and adaption to new social roles (Arnett, 2000; Roisman et al., 2004). In this chapter in life, social networks transform, new relationships gain importance, and others have to be redefined (Wagner et al., 2014). Therefore, it is important to understand which factors contribute to adolescents' establishment and maintenance of well-functioning, satisfying social relationships and repeated interactions within these dyads.

Personality traits are a key ingredient of functioning social relationships (Back et al., 2011; Back, 2021), or—as assumed in the dynamic-interactional paradigm—personality traits and social relationships co-develop over time (Neyer & Asendorpf, 2001). Within the Big Five taxonomy (McCrae & Costa, 1989), research has consistently pointed to the impact of extraversion, agreeableness, and neuroticism on socially relevant outcomes, whereas the effects of openness and conscientiousness seem to be less pronounced (Harris & Vazire, 2016; Mund et al., 2016). Therefore, the current study focuses on how neuroticism, extraversion, and agreeableness are associated with interindividual differences in social relationships and social interactions. Whereas most previous studies have provided information about personality-social-relationship dynamics in the long run (i.e., on the macrolevel), little research has examined these dynamics from a short-term perspective (i.e., on the microlevel). Dynamic interactional theories (Back et al., 2011; Thibaut & Kelley, 1978) suggest that multiple positive or negative interpersonal experiences accumulate into an overall level of relationship satisfaction. In order to understand how personality traits are related to adolescents' social relationships over time, it is necessary to understand how these traits are related to momentary satisfaction with social interactions.

Perceived Social Interaction Behavior: Mediator of the Interplay Between Personality Traits and Social Satisfaction?

Back et al.'s (2011) framework for analyzing the complex dynamics of personality and social relationships—the *PERSOC* framework—provides theoretical scaffolding for studying the links between personality traits and interpersonal outcomes. The model proposes that personality traits and social relationships can mutually influence each other and that (perceptions of) daily social interactions are central mediators for explaining this association. To gain a better understanding of these dynamics, we investigated how stable interindividual differences (i.e., at the person-level) are related to average measures of momentary social interaction processes (i.e., at the situation-level). Specifically, we examined whether perceptions of momentary social interaction behaviors function as mediators of the associations between personality traits and momentary satisfaction with social interactions. To maintain parsimony, and in line with our study design, we focused on interactions between two people and on the perceptions of one interaction partner.

From the perspective of an individual, (at least) two types of information appear to be relevant for the experience of a social interaction: the individual's momentary perception of their own behavior (*perception of self*) and their momentary perception of the interaction partner's behavior (*perception of other*). Whereas each of these types of perceived behaviors partly reflect actual external (social) events and partly reflect the individual's tendency to process information (Barrett & Pietromonaco, 1997; Bond, 1994), it is the interwoven combination of these two factors that accounts for a person's subjective experience of the social interaction (Furr & Funder, in press). Initial empirical research using ESM data from student samples (Geukes et al., 2019) and married couples' problem-solving discussions in the laboratory (McNulty, 2008) have demonstrated that an individual's perception of self and other are both related to, first, this person's personality traits and, second, to the individual's social experience (e.g., Caughlin et al., 2000). For example, people higher on extraversion reveal more information about themselves over the course of a social interaction (Geukes et al., 2017) and experience greater satisfaction from perceiving themselves as self-revealing (Collins & Miller, 1994). Along these lines, we hypothesize that both types of perception are likely to partially explain the links between personality traits and momentary satisfaction with social interactions in our adolescent sample.

Links of Personality Traits With Perceived Social Interaction Behaviors and Social Satisfaction: Trait-Specific Mediation Models

Whereas manifestations of personality traits in daily and momentary social interactions are not very well understood, previous empirical studies using adolescent and young adult samples have supported the theoretically proposed associations between personality traits and social relationship characteristics on the macrolevel. Extraversion has predicted the formation of new relationships (Asendorpf & Wilpers, 1998; Harris et al., 2017; Klimstra et al., 2013; Wagner et al., 2014) and higher levels of emotional closeness (Harris et al., 2017; Wagner et al., 2014). Agreeableness has predicted lower rates of conflict (Asendorpf & Wilpers, 1998; Deventer et al., 2019; Parker et al., 2012), declines in insecurity (Deventer et al., 2019; Parker et al., 2012), and higher levels of emotional closeness as well as relationship stability (Wagner et al., 2014). Neuroticism has predicted increases in insecurity (Deventer et al., 2019; Parker et al., 2012), higher rates of conflict (Borghuis et al., 2019), and lower levels of emotional closeness (Wagner et al., 2014).

Overall, both extraversion and agreeableness have primarily been associated with positive relationship outcomes, whereas neuroticism has shown largely negative effects. On the level of daily social interactions, we argue that these macrolevel associations should be mirrored in each trait's associations with higher (or lower) average levels of momentary social satisfaction. In addition, we propose that extraversion, agreeableness, and neuroticism also differ in their associations with the perception of self and the perception of other. Based on this trait-specificity of both social satisfaction and social perceptions, in turn, the perception of self and perception of other should ultimately emerge as distinct mediators in the association between each trait and momentary satisfaction (see Morse et al., 2015). In the following, we summarize findings from social interaction studies—most of which have used university student samples—that seem to support this differential argumentation.

We propose that extraversion—the most observable of all traits (Back, 2021; McCrae & Costa, 1989)—is most salient in an individual's behavior and corresponding self-perceptions. In previous studies that have used experience-sampling data (Breil et al., 2019; Geukes et al., 2017; Wilson et al., 2015) and ratings of videotaped interactions in unacquainted triads (Morse et al., 2015), extraversion was related to more sociable, friendly, and self-revealing behavior and to less emotion suppression. In addition, extraversion has been associated with perceptions of control in social interactions (Barrett & Pietromonaco, 1997; Cuperman & Ickes, 2009) and being the focus of attention (Sherman et al., 2013). Overall, it seems likely that individuals high

on extraversion will attribute social experiences primarily to their own behavior. Their momentary satisfaction with social interactions should thus depend mainly on their perception of self.

Agreeableness' relevance to interpersonal behavior is similar to extraversion's (McCrae & Costa, 1989) but instead concerns the maintenance of positive relationships with others rather than social impact (e.g., Wagner et al., 2014). We propose that agreeableness becomes salient in both an individual's self-perceptions and the person's perceptions of the interaction partner. In previous studies using experience-sampling reports (Geukes et al., 2017) or ratings of undergraduates' videotaped social interactions (Back et al., 2009; Berry & Hansen, 2000), agreeableness was related to more expressive, modest, and attentive behavior and to less arrogant behavior. The trait has been linked to tender-mindedness and a tendency to perceive positive characteristics in other people (Cuperman & Ickes, 2009; McCrae & Costa, 1989; Rau et al., 2020). Moreover, agreeable behavior and its conflict-avoiding aspects (Jensen-Campbell & Graziano, 2001; Parker et al., 2012) can potentially trigger friendlier behavior in the interaction partner. Overall, it seems likely that individuals who score high on agreeableness will attribute social experiences to both their own and the other person's behavior. Their momentary satisfaction with social interactions should thus depend on perceptions of both self and other.

Finally, we propose that neuroticism—a trait that is predominantly related to thoughts and feelings (McCrae & Costa, 1989)—is most salient in an individual's perceptions of the interaction partner. In previous research on romantic couples, individuals higher on neuroticism perceived their partner's behavior in problem-solving discussions more negatively (McNulty, 2008), and an interpretation bias in hypothetical scenarios mediated the trait's negative effect on relationship satisfaction (Finn et al., 2013). Using ESM, Hannuschke et al. (2020) found that neuroticism was related to perceptions of more warmth and sociability in the interaction partner and argued that these results might reflect the tendency of people high on neuroticism to perceive others more positively in contrast to themselves. Other studies have found associations between high neuroticism and a stronger responsiveness to (negative) social cues (Denissen & Penke, 2008; Geukes et al., 2017), a closer coupling with the romantic partner's positive affect (Mueller et al., 2021), attempts to adapt to others' behavior (Cuperman & Ickes, 2009), and perceptions of threat, criticism, deception, and negativity (Morse et al., 2015; Sherman et al., 2013). Overall, it seems likely that individuals high on neuroticism will attribute social experiences primarily to their interaction partner's behavior. Their momentary satisfaction with social interactions should thus depend mainly on the perception of other.

Despite the presence of all these rich studies that have examined the complex relationships between personality traits, interpersonal dynamics, and relationship experiences, we identified four limitations that we aimed to address with our study: First, many studies took place in a laboratory setting (e.g., Berry & Hansen, 2000; McNulty, 2008; Vater & Schröder-Abé, 2015), leaving unknown the extent to which the results could be generalized to real-life interactions. Second, using university students at zero-acquaintance (e.g., Berry & Hansen, 2000; Morse et al., 2015), psychology freshmen (e.g., Geukes et al., 2017; Hannuschke et al., 2020), or married couples (e.g., McNulty, 2008), only specific types of relationships, social interactions, and life circumstances have been studied. Third, some studies (Caughlin et al., 2000) have used retrospective accounts of interpersonal behavior, interpretations of behavior in hypothetical scenarios (Finn et al., 2013), or aggregated data (Wilson et al., 2015), thus complicating any conclusions that could be drawn about the associations between momentary perceptions and corresponding satisfaction with specific interactions or relationships. Finally, most of the abovementioned studies did not differentiate between participants' perception of self and perception of other, leading to further ambiguities in the interpretation of social interaction processes.

In sum, scientific evidence regarding the roles of social interaction behaviors and perceptions in the associations between personality traits and momentary social satisfaction is sparse. Next to the small number of existing microlevel studies, methodological challenges and the complex nature of social dynamics have made it difficult to draw any conclusions about mediating mechanisms yet. Looking at adolescence, current assumptions are on even shakier ground because nearly all previous studies have used adult samples. Therefore, further research on these dynamics is still required.

The Current Study

Two samples of more than 200 late adolescents (in total) who were in their final year of high school provided ratings of their personality traits in a questionnaire and reported on their everyday social interactions in an ESM week. The purpose of the current study was twofold: first, to test whether associations between personality traits (i.e., extraversion, agreeableness, and neuroticism) and satisfaction with social interactions generalize to adolescents, and, second, to identify perceptions of social interaction behaviors that can (partly) explain these associations in real-life contexts. In line with research on broader relationship outcomes (Asendorpf & Wilpers, 1998; Parker et al., 2012; Wilson et al., 2015) and on momentary happiness in social interactions (Mueller et al., 2019; Sun et al. 2017; Wilt et al., 2012), we expected that higher

extraversion and higher agreeableness as well as lower neuroticism would predict higher satisfaction with social interactions also in adolescence (Hypothesis 1). Due to the specified conceptual relevance of extraversion, agreeableness, and neuroticism for either social behavior, emotional-cognitive processes, or both in adulthood (McCrae & Costa, 1989; Wiggins, 1991), we further expected that perceptions of self and perceptions of other would differentially account for the links between the Big Five personality traits and satisfaction with the social interaction in our sample of late adolescents (Hypothesis 2). More precisely, we hypothesized that extraversion would predict greater satisfaction with social interactions through perceptions of self (partial mediation; Hypothesis 2a), that agreeableness would predict greater satisfaction with social interactions through perceptions of self as well as perceptions of other (partial mediations; Hypothesis 2b), and that neuroticism would predict lower satisfaction with social interactions through perceptions of other (partial mediation; Hypothesis 2c).

Given the diversity in possible social interaction behaviors and the lack of an established system for classifying such behaviors (for initial conceptual integrations based on adult samples, see Geukes et al., 2017; Leising & Bleidorn, 2011), we refrained from making specific predictions about which types of behaviors would contribute to the perception of self or to the perception of other. Instead, we addressed this as an open, exploratory research question. Specifically, we focused on the psychological consequences of *perceived* social interaction behaviors enacted by an individual and their interaction partner over the course of the interplay between personality traits and social satisfaction. For example, we assessed how sociable, dominant, or self-revealing participants perceived themselves and their social interaction partner to be during a specific social interaction, using the exact same dimensions for both evaluations (see Geukes et al., 2017). To arrive at a classification of perceived social interaction behaviors in adolescents, we then conducted an exploratory factor analysis to form indices of participants' perceptions of self and perceptions of other.

Recently, a growing number of researchers in personality science (e.g., Mueller et al., 2019; Mund & Neyer, 2014) have concluded that the relationships between specific characteristics of situations or social experiences and personality traits should be studied on the facet level as opposed to the examination of broad personality factors. Therefore, we investigated the facet scores of extraversion (sociability, assertiveness, activity), agreeableness (compassion,

respectfulness, trust), and neuroticism (anxiety, depression, volatility) in an exploratory manner[1]. Moreover, acknowledging that specific social context characteristics potentially represent an important source of intraindividual variation (e.g., Geukes et al., 2017; Ram et al., 2014; Chui et al. 2014), we decided to control for a number of situational characteristics, including the participant's familiarity with the interaction partner, the partner's gender, whether the social interactions took place on weekdays or weekends, and the day of the ESM. In addition, in line with previous research on social interactions (e.g., Mueller et al., 2019), we included participant gender as a control variable.

Method

The present article represents the first research to use data from the SELFIE study (https://osf.io/4gnz9/), a German multimethod longitudinal study on the development of personality traits and self-esteem across major life transitions. Thus, no other research using these data has been published yet. Ethical approval for the study was granted by the German Psychological Society (DGPs). In SELFIE, adolescents in their final year of high school participated at three measurement points. Data were collected from two samples: For the first sample, the introductory session took place in a laboratory in Berlin, Germany, and the follow-up sessions were online (Sample 1). The second sample completed everything online (Sample 2). In both samples, the introductory session was followed by an ESM week and all participants received monetary compensation that was proportional to the number of ESM questionnaires they completed. The current project used personality trait assessments and ESM data from adolescent participants at the first measurement point, testing hypotheses in the two samples separately. Hypotheses and data analyses were preregistered at https://osf.io/nxugc/ via the Open Science Framework (Center for Open Science, 2011–2020).

Participants

In the SELFIE study, 103 adolescents in Sample 1 and 143 adolescents in Sample 2 completed demographic and personality trait measures at the introductory session. Because we were interested in late adolescents' social interactions, participants who did not rate any social interactions during the ESM (n = 1 in Sample 1, n = 27 in Sample 2) were excluded prior to the

[1] Generally, we expected that the personality facets would be related to momentary perceived behavior and satisfaction with the social interaction in a manner similar to the effects of corresponding personality factors but that the strength of these associations might differ. Given the lack of previous empirical evidence, however, we refrained from making facet-specific predictions.

analyses.[2] In our final Sample 1, N = 102 late adolescents (70.59% female) aged 16–22 (M = 17.53, SD = 1.04) rated an average of 15.32 (SD = 5.66, Range: 4–29) social interactions during the ESM week. This resulted in a total of 1,563 social interaction ratings. In our final Sample 2, N = 116 late adolescents (81.03% female) aged 16–20 (M = 17.85, SD = 0.89) rated an average of 11.90 (SD = 7.43, Range: 1–29) social interactions during the ESM week.[3] This resulted in a total of 1,380 social interaction ratings.[4] In Sample 1 (Sample 2), 32.25% (28.62%) of the social interactions were with friends, 23.99% (29.71%) were with family members, 14.14% (10.51%) were with classmates, 9.02% (11.09%) were with a romantic partner, and the remaining interactions were with other people. Thus, the majority of the social interactions took place with a rather familiar person.

We conducted a Monte Carlo simulation in Mplus (Muthén & Muthén, 2002) and derived parameter estimates from our own multilevel mediation analyses for power estimations of our overall sample ($N_{overall}$ = 218; for Mplus outputs of the power simulations, see the supplementary materials at https://osf.io/mxbfw/). The simulations indicated overall satisfactory power ranging from 76.50% to 100% to detect effects with *b*-coefficients equal to or larger than 0.12, with higher power for effects with larger *b*-coefficients. Therefore, our data appeared to be sufficient to detect very small to small[5] effects reported in the Results but insufficient to detect exceedingly small effects (i.e., *b*-coefficients much smaller than 0.12). Thus, we refrained from interpreting these effects.

Procedure

At the first measurement point, demographic information and personality traits were assessed using online questionnaires implemented with the open-source software formr (Arslan et al., 2020). Participants in Sample 1 answered these questionnaires during an introductory

[2] In Sample 1, no selectivity analysis was conducted because only one participant was excluded. In Sample 2, Welch *t* tests were used to compare the 27 excluded participants with the included ones (N = 116). Selectivity analyses revealed that, compared with the final sample, the excluded group scored lower on agreeableness, $t(47.72) = -3.11$, $p = .003$, $d = -0.57$, 95% CI [−1.00, −0.14], and its facets compassion, $t(40.40) = -2.84$, $p = .007$, $d = -0.59$, 95% CI [−1.02, −0.16], and respectfulness, $t(50.96) = -2.02$, $p = .048$, $d = -0.36$, 95% CI [−0.78, 0.07], with small to medium effect sizes.

[3] For n = 1 participant in Sample 1, who indicated being 13 years old, and n = 2 participants, who indicated being 1 year old, age was coded as a missing value because we suspected typing errors. As a consequence, these participants' ages were excluded from the descriptive statistics but their data were used in all confirmatory and exploratory analyses.

[4] Relative to each participant's opportunity to provide 35 ratings across the ESM weeks, the actual number of reported social interactions reflect response rates of 43.78% and 33.99% in Samples 1 and 2, respectively. It should be noted, however, that these rates do not reflect mere study commitment but also the frequency of social interactions occurring within the ESM time window: If no social interaction occurred, no social interaction rating was provided even when the participant responded to other ESM measures at the given assessment.

[5] In our simulations, we simulated the power to detect indirect effects with *b*-coefficients of 0.12 and 0.24. These coefficients correspond to standardized effects of β = .06 (very small effect) and β = .13 (small effect), respectively.

session in the laboratory with computers provided by the study team. Participants in Sample 2 answered the questionnaires through a public survey link on their own devices. One day after completing the introductory session, participants in both samples began the ESM period and received five questionnaires per day (9 a.m., 12 p.m., 3 p.m., 6 p.m., 8 p.m.) on their smart phones for a 1-week period. In each of these questionnaires, participants were asked what activities they had engaged in since answering the last questionnaire (or since getting up) and whether they had socialized with another person. If this was the case, participants were further asked to rate their own and the other person's behaviors (i.e., the perception of self and the perception of other) during the social interaction and to evaluate the quality of the social interaction per se. If participants indicated that they had been alone, these items were skipped. The questionnaires included a number of other measures that are not relevant to this study.

Measures

Demographics

In the demographic questionnaire that was part of the introductory session, participants indicated whether they identified as male or female. Gender was coded 0 for male and 1 for female adolescents.

Personality Traits

Big Five personality traits were measured on the factor and facet levels during the introductory session with the German version of the Big Five Inventory 2 (BFI-2; Danner et al., 2019; Soto & John, 2017). Extraversion (sociability, assertiveness, activity), agreeableness (compassion, respectfulness, trust), and neuroticism (anxiety, depression, volatility) were measured with 12 items per factor, which can be further split into four items per facet. Specification of the degree of agreement with the item content was done on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). In Sample 1 (Sample 2), internal consistencies of personality factors and their subscales as indicated by total omega ω ranged from .73 to .89 (.66 to .83) for extraversion, from .57 to .75 (.64 to .81) for agreeableness, and from .70 to .88 (.71 to .88) for neuroticism. In Table 2, internal consistencies are provided in detail.

Social Interaction

All measures relating to the social interaction were assessed via adolescents' self-reports during the ESM week. Items were adapted from a study with a design similar to ours by Geukes et al. (2017, 2019).

Perceptions of Self and Perceptions of Other. Each time adolescents reported that they had socialized with someone within the ESM interval, they were asked to rate their own

and the other person's behaviors during the social interaction (i.e., perceptions of self and perceptions of other) on the exact same adjectives. Ratings of nine behaviors were given on bipolar scales ranging from 0 to 10, anchored with *in a bad mood* versus *in a good mood*, *bored* versus *activated*, *submissive* versus *dominant*, *reclusive* versus *sociable*, *unfriendly* versus *friendly*, *arrogant* versus *modest*, *exploiting* versus *cooperative*, *self-revealing* versus *reserved*, and *reliable* versus *unreliable*.

Satisfaction With the Social Interaction. Satisfaction with the social interaction was measured after each reported social contact by asking participants to rate the interaction on a scale ranging from 0 (*negative*) to 10 (*positive*).

Characteristics of the Social Interaction. After each social contact, adolescents were asked to indicate the degree of familiarity by rating how well they knew the interaction partner on a scale ranging from 0 (*not at all*) to 10 (*very*) and to indicate whether the other person was male or female. Relative to each participant's gender, the interaction partner's gender was coded 0 for the same and 1 for the opposite gender. Using participation dates, we computed a variable indicating whether the social interaction took place on a weekday (0) or the weekend (1) plus a variable indicating the ESM day relative to the individual ESM start date ranging from Day 1 (0) to Day 7 (6).

Data Analysis

Data cleaning, data structuring, and the computation of descriptive statistics including correlation matrices were performed with R version 3.6.0 (R Core Team, 2018) and various R packages. Our data represent a two-level structure, with social interactions (Level 1) nested within persons (Level 2). Accounting for the fact that within-person data are not independent from each other, multilevel analyses were conducted with Mplus 8.2 (Muthén & Muthén, 1998–2017) and the R package MplusAutomation (Hallquist & Wiley, 2018) using maximum likelihood estimation with robust standard errors and manifest means. To address multiple testing, we only discuss effects that were significant at an alpha level of $\alpha = .05$ (two-tailed tests) and that were replicated at this alpha level across our two samples. Given the novelty of our research question and the opportunity to identify associations that have not yet been studied, we applied no additional corrections for multiple testing. Following McShane et al.'s (2019) recommendations, however, we provide readers with all necessary information to evaluate our results by reporting exact *p*-values for all confirmatory analyses. In addition, we report confidence intervals for the indirect effects in our mediation models. The code and the data that are necessary to reproduce all results and supplementary materials can be retrieved from https://osf.io/mxbfw/. The Appendix of this article is provided online at https://osf.io/crkh9/.

Index Formation: Factor Analysis

Before hypothesis testing, we aimed to identify integrative indices describing the participants' perceptions of self and perceptions of other in social interactions using exploratory multilevel factor analysis (EMFA) with maximum likelihood estimation, robust standard errors, and oblique rotation. A similar approach has been used in other studies that used an intensive repeated-measures design (e.g., Goetz et al., 2013; Rush & Hofer, 2014). Analyses were conducted for perceptions of self and other separately and repeated in Samples 1 and 2 with the analyses differentiating within-person and between-person levels. After a preliminary exploration of different factor solutions and after applying the eigenvalue > 1 rule (for these analyses, see Tables A1-A3), we decided to extract indices from models with two factors as well as one single-item behavior on the within-person and between-person levels. Results from the EMFAs can be found in Table 1. Results appeared to be consistent across perceptions of self and perceptions of other, across the two samples, and across the within- and between-person levels: Most ratings on perceived behaviors loaded on two positively related broader factors. As an exception, ratings of dominant behavior were not consistently related to either factor and were largely unrelated to the other behaviors (for intercorrelations, see Table B1). Thus, dominant behavior had to remain a single-item behavior.

Table 1

Significant Rotated Factor Loadings of the 2/2 (w/b) Factor Solutions for the Perception of Self and Other

	Sample 1				Sample 2				
	Within		Between		Within		Between		
	1	2	1	2	1	2	1	2	Assigned Factor
Perception of self									
Good mood	0.60	0.28	0.74	0.31	0.68	0.21	0.95		Expressive
Activated	0.65		0.88		0.65		1.04		Expressive
Dominant	0.50	−0.45	0.47		0.42	−0.37			Dominant
Sociable	0.83		0.59	0.43	0.89	−0.10	0.89		Expressive
Friendly	0.37	0.55	0.35	0.73	0.53	0.45	0.62	0.39	Communal
Modest		0.49		0.91		0.57		0.74	Communal
Cooperative	0.25	0.47		0.93	0.33	0.48		0.795	Communal
Self−revealing	0.60			0.63	0.64		0.70		Expressive
Reliable	0.36	0.27		0.81	0.41	0.36	0.62	0.33	Communal
Factor Correlations	.36		.54		.29		.70		
Perception of other									
Good mood	0.33	0.53	0.99		0.50	0.37	0.41	0.59	Expressive
Activated	0.63		0.79		0.70		1.02		Expressive
Dominant	0.42	−0.39		0.53	0.45	−0.36	0.54	−0.36	Dominant
Sociable	0.70	0.17	0.58	0.46	0.83		0.35	0.70	Expressive
Friendly		0.84	0.56	0.46	0.25	0.66		0.95	Communal
Modest	−0.20	0.72		0.78	−0.17	0.73		0.75	Communal
Cooperative		0.70		0.99		0.79		0.99	Communal
Self−revealing	0.38	0.17		0.65	0.44	0.17	0.41	0.46	Expressive
Reliable	0.11	0.51		0.81	0.08	0.64		0.93	Communal
Factor Correlations	.52		.70		.60		.53		

Note. Results are based on $N = 102$ individuals providing a total of 1,563 observations in Sample 1 and $N = 116$ individuals providing a total of 1,380 observations in Sample 2.

Loadings are significant at $p < .05$. Overall, model fit statistics indicated good fit (CFI $\geq .95$; TLI $\geq .91$; RMSEA $\leq .06$; SRMR(within and between) $\leq .06$).

We used these results to form the following indices on the within- and between-person levels, applying to both perceptions of self and perceptions of other: *expressive* behavior (good mood, activated, sociable, self-revealing), *communal* behavior (friendly, modest, cooperative, reliable), and *dominant* behavior (one-item measure). Our indices were aligned with the two factors from the agency and communion framework (Bakan, 1966; Leising & Bleidorn, 2011), reflecting a person's motivation and capacity to "get ahead" or "get along," respectively (Hogan, 1983). Specifically, expressive and dominant behavior reflect two key aspects of agency, whereas communal behavior corresponds to communion. Moreover, expressive and communal behavior largely resemble the indices that were conceptually derived and used by Geukes et al. (2017) for expressive and antagonistic (the opposite of agreeable) behavior, but we included a wider range of behaviors in our indices. For the perception of self, internal consistencies for Sample 1 (Sample 2) as indicated by total omega ω were .82 (.84) for expressive behavior and .79 (.82) for communal behavior. For the perception of other, the corresponding consistencies were .78 (.82) and .83 (.86). In sum, our exploratory approach suggested that within- and between-person variance in adolescents' perceptions of social interaction behavior could be represented by two related dimensions, expressive and communal behavior, and a third dimension reflecting dominant behavior.

Hypothesis Testing and Exploratory Analyses

We used the newly formed indices to set up a series of multilevel models to investigate the associations between our predictors (extraversion, agreeableness, neuroticism), mediators (perception of self, perception of other), and outcome variable (satisfaction with the social interaction).[6] To avoid problems with multicollinearity and to facilitate the interpretability of the models, separate models were specified for each personality trait (and facet) and for each index of the perceptions of self and other. To maintain parsimony in the following descriptions, however, we uniformly refer to the perceptions of self and other as perceived social interaction behavior.

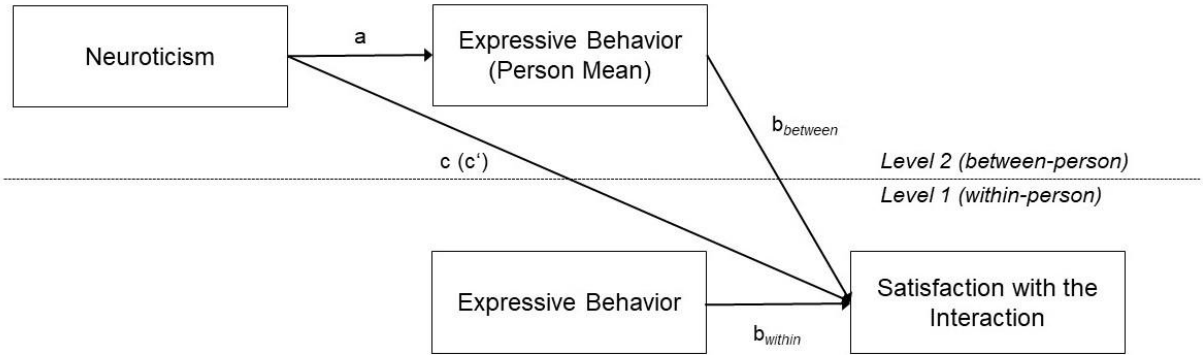
To test the multilevel mediation in a 2-1-1 design, we followed Preacher et al.'s (2010, 2011) approach: the predictor personality trait was assessed between persons (Level 2), whereas the mediator momentary perceived behavior and the outcome momentary satisfaction were assessed across social interactions within individuals (Level 1; see Figure 1). As is common in the literature (e.g., Bolger & Laurenceau, 2013), we use *a* to label the predictor-to-mediator link, *b* to label the mediator-to-outcome link, *c* to label the predictor-to-outcome link (total

[6] A more detailed depiction of the models described in this section and corresponding mathematical equations can be obtained from our preregistration (https://osf.io/nxugc/.

effect), and *c'* to label the predictor-to-outcome link after extracting the mediation effect (partial effect). Importantly, Preacher et al.'s (2010, 2011) approach accounts for the fact that the mediator can manifest within and between persons. Even though situation-specific perceived behavior was assessed as a Level 1 variable, each participant's average perceived behavior could additionally be considered as a Level 2 variable. This decomposition of the mediator into a within and a between component leads to the estimation of two meditator-to-outcome links, b_{within} and $b_{between}$. Following Preacher et al.'s recommendations, we modeled both of these paths in our statistical analysis but only interpreted the $b_{between}$ path because the 2-1-1 design only allows for the calculation of indirect effects on the between-person level. Thus, in line with the current study's focus on interindividual differences, the mediated effect of personality traits on satisfaction with the interaction through perceived social interaction behavior could be calculated from the product of the mediation paths $a \times b_{between}$. This indirect effect evaluates the extent to which between-person differences in personality traits are related to between-person differences in perceived behavior and the extent to which such between-person differences in perceived behavior, in turn, are related to the average level of satisfaction with social interactions.

Figure 1

2-1-1 Mediation Model



Note. Illustration of the mediation model with the exemplary predictor neuroticism, exemplary mediator perceived expressive behavior, and outcome satisfaction with the social interaction in a 2-2-1 design (Preacher et al., 2010, 2011). The *a* path represents the link between predictor and mediator. The *b* path between the mediator and outcome can be separated into a within-person effect b_{within} and a between-person effect $b_{between}$. On the path between the predictor and outcome, *c* represents the total effect and *c'* represents the partial effect after the mediation effect has been extracted.

In line with our preregistration, we carried out the mediation analyses in a stepwise manner for two reasons: First, given the novelty of microlevel investigations on explaining the mechanisms behind the interplay between personality traits and social satisfaction and the exploratory nature of our interaction behavior indices, we sought to understand the plain interrelatedness between variables. Second, given the large number of potential mediations, we aimed to restrict the number of mediation models. Thus, in the first step, we analyzed all mediation paths separately using multilevel regression modeling. In the second step, we conducted multilevel mediation analyses for the personality traits (or facets) and perceived social interaction behaviors that were significantly related to each other (*a* path in Figure 1) and to satisfaction with the interaction (b_{within}, $b_{between}$, and the *c* paths in Figure 1) in the preliminary analyses. For all multilevel models directly relevant to our two research questions, we additionally explored whether the effects remained robust when the control variables were included. The control variables on the within-person level were familiarity with the interaction partner, interaction partner's gender, weekday versus weekend, and day of the experience sampling. On the between-person level, participant gender was the only control variable. In all analyses, continuous within-person predictors were centered at the participants' individual mean, and continuous between-person predictors and all control variables were centered at their grand mean.

In the following, we first present the results from our main analyses that were performed to address our research questions. Then, we present results from exploratory analyses that included the control variables. For our main analyses, we report results for random effects (e.g., variation in random intercepts) and estimates for the variance explained by our multilevel regression models. Following the approach outlined by Snijders and Bosker (1994, 2011), we calculated R_w^2 and R_b^2 as the proportional reduction in mean squared prediction error for predicting values at the within-person level and the proportional reduction in mean squared prediction error for predicting values at the between-person level, respectively.

Results

Descriptive statistics and bivariate intercorrelations among the between- and within-person study variables can be found in Tables 2 and 3, respectively. On the within-person level, ratings of expressive behavior and communal behavior largely converged within and across the perceptions of self and other: Between these variables, the correlation coefficient *r* ranged from .55 to .70 in Sample 1 and from .53 to .76 in Sample 2 (all *p*s < .001). Thus, on average, adolescents perceived that they and their interaction partners behaved similarly, and perceived expressive behavior went along with communal behavior. By contrast, dominant behavior showed

little association with the other types of perceived behaviors, and the corresponding perceptions of self and other were negatively related (Sample 1: $r = -.20$, $p < .001$; Sample 2: $r = -.30$, $p < .001$). For further details, Table B1 provides descriptive statistics and bivariate intercorrelations for the single items measuring the perceptions of self and other.

Table 2

Descriptive Statistics, Internal Consistencies of the BFI-2 Scales, and Intercorrelations Among Continuous Study Variables: Between-Person Associations

	Sample1			Sample2			Intercorrelations												
	M	*SD*	ω	*M*	*SD*	ω	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	17.53	1.04		17.85	0.89			−.17	−.07	−.20	−.12	−.02	−.03	−.02	−.01	−.04	−.09	.04	−.06
2. Extraversion	4.84	1.00	.89	4.54	0.90	.83	.03		.85	.75	.72	.28	.32	.13	.22	−.22	−.18	−.10	−.25
3. Sociability	4.79	1.23	.86	4.28	1.19	.78	.03	.88		.48	.50	.33	.30	.15	.34	−.21	−.18	−.10	−.22
4. Assertiveness	4.75	1.14	.79	4.81	1.23	.81	.06	.84	.62		.22	−.03	.13	−.04	−.16	−.37	−.31	−.22	−.33
5. Activity	4.97	1.13	.73	4.53	1.08	.66	−.01	.84	.62	.55		.37	.33	.20	.36	.02	.05	.07	−.09
6. Agreeableness	5.20	0.71	.75	4.95	0.87	.81	−.11	.18	.16	−.04	.34		.81	.81	.76	−.23	.08	−.35	−.28
7. Compassion	5.72	0.87	.75	5.35	1.08	.74	−.17	.16	.12	.03	.25	.74		.51	.41	−.12	.13	−.19	−.22
8. Respectfulness	5.41	0.82	.57	5.25	1.12	.75	−.01	.12	.07	−.01	.25	.80	.47		.39	−.24	−.01	−.26	−.31
9. Trust	4.46	1.04	.61	4.25	1.10	.64	−.09	.14	.17	−.11	.29	.79	.31	.45		−.21	.10	−.42	−.17
10. Neuroticism	3.87	1.05	.88	3.89	1.09	.88	−.00	−.39	−.37	−.51	−.11	−.24	−.10	−.20	−.29		.87	.83	.84
11. Anxiety	4.34	1.12	.72	4.17	1.20	.71	.03	−.25	−.24	−.40	.01	.06	.16	−.02	.03	.88		.60	.65
12. Depression	3.39	1.33	.85	3.65	1.37	.87	−.08	−.36	−.33	−.46	−.11	−.31	−.13	−.24	−.39	.84	.66		.49
13. Volatility	3.89	1.29	.82	3.84	1.30	.79	.04	−.40	−.39	−.45	−.18	−.30	−.24	−.20	−.32	.81	.59	.44	

Note. Results are based on $N = 102$ individuals in Sample 1 and $N = 116$ individuals in Sample 2. Internal consistencies are provided as total omega (ω). Intercorrelations below and above the diagonal correspond to the data of Sample 1 and Sample 2, respectively. In both samples, intercorrelations of $r = |.19|$ or above are statistically significantly different from zero at $p < .05$. Grey-shaded values show intercorrelation of the factor and facet values of the same Big Five trait.

Table 3

Intercorrelations Among Continuous Study Variables: Within-Person Associations

	Sample 1			Sample 2											
	M	*SD*	ICC	*M*	*SD*	ICC	1	2	3	4	5	6	7	8	9
1. Satisfaction	8.27	2.05	.16	8.10	2.11	.15		.61	.54	.11	.60	.67	−.11	.24	.08
2. PoS: expressive	7.31	1.85	.28	7.05	1.82	.25	.62		.63	.24	.59	.57	−.05	.21	.12
3. PoS: communal	7.84	1.43	.51	7.60	1.48	.49	.52	.61		−.01	.53	.76	.02	.08	.14
4. PoS: dominant	5.36	1.87	.20	5.02	1.71	.15	.11	.29	.00		.03	.07	−.30	.21	.06
5. PoO: expressive	7.59	1.66	.29	7.21	1.73	.22	.60	.61	.55	.08		.64	.14	.16	.08
6. PoO: communal	7.92	1.60	.35	7.63	1.63	.39	.70	.56	.70	.08	.64		−.06	.11	.09
7. PoO: dominant	6.00	1.84	.18	5.73	1.69	.12	−.10	.01	.12	−.20	.14	−.02		−.18	−.01
8. Familiarity	7.66	2.65	.16	7.88	2.71	.14	.23	.21	.05	.17	.17	.12	−.12		.04
9. Day	2.62	2.00	.00	2.70	2.00	.03	.03	.05	.09	.01	.10	.10	−.02	−.06	

Note. PoS = perception of self, PoO = perception of other. Results are based on $N = 102$ individuals providing a total of 1,563 observations in Sample 1 and $N = 116$ individuals providing a total of 1,380 observations in Sample 2. Intercorrelations below and above the diagonal correspond to the data of Sample 1 and Sample 2, respectively. In both samples, intercorrelations of $r = |.06|$ or above are statistically significantly different from zero at $p < .05$. Grey-shaded values show intercorrelation of the corresponding perception of self and perception of other.

Before the confirmatory analyses, we estimated a multilevel null model of satisfaction with the social interaction to assess the proportion of variability located within and between persons. As indicated by the ICC values, 16% (15%) of the variance in satisfaction with the social interaction was on the between-person level in Sample 1 (Sample 2). This illustrates that most variance was at the within-person level, that is, satisfaction with social interactions showed more variability across social interactions within one person than between persons. The ICCs of the other variables measured at the within-person level can be found in Table 3. Similar to momentary social satisfaction, the variance of perceived interaction behaviors was based primarily on variability across social interactions within one person. As an exception, the variance of self-perceived communal behavior was equally distributed across the within- and between-person levels, as indicated by an ICC of .51 (.49) in Sample 1 (Sample 2). Thus, compared with the other-perceptions, communal behavior in the perception of self was driven more strongly by a general tendency of the participant than by characteristics of the specific social interaction.

The Association Between Personality Traits and Satisfaction With the Social Interaction

Our first research question addressed the total effect in our mediation model (*c* path): Are between-person differences in personality traits related to average levels of momentary satisfaction in social interactions? In line with research on relationship outcomes on the macrolevel and on momentary happiness in adult participants, extraversion and agreeableness were positively related and neuroticism was negatively related to momentary satisfaction with the social interaction (see Table 4). Despite the consistent trait effects, the facet-level analyses further revealed substantial associations between personality traits and social satisfaction: On average, adolescents showing higher levels of activity (extraversion) and compassion (agreeableness) and lower levels of depression (neuroticism) had more satisfying social interactions. For these traits, the estimated amount of explained between-person variance as indicated by R_b^2 in Sample 1 (Sample 2) ranged from .07 (.06) to .21 (.10), with the highest values for the models predicting momentary satisfaction from agreeableness and compassion. By contrast, being sociable and assertive, respectful and trusting, as well as anxious and volatile were not related to satisfaction with the social interaction in a consistent manner.

Table 4

Fixed Effects of Personality on Satisfaction With the Social Interaction

	DV: Satisfaction with the Social Interaction											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Intercept γ_{00}	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.10	<.001	8.28	0.09	<.001
Personality γ_{01}	0.23	0.09	.010	0.16	0.07	.035	0.05	0.08	.574	0.31	0.08	<.001
Sample 2												
Intercept γ_{00}	8.05	0.10	<.001	8.06	0.10	<.001	8.07	0.10	<.001	8.05	0.10	<.001
Personality γ_{01}	0.25	0.10	.013	0.11	0.08	.151	0.09	0.07	.196	0.27	0.09	.004
	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Intercept γ_{00}	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.09	<.001
Personality γ_{01}	0.50	0.11	<.001	0.45	0.11	<.001	0.18	0.10	.064	0.27	0.08	.001
Sample 2												
Intercept γ_{00}	8.06	0.10	<.001	8.06	0.10	<.001	8.06	0.10	<.001	8.06	0.10	<.001
Personality γ_{01}	0.33	0.11	.003	0.24	0.10	.013	0.25	0.10	.008	0.14	0.09	.120
	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Intercept γ_{00}	8.29	0.09	<.001	8.29	0.09	<.001	8.29	0.09	<.001	8.28	0.09	<.001
Personality γ_{01}	−0.20	0.08	.009	−0.13	0.08	.110	−0.16	0.06	.012	−0.13	0.07	.060
Sample 2												
Intercept γ_{00}	8.07	0.10	<.001	8.07	0.10	<.001	8.06	0.10	<.001	8.07	0.10	<.001
Personality γ_{01}	−0.26	0.09	.005	−0.16	0.09	.065	−0.19	0.07	.007	−0.20	0.08	.012

Note. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1 and N = 116 individuals providing a total of 1,380 observations in Sample 2.

For better readability, we do not report random effects and explained variance estimates here but they can be obtained in from Table D1 in the Appendix.

When we reran the multilevel regression models with the control variables included (see Table E1), we found a positive effect of familiarity with the interaction partner in all models and both samples: In line with previous research on momentary affect in adults, adolescents indicated higher levels of satisfaction when interacting with somebody more familiar. The remaining control variables, participant's gender, interaction partner's gender, day of the experience sampling, and weekday versus weekend had no consistent effect on momentary satisfaction with the social interaction. Overall, the results on the associations between personality traits and social satisfaction remained unaffected after entering the control variables.

The Mediating Role of Perceived Social Interaction Behavior

Our second research question addressed the indirect effect in our mediation model ($a \times b_{between}$ paths) and tested whether between-person differences in personality traits are related to average levels of momentary satisfaction in social interactions mediated by perceived social interaction behavior. Results for Research Question 1 illustrated that all three personality factors and one facet per factor were each related to adolescents' momentary satisfaction with the interaction (*c* path). Accordingly, before conducting the multilevel mediation analyses, we examined potential mediators of the associations between personality traits and social satisfaction for extraversion and activity, agreeableness and compassion, as well as neuroticism and depression. To do so, we established the separate associations between our predictors (i.e., personality traits) and our mediators (i.e., perceptions of self and other; *a* path; Tables C1 and C2), and the within- and between-person associations between our mediators (i.e., perceptions of self and other) and our outcome (i.e., satisfaction with the social interaction; b_{within} and $b_{between}$ paths; Table C3).

Results from the separate analyses illustrated that expressive and communal behavior in the perceptions of self and other were related to both personality traits (facets) and social satisfaction and therefore qualified as potential mediators. Specifically, expressive and communal behavior were related to extraversion (activity) and agreeableness (compassion), whereas only expressive behavior was related to neuroticism (depression). By contrast, dominant behavior was not consistently linked to any of the personality traits or facets with respect to perception of self or perception of other. Furthermore, it showed no association with momentary satisfaction with the interaction on the between-person level. Given our selection criteria, dominant behavior did not emerge as a potential mediator of the interplay between personality traits

and social satisfaction.[7] We address this null finding in the Discussion section. Given these preliminary analyses, we tested a total of 20 mediation models in both samples.

Results from the multilevel mediation models for Samples 1 and 2 are summarized in Tables 5 and 6, respectively. Before going into detail, we would like to highlight two overall findings: First, *c'* paths yielded nonsignificant *p*-values in all but three models, suggesting that the indirect effects of the perceptions of self and other accounted for most of the association between personality traits and satisfaction with the social interaction. Given that our sample was too small to detect such small effects, however, we cannot determine whether this were full or partial mediations. Second, contrary to our hypotheses, the perceptions of self and other continuously appeared as mediators in a completely parallel manner between personality traits and satisfaction with the social interaction. That is, there were no distinct effects between social interaction behaviors corresponding to the perceptions of self and other.

[7] Notably, dominant behavior in the perception of self (other) was positively (negatively) related to momentary satisfaction at the within-person level. Thus, adolescents felt more satisfied after social interactions in which they perceived themselves as the more dominant partner.

Table 5

Multilevel Mediation Models (2-1-1 Design): Sample 1

DV: Satisfaction with the social interaction																
Model		*a* path			b_{within} path			$b_{between}$ path			*c*‘ path			$a*b_{between}$			
Predictor	Mediator	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	95% CI
Extraversion	PoS: expressive	0.38	0.10	<.001	0.69	0.04	<.001	0.68	0.07	<.001	−0.02	0.06	.805	0.26	0.07	.001	[0.11, 0.40]
	PoO: expressive	0.32	0.09	<.001	0.73	0.04	<.001	0.75	0.07	<.001	0.00	0.06	.983	0.24	0.06	<.001	[0.12, 0.36]
	PoS: communal	0.20	0.10	.055	0.89	0.06	<.001	0.58	0.06	<.001	0.12	0.06	.049	0.12	0.06	.049	[0.00, 0.23]
	PoO: communal	0.25	0.10	.016	0.99	0.04	<.001	0.71	0.05	<.001	0.07	0.05	.206	0.17	0.07	.013	[0.04, 0.31]
Activity	PoS: expressive	0.35	0.09	<.001	0.69	0.04	<.001	0.64	0.07	<.001	0.09	0.06	.110	0.23	0.06	.001	[0.10, 0.35]
	PoO: expressive	0.34	0.07	<.001	0.73	0.04	<.001	0.71	0.07	<.001	0.08	0.06	.224	0.24	0.06	<.001	[0.13, 0.35]
	PoS: communal	0.25	0.09	.004	0.89	0.06	<.001	0.56	0.06	<.001	0.18	0.06	.001	0.14	0.05	.004	[0.04, 0.23]
	PoO: communal	0.28	0.09	.001	0.99	0.04	<.001	0.68	0.06	<.001	0.13	0.04	.004	0.19	0.06	.001	[0.08, 0.30]
Agreeableness	PoS: expressive	0.72	0.13	<.001	0.69	0.04	<.001	0.67	0.07	<.001	0.03	0.09	.701	0.48	0.10	<.001	[0.27, 0.68]
	PoO: expressive	0.60	0.12	<.001	0.73	0.04	<.001	0.72	0.07	<.001	0.09	0.09	.325	0.43	0.10	<.001	[0.24, 0.62]
	PoS: communal	0.84	0.12	<.001	0.89	0.06	<.001	0.60	0.06	<.001	0.01	0.11	.914	0.50	0.10	<.001	[0.31, 0.70]
	PoO: communal	0.64	0.12	<.001	0.99	0.04	<.001	0.70	0.05	<.001	0.06	0.08	.443	0.45	0.10	<.001	[0.26, 0.64]
Compassion	PoS: expressive	0.49	0.11	<.001	0.69	0.04	<.001	0.63	0.06	<.001	0.15	0.08	.054	0.31	0.08	<.001	[0.15, 0.46]
	PoO: expressive	0.38	0.11	<.001	0.73	0.04	<.001	0.69	0.06	<.001	0.20	0.07	.005	0.26	0.08	.001	[0.11, 0.41]
	PoS: communal	0.62	0.11	<.001	0.89	0.06	<.001	0.56	0.06	<.001	0.12	0.09	.197	0.35	0.07	<.001	[0.21, 0.48]
	PoO: communal	0.52	0.11	<.001	0.99	0.04	<.001	0.69	0.05	<.001	0.10	0.08	.206	0.36	0.08	<.001	[0.20, 0.52]
Neuroticism	PoS: expressive	−0.37	0.10	<.001	0.69	0.04	<.001	0.70	0.07	<.001	0.05	0.07	.430	−0.26	0.07	<.001	[−0.39, −0.12]
	PoO: expressive	−0.29	0.08	<.001	0.73	0.04	<.001	0.75	0.07	<.001	0.00	0.06	.958	−0.22	0.06	.001	[−0.34, −0.10]
Depression	PoS: expressive	−0.33	0.08	<.001	0.69	0.04	<.001	0.72	0.07	<.001	0.08	0.05	.108	−0.24	0.06	<.001	[−0.35 −0.12]
	PoO: expressive	−0.20	0.06	.002	0.73	0.04	<.001	0.74	0.07	<.001	−0.02	0.05	.727	−0.15	0.05	.002	[−0.24, −0.05]

Note: PoS = perception of self; PoO = perception of other; *a* path = mediator mean regressed on predictor; b_{within} path = satisfaction with the social interaction regressed on mediator; $b_{between}$ path = satisfaction with the social interaction regressed on mediator mean; *c*' path = partial predictor effect on satisfaction with the social interaction; $a*b_{between}$ = indirect between-effect. Results are based on N = 102 individuals providing a total of 1,563 observations.

Table 6

Multilevel Mediation Models (2-1-1 Design): Sample 2

DV: Satisfaction with the social interaction																
Model		*a* path			b_{within} path			$b_{between}$ path			*c*‘ path			$a*b_{between}$			
Predictor	Mediator	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	95% CI
Extraversion	PoS: expressive	0.44	0.12	<.001	0.71	0.04	<.001	0.75	0.07	<.001	−0.08	0.07	.255	0.34	0.09	<.001	[0.15, 0.52]
	PoO: expressive	0.34	0.11	.003	0.71	0.05	<.001	0.77	0.07	<.001	−0.03	0.08	.714	0.26	0.09	.005	[0.08, 0.44]
	PoS: communal	0.29	0.13	.031	0.88	0.07	<.001	0.65	0.07	<.001	0.07	0.08	.340	0.19	0.09	.037	[0.01, 0.36]
	PoO: communal	0.32	0.13	.015	1.00	0.06	<.001	0.68	0.06	<.001	0.05	0.08	.530	0.22	0.09	.019	[0.04, 0.41]
Activity	PoS: expressive	0.36	0.10	<.001	0.71	0.04	<.001	0.72	0.07	<.001	0.01	0.06	.855	0.26	0.08	.001	[0.11, 0.41]
	PoO: expressive	0.26	0.09	.003	0.71	0.05	<.001	0.75	0.07	<.001	0.06	0.07	.437	0.20	0.07	.006	[0.06, 0.34]
	PoS: communal	0.34	0.12	.004	0.88	0.07	<.001	0.64	0.07	<.001	0.07	0.07	.293	0.22	0.08	.007	[0.06, 0.38]
	PoO: communal	0.35	0.12	.004	1.00	0.06	<.001	0.68	0.06	<.001	0.06	0.07	.394	0.24	0.09	.006	[0.07, 0.41]
Agreeableness	PoS: expressive	0.41	0.11	<.001	0.71	0.04	<.001	0.71	0.07	<.001	0.10	0.08	.232	0.29	0.09	.001	[0.12, 0.46]
	PoO: expressive	0.35	0.10	.001	0.71	0.05	<.001	0.74	0.07	<.001	0.07	0.09	.395	0.26	0.09	.002	[0.10, 0.43]
	PoS: communal	0.42	0.13	.001	0.88	0.07	<.001	0.64	0.07	<.001	0.11	0.09	.253	0.27	0.09	.003	[0.09, 0.45]
	PoO: communal	0.40	0.13	.003	1.00	0.06	<.001	0.67	0.06	<.001	0.10	0.08	.237	0.27	0.10	.006	[0.08, 0.46]
Compassion	PoS: expressive	0.36	0.09	<.001	0.71	0.04	<.001	0.72	0.07	<.001	0.01	0.07	.859	0.26	0.07	<.001	[0.12, 0.40]
	PoO: expressive	0.32	0.08	<.001	0.71	0.05	<.001	0.76	0.07	<.001	0.00	0.08	.991	0.24	0.06	<.001	[0.12, 0.37]
	PoS: communal	0.33	0.10	.001	0.88	0.07	<.001	0.65	0.07	<.001	0.08	0.08	.308	0.21	0.07	.003	[0.07, 0.35]
	PoO: communal	0.29	0.11	.009	1.00	0.06	<.001	0.67	0.06	<.001	0.08	0.07	.262	0.20	0.08	.014	[0.04, 0.35]
Neuroticism	PoS: expressive	−0.31	0.09	.001	0.71	0.04	<.001	0.71	0.07	<.001	−0.06	0.06	.311	−0.22	0.07	.001	[−0.35, −0.09]
	PoO: expressive	−0.24	0.09	.005	0.71	0.05	<.001	0.74	0.07	<.001	−0.07	0.07	.372	−0.18	0.07	.008	[−0.31, −0.05]
Depression	PoS: expressive	−0.28	0.08	<.001	0.71	0.04	<.001	0.73	0.07	<.001	0.00	0.05	.938	−0.20	0.06	<.001	[−0.31, −0.09]
	PoO: expressive	−0.16	0.07	.020	0.71	0.05	<.001	0.74	0.07	<.001	−0.06	0.06	.366	−0.12	0.06	.027	[−0.23, −0.01]

Note: PoS = perception of self; PoO = perception of other; *a* path = mediator mean regressed on predictor; b_{within} path = satisfaction with the social interaction regressed on mediator; $b_{between}$ path = satisfaction with the social interaction regressed on mediator mean; *c*' path = partial predictor effect on satisfaction with the social interaction; $a*b_{between}$ = indirect between-effect. Results are based on N = 116 individuals providing a total of 1,380 observations.

Looking into the specific effects with respect to extraversion, the link between the trait (as well as its facet, activity) and momentary satisfaction with the social interaction was mediated by perceptions of expressive and communal behavior from both the self and other perspectives. Accordingly, adolescents higher on extraversion (and especially activity) reported higher satisfaction with their daily social interactions in the light of perceiving themselves and their interaction partner as behaving on average both more expressively and more communally. Similar to extraversion, the link between trait agreeableness (as well as its facet, compassion) and momentary satisfaction with the social interaction was mediated by perceptions of expressive and communal behavior from both the self and other perspectives. That is, adolescents higher on agreeableness (and especially compassion) reported higher satisfaction with their daily social interactions in the light of perceiving themselves and their interaction partner as behaving on average both more expressively and more communally. Finally, the link between neuroticism (as well as its facet, depression) and satisfaction with the social interaction was mediated by perceptions of expressive behavior. Thus, adolescents higher on neuroticism (and especially depression) reported lower satisfaction with their daily social interactions in the light of perceiving themselves and their interaction partner as behaving less expressively on average.

We reran the multilevel mediation models with the control variables included. Results for Samples 1 and 2 are presented in the Appendix (Tables E2 and E3, respectively). All indirect effects remained unaffected by the presence of the control variables. Apart from the familiarity effect reported above, participant gender, interaction partner's gender, weekend, and day of the ESM did not have consistent effects on momentary satisfaction with the social interaction in these models.

Given that participants self-rated both the interaction behaviors and their social satisfaction with some temporal delay, both ratings might have been biased by adolescents' general tendency to feel positive and to recall events in a positive way. In a final step, we ran additional exploratory analyses controlling for the participant's momentary happiness[8] and for the individual mean of momentary happiness in addition to the remaining control variables (see the supplementary materials). This additional analysis tested the robustness of our results when controlling for both momentary happiness when rating the interaction and for adolescents' general tendency to feel happy across the ESM. Whereas both happiness variables were positive predictors of momentary satisfaction with the social interaction in most mediation models, all previously reported indirect effects of personality traits on momentary social satisfaction

[8] Participants rated their momentary happiness at the beginning of each ESM report on a scale ranging from 0 (*not at all*) to 10 (*very*).

through perceived interaction behavior remained significant. Compared to the main analyses, effect sizes were slightly reduced when taking all control variables including happiness into account: In Sample 1, the average b-coefficient for the indirect effects changed from M_{IND} = 0.28 to M_{IND} = 0.23. In Sample 2, the average b-coefficient for the indirect effects changed from M_{IND} = 0.23 to M_{IND} = 0.19. In sum, the mediation models pointed to the explanatory function of the expressive and communal behavior that adolescents perceived in the association between personality traits and social satisfaction on average. Contrary to our expectations, however, the perceptions of self and other did not function as differentially relevant mediators across traits.

Discussion

Using experience sampling data from two samples of more than 200 late adolescents in total, the current study investigated two research questions: First, how are extraversion, agreeableness, and neuroticism related to momentary social satisfaction in late adolescents? Second, which perceived social interaction behaviors mediate this link? Providing new insights into the real-life associations between personality traits and the social relationships of adolescents from a microlevel perspective, we highlight four main findings: First, we identified three indices of expressive, communal, and dominant behavior in the reflection of interpersonal perceptions and subsequently used them to test our mediation hypotheses. Second and along the lines of previous studies on associations between personality traits and social satisfaction, we found that extraversion and agreeableness had positive associations and neuroticism had negative associations with average levels of momentary social satisfaction. Third, multilevel mediation models revealed that interpersonal perceptions of expressive and communal behavior mediated the associations between personality traits and social satisfaction. Finally, contrary to our expectations, we were unable to support distinct effects of social interaction behavior in its correspondence with perceptions of self and other. Next, we discuss our findings in detail and provide an outlook for future research.

Associations Between Personality Traits and Momentary Social Satisfaction in Late Adolescence

Regarding the associations between personality traits and momentary satisfaction with the social interaction, results were in line with previous research on broader relationship outcomes (Asendorpf & Wilpers, 1998; Parker et al., 2012; Wilson et al., 2015) and on momentary happiness (Mueller et al., 2019; Sun et al., 2017; Wilt et al., 2012). Our findings extend existing research on the personality-relationship interplay to late adolescence and further highlight the importance of certain personality facets: Specifically, whether adolescents were more or less

active, compassionate, and depressed appeared to be especially relevant for their social interactions. Only these respective facets of extraversion, agreeableness, and neuroticism emerged as consistent predictors of momentary social satisfaction across our two samples, whereas the roles of the remaining facets were less clear.

Given that this is the first microlevel study on personality traits and social relationships to include facet-level analyses and that previous macrolevel research used different facet measures, it is rather difficult to compare our results with previous findings. In two longitudinal studies (Deventer et al., 2019; Mund & Neyer, 2014), negative affect, a construct resembling the neuroticism facet of depression, was related to negative relationship outcomes as it was also the case in our study. Furthermore, the two macrolevel longitudinal studies found that sociability was a predictor of positive relationship outcomes in friendships, whereas we found no consistent associations between sociability and momentary satisfaction with the social interaction. These macro- and our microlevel analyses emphasize that facets are pivotal for better understanding personality-relationship associations. At the same time, diverging findings across studies highlight that different measures across studies might complicate integrative discussions. Overall, it should be noted that this is the first study to explore how personality facets are related to satisfaction with social interactions and that some facets (e.g., agreeableness' respectfulness or neuroticism's volatility) emerged as predictors in only one of our two adolescent samples. Therefore, we emphasize that whereas activity, compassion, and depression seem important for social interactions, other personality facets might be relevant too, and the facet-specific findings need to be replicated in future research.

Our findings have implications for dynamic interactional theories (Back et al., 2011; Thibaut & Kelley, 1978). Given that we were able to replicate macrolevel associations between personality traits and broader relationship outcomes (e.g., Harris & Vazire, 2016) on the microlevel for social interactions, our findings suggest that the links of extraversion, agreeableness, and neuroticism with interindividual differences in satisfaction with social interactions might ultimately accumulate into long-term relationship satisfaction. In addition, we set out to shed light on the processes that might explain this interplay on the level of social interactions. Accordingly, we discuss the role of perceived social interaction behavior next.

Expressive, Communal, and Dominant Social Interaction Behavior

With this study, we aimed to gain a better understanding of the perceptions of social interaction behavior that could explain the associations between personality traits and social satisfaction. We used late adolescents' ratings of their own and their interaction partner's behavior to identify three indices that (a) reflect interpersonal perceptions that vary within and

between persons and (b) apply to the perception of self and other: expressive, communal, and dominant behavior. The first two behaviors, expressive and communal behavior, each summarize a range of interaction behaviors that largely map onto dimensions of interpersonal behavior that have been identified in previous research with adult samples (Geukes et al., 2017; Leising & Bleidorn, 2011) and that are aligned with the two factors from the agency and communion framework (Bakan, 1966; Wiggins, 1991). In line with interpersonal theory and previous research on interpersonal behavior (e.g., Fournier et al., 2008), adolescents' perceptions of self and other were positively related to each other with regard to communal behavior (i.e., interpersonal correspondence), and negatively related to each other with regard to dominant behavior (i.e., interpersonal complementarity). Going beyond previous findings, we additionally illustrated that perceptions of self and other with regard to expressive behavior were also characterized by interpersonal correspondence.

Looking at trait-specific associations of perceived social interaction behaviors, extraversion and agreeableness were, on average, positively related to both expressive and communal behavior in perceptions of self and other, whereas neuroticism was only negatively related to the average perception of expressive behavior. Contrary to findings from an ESM study reporting that individuals higher on neuroticism perceived more warmth in their interaction partners (Hannuschke et al., 2020), our results did not indicate that individuals higher on neuroticism perceived more warmth in their interaction partners. This inconsistency might derive from differences in the sample (adolescents vs. psychology undergraduates), the personality trait measure (BFI-2 vs. BFI-S), or the type of social interaction partner (diverse interaction partners vs. only psychology undergraduates) in our and Hannuschke et al.'s study, respectively. Next to their links with personality traits, perceptions of expressive and communal behavior were also positively related to momentary satisfaction with the social interaction on the within- and between-person levels, underscoring both their situational and differential relevance. These findings are in line with studies reporting positive relationships between an individual's own extraverted (e.g., Jacques-Hamilton et al., 2019; Margolis & Lyubomirsky, 2019) as well as agreeable behavior (Kritzler et al., 2020) with momentary positive affect. At the same time, they point to the relevance of a broader range of social interaction behaviors (i.e., expressive and communal behavior) in the context of momentary social satisfaction and to the relevance of perceptions of both interaction partners' behavior.

When looking at perceptions of dominant behavior, a number of deviations from the pattern found with regard to perceptions of expressive and communal behavior became evident. First, dominant behavior stood out as mostly unrelated to the other interpersonal behaviors.

Second and in line with meta-analytic findings by Gerpott et al. (2018), hardly any personality trait or facet was consistently associated with perceptions of dominant behavior across the two samples. Third, dominant behavior was not related to satisfaction with the interaction at the between-person level for perceptions of self or other. Given this lack of differential effects, perceptions of dominant behavior appear to play only a minor role in mediating associations between personality traits and social satisfaction. By contrast, within-person dominant behavior in the perception of self was positively related to momentary satisfaction, whereas within-person dominant behavior in the perception of other was negatively related to momentary satisfaction. It appears that adolescents evaluate their social interactions more positively when they perceive themselves as acting more dominant and others as acting less dominant than usual in a specific daily interaction. These contrasting perceptions of self and other might illustrate that adolescents who perceived themselves as more dominant and their interaction partner as acting less dominant in a social interaction felt that they themselves must have a higher agentic reputation (Rau et al., 2019). This, in turn, might be related to higher momentary social satisfaction. Alternatively, our finding might simply reflect that, when acting more dominant than usual, adolescents were also more successful in getting their way and therefore felt more satisfied.

Perceived Social Interaction Behaviors Mediate Associations Between Personality Traits and Momentary Social Satisfaction

In line with our hypotheses and the theoretical notions of the PERSOC model (Back et al., 2011), the links between personality traits and social satisfaction were mediated by perceived momentary social interaction behavior. Given the different conceptual relevance of extraversion, agreeableness, and neuroticism for emotional-cognitive processes and social behavior in adulthood (McCrae & Costa, 1989; Wiggins, 1991), we had hypothesized that perceptions of self and other would serve as differentially relevant mediators of the interplay between personality traits and social satisfaction. Despite these strong theoretical indications, we found that late adolescents' self- and other-perceptions of expressive or communal behavior did not only occur in terms of interpersonal correspondence (see Fournier et al., 2008), but also mediated the associations between personality traits and social satisfaction in a parallel manner. More specifically, extraversion and agreeableness' positive links with satisfaction were mediated by perceptions of more expressive and communal behavior, whereas only perceptions of less expressive behavior accounted for the link between neuroticism and social satisfaction. Thus, although our results pointed to different mediators across traits, we did not find support for our hypothesis that the perceptions of self and other would play different roles.

How can this lack of differentiable findings for the perceptions of self and other be explained? First, our participants may have been unable to distinguish between these two types of perception. Given the relatively young age of our participants, results might indicate ongoing developmental processes (Blakemore, 2012; Suleiman & Dahl, 2019), including the establishment of interpersonal abilities. Alternatively, trouble distinguishing between one's own and one's interaction partner's behavior might be independent of age. In an experience sampling study by Sun and Vazire (2019), university students showed relatively little self-insight into their own agreeable behavior, pointing to perceptual limitations even in adulthood. Such limitations might also explain why the perceptions of self and other with regard to communal behavior, which is similar to agreeable behavior, were so closely interrelated in our study. Second, it could be argued that it is not the perceptions of self or other nor is it the specific perception of expressive or communal behavior, but rather, it may be a common factor of perceived positivity (e.g., Rau et al., 2020; Rauthmann et al., 2015) that accounts for the association between personality traits and social satisfaction. However, our additional analyses revealed that our findings remained robust when controlling for adolescents' happiness during the experience sampling, making this explanation less plausible. Finally, the relatively high intercorrelations between self- and other-perceptions might have disguised distinct effects: Given this strong statistical overlap, which was most pronounced with regard to communal behavior, parallel findings for the two types of perception come as no surprise. We decided to run separate analyses for each personality trait and each index of perceived behavior to facilitate interpretations of the indirect effects and to avoid multicollinearity. On the basis of this analytical strategy, however, we were not in a position to extract the unique effects of each of our mediators in the interplay between personality traits and social satisfaction by controlling for the remaining perceptions of self and other. Because this is the first study to test the potential mediating effects of interaction behaviors, we suggest that readers accept these findings as an initial indication that requires further research and replication.

In sum, while acknowledging the potential impact of our design and analytical decisions, the current study indicates that expressive and communal social interaction behaviors in the perceptions of both self and other might be relevant for explaining the interplay between personality traits and social satisfaction.

Limitations and Future Directions

Our study has multiple strengths, including the use of experience sampling data to provide insights into the daily lives of late adolescents, the use of empirically derived indices of

perceived interaction behaviors, the differentiation across personality facets and between perceptions of self and other, as well as the availability of two samples to test the robustness of our effects. Nonetheless, a number of limitations should be considered.

Beginning with limitations regarding our design, this study aimed to investigate inter-individual differences in the ways in which people perceive and enjoy social interactions. Whereas only self-reports can provide insights into subjective experience, their sole use might also bear some problems such as shared measurement variance (Podsakoff et al., 2003). Whereas we would like to emphasize that self-reports of perceptions of the self and satisfaction cannot be replaced and that our additional analyses provided no support for the idea that a general positivity bias could explain the associations, future research could use other-reports of personality traits.

Second, although our design offers insights into real-life social interactions, the correlational nature of our data does not allow for causal conclusions with regard to the complete mediation: Whereas the required temporal ordering exists for the associations between personality traits and perceived behaviors, this was not as clearly the case for the associations between momentary perceived behaviors and social satisfaction, which were assessed in this order one after the other but during the same ESM assessment. Accordingly, although our mediation analyses were based on previous research and theoretical arguments, we are unable to determine whether interpersonal perceptions might, as reasoned in our paper, "influence" momentary satisfaction with the social interaction. Alternatively, it is possible that the opposite direction of effects or a bidirectional pattern is at work here.

Third, our sample was composed only of students in the highest track within the German school system and was thus not representative of late adolescents attending other school and educational tracks.

Finally, as a more general limitation, we could not confirm our theoretically derived hypothesis that the associations of extraversion, agreeableness, and neuroticism with momentary social satisfaction would be differentially mediated by the perception of self or the perception of other. Whereas we need to consider the possibility that no such distinct associations exist, future studies should implement different research designs using laboratory settings to be able to clearly differentiate or manipulate perceptions of self or other. This might enable researchers to test for their unique influence in combined models.

The present research could be further extended in several potential directions. First, future studies might want to examine other personality traits, such as the remaining Big Five traits of openness and conscientiousness (e.g., Danner et al., 2019), traits from the HEXACO model

of personality (Lee & Ashton, 2004), or other traits relevant to social satisfaction, such as narcissism (Rentzsch et al., 2021). Similarly, future studies might investigate a broader range of personality facets: Whereas the BFI-2 facets measured in the current study balance differentiation and brevity (Soto & John, 2017), other personality trait questionnaires, such as the NEO-PI-R (Costa & McCrae, 1992), enable a more nuanced assessment of personality facets. In addition, it is important to note that this is the first study to examine personality facets in social interactions. Because some of our results were not consistent across the two samples and might look different in a nonadolescent sample, we would like to encourage researchers to continue analyzing facets in addition to personality traits.

Second, by using empirically formed indices, we took a first step toward a systematic assessment of perceived social interaction behaviors that might be relevant for explaining the interplay between personality traits and social interaction. In line with previous research (Geukes et al., 2017) and the agency and communion model (Bakan, 1966), perceptions of expressive and communal behavior emerged as relevant dimensions. Given the lack of an established taxonomy and the wide range of social perceptions that might not have been measured in the current study, future studies should continue investigating the behavioral dimensions that people use to describe their social interactions and how these dimensions are related to social satisfaction. Moreover, research could explore whether these dimensions differ by age group.

Third, the use of only self-reports of social interactions did not allow us to differentiate between observable interaction behavior and individual construal (Rauthmann et al., 2015). In this study, this distinction did not matter because we were interested in the individual's subjective daily social experience, which is most likely mixing both aspects (see Furr & Funder, 2021). Nonetheless, future studies might want to further disentangle how personality traits are related to momentary social satisfaction via actual interaction behavior as opposed to individual (biased) perceptions by comparing self- and other-reports of social interaction behavior.

Fourth, it is important to note that when looking at personality traits as we did in this study, only average between-person differences in perceived social interaction behavior and social satisfaction can be observed. At the same time, most of our momentary measures showed more variance within than between persons. That is, a person's perceptions of behavior and satisfaction during a social interaction seem to depend on situational characteristics to an even stronger degree than on stable individual differences. In addition, a growing number of researchers have sought to adapt momentary measures of the Big Five (i.e., *states*; Fleeson, 2001; Rauthmann et al., 2019). In future studies, it would be interesting to examine how within-person

differences in personality states are related to social satisfaction through perceived social interaction behaviors. For example, dominant behavior, which showed only within-person associations with satisfaction, might mediate effects of extraversion when measured as a state.

Conclusion

To our knowledge, no previous study has examined how personality traits are related to satisfaction with social interactions in late adolescence and whether perceived social interaction behaviors serve as mediators of this interplay. Given the extensive theoretical and empirical work on macrolevel associations between personality traits and social relationships, we made use of students' experience-sampling reports of real-life social interactions to close this research gap. Our results suggest that personality traits are related to momentary social satisfaction in a manner that is fairly similar to how such traits are related to relationship satisfaction in long-term studies, with positive associations for extraversion and agreeableness and a negative association for neuroticism. Importantly, these associations were mediated by perceptions of expressive and communal interaction behaviors during the social interaction. Whereas our results provided no support for differences across traits regarding their associations with the perceptions of self and other, they pointed to the possibility of differences in associations with certain types of perceived behavior. Given that this is the first study of its kind on this topic, future research should replicate our findings, extend our knowledge to different age groups, and further explore the roles that diverse personality facets and interaction behaviors play in this dynamic interplay.

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Online Appendix A

Table A1

Intra-Class Correlations of the Perception of Self and Other

	Good mood	Activated	Dominant	Sociable	Friendly	Modest	Cooperative	Self-revealing	Reliable
Perception of self									
Sample 1	.17	.20	.20	.26	.25	.49	.39	.31	.41
Sample 2	.17	.21	.15	.21	.34	.45	.38	.24	.42
Perception of other									
Sample 1	.17	.19	.18	.24	.19	.38	.29	.27	.29
Sample 2	.16	.16	.12	.18	.25	.40	.34	.24	.29

Note. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1 and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Table A2

Eigenvalues of the Perception of Self and Other

	Within-level factors									Between-level factors								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Perception of self																		
Sample 1	3.55	1.37	0.83	0.72	0.65	0.59	0.56	0.39	0.35	5.82	1.32	0.79	0.35	0.28	0.23	0.11	0.07	0.03
Sample 2	3.87	1.38	0.78	0.64	0.60	0.55	0.52	0.34	0.32	5.78	1.23	0.66	0.45	0.38	0.19	0.18	0.10	0.03
Perception of other																		
Sample 1	3.68	1.37	0.85	0.78	0.59	0.57	0.44	0.42	0.31	6.23	0.99	0.72	0.40	0.29	0.18	0.11	0.08	0.02
Sample 2	4.08	1.34	0.83	0.68	0.55	0.48	0.39	0.37	0.28	5.89	1.336	0.76	0.35	0.26	0.17	0.14	0.06	0.05

Note. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1 and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Table A3

EMFAs with the Perception of Self and Other: Model Fits of the 2/2 (w/b) Factor Solution

	χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*	*SRMR* (w/b)	*AIC*	*BIC*
Perception of self									
Sample 1	247.38	38	< .001	.95	.91	.06	.03/.06	52621.252	52947.868
Sample 2	188.26	38	< .001	.97	.94	.05	.03/.03	45494.591	45813.611
Perception of other									
Sample 1	268.07	38	< .001	.95	.91	.06	.03/.05	52830.463	53157.080
Sample 2	212.09	38	< .001	.97	.94	.06	.03/.05	45867.832	46186.852

Note. Chi: Test of model fit; w = within-level, b = between-level. Results are based on *N* = 102 individuals providing a total of 1,563 observations in Sample 1 and *N* = 116 individuals providing a total of 1,380 observations in Sample 2.

Online Appendix B

Table B1

Intercorrelations Among Perceived Behavior Measures and Satisfaction With the Social Interaction: Within-Person Associations

	Sample 1		Sample 2		Intercorrelations																
					Perception of self									**Perception of other**							
	M	*SD*	*M*	*SD*	GM	Ac	Do	So	Fr	Mo	Co	SR	Re	GM	Ac	Do	So	Fr	Mo	Co	SR	Re	Sat
Perception of self																							
GM	7.78	2.15	7.71	2.07		.58	.12	.64	.68	.27	.47	.50	.49	.55	.35	−.03	.43	.54	.34	.49	.37	.44	.62
Ac	6.80	2.34	6.55	2.28	.57		.17	.60	.45	.20	.39	.44	.42	.38	.44	.01	.36	.35	.24	.37	.26	.35	.40
Do	5.36	1.87	5.02	1.71	.12	.23		.28	.03	−.13	−.02	.21	.09	.04	−.01	−.30	−.03	.06	.12	.04	.10	−.01	.53
So	7.55	2.34	7.24	2.27	.62	.56	.31		.59	.20	.48	.59	.50	.41	.31	−.09	.45	.46	.31	.46	.36	.40	.59
Fr	8.42	1.76	8.24	1.87	.63	.39	.01	.56		.39	.62	.44	.62	.50	.31	−.03	.46	.68	.39	.62	.35	.55	.24
Mo	6.77	2.02	6.55	1.88	.27	.14	−.06	.26	.43		.50	.19	.40	.24	.18	.13	.27	.31	.57	.42	.22	.38	.42
Co	8.13	1.76	7.83	1.86	.42	.32	.00	.47	.58	.50		.40	.60	.40	.31	−.02	.42	.53	.46	.63	.33	.52	.45
SR	7.13	2.40	6.73	2.25	.41	.39	.25	.59	.43	.34	.43		.45	.38	.27	−.06	.36	.40	.30	.40	.49	.38	.45
Re	8.06	1.76	7.80	1.82	.37	.30	.07	.43	.48	.39	.54	.40		.41	.31	−.01	.40	.51	.43	.54	.38	.57	.62
Perception of other																							
GM	7.88	2.15	7.57	2.24	.55	.32	.05	.44	.50	.30	.38	.31	.30		.58	.00	.61	.68	.36	.54	.43	.49	.63
Ac	7.16	2.22	6.84	2.17	.31	.44	.05*	.31	.28	.19	.28	.25	.23	.47		.19	.60	.43	.23	.38	.42	.36	.38
Do	6.00	1.84	5.73	1.69	−.01	.05	−.20	−.05	.01	.17	.11	.02	.07	−.01	.19		.18	−.06	−.09	−.05	.07	.02	−.12
So	7.98	1.95	7.55	2.04	.45	.34	.03	.50	.47	.32	.46	.40	.37	.61	.53	.14		.60	.29	.50	.52	.47	.51
Fr	8.46	1.87	8.17	1.99	.48	.30	.06	.44	.62	.34	.45	.35	.35	.67	.35	−.11	.53		.49	.71	.46	.63	.69
Mo	6.90	2.28	6.55	2.10	.31	.21	.17	.38	.41	.57	.42	.41	.33	.39	.20	−.08	.34	.54		.56	.28	.51	.41
Co	8.15	1.84	7.86	1.89	.42	.29	.05	.45	.52	.43	.57	.39	.40	.52	.30	.02	.53	.64	.56		.42	.69	.59
SR	7.34	2.25	6.87	2.19	.31	.24	.10	.41	.34	.33	.39	.57	.32	.36	.35	.11	.52	.36	.38	.42		.40	.44
Re	8.19	1.83	7.93	1.85	.43	.28	−.04	.40	.50	.37	.49	.38	.46	.44	.32	.10	.47	.54	.46	.63	.42		.56
Sat	8.27	2.05	8.10	2.11	.60	.39	.11	.57	.59	.31	.43	.47	.35	.61	.34	−.11	.49	.70	.49	.58	.42	.54	

Note. GM= good mood, Ac= activated, Do = dominant, So = sociable, Fr = friendly, Mo = modest, Co = cooperative, SR = self-revealing, Re = reliable, Sat = satisfaction with the social interaction; Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1 and N = 116 individuals providing a total of 1,380 observations in Sample 2. Intercorrelations below and above the diagonal correspond to the data of Sample 1 and Sample 2, respectively. In both samples, intercorrelations of r = |.06| or above are

statistically significantly different from zero at $p < .05$; *significant at $p = .036$. Grey-shaded values show intercorrelations within the perception of self or within the perception of other.

Online Appendix C

Table C1

Fixed and Random Effects of Personality on the Perception of Self Including Explained Variance Estimates

	DV: Expressive Behavior											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.34	0.10	<.001	7.33	0.10	<.001	7.33	0.11	<.001	7.33	0.10	<.001
Personality γ_{01}	0.37	0.10	<.001	0.27	0.08	.001	0.20	0.09	.028	0.35	0.09	<.001
Random effects												
Variance intercept σ^2_{u0}	0.85	0.12	<.001	0.88	0.13	<.001	0.94	0.13	<.001	0.82	0.13	<.001
Residual variance σ^2_r	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001
Explained variance												
R_w^2	0.04			0.03			0.01			0.05		
R_b^2	0.14			0.11			0.05			0.17		
Sample 2												
Fixed effects												
Intercept γ_{00}	6.98	0.09	<.001	6.99	0.10	<.001	7.00	0.10	<.001	6.99	0.09	<.001
Personality γ_{01}	0.43	0.11	<.001	0.26	0.08	.001	0.19	0.08	.023	0.35	0.10	<.001
Random effects												
Variance intercept σ^2_{u0}	0.70	0.13	<.001	0.75	0.13	<.001	0.79	0.14	<.001	0.71	0.12	<.001
Residual variance σ^2_r	2.49	0.16	<.001	2.49	0.17	<.001	2.49	0.16	<.001	2.49	0.16	<.001
Explained variance												
R_w^2	0.04			0.03			0.02			0.04		
R_b^2	0.16			0.10			0.06			0.15		
	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*

Sample 1												
Fixed effects												
Intercept γ_{00}	7.33	0.10	<.001	7.33	0.10	<.001	7.33	0.10	<.001	7.33	0.10	<.001
Personality γ_{01}	0.71	0.13	<.001	0.48	0.11	<.001	0.46	0.11	<.001	0.37	0.10	<.001
Random effects												
Variance intercept σ^2_{u0}	0.74	0.12	<.001	0.82	0.14	<.001	0.85	0.13	<.001	0.84	0.14	<.001
Residual variance σ^2_r	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001
Explained variance												
R_w^2	0.07			0.05			0.04			0.04		
R_b^2	0.25			0.17			0.14			0.15		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.00	0.10	<.001	7.00	0.10	<.001	7.00	0.10	<.001	7.00	0.10	<.001
Personality γ_{01}	0.34	0.10	.001	0.33	0.09	<.001	0.17	0.09	.064	0.16	0.10	.097
Random effects												
Variance intercept σ^2_{u0}	0.77	0.14	<.001	0.73	0.13	<.001	0.82	0.15	<.001	0.81	0.15	<.001
Residual variance σ^2_r	2.49	0.16	<.001	2.49	0.16	<.001	2.49	0.16	<.001	2.49	0.16	<.001
Explained variance												
R_w^2	0.02			0.03			0.01			0.01		
R_b^2	0.08			0.13			0.02			0.03		

	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.34	0.10	<.001	7.34	0.10	<.001	7.34	0.10	<.001	7.33	0.10	<.001
Personality γ_{01}	−0.37	0.09	<.001	−0.23	0.10	.020	−0.33	0.08	<.001	−0.21	0.09	.014
Random effects												
Variance intercept σ^2_{u0}	0.84	0.12	<.001	0.92	0.14	<.001	0.79	0.12	<.001	0.92	0.14	<.001
Residual variance σ^2_r	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001	2.48	0.17	<.001
Explained variance												

R_w^2	0.04			0.02			0.06			0.02		
R_b^2	0.15			0.07			0.20			0.07		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.00	0.10	<.001	7.00	0.10	<.001	7.00	0.10	<.001	7.01	0.10	<.001
Personality γ_{01}	−0.28	0.08	.001	−0.18	0.07	.012	−0.26	0.07	<.001	−0.15	0.07	.039
Random effects												
Variance intercept σ^2_{u0}	0.76	0.13	<.001	0.80	0.15	<.001	0.73	0.12	<.001	0.81	0.15	<.001
Residual variance σ^2_r	2.49	0.16	<.001	2.49	0.16	<.001	2.49	0.16	<.001	2.49	0.16	<.001
Explained variance												
R_w^2	0.02			0.01			0.03			0.01		
R_b^2	0.09			0.05			0.13			0.03		

	DV: Communal Behavior											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.82	0.11	<.001	7.82	0.11	<.001	7.82	0.11	<.001	7.82	0.10	<.001
Personality γ_{01}	0.19	0.10	.058	0.14	0.08	.104	0.05	0.09	.634	0.25	0.09	.005
Random effects												
Variance intercept σ^2_{u0}	1.04	0.14	<.001	1.05	0.14	<.001	1.07	0.14	<.001	1.00	0.14	<.001
Residual variance σ^2_r	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001
Explained variance												
R_w^2	0.01			0.01			0.00			0.03		
R_b^2	0.03			0.02			0.00			0.06		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.51	0.10	.000	7.51	0.10	<.001	7.51	0.10	<.001	7.50	0.10	<.001
Personality γ_{01}	0.27	0.12	.030	0.12	0.09	.209	0.08	0.08	.305	0.32	0.11	.005
Random effects												

Variance intercept σ^2_{u0}	1.06	0.15	<.001	1.10	0.16	<.001	1.10	0.16	<.001	1.02	0.13	<.001
Residual variance σ^2_r	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001
Explained variance												
R_w^2	0.03			0.01			0.01			0.04		
R_b^2	0.05			0.02			0.02			0.09		

	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.82	0.12	<.001	7.81	0.09	<.001	7.82	0.10	<.001	7.82	0.10	<.001
Personality γ_{01}	0.83	0.12	<.001	0.61	0.11	<.001	0.57	0.11	<.001	0.82	0.10	<.001
Random effects												
Variance intercept σ^2_{u0}	0.73	0.11	<.001	0.80	0.12	<.001	0.86	0.13	<.001	0.92	0.13	<.001
Residual variance σ^2_r	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001
Explained variance												
R_w^2	0.16			0.13			0.10			0.07		
R_b^2	0.31			0.25			0.19			0.14		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.51	0.10	<.001	7.51	0.10	<.001	7.51	0.10	<.001	7.51	0.10	<.001
Personality γ_{01}	0.38	0.12	.001	0.30	0.10	.002	0.32	0.10	.002	0.11	0.09	.202
Random effects												
Variance intercept σ^2_{u0}	1.01	0.15	<.001	1.03	0.15	<.001	1.00	0.15	<.001	1.10	0.16	<.001
Residual variance σ^2_r	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001
Explained variance												
R_w^2	0.05			0.04			0.05			0.01		
R_b^2	0.10			0.08			0.11			0.02		

	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												

Fixed effects												
Intercept γ_{00}	7.82	0.11	<.001	7.82	0.11	<.001	7.82	0.11	<.001	7.82	0.11	<.001
Personality γ_{01}	−0.17	0.10	.115	−0.07	0.10	.491	−0.12	0.07	.095	−0.14	0.09	.098
Random effects												
Variance intercept σ^2_{u0}	1.04	0.14	<.001	1.07	0.14	<.001	1.05	0.14	<.001	1.04	0.13	<.001
Residual variance σ^2_r	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001	1.05	0.08	<.001
Explained variance												
R_w^2	0.01			0.00			0.01			0.01		
R_b^2	0.03			0.00			0.02			0.03		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.51	0.10	<.001	7.51	0.10	<.001	7.51	0.10	<.001	7.52	0.10	<.001
Personality γ_{01}	−0.28	0.09	.003	−0.19	0.09	.032	−0.15	0.07	.043	−0.28	0.08	.001
Random effects												
Variance intercept σ^2_{u0}	1.02	0.14	<.001	1.06	0.14	<.001	1.08	0.15	<.001	0.98	0.14	<.001
Residual variance σ^2_r	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001	1.15	0.11	<.001
Explained variance												
R_w^2	0.04			0.03			0.02			0.06		
R_b^2	0.09			0.05			0.04			0.12		

	DV: Dominant Behavior											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	5.39	0.09	<.001	5.38	0.09	<.001	5.39	0.10	<.001	5.39	0.09	<.001
Personality γ_{01}	0.15	0.08	.074	0.16	0.08	.032	0.04	0.07	.610	0.11	0.08	.170
Random effects												
Variance intercept σ^2_{u0}	0.68	0.14	<.001	0.66	0.14	<.001	0.7	0.15	<.001	0.68	0.14	<.001
Residual variance σ^2_r	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001
Explained variance												

R_w^2	0.01			0.01			0.00			0.01		
R_b^2	0.03			0.05			0.00			0.03		
Sample 2												
Fixed effects												
Intercept γ_{00}	5.01	0.08	<.001	5.01	0.08	<.001	5.02	0.08	<.001	5.03	0.08	<.001
Personality γ_{01}	0.23	0.10	.026	0.15	0.08	.040	0.20	0.08	.011	0.03	0.08	.684
Random effects												
Variance intercept σ^2_{u0}	0.41	0.11	<.001	0.42	0.11	<.001	0.38	0.10	<.001	0.44	0.13	.001
Residual variance σ^2_r	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001
Explained variance												
R_w^2	0.01			0.01			0.02			0.00		
R_b^2	0.06			0.04			0.13			0.00		

	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	5.38	0.09	<.001	5.39	0.10	<.001	5.38	0.10	<.001	5.38	0.09	<.001
Personality γ_{01}	0.13	0.15	.404	−0.04	0.11	.693	0.03	0.11	.814	0.19	0.11	.086
Random effects												
Variance intercept σ^2_{u0}	0.69	0.14	<.001	0.70	0.15	<.001	0.70	0.15	<.001	0.67	0.13	<.001
Residual variance σ^2_r	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001
Explained variance												
R_w^2	0.00			0.00			0.00			0.01		
R_b^2	0.01			0.00			0.00			0.04		
Sample 2												
Fixed effects												
Intercept γ_{00}	5.03	0.08	<.001	5.03	0.08	<.001	5.03	0.08	<.001	5.03	0.08	<.001
Personality γ_{01}	−0.13	0.09	.154	−0.04	0.08	.588	−0.10	0.07	.167	−0.11	0.08	.190
Random effects												
Variance intercept σ^2_{u0}	0.42	0.12	<.001	0.44	0.13	.001	0.42	0.12	.001	0.42	0.12	<.001

Residual variance σ^2_r	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001
Explained variance												
R_w^2	0.01			0.00			0.01			0.01		
R_b^2	0.04			0.00			0.04			0.04		
	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	5.39	0.09	<.001	5.39	0.09	<.001	5.39	0.09	<.001	5.38	0.09	<.001
Personality γ_{01}	−0.19	0.09	.028	−0.15	0.08	.046	−0.13	0.08	.082	−0.11	0.08	.116
Random effects												
Variance intercept σ^2_{u0}	0.66	0.14	<.001	0.67	0.14	<.001	0.66	0.16	<.001	0.68	0.14	<.001
Residual variance σ^2_r	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001	2.85	0.22	<.001
Explained variance												
R_w^2	0.01			0.01			0.01			0.01	0.01	
R_b^2	0.05			0.04			0.05			0.03	0.05	
Sample 2												
Fixed effects												
Intercept γ_{00}	5.03	0.08	<.001	5.03	0.08	<.001	5.02	0.08	<.001	5.03	0.08	<.001
Personality γ_{01}	−0.13	0.08	.121	−0.13	0.07	.079	−0.13	0.06	.052	−0.03	0.07	.617
Random effects												
Variance intercept σ^2_{u0}	0.43	0.12	.001	0.42	0.12	.001	0.42	0.12	.001	0.44	0.13	.001
Residual variance σ^2_r	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001	2.53	0.21	<.001
Explained variance												
R_w^2	0.00			0.01			0.01			0.00		
R_b^2	0.02			0.04			0.04			0.00		

Note. R_w^2 = explained variance at the within-level; R_b^2 = explained variance at the between-level. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1, and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Table C2

Fixed Effects and Random Effects of Personality on the Perception of Other Including Explained Variance Estimates

	DV: Expressive Behavior											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.63	0.09	<.001	7.63	0.09	<.001	7.63	0.10	<.001	7.63	0.09	<.001
Personality γ_{01}	0.32	0.09	<.001	0.22	0.07	.003	0.15	0.08	.056	0.34	0.08	<.001
Random effects												
Variance intercept σ^2_{u0}	0.70	0.10	<.001	0.73	0.11	<.001	0.77	0.11	<.001	0.65	0.09	<.001
Residual variance σ^2_r	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001
Explained variance												
R_w^2	0.04			0.03			0.01			0.05		
R_b^2	0.12			0.09			0.04			0.18		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.16	0.09	<.001	7.16	0.09	<.001	7.17	0.09	<.001	7.16	0.09	<.001
Personality γ_{01}	0.34	0.09	<.001	0.21	0.07	.006	0.16	0.08	.039	0.27	0.08	.001
Random effects												
Variance intercept σ^2_{u0}	0.58	0.12	<.001	0.62	0.11	<.001	0.65	0.12	<.001	0.60	0.11	<.001
Residual variance σ^2_r	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001
Explained variance												
R_w^2	0.03			0.02			0.01			0.03		
R_b^2	0.14			0.09			0.04			0.11		
	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												

Intercept γ_{00}	7.63	0.09	<.001	7.63	0.09	<.001	7.63	0.09	<.001	7.63	0.09	<.001
Personality γ_{01}	0.59	0.12	<.001	0.37	0.11	.001	0.35	0.10	<.001	0.34	0.08	<.001
Random effects												
Variance intercept σ^2_{u0}	0.63	0.10	<.001	0.70	0.11	<.001	0.72	0.10	<.001	0.67	0.10	<.001
Residual variance σ^2_r	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001
Explained variance												
R_w^2	0.06			0.04			0.03			0.05		
R_b^2	0.21			0.12			0.10			0.16		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.17	0.09	<.001	7.17	0.09	<.001	7.18	0.09	<.001	7.18	0.09	<.001
Personality γ_{01}	0.34	0.09	<.001	0.32	0.07	<.001	0.23	0.08	.004	0.11	0.08	.183
Random effects												
Variance intercept σ^2_{u0}	0.60	0.11	<.001	0.57	0.11	<.001	0.63	0.11	<.001	0.66	0.12	<.001
Residual variance σ^2_r	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001
Explained variance												
R_w^2	0.03			0.04			0.02			0.01		
R_b^2	0.11			0.16			0.07			0.03		

	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.63	0.09	<.001	7.63	0.09	<.001	7.63	0.10	<.001	7.63	0.09	<.001
Personality γ_{01}	−0.29	0.08	.001	−0.19	0.08	.025	−0.20	0.07	.003	−0.22	0.07	.001
Random effects												
Variance intercept σ^2_{u0}	0.71	0.10	<.001	0.75	0.11	<.001	0.73	0.10	<.001	0.72	0.10	<.001
Residual variance σ^2_r	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001	1.98	0.14	<.001
Explained variance												
R_w^2	0.03			0.02			0.03			0.03		
R_b^2	0.11			0.06			0.09			0.10		

Sample 2												
Fixed effects												
Intercept γ_{00}	7.18	0.09	<.001	7.18	0.09	<.001	7.17	0.09	<.001	7.18	0.09	<.001
Personality γ_{01}	−0.24	0.08	.002	−0.18	0.08	.019	−0.16	0.06	.007	−0.18	0.07	.012
Random effects												
Variance intercept σ^2_{u0}	0.61	0.11	<.001	0.63	0.11	<.001	0.63	0.11	<.001	0.62	0.11	<.001
Residual variance σ^2_r	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001	2.35	0.18	<.001
Explained variance												
R_w^2	0.02			0.02			0.02			0.02		
R_b^2	0.10			0.07			0.07			0.09		

	DV: Communal Behavior											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.93	0.10	<.001	7.92	0.10	<.001	7.92	0.10	<.001	7.92	0.10	<.001
Personality γ_{01}	0.24	0.10	.018	0.20	0.08	.008	0.05	0.09	.593	0.28	0.09	.001
Random effects												
Variance intercept σ^2_{u0}	0.84	0.12	<.001	0.84	0.13	<.001	0.89	0.12	<.001	0.80	0.12	<.001
Residual variance σ^2_r	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001
Explained variance												
R_w^2	0.02			0.02			0.00			0.04		
R_b^2	0.07			0.07			0.01			0.11		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.56	0.10	<.001	7.57	0.10	<.001	7.57	0.10	<.001	7.56	0.10	<.001
Personality γ_{01}	0.29	0.12	.012	0.14	0.09	.099	0.10	0.08	.179	0.32	0.11	.004
Random effects												
Variance intercept σ^2_{u0}	0.99	0.14	<.001	1.03	0.15	<.001	1.04	0.15	<.001	0.96	0.13	<.001
Residual variance σ^2_r	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001

Explained variance												
R_w^2	0.03			0.01			0.01			0.04		
R_b^2	0.07			0.03			0.02			0.09		
	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.92	0.09	<.001	7.92	0.09	<.001	7.92	0.10	<.001	7.92	0.09	<.001
Personality γ_{01}	0.64	0.12	<.001	0.52	0.11	<.001	0.32	0.11	.005	0.32	0.09	<.001
Random effects												
Variance intercept σ^2_{u0}	0.70	0.10	<.001	0.70	0.11	<.001	0.83	0.12	<.001	0.78	0.11	<.001
Residual variance σ^2_r	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001
Explained variance												
R_w^2	0.08			0.08			0.03			0.05		
R_b^2	0.22			0.22			0.08			0.13		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.57	0.10	<.001	7.57	0.10	<.001	7.57	0.10	<.001	7.57	0.10	<.001
Personality γ_{01}	0.37	0.12	.003	0.26	0.10	.009	0.32	0.11	.004	0.11	0.09	.217
Random effects												
Variance intercept σ^2_{u0}	0.96	0.15	<.001	0.99	0.14	<.001	0.95	0.16	<.001	1.04	0.15	<.001
Residual variance σ^2_r	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001
Explained variance												
R_w^2	0.04			0.03			0.04			0.01		
R_b^2	0.09			0.07			0.10			0.02		
	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	7.92	0.10	<.001	7.92	0.10	<.001	7.92	0.10	<.001	7.92	0.10	<.001

Personality γ_{01}	−0.14	0.10	.150	−0.04	0.10	.643	−0.11	0.08	.163	−0.14	0.08	.072
Random effects												
Variance intercept σ^2_{u0}	0.87	0.12	<.001	0.89	0.13	<.001	0.88	0.12	<.001	0.86	0.12	<.001
Residual variance σ^2_r	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001	1.65	0.16	<.001
Explained variance												
R_w^2	0.01			0.00			0.01			0.02		
R_b^2	0.03			0.01			0.02			0.04		
Sample 2												
Fixed effects												
Intercept γ_{00}	7.57	0.10	<.001	7.57	0.10	<.001	7.57	0.10	<.001	7.58	0.10	<.001
Personality γ_{01}	−0.26	0.10	.006	−0.16	0.09	.060	−0.14	0.07	.061	−0.26	0.08	.001
Random effects												
Variance intercept σ^2_{u0}	0.98	0.14	<.001	1.02	0.15	<.001	1.02	0.15	<.001	0.94	0.15	<.001
Residual variance σ^2_r	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001	1.68	0.15	<.001
Explained variance												
R_w^2	0.03			0.01			0.01			0.04		
R_b^2	0.07			0.04			0.04			0.11		

DV: Dominant Behavior

	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001
Personality γ_{01}	0.12	0.09	.173	0.07	0.09	.346	0.10	0.07	.161	0.10	0.08	.205
Random effects												
Variance intercept σ^2_{u0}	0.58	0.11	<.001	0.59	0.11	<.001	0.59	0.11	<.001	0.59	0.11	<.001
Residual variance σ^2_r	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001
Explained variance												
R_w^2	0.01			0.00			0.00			0.00		
R_b^2	0.03			0.02			0.02			0.02		

Sample 2												
Fixed effects												
Intercept γ_{00}	5.74	0.08	<.001	5.74	0.08	<.001	5.74	0.08	<.001	5.75	0.08	<.001
Personality γ_{01}	0.07	0.08	.371	0.03	0.06	.581	0.07	0.06	.261	0.02	0.06	.766
Random effects												
Variance intercept σ^2_{u0}	0.34	0.11	.002	0.35	0.11	.002	0.34	0.11	.002	0.35	0.11	.002
Residual variance σ^2_r	2.54	0.18	<.001	2.53	0.18	<.001	2.54	0.18	<.001	2.54	0.18	<.001
Explained variance												
R_w^2	0.00			0.00			0.00			0.00		
R_b^2	0.03			0.00			0.03			0.00		

	Agreeableness			Compassion			Respectfulness			Trust		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001
Personality γ_{01}	0.26	0.14	.055	0.21	0.09	.024	0.24	0.12	.038	0.07	0.09	.454
Random effects												
Variance intercept σ^2_{u0}	0.57	0.11	<.001	0.57	0.11	<.001	0.57	0.11	<.001	0.59	0.11	<.001
Residual variance σ^2_r	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001
Explained variance												
R_w^2	0.01			0.01			0.01			0.00		
R_b^2	0.05			0.05			0.05			0.02		
Sample 2												
Fixed effects												
Intercept γ_{00}	5.75	0.08	<.001	5.75	0.08	<.001	5.75	0.07	<.001	5.75	0.07	<.001
Personality γ_{01}	−0.09	0.08	.296	0.06	0.07	.445	−0.10	0.06	.107	−0.11	0.07	.102
Random effects												
Variance intercept σ^2_{u0}	0.33	0.11	.003	0.35	0.11	.002	0.33	0.11	.003	0.32	0.11	.005
Residual variance σ^2_r	2.54	0.18	<.001	2.53	0.18	<.001	2.54	0.18	<.001	2.54	0.18	<.001
Explained variance												

R_w^2	0.01			0.00			0.01			0.01		
R_b^2	0.05			0.00			0.05			0.08		
	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001	6.03	0.09	<.001
Personality γ_{01}	−0.03	0.09	0.762	−0.05	0.08	0.546	0.02	0.07	.789	−0.04	0.08	0.611
Random effects												
Variance intercept σ^2_{u0}	0.60	0.11	<.001	0.60	0.11	<.001	0.60	0.11	<.001	0.60	0.11	<.001
Residual variance σ^2_r	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001	2.80	0.22	<.001
Explained variance												
R_w^2	0.00			0.00			0.00			0.00		
R_b^2	0.00			0.00			0.00			0.00		
Sample 2												
Fixed effects												
Intercept γ_{00}	5.75	0.07	<.001	5.75	0.07	<.001	5.75	0.08	<.001	5.75	0.07	<.001
Personality γ_{01}	0.13	0.07	.049	0.10	0.06	.106	0.07	0.06	.203	0.12	0.05	.030
Random effects												
Variance intercept σ^2_{u0}	0.32	0.11	.005	0.32	0.11	.003	0.34	0.11	.003	0.31	0.11	.005
Residual variance σ^2_r	2.54	0.18	<.001	2.54	0.18	<.001	2.54	0.18	<.001	2.54	0.18	<.001
Explained variance												
R_w^2	0.01			0.01			0.00			0.01		
R_b^2	0.08			0.08			0.03			0.11		

Note. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1, and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Table C3

Fixed Effects of the Perception of Self and the Perception of Other on Satisfaction With the Social Interaction Including Explained Variance Estimates

	DV: Momentary satisfaction with the social interaction											
	Sample 1						Sample 2					
	Perception of Self			Perception of Other			Perception of Self			Perception of Other		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Expressive behavior												
Fixed effects												
Intercept γ_{00}	8.29	0.06	<.001	8.29	0.06	<.001	8.02	0.07	<.001	8.04	0.07	<.001
Perception-within γ_{10}	0.69	0.04	<.001	0.73	0.04	<.001	0.71	0.04	<.001	0.71	0.05	<.001
Perception-between γ_{01}	0.68	0.06	<.001	0.75	0.06	<.001	0.73	0.07	<.001	0.76	0.07	<.001
Random effects												
Variance intercept σ^2_{u0}	0.23	0.05	<.001	0.22	0.06	<.001	0.26	0.06	<.001	0.25	0.07	<.001
Residual variance σ^2_r	2.31	0.18	<.001	2.43	0.20	<.001	2.51	0.21	<.001	2.60	0.21	<.001
Explained variance												
R_w^2	0.39			0.36			0.38			0.36		
R_b^2	0.64			0.65			0.61			0.62		
Communal behavior												
Fixed effects												
Intercept γ_{00}	8.27	0.07	<.001	8.28	0.06	<.001	8.02	0.10	<.001	8.03	0.07	<.001
Perception-within γ_{10}	0.89	0.06	<.001	0.99	0.04	<.001	0.92	0.07	<.001	1.00	0.06	<.001
Perception-between γ_{01}	0.60	0.06	<.001	0.72	0.05	<.001	0.65	0.08	<.001	0.69	0.06	<.001
Random effects												
Variance intercept σ^2_{u0}	0.32	0.08	<.001	0.24	0.06	<.001	0.27	0.06	<.001	0.29	0.06	<.001
Residual variance σ^2_r	2.67	0.23	<.001	1.89	0.16	<.001	2.87	0.23	<.001	2.10	0.15	<.001
Explained variance												
R_w^2	0.28			0.49			0.30			0.47		
R_b^2	0.50			0.63			0.59			0.57		
Dominant behavior												

Fixed effects												
Intercept γ_{00}	8.28	0.09	<.001	8.28	0.09	<.001	8.07	0.10	<.001	8.07	0.10	<.001
Perception-within γ_{10}	0.10	0.05	.029	−0.17	0.04	<.001	0.14	0.05	.008	−0.14	0.06	.020
Perception-between γ_{01}	0.15	0.10	.113	0.13	0.10	.205	0.15	0.11	.180	−0.12	0.11	.269
Random effects												
Variance intercept σ^2_{u0}	0.64	0.12	<.001	0.65	0.13	<.001	0.68	0.13	<.001	0.68	0.13	<.001
Residual variance σ^2_r	3.47	0.30	<.001	3.41	0.28	<.001	3.73	0.31	<.001	3.74	0.29	<.001
Explained variance												
R_w^2	0.01			0.02			0.01			0.01		
R_b^2	0.03			0.02			0.01			0.01		

Note. R_w^2 = explained variance at the within-level; R_b^2 = explained variance at the between-level. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1, and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Online Appendix D

Table D1

Fixed and Random Effects of Personality on Satisfaction With the Social Interaction Including Explained Variance Estimates

	DV: Satisfaction with the Social Interaction											
	Extraversion			Sociability			Assertiveness			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.10	<.001	8.28	0.09	<.001
Personality γ_{01}	0.23	0.09	.010	0.16	0.07	.035	0.05	0.08	.574	0.31	0.08	<.001
Random effects												
Variance intercept σ^2_{u0}	0.61	0.13	<.001	0.62	0.13	<.001	0.66	0.12	<.001	0.53	0.12	<.001
Residual variance σ^2_r	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001
Explained variance												
R_w^2	.01			.01			.00			.03		
R_b^2	.08			.05			.00			.19		
Sample 2												
Fixed effects												
Intercept γ_{00}	8.05	0.10	<.001	8.06	0.10	<.001	8.07	0.10	<.001	8.05	0.10	<.001
Personality γ_{01}	0.25	0.10	.013	0.11	0.08	.151	0.09	0.07	.196	0.27	0.09	.004
Random effects												
Variance intercept σ^2_{u0}	0.65	0.12	<.001	0.68	0.13	<.001	0.68	0.13	<.001	0.63	0.12	<.001
Residual variance σ^2_r	3.78	0.31	<.001	3.78	0.31	<.001	3.78	0.31	<.001	3.78	0.31	<.001
Explained variance												
R_w^2	.01			.00			.00			.01		
R_b^2	.06			.01			.01			.08		
	Agreeableness			Compassion			Respectfulness			Trust		

	Est.	*SE*	*P*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.09	<.001	8.28	0.09	<.001
Personality γ_{01}	0.50	0.11	<.001	0.45	0.11	<.001	0.18	0.10	.064	0.27	0.08	.001
Random effects												
Variance intercept σ^2_{u0}	0.54	0.11	<.001	0.51	0.10	<.001	0.64	0.12	<.001	0.58	0.12	<.001
Residual variance σ^2_r	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001
Explained variance												
R_w^2	.03			.04			.01			.02		
R_b^2	.18			.21			.03			.11		
Sample 2												
Fixed effects												
Intercept γ_{00}	8.06	0.10	<.001	8.06	0.10	<.001	8.06	0.10	<.001	8.06	0.10	<.001
Personality γ_{01}	0.33	0.11	.003	0.24	0.10	.013	0.25	0.10	.008	0.14	0.09	.120
Random effects												
Variance intercept σ^2_{u0}	0.62	0.11	<.001	0.63	0.12	<.001	0.64	0.12	<.001	0.66	0.12	<.001
Residual variance σ^2_r	3.78	0.31	<.001	3.78	0.31	<.001	3.77	0.31	<.001	3.78	0.31	<.001
Explained variance												
R_w^2	.02			.01			.01			.01		
R_b^2	.10			.08			.07			.04		

	Neuroticism			Anxiety			Depression			Volatility		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Sample 1												
Fixed effects												
Intercept γ_{00}	8.29	0.09	<.001	8.29	0.09	<.001	8.29	0.09	<.001	8.28	0.09	<.001
Personality γ_{01}	−0.20	0.08	.009	−0.13	0.08	.110	−0.16	0.06	.012	−0.13	0.07	.060
Random effects												

Variance intercept σ^2_{u0}	0.61	0.12	<.001	0.63	0.13	<.001	0.61	0.13	<.001	0.63	0.12	<.001
Residual variance σ^2_r	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001	3.50	0.30	<.001
Explained variance												
R_w^2	.01			.01			.01			.01		
R_b^2	.07			.04			.07			.05		
Sample 2												
Fixed effects												
Intercept γ_{00}	8.07	0.10	<.001	8.07	0.10	<.001	8.06	0.10	<.001	8.07	0.10	<.001
Personality γ_{01}	−0.26	0.09	.005	−0.16	0.09	.065	−0.19	0.07	.007	−0.20	0.08	.012
Random effects												
Variance intercept σ^2_{u0}	0.63	0.12	<.001	0.67	0.12	<.001	0.65	0.12	<.001	0.63	0.13	<.001
Residual variance σ^2_r	3.77	0.31	<.001	3.78	0.31	<.001	3.77	0.31	<.001	3.78	0.31	<.001
Explained variance												
R_w^2	.02			.00			.01			.01		
R_b^2	.08			.03			.06			.08		

Note. R_w^2 = explained variance at the within-level; R_b^2 = explained variance at the between-level. Results are based on N = 102 individuals providing a total of 1,563 observations in Sample 1 and N = 116 individuals providing a total of 1,380 observations in Sample 2.

Online Appendix E

Table E1

Satisfaction With the Social Interaction on Personality and Control Variables

	DV: Momentary satisfaction with the social interaction											
	Sample1						Sample 2					
	Extraversion			Activity			Extraversion			Activity		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept γ_{00}	8.33	0.17	<.001	8.41	0.17	<.001	7.99	0.25	<.001	7.96	0.25	<.001
Personality γ_{01}	0.23	0.08	.004	0.32	0.07	<.001	0.20	0.09	.018	0.22	0.09	.011
Control variables												
Familiarity γ_{10}	0.16	0.03	<.001	0.16	0.03	<.001	0.17	0.03	<.001	0.17	0.03	<.001
Othersex γ_{20}	−0.10	0.10	.352	−0.09	0.10	.355	−0.29	0.15	.048	−0.28	0.15	.058
Weekend γ_{30}	−0.02	0.14	.882	−0.01	0.14	.910	−0.27	0.16	.087	−0.26	0.16	.098
Day γ_{40}	0.04	0.03	.116	0.04	0.03	.120	0.09	0.03	.007	0.09	0.03	.007
Gender γ_{02}	0.00	0.19	.978	−0.11	0.19	.553	0.34	0.24	.172	0.36	0.24	.141
Random effects												
Variance intercept σ^2_{u0}	0.50	0.11	<.001	0.43	0.10	<.001	0.49	0.10	<.001	0.47	0.10	<.001
Residual variance σ^2_r	3.37	0.30	<.001	3.37	0.30	<.001	3.59	0.30	<.001	3.59	0.30	<.001
	Agreeableness			Compassion			Agreeableness			Compassion		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept γ_{00}	8.39	0.17	<.001	7.49	0.18	<.001	8.08	0.26	<.001	8.12	0.26	<.001
Personality γ_{01}	0.43	0.11	<.001	0.41	0.10	<.001	0.25	0.10	.012	0.18	0.09	.043
Control variables												
Familiarity γ_{10}	0.15	0.03	<.001	0.15	0.03	<.001	0.17	0.03	<.001	0.17	0.03	<.001
Othersex γ_{20}	−0.10	0.10	.341	−0.10	0.10	.324	−0.28	0.15	.060	−0.29	0.15	.049
Weekend γ_{30}	−0.02	0.14	.863	−0.02	0.14	.878	−0.28	0.16	.081	−0.28	0.16	.081
Day γ_{40}	0.04	0.03	.115	0.04	0.03	.116	0.09	0.03	.005	0.09	0.03	.005
Gender γ_{02}	−0.09	0.20	.633	−0.24	0.20	.237	0.23	0.26	.373	0.19	0.26	.450
Random effects												
Variance intercept σ^2_{u0}	0.47	0.10	<.001	0.44	0.09	<.001	0.48	0.09	<.001	0.49	0.09	<.001

Residual variance σ^2_r	3.37	0.30	<.001	3.37	0.30	<.001	3.59	0.30	<.001	3.60	0.30	<.001
	Neuroticism			Depression			Neuroticism			Depression		
	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept γ_{00}	8.17	0.17	<.001	8.21	0.18	<.001	7.84	0.26	<.001	7.90	0.26	<.001
Personality γ_{01}	−0.25	0.08	.002	−0.17	0.06	.008	−0.26	0.09	.003	−0.17	0.06	.008
Control variables												
Familiarity γ_{10}	0.16	0.03	<.001	0.16	0.03	<.001	0.17	0.03	<.001	0.17	0.03	<.001
Othersex γ_{20}	−0.10	0.10	.335	−0.10	0.10	.333	−0.27	0.15	.063	−0.27	0.15	.063
Weekend γ_{30}	−0.03	0.14	.855	−0.03	0.14	.856	−0.28	0.16	.072	−0.28	0.16	.073
Day γ_{40}	0.04	0.03	.127	0.04	0.03	.121	0.09	0.03	.007	0.09	0.03	.006
Gender γ_{02}	0.23	0.20	.270	0.17	0.21	.403	0.53	0.25	.032	0.45	0.25	.072
Random effects												
Variance intercept σ^2_{u0}	0.50	0.12	<.001	0.51	0.12	<.001	0.46	0.09	<.001	0.49	0.10	<.001
Residual variance σ^2_r	3.37	0.30	<.001	3.37	0.30	<.001	3.59	0.30	<.001	3.59	0.30	<.001

Note. Results are based on $N = 102$ individuals providing a total of 1,563 observations in Sample 1 and on $N = 116$ individuals providing a total of 1,380 observations in Sample 2.

Table E2

Multilevel Mediation Models (2-1-1 Design) With Control Variables: Sample 1

DV: Momentary satisfaction with the social interaction																			
Model		*a* path		b_{within} path		$b_{between}$ path		*c*‘ path		$a*b_{between}$		Familiarity		Opposite Gender		Weekend		Day		Gender	
Predictor	Mediator	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*
Extraversion	PoS: exp	**0.38**	0.10	**0.67**	0.04	**0.64**	0.07	0.00	0.06	**0.24**	0.07	**0.08**	0.02	0.00	0.08	-0.05	0.11	0.00	0.02	0.12	0.13
	PoO: exp	**0.32**	0.09	**0.72**	0.04	**0.71**	0.07	0.01	0.06	**0.23**	0.06	**0.10**	0.02	-0.02	0.09	-0.07	0.10	-0.02	0.02	0.07	0.12
	PoS: com	0.20	0.10	**0.91**	0.06	**0.54**	0.06	**0.14**	0.06	0.11	0.05	**0.17**	0.02	-0.04	0.09	-0.09	0.11	-0.01	0.02	-0.11	0.13
	PoO: com	**0.25**	0.10	**0.98**	0.05	**0.68**	0.05	0.08	0.05	**0.17**	0.07	**0.11**	0.02	0.07	0.08	-0.02	0.09	-0.03	0.02	-0.02	0.12
Activity	PoS: exp	**0.35**	0.09	**0.67**	0.04	**0.60**	0.07	0.10	0.05	**0.21**	0.06	**0.08**	0.02	0.00	0.08	-0.04	0.11	0.00	0.02	0.08	0.13
	PoO: exp	**0.34**	0.07	**0.72**	0.04	**0.67**	0.07	0.09	0.06	**0.23**	0.05	**0.10**	0.02	-0.02	0.09	-0.07	0.10	-0.02	0.02	0.04	0.12
	PoS: com	**0.25**	0.09	**0.91**	0.06	**0.50**	0.06	**0.20**	0.05	**0.13**	0.04	**0.17**	0.02	-0.04	0.09	-0.09	0.11	-0.01	0.02	-0.17	0.12
	PoO: com	**0.28**	0.09	**0.98**	0.05	**0.64**	0.05	**0.14**	0.04	**0.18**	0.06	**0.11**	0.02	0.07	0.08	-0.02	0.09	-0.03	0.02	-0.07	0.11
Agreeableness	PoS: exp	**0.72**	0.13	**0.67**	0.04	**0.64**	0.07	0.00	0.09	**0.46**	0.10	**0.08**	0.02	0.00	0.08	-0.05	0.11	0.00	0.02	0.12	0.14
	PoO: exp	**0.60**	0.12	**0.72**	0.04	**0.70**	0.07	0.04	0.10	**0.42**	0.10	**0.10**	0.02	-0.02	0.09	-0.07	0.10	-0.02	0.02	0.07	0.12
	PoS: com	**0.84**	0.12	**0.91**	0.06	**0.58**	0.07	-0.05	0.12	**0.48**	0.10	**0.17**	0.02	-0.04	0.09	-0.10	0.11	-0.01	0.03	-0.12	0.14
	PoO: com	**0.64**	0.12	**0.98**	0.05	**0.69**	0.05	0.02	0.08	**0.44**	0.10	**0.11**	0.02	0.07	0.08	-0.03	0.09	-0.03	0.02	-0.03	0.12
Compassion	PoS: exp	**0.49**	0.11	**0.67**	0.04	**0.61**	0.06	0.12	0.08	**0.30**	0.08	**0.08**	0.02	0.00	0.08	-0.04	0.11	0.00	0.02	0.05	0.14
	PoO: exp	**0.38**	0.11	**0.72**	0.04	**0.66**	0.06	0.17	0.07	**0.25**	0.07	**0.10**	0.02	-0.03	0.09	-0.07	0.10	-0.02	0.02	-0.02	0.13
	PoS: com	**0.62**	0.11	**0.91**	0.06	**0.53**	0.06	0.08	0.09	**0.33**	0.07	**0.17**	0.02	-0.04	0.09	-0.09	0.11	-0.01	0.02	-0.16	0.14
	PoO: com	**0.52**	0.11	**0.98**	0.05	**0.67**	0.05	0.07	0.07	**0.35**	0.08	**0.11**	0.02	0.07	0.08	-0.03	0.09	-0.03	0.02	-0.06	0.12
Neuroticism	PoS: exp	**-0.37**	0.10	**0.67**	0.04	**0.65**	0.07	0.01	0.08	**-0.24**	0.07	**0.08**	0.02	0.00	0.08	-0.05	0.11	0.00	0.02	0.10	0.16
	PoO: exp	**-0.29**	0.08	**0.72**	0.04	**0.70**	0.07	-0.03	0.08	**-0.20**	0.06	**0.10**	0.02	-0.02	0.09	-0.07	0.10	-0.02	0.02	0.11	0.15
Depression	PoS: exp	**-0.33**	0.08	**0.67**	0.04	**0.67**	0.07	0.06	0.06	**-0.22**	0.06	**0.08**	0.02	0.00	0.08	-0.05	0.11	0.00	0.02	0.06	0.15
	PoO: exp	**-0.20**	0.06	**0.72**	0.04	**0.70**	0.07	-0.04	0.06	**-0.14**	0.05	**0.10**	0.02	-0.02	0.09	-0.07	0.10	-0.02	0.02	0.11	0.13

Note. PoS = perception of self; PoO = perception of other; exp = expressive behavior, com = communal behavior; *a* path = mediator mean regressed on predictor; b_{within} path = satisfaction with the social interaction regressed on mediator; $b_{between}$ path = satisfaction with the social interaction regressed on mediator mean; *c*’ path = partial predictor effect on satisfaction with the social interaction; $a*b_{between}$ = indirect between-effect. Results are based on *N* = 102 individuals providing a total of 1,563 observations. Estimates in bold font

are statistically significantly different from zero at $p < .05$. For better readability, we do not report exact *p*-values and confidence intervals here. Outputs including these details can be requested from the first author or reproduced with the open data and scripts provided at https://osf.io/mxbfw/.

Table E3

Multilevel Mediation Models (2-1-1 Design) With Control Variables: Sample 2

DV: Momentary satisfaction with the social interaction																			
Model		*a* path		b_{within} path		$b_{between}$ path		*c*‘ path		$a*b_{between}$		Familiarity		Opposite Gender		Weekend		Day		Gender	
Predictor	Mediator	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*
Extraversion	PoS: exp	**0.44**	0.12	**0.69**	0.04	**0.70**	0.06	-0.07	0.07	**0.31**	0.09	**0.09**	0.02	-0.20	0.13	**-0.20**	0.10	0.02	0.03	0.33	0.18
	PoO: exp	**0.34**	0.11	**0.69**	0.04	**0.71**	0.07	-0.03	0.08	**0.24**	0.08	**0.11**	0.02	-0.20	0.12	-0.18	0.12	0.04	0.03	0.19	0.19
	PoS: com	**0.29**	0.13	**0.88**	0.07	**0.59**	0.07	0.06	0.07	**0.17**	0.08	**0.16**	0.02	-0.13	0.14	-0.17	0.12	0.00	0.03	0.18	0.17
	PoO: com	**0.32**	0.13	**0.99**	0.05	**0.63**	0.06	0.03	0.07	**0.20**	0.09	**0.13**	0.02	-0.01	0.11	-0.16	0.12	0.02	0.03	0.09	0.17
Activity	PoS: exp	**0.36**	0.10	**0.69**	0.04	**0.67**	0.07	0.01	0.06	**0.24**	0.07	**0.09**	0.02	-0.21	0.13	**-0.20**	0.10	0.02	0.03	0.34	0.18
	PoO: exp	**0.26**	0.09	**0.69**	0.04	**0.69**	0.07	0.04	0.07	**0.18**	0.07	**0.11**	0.02	-0.20	0.12	-0.17	0.12	0.04	0.03	0.21	0.19
	PoS: com	**0.34**	0.12	**0.88**	0.07	**0.58**	0.07	0.06	0.07	**0.20**	0.07	**0.15**	0.02	-0.13	0.14	-0.16	0.12	0.00	0.03	0.19	0.17
	PoO: com	**0.35**	0.12	**0.99**	0.05	**0.62**	0.06	0.04	0.07	**0.22**	0.08	**0.13**	0.02	-0.01	0.11	-0.16	0.12	0.02	0.02	0.10	0.17
Agreeableness	PoS: exp	**0.41**	0.11	**0.69**	0.04	**0.66**	0.07	0.06	0.08	**0.27**	0.08	**0.09**	0.02	-0.21	0.13	**-0.20**	0.10	0.02	0.03	0.32	0.18
	PoO: exp	**0.35**	0.10	**0.69**	0.04	**0.69**	0.07	0.04	0.08	**0.24**	0.08	**0.11**	0.02	-0.20	0.12	-0.18	0.12	0.04	0.03	0.19	0.19
	PoS: com	**0.42**	0.13	**0.87**	0.07	**0.59**	0.07	0.06	0.08	**0.24**	0.08	**0.16**	0.02	-0.13	0.14	-0.17	0.12	0.00	0.03	0.16	0.16
	PoO: com	**0.40**	0.13	**0.99**	0.05	**0.62**	0.06	0.07	0.08	**0.25**	0.09	**0.13**	0.02	-0.01	0.11	-0.16	0.12	0.02	0.02	0.07	0.16
Compassion	PoS: exp	**0.36**	0.09	**0.69**	0.04	**0.68**	0.07	-0.03	0.07	**0.24**	0.07	**0.09**	0.02	-0.21	0.13	**-0.20**	0.10	0.02	0.03	**0.36**	0.18
	PoO: exp	**0.32**	0.08	**0.69**	0.04	**0.71**	0.06	-0.03	0.08	**0.23**	0.06	**0.11**	0.02	-0.20	0.12	-0.18	0.12	0.04	0.03	0.22	0.18
	PoS: com	**0.33**	0.10	**0.87**	0.07	**0.59**	0.06	0.04	0.07	**0.19**	0.07	**0.16**	0.02	-0.13	0.13	-0.17	0.12	0.00	0.03	0.15	0.16
	PoO: com	**0.29**	0.11	**0.99**	0.05	**0.62**	0.06	0.05	0.06	**0.18**	0.07	**0.13**	0.02	-0.01	0.11	-0.16	0.12	0.02	0.02	0.06	0.16
Neuroticism	PoS: exp	**-0.31**	0.09	**0.69**	0.04	**0.65**	0.06	-0.10	0.06	**-0.20**	0.06	**0.09**	0.02	-0.20	0.13	**-0.20**	0.10	0.02	0.03	**0.43**	0.18
	PoO: exp	**-0.24**	0.09	**0.69**	0.04	**0.67**	0.07	-0.08	0.07	**-0.16**	0.06	**0.11**	0.02	-0.20	0.12	-0.18	0.12	0.04	0.03	0.27	0.19
Depression	PoS: exp	**-0.28**	0.08	**0.69**	0.04	**0.67**	0.07	-0.01	0.05	**-0.18**	0.05	**0.09**	0.02	-0.21	0.13	**-0.20**	0.10	0.02	0.03	0.35	0.18
	PoO: exp	**-0.16**	0.07	**0.69**	0.04	**0.68**	0.07	-0.05	0.06	**-0.11**	0.05	**0.11**	0.02	-0.20	0.12	-0.18	0.12	0.04	0.03	0.24	0.19

Note. PoS = perception of self; PoO = perception of other; exp = expressive behavior, com = communal behavior; *a* path = mediator mean regressed on predictor; b_{within} path = satisfaction with the social interaction regressed on mediator; $b_{between}$ path = satisfaction with the social interaction regressed on mediator mean; *c*’ path = partial predictor effect

on satisfaction with the social interaction; $a*b_{between}$ = indirect between-effect. Results are based on N = 116 individuals providing a total of 1,380 observations. Estimates in bold font are statistically significantly different from zero at $p < .05$. For better readability, we do not report exact p-values and confidence intervals here. Outputs including these details can be requested from the first author or reproduced with the open data and scripts provided at https://osf.io/mxbfw/.

3. Moody and in Love? The Role of Neuroticism and Romantic Relationships for Momentary Affect in Adolescence

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Abstract

The affective lives of adolescents are unique, such that momentary affect in this age group is more negative and variable. Whereas daily affective experiences differ considerably between individuals, little is known about the factors contributing to these differences. Analyzing data from $N = 408$ adolescents (age: $M = 16.83$) reporting on their momentary positive and negative affect in a total of 8,349 experience-sampling surveys, we examined how neuroticism and different aspects of romantic relationships (i.e., relationship involvement and relationship quality) explain interindividual differences in adolescents' affect level and variability. Mixed-effects location scale models revealed four main findings: First, adolescents with higher neuroticism experienced lower levels of positive affect, higher levels of negative affect, as well as higher variability of both positive and negative affect. Second, adolescents with a romantic partner did not differ from their single peers with regard to affect level, but experienced higher affect variability, although evidence for these effects was only weak. Third, among participants who were currently involved in a romantic relationship, adolescents with higher relationship quality experienced more variability in their positive affect if they scored higher in neuroticism. Finally, across all models, effect sizes systematically differed between affect level and variability, positive and negative affect, as well as neuroticism facets. We discuss these findings in light of adolescents' affective development and the role of personality-social relationship interactions.

Keywords: Momentary affect; Affect variability; Neuroticism; Romantic relationships; Adolescence

Moody and in Love? The Role of Neuroticism and Romantic Relationships for Momentary Affect in Adolescence

Momentary affect—broadly defined as basic, consciously accessible states with a certain valence—is at the heart of an individual's day-to-day experience and lays the foundations for any more complex emotion (Ekkekakis, 2013; Russell, 2003). Compared to children and adults, it has been proposed that the affective life of adolescents is characterized by increased moodiness (Rosenblum & Lewis, 2003) and a series of studies using the experience sampling method (ESM) suggests that, on average, adolescents' momentary affect is more negative and changes more frequently (for an overview, see Larson & Sheeber, 2008). As such, adolescence appears to be a unique and relevant age period to study both individuals' *affect level* (i.e., how negative or positive affect is on average) and within-person *affect variability* (i.e., how much affect fluctuates across time and situations). This opportunity is further emphasized by the fact that scholars have highlighted considerable interindividual differences regarding adolescents' affective experiences (Bailen et al., 2019; Maciejewski et al., 2015).

To date, the factors contributing to these interindividual differences in affect level and variability are not well understood. In parts, they might arise from adolescents' relatively stable patterns of thoughts, feelings, and behaviors, that is, their personality traits (Roberts et al., 2006). In particular, the personality trait neuroticism has been found to reliably explain interindividual differences in persons' affect level and variability (e.g., Eid & Diener, 1999; Kuppens et al., 2007). Moreover, neuroticism has been linked with stronger affective responses to social cues (Denissen & Penke, 2008a; Mueller et al., 2021). Above that, interindividual differences in affect might relate to the multiple life changes that occur in adolescence, including the adaptation to new social roles (Larson & Richards, 1994). As one of the most pivotal experiences in adolescence, the emergence of romantic relationships might be key in explaining interindividual differences in momentary affect (Collins et al., 2009; Larson et al., 1980). Combining these strings of research, this study aims at investigating how neuroticism and different aspects of romantic relationships (i.e., relationship involvement and relationship quality) jointly explain interindividual differences in adolescents' affect level and variability. To reach this goal, the current study uses ESM data from German adolescent participants (N = 408; age range: 14-22) with and without a romantic partner who provided a total of 8,349 momentary affect ratings (Mdn = 23.00) over the course of a week.

Affect in Adolescence

As adolescents are confronted with multiple changes, including a shift of hormone levels, developing cognitive abilities, and more complex social experiences (e.g., Dahl et al., 2018;

Suleiman et al., 2017), the transition from childhood to adulthood represents an important period for affective[9] development. In the long run, these changes are thought to contribute to the enhancement of emotional capacities, such as the ability of experiencing and reflecting on (mixed) emotions, of regulating or dissembling emotions, and of interacting in an empathic manner (Furman et al., 2008; Rosenblum & Lewis, 2003). In adolescents' daily life, their affect has been characterized by greater negativity as well as greater variability, potentially stemming from greater reactivity (Bailen et al., 2019; Larson & Sheeber, 2008). Less is known, however, about the factors accounting for interindividual differences in the intraindividual level and variability of momentary affect during adolescence.

Moreover, it is unclear whether the same patterns apply to different affect categories: Although it is possible to distinguish among an almost infinite number of specific types of emotional states (e.g., anxiety, joy, interest, depression), on a broader level, researchers generally agree that these can be subsumed under the two dimensions *positive affect* and *negative affect* (Watson & Clark, 1997). In this tradition, positive and negative affect have been conceptualized as independent constructs rather than opposite ends of the same scale (Watson & Clark, 1997). Accordingly, it is important to explore affect level and variability separately for positive and negative affect.

Neuroticism and Momentary Affect

Defined as the tendency to feel anxious and easily stressed (Barlow et al., 2014; Soto & John, 2017), neuroticism has been suggested to be the Big Five personality trait with the most profound implications for an individuals' affective life. A large number of theories propose that neuroticism does not only relate to higher levels of negative affect (Barlow et al., 2014; Soto & John, 2017), but also to stronger affective swings, lower capacities for affect regulation, and higher reactivity to stress (for an overview, see Denissen & Penke, 2008b).

Various ESM studies using adult samples (mainly university students) have supported the theoretically proposed associations between neuroticism and interindividual differences referring to both individuals' affect level and variability on the daily and momentary level (Eid & Diener, 1999; Kuppens et al., 2007; Miller et al., 2009). First, neuroticism was shown to be positively associated with negative affect level and negatively associated with positive affect level (cf. Geukes et al., 2017). Second, results have suggested a link between neuroticism and

[9] In past research, the terms *mood*, *affect*, and *emotion* have been used interchangeably. In this study, we refer to affect, which is considered as the broadest of the three constructs: Affect can involve but is not limited to emotion and mood (for a discussion, see Ekkekakis, 2013). Nonetheless, we build on literature that uses either of these terms.

higher affect variability, although this association was not consistent across affect measures (e.g., negative versus positive affect) and is still a subject of debate (Hisler et al., 2020; Wenzel & Kubiak, 2020). Compared to these rich findings, only few studies have examined the role of neuroticism for momentary affect in younger age groups, yet two ESM studies provide initial evidence that the associations between neuroticism and individual differences in momentary affect may generalize to adolescence. In a longitudinal study with up to 15 ESM assessment bursts, Borghuis et al. (2020) found that the association between neuroticism and the level of momentary negative affect could also be established in a large sample of Dutch adolescents (N = 1,046). In another study with up to 9 ESM assessment bursts that was also based on a Dutch adolescent sample (N = 246), Reitsema et al. (2022) found that adolescents with higher neuroticism experienced lower levels of positive affect and higher affect variability, too.

Romantic Relationships in Adolescence and Affect

One of the hallmarks of adolescence are the first experiences of romantic relationships. Romantic relationships are defined as on-going, voluntary social interactions that are mutually acknowledged by two individuals, and that have a peculiar intensity often marked by verbal and physical expressions of affection (Collins, 2003). Theories on life-span development (Erikson, 1968; Furman & Wehner, 1994; Havighurst, 1948) unanimously propose that finding a romantic partner belongs to one of the most central developmental tasks in adolescence. According to these theories, romantic relationship involvement represents an opportunity for adolescents of experimenting with adult roles and of discovering new forms of emotional and physical intimacy. The (new) experience of being in love can, on the one hand, evoke (very) positive emotions and heighten adolescents' self-esteem (Bouchey & Furman, 2003; Furman & Shaffer, 2003). On the other hand, conflicts with the romantic partner as well as insecurity and confusion about relationship aspects can be (very) stressful (e.g., Laursen, 1995; Welsh et al., 2003). Thus, romantic relationships can be regarded as a potential source of both (very) positive and (very) negative affect and might provide an important context for affective experiences in adolescence (see Furman et al., 2008; Rosenblum & Lewis, 2003).

Relationship Involvement

Most adolescents have made some experiences with dating by the age of 14 or 15, and enter their first romantic relationship as this period proceeds (Carver et al., 2003; Connolly & Johnson, 1996; Rubin et al., 2006). At the same time, research indicates great interindividual differences in romantic relationship experiences, including adolescents who are not romantically active at all during this developmental phase (Gonzalez Avilés et al., 2021). This raises the question whether relationship involvement (i.e., whether or not a person has a romantic

partner) relates to interindividual differences in adolescents' momentary affect. Tracking the dating behavior between ages 10 and 20 in a large sample of German adolescents (N = 2457), Gonzalez Avilés et al. (2021) found that individuals participating in *moderate* dating were more satisfied and felt less lonely than peers who were continuously single, but did not differ from late starters of dating or from those with a frequent change of dating partners. Thus, differences in relationship involvement related to interindividual differences in socio-emotional well-being. So far, however, only little is known about how and whether the affective lives of adolescents with and without a romantic partner differ on a momentary level.

To our knowledge, no previous research has investigated the association between relationship involvement and the level of momentary affect. There is one ESM study, however, that focused on its association with variability of momentary affect. In this seminal study, Larson et al. (1980) illustrated stronger affect variability, measured as within-person standard deviation (i.e., *SD*), in adolescents with a romantic partner as compared to their single peers across one week. Despite providing vital evidence for the potential impact of romantic relationships for momentary affect in adolescence, the findings of Larson et al. were based on only a small sample (N = 75) and did not differentiate between positive and negative affect. Moreover, the methodological knowledge advanced over the last years and the use of within-person *SD*s for analyzing affect variability is not recommended anymore (for more detailed explanations see Geukes et al., 2017; Wenzel & Kubiak, 2020). Given that, to our knowledge, the association between romantic relationship involvement and affect variability (Larson et al., 1980) has not been replicated using appropriate affect measures and up-to date statistical methods so far, it remains a topic for investigation.

Relationship Quality

Romantic experiences in adolescence do not only differ by romantic relationship involvement per se, but, importantly, also by the quality of adolescents' romantic relationships (Collins et al., 2009). Relationship quality refers to the degree of support that romantic partners experience from each other and can range from high levels of affection, intimacy, and nurturance at the upper end to frequent conflicts, irritation, and antagonism at the lower end of this dimension (Galliher et al., 2004). In studies investigating romantic relationships of adolescents and emerging adults, higher perceived relationship quality has been linked to a number of broader affective outcomes, such as higher happiness (Demir, 2008) and lower depression (Mirsu-Paun & Oliver, 2017). As such, relationship quality might be an important contributor to the level of momentary affect in adolescents' daily lives. In addition, given the more frequent occurrence of stressful events such as relationship conflicts (see Galliher et al., 2004; Laursen,

1995), it could be argued that lower relationship quality might provoke higher affect variability. Altogether, literature and previous empirical research suggest that relationship quality can play an important role for adolescents' affect in everyday life. Accordingly, interindividual differences in perceived relationship quality might explain interindividual differences in affect level and variability in those adolescents who have a romantic partner.

The Joint Role of Neuroticism and Romantic Relationships

According to the dynamic-interactional paradigm (Neyer & Asendorpf, 2001), personality traits and social relationships co-develop over time and reciprocally interact with each other. Specifically with respect to neuroticism, it has been argued that the heightened stress-reactivity of individuals with higher neuroticism primarily pertains to the reaction to social stressors, such as being criticized or rejected (Denissen & Penke, 2008b; Holmes, 2002). Accordingly, the interplay of adolescents' neuroticism and their romantic relationships (i.e., their relationship involvement and relationship quality) might additionally contribute to their momentary affect beyond the independent effect of both variables.

Although these specific interaction hypotheses have not been tested yet, a number of studies based on adult samples provide initial evidence for a moderating role of neuroticism for the association between romantic relationship variables and momentary affect. First, a study on imagined social and non-social threats found that individuals with higher neuroticism are more sensitive to social stressors (Denissen & Penke, 2008a). This finding might imply that the momentary affect of adolescents with higher neuroticism is also more closely associated with potential social threats related to their romantic relationships, such as the fear of being left by one's partner. Along these lines, results from an ESM study on social interactions (Mueller et al., 2019) suggest that individuals with higher levels in trait neuroticism feel less happy when interacting with their romantic partner compared to other types of interaction partners. The authors of the study argue that this moderation effect of neuroticism on the association between interactions with the romantic partner and momentary happiness might reflect that individuals higher in neuroticism feel particularly insecure when ambiguous situations involve their partner. Second, another recent ESM study provides initial evidence that people with higher neuroticism are also more sensitive to social cues with positive valence: Using a sample of older romantic couples, Mueller et al. (2021) found that higher neuroticism reinforced the positive coupling between individuals' own and the partners' momentary positive affect.

Altogether, neuroticism appears to reinforce associations between social variables and momentary affect, especially in the context of romantic relationships. Accordingly, the degree to which romantic relationship involvement relates to adolescents' momentary affect level and

affect variability might be moderated by their neuroticism. Similarly, among those adolescents who are in a current relationship, neuroticism might shape the way in which the quality of the relationship relates to momentary affect variables.

The Current Study

Using momentary affect ratings from more than 400 adolescents (two combined ESM samples), the goal of the current study was threefold: First, we aimed at examining how neuroticism relates to adolescents' affect level and variability. Second, we aimed at investigating to what degree adolescents with and without a romantic relationship differ in their affect level and variability and how romantic relationship quality may explain differences in momentary affect variables among adolescents who are in a current romantic relationship. Finally, we aimed at investigating whether neuroticism moderates the effects of romantic relationship involvement and romantic relationship quality on adolescents' affect level and variability. In line with the conceptualization of positive and negative affect as separate constructs (Watson & Clark, 1997), we analyze and report them in a parallel manner as two measures of adolescents' momentary affect. Given the current state of evidence, we specified hypotheses about interindividual differences in the mean level of momentary positive and negative affect in adolescence, but investigated potential differences with regard to adolescent positive and negative affect variability in an exploratory manner.

Referring to the first research question and based on previous research that was mainly established using young adult samples (e.g. Borghuis et al., 2020; Eid & Diener, 1999; Geukes et al., 2017), we expected that, on average, higher neuroticism is related to lower levels of positive and higher levels of negative momentary affect (Hypothesis 1.1) as well as higher affect variability (Hypothesis 1.2). Referring to the second research question, we refrained from predictions regarding an association between romantic relationship involvement and adolescents' average affect-level because previous findings or a clear theoretical outline are lacking. Therefore, we addressed the research question on average affect level in an exploratory manner. Based on the findings by Larson et al. (1980), however, we expected that adolescents in a current romantic relationship, on average, experience stronger affect variability than those without a romantic partner (Hypothesis 2.1). Looking at adolescents who are currently involved in a romantic relationship, we further expected that, in line with previous findings (e.g., Demir, 2008; Mirsu-Paun & Oliver, 2017), on average, higher relationship quality is associated with lower levels of negative and higher levels of positive momentary affect (Hypothesis 2.2). Moreover, given the reduced likelihood of stressful events (e.g., Galliher et al., 2004), we expected

that, on average, higher relationship quality is associated with lower affect variability (Hypothesis 2.3). Referring to the third research question and based on the heightened responsiveness of individuals with higher neuroticism to social cues (Denissen & Penke, 2008a; Mueller et al., 2021), we expected that neuroticism reinforces the association between romantic relationship involvement and adolescents' affect level (Hypothesis 3.1) and variability (Hypothesis 3.2). Moreover, we expected that neuroticism also reinforces the association between relationship quality and both affect level (Hypothesis 3.3) and variability (Hypothesis 3.4).

In personality research, a growing number of scientists has highlighted the advantages of studying personality traits on the facet level in addition to examining broad personality factors only: By capturing more specific behaviors, thoughts, and feelings, personality facets might help getting closer to causal explanations for interindividual differences in psychological outcomes (Mõttus, 2016; Mõttus et al., 2020). Supporting such claims, a recent study by Wieczorek et al. (2021) provides empirical evidence for distinct roles of personality facets in the context of adolescents' daily social interactions. Therefore, we investigated the effects of the facet scores of neuroticism (based on the Big Five Inventory-2, Danner et al., 2019; anxiety, depression, volatility) in addition to the effect of the overall score in an exploratory manner. Furthermore, and in line with previous research on momentary affect (e.g., Geukes et al., 2017; Kroencke et al., 2020), we controlled for longitudinal trends in affect across the ESM measurement period by controlling for a linear time effect in all models (Bolger & Laurenceau, 2013). Finally, we tested for the overall robustness of our results by including a number of control variables. First, regarding characteristics varying within persons across time, we controlled for the presence of an interaction partner and whether momentary affect was measured on weekdays or weekends. Second, in analyses restricted to participants in a current romantic relationship, we additionally differentiated between the presence of the romantic partner and the presence of any other interaction partner. Third, regarding interindividual characteristics varying between persons, we controlled for gender, age, and sample of the original study.

With the current study, we aimed at extending previous research in four important ways. First, we tested whether associations between neuroticism and momentary affect (i.e., level and variability) that have been established in adult samples replicate in adolescent samples, while differentiating between neuroticism facets. Second, we moved beyond broad measures of socio-emotional well-being and took a closer look at how romantic relationship involvement relates to both the level and variability of adolescents' momentary affect, while differentiating between positive and negative affect and using up-to date statistical methods (i.e., mixed effects location

scale models; Hedeker et al., 2009). Third, we looked beyond romantic relationship involvement per se and zoomed into interindividual differences between adolescents who were currently involved in a romantic relationship by investigating the role of relationship quality for momentary affect variables. Finally, by examining how neuroticism (and its facets) may moderate the associations between romantic relationships and momentary affect, we shed light on the interplay between individual and relationship variables. This way, our study offers a first approach to bridge the previously largely unconnected fields of affective experiences in the context of romantic relationships and personality research.

Method

Hypotheses and data analyses were preregistered at https://osf.io/kdh7u?view_only=1319f8b1920d4019a40652ed3ef2924d via the Open Science Framework (Center for Open Science, 2011-2022). We analyzed combined data from two longitudinal studies with adolescent samples and similar designs: SELFIE (BLINDED) and SchoCo (BLINDED). To maintain a high comparability in terms of timing of measurements, we used data from the first measurement point (T1) and the first ESM week of both samples for the current study. In SELFIE, data were collected from students in their final year of high school (age: M = 17.69, SD = 0.98), who completed the introductory session either in the laboratory in BLINDED or online. In SchoCo, data were collected online from adolescent students attending different school tracks (age: M = 15.89, SD = 1.21). In both studies, the first measurement point was followed directly by the ESM week. Parts of the data have been used in previous publications but none of them concerned momentary affect. On our OSF page (https://osf.io/84ahu/?view_only=341ed8bc6ba94872a7cc8361c2bfc56d), we provide supplemental materials, including data, code, and additional results.

Participants

In the original data sets, 220 adolescents in SELFIE and 243 participants in SchoCo took part in the introductory session and the ESM period. This resulted in a total of 461 participants who were treated as a combined sample in all following steps of our study. Given that our research questions concerning affect variability required repeated measurements, however, we excluded 53 participants who provided less than three ESM reports[10]. Consequently, our

[10] Compared to the final sample, excluded participants reported lower levels of positive affect, d = −0.30, 95% CI [−0.52, −0.08], higher levels of negative affect, d = 0.64, 95% CI [0.40, 0.88], and more social interactions, d = 0.48, 95% CI [0.25, 0.70], with small to medium effect sizes. They also were younger, d = −0.48, 95% CI [−0.78, −0.18] and more likely from the SchoCo study, d = 0.85, 95% CI [0.52, 1.18], with small to large effect sizes.

final total sample consisted of 408 adolescents (81.62% female) aged 14 to 22 years (M = 16.83, SD = 1.41) who provided an average of 20.49 (SD = 9.91, Range: 3 to 35) entries during the ESM week. This resulted in a total of 8,349 momentary affect ratings. Whereas most (71.32%) participants of our final sample were single, a subsample of 117 adolescents was currently involved in a romantic relationship, providing a total of 2,589 momentary affect ratings. At the time of assessment, most adolescents (88.73%) attended high school.

Comparing participants of the two original studies within our final sample, we found that, compared to adolescents in SELFIE, adolescents in SchoCo reported lower levels of positive affect, d = −0.21, 95% CI [−0.26, −0.17], higher levels of negative affect, d = 0.48, 95% CI [0.43, 0.52], as well as fewer daily social interactions in general, d = −0.18, 95% CI [−0.22, −0.13], and with romantic partners, d = −0.11, 95% CI [−0.15, −0.06], with small to medium effect sizes. They also scored higher in neuroticism, d = 0.33, 95% CI [0.14, 0.53], anxiety, d = 0.27, 95% CI [0.08, 0.47], depression, d = 0.35, 95% CI [0.15, 0.55], and volatility, d = 0.22, 95% CI [0.02, 0.41], and were less likely to be involved in a current romantic relationship, d = −0.39, 95% CI [−0.59, −0.19], younger, d = −1.64, 95% CI [−1.89, −1.39], and more likely to be female, d = 0.31, 95% CI [0.12, 0.51], with small to large effect sizes. Comparing participants who were in a current romantic relationship and those who were single, we found that adolescents with a romantic partner reported more frequent social interactions, d = 0.12, 95% CI [0.07, 0.17] and were older, d = 0.48, 95% CI [0.26, 0.70], with a small to medium effect sizes, but no differences with regard to the remaining study variables.

To evaluate the statistical power to detect the effects of interest in our models, we conducted a simulation-based power analysis. We carried out simulations for varying sizes of standardized fixed effect estimates (β =.30, β = .20, β = .15, β = .10, β = .05) at an alpha level of .05 and for simulated values of both of our outcomes (i.e., positive and negative affect). We simulated power for the between-person effects of neuroticism, relationship status, and their interaction, as well as the within-person effect of time on the level of positive and negative affect. These simulations were run for the two scenarios of the complete sample and the subsample of participants in a current romantic relationship. The R code for the simulation was adapted from Kroencke et al. (2020) and can be retrieved from our OSF page together with the results for all standardized effect estimates. In the complete sample, our simulation indicated generally satisfactory power ranging from 85% to 100% to detect effects on both outcomes with standardized β-coefficients equal to or larger than .10, with higher power for effects with larger β-coefficients. In the sub-sample of participants in a current romantic relationship, our simulation indicated generally satisfactory power ranging from 93% to 100% to detect effects on both

outcomes with β-coefficients equal to or larger than .20, with higher power for effects with larger β-coefficients.

Procedure

Ethical approval for the SELFIE and SchoCo studies was granted by the German Psychological Society (DGPs) and by the ethics committee of BLINDED. The procedure of both studies was quite similar, such that participants first completed a number of questionnaires during an introductory session and then entered a weeklong ESM period. During this time, participants received five questionnaires per day (9 a.m., 12 p.m., 3 p.m., 6 p.m., and 8 p.m.) on their smartphones, which included questions concerning the adolescents' momentary affect and social interactions. All questionnaires in SELFIE and SchoCo were implemented with the open-source software formr (Arslan et al., 2020). The study set-up did not allow for missing values apart from the option to skip questionnaire prompts during the ESM period, resulting in a different number of ESM reports across the participants. Both studies were promoted via social media platforms, personal outreach to schools, and leaflets in public spaces. In SELFIE, participants received monetary compensation that was proportional to the number of completed questionnaires and ESM reports, personalized feedback, and the chance to win prizes when completing the entire study. In SchoCo, adolescents had the chance to win gift vouchers and sweets in a lottery after each measurement point and received personalized feedback after completing the entire study.

Measures

Whereas person variables were measured during the introductory session, momentary variables were repeatedly obtained during the ESM period. If not specified otherwise, the same measures were used in SELFIE and SchoCo, and corresponding data of the two original studies can thus be easily combined. The complete wordings and response formats of the items used in the current study can be obtained from the codebooks provided at the OSF pages of the SELFIE (BLINDED) and SchoCo study (BLINDED).

Demographics

In the demographic questionnaire that was part of the introductory session, participants indicated their age in years and identified themselves as *female* (*0*) or *male* (*1*). In addition, we coded each participants' original sample as *SELFIE* (0) or *SchoCo* (1).

Neuroticism

Neuroticism and its facets anxiety, depression, and volatility were measured with the German version of the BFI-2 ((Danner et al., 2019; Soto & John, 2017). Each facet was measured with four items, resulting in a total of 12 items reflecting neuroticism. Items were answered

on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Internal consistencies as indicated by total omega were .90 for the overall score of neuroticism and .70, .86, and .82 for the scores of the anxiety, depression, and volatility facets, respectively.

Romantic Relationship Variables

Relationship involvement. To indicate their current relationship status, participants had to choose one of the following options: (a) "I have never been in a committed relationship so far", (b) "I am not in a committed partnership at the moment, but I have already been in a/several committed relationship(s)", or (c) "I am currently in a committed relationship". Based on these answers, relationship involvement was coded as a dummy variable, where participants who never were in a romantic relationship and those who were in a relationship in the past but not at the moment are grouped into the *single* category (0), while those reporting a current romantic relationship are assigned to the *relationship* category (1).

Relationship Quality. In SELFIE, relationship quality was measured with the relationship assessment scale (RAS; Hendrick, 1988), while a composite of six items was used in SchoCo. In both cases, answers were given on a scale ranging from 1 to 7, with higher values indicating higher relationship quality. Based on a pilot study (for full details, please refer to our preregistration at https://osf.io/xj3ck/?view_only=1319f8b1920d4019a40652ed3ef2924) we identified and selected items of both original studies that were comparable in terms of content and matched them with each other. For example, we matched the items "In general, how satisfied are you with your relationship?" (SELFIE) and "With the relationship to my partner, I am very satisfied" (SchoCo). This procedure resulted in four combined items that we aggregated to a relationship quality score with a total omega of .83.

Positive and Negative Momentary Affect

During the ESM period, momentary affect was measured with twelve items following the form "How [adjective] do you feel right now?". Participants provided their answers to each item on a scale ranging from 0 (*not at all*) to 10 (*very much so*). Momentary *negative affect* was computed as the aggregate of six items measuring how overwhelmed, angry, jittery, disappointed, depressed, and downcast participants felt. Momentary *positive affect* was computed as the aggregate of six items measuring how happy, interested, energetic, relaxed, balanced, and appreciated participants felt. Similar indices have been used in previous research (Geukes et al., 2017; Kuppens et al., 2007; Mueller et al., 2021). Internal consistencies as indicated by total omega were .89 for positive affect and .92 for negative affect.

ESM Characteristics

At each ESM measurement, we assessed a number of additional variables. Whenever participants provided a momentary rating, they were asked whether any other person was present and who this person was. From these answers, we computed two dummy variables: First, *presence of a social interaction partner* was coded as *not present* (0) or *present* (1). Second, *presence of the romantic partner* was dummy-coded as *not present* (0) or *present* (1).

In addition to these social characteristics, we computed two variables indicating temporal characteristics of the ESM. First, the measurement dates that were automatically recorded by formr during the ESM were categorized as either *weekday* (Monday to Friday; coded with 0) or *weekend* (Saturday and Sunday; coded with 1). Second, we computed a time variable that specified the linear progress of the ESM assessments as a number ranging from 1 to 35 corresponding to each of the five measurements per day, which were scheduled for seven days.

Data Analysis

All analyses were conducted in R version 4.0.4 (R Core Team, 2021) using R Studio (RStudio Team, 2021) as well as in Mplus version 8 (Muthén & Muthén, 1998) by means of the *MplusAutomation* package (Hallquist & Wiley, 2018). To test our hypotheses and to answer our explorative research questions regarding the effects of personality and relationship variables on the level and variability of momentary affect, we used *mixed-effects location scale models* (MELSMs; Hedeker et al., 2009; for an application of this approach in studies with a similar design, see Geukes et al., 2017; Kroencke et al., 2020; Rast et al., 2012). Accounting for the nested data structure, models were specified on two levels: Measurement occasions (Level 1) were nested within individuals (Level 2). The MELSM approach has three attractive properties that make it well suited for studying interindividual differences in affect level and variability. First, it allows estimating both the level (represented by the random intercept) and the variability (represented by the random residual variance) of momentary affect within one model. Second, it allows investigating the effects of person-level predictor variables (e.g., neuroticism) on affect level and variability. Finally, the MELSM approach allows controlling for linear trends over time, which are represented by the random slope of the time variable.

We estimated our MELSMs using Bayesian estimation because previous research has illustrated that they outperform the (frequentist) maximum-likelihood approach when the number of momentary measurements is small or varies strongly across participants (van de Schoot et al., 2014). Given that our ESM measurements varied between a minimum of 3 up to 35 assessments, this is the case in our data. Interindividual differences in the number of ESM reports were automatically taken into account by the MELSMs using Bayesian estimation. In

each MELSM, the random effects (i.e., random intercepts, random slopes of time trends, and random residual variances) are assumed to follow a multivariate normal distribution. As further specification, all continuous between-person predictors and the time variable were centered on their respective grand-means (i.e., sample averages).

To address our three research questions, we examined the main and interaction effects of neuroticism and romantic relationships in a set of MELSMs for each of the affect outcomes, momentary negative and positive affect, based on the recommendations of and the Mplus code provided by McNeish (2021). Addressing Research Question 1, in the first set of MELSMs, affect level and variability were regressed on adolescents' neuroticism. This set of MELSMs was run with data of the complete sample. To address the parts of Research Question 2 and 3 that referred to the main and moderated effects of romantic relationship involvement, we extended this first set of MELSMs, such that affect level and variability were regressed on adolescents' neuroticism, their relationship status, the interactions between neuroticism and relationship status.[11] As before, this set of MELSMs was run with data of the complete sample. The last set of MELSMs addressed the parts of Research Question 2 and 3 that referred to the main and moderated effects of relationship quality, instead of relationship status. To this end, we only used the sub-sample of participants who indicated that they were currently involved in a romantic relationship and predicted affect level and variability from adolescents' neuroticism, their relationship quality, the interactions between neuroticism and relationship quality.

As a follow-up, we re-ran all MELSM sets including a number of control variables. At Level 1, models controlled for the presence of a social interaction and weekday vs. weekend. At Level 2, models controlled for age, gender, and sample of the original study. In the third MELSM set that was based on the sub-sample of participants with a romantic partner, presence of the romantic partner was included as an additional control variable at Level 1.

In Mplus, MELSMs were computed using the Bayes estimator with Markov Chain Monte Carlo (MCMC) methods, a default of two chains and Mplus' default diffuse priors (Asparouhov & Muthén, 2010; McNeish, 2021). We evaluated the convergence of our models based on the potential scale reduction factor (PSR; Gelman & Rubin, 1992; Zitzmann & Hecht, 2019) and the inspection of trace and autocorrelation plots. Based on this evaluation, we specified 20,000 iterations per chain for all models, which included a burn-in period of 10,000 iterations. For these specifications, the PSR indicated good convergence for all models, with the maximum values per model ranging from 1.000 to 1.002. The trace and autocorrelation plots

[11] Corresponding mathematical equations of this model set can be found in our preregistration (https://osf.io/kdh7u?view_only=1319f8b1920d4019a40652ed3ef2924d).

illustrated good convergence and mixing, with autocorrelations that were near zero after about 5 to 25 iterations (see the supplemental materials at our OSF page). Throughout this article, we report the medians and 95% credible intervals of the posterior distributions for the parameters of interest, and we regard coefficients as statistically significant if the corresponding 95% credible intervals did not include zero. In addition and as an indicator of effect size, we calculated R^2_{Level} and $R^2_{Variability}$ as the amount of variance of the participants' affect level and variability, respectively, that was explained by all model predictors as compared with a null model (Raudenbush & Bryk, 2002).

Results

Descriptive statistics and intercorrelations of the within- and between-person variables are presented in Tables 1 and 2. As indicated by the intraclass correlation coefficient (ICC), 39% of the variance of positive affect and 43% of the variance in negative affect was on the between-person level. Thus, adolescents systematically differed in their positive and negative affect, but there still was substantial within-person variability. On the within-person level, time was positively related to positive affect and negatively related to negative affect, indicating that adolescents' affect slightly improved across the ESM week on average. In the following, we present the findings of the MELSM sets corresponding to our three research questions. Because, in general, most findings were consistent across models with and without covariates, we focus on the models controlling for presence of a social interaction partner (in general and the romantic partner), weekday vs. weekend, age, gender, and sample of the original study. The full set of results of models excluding control variables can be found in the online Appendix (see the supplemental materials at our OSF page) and all deviations between models with and without covariates are reported within this section.

Table 1

Means, Standard Deviations, and Intercorrelations of Within-Person Variables

Variable	*M*	*SD*	1	2	3	4	5
1. Positive affect	5.67	1.92					
2. Negative affect	2.39	2.09	−.62*				
3. Time	11.23	8.43	.05*	−.05*			
4. Weekend	0.29	0.45	.04*	−.04*	−.00		
5. Social interaction	0.51	0.50	.09*	−.04*	−.12*	−.07*	
6. Social interaction (P)	0.05	0.23	.05*	−.01	.01	.05*	.24*

Note. Intercorrelations are based on N = 8,349 observations nested in 408 individuals. Social interaction (P) = social interaction with the romantic partner. Weekend and social interaction were dummy coded (0 = weekday, 1 = weekend; 0 = no interaction partner present, 1 = interaction partner present). * $p < .05$

Table 2

Means, Standard Deviations, and Intercorrelations of Between-Person Variables

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. Positive affect BP	5.53	1.30										
2. Negative affect BP	2.65	1.49	−.63*									
3. Neuroticism	4.05	1.06	−.51*	.47*								
4. Anxiety	4.40	1.14	−.39*	.41*	.88*							
5. Depression	3.74	1.37	−.57*	.51*	.85*	.65*						
6. Volatility	4.00	1.28	−.30*	.26*	.81*	.60*	.46*					
7. Relationship involvement	0.29	0.45	.01	−.02	.08	.07	.04	.09				
8. Relationship quality	5.88	0.96	.28*	−.23*	−.23*	−.16	−.35*	−.06	NA			
9. Age	16.83	1.41	.09	−.18*	−.12*	−.11*	−.11*	−.08	.21*	−.13		
10. Gender	0.18	0.39	.18*	−.14*	−.33*	−.27*	−.29*	−.27*	−.08	.01	.14*	
11. Sample	0.48	0.50	−.20*	.35*	.16*	.13*	.17*	.11*	−.19*	.14	−.63*	−.16*

Note. Intercorrelations are based on $N = 408$ observations. As an exception, relationship quality ratings and corresponding intercorrelations are based on $N = 117$ observations of individuals with a current romantic relationship. BP = between-person (for each individual, momentary variables were averaged across measurements and then aggregated to a sample mean). Gender, relationship involvement, and sample of the original study were dummy coded (0 = female, 1 = male; 0 = single, 1 = in a current relationship; 0 = SELFIE, 1 = SchoCo). * $p < .05$

The Association Between Neuroticism and Momentary Affect

Our first research question addressed the associations between neuroticism (and its facets) and adolescents' affect level and variability. The corresponding findings of our first set of MELSMs can be found in Table 3. In line with previous research using adult samples, adolescents with higher levels of neuroticism reported lower levels of positive affect and higher levels of negative affect. In addition, adolescents with higher neuroticism displayed higher variability of both positive and negative affect. Across the different models, neuroticism and the covariates explained substantial amounts of variance in both adolescents' affect level and their affect variability. As indicated by R^2_{Level}, the estimated amount of explained between-person variance in affect level ranged from .15 to .38 in the case of positive affect, and from .19 to .36 in the case of negative affect. As indicated by $R^2_{Variability}$, the estimated amount of explained between-person variance in affect variability ranged from .14 to .16 in the case of positive affect, and from .15 to .21 in the case of negative affect. Comparing the findings across the specific measures of momentary affect and to the facet scores of neuroticism, three overall patterns are particularly noteworthy. First, our predictor variables explained more variance in adolescents' affect level compared to their variability. Second, comparing findings regarding adolescents' negative and positive momentary affect, there was little difference with respect to the affect level, but the predictor variables tended to explain more variance in the variability of negative affect compared to the variability of positive affect. Finally, out of the three neuroticism facets, depression explained most between-person variance across all affect measures, while volatility tended to explain the least variance.

Table 3

MELSM Set 1: Momentary Affect Predicted from Neuroticism and Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.55**	[5.37, 5.73]	**5.55**	[5.36, 5.74]	**5.52**	[5.34, 5.69]	**5.54**	[5.34, 5.74]
Affect variability intercept	**0.66**	[0.55, 0.76]	**0.65**	[0.54, 0.76]	**0.66**	[0.56, 0.77]	**0.66**	[0.55, 0.76]
Linear time trend	**0.01**	[0.01, 0.02]	**0.01**	[0.01, 0.02]	**0.01**	[0.00, 0.02]	**0.01**	[0.00, 0.02]
Affect level ←								
Neuroticism (facet)	**−0.58**	[−0.69, −0.47]	**−0.40**	[−0.50, −0.30]	**−0.51**	[−0.58, −0.43]	**−0.26**	[−0.36, −0.17]
Control variables								
Social interaction[a]	**0.26**	[0.19, 0.32]	**0.26**	[0.19, 0.32]	**0.26**	[0.19, 0.32]	**0.26**	[0.19, 0.32]
Weekend[a]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]
Age	−0.07	[−0.16, 0.03]	−0.07	[−0.17, 0.03]	−0.05	[−0.14, 0.04]	−0.06	[−0.16, 0.04]
Gender	0.04	[−0.25, 0.33]	0.23	[−0.07, 0.53]	0.06	[−0.21, 0.33]	0.31	[−0.01, 0.62]
Sample	**−0.34**	[−0.62, −0.07]	**−0.42**	[−0.71, −0.13]	**−0.28**	[−0.55, −0.02]	**−0.44**	[−0.74, −0.14]
Affect variability ←								
Neuroticism (facet)	**0.11**	[0.05, 0.18]	**0.09**	[0.03, 0.15]	**0.08**	[0.03, 0.13]	**0.06**	[0.01, 0.12]
Control variables								
Age	−0.05	[−0.11, 0.01]	−0.05	[−0.11, 0.01]	−0.06	[−0.12, 0.01]	−0.05	[−0.12, 0.01]
Gender	**−0.25**	[−0.42, −0.07]	**−0.28**	[−0.45, −0.10]	**−0.27**	[−0.45, −0.09]	**−0.29**	[−0.47, −0.11]
Sample	0.10	[−0.08, 0.27]	0.11	[−0.07, 0.28]	0.09	[−0.09, 0.26]	0.11	[−0.07, 0.29]
Residual variance								
Affect level	**1.03**	[0.88, 1.21]	**1.17**	[1.00, 1.38]	**0.93**	[0.79, 1.10]	**1.27**	[1.09, 1.50]
Affect variability	**0.31**	[0.26, 0.38]	**0.32**	[0.26, 0.39]	**0.32**	[0.26, 0.39]	**0.32**	[0.26, 0.39]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.31		0.21		0.38		0.15	
$R^2_{Variability}$	0.16		0.14		0.14		0.14	
	DV: Negative Affect							
	Neuroticism		Anxiety		Depression		Volatility	

	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**2.14**	[1.95, 2.34]	**2.14**	[1.94, 2.35]	**2.18**	[1.99, 2.37]	**2.17**	[1.95, 2.39]
Affect variability intercept	**0.49**	[0.34, 0.65]	**0.49**	[0.33, 0.65]	**0.51**	[0.35, 0.67]	**0.51**	[0.35, 0.68]
Linear time trend	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]
Affect level ←								
Neuroticism (facet)	**0.61**	[0.49, 0.73]	**0.47**	[0.36, 0.58]	**0.50**	[0.41, 0.59]	**0.26**	[0.16, 0.37]
Control variables								
social interaction[a]	−0.01	[−0.05, 0.04]	−0.01	[−0.05, 0.04]	−0.01	[−0.05, 0.04]	0.00	[−0.05, 0.04]
weekend[a]	**−0.09**	[−0.14, −0.04]	**−0.09**	[−0.14, −0.04]	**−0.09**	[−0.14, −0.04]	**−0.09**	[−0.14, −0.04]
Age	0.09	[−0.02, 0.20]	0.10	[−0.01, 0.21]	0.08	[−0.03, 0.19]	0.09	[−0.03, 0.20]
Gender	0.18	[−0.15, 0.50]	0.01	[−0.32, 0.34]	0.12	[−0.18, 0.44]	−0.11	[−0.46, 0.24]
Sample	**0.96**	[0.66, 1.27]	**1.03**	[0.71, 1.35]	**0.91**	[0.61, 1.21]	**1.07**	[0.73, 1.40]
Affect variability ←								
Neuroticism (facet)	**0.34**	[0.25, 0.44]	**0.26**	[0.17, 0.35]	**0.26**	[0.19, 0.33]	**0.18**	[0.10, 0.27]
Control variables								
Age	0.00	[−0.09, 0.09]	0.00	[−0.09, 0.09]	−0.01	[−0.1, 0.08]	0.00	[−0.10, 0.09]
Gender	−0.07	[−0.32, 0.19]	−0.16	[−0.42, 0.10]	−0.12	[−0.37, 0.14]	−0.20	[−0.46, 0.06]
Sample	**0.39**	[0.14, 0.64]	**0.43**	[0.17, 0.68]	**0.37**	[0.12, 0.62]	**0.44**	[0.18, 0.70]
Residual variance								
Affect level	**1.31**	[1.12, 1.55]	**1.43**	[1.22, 1.68]	**1.25**	[1.06, 1.47]	**1.58**	[1.35, 1.85]
Affect variability	**0.80**	[0.67, 0.95]	**0.83**	[0.70, 0.99]	**0.80**	[0.68, 0.96]	**0.86**	[0.73, 1.03]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.32		0.26		0.36		0.19	
$R^2_{Variability}$	0.21		0.18		0.21		0.15	

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 8,349 observations nested in 408 individuals. Weekend, social interaction, gender, relationship involvement, and sample of the original study were dummy coded (0 = weekday, 1 = weekend; 0 = no interaction partner present, 1 = interaction partner present; 0 = female, 1 = male; 0 = single, 1 = in a current relationship; 0 = SELFIE, 1 = SchoCo). R^2_{Level} and $R^2_{Variability}$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero. [a]These variables were measured at the within-person level, while all remaining predictors were measured at the between-person level.

Among the covariates included for statistical control, we found a number of additional significant associations with adolescents' momentary affect. At Level 1, the presence of a social interaction partner was associated with higher levels of momentary positive affect, but had no effect on negative affect. Moreover, adolescents' affect appeared to improve on weekends, as indicated by positive effects of weekends vs. weekdays on the level of positive affect and negative effects on the level of negative affect. At Level 2, male participants displayed less variability in positive affect, while there was no gender difference with respect to adolescents' affect level or their variability of negative affect. Finally, we found sample effects, such that participants of the SchoCo study showed lower levels of positive affect, higher levels of negative affect, and higher variability of negative affect.

Altogether, neuroticism related to interindividual differences in both adolescents' affect level and affect variability and these associations remained robust when controlling for covariates. Moreover, analyses revealed that the strength of these effects differed across the considered momentary affect variables (i.e., affect level vs. affect variability), across the measures of momentary affect (i.e., positive vs. negative affect), and across the neuroticism facets (i.e., anxiety, depression, and volatility).

The Role of Romantic Relationship Involvement

In our second and third research question, we aimed at investigating the role of romantic relationship involvement for interindividual differences in adolescents' momentary affect. Accordingly, we extended our first model set and entered romantic relationship involvement and its interaction with neuroticism as additional predictors. The results of this second set of MELSMs can be found in Table 4. After including romantic relationship involvement and the interaction term to our models, all effects of neuroticism and its facets were in line with the first model set.

Table 4

MELSM Set 2: Momentary Affect Predicted from Neuroticism, Relationship Involvement, and Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.52**	[5.33, 5.73]	**5.53**	[5.32, 5.75]	**5.51**	[5.32, 5.70]	**5.53**	[5.31, 5.75]
Affect variability intercept	**0.60**	[0.48, 0.73]	**0.60**	[0.48, 0.72]	**0.61**	[0.49, 0.73]	**0.60**	[0.48, 0.72]
Linear time trend	**0.01**	[0.00, 0.02]	**0.01**	[0.00, 0.02]	**0.01**	[0.00, 0.02]	**0.01**	[0.00, 0.02]
Affect level ←								
Neuroticism (facet)	**−0.54**	[−0.67, −0.42]	**−0.36**	[−0.48, −0.24]	**-0.48**	[-0.57, -0.38]	**-0.23**	[-0.35, -0.12]
Relationship involvement	0.07	[−0.18, 0.31]	0.03	[−0.22, 0.29]	0.02	[-0.21, 0.25]	0.02	[-0.24, 0.29]
Neuroticism × relationship involvement	−0.12	[−0.34, 0.09]	−0.14	[−0.36, 0.08]	-0.10	[-0.26, 0.06]	-0.09	[-0.28, 0.11]
Control variables								
Social interaction[a]	**0.25**	[0.19, 0.32]	**0.26**	[0.19, 0.32]	**0.26**	[0.19, 0.32]	**0.25**	[0.19, 0.32]
Weekend[a]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]	**0.13**	[0.07, 0.20]
Age	−0.06	[−0.16, 0.04]	−0.06	[−0.17, 0.04]	-0.05	[-0.15, 0.04]	-0.05	[-0.16, 0.06]
Gender	0.05	[−0.24, 0.34]	0.22	[−0.07, 0.53]	0.06	[-0.21, 0.33]	**0.31**	[0.00, 0.62]
Sample	**−0.32**	[−0.60, −0.04]	**−0.39**	[−0.69, −0.10]	**-0.27**	[-0.54, -0.01]	**-0.42**	[-0.73, -0.11]
Affect variability ←								
Neuroticism (facet)	**0.12**	[0.04, 0.20]	**0.09**	[0.02, 0.16]	**0.08**	[0.02, 0.14]	**0.07**	[0.01, 0.14]
Relationship involvement	0.14	[−0.01, 0.29]	0.14	[−0.01, 0.30]	0.15	[-0.01, 0.30]	**0.15**	[0.00, 0.30]
Neuroticism × relationship involvement	−0.04	[−0.17, 0.10]	−0.01	[−0.14, 0.12]	-0.01	[-0.12, 0.09]	-0.05	[-0.16, 0.06]
Control variables								
Age	−0.06	[−0.12, 0.01]	−0.06	[−0.12, 0.01]	-0.06	[-0.13, 0.00]	-0.06	[-0.12, 0.01]
Gender	**−0.24**	[−0.42, −0.05]	**−0.26**	[−0.44, −0.08]	**-0.26**	[-0.43, -0.07]	**-0.27**	[-0.45, -0.09]
Sample	0.12	[−0.06, 0.30]	0.13	[−0.05, 0.31]	0.11	[-0.07, 0.28]	0.14	[-0.04, 0.32]
Residual variance								
Affect level	**1.03**	[0.88, 1.22]	**1.18**	[1.00, 1.38]	**0.93**	[0.79, 1.10]	**1.28**	[1.10, 1.50]
Affect variability	**0.31**	[0.26, 0.38]	**0.32**	[0.26, 0.39]	**0.31**	[0.25, 0.38]	**0.32**	[0.26, 0.39]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.31		0.21		0.38		0.14	

$R^2_{Variability}$	0.16		0.14		0.16		0.14	
	DV: Negative Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**2.13**	[1.91, 2.36]	**2.12**	[1.89, 2.35]	**2.15**	[1.94, 2.37]	**2.13**	[1.89, 2.37]
Affect variability intercept	**0.41**	[0.24, 0.59]	**0.41**	[0.23, 0.59]	**0.43**	[0.25, 0.60]	**0.41**	[0.23, 0.59]
Linear time trend	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**-0.01**	[-0.01, 0.00]	**-0.01**	[-0.01, 0.00]
Affect level ←								
Neuroticism (facet)	**0.64**	[0.50, 0.78]	**0.49**	[0.36, 0.62]	**0.52**	[0.41, 0.62]	**0.27**	[0.14, 0.40]
Relationship involvement	0.02	[−0.25, 0.29]	0.05	[−0.23, 0.33]	0.06	[-0.2, 0.33]	0.06	[-0.23, 0.36]
Neuroticism × relationship involvement	−0.10	[−0.35, 0.14]	−0.09	[−0.34, 0.15]	-0.05	[-0.24, 0.13]	-0.02	[-0.24, 0.20]
Control variables								
Social interaction[a]	−0.01	[−0.05, 0.04]	−0.01	[−0.05, 0.04]	-0.01	[-0.05, 0.04]	0.00	[-0.05, 0.04]
Weekend[a]	**−0.09**	[−0.14, −0.04]	**−0.09**	[−0.14, −0.04]	**-0.09**	[-0.14, -0.04]	**-0.09**	[-0.14, -0.04]
Age	0.10	[−0.01, 0.21]	0.10	[−0.01, 0.22]	0.08	[-0.03, 0.19]	0.09	[-0.04, 0.21]
Gender	0.18	[−0.15, 0.50]	0.01	[−0.32, 0.34]	0.13	[-0.18, 0.44]	-0.10	[-0.46, 0.25]
Sample	**0.98**	[0.67, 1.30]	**1.05**	[0.72, 1.38]	**0.92**	[0.62, 1.23]	**1.08**	[0.74, 1.43]
Affect variability ←								
Neuroticism (facet)	**0.38**	[0.26, 0.49]	**0.28**	[0.18, 0.39]	**0.29**	[0.21, 0.38]	**0.18**	[0.08, 0.28]
Relationship involvement	**0.22**	[0.00, 0.43]	**0.23**	[0.01, 0.45]	**0.24**	[0.02, 0.46]	**0.23**	[0.00, 0.46]
Neuroticism × relationship involvement	−0.12	[−0.31, 0.08]	−0.10	[−0.29, 0.09]	-0.11	[-0.26, 0.04]	-0.01	[-0.17, 0.16]
Control variables								
Age	−0.01	[−0.1, 0.08]	0.00	[−0.10, 0.09]	-0.02	[-0.11, 0.07]	-0.01	[-0.11, 0.08]
Gender	−0.05	[−0.31, 0.21]	−0.14	[−0.40, 0.12]	-0.10	[-0.35, 0.16]	-0.18	[-0.44, 0.09]
Sample	**0.43**	[0.17, 0.68]	**0.47**	[0.21, 0.72]	**0.40**	[0.15, 0.66]	**0.47**	[0.21, 0.74]
Residual variance								
Affect level	**1.31**	[1.12, 1.54]	**1.43**	[1.22, 1.68]	**1.25**	[1.06, 1.47]	**1.58**	[1.35, 1.86]
Affect variability	**0.79**	[0.66, 0.94]	**0.83**	[0.70, 0.98]	**0.79**	[0.67, 0.94]	**0.86**	[0.73, 1.02]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.32		0.26		0.36		0.19	
$R^2_{Variability}$	0.22		0.18		0.22		0.15	

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 8,349 observations nested in 408 individuals. Weekend, social interaction, gender, relationship involvement, and sample of the original study were dummy coded (0 = weekday, 1 = weekend; 0 = no interaction partner present, 1 = interaction partner present; 0 = female, 1 = male; 0 = single, 1 = in a current relationship; 0 = SELFIE, 1 = SchoCo). R_{Level}^2 and $R_{Variability}^2$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero. [a]These variables were measured at the within-person level, while all remaining predictors were measured at the between-person level.

Corresponding to our second research question regarding the main effect of romantic relationship involvement, we did not find any differences in the level of momentary positive and negative affect between adolescents in romantic relationships and their single peers. Looking at affect variability, in contrast, our findings indicated that being in a romantic relationship was associated with higher variability of negative affect. While adolescents in a romantic relationship also tended to experience higher variability of positive affect, this effect was only significant in the model predicting momentary affect from volatility. Overall, it should be noted, that evidence for the association between romantic relationship involvement and higher affect variability was only weak: First, across models, lower bounds of the 95% credible intervals of the estimated effect sizes were zero or close to zero. In the models without control variables, zero was even included in all corresponding 95% credible intervals (see Table A2). Second, compared to our first set of MELSMs, additionally including romantic relationship involvement as a predictor of adolescents' momentary affect level and variability did not increase the amount of explained variance as indicated by the models' R^2_{Level} and $R^2_{Variability}$.

Corresponding to our third research question, we found no evidence for interaction effects between neuroticism and relationship involvement across all neuroticism facets and momentary affect measures. Accordingly, neuroticism did not moderate the association between relationship involvement and adolescents' level or variability of positive and negative affect.

Sub-Sample Analysis: The Role of Relationship Quality

In addition to the role of romantic relationship involvement, our second and third research question also addressed the role of relationship quality for interindividual differences in momentary affect among those adolescents who were currently involved in a romantic relationship. The results of this third set of MELSMs, using only the sub-sample of adolescents with a current romantic partner, can be found in Table 5. In line with the analyses based on the entire sample, we found that neuroticism and its facets negatively related to the level of positive affect and positively related to both the level of negative affect as well as the variability of negative affect. In contrast to the findings obtained in the entire sample, results of the sub-sample analysis illustrated no significant effect of neuroticism on the variability in positive affect anymore.

Table 5

MELSM Set 3: Momentary Affect Predicted from Neuroticism, Relationship Quality, and Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.58**	[5.30, 5.87]	**5.55**	[5.25, 5.86]	**5.57**	[5.30, 5.85]	**5.57**	[5.26, 5.89]
Affect variability intercept	**0.86**	[0.70, 1.00]	**0.82**	[0.67, 0.97]	**0.85**	[0.69, 1.00]	**0.84**	[0.69, 0.99]
Linear time trend	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]
Affect level ←								
Neuroticism (facet)	**−0.62**	[−0.81, −0.43]	**−0.44**	[−0.64, −0.25]	**−0.57**	[−0.71, −0.42]	**−0.26**	[−0.42, −0.11]
Relationship quality	0.14	[−0.07, 0.35]	**0.26**	[0.04, 0.48]	0.02	[−0.20, 0.24]	**0.31**	[0.10, 0.53]
Neuroticism × relationship quality	0.11	[−0.05, 0.28]	0.07	[−0.11, 0.25]	0.03	[−0.10, 0.16]	0.14	[0.00, 0.28]
Control variables								
Social interaction[a]	**0.21**	[0.08, 0.34]	**0.22**	[0.09, 0.35]	**0.22**	[0.09, 0.35]	**0.22**	[0.09, 0.35]
Social interaction (p)[a]	**0.33**	[0.15, 0.51]	**0.32**	[0.15, 0.51]	**0.32**	[0.15, 0.50]	**0.32**	[0.14, 0.50]
Weekend[a]	**0.20**	[0.07, 0.33]	**0.19**	[0.07, 0.32]	**0.20**	[0.07, 0.33]	**0.20**	[0.07, 0.32]
Age	−0.04	[−0.21, 0.12]	−0.04	[−0.23, 0.14]	−0.10	[−0.25, 0.06]	−0.05	[−0.24, 0.14]
Gender	0.03	[−0.52, 0.58]	0.23	[−0.37, 0.82]	0.00	[−0.52, 0.51]	0.50	[−0.09, 1.08]
Sample	−0.34	[−0.82, 0.14]	−0.46	[−0.98, 0.06]	−0.35	[−0.79, 0.10]	**−0.66**	[−1.19, −0.13]
Affect variability ←								
Neuroticism (facet)	0.08	[−0.02, 0.19]	0.09	[−0.01, 0.19]	0.06	[−0.03, 0.14]	0.04	[−0.03, 0.12]
Relationship quality	**−0.11**	[−0.23, 0.00]	−0.08	[−0.20, 0.03]	−0.12	[−0.25, 0.02]	−0.10	[−0.20, 0.02]
Neuroticism × relationship quality	**0.15**	[0.06, 0.25]	**0.11**	[0.01, 0.20]	**0.11**	[0.02, 0.18]	**0.11**	[0.04, 0.19]
Control variables								
Age	**−0.13**	[−0.22, −0.03]	**−0.12**	[−0.22, −0.03]	**−0.11**	[−0.2, −0.01]	**−0.14**	[−0.24, −0.04]
Gender	−0.30	[−0.6, 0.01]	−0.27	[−0.58, 0.05]	**−0.32**	[−0.63, −0.01]	**−0.32**	[−0.61, −0.02]
Sample	−0.01	[−0.28, 0.28]	0.03	[−0.25, 0.32]	0.07	[−0.20, 0.35]	−0.02	[−0.30, 0.27]
Residual variance								
Affect level	**0.77**	[0.57, 1.07]	**0.94**	[0.69, 1.30]	**0.67**	[0.49, 0.95]	**0.99**	[0.73, 1.36]
Affect variability	**0.17**	[0.10, 0.26]	**0.18**	[0.11, 0.28]	**0.17**	[0.11, 0.27]	**0.17**	[0.11, 0.27]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								

R^2_{Level}	0.46	0.34	0.53	0.30
$R^2_{Variability}$	0.26	0.22	0.26	0.26

	DV: Negative Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**2.18**	[1.85, 2.51]	**2.20**	[1.86, 2.55]	**2.20**	[1.87, 2.53]	**2.16**	[1.82, 2.51]
Affect variability intercept	**0.71**	[0.45, 0.96]	**0.69**	[0.43, 0.94]	**0.70**	[0.44, 0.96]	**0.69**	[0.44, 0.94]
Linear time trend	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]
Affect level ←								
Neuroticism (facet)	**0.47**	[0.25, 0.70]	**0.34**	[0.12, 0.56]	**0.43**	[0.25, 0.60]	**0.19**	[0.02, 0.36]
Relationship quality	−0.22	[−0.46, 0.02]	**−0.32**	[−0.56, −0.07]	−0.16	[−0.42, 0.11]	**−0.34**	[−0.58, −0.11]
Neuroticism × relationship quality	−0.10	[−0.30, 0.09]	−0.06	[−0.27, 0.14]	−0.01	[−0.17, 0.14]	−0.16	[−0.32, −0.01]
Control variables								
Social interaction[a]	−0.05	[−0.16, 0.06]	−0.05	[−0.16, 0.06]	−0.05	[−0.16, 0.06]	−0.05	[−0.16, 0.06]
Social interaction (p)[a]	−0.06	[−0.20, 0.09]	−0.06	[−0.21, 0.09]	−0.06	[−0.20, 0.09]	−0.06	[−0.20, 0.09]
Weekend[a]	−0.07	[−0.18, 0.04]	−0.07	[−0.18, 0.04]	−0.07	[−0.18, 0.04]	−0.07	[−0.18, 0.03]
Age	0.10	[−0.10, 0.30]	0.10	[−0.11, 0.31]	0.14	[−0.06, 0.33]	0.12	[−0.09, 0.34]
Gender	0.11	[−0.54, 0.76]	−0.05	[−0.73, 0.64]	0.11	[−0.53, 0.75]	−0.26	[−0.90, 0.39]
Sample	**0.91**	[0.34, 1.48]	**1.00**	[0.42, 1.59]	**0.92**	[0.38, 1.47]	**1.22**	[0.63, 1.82]
Affect variability ←								
Neuroticism (facet)	**0.29**	[0.12, 0.46]	**0.21**	[0.05, 0.38]	**0.19**	[0.06, 0.32]	**0.19**	[0.06, 0.32]
Relationship quality	−0.09	[−0.27, 0.10]	−0.11	[−0.29, 0.08]	−0.07	[−0.28, 0.14]	−0.12	[−0.30, 0.06]
Neuroticism × relationship quality	0.10	[−0.04, 0.25]	0.09	[−0.07, 0.24]	0.08	[−0.05, 0.20]	0.06	[−0.05, 0.18]
Control variables								
Age	−0.04	[−0.20, 0.12]	−0.03	[−0.18, 0.13]	0.00	[−0.16, 0.15]	−0.05	[−0.21, 0.11]
Gender	0.08	[−0.42, 0.6]	0.02	[−0.50, 0.54]	0.00	[−0.52, 0.53]	−0.05	[−0.54, 0.44]
Sample	0.24	[−0.19, 0.69]	0.32	[−0.11, 0.78]	0.36	[−0.06, 0.81]	0.29	[−0.16, 0.75]
Residual variance								
Affect level	**1.08**	[0.78, 1.51]	**1.20**	[0.88, 1.66]	**1.03**	[0.75, 1.45]	**1.19**	[0.87, 1.66]
Affect variability	**0.61**	[0.43, 0.86]	**0.64**	[0.46, 0.91]	**0.63**	[0.45, 0.90]	**0.64**	[0.46, 0.90]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.35		0.28		0.38		0.29	

$R^2_{Variability}$	0.16	0.12	0.14	0.12

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 2,589 observations nested in 117 individuals. Weekend, social interaction, gender, relationship involvement, and sample of the original study were dummy coded (0 = weekday, 1 = weekend; 0 = no interaction partner present, 1 = interaction partner present; 0 = female, 1 = male; 0 = single, 1 = in a current relationship; 0 = SELFIE, 1 = SchoCo). R^2_{Level} and $R_{\text{Variability}^2}$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero. [a]These variables were measured at the within-person level, while all remaining predictors were measured at the between-person level.

Furthermore, the subsample analysis revealed a number of relationship quality effects: First, and corresponding to our second research question, we found that higher relationship quality was related to higher levels of positive and lower levels of negative momentary affect in the models predicting momentary affect from the neuroticism facets anxiety and volatility. In contrast, relationship quality was no significant predictor of adolescents' level of momentary affect when concurrently considering depression or the overall score of neuroticism. Second, also corresponding to our second research question, higher relationship quality tended to relate to lower levels of affect variability. This effect, however, was only significant in the model predicting the variability of momentary positive affect from the overall score of neuroticism, and it only occurred when controlling for all covariates (see Table A3). Although the coefficients for the associations between relationship quality and adolescents' variability of both positive and negative affect were also slightly negative in all other models, the corresponding 95% credible intervals consistently included zero. Third, and corresponding to our third research question, we found a positive interaction effect between neuroticism and relationship quality on adolescents' variability of positive affect across all models. Thus, although neuroticism and relationship quality mainly did not show significant main effects on positive affect variability, adolescents reporting both higher neuroticism and higher relationship quality also reported more variability in momentary positive affect.

Looking at the amount of explained variance, the consideration of relationship quality as predictor explained a substantial amount of variance together with neuroticism and covariates within our sub-sample. As indicated by R^2_{Level}, the estimated amount of explained between-person variance in affect level ranged from .30 to .53 in the case of positive affect and from .28 to .38 in the case of negative affect. As indicated by $R^2_{Variability}$, the estimated amount of explained between-person variance in affect variability ranged from .22 to .26 in the case of positive affect and from .12 to .16 in the case of negative affect. In line with the analyses with the complete sample, the predictor variables explained more variance in adolescents' affect level than in their affect variability. Moreover, depression again appeared to be the strongest predictor of adolescents' momentary positive affect among the neuroticism facets. In contrast to the analyses with the complete sample, the consideration of relationship quality as additional predictor variable in the subsample analysis explained more variance in positive affect than negative affect. Generally, covariates displayed consistent effects across our three MELSM sets.

Discussion

The current study is the first to investigate the combined effects of neuroticism and romantic relationship variables on affect level and affect variability. Analyzing extensive ESM data of adolescents' positive and negative momentary affect, our results revealed four main findings: First, adolescents with higher neuroticism experienced lower levels of positive affect, higher levels of negative affect, as well as higher variability of both positive and negative affect. Second, in addition to these personality effects, being in a romantic relationship was not systematically related to interindividual differences in affect level, but related to higher affect variability, although evidence for these effects was only weak. Third, among participants with a current romantic partner, our findings pointed to an interaction effect, such that adolescents with higher relationship quality experienced more variability in their positive affect if they scored higher in neuroticism. Finally, as an overarching pattern, we found that effect sizes differed between affect level and variability, positive and negative affect, as well as neuroticism facets. Below, we discuss these findings together with their theoretical implications and directions for future investigations in more detail.

Neuroticism Effects on Adolescents' Affect Level and Variability

Regarding our first major aim, findings on the association between neuroticism and momentary affect were mainly consistent with previous studies, which were based on adult samples (Eid & Diener, 1999; Geukes et al., 2017; Kuppens et al., 2007; Miller et al., 2009). Thus, our study adds to the evidence that neuroticism relates to interindividual differences in both a person's affect level and variability and that these relationships generalize to adolescence (also see Borghuis et al., 2020; Reitsema et al., 2022). Given that neuroticism has been found to temporarily increase during adolescence (e.g. Aldinger et al., 2014; Borghuis et al., 2017; c.f. Göllner et al., 2017), these links between the trait and momentary affect seem to be particularly important for this age group. Specifically, increases in neuroticism might explain why many adolescents experience more negative and more variable affect in their daily lives compared to younger children or adults (Bailen et al., 2019; Larson & Sheeber, 2008).

Moreover, our results refine this picture in several important ways: First, neuroticism generally explained more variance in adolescents' affect level compared to their affect variability. This is consistent with current discussions emphasizing that the association between the trait and affect level is well-established, whereas its link with higher affect variability is more controversial (Hisler et al., 2020; Wenzel & Kubiak, 2020). Potentially, the measurement of affect variability is less reliable, as it has been discussed to be more prone to other influences, such as the applied analytical method (Wenzel et al., 2022). Second, in the analyses with the

complete sample, neuroticism explained more variance in the variability of negative affect compared to the variability of positive affect. While this finding is in line with the definition of neuroticism, which emphasizes the trait's relevance for experiencing and handling stress (Barlow et al., 2014; Soto & John, 2017), it also highlights the relevance of differentiating between the constructs of positive and negative affect (Watson & Clark, 1997). Third, out of the three neuroticism facets measured in this study, depression seemed to be most closely linked to adolescents' affect level and variability. Being more or less volatile, in contrast, had the smallest effects. Whereas the findings with regard to affect level are in line with the construct definitions of depression and volatility (Soto & John, 2017), the comparably weak association between volatility and affect variability is rather surprising, since these concepts are closely related. Consistent with our results, Kroencke et al. (2020) similarly found only a weak association between volatility and variability of negative affect in an adult sample. Taken together, these findings raise the question of what the measured volatility facet, based on the BFI-2, captures (Danner et al., 2019; Soto & John, 2017). As one possibility, it might only capture the variability of more specific types of momentary affect (e.g., anger), which were not reflected in our indices of positive and negative affect. As a second possibility, people might have only limited insights into the variability of their own affect, resulting in reduced validity of self-reported trait volatility in general. To clarify these questions, future research should focus on the measurement of volatility and its role for momentary affect.

Distinct Patterns of Romantic Relationship Involvement and Quality

The second major aim of this study was a better understanding of how romantic relationship variables contribute to adolescents' affective experiences. Looking at romantic relationship involvement and relationship quality, two distinct patterns emerged. First, whereas relationship involvement showed no effect on adolescents' affect level, it was associated with interindividual differences in affect variability. In line with the findings by Larson et al. (1980), adolescents with a romantic partner reported higher affect variability than their single peers. Refining this picture, our results indicated that this association mainly pertained to the variability of negative affect, while it was less pronounced regarding the variability of momentary positive affect. The experience of being involved in a romantic relationship thus seems to contribute to interindividual differences in adolescents' affect variability beyond the effects of neuroticism. At the same time, the effect sizes of romantic relationship involvement obtained in our study were only small and, in the case of variability of positive affect, partly not significant. This way, our results suggest that the contribution of neuroticism might be more relevant for adolescents' momentary affective experiences. Nonetheless, romantic relationship involvement

might be relevant for adolescents' affective lives on a larger time-scale, such that they contribute to the development of their emotional capacities by broadening the spectrum of daily affect (see Furman et al., 2008; Rosenblum & Lewis, 2003). To examine this possibility, studies combining several ESM phases and follow-up assessments across years are required (see Borghuis et al., 2020; Mueller et al., 2021).

Second, and in line with research on broader affective outcomes (Demir, 2008; Mirsu-Paun & Oliver, 2017), perceived relationship quality with current romantic partners was associated with interindividual differences in the level of adolescents' momentary affect beyond the effects of anxiety and volatility. Specifically, adolescents who evaluated their romantic relationship more positively also experienced higher levels of positive affect and lower levels of negative affect. When simultaneously considering the effects of depression, both as facet score but also within the overall score of neuroticism, these effects were similar in size but not statistically significant. Accordingly, whether adolescents were more or less depressed appeared to be more relevant for their affect level than the quality of their romantic relationship. With regard to the variability of adolescents' momentary affect, we had hypothesized a mitigating effect of higher relationship quality. On a descriptive level, relationship quality and affect variability were indeed negatively associated, yet this link was only significant when predicting the variability of momentary positive affect from the overall score of neuroticism. Thus, contrary to our expectation, relationship quality and affect variability were not meaningfully related in our adolescent sample. Alternatively, this finding might reflect a ceiling effect: On average, adolescents in our sample reported high levels of relationship quality, indicating that most of them were generally satisfied with their romantic relationship. As a consequence, stressful events such as relationship conflicts that might have provoked higher affect variability (see Galliher et al., 2004; Laursen, 1995), were probably very rare during the ESM week. To examine this possibility, future research should track momentary affect in adolescent samples with more diverse levels of relationship quality and across several weeks.

The Interplay of Neuroticism and Romantic Relationships

Going beyond the main effects of neuroticism and romantic relationship variables, we were further interested in their interplay in our third research question. Based on personality theory (Denissen & Penke, 2008b; Holmes, 2002) and empirical findings on reactivity to social cues (Denissen & Penke, 2008a; Mueller et al., 2019), we expected stronger relationship effects in adolescents with higher levels of neuroticism. With regard to neuroticism and romantic relationship involvement, we found no evidence for such moderating effects. Thus, the role of having a romantic partner for adolescents' affective experiences did not differ between individuals

with lower and higher neuroticism. Among adolescents with a current romantic partner, however, we consistently found that individuals with higher neuroticism and with higher relationship quality experienced more variability in positive affect in their daily life if they scored higher in neuroticism.

The positive interaction between neuroticism and relationship quality can be interpreted in at least two ways. First and despite the lack of significance in main effects, higher relationship quality tended to go along with a reduced degree of variability in adolescents' momentary positive affect in our models. The interaction effect suggests that this effect might be attenuated or even reversed for adolescents with higher neuroticism, such that the positive affect of individuals with (very) high trait levels fluctuates strongly even if the quality of their romantic relationship is high. Whereas this interpretation converges with the canon of literature emphasizing affective instability as a core component of neuroticism (e.g., Barlow et al., 2014; Denissen & Penke, 2008b), it leaves open why we found no corresponding interaction effect with regard to negative affect. Second, our findings can be considered in the context of previous research highlighting that neuroticism might act as a potential resource in social relationships through heightened sensitivity to positive social cues (Lay & Hoppmann, 2014; Mueller et al., 2021). Along these lines, the positive interaction between neuroticism and relationship quality might reflect that adolescents with higher levels in neuroticism are more sensitive to positive situations in their romantic relationship and therefore experience more variability in their positive affect. This interpretation is further strengthened by the fact that no corresponding effects were found with regard to the variability of negative affect. Whereas previous studies (e.g., Mueller et al., 2021) have focused on aging couples, our study provides initial evidence for a beneficial role of neuroticism in adolescent romantic relationships.

In addition to these interpretations, we would like to highlight that the interaction between neuroticism and relationship quality contrasts with the lack of evidence for an interaction between neuroticism and relationship involvement. Together, these findings suggest that the moderating effect of neuroticism on the association between social relationships and momentary affect might primarily apply to social cues with a certain valence (i.e., positive or negative; see Denissen & Penke, 2008a; Mueller et al., 2019), but not to broader social features, such as having a certain type of relationship or not.

With regard to the amount of variance explained in affect variability, our results converge with extant work indicating that personality primarily relates to interindividual differences in the variability of momentary negative affect (Eid & Diener, 1999). Extending this previous finding, our study illustrated that accounting for social relationship features and their

interaction with personality might explain similar amounts of variance in the variability of positive affect. Specifically, positive affect variability was predicted by their interaction and not the independent effects of neuroticism and relationship quality. Accordingly, the variability of positive affect might be better understood by the conjoint consideration of personality and social relationship variables.

Limitations and Future Directions

Although the current study possessed several strengths, such as the use of ESM data from two adolescent samples and up-to-date statistical methods, it also had a number of limitations that need to be considered. First, the correlational design of our study does not allow for causal interpretations. Despite measuring neuroticism and romantic relationship variables earlier than momentary affect and controlling for a number of potential individual and situational confounders, we cannot exclude that the association between predictor and outcome variable was mediated by other (unobserved) variables or driven by selection effects.

Second, our power was limited to detect small effects. This was especially critical with regard to our smaller sub-sample of participants with a current romantic partner. Therefore, these findings need to be interpreted with caution and require replication in larger samples including a greater number of adolescents who are currently involved in a romantic relationship. As another limitation pertaining to our sample, our participants were relatively homogeneous with regard to gender (over 80% female) and educational background (over 80% on the highest school track) despite stemming from two different original studies. In the future, studies using more diverse samples are required to test whether our findings generalize to other groups of adolescents.

Fourth, the BFI-2 (Soto & John, 2017) might have been too broad to adequately measure the neuroticism facets that were relevant to our research questions. Although our findings point to the specific relevance of depression for adolescents' momentary affect, a more nuanced personality questionnaire, such as the NEO-PI-R (Costa & McCrae, 1992) might help to further differentiate between the components of neuroticism contributing to interindividual differences in affect level and affect variability. For example, further distinguishing between the facets anger/hostility, impulsiveness, and vulnerability to stress might be more informative than the relatively broad construct volatility (Soto & John, 2017) for explaining interindividual differences in affect variability.

Finally, it is noteworthy to mention that – besides the effects of neuroticism and romantic relationship variables – we found some differences between participants of our two original study samples, such that adolescents from the SchoCo study reported lower levels of positive

affect, higher levels of negative affect, and higher variability of negative affect. Since data collection of the SchoCo study took place during the COVID-19 pandemic, this might be interpreted as heightened stress that participants experienced during this time (e.g., Magson et al., 2021). Whereas we controlled for these effect in our statistical models, it highlights the potential relevance of the historical/sociological context and points to possibilities for future research of including environmental predictors of momentary affect in addition to personality and relationship variables.

There are several opportunities of extending the present study. With regard to personality traits, we focused on neuroticism as the "most affective" of the Big Five traits (Barlow et al., 2014; McCrae & Costa, 1989) and the trait with the strongest theoretically derived predictions regarding interactions with social relationships (Denissen & Penke, 2008b). Nonetheless, other Big Five traits might also be relevant for adolescents' level and variability of momentary affect. Accordingly, future studies should explore the role of the remaining Big Five personality traits for adolescents' momentary affect in social and nonsocial contexts. With regard to the variability of positive and negative momentary affect, we focused on variability across situations as adolescents' general tendency to fluctuate in their affect. Future studies could extend our approach by differentiating between affect variability across versus within certain types of situations (Geukes et al., 2017). Specifically, Geukes et al. distinguish the three processes *inconsistency* (i.e., internal sources of variation that are independent of external cues), *responsiveness* (i.e., flexible responses to the unique situational characteristics, and (c) *rigidity* (i.e., consistent reactions). For example, neuroticism might be associated with higher inconsistency of affect within all types of situations. Being involved in a romantic relationship, in contrast, might be associated with especially strong affective responsiveness when adolescents interact with or think about their romantic partner, but less so in other situations such as training with their sports team or studying for school. This way, future research could help to further disentangle adaptive and maladaptive forms of affect variability. Given that such analyses require the distinction of at least three different contexts and, within each context, at least three momentary affect measurements per participant, the data of the present study was not suited to answer such questions. Future research could therefore extend ESM periods to more days and should invest in more differentiated assessments of the situational context.

Conclusion

The current research aimed at bridging personality and social relationship research by jointly investigating the role of neuroticism and romantic relationship variables for both adolescents' level and variability of momentary affect. Findings indicated that neuroticism, and

especially its facet depression, was associated with lower levels of positive affect, higher levels of negative affect, and higher variability of both positive and negative affect. Whereas personality effects were generally more pronounced than romantic relationship effects, romantic relationship involvement related to higher affect variability and higher relationship quality related to higher levels of positive affect as well as lower levels of negative affect. Examining the joint role of personality and romantic relationships, we found that adolescents who reported higher levels of both neuroticism and relationship quality experienced higher variability in their positive affect. Our results highlight the relevance of differentiating between affect level and affect variability as well as positive and negative affect and between personality facets. Moreover, they call for future research that relates the level and variability of momentary affect to the affective long-term development in adolescence.

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Online Appendix

Table A1

MELSM Set 1: Momentary Affect Predicted from Neuroticism Without Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.57**	[5.46, 5.68]	**5.57**	[5.45, 5.68]	**5.56**	[5.46, 5.67]	**5.57**	[5.44, 5.69]
Affect variability intercept	**0.65**	[0.58, 0.72]	**0.65**	[0.58, 0.72]	**0.65**	[0.58, 0.72]	**0.65**	[0.58, 0.72]
Linear time trend	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]
Affect level ← Neuroticism	**−0.60**	[−0.70, −0.50]	**−0.43**	[−0.53, −0.33]	**−0.52**	[−0.60, −0.45]	**−0.30**	[−0.39, −0.21]
Affect variability ← Neuroticism	**0.16**	[0.10, 0.23]	**0.13**	[0.07, 0.19]	**0.12**	[0.06, 0.17]	**0.10**	[0.05, 0.15]
Residual variance								
Affect level	**1.06**	[0.91, 1.26]	**1.23**	[1.05, 1.45]	**0.96**	[0.82, 1.13]	**1.34**	[1.15, 1.58]
Affect variability	**0.34**	[0.28, 0.41]	**0.35**	[0.28, 0.42]	**0.34**	[0.28, 0.42]	**0.35**	[0.29, 0.43]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.29		0.17		0.36		0.10	
$R^2_{Variability}$	0.08		0.05		0.08		0.05	
	DV: Negative Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**2.59**	[2.46, 2.72]	**2.59**	[2.46, 2.72]	**2.59**	[2.47, 2.72]	**2.60**	[2.46, 2.73]
Affect variability intercept	**0.66**	[0.56, 0.76]	**0.66**	[0.56, 0.76]	**0.66**	[0.56, 0.76]	**0.66**	[0.56, 0.77]
Linear time trend	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]
Affect level ← Neuroticism	**0.64**	[0.53, 0.76]	**0.51**	[0.40, 0.62]	**0.54**	[0.45, 0.63]	**0.31**	[0.20, 0.42]
Affect variability ← Neuroticism	**0.39**	[0.29, 0.48]	**0.30**	[0.22, 0.39]	**0.30**	[0.22, 0.37]	**0.22**	[0.14, 0.30]
Residual variance								
Affect level	**1.47**	[1.25, 1.73]	**1.60**	[1.37, 1.88]	**1.38**	[1.18, 1.63]	**1.79**	[1.53, 2.10]
Affect variability	**0.84**	[0.71, 0.99]	**0.88**	[0.75, 1.05]	**0.84**	[0.71, 1.00]	**0.93**	[0.78, 1.10]

Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.24		0.18		0.29		0.08	
$R^2_{Variability}$	0.17		0.13		0.17		0.08	

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 8,349 observations nested in 408 individuals. R^2_{Level} and $R_{\text{Variability}}{}^2$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero.

Table A2

MELSM Set 2: Momentary Affect Predicted from Neuroticism and Relationship Involvement Without Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.54**	[5.41, 5.67]	**5.55**	[5.41, 5.69]	**5.55**	[5.43, 5.68]	**5.55**	[5.40, 5.69]
Affect variability intercept	**0.62**	[0.54, 0.71]	**0.62**	[0.54, 0.70]	**0.62**	[0.54, 0.70]	**0.62**	[0.54, 0.71]
Linear time trend	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]	**0.01**	[0.00, 0.01]
Affect level ←								
Neuroticism	**−0.55**	[−0.68, −0.43]	**−0.38**	[−0.50, −0.26]	**−0.49**	[−0.58, −0.40]	**−0.27**	[−0.38, −0.15]
Relationship involvement	0.10	[−0.13, 0.34]	0.08	[−0.18, 0.33]	0.05	[−0.18, 0.28]	0.08	[−0.19, 0.34]
Neuroticism × relationship involvement	−0.16	[−0.37, 0.06]	−0.20	[−0.42, 0.02]	−0.11	[−0.27, 0.05]	−0.10	[−0.30, 0.09]
Affect variability ←								
Neuroticism	**0.18**	[0.10, 0.26]	**0.13**	[0.06, 0.21]	**0.12**	[0.06, 0.18]	**0.12**	[0.06, 0.19]
Relationship involvement	0.09	[−0.06, 0.24]	0.10	[−0.05, 0.26]	0.11	[−0.04, 0.26]	0.11	[−0.05, 0.26]
Neuroticism × relationship involvement	−0.06	[−0.19, 0.08]	−0.01	[−0.14, 0.12]	−0.01	[−0.12, 0.09]	−0.07	[−0.18, 0.04]
Residual variance								
Affect level	**1.06**	[0.91, 1.25]	**1.23**	[1.05, 1.44]	**0.96**	[0.82, 1.13]	**1.35**	[1.16, 1.58]
Affect variability	**0.34**	[0.28, 0.41]	**0.35**	[0.29, 0.42]	**0.34**	[0.28, 0.42]	**0.35**	[0.29, 0.43]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.29		0.17		0.36		0.09	
$R^2_{Variability}$	0.08		0.05		0.08		0.05	
	DV: Negative Affect							
	Neuroticism		**Anxiety**		**Depression**		**Volatility**	
	Est.	**95% CI**	**Est.**	**95% CI**	**Est.**	**95% CI**	**Est.**	**95% CI**
Affect level intercept	**2.64**	[2.49, 2.79]	**2.63**	[2.47, 2.79]	**2.62**	[2.48, 2.77]	**2.63**	[2.47, 2.79]
Affect variability intercept	**0.63**	[0.52, 0.75]	**0.62**	[0.51, 0.74]	**0.62**	[0.51, 0.74]	**0.63**	[0.51, 0.75]
Linear time trend	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]	**−0.01**	[−0.01, 0.00]
Affect level ←								
Neuroticism	**0.67**	[0.53, 0.81]	**0.52**	[0.39, 0.65]	**0.56**	[0.45, 0.66]	**0.31**	[0.18, 0.44]

Relationship involvement	−0.15	[−0.42, 0.13]	−0.12	[−0.41, 0.16]	−0.10	[−0.36, 0.17]	−0.12	[−0.42, 0.18]
Neuroticism × relationship involvement	−0.05	[−0.30, 0.20]	−0.02	[−0.27, 0.23]	−0.04	[−0.23, 0.15]	0.02	[−0.21, 0.24]
Affect variability ←								
Neuroticism	**0.42**	[0.31, 0.53]	**0.32**	[0.22, 0.43]	**0.33**	[0.24, 0.42]	**0.22**	[0.12, 0.32]
Relationship involvement	0.12	[−0.10, 0.33]	0.13	[−0.09, 0.35]	0.15	[−0.07, 0.36]	0.12	[−0.10, 0.35]
Neuroticism × relationship involvement	−0.11	[−0.31, 0.09]	−0.07	[−0.27, 0.13]	−0.11	[−0.27, 0.04]	−0.01	[−0.18, 0.16]
Residual variance								
Affect level	**1.47**	[1.25, 1.72]	**1.61**	[1.38, 1.88]	**1.39**	[1.19, 1.63]	**1.79**	[1.53, 2.10]
Affect variability	**0.84**	[0.71, 0.99]	**0.88**	[0.75, 1.04]	**0.84**	[0.71, 0.99]	**0.93**	[0.79, 1.10]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.24		0.17		0.28		0.08	
$R^2_{Variability}$	0.17		0.13		0.17		0.08	

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 8,349 observations nested in 408 individuals. R^2_{Level} and $R_{\text{Variability}^2}$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero.

Table A3

MELSM Set 3: Momentary Affect Predicted from Neuroticism and Relationship Quality Without Covariates

	DV: Positive Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level intercept	**5.70**	[5.52, 5.88]	**5.67**	[5.47, 5.86]	**5.66**	[5.48, 5.84]	**5.66**	[5.46, 5.86]
Affect variability intercept	**0.76**	[0.65, 0.86]	**0.74**	[0.64, 0.85]	**0.77**	[0.66, 0.88]	**0.73**	[0.63, 0.84]
Linear time trend	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]	**0.02**	[0.01, 0.03]
Affect level ←								
Neuroticism	**−0.67**	[−0.84, −0.50]	**−0.53**	[−0.70, −0.36]	**−0.59**	[−0.72, −0.46]	**−0.34**	[−0.49, −0.19]
Relationship quality	0.12	[−0.09, 0.33]	0.24	[0.02, 0.46]	0.00	[−0.21, 0.22]	0.29	[0.07, 0.52]
Neuroticism × relationship quality	0.12	[−0.04, 0.28]	0.07	[−0.11, 0.25]	0.05	[−0.08, 0.18]	0.13	[−0.01, 0.27]
Affect variability ←								
Neuroticism	**0.13**	[0.04, 0.23]	**0.13**	[0.03, 0.22]	**0.11**	[0.04, 0.19]	0.06	[−0.02, 0.14]
Relationship quality	−0.04	[−0.16, 0.07]	−0.02	[−0.14, 0.09]	−0.02	[−0.15, 0.11]	−0.05	[−0.16, 0.07]
Neuroticism × relationship quality	**0.14**	[0.04, 0.23]	0.09	[−0.01, 0.19]	**0.09**	[0.01, 0.17]	**0.10**	[0.03, 0.18]
Residual variance								
Affect level	**0.78**	[0.57, 1.09]	**0.97**	[0.71, 1.34]	**0.70**	[0.5, 0.98]	**1.09**	[0.80, 1.49]
Affect variability	**0.19**	[0.12, 0.30]	**0.21**	[0.13, 0.32]	**0.20**	[0.12, 0.30]	**0.21**	[0.13, 0.32]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.45		0.32		0.51		0.23	
$R^2_{Variability}$	0.17		0.09		0.13		0.09	
	DV: Negative Affect							
	Neuroticism		Anxiety		Depression		Volatility	
	Est.	95% CI	Est.	95% CI	Est.	95% CI	Est.	95% CI
Affect level	**2.45**	[2.23, 2.67]	**2.48**	[2.25, 2.71]	**2.50**	[2.27, 2.72]	**2.48**	[2.25, 2.71]
Affect variability	**0.78**	[0.62, 0.94]	**0.77**	[0.61, 0.94]	**0.81**	[0.64, 0.98]	**0.75**	[0.59, 0.92]
Linear time trend	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]	**−0.01**	[−0.02, 0.00]
Affect level ←								
Neuroticism	**0.58**	[0.38, 0.77]	**0.46**	[0.26, 0.66]	**0.49**	[0.33, 0.65]	**0.30**	[0.13, 0.47]

Relationship quality	−0.18	[−0.42, 0.07]	**−0.26**	[−0.51, −0.01]	−0.09	[−0.36, 0.17]	**−0.30**	[−0.55, −0.05]
Neuroticism × relationship quality	−0.07	[−0.26, 0.13]	−0.04	[−0.24, 0.17]	−0.01	[−0.17, 0.15]	−0.11	[−0.26, 0.05]
Affect variability ←								
Neuroticism	**0.32**	[0.17, 0.47]	**0.25**	[0.10, 0.40]	**0.23**	[0.10, 0.35]	**0.21**	[0.09, 0.33]
Relationship quality	−0.05	[−0.23, 0.13]	−0.07	[−0.25, 0.11]	−0.02	[−0.22, 0.19]	−0.09	[−0.26, 0.09]
Neuroticism × relationship quality	0.12	[−0.03, 0.26]	0.10	[−0.06, 0.25]	0.08	[−0.05, 0.20]	0.07	[−0.04, 0.19]
Residual variance								
Affect level	**1.19**	[0.86, 1.66]	**1.33**	[0.97, 1.83]	**1.15**	[0.83, 1.61]	**1.39**	[1.01, 1.94]
Affect variability	**0.62**	[0.44, 0.87]	**0.65**	[0.47, 0.92]	**0.64**	[0.46, 0.90]	**0.66**	[0.47, 0.92]
Time	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]	0.00	[0.00, 0.00]
Explained variance								
R^2_{Level}	0.29		0.20		0.31		0.17	
$R^2_{Variability}$	0.15		0.11		0.12		0.10	

Note. Results of the mixed-effects location scale models (MELSMs) are based on N = 2,589 observations nested in 117 individuals. R_{Level}^2 and $R_{\text{Variability}}^2$ represent the amount of variance that can be explained by all model predictors. Estimates in bold font have 95% credible intervals not including zero.

4. Understanding Loneliness in Adolescence: A Test of Competing Hypotheses on the Interplay of Extraversion and Neuroticism

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Abstract

Given that adolescents often experience fundamental changes in social relationships, they are considered to be especially prone to loneliness. Meanwhile, theory and research highlight that both extraversion and neuroticism are closely intertwined with individual differences in loneliness. Extant research has explored the linear main effects of these personality traits, yet potential non-linear associations (e.g., exponential effects) and the potential interplay of extraversion and neuroticism (e.g., mutual reinforcement effects) remain unknown. We addressed these open questions using cross-sectional and one-year longitudinal data from two adolescent samples (overall N = 583, M_{age}= 17.57, 60.55% girls) and an information-theoretic approach combined with polynomial regression. Analyses showed little evidence for interaction effects, but revealed non-linear effects in addition to the main effects of extraversion and neuroticism on loneliness. For example, the positive cross-sectional association between neuroticism and loneliness was stronger at higher neuroticism levels (i.e., exponential effect). Results differed across loneliness facets in that both traits predicted emotional loneliness, but only extraversion predicted social loneliness. Longitudinal analyses showed that loneliness changes were mainly related to neuroticism. We discuss results in the light of sample differences, elaborate on the importance to differentiate between emotional versus social aspects of loneliness, and outline implications for adolescent development.

Keywords: loneliness; personality; adolescence; polynomial regression; information-theoretic approach

Understanding Loneliness in Adolescence: A Test of Competing Hypotheses on the Interplay of Extraversion and Neuroticism

Loneliness is defined as the distressing feeling that accompanies the perceived discrepancy between desired and actual quality or quantity of social relationships (de Jong Gierveld et al., 2018; Hawkley & Cacioppo, 2010). Although temporary feelings of social isolation reflect a common experience, more chronic feelings of loneliness can have serious consequences for mental and physical health (Hawkley & Cacioppo, 2010; Holt-Lunstad et al., 2015). The adolescent years mark a time during which many developmental changes takes place, including the transition out of school, identity exploration, and social relationship reorganization (Erikson, 1959; Rubin et al., 2006). Specifically, adolescents increasingly individualize from their parents and try to initiate new relationships with peers and romantic partners. Given these fundamental changes in social networks and relationships, adolescents are considered to be especially prone to loneliness (Heinrich & Gullone, 2006; Laursen & Hartl, 2013). Aiming to understand who is at risk to experience feelings of loneliness, scholars have long investigated associations between personality (i.e., relatively stable patterns of thoughts, feelings, and behavior (Roberts et al., 2006)) and loneliness. Previous studies indicate that, among the Big Five personality traits, lower levels of extraversion and higher levels of neuroticism are the strongest unique predictors of loneliness (Buecker et al., 2020; Vanhalst et al., 2012). Less is known, however, about the potential differential role of each trait, possible non-linear predictive effects, and how extraversion and neuroticism interact in predicting loneliness. For example, the predictive effect of extraversion might be more pronounced for individuals with higher neuroticism (Hotard et al., 1989).

To disentangle and explore these potentially complex associations, we combined polynomial regression analysis with an information-theoretic approach for model comparison (Burnham & Anderson, 2002; Humberg, Dufner, et al., 2019). Specifically, we derived competing theoretical hypotheses about the associations in question, translated them into corresponding statistical models and compared their empirical evidence with information-theoretic indices that reflect the relative support of the models in the data. In addition, we explored whether the specific interplay of extraversion and neuroticism differs across loneliness facets (Weiss, 1973).

Personality and Loneliness in Adolescence

Put simply, extraversion describes the tendency to socially approach others and to enjoy their company, while neuroticism characterizes an individual's tendency to feel anxious (Hofstee et al., 1992; Soto & John, 2017). Adolescents higher in extraversion may find it easier to

form new friendships and experience higher levels of emotional closeness (Wagner et al., 2014), be more satisfied with their social interactions (Wieczorek et al., 2021), perceive more support from their peers (Asendorpf & Van Aken, 2003), and be more liked and popular among their classmates (van der Linden et al., 2010). In contrast, adolescents higher in neuroticism may be more insecure in their social relationships (Deventer et al., 2019; Parker et al., 2012), experience lower levels of emotional closeness (Wagner et al., 2014), be less satisfied with their social interactions (Wieczorek et al., 2021), and be less liked and popular among their classmates (van der Linden et al., 2010). Given these strong social implications of extraversion and neuroticism, both traits might help to identify adolescents who are at risk of developing loneliness.

Along these lines, a recent meta-analysis by Buecker et al. (2020), including both cross-sectional and longitudinal studies, suggested that among the Big Five personality traits, extraversion and neuroticism are the strongest predictors of loneliness: Individuals lower in extraversion ($r = -.37$) and higher in neuroticism ($r = .36$) reported higher levels of loneliness at baseline and up to 17 years later. Notably, most of the studies included in the meta-analysis used adult samples, yet similar associations were observed in studies using adolescent samples (Asendorpf & Van Aken, 2003; Vanhalst et al., 2012). Age-specific analyses suggested that associations of lower extraversion with higher loneliness might be even more pronounced in adolescence than in adulthood (Buecker et al., 2020; Vanhalst et al., 2013), although these findings await replication. In sum, there is strong evidence for the predictive effects of extraversion and neuroticism for loneliness in adolescence, yet the potential differential role of each trait and their interplay are less clear.

A widely accepted conceptualization of the nature of loneliness proposed by Weiss (Weiss, 1973) differentiates between the two facets *emotional loneliness* (i.e., the absence of an attachment figure) and *social loneliness* (i.e., the absence of a social network or the lack of belongingness). Whereas emotional and social loneliness share a common core of experiences and can thus be aggregated into an overall loneliness score (Russell et al., 1984), recent empirical work points to differential associations of the two facets with personality and to differences in developmental trajectories. For example, Buecker et al. (2020) found that, on average, extraversion was more strongly associated with social loneliness and neuroticism seemed to relate to both loneliness facets equally. In a study tracking participants from a large Norwegian sample ($N = 3{,}116$) across adolescence and young adulthood, von Soest et al. (von Soest et al., 2020) found that emotional loneliness increased and social loneliness decreased over the course of seven years. Together, these studies highlight the importance of distinguishing between the two facets of loneliness (Schermer & Martin, 2019; Vanhalst et al., 2012).

Relatively little research has examined how personality traits relate to prospective changes in loneliness. As one of few exceptions, Mund and Neyer (Mund & Neyer, 2016) tracked young adults across two measurement points (1995 and 2010). Accounting for the initial levels of all constructs included in their statistical model, Mund and Neyer found that, out of the Big Five, only higher neuroticism predicted subsequent 15-year increases in loneliness. In adolescence, we are aware of only one study looking at personality profiles that help distinguish trajectory classes of loneliness (Vanhalst et al., 2013), but to the best of our knowledge no longitudinal study exists that has examined for this age group whether and how extraversion and neuroticism is predictive of subsequent changes in loneliness. To fill this research gap, it is important to go beyond cross-sectional personality—loneliness associations and to investigate longitudinal associations while controlling for the initial level of loneliness.

Going Beyond Linear Main Effects of Extraversion and Neuroticism

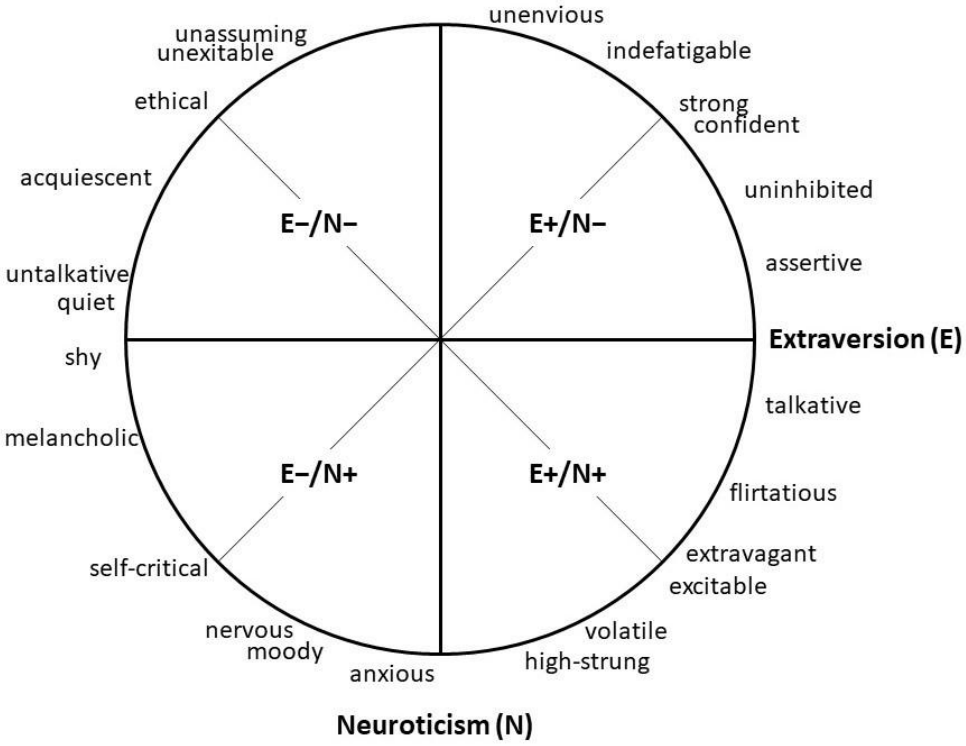
Research so far has largely focused on linear main effects in the prediction of personality traits for loneliness. This is surprising, given that as early as 1985, Eysenck and Eysenck have suggested that reactions to social stimuli of people with high neuroticism should differ significantly depending on their level of extraversion (Eysenck & Eysenck, 1985). Continuing this line of argumentation, Hotard et al. (Hotard et al., 1989) reasoned that neuroticism could reinforce the negative reactions individuals low in extraversion experience in social interactions, resulting in particularly strong social withdrawal of people who are both low in extraversion and high in neuroticism. Thus, whereas theory suggests more complex ramifications of extraversion and neuroticism for loneliness, to the best of our knowledge this possibility has so far not yet been tested empirically. In order to better understand how extraversion and neuroticism predict loneliness in adolescence, it is important to consider non-linear and interaction effects in addition to linear ones and to investigate both traits in an integrative manner.

Unlike bipolar personality models, circumplex models take into account that descriptions of interpersonal behavior can often be assigned to more than one trait (Wiggins, 1980). Specifically, the E-N circumplex model by Hofstee et al. (1992) (see Figure 1) maps facets of extraversion and neuroticism dimensions as blends of two factors and thereby offers a framework for the integrative study of both personality traits. Spanning around two axes representing extraversion and neuroticism, the four spaces between these axes capture a range of attributes referring to the specific trait intersections. First, the combination high extraversion/low neuroticism (E+/N–) refers to individuals who are unenvious, strong, and assertive. Second, high extraversion/high neuroticism (E+/N+) describes people who are talkative, excitable, and high-

strung. Third, low extraversion/low neuroticism (E–/N–) portrays quiet, acquiescent, and unassuming individuals. Fourth and finally, low extraversion/high neuroticism (E–/N+) refers to people who are anxious, self-critical, and shy. As we will illustrate in the following, both the axes and the intersections of the E-N circumplex (Hofstee et al., 1992) can serve as a basis to form more specific predictions for how extraversion and neuroticism as well as their interplay could relate to loneliness.

Figure 1

The E-N Circumplex by Hofstee et al. (1992)



Note. The bold axes represent the two traits extraversion and neuroticism. In the spaces between these axes, adjectives describing different combinations of high (+) and low (−) levels of extraversion and neuroticism can be assigned. Adapted from the Journal of Personality and Social Psychology 1992, Vol. 63, No. 1, 146-163, Copyright © 1992 by the American Psychological Association. Reproduced with permission.

Monotonous but Non-Linear Effects of Extraversion and Neuroticism

Previous studies have often estimated linear predictive effects of extraversion and neuroticism for loneliness (Cheng & Furnham, 2002; Teppers et al., 2013), but the strength of these associations might vary across trait levels. Such associations can be assigned to the family of monotonic but non-linear effects and, more specifically, can take the form of saturating or exponential effects. Considering the extraversion axis in the E-N circumplex (Hofstee et al., 1992), one such scenario is that the beneficial effects of extraversion might saturate at higher

levels: At the lower end, being very or modestly low in extraversion (e.g., very or modestly shy) might make a big difference, such that those adolescents with very low trait levels are especially prone to loneliness, whereas people who are modestly low in extraversion may not. At the higher end of extraversion, in contrast, being fairly versus very high in extraversion (e.g., fairly or very talkative) might not make much of a difference for loneliness because people at these levels of extraversion are rather unlikely to be or become lonely. Considering the neuroticism axis in the E-N circumplex (Hofstee et al., 1992), a second complementary scenario is that the detrimental implications of neuroticism might be exacerbated at higher levels: At the lower end, being very or modestly low in neuroticism (e.g., very or modestly unenvious) might not make much of a difference for loneliness, in the sense that people with both levels are rather unlikely to feel lonely. At the higher end of neuroticism, in contrast, being fairly or very high in neuroticism (e.g., fairly or very anxious) might make a big difference, such that individuals with very high neuroticism are at an exponential risk to experience loneliness.

In sum, monotonous but non-linear effects would indicate that the predictive effects of extraversion and/or neuroticism for loneliness either attenuate or amplify at higher trait levels. To provide a comprehensive description of both trait's associations with loneliness, it thus appears promising to consider monotonous but non-linear associations in addition to linear ones.

Interaction Effects between Extraversion and Neuroticism

In addition to monotonous, non-linear effects, associations might be even more complex and involve interaction effects between both traits (Eysenck & Eysenck, 1985; Hotard et al., 1989). Whereas empirical tests of such claims with respect to loneliness have yet to be conducted, initial support comes from research on another outcome: Interaction effects between extraversion and neuroticism have been found to predict subjective well-being beyond the main effects of each of these traits (Hotard et al., 1989; Lynn & Steel, 2006; Morris et al., 2015). Based on these findings, we propose that the effects of extraversion and neuroticism on loneliness might moderate and mutually depend on each other, but the exact nature of this potential interplay requires further theoretical consideration.

Even though the circumplex traits are not identical to a trait by trait statistical interaction (Judge & Erez, 2007), the four intersections of the E-N circumplex (Hofstee et al., 1992) are useful to consider how different combinations of extraversion and neuroticism could relate to loneliness. The model assigns attributes that are favorable for the initiation and maintenance of social relationships to the intersection of high extraversion combined with low neuroticism (E+/N–), whereas attributes that are rather disadvantageous for people's social lives are as-

signed to the intersection of low extraversion combined with high neuroticism (E–/N+). Corroborated by empirical research (Buecker et al., 2020), the theoretical model suggests that lower levels of extraversion and higher levels of neuroticism are indeed associated with more loneliness. In addition, the circumplex model highlights two further intersections that are theoretically relevant, but have not yet been examined empirically: Higher extraversion combined with higher neuroticism and lower extraversion combined with lower neuroticism.

According to the E-N circumplex (Hofstee et al., 1992), individuals with higher extraversion/higher neuroticism (E+/N+) are characterized by a more extravagant and excitable nature. It is possible that such characteristics might act as a resource to get to know new people and to build a large social network. In contrast, it is also possible that these same attributes might constitute a barrier for satisfying close relationships and thus might be a source of loneliness. Similarly, two opposing predictions with regard to loneliness can be derived for individuals characterized by lower extraversion combined with lower neuroticism (E–/N–): According to the circumplex, people with this trait combination are ethical, acquiescent, and unassuming. It is possible that such attributes are less helpful for the acquisition of social contacts. In contrast though, people with those attributes could also desire less frequent social interactions and spend less time brooding over their social relationships, and thus feel less lonely.

In a linear model, the effects of extraversion and neuroticism would simply add up, such that adolescents with both combinations (E+/N+ and E–/N–) have loneliness scores at the medium level. Alternatively, the effects of extraversion and neuroticism might mutually depend on each other, resulting in two scenarios where only specific constellations of both traits relate to increased or decreased loneliness. A first scenario is one of mutual compensation according to which the beneficial effects of higher extraversion might compensate the detrimental effect of higher neuroticism, while the beneficial effects of lower neuroticism compensate the detrimental effects of lower extraversion. Looking at the very low and very high ends of each trait's spectrum, loneliness would be rather low as long as extraversion is higher or neuroticism is lower, but it would be higher when lower extraversion co-occurs with higher neuroticism. A second scenario is one of an optimal constellation according to which the beneficial effects of higher extraversion might be reinforced for those who are also lower in neuroticism but weaker for those with higher neuroticism. In turn, the detrimental effects of lower extraversion would be even stronger for people with higher neuroticism, resulting in only one specific constellation that relates to lower loneliness. Looking at the very low and very high ends of each trait's spectrum, individuals who are either lower in extraversion or higher in neuroticism would tend

to feel lonely. Only those who are both higher in extraversion and lower in neuroticism would be expected to score lower in loneliness in this scenario.

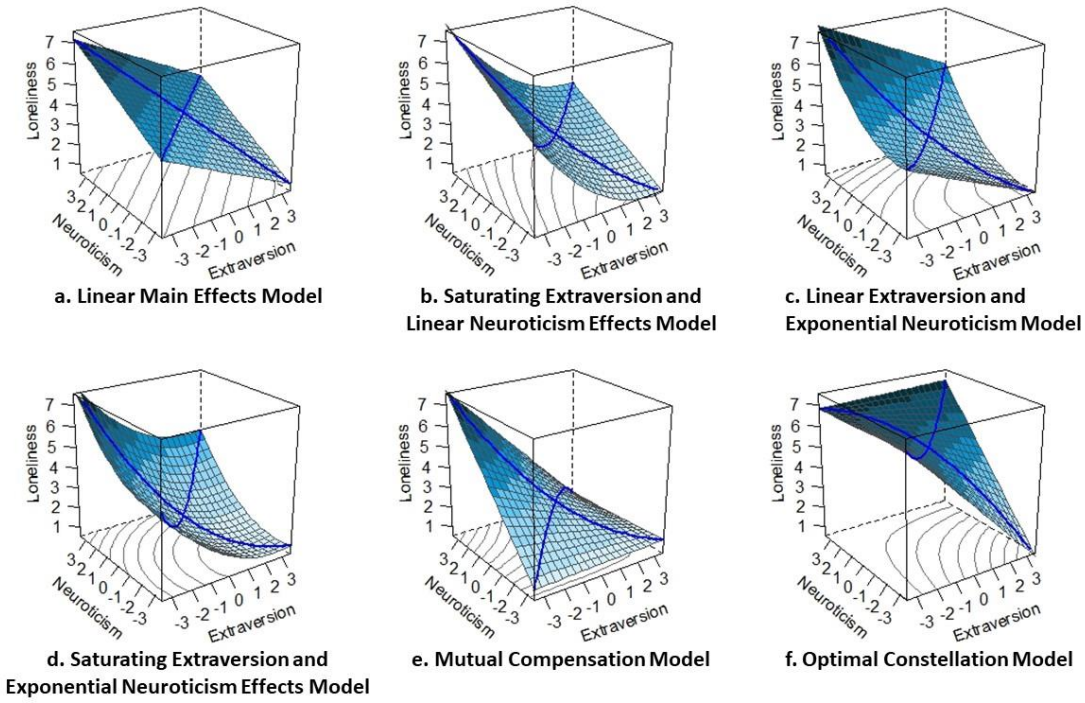
Importantly, the predictions outlined above might be less opposing when we add in a time perspective on social relationships: It is conceivable that the E+/N+ combination has in the short-term both advantages and disadvantages. In contrast, though, the combination might be detrimental in the long run in fostering existing social relationships. For example, disadvantages relating to high neuroticism might be balanced by the advantages relating to high extraversion at early relationship stages, but accelerate the development of loneliness if the relationship persists and does not develop in the expected direction, such as reaching an increase in emotional closeness. Therefore, this combination might rather be associated with loneliness changes (i.e., increases) instead of loneliness manifestations at a given point in time (i.e., cross-sectional association). Similarly, the E–/N– combination may balance harmful and helpful aspects in early relationship stages, but one could argue that low extraversion likely becomes less important once a social relationship has been established and, therefore, might be rather unrelated to changes in loneliness.

The Current Study

In sum, despite a rich tradition of research on loneliness, it remains an unanswered question whether the predictive effects of extraversion and neuroticism simply add up, or whether the predictive effects are more complex and involve non-linear associations or interdependent effects between both traits. To provide a comprehensive test of possible patterns, we specified six competing hypotheses, each operationally defined with a statistical model (see Figure 2 and Table A1 for an overview). As outlined in the following, our hypotheses and models can be grouped into three categories, namely linear main effects (see Figure 2a), monotonous but non-linear effects (see Figures 2b-d), and linear interactions (mutual dependence; see Figures 2e-f).

Figure 2

Prototypical Model Representations of the Tested Models



Note. The blue color indicates the hypothesized levels of loneliness from light (*low*) to dark (*high*). Whereas model *a* is the only model representing mere linear main effects of extraversion and neuroticism on loneliness, models *b-d* reflect monotonous but non-linear effects of one or both traits, and models *e-f* involve linear interactions (i.e., mutual dependence) of extraversion and neuroticism.

To begin with, current empirical evidence (Buecker et al., 2020) suggests linear main effects of both extraversion and neuroticism. We refer to this scenario as Linear Main Effects Hypothesis according to which lower extraversion and higher neuroticism are each associated with more loneliness (*Linear Main Effects Hypothesis*; Figure 2a). Based on theoretical accounts of associations between extraversion and neuroticism (Eysenck & Eysenck, 1985; Hotard et al., 1989) and on theoretical implications of the E-N circumplex (Hofstee et al., 1992), we consider a range of potential alternative hypotheses. Importantly, these hypotheses do not necessarily contradict the Linear Main Effects Hypothesis, but rather add to its complexity.

Going beyond simple linear effects, we consider three hypotheses specifying that extraversion and/or neuroticism have monotonous, but non-linear predictive effects for loneliness. First, looking at the extraversion axis within the E-N circumplex (Hofstee et al., 1992), the trait's beneficial effect might saturate at higher levels *(Saturating Extraversion and Linear Neuroticism Effects Hypothesis*; Figure 2b). Second, looking at the neuroticism axis of the E-N

circumplex, a complementary scenario seems possible such that the trait's detrimental implications might be exacerbated at higher levels (*Linear Extraversion and Exponential Neuroticism Effects Hypothesis*; Figure 2c). Third, looking at the predictive effects of both traits, we might find that the main effect of extraversion saturates *and* the main effect of neuroticism increases at higher levels of the respective trait (*Saturating Extraversion and Exponential Neuroticism Effects Hypothesis*; Figure 2d).

Going beyond main effects, the third group of hypotheses considers how the effects of extraversion and neuroticism might moderate and mutually depend on each other. First, the effects of extraversion and neuroticism might compensate each other, such that only lower extraversion paired with higher neuroticism relates to higher loneliness (*Mutual Compensation Hypothesis*; Figure 2e*)*. Second, the effects of extraversion and neuroticism might reinforce each other, such that only higher extraversion paired with lower neuroticism relates to lower loneliness (*Optimal Constellation Hypothesis*; Figure 2f).

In our study, we compared the empirical evidence for these competing hypotheses against each other by using an information-theoretic approach (Burnham & Anderson, 2002; Humberg, Dufner, et al., 2019). In doing so, we conducted separate analyses in which we considered cross-sectional associations versus longitudinal associations of the personality traits extraversion and neuroticisms and an overall-score of loneliness. We also distinguished between emotional and social loneliness. Previous research (Mund & Neyer, 2016) indicates that neuroticism might be particularly relevant for loneliness increases over time and that extraversion might be particularly relevant for differences in social loneliness (Buecker et al., 2020; Vanhalst et al., 2013). Given the lack of previous research on interactive patterns between personality traits and their link with loneliness, however, we refrained from making specific predictions regarding changes in loneliness or regarding the different facets of loneliness.

Method

Hypotheses and data analyses were preregistered at https://osf.io/mx57d via the Open Science Framework (Center for Open Science, 2011). We analyzed data from two longitudinal studies conducted in Germany so as to compare the competing hypotheses in each of the two samples separately.

First, as Sample 1, we used data from the German Family Panel (pairfam) release 11.0 (Brüderl et al., 2020). Ethical approval for the study was given by the ethics committee of the Faculty of Management, Economics and Social Sciences of the University of Cologne; a detailed description of pairfam can be found in Huinink et al. (Huinink et al., 2011). pairfam

sampled individuals from three different birth cohorts, born between 1971 and 1993 and additionally surveyed the children of these individuals. After age 15, these children were asked to enter the study as participants themselves and were subsequently termed *step-ups*. In this study, we only used data from adolescent participants of the step-up sample assessed at waves 10 and 11 (years of data collection: 2017-2019) who were aged between 16 and 20 at wave 10. Participants of Sample 1 were selected this way to most closely match the participants of Sample 2 with regard to the age and time of data collection. In the following, we will refer to the data collection at wave 10 as T1 and to the data collection at wave 11 as T2.

Second, as Sample 2, we used data from the SELFIE study (Wagner et al., 2021), a German multimethod longitudinal study on the development of personality traits and self-esteem across major life transitions. Ethical approval for the study was given by the German Psychological Society (DGPs). SELFIE collected data from adolescents in their final year of high school and from adults awaiting their retirement at three measurement points with half-year intervals in-between. In the current study, only data from adolescent participants were used. In the following, we will refer to the data collection at the first measurement point as T1 and to the data collection at third measurement point (i.e., the second follow-up) as T2.

Participants

Following the exclusion of $n = 4$ participants who did not provide loneliness ratings at T1, Sample 1 consisted of $N_{T1} = 346$ adolescents (50.00% female) aged 16–20 ($M = 17.45$, $SD = 1.34$). Most participants attended high school (45.09%), whereas the remaining ones attended schools from medium (24.28%) and lower (7.23%) school tracks within the German school system. The remaining adolescents of this sample attended other school types, such as comprehensive schools (21.10%), or provided no answer to this question. With a dropout of 18.21%, $N_{T2} = 283$ adolescents of Sample 1 also participated at T2. Compared to the continuers, the dropout group of Sample 1 was older, $t(88.01) = 2.79$, $p = .006$, $d = 0.40$, 95% CI [0.13, 0.68], with a small effect. With regard to gender, extraversion, neuroticism, and loneliness, no significant differences were found.

Requiring no data exclusion, Sample 2 consisted of $N_{T1} = 237$ adolescents (75.95% female) aged 15–22 ($M = 17.73$, $SD = 1.02$). Due to the inclusion criteria of SELFIE, all participants of Sample 2 attended high school (i.e., the highest school track in the German school system) at the time of data collection. With a dropout of 45.57%, $N_{T2} = 129$ adolescents of Sample 2 also participated at T2. Compared to the continuers, the dropout group of Sample 2 scored higher on extraversion $t(230.62) = 2.40$, $p = .017$, $d = 0.31$, 95% CI [0.05, 0.57], with a

small effect. With regard to age, gender, neuroticism, and loneliness, no differences significant were found.

Since we were working with existing data, the sample size was predetermined. Nonetheless, we performed a simulation in R (R Core Team, 2021) to determine a priory power for our different samples and subsamples. Results indicated that we had a power of 99.99% or higher to obtain a significant full model when the population model explains a typical amount of variance (R^2 = .20) in loneliness, and a power of 98.43% or higher to detect even a small effect (R^2 = .10). The typical amount of variance was estimated on the basis of the correlations between personality traits and loneliness reported in the meta-analysis by Buecker et al. (Buecker et al., 2020) and on the correlation between extraversion and neuroticism in our own data (*r*s ranging from –.31 to –.34; see Table 1).

Procedure and Measures

All measures relevant to this study were assessed via participants' self-reports. In Sample 1, participants were interviewed once a year at home. In Sample 2, participants entered their answers into online questionnaires, either at the laboratory in Berlin or at home. In order to obtain cross-sectional and longitudinal associations, we used personality measures from T1 and loneliness measures from T1 and T2 in both samples.

Personality Traits

In Sample 1, trait extraversion and neuroticism were measured with the short version of the German Big Five Inventory (BFI-K) (Rammstedt & John, 2005). Traits were assessed with four items each and participants specified their level of agreement on a Likert-type rating scale ranging from 1 (*absolutely incorrect*) to 5 (*absolutely correct*). Internal consistencies of the extraversion and neuroticism scales as indicated by Cronbach's α were .72 and .74, respectively.

In Sample 2, trait extraversion and neuroticism were measured with the German version of the Big Five Inventory 2 (BFI-2) (Danner et al., 2019). Specification of the level of agreement with the item content was done on a Likert-type rating scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Internal consistencies of the extraversion and neuroticism scales as indicated by Cronbach's α were .86 and .88, respectively.

Loneliness

In Sample 1, loneliness was measured with a single item translating to "I feel lonely". Answers were given on a Likert-type rating scale ranging from 1 (*not at all*) to 5 (*absolutely*).

In Sample 2, loneliness was measured with German translations of four items from the revised University of California Los Angeles (UCLA) Loneliness Scale (Russell et al., 1980). Specification of the level of agreement with the items content was done on a Likert-type rating

scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). As demonstrated by Hawkley et al. (Hawkley et al., 2005), the full UCLA Loneliness scale possess a multidimensional structure representing either emotional or social aspects. Thus, in line with the suggested differentiation by Weiss (Weiss, 1973) (for a similar approach, see (von Soest et al., 2020)), this study assessed emotional loneliness with two items ("I lack companionship" and "I feel left out") and social loneliness with two reverse-coded items ("there are people I can turn to" and "there are people I can talk to"). Based on the four items, we formed two specific loneliness scores, emotional and social loneliness, and an overall loneliness score, which is the aggregate of the former two scores. Internal consistencies of the overall loneliness, emotional loneliness, and social loneliness scales at T1 (at T2) as indicated by Cronbach's α were .73 (.78), .70 (.53), and .86 (.91), respectively.

Data Analysis

In order to test how different configurations of extraversion and neuroticism relate to loneliness, we used an information-theoretic (IT) approach for model comparison (Burnham & Anderson, 2002), following a similar strategy as described by Humberg, Dufner, et al. (Humberg, Dufner, et al., 2019). That is, we translated the competing hypotheses into corresponding polynomial models and compared their empirical evidence via Akaike weights, which are measures of evidence computed from the second-order Akaike information criterion (*AICc*) (Akaike, 1973; Hurvich & Tsai, 1989; Sugiura, 1978). We chose the AICc for model comparison because it allowed us to compare non-nested models, avoids overfitting, and has a strong theoretical foundation in Kullback-Leibler information theory (Akaike, 1973; Burnham & Anderson, 2002). The global model in our analysis is the full second-order polynomial model with two predictors (Edwards, 2002; Fox, 2016):

$$L_n = b_0 + b_1E_n + b_2N_n + b_3E_n^2 + b_4E_nN_n + b_5N_n^2 \quad (1)$$

where L_n is the loneliness score of person n, E_n (extraversion) and N_n (neuroticism) are the predictors, E_nN_n is their product, and E_n^2 and N_n^2 are their squared values. All six theoretically derived alternative hypotheses can be represented by polynomial models that are nested in the global model (Equation 1). We defined these hypothesis-testing models by constraining the coefficients of the global model based on basic mathematical rules about quadratic equations (Fox, 2016). The respective constraints are defined in Table A1. They were chosen in a

way that ensures that the model's predictions are in line with the respective hypothesis' predictions for the entire range of realistic values of the personality variables. A detailed explanation of how the constraints were derived can be found online at https://osf.io/s8nbk.

Extension of the Initial Model Set

We extended the initial model set by further models. The application of information-theoretical model comparison requires the set of models to be complete, in the sense that it contains models for all theoretically plausible (even if less expected) hypotheses (Burnham & Anderson, 2002; Dochtermann & Jenkins, 2011). To achieve this, we identified a number of supplementary hypotheses, which we also translated into corresponding polynomial models (see Table A1).

First, only one of the two main effects, that is, the main effect of extraversion or neuroticism, might predict loneliness when controlling for the other trait (*Linear Main Effect of Extraversion Model* and *Linear Main Effect of Neuroticism Model*). Second, these monotonously positive or negative main effects might be nonlinear, reflecting that the trait's effect either attenuates or becomes stronger at higher levels. Overall, this adds two more models for extraversion (*Saturating Effect of Extraversion Model* and *Exponential Effect of Extraversion Model*) and neuroticism (*Exponential Effect of Neuroticism Model* and *Saturating Effect of Neuroticism Model*) each. Third, as reflected in our hypothesis set (see Figures 2b-c), it might be the case that both traits have a monotonously positive/negative main effect but that one or both of these effects are non-linear. As a supplement to the models representing our hypotheses, we added three more models. These posit monotonous main effects of both traits, where the strength of the monotonously negative effect of extraversion is stronger at higher trait levels (*Exponential Extraversion and Linear Neuroticism Effects Model*), the strength of the monotonously positive effect of neuroticism is less pronounced at higher trait levels (*Linear Extraversion and Saturating Neuroticism Effects Model*), or both (*Exponential Extraversion and Saturating Neuroticism Effects Model*). Fourth, for statistical reasons, we included an intercept-only model (*Null Model*), which represents the possibility that both extraversion and neuroticism are unrelated to loneliness, and we included the global model (Equation 1) in which all other models are nested (*Full Model*). Combining the theoretically derived and the supplemental models, our complete model set contains a total of 19 models for competitive testing.

Test of Competing Hypotheses

We tested all models cross-sectionally and longitudinally. For the longitudinal analyses, we used loneliness scores at T2 as the outcome variable in the global model (Equation 1) and included loneliness at T1 as an additional predictor with a freely estimated coefficient. The

nested models for the longitudinal analyses are defined by the same coefficient constraints as stated in Table A1 (e.g., the null model in the longitudinal analyses freely estimates the intercept and the coefficient of T1 loneliness). When using the overall score of loneliness as outcome, parallel, but separate analyses were conducted for each sample. Using the data of Sample 2, we re-run these analyses with emotional and social loneliness as outcome. To ensure comparable metrics across the different measures used in our two samples, we linearly transformed all scores (i.e., extraversion, neuroticism, and loneliness) of Sample 1 via proportion of maximum scaling method (POMS) (Little, 2013). Like the variable scores from Sample 2, variable scores from Sample 1 also ranged from 1 to 7 after transformation. In addition, to facilitate interpretation, the scores of extraversion and neuroticism were centered at their respective mean within each sample.

All analyses were conducted in R (R Core Team, 2021) and R Studio (RStudio Team, 2021). In a first step of each analysis, we estimated the global model (full model) and the null model with the lm() function in the R package *stats* and compared their fit with a chi-square likelihood ratio test. We proceeded with the analysis only if this test revealed that the full model explained significantly more variance in the outcome than the null model. We then estimated all models in the initial model set with the sem() function in *lavaan* (Rosseel, 2012), using ML estimation with robust standard errors, and treating missing data with FIML. We then computed the models' AICc values from the respective number of free parameters (K) and the maximized Log-Likelihood (LL). The AICcs were used to calculate the models' Akaike weights with the *AICcmodavg* package (Mazerolle, 2020). For the computation of Akaike weights, we removed redundant models (Arnold, 2010). More specifically, when the difference between the maximized log-likelihood values of two nested models was less than 1 (for the rationale behind this choice, see (Humberg, Dufner, et al., 2019)), we excluded the more complex of the two models for the computation of the Akaike weights. We tested for influential cases using the full polynomial model and three standard indicators of influence and leverage (i.e., *dfFit*, Cook's distance D, and the *hat* value) (Bollen & Jackman, 1985; Cohen et al., 2003; Edwards, 2002), but no such cases were identified (for a more specific definition of the conditions that we applied to categorize a data point as an influential case, see the R code and preregistration provided at https://osf.io/4dgku/). We used the *RSA* package (Schönbrodt & Humberg, 2020) to plot the estimated regression surfaces. The code that is necessary to reproduce all results and the data of Sample 2 are provided online at https://osf.io/4dgku/ (data of Sample 1 cannot be shared publicly due to the copyright in place, but requested for scientific use from the official pairfam web page: https://www.pairfam.de/en/).

The interpretation of the model comparisons is based on the models' Akaike weights. The Akaike weight of a model is the likelihood that the respective model is the best model to explain the data at hand, as compared to all models in the initial model set (Akaike, 1973; Hurvich & Tsai, 1989; Sugiura, 1978). The IT approach thereby differs from classical null-hypothesis testing in that it refrains from dichotomous decisions based on statistical significance (e.g., inspection of *p*-values). Instead, it allows for a simultaneous evaluation and comparison of the empirical evidence of all competing models and their corresponding hypotheses (Burnham & Anderson, 2002).

Results

Descriptive Statistics

Descriptive statistics and bivariate intercorrelations at T1 and T2 can be obtained from Table 1. Compared to Sample 1, participants of Sample 2 scored higher on neuroticism, $t(554.83) = 2.74$, $p = .006$, $d = 0.22$, 95% CI [0.06, 0.39], and lower on overall loneliness at T1, $t(568.33) = -3.03$, $p = .003$, $d = -0.23$, 95% CI [−0.40, −0.07], and T2 $t(568.33) = -4.03$, $p < .001$, $d = -0.36$, 95% CI [−0.57, −0.14], with small effect sizes. Loneliness consistency across one year from T1 to T2 was moderate in Sample 1 ($r = .47$) and strong in Sample 2 (*rs* ranging from .63 to .71). On average, loneliness (and its facets) did not change across one year in both samples (see Table 1 for Cohen's *d*). The individual differences between overall loneliness at T1 and T2 within each sample are illustrated in Figure A1. Looking at the bivariate correlations between personality traits and loneliness in both samples, all variables were significantly related to each other except (a) neuroticism and social loneliness and (b) neuroticism and overall loneliness at T2 in Sample 2. Looking at the role of demographic characteristics, older age was associated with higher neuroticism ($r = .12$, $p = .023$) and overall loneliness at T1 ($r = .16$, $p = .003$) in Sample 1, and female participants reported higher neuroticism in both samples (Sample 1: $r = .33$, $p < .001$; Sample 2: $r = .38$, $p < .001$). Age and gender were not significantly related to any of the other study variables.

Table 1

Descriptive Statistics, Internal Consistencies, and Intercorrelations

								Intercorrelations							
								T1 variables					T2 variables		
	M_{T1}	SD_{T1}	M_{T2}	SD_{T2}	*d*	α_{T1}	α_{T2}	E	N	L	L(e)	L(s)	L	L(e)	L(s)
Sample 1															
E	4.54	1.22				.72							**-.21**		
N	3.60	1.26				.74		**-.34**					**.34**		
L	2.52	1.61	2.71	1.64	0.09	--		**-.32**	**.45**				**<u>.47</u>**		
Sample 2															
E	4.69	0.95				.86							**-.44**	**-.40**	**-.38**
N	3.87	1.07				.88		**-.31**					.15	**.19**	.07
L	2.20	0.94	2.19	0.96	0.00	.73	.78	**-.57**	**.31**				**<u>.71</u>**		
L(e)	2.72	1.30	2.69	1.16	-0.06	.70	.53	**-.54**	**.39**	**.89**			**.67**	**<u>.63</u>**	
L(s)	1.68	0.93	1.70	1.01	0.08	.86	.91	**-.41**	.09	**.78**	**.41**		**.57**	**.40**	**<u>.63</u>**

Note. E = extraversion, N = neuroticism, L = loneliness, L(e) = emotional loneliness, L(s) = social loneliness. Results are based on N_{T1} = 346 and N_{T2} = 283 observations in Sample 1 and N_{T1} = 237 and N_{T2} = 129 observations in Sample 2. For reasons of comparability across samples, we transformed all variables of Sample 1 via POMS prior to the analysis. Internal consistencies are provided as Cronbach's alpha (α). Bivariate correlations in bold font were significant at p <.05. Underlined intercorrelations represent retest reliabilities ($r_{T1,T2}$).

Predicting Loneliness From the Interplay of Extraversion and Neuroticism: Model Comparison Analyses

For each of our analyses, Table 2 presents the *95% confidence set* of models (Burnham & Anderson, 2002) of all analyses: Starting with the model with the largest Akaike weight and continuing with the next best models, models were added to the confidence set until the cumulated weights in the set exceeded 95%. This way, the confidence set includes the models with the highest likelihood of being the best models among all models in the initial set. Models which are not included in this set have very little empirical support (i.e., a likelihood < 5% of being the best model to explain the data) and were therefore excluded from interpretation. In the case that the global model was included in the confidence set, we interpreted its coefficients by use of response surface methodology, following the guidance by Edwards (Edwards, 2002) and Humberg, Nestler, et al. (Humberg, Nestler, et al., 2019). This allowed us to detect any empirical patterns that are not represented by the models of our hypothesis set. In the following, we will explain the results of each model in the confidence set in detail. This will be done first for the cross-sectional models and then for the longitudinal models.

Table 2

95% Confidence Set of Models Predicting Loneliness From Extraversion and Neuroticism

	b_1	b_2	b_3	b_4	b_5	K	LL	AIC_c	w	Adj. R^2_{Model}	Adj. $R^2_{Full\ Model}$
Cross-sectional											
Overall loneliness											
Sample 1											.237
Linear Extraversion and Exponential Neuroticism Model	-.26	.47	0	0	.07	5	-608.42	1227.02	.42	.233	
Full Model	-.26	.47	.04	.11	.11	7	-606.59	1227.51	.33	.237	
Linear Main Effects Model	-.25	.49	0	0	0	4	-609.98	1228.08	.25	.229	
Sample 2											.347
Linear Main Effects Model	-.52	.13	0	0	0	4	-271.22	550.61	.66	.342	
Full Model	-.51	.13	.07	.07	-.04	7	-268.88	552.25	.29	.347	
Emotional loneliness											.335
Linear Main Effects Model	-.64	.30	0	0	0	4	-348.43	705.03	1	.338	
Social loneliness											.165
Linear Main Effect of Extraversion Model	-.40	0	0	0	0	3	-296.95	600.00	.84	.161	
Full Model	-.39	-.03	.08	.08	-.03	7	-294.44	603.36	.16	.165	
Longitudinal											
Overall loneliness (change)											.254
Saturating Effect of Neuroticism Model	0	.26	0	0	-.04	5	-499.99	1010.15	.50	.251	
Linear Main Effect of Neuroticism Model	0	.23	0	0	0	4	-501.51	1011.14	.31	.246	
Full Model	-.04	.25	.08	.04	-.10	8	-497.86	1012.14	.19	.254	

Note. Results are based on N_{T1} = 346 and N_{T2} = 283 observations in Sample 1 and N_{T1} = 237 and N_{T2} = 129 observations in Sample 2. Following an information-theoretic approach for model comparison, we do not report *p*-values. Instead, interpretation should be based on the models' Akaike weights that reflect the relative evidence for all competing models. K = number of estimated parameters; LL = maximized Log-Likelihood; AIC_c = second-order Akaike information criterion; w = Akaike weight of the model (i.e., likelihood of being the best model in the 95% confidence set); adj. R^2 = adjusted R^2; b_1 to b_5 refer to regression coefficients of the full polynomial model $L_n = b_0 + b_1E_n + b_2N_n + b_3E_n^2 + b_4E_nN_n + b_5N_n^2$. For reasons of comparability across samples, we transformed all variables of Sample 1 via POMS prior to the analysis. Results for emotional and social loneliness are based on the data of Sample 2 only. Longitudinal analyses additionally controlled for loneliness at T1. In Sample 2, we could not compute longitudinal results because the predictors explained no variance after controlling for loneliness at T1.

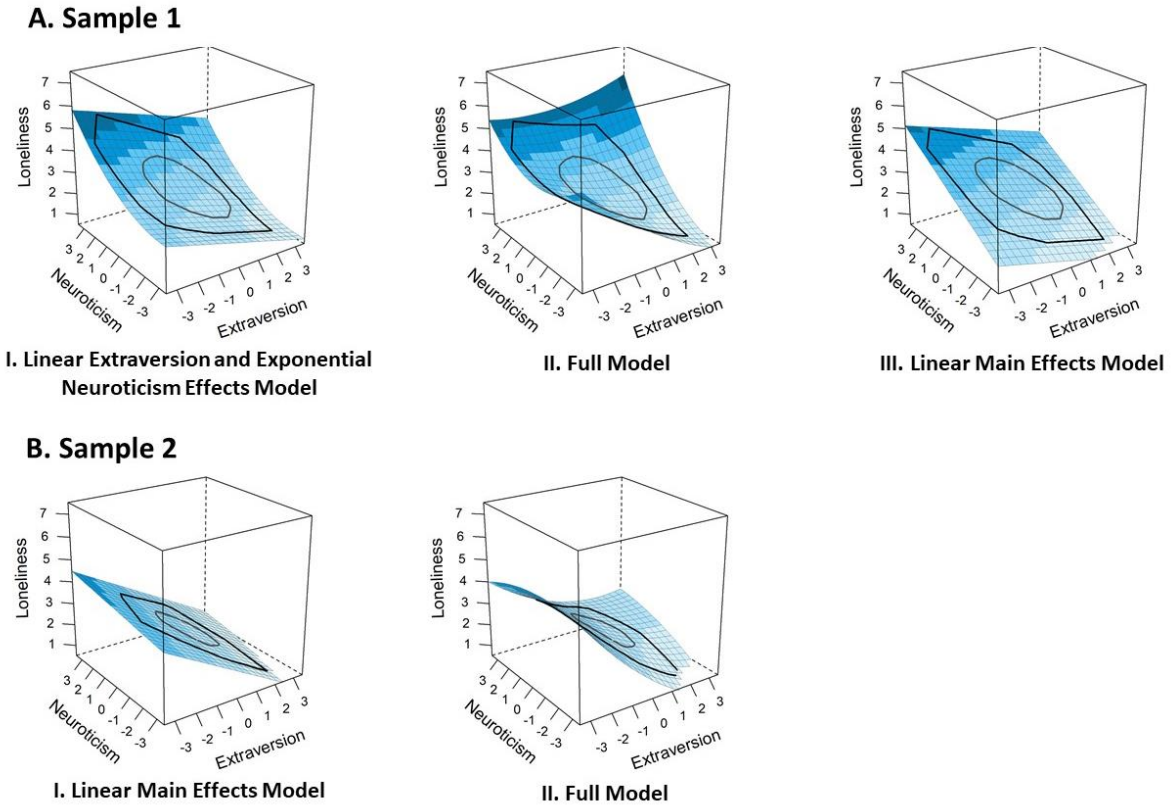
Cross-Sectional Analyses

In this section, we present the results of the cross-sectional models in several steps: First, starting with the models predicting overall loneliness, we will outline the results from Sample 1 and 2 one after each other. Second, we report on the results from the models predicting the loneliness facets based on the data of Sample 2. Then, as a final step, we will summarize the most relevant findings of the cross-sectional models across samples and loneliness scales.

Overall Loneliness. In Sample 1, three models predicting overall loneliness at T1 were included in the confidence set (see Figure 3 Panel A). Together, the three models provided evidence for main effects of both personality traits, for non-linear effects, and for the possibility of a weak interaction effect. First, the Linear Extraversion and Exponential Neuroticism Effects Model had a likelihood of 42% (w = .42) of being the best model out of our alternative models. It showed a stronger association between neuroticism and loneliness as compared to the association between extraversion and loneliness. Going beyond the linear negative/positive associations between extraversion/neuroticism and loneliness, this model indicated a slightly curvilinear nature of the effect of neuroticism. That is, adolescents with higher neuroticism felt lonelier in general, and this effect was even more pronounced the higher the level of neuroticism was (i.e., exponential effect).

Figure 3

Graphs of the Models in the Confidence Set: Cross-Sectional Models Predicting Overall Loneliness



Note. The blue color indicates the levels of loneliness from light (*low*) to dark (*high*). The black lines represent the bagplot that indicates the distribution of extraversion and neuroticism. The interpretation of the surface must be restricted to this area.

Second, the Full Model was the next best model (w = .33). In addition to the previously described effects, the Full Model reflected the possibility that the negative association of extraversion and loneliness might be weaker at higher levels of the trait (i.e., saturating effect) and the possibility of a weak positive interaction between extraversion and neuroticism. That is, effects of neuroticism might be slightly more pronounced for adolescents with higher levels of extraversion. Conversely, effects of extraversion might be slightly more pronounced for adolescents with higher levels of neuroticism.

Finally, the set was completed by the Linear Main Effects Model (w = .25). According to the Linear Main Effects Model, higher loneliness in adolescence simply related to lower extraversion and higher neuroticism without any curvilinear or interaction effects.

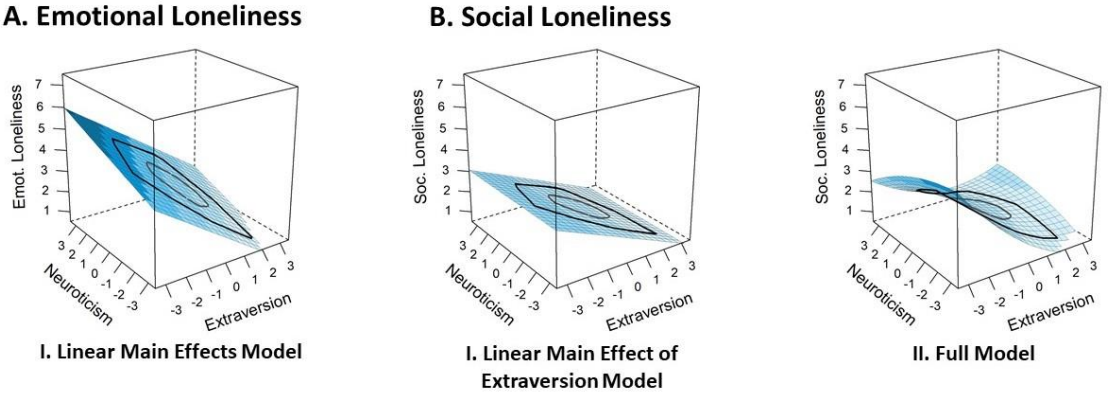
In Sample 2, the confidence set included two models (see Figure 3 Panel B), which provided support for main effects of both personality traits and weak evidence for non-linear effects and a positive interaction effect. The Linear Main Effects Model had the most evidence

(w =.66) out of the models predicting overall loneliness at T1. Thus, in this sample, adolescents' loneliness was linearly predicted from lower extraversion and higher neuroticism, with a stronger association between extraversion and loneliness compared to the association between neuroticism and loneliness. The confidence set also included the Full Model (w =.29), which pointed to the possibility of three additional effects. As in Sample 1, the Full Model indicated that the negative effect of extraversion might be saturating (i.e., weaker association between extraversion and loneliness at higher levels of extraversion) and that extraversion and neuroticism might positively interact when predicting loneliness. Furthermore, deviating from the results in Sample 1, the Full Model in Sample 2 reflected the possibility that the positive effect of neuroticism might also be saturating in this sample. Given that this effect was very small, however, it should considered with caution.

Emotional and Social Loneliness. Being available in Sample 2 only, we differentiated between the specific loneliness facets. In the case of emotional loneliness, the confidence set included only the Linear Main Effects Model (see Figure 4 Panel A), which had a 100% likelihood (w = 1) of being the best model predicting emotional loneliness. Both traits linearly predicted adolescents' emotional loneliness and the effect of extraversion exceeded the effect of neuroticism. Thus, as for overall loneliness in Sample 2, this model provided evidence for main effects of both personality traits, but not for non-linear effects or interactions in the case of emotional loneliness.

Figure 4

Graphs of the Models in the Confidence Set: Cross-Sectional Models Predicting Loneliness Facets



Note. Plots are based on the data of Sample 2 only. The blue color indicates the levels of loneliness from light (*low*) to dark (*high*). The black lines represent the bagplot that indicates the distribution of extraversion and neuroticism. The interpretation of the surface must be restricted to this area.

In the case of social loneliness, the confidence set included two models (see Figure 4 Panel B). Together, the two models provided strong evidence for a main effect of extraversion along with the possibility of non-linear effects of both traits and of a weak interaction. First, the Linear Main Effect of Extraversion Model had a likelihood of 84% (w =.84) of being the best model in the model set, indicating that higher social loneliness was linearly related to adolescents‘ lower extraversion only. Second, the Full Model (w =.16) diversified the picture in three ways: (1) by the possibility that the strong negative effect of extraversion on social loneliness was less pronounced at higher trait levels (i.e., saturating effect), (2) by the possibility of a weak inverse u-shaped effect of neuroticism (i.e., an overall positive but saturating effect of neuroticism on social loneliness for 89.03% of the participants, but a negative effect on social loneliness for the remaining 10.97% at the highest end of the neuroticism spectrum), and (3) by the possibility of a positive interaction between extraversion and neuroticism (i.e., the effects of both traits reinforce each other). It should be noted, however, that all effects except the negative linear main effect of extraversion were very small and should not be overinterpreted. In addition, comparing the two models predicting social loneliness, the Linear Main Effect of Extraversion Model was 5.25 times more likely than the Full Model (*evidence ratio* .84/.16 = 5.25), so the nuanced nature of the effects as reflected by the Full Model should be considered with caution.

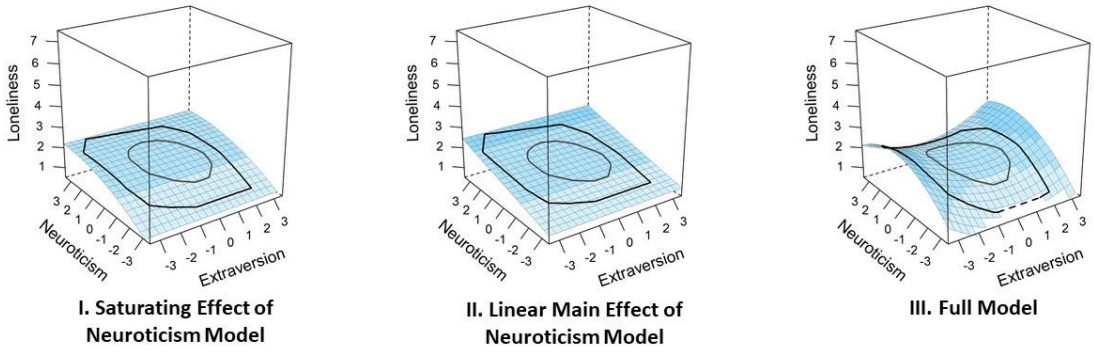
Summary of Cross-Sectional Results. An integrative view on the commonalities of the cross-sectional models across both samples implies strong evidence for the notion that both lower extraversion and higher neuroticism are related to adolescents' higher overall loneliness. Whereas neuroticism was the strongest predictor of overall loneliness in Sample 1, extraversion appeared as the more predictive personality trait in Sample 2. Going beyond linear main effects, results provided weak but consistent support for a saturating effect of extraversion and a positive interaction effect of extraversion and neuroticism on loneliness. Moreover, results of Sample 1 provided strong support for an exponential effect of neuroticism, but this was not replicated in Sample 2. Facet-specific analyses in Sample 2 pointed to distinct effects of extraversion and neuroticism with regard to emotional versus social loneliness: Whereas both lower extraversion and higher neuroticism appeared to represent relevant correlates of adolescents' higher emotional loneliness, results supported a linear main effect of extraversion only in the case of social loneliness, which might be saturating at higher levels. Thus, adolescents' social loneliness seemed to relate exclusively or at least predominantly to their extraversion and less to their levels of neuroticism.

Longitudinal Analyses

In Sample 1, three models predicting overall loneliness at T2 while controlling for loneliness at T1 (i.e., predicting relative change in loneliness) were included in the confidence set (see Figure 5). Together, the three models provided strong evidence for a (non-linear) main effect of neuroticism, but rather little evidence for an effect of extraversion or for an interaction effect. First, the saturating effect of neuroticism model had a likelihood of 50% (w = .50) of being the best model out of the alternatives. Accordingly, adolescents with higher neuroticism were generally at higher risk to increase in loneliness and the strength of this effect differed across the trait levels: At the lower end, being very low or modestly low in neuroticism appeared to make a big difference for increases in loneliness. At the higher end of neuroticism, however, loneliness of both adolescents with fairly high versus very high neuroticism is likely to increase, but the exact level of neuroticism might not make much of a difference for the amount of this increase. Extraversion, by contrast, did not seem to predict loneliness changes at all.

Figure 5

Graphs of the Models in the Confidence Set: Models Predicting Overall Loneliness Change



Note. Plots are based on the data of Sample 1 only. The blue color indicates the levels of loneliness increases from light (*very weak*) to medium (*weak*). The black lines represent the bagplot that indicates the distribution of extraversion and neuroticism. The interpretation of the surface must be restricted to this area.

Second, the linear main effect of neuroticism model was the next best model (w = .31) Like the first model in the confidence set, this model indicated that adolescents with higher neuroticism were more likely to increase in loneliness from T1 to T2 and that extraversion played no role in this. Contrary to the first model, however, the second model did not indicate that longitudinal association differ across different levels of neuroticism. Finally, the full model (w = .19) reflected the additional possibility of a negative saturating effect of extraversion and of a positive interaction between extraversion and neuroticism. However, all additional effects were rather small.

In Sample 2, extraversion and neuroticism did not explain any additional variance of loneliness at T2 when controlling for loneliness at T1. This was the case for both overall loneliness as well as the two facets. Therefore, we did not proceed with longitudinal model comparisons in Sample 2. Altogether, whereas it is important to note that analyses were restricted to Sample 1, the longitudinal models provided support for a positive effect of neuroticism on loneliness increases across one year, which might be saturating. In contrast, they provided no evidence for any longitudinal effects of extraversion on loneliness changes.

Discussion

The goal of this study was to examine the interplay of extraversion and neuroticism in predicting loneliness and its facets in late adolescence. To this aim, we specified six competing hypotheses based on theory and previous research and tested them competitively in two samples of almost 600 late adolescents in total. We obtained four sets of major findings: First, at the cross-sectional level, there was evidence for more complex, non-linear effects in addition to the previously established linear effects of extraversion and neuroticism on loneliness, but only little evidence for interaction effects. Second, specific associative patterns differed between emotional and social loneliness facets. Third, longitudinal changes in loneliness were mainly related to neuroticism. Finally, as a methodological aspect, inconsistencies across our two samples pointed to the relevance of the studied population. In the following, we will discuss these aspects in more detail, refer to implications for theory and adolescent development, and outline directions for future research.

The Distinct Roles of Extraversion and Neuroticism

To elucidate the relative importance of extraversion and neuroticism for adolescents' loneliness, we compared the effects of these two traits (1) at the cross-sectional level, (3) across loneliness facets, and (3) longitudinally. As outlined in the following, our findings imply that the distinct roles of both personality traits for loneliness might vary depending on which of these three perspectives is taken.

In line with previous research (Buecker et al., 2020), both lower extraversion and higher neuroticism characterized adolescents who felt more lonely as compared to others. Looking at the relative importance of each trait for loneliness, neuroticism was the strongest predictor in Sample 1, but extraversion was the strongest predictor in Sample 2. This difference might originate in the fact that the two samples varied in three important ways. First, in Sample 1 we assessed loneliness with a direct item that required labeling oneself as (more or less) lonely, whereas Sample 2 involved a more indirect measure (i.e., items of the UCLA loneliness scale

(Russell et al., 1980)) which avoids the term *loneliness* (Mund et al., 2020). Even though both types of measures have shown high convergent validity (Mund et al., 2020), a self-concept that involves labeling oneself as lonely might be more closely related to neuroticism at least in adolescence and thus, could explain the stronger association between the trait and the direct measure of loneliness. Second, the loneliness items used in Sample 2 (Russell et al., 1980) refer more to social contents than those in Sample 1. Despite reflecting different aspects of loneliness, both emotional and social loneliness refer to a person's social relationships (i.e., an attachment figure and a social network (Weiss, 1973)) and might therefore explain the stronger association with extraversion. Third, Sample 1 was more diverse with respect to gender and educational background than Sample 2. Given that the function of personality traits can differ for boys and girls (Oberle et al., 2010) and across school tracks (Brandt et al., 2020), extraversion and neuroticism might have played different roles for adolescents' loneliness based on the samples' demographic compositions.

Our results further indicated different cross-sectional patterns across loneliness facets. Whereas both extraversion and neuroticism were associated with emotional loneliness, only extraversion was associated with social loneliness. This finding is largely consistent with previous research (Buecker et al., 2020) and suggests that different behaviors and cognitions might be associated with emotional and social loneliness. Specifically, our results highlight the role of extraversion for feeling embedded into a social network: Adolescents with higher extraversion enjoy to be around others, are talkative and initiate or approach social interactions (Hofstee et al., 1992; Soto & John, 2017) and therefore might find it easier to build a functioning social network. Importantly, previous research indicated that the quantity of social contacts is only weakly associated with loneliness (de Jong Gierveld et al., 2018). Instead, based on the subjective nature of loneliness (Perlman & Peplau, 1981), adolescents' perceived quality of social contacts and their self-identification as someone with good social relationships appears to be more crucial. In the future, studies should aim to identify the processes that are involved in the interplay between personality traits and the two facets of emotional and social loneliness to provide specific support to those adolescents who are more prone to suffer from one or both loneliness types (for an overview on existing loneliness intervention strategies, see (Masi et al., 2011))

We found that longitudinal changes in loneliness mainly related to neuroticism, whereas extraversion seemed to play only a minor role. In line with Mund and Neyer's (Mund & Neyer, 2016) study tracking young adults, our results indicated that adolescents with higher neuroticism were more likely to show an increase in loneliness within the following year. Thus, acting

and feeling in a more anxious and nervous manner, as it is typical for individuals with higher neuroticism (Hofstee et al., 1992; Soto & John, 2017), might be detrimental to the development of social relationships in the long run, for example by fostering insecurity (Deventer et al., 2019) and undermining emotional closeness (Wagner et al., 2014). The role of extraversion, by contrast, might be primarily related to adolescents' momentary experience of their social relationships and loneliness.

In sum, our results suggest that, at the cross-sectional level, both extraversion and neuroticism might be important predictors of loneliness in adolescence. A more differentiated picture appears, however, when looking at facet-specific effects: Both traits were associated with adolescent's emotional loneliness, but only extraversion was linked to social loneliness. Neuroticism, in turn, appears to be particularly relevant to loneliness changes, as suggested by our longitudinal results. Given these differences across loneliness facets and cross-sectional versus longitudinal results, future studies investigating associations between personality traits and loneliness should carefully choose the ways in which loneliness is conceptualized and the time-window during which it is observed.

There is More: Tentative Support for Non-Linear and Interaction Effects

Across both samples and across most loneliness facets, results provided consistent support for linear main effects of extraversion and neuroticism. Specifically, findings mainly supported the Linear Main Effects Hypothesis (cross-sectional analyses) and the Linear Main Effect of Neuroticism Hypothesis (longitudinal analyses). Extending this picture, we also found tentative evidence for a non-linear nature of all of these main effects. In addition, there was some, albeit weak, support for the possibility that the effects of extraversion and neuroticism might mutually depend on each other (i.e., interaction effects).

Stronger Effects at One End of the Scale: Saturating Extraversion and Exponential Neuroticism Effects

The cross-sectional analyses indicated a saturating effect of extraversion (as indicated by the Full Model), such that its negative association with loneliness was weaker for adolescents with very high extraversion scores. To illustrate this effect with the E-N circumplex (Hofstee et al., 1992), being fairly or very high in extraversion, which relates to characteristics of being talkative or assertive, might not make much of a difference for adolescents' loneliness. In contrast, adolescents who are very, rather than only modestly, shy, quiet, and untalkative (i.e., at the low end of extraversion) during social interactions might be much more likely to feel lonely. With respect to neuroticism, our results indicated a non-linear effect in the opposite direction: The effect of neuroticism appeared to be exponential, suggesting that the association between

neuroticism and loneliness was stronger for adolescents with very high neuroticism scores. Again, illustrating this effect with the E-N circumplex (Hofstee et al., 1992), adolescents who are very (rather than only fairly) anxious, moody and high-strung (i.e., at the high end of neuroticism) during social interactions might be especially prone to feeling lonely. In contrast, being modestly or low in neuroticism, which relates to characteristics of being quiet or unenvious, might not make much of a difference for feelings of loneliness.

Altogether, our results provide support for the Saturating Extraversion and Exponential Neuroticism effects hypothesis at the cross-sectional level. This suggests that extraversion and neuroticism might not serve as continuous protection or vulnerability factors for loneliness in adolescence. In the case of extraversion, especially those adolescents with very low trait levels might require help, whereas being at the mid-range might be a sufficient resource against loneliness. Conversely, adolescents with very high neuroticism might be considered as a high-risk group for loneliness, whereas being at the mid-range might reduce this risk dramatically. Given these non-linear associations of extraversion and neuroticism with loneliness, future research and intervention programs should focus on certain areas of each trait's range.

Of note, evidence for these more complex patterns was not conclusive. In the case of extraversion, saturating effects were found to be consistent across samples. At the same time, effects were rather small. In the case of neuroticism, evidence for an exponential effect was relatively strong in Sample 1, but could not be replicated in Sample 2. Instead, findings in Sample 2 even pointed to the possibility that the positive effect of neuroticism on loneliness was saturating, although evidence for this finding was only weak. Again, differences across our two samples might explain these divergent findings. First, inconsistencies might origin in the use of different measures and differences in the samples' demographic compositions. For example, facet-specific analyses in Sample 2 showed that the evidence for a saturating effect of neuroticism was only given for social, but not for emotional loneliness. Accordingly, the way loneliness is conceptualized and measured appears to make a difference. Second, adolescents of Sample 2 scored lower on loneliness than those of Sample 1. Therefore, bottom effects might have disguised an exponential effect of neuroticism on loneliness in Sample 2. Overall, the results involving non-linear effects have to be regarded with caution and further replication attempts should be initiated. In addition, future studies should explore the potential moderating role of used loneliness measures and sample characteristics.

Turning to the longitudinal analyses, the results for Sample 1 extend previous research (Mund & Neyer, 2016) by indicating that the positive effect of neuroticism on loneliness changes might be saturating. This result contrasts the detected cross-sectional associations,

which indicated an exponential risk to experience loneliness for adolescents with higher neuroticism. Thus, higher neuroticism predicted loneliness increases in general, but there was no large difference between adolescents who scored high vs. very high on neuroticism. Possibly, there is a ceiling effect, such that the degree to which loneliness can increase within one year is limited. As an alternative explanation, it should be considered that neuroticism is also recognized as a source of vulnerability in clinical contexts (Wright et al., 2016): Next to feeling lonely, individuals with very high neuroticism are likely to experience other forms of psychological distress (Hansell et al., 2012; Lucas & Diener, 2009; Ormel & Wohlfarth, 1991). Therefore, adolescents who score very high on neuroticism might get help and therefore develop in a similar way as their peers with slightly lower trait scores. Notably, given that we could test for longitudinal associations in one sample only, our findings on neuroticism and loneliness changes need to be replicated in future studies.

Mutual Dependence: Positive Interactions Between Extraversion and Neuroticism

Providing some—albeit weak—support for our predictions based on personality theory (Eysenck & Eysenck, 1985; Hofstee et al., 1992; Hotard et al., 1989), we found initial evidence for interaction effects between extraversion and neuroticism in the prediction of loneliness at the cross-sectional and longitudinal level (as indicated by the corresponding Full Models). Specifically, there was no support for the Mutual Compensation Hypothesis. Neither could higher extraversion buffer the effect of higher neuroticism nor could lower neuroticism buffer the effect of lower extraversion beyond their additive effects. There was, however, some support for the Optimal Constellation Hypothesis in the case of overall loneliness and social loneliness, indicating that the effects of extraversion and neuroticism might reinforce each other. Illustrating this with the E-N circumplex (Hofstee et al., 1992), this would mean that only adolescents who are at the high end of extraversion and at the low end of neuroticism, which relates to acting strong, confident, and indefatigable during social interactions, might have a reduced likelihood to feel lonely. In this combination, the beneficial effects of higher extraversion and lower neuroticism might even go beyond the additive effects of both traits. In contrast, adolescents with all other combinations (i.e., adolescents with either lower extraversion or higher neuroticism) would have a relatively high risk to feel lonely. Moreover, this risk might be even multiplied for those who tend to act self-critical, nervous, and moody (i.e., who are at the low end of extraversion and at the high end of neuroticism (Hofstee et al., 1992)). Thus, while the combination of higher extraversion and lower neuroticism may be a protective factor against loneliness, the individual traits may not be. As such, it might be prudent to pay particular attention to

adolescents who do not possess this combination of trait levels, as they may be at higher risk of feeling lonely.

Altogether, our findings provide first evidence for the existence of positive interaction effects between extraversion and neuroticism. Whereas most effects were only weak and results need to be replicated in both adolescent and non-adolescent samples, the effects of extraversion and neuroticism might not simply add up to a certain loneliness level, but reinforce each other instead. Future research should therefore move beyond the exclusive consideration of linear effects: Although our findings should be considered preliminary, they clearly highlight the importance of considering more complex effects (i.e., non-linear and interaction effects) of personality traits on loneliness in theoretical and statistical models for a more precise understanding of this interplay (Edwards & Berry, 2010).

Implications for Adolescent Development

In addition to our findings on the importance of extraversion and neuroticism for loneliness, our results might have a number of implications for adolescent development. First, loneliness and its facets were relatively stable across one year. Specifically, the stability of loneliness was moderate in Sample 1 and strong in Sample 2 and thus comparable to the stabilities reported by (Vanhalst et al. (2013; *r*s ranging between .40 and .66), who measured loneliness of adolescents across a five-year period (ages 15-20). Accordingly, our findings add further empirical evidence to the definition of loneliness as a trait-like construct (Bartels et al., 2008; Mund et al., 2020).

Second, loneliness did not change at the mean level across one year. This finding is in line with previous longitudinal research (Mund et al., 2020). Nevertheless, it is noteworthy to mention that most participants in Sample 2 transitioned out of high school between the two measurement points. Although this transitions has been related to fundamental changes across different characteristics (Bleidorn, 2012; Lenz, 2001; Lüdtke et al., 2011; Wagner et al., 2014), loneliness of these adolescents did not increase (or decrease) on average. There are at least three explanations for this finding. First, most adolescents in Sample 2 might have had sufficient resources to cope with this important transition. Second, it could be the case that loneliness at this age is only weakly related to environmental as opposed to heritable factors (Bartels et al., 2008). Finally, the time window of the study might have been too small to detect any transition-related changes in loneliness. Whereas it is important to note that these temporal dynamics are not well understood yet and are likely to vary across individuals (Aquilino, 2006), most adolescents might remain in their familiar social environments when finishing school first, and start

to individuate from their parents and contacts from school (Rubin et al., 2006) with some temporal delay. Thus, loneliness changes in this context might not occur right after graduation, but later. To test this possibility, longitudinal studies tracking loneliness of adolescents across their transition out of school and thereafter for a longer time are required.

Third, our findings suggest that adolescents' risk to experience loneliness should normatively decrease as they grow older because, on average, neuroticism decreases on the way from adolescence to young adulthood (Roberts et al., 2006). This is consistent with both theory on the co-development of a mature personality and the successful adaption to new social roles (Roberts & Wood, 2006) and empirical findings on the life-span development of loneliness (Mund et al., 2020; van Roekel et al., 2010). Moreover, our findings imply that personality maturation might primarily reduce the risk to experience emotional loneliness because only this loneliness facet was associated with neuroticism in our data.

Limitations

A number of limitations should be kept in mind when interpreting our results. First, our results were solely based on self-reports. Whereas the subjective experience is a core feature of loneliness (Perlman & Peplau, 1981) and other-ratings of loneliness should be treated with caution when exclusively used (Geukens et al., 2021), our results might be partly based on shared measurement variance (Podsakoff et al., 2003). Therefore, it might be helpful to use other-reports of either personality traits or loneliness. Along these lines, Matthews et al. (Matthews et al., 2021) analyzed data of 18-year olds from a large representative sample from the UK (N = 2,232) and found that the personality-loneliness associations could be established for other-rated extraversion and neuroticism, too. Therefore, we expect that similar patterns as those indicated by our findings would be observed when using other-rated personality traits to predict loneliness.

Second, our longitudinal analyses were based on a relatively short time interval of one year. Therefore, our results cannot inform on how (the interplay of) extraversion and neuroticism may predict adolescents' loneliness changes over the course of several years. In the case of Sample 2, the stability of loneliness was very high and personality did not explain any additional variance after controlling for loneliness at T1. Future studies on individual differences in loneliness should investigate longitudinal effects over the course of several years while at the same time covering not only overall loneliness but additionally differentiating between loneliness facets.

Third, our two samples had different strengths and limitations. Specifically, Sample 1 provided the opportunity to study associations between personality traits and loneliness in a

sample that was relatively large and diverse with regard to education and gender, but the BFI-K (Rammstedt & John, 2005) that was used to assess personality traits represents a relatively short scale and loneliness was assessed with one item only. Whereas both of these measures are economic and widely accepted, scales including more items might be more reliable and provide a more nuanced picture (Schmidt-Atzert & Amelang, 2012). In Sample 2, more differentiated measures of both personality traits (i.e., BFI-2 (Soto & John, 2017)) and loneliness (i.e., four UCLA loneliness scale items (Russell et al., 1980) were used. Whereas these measures provided a broader operationalization of both constructs and the possibility to distinguish between loneliness facets (Weiss, 1973), Sample 2 was smaller and overrepresented female and highly educated adolescents. Therefore, it remains to be clarified whether the results generalize to male adolescents or those from lower school tracks. In addition, using the full UCLA loneliness scale (Russell et al., 1980) instead of four items might lead to more reliable results. By running parallel analyses with two samples, we aimed to account for the limitation of each sample and to provide a broader picture. In future research, however, it would be even better to use data that are based on both large and diverse samples and on differentiated measures.

Conclusions

Our study is the first to examine non-linear and interaction effects of extraversion and neuroticism on loneliness and the first to explore these associations in longitudinal data in adolescence. At the cross-sectional level, we found strong evidence for linear main effects of both traits, with additional hints that the negative effect of extraversion might saturate and that the positive effect of neuroticism might be exponential. Importantly, both personality traits were associated with overall loneliness and emotional loneliness, but only extraversion was related to social loneliness. Longitudinally, our findings suggested that only neuroticism predicted loneliness changes and provided tentative evidence for a saturating nature of this effect. Finally, there was some (albeit weak) evidence for positive interaction effects between extraversion and neuroticism. Our results contribute to a more nuanced and integrative understanding of the way personality relates to loneliness in adolescence. They also emphasize the importance of differentiating between emotional and social aspects of loneliness. To conclude, we hope that our study inspires future research to investigate the interplay between personality traits and loneliness in a more nuanced and integrative manner. As a next step, we propose that studies with large and diverse samples, tracking adolescents' personality traits and loneliness across several years and measurement points are required in order to shed further light on these more complex associations.

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Appendix

Table A1

Hypotheses and Corresponding Polynomial Regression Models

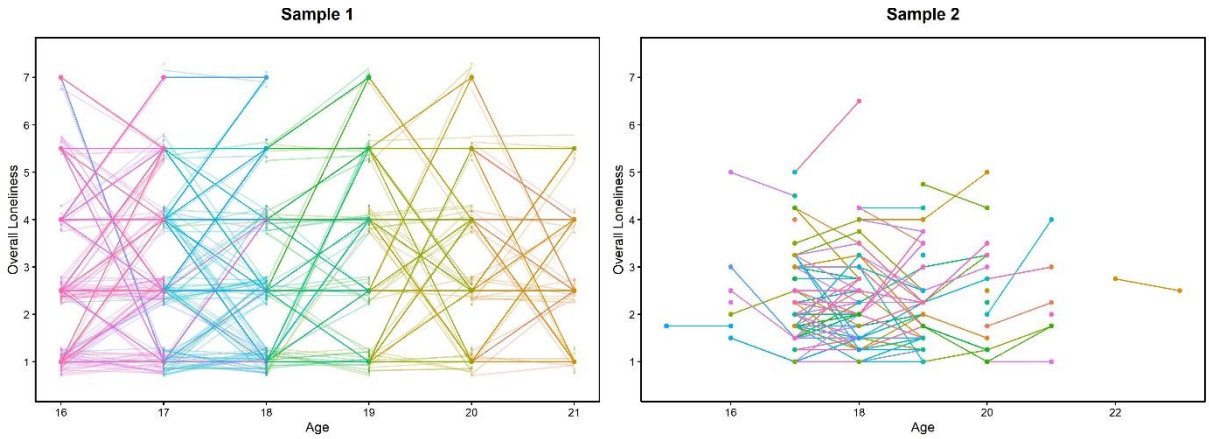
Nr.	Hypothesis	Model name: Corresponding model constraints imposed on the coefficients of the full second-order polynomial model $L_n = b_0 + b_1E_n + b_2N_n + b_3E_n^2 + b_4E_nN_n + b_5N_n^2$	Figure
1		Null Model: $b_1 = b_2 = b_3 = b_4 = b_5 = 0$	
2		Full Model: No constraints	
	Linear main effects		
3	**Lower extraversion and higher neuroticism are linearly related to higher loneliness**	**Linear Main Effects Model:** **$b_1 < 0, b_2 > 0, b_3 = b_4 = b_5 = 0$**	**2a**
4	Lower extraversion is linearly related to higher loneliness; no effect of neuroticism	Linear Main Effect of Extraversion Model: $b_1 < 0, b_2 = b_3 = b_4 = b_5 = 0$	
5	Higher neuroticism is linearly related to higher loneliness; no effect of extraversion	Linear Main Effect of Neuroticism Model: $b_2 > 0, b_1 = b_3 = b_4 = b_5 = 0$	
	Monotonous but non-linear models		
6	Higher extraversion relates to lower loneliness and this saturates; no effect of neuroticism	Saturating Effect of Extraversion Model: $b_3 > 0, -b_1 > 2b_3E_{max}, b_2 = b_4 = b_5 = 0$	
7	Higher extraversion relates to lower loneliness and this effect is exponential; no effect of neuroticism	Exponential Effect of Extraversion Model: $b_3 < 0, -b_1 > 2b_3E_{min}, b_2 = b_4 = b_5 = 0$	
8	Higher neuroticism relates to higher loneliness and this effect is exponential; no effect of extraversion	Exponential Effect of Neuroticism Model: $b_5 > 0, -b_2 < 2b_5N_{min}, b_1 = b_3 = b_4 = 0$	
9	Higher neuroticism relates to higher loneliness and this effect saturates; no effect of extraversion	Saturating Effect of Neuroticism Model: $b_5 < 0, -b_2 < 2b_5N_{max}, b_1 = b_3 = b_4 = 0$	
10	**Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of extraversion saturates.**	**Saturating Extraversion and Linear Neuroticism Effects Model:** **$b_2 > 0, b_3 > 0, -b_1 > 2b_3E_{max}, b_4 = b_5 = 0$**	**2b**
11	Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of extraversion is exponential.	Exponential Extraversion and Linear Neuroticism Effects Model: $b_2 > 0, b_3 < 0, -b_1 > 2b_3E_{min}, b_4 = b_5 = 0$	
12	**Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of neuroticism is exponential.**	**Linear Extraversion and Exponential Neuroticism Effects Model:** **$b_1 < 0, b_5 > 0, -b_2 < 2b_5N_{min}, b_3 = b_4 = 0$**	**2c**

13	Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of neuroticism saturates.	Linear Extraversion and Saturating Neuroticism Effects Model: $b_1 < 0, b_5 < 0, -b_2 < 2b_5N_{max}, b_3 = b_4 = 0$	
14	**Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of extraversion saturates while the effect of neuroticism is exponential.**	**Saturating Extraversion and Exponential Neuroticism Effects Model: $b_3 > 0, b_5 > 0, -b_1 > 2b_3E_{max}, -b_2 < 2b_5N_{min}, b_4 = 0$**	**2d**
15	Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effect of extraversion is exponential while the effect of neuroticism saturates.	Exponential Extraversion and Saturating Neuroticism Effects Model: $b_3 < 0, b_5 < 0, -b_1 > 2b_3E_{min}, -b_2 < 2b_5N_{max}, b_4 = 0$	
16	Lower extraversion and higher neuroticism are monotonously related to higher loneliness and the effects of both traits saturate.	Saturating Effects of Extraversion and Neuroticism Model: $b_3 > 0, b_5 < 0, -b_1 > 2b_3E_{max}, -b_2 < 2b_5N_{max}, b_4 = 0$	
17	Lower extraversion and higher neuroticism are monotonously related to high loneliness and the effects of both traits are exponential.	Exponential Effects of Extraversion and Neuroticism Model: $b_3 < 0, b_5 > 0, -b_1 > 2b_3E_{min}, -b_2 < 2b_5N_{min}, b_4 = 0$	
	Linear interactions (mutual dependence)		
18	**Lower extraversion and higher neuroticism are linearly associated with higher loneliness and both effects buffer each other.**	**Mutual Compensation Model: $b_4 < 0, b_1 + b_4N_{min} < 0, b_2 + b_4E_{max} > 0, b_3 = b_5 = 0$**	**2e**
19	**Lower extraversion and higher neuroticism are linearly associated with higher loneliness and both effects reinforce each other.**	**Optimal Constellation Model: $b_4 > 0, b_1 + b_4N_{max} < 0, b_2 + b_4E_{min} > 0, b_3 = b_5 = 0$**	**2f**

Note. In the statistical Models, L_n denotes the outcome variable loneliness, and E_n and N_n denote the predictor variables extraversion and neuroticism, respectively. E_{min}/E_{max} = minimal/maximal value of extraversion in the data, N_{min}/N_{max} = minimal/maximal value of neuroticism in the data. The constraints that involve E_{min}, E_{max}, N_{min}, and/or N_{max} ensure that the Model's predictions are in line with the respective hypothesis for the whole range of realistic predictor values, where the empirically observed values are used as a proxy for the range that is realistic. In the longitudinal analyses, L_n measured at T2 served as outcome variable and L_n measured at T1 were added as a control variable. Hypotheses and Models in bold were included in the initial hypothesis set.

Figure A1

Individual Changes of Loneliness Between T1 and T2 Plotted Over Age



Note. The colored dots and lines represent individual scores of overall loneliness. In Sample 1, loneliness was assessed with a one-item measure and the plot is based on data of N = 283 adolescents who participated at T1 and T2. To avoid overplotting and to illustrate the distribution of values within this sample, we added transparent dots and lines, which represent the true values plus noise. In Sample 2, overall loneliness was computed from the average of four items and the plot is based on data of N = 129 adolescents who participated at T1 and T2. Please note that whereas loneliness is plotted over age for illustrative purposes, statistical models were estimated over measurement points of the study.

5. General Discussion

The present dissertation aims at improving our understanding of the complex interplay between adolescents' personality and their social relationships. To this end, I conducted three studies that investigated how personality relates to different socio-emotional outcomes on the three levels (micro, meso, and macro) in adolescent social relationships. At the micro level, Study 1 provides insights into the perceived social interaction behaviors that mediate the relationship between adolescents' personality traits and momentary social satisfaction. At the meso level, Study 2 contributes to a better understanding of interactions between adolescents' personality and their social environment by investigating the joint role of neuroticism and romantic relationship variables for momentary affect. Finally, at the macro level, Study 3 extends the linear view on the association between personality and social relationships in adolescence by investigating how the interplay between neuroticism and extraversion relates to individual differences in loneliness. Altogether, the three studies contribute to a better understanding of the dynamic interplay characterizing the association between personality and social relationships in adolescence. In the following, I summarize the most central findings of each study, discuss their theoretical and methodological implications, and outline recommendations for supporting positive social experiences in adolescence. I close this chapter with a critical discussion of the limitations of this dissertation and an outlook on future research in the field of personality and social relationships in adolescence.

5.1. Central Findings

In the three empirical studies of this dissertation, I investigated the association between social relationships in adolescence on different levels and timelines and with respect to different social contexts and socio-emotional outcomes. In line with the three overarching research aims of this dissertation, the central findings focus on the role of neuroticism, extraversion, and agreeableness for adolescents' experiences in social relationships (first research question), the underlying mechanisms (second research question), and the more complex patterns within this interplay (third research question). In addition, I recapitulate insights from exploratory findings regarding personality facets and more specific socio-emotional outcome measures.

5.1.1. The Role of Personality for Adolescents' Experiences in Social Relationships

Across the three studies of this dissertation, findings revealed that neuroticism was mainly associated with negative socio-emotional outcomes, whereas extraversion and agreeableness showed beneficial effects. Specifically, neuroticism was linked to lower momentary

social satisfaction (Study 1), lower levels of momentary positive affect, higher levels of momentary negative affect, and higher affect variability (Study 2), as well as higher loneliness (Study 3). In contrast, higher extraversion related to higher momentary social satisfaction (Study 1) and lower loneliness (Study 3), and higher agreeableness was associated with higher momentary social satisfaction (Study 1). In general, these results are in line with previous research studying the interplay between personality and social relationships in adolescence regarding broader socio-emotional outcomes (e.g., Asendorpf & Wilpers, 1998; Parker et al., 2012; Wagner et al., 2014). Extending these findings, the results of this dissertation demonstrate that personality is an important ingredient of social relationships at all three relationship levels (i.e., micro, meso, and macro) and with respect to both short- and long-term (i.e., momentary and one-year) associations. Furthermore, the three studies making up this dissertation extend existing research using adult samples (e.g., Eid & Diener, 1999; Mueller et al., 2019; Mund & Neyer, 2016) to middle and late adolescent samples, pointing to a number of parallel functions of personality for socio-emotional outcomes in adulthood and middle to late adolescence.

While Study 1 sheds light on the role of personality for adolescents' social interactions with respect to neuroticism, extraversion, and agreeableness, the other two studies in this dissertation focused on one or two of these personality traits. This way, the findings of Studies 2 and 3 provide additional insights into the roles of neuroticism and extraversion for socio-emotional outcomes in adolescence. Regarding adolescents' momentary affect, Study 2 shows that neuroticism emerges as a more powerful predictor than romantic relationship variables: Whereas the personality trait explained considerable amounts of variance in both adolescents' affect level and affect variability, comparing adolescents with and without a romantic partner revealed no differences regarding their average level of momentary positive and negative affect. Nonetheless, in line with the findings by Larson et al. (1980), adolescents in a current romantic relationship experienced higher variability in their positive and negative affect compared to their single peers, but this effect was only small and inconsistent in the case of positive affect. Moreover, among adolescents in a current relationship, higher relationship quality tended to go along with the experience of less negative momentary affect, more positive momentary affect, and lower affect variability, but these effects were not significant when concurrently considering neuroticism. Thus, it seems that in the short run at least, the main effects of adolescent personality on momentary affect exceed those of romantic relationships. Regarding adolescents' loneliness, findings of Study 3 pointed to differences between cross-sectional and longitudinal effects, such that both neuroticism and extraversion were cross-sectionally related to adolescents' loneliness, but only neuroticism predicted subsequent one-year changes. These

findings are in line with initial research based on adult participants (Mund & Neyer, 2016) and suggest that neuroticism and extraversion may have different functions concerning current social experiences versus socio-emotional development in adolescence. I address this finding in more detail below (see Implications for Supporting Positive Social Experiences in Adolescence).

Overall, adolescents' neuroticism, extraversion, and agreeableness emerged as powerful predictors of individual differences in a range of socio-emotional outcomes, highlighting the relevance of personality to adolescents' experiences in social relationships. While this link holds within the context of adolescents' relationships in general and their romantic relationships specifically, the effects of specific traits seem to differ between cross-sectional and longitudinal associations. As discussed in the following, this picture can be further differentiated, as analyses of the three studies making up this dissertation reveal insights into underlying mechanisms, more complex patterns, and differences across personality facets and more detailed measures of socio-emotional outcomes.

5.1.2. Underlying Mechanisms: The Role of Perceived Social Interaction Behavior

Zooming in on the micro level of social interactions, the results of Study 1 provide important insights into the specific momentary perceptions and behaviors that mediate the association between personality traits and social satisfaction in adolescents' daily life. This way, Study 1 contributes to a better understanding of the mechanisms underlying the interplay between personality and social relationships (see Back et al., 2011). First, adolescents distinguished between expressive, communal, and dominant behavior displayed by themselves and their interaction partners during their daily social interactions. Whereas these perceptions align with the theoretical concepts of agency and communion (Bakan, 1966; Wiggins, 1991) and initial research using adult samples (Geukes et al., 2017; Leising & Bleidorn, 2011), Study 1 is the first to form empirically derived indices capturing a wide range of naturally occurring perceived behaviors in adolescents' daily social interactions. Second, only perceptions of expressive and communal behavior but not perceptions of dominant behavior mediated the association between adolescents' personality traits and their momentary social satisfaction. Accordingly, the three perceptions appear to have different functions, such that only perceptions of expressive and communal behavior are involved in the mechanisms underlying the association between personality and social relationships in adolescence. Perceptions of dominant behavior, in contrast, seems to play only a minor role within this interplay. Third, in the case of neuroticism, the trait's negative association with momentary satisfaction was only mediated by perceptions of less expressive behavior. In contrast, in the case of extraversion and agreeableness, both

perceptions of more expressive and more communal behavior explained the traits' positive associations with momentary social satisfaction. Accordingly, findings suggest that the specific mediation processes differ across personality traits with respect to the types of perceived behaviors that function as mediators. Finally, across all traits, findings were the same regardless of the fact whether perceptions of their own or their interaction partner's interpersonal behavior were used as mediators. Thus, the results provide no evidence for differences between mediation effects corresponding to adolescents' perceptions of themselves and the other person.

In sum, the findings of Study 1 emphasize that although adolescents are capable of perceiving a range of distinct behaviors during social interactions, only perceptions of expressive and communal behavior play a key role in explaining how personality relates to individual differences in social relationships. Importantly, results suggest that the specific underlying mechanisms differ across personality traits, such that different types of perceived behaviors mediate the association between each trait and momentary social satisfaction. Given that Study 1 is the first study of its kind on this topic, future research needs to replicate these findings and extend knowledge on underlying meachanisms to other age groups.

5.1.3. More Complex Patterns: Non-Linear Effects and Interactions

Broadening the scope of this dissertation to the meso and macro level, respectively, Studies 2 and 3 go beyond the study of linear main effects of personality on social relationships in adolescence. This way, the findings of both studies reveal more complex patterns within the interplay between personality and social relationships that have been neglected in previous research. Specifically, the results of Study 2 shed light on interactions between adolescents' personality and their social environment, whereas Study 3 shows evidence for non-linear effects and interactions between adolescents' personality traits.

First, at the meso level, Study 2 investigated how the interplay between neuroticism and romantic relationship variables relates to individual differences in momentary affect. Results suggest that, among adolescents who are currently involved in a romantic relationship, neuroticism moderates the relationship between relationship quality and variability of positive affect. Specifically, a positive interaction between neuroticism and relationship quality indicates that those adolescents with higher relationship quality experienced higher variability in momentary positive affect if they scored higher in neuroticism. No corresponding link was found with respect to momentary negative affect. There are at least two ways to interpret this pattern of findings: The first interpretation assumes that higher relationship quality reduces the variability in adolescents' momentary positive affect, although this effect was not significant in all models. Converging with literature emphasizing affective instability as a core component of neuroticism

(e.g., Barlow et al., 2014; Denissen & Penke, 2008b), the interaction may then reflect that positive affect of individuals with (very) high trait levels fluctuates strongly even if the quality of their romantic relationship is high. As an alternative, the second interpretation aligns with initial evidence showing that neuroticism might act as a potential resource in social relationships through heightened sensitivity to positive social cues (Lay & Hoppmann, 2014; Mueller et al., 2021). As such, the positive interaction between neuroticism and relationship quality might reflect that adolescents with higher neuroticism are more sensitive to positive situations in their romantic relationship and therefore experience more variability in their positive affect. Whereas these possible interpretations require further research, Study 2 highlights the relevance of considering interactions between personality and the social environment when investigating the interplay between personality and social relationships in adolescence. Adding to previous research with adult samples illustrating that neuroticism can reinforce an individual's affective reactions to social cues (Denissen & Penke, 2008a; Lay & Hoppmann, 2014; Mueller et al., 2019, 2021), the findings reported in this dissertation suggest that neuroticism has particular relevance for affective experiences within the context of adolescents' romantic relationships, too.

Second, at the macro level, Study 3 examined how the interplay between neuroticism and extraversion relates to loneliness in adolescence. The results generally align with early theoretical notions predicting that the effects of neuroticism and extraversion interact (Eysenck & Eysenck, 1985; Hofstee et al., 1992; Hotard et al., 1989). However, it is the first study to explicitly test for and reveal such more complex patterns with respect to individual differences in loneliness. Importantly, findings suggest that the specific nature of these effects differs across cross-sectional and longitudinal associations. At the cross-sectional level, neuroticism had an exponential effect, indicating that the positive association between neuroticism and loneliness is most pronounced among adolescents at the higher end of the neuroticism spectrum. In contrast, adolescents with very or modestly low levels of neuroticism seem to differ only slightly in their loneliness. Unlike the exponential effect of neuroticism, the effect of extraversion was saturating, meaning that the negative association between extraversion and loneliness is most pronounced among adolescents at the lower end of the extraversion spectrum. In contrast, adolescents with fairly or very high levels of extraversion seem to differ only slightly in their loneliness. Accordingly, the higher end of neuroticism and at the lower end of extraversion appear to be most informative, suggesting that individual differences in these areas of each trait's spectrum have the largest implications for the risk to experience loneliness in adolescence. Besides

highlighting these non-linear effects, results provided tentative evidence for a positive interaction between neuroticism and extraversion, suggesting that the risk of experiencing loneliness might be multiplied for those adolescents who score higher on neuroticism while being lower in extraversion.

Representing an important asset, Study 3 also investigated how the interplay between neuroticism and extraversion relates to one-year changes in adolescents' loneliness. Standing in contrast to the cross-sectional results, the longitudinal analyses revealed that the positive effect of neuroticism was saturating. Accordingly, the trait's predictive effect on changes in loneliness seems to be most pronounced at the lower end of the neuroticism spectrum, whereas adolescents at the higher end of neuroticism do not differ much from each other in how much their loneliness increases over a year. This might reflect a ceiling effect, such that the degree to which loneliness can increase within one year is limited, especially among adolescents who are already higher in loneliness at baseline. Alternatively, adolescents with very high neuroticism scores might receive help from clinical professionals because they also tend to be prone to other forms of psychological distress (e.g., Hansell et al., 2012) and therefore show similar increases in loneliness as adolescents with slightly lower neuroticism scores. Altogether, by highlighting non-linear effects and interactions between neuroticism and extraversion, the findings of Study 3 extend the large body of research on linear associations between personality and loneliness (Buecker et al., 2020; Mund & Neyer, 2016; Vanhalst et al., 2013).

5.1.4. Mind the Detail: Personality Facets and Specific Socio-Emotional Outcomes

Besides the analysis of overall scores, this dissertation pursued a higher resolution by differentiating across personality facets (McCrae, 2015; Soto & John, 2017) and more specific socio-emotional outcomes (e.g., Watson & Clark, 1997; Weiss, 1973). Across the three studies, findings underline the relevance of minding these details for grasping the link between personality and social relationships in adolescence.

First, Studies 1 and 2 explored the role of adolescents' personality facets for their experiences in social relationships in addition to the role of the overall scores of each personality trait. Although a growing number of researchers has underlined the relevance of personality facets for understanding the role of personality for psychological outcomes in general (e.g., McCrae, 2015; Mõttus, 2016) and the link between personality and social relationships in particular (e.g., Mueller et al., 2019; Mund & Neyer, 2014), corresponding research is still in its infancy, especially in adolescence. This way, the results of Studies 1 and 2 represent an important extension of the current empirical literature on personality facets and social relationships (e.g., Deventer et al., 2019; Kroencke et al., 2020; Mund & Neyer, 2014). Regarding

adolescents' momentary social satisfaction, Study 1 highlights the relevance of selected personality facets corresponding to neuroticism, extraversion, and agreeableness. Specifically, depression seemed to account for the effect of neuroticism, activity for the effect of extraversion, and compassion for the effect of agreeableness. In contrast, the effects of anxiety and volatility (neuroticism), sociability and assertiveness (extraversion), and respectfulness and trust (agreeableness) were less consistent. As such, findings suggest that the effects of neuroticism, extraversion, and agreeableness on adolescents' momentary social satisfaction are driven by one facet per trait. Regarding adolescents' momentary affect, Study 2 sheds further light on the differential meaning of the facets of neuroticism. Whereas depression explained the largest amounts of variance in the mean level and variability of adolescents' momentary affect, volatility could explain at least variance. The findings regarding affect level align with the definition of the depression facet, which describes the tendency to feel sad and low on energy (Soto & John, 2017). In contrast, the comparably weak association between the volatility facet, which defines the tendency to experience volatile mood swings (Soto & John, 2017), and affect variability is rather surprising although it converges with previous findings in an adult sample (Kroencke et al., 2020). Given this inconsistency between the construct definition of volatility and empirical findings, future research needs to clarify what the volatility facet measured with the BFI-2 (Danner et al., 2019; Soto & John, 2017) captures and to what degree people have self-insights into the variability of their own affect.

Altogether, the findings of Studies 1 and 2 underline the distinct meanings of personality facets and provide important insights into the more narrowly defined thoughts, feelings, and behaviors, which are involved in the association between personality and specific socio-emotional outcomes. At the same time, it should be noted that Studies 1 and 3 are among the first studies that examine the association between personality and social relationships in adolescence at the facet level (cf. Deventer et al., 2019). Accordingly, the facet-specific findings should be seen as initial evidence that needs to be replicated in future research.

Second, Studies 2 and 3 explored whether the effects of personality differed across more specific socio-emotional outcomes. Comparing findings regarding adolescents' momentary affect, Study 2 showed that neuroticism explained more variance in adolescents' affect level compared to their affect variability. Whereas this finding is consistent with current discussions illustrating that the association between neuroticism and affect level is more established than its link with affect variability (Hisler et al., 2020; Wenzel & Kubiak, 2020), it highlights the relevance of differentiating between both aspects of momentary affect. As a second difference between specific measures of momentary affect, findings differed with respect to the variability

of positive and negative affect. Regarding main effects of adolescents' personality, neuroticism was more strongly related to individual differences in the variability of negative affect as compared to the variability of positive affect. This is in line with the definition of neuroticism, which emphasizes the trait's particular relevance for experiencing and handling stress (Barlow et al., 2014; Costa & McCrae, 1980) and with previous empirical findings suggesting that personality primarily relates to interindividual differences in the variability of momentary negative affect (Eid & Diener, 1999). Regarding interactions between adolescents' personality and their social environment, in contrast, the interplay between neuroticism and relationship quality was only related to individual differences in the variability of positive affect but not the variability of negative affect. Accordingly, the conjoint consideration of personality and social relationship variables might be particularly relevant to understand individual differences in the variability of positive affect. Altogether, these findings further support the conceptualization of positive and negative affect as independent constructs (Watson & Clark, 1997). Comparing findings regarding adolescents' emotional and social loneliness (Weiss, 1973), Study 3 revealed that both higher neuroticism and lower extraversion were related to emotional loneliness, while only lower extraversion was related to social loneliness. This finding sheds light on the distinct contributions of neuroticism and extraversion to adolescents' overall experience of loneliness, with extraversion being particularly relevant to feeling embedded into a social network, and highlights the relevance of analyzing emotional and social loneliness as separate constructs (Weiss, 1973; also see Schermer & Martin, 2019; Vanhalst et al., 2012).

Altogether, the findings of Studies 2 and 3 suggest that many socio-emotional outcomes are—similar to personality traits—multidimensional constructs. Whereas the use of aggregate measures may disguise effects, differentiating across more specific socio-emotional outcomes can make an important contribution towards understanding the dynamic interplay between personality and social relationships in adolescence in more detail.

5.2. Theoretical Implications

By demonstrating the close link between personality and social relationships in adolescence with respect to a range of socio-emotional outcomes, the findings of all three studies generally align with both circumplex models of interpersonal behavior (Hofstee et al., 1992; Wiggins, 1980) and dynamic models on personality and social relationships (e.g., Back et al., 2011; Neyer & Asendorpf, 2001). Furthermore, by both supporting more specific assumptions of these models and pointing to possible extensions, they advance the theoretical understanding

of the association between personality and social relationships in adolescence in five important ways.

First, Study 1 provides strong support for a key assumption of the PERSOC framework (Back et al., 2011) by demonstrating that the effects of personality on momentary social satisfaction are mediated through perceptions of interpersonal behaviors during social interactions. By identifying perceptions of expressive and communal behaviors as relevant mediators and highlighting trait-specific mediation processes, the findings make an important step towards further specifying the framework's predictions on mechanisms underlying the interplay between personality and social relationships in adolescence. Moreover, the findings on adolescents' perceptions of their own and their interaction partner's behavior support and extend assumptions from the interpersonal circumplex model (Kiesler, 1983; Wiggins, 1980). Reflecting *interpersonal complementarity*, adolescents' perceptions of their own and their interaction partner's behavior were negatively related to each other concerning dominant behavior, suggesting that acting dominant elicits submissive behavior in the interaction partner. Reflecting *interpersonal correspondence*, in contrast, corresponding perceptions concerning communal behavior were positively related to each other, suggesting that acting communally elicits similar behavior. While these findings are in line with previous research (Fournier et al., 2008), adolescents' self- and other perceptions of expressive behavior were also positively related to each other. This refines previous predictions from the interpersonal circumplex model and illustrates that expressive behavior, which falls at the intersection of agency and communion, also appears to follow the principle of interpersonal correspondence and elicit similar behavior (also see Schauf et al., 2022).

Second, in line with the dynamic-interactional paradigm (Caspi, 1998; Magnusson, 1990; Neyer & Asendorpf, 2001), Study 2 highlights that the association between personality and social relationships in adolescence is characterized by interactions between adolescents' personality and their social environment. Specifically, by revealing that neuroticism moderates the association between relationship quality and the variability of adolescents' positive affect, findings provide empirical support for conceptualizing neuroticism as a trait that shapes an individual's affective responses to social cues (Denissen & Penke, 2008b; Holmes, 2002). In line with findings in late adulthood (Mueller et al., 2021), the results of Study 2 demonstrate that this does not only apply to negative social cues, such as cues of exclusion or social threat (see Denissen & Penke, 2008a) but also to social cues with positive valence (i.e., relationship quality). At the same time, Study 2 provides no evidence for an interaction between neuroticism and relationship involvement. As such, the moderating effect of neuroticism seems to primarily

apply to social cures with a certain valence (i.e., positive or negative), but not to broader relationship features, such as having a certain type of relationship or not. Finally, the results of Study 2 further refine the concept of neuroticism by showing that its moderating effect on affective responses to social cues may not only pertain to the *level* of momentary affect, as shown in previous research (Denissen & Penke, 2008a; Mueller et al., 2019, 2021), but may also extend to the *variability* of momentary affect.

Third, Study 3 highlights the usefulness of the AB5C model (Hofstee et al., 1992), which conceptualizes the interplay between two Big Five traits in the form of an interpersonal circumplex. Specifically, by revealing interactions between neuroticism and extraversion, findings of Study 3 demonstrate that Hofstee's neuroticism-extraversion circumplex defined within the AB5C model is a fruitful approach for studying individual differences in loneliness. When examining individual differences in other socio-emotional outcomes than loneliness, different trait combinations specified within the AB5C model may be more relevant: For example, previous research on interpersonal aggression points to the relevance of interactions between neuroticism and agreeableness (Ode et al., 2008; Ode & Robinson, 2007), which can be conceptualized with the corresponding circumplex model (i.e., the neuroticism-agreeableness circumplex). Going beyond the assumptions of the AB5C model (Hofstee et al., 1992), the findings of Study 3 further emphasize that the associations between personality traits and social relationships can be non-linear. By depicting the effects of two personality traits on interpersonal behaviors in a two-dimensional space, the AB5C model may suggest that these effects are linear. To reflect non-linear relationships, theoretical frameworks on specific socio-emotional outcomes could extend the AB5C model to a three-dimensional space: As in the original model, this framework could map interpersonal behavior within a circumplex that defines the intersection of two traits represented by two dimensions. Going beyond the original model, the strength of associations between these interpersonal behaviors and the socio-emotional outcome could then be depicted on a third dimension. Using the example of loneliness as a socio-emotional outcome, such an extended version of the neuroticism-extraversion circumplex could reflect that the effect of neuroticism can be exponential and that the effect of extraversion can be saturating, as has been found in Study 3.

Fourth, findings of all three studies show that circumplex models of interpersonal behavior (Hofstee et al., 1992; Wiggins, 1980) and the dynamic models on personality and social relationships (Back et al., 2011; Denissen & Penke, 2008b; Neyer & Asendorpf, 2001) can be applied to middle and late adolescence. At the same time, it is important to note that adolescence represents a time of rapid changes with respect to both biological and environmental factors

(e.g., Dahl et al., 2018). Correspondingly, associations between personality and social relationships in adolescence might underlie more rapid changes than in later periods of life and thus require consideration within shorter time intervals. Moreover, adolescents relocate their focus from relationships with parents to relationships with same-aged others outside their family (Rubin et al., 2006; Smetana et al., 2006) and this shift also manifests in their biological constitution, such as heightened sensation seeking and sensitivity to feedback from peers (e.g., Blakemore, 2012; Steinberg, 2005). These developmental processes may regulate which social cues are perceived and with which valence they are perceived. For example, first experiences with romantic relationships often occur in adolescence and might thus provide particularly salient social cues during this period of life (Collins, 2003). Along these lines, Study 2 illustrates the benefits of jointly considering literature from personality and developmental psychology, by showing that neuroticism, romantic relationships, and their interplay contributed to individual differences in adolescents' momentary affect. To date, however, a theoretical framework that guides research on the specific interplay between personality and social relationships in adolescence is absent. Existing theories and frameworks thus need to add a developmental perspective that accounts for age-specific social needs and relationships. As Back et al (2023) note, one challenge here is to enable a broad and diverse consideration of concepts from different fields of research, while remaining parsimonious and finding a common language to integrate those different concepts.

Fifth, an important task for future theoretical and empirical research on personality and social relationships in adolescence is to examine the meaning of within-person variability of affect and within-person variability more generally. Although the general interest in within-person variability has increased sharply in recent years in personality research (see Beck & Jackson, 2021), the concept is still poorly understood (see Back et al., 2023). In research on neuroticism, higher affect variability is typically interpreted as higher affective instability and stress (e.g., Bolger & Schilling, 1991; Miller et al., 2009; Suls & Martin, 2005). Variability in momentary affect can, however, also be seen as a sign of flexibility, reflecting adaptive responses to changing situations (Geukes et al., 2017). As such, Geukes et al. (2017) highlight the need to differentiate between variability within certain types of social situations (reflecting inconsistency) and across different types of social situations (reflecting flexibility versus rigidity). Besides these differences referring to the specific social situations in which variability is observed, another challenge for research is that its meaning may differ across developmental contexts and time scales (i.e., short- versus long-term effects). For example, Study 2 revealed that adolescents in a romantic relationship experienced higher affect variability than their single

peers. In the short run, this finding may reflect heightened stress in daily life relating to the romantic relationship, such as insecurity regarding one's feelings towards the romantic partner (Welsh et al., 2003). Yet, in the long run, experiencing higher affect variability may broaden adolescents' affective spectrum and provide a unique learning context for the acquisition of affect regulation strategies (see Furman et al., 2008; Rosenblum & Lewis, 2003). Finally, the consequence of within-person variability likely differs across specific psychological outcomes (Back et al., 2023). Looking at other variables than momentary affect, future research on personality and social relationships in adolescence could examine the role of variability concerning other socio-emotional outcomes, such as momentary social satisfaction or (momentary) loneliness, or concerning adolescents' interpersonal perceptions and behaviors (see Bühler et al., 2020; Sadikaj et al., 2015). To conclude, more research is needed that investigates individual differences in within-person variability across different social situations, developmental contexts, time scales, and psychological outcomes. In this regard, one important next step will be to develop a theoretical framework to direct future investigations on within-person variability in the context of associations between personality and social relationships in general and in adolescence in particular.

5.3. Methodological Implications

The current dissertation offers several insights of methodological relevance. In the following, I discuss three implications regarding the measurement and statistical modeling of the association between personality and social relationships in adolescence.

First, the results of this dissertation demonstrate that measuring the association between adolescents' personality and their social relationships on different levels (i.e., micro, meso, macro) and time scales (i.e., short- and long-term) yields insights that complement each other on the descriptive, explanatory and predictive level. This highlights the relevance of multimethod studies that combine trait questionnaires with experience sampling and the use of multilevel modeling approaches (Bolger & Laurenceau, 2013; Mehl & Conner, 2012). Importantly, this includes statistical approaches that allow modeling of individual differences in within-person variability across time in addition to individual differences in the mean level of socio-emotional outcomes (e.g., Hedeker et al., 2009; McNeish, 2021), although how variability should be modeled is still under debate (see Beck & Jackson, 2021; Wenzel et al., 2022). Second, the results of this dissertation support the relevance of non-linear associations and interaction terms within the interplay between personality and social relationships in adolescence. To account for

the complexity of this interplay, statistical models need to include non-linear effects and interaction terms in addition to linear effects (see Chaplin, 1997). Third, findings highlight that some associations between personality and social relationships in adolescence are specific to certain personality facets or sub-components of socio-emotional outcomes. Therefore, research on the interplay between personality and social relationships in adolescence needs to consider nuanced measures of both personality and socio-emotional outcomes (see Mund & Neyer, 2014). When studying broader psychological constructs, facet-specific analyses should supplement the analysis of overall scores.

Whereas these implications for measurement and analysis seem necessary for a detailed and accurate understanding of the interplay between personality and social relationships, their concurrent consideration would result in very complex statistical models. In this context, two practical considerations are important. The first consideration refers to the requirements for statistical power and computational capacities which both increase immensely as models get more complex (Aiken & West, 1991; J. Cohen et al., 2003). Although technical advances allow for both easier data collection and better data processing (e.g., Gosling & Mason, 2015; Stachl et al., 2020, 2021), assessing many variables in a nuanced manner via self-report comes along with a high participant burden and therefore should be limited. Moreover, it may remain challenging to draw large samples that provide sufficient statistical power from adolescent populations for reasons such as concerns about research ethics or possible lack of interest in study participation (e.g., Faden et al., 2004; Poole & Peyton, 2013).

The second consideration refers to the need for communicability and practical utility that has to be balanced with the complexity of statistical models and their results (Chaplin, 1997). Specifically, as models get more complex, they tend to become more accurate, but the corresponding presentation of results also gets less parsimonious and harder to understand. Whether this trade-off should lean more towards complexity and accuracy versus parsimoniousness differs across research aims (i.e., description, explanation, prediction; see Mõttus et al., 2020). In the case of description, Mõttus et al. (2020) propose that researchers should provide highly detailed information since parsimonious summaries can always be extracted from detailed findings while the opposite direction is not possible. In research on the link between personality and social relationships in adolescence, for example, this can be easily achieved by adding tables on facet-specific associations. Nonetheless, in the case of explanation and prediction, filtering for relevant variables and statistical terms seems more necessary because the results of statistical models become too difficult to present and interpret otherwise. To find (causal) explanations, it is thus recommendable to focus on specific constructs (see McCrae,

2015; Mõttus et al., 2020) and statistical relationships among variables that are based on theory. For example, researchers studying the interplay between personality and social relationships can ask themselves which personality facets or which dimensions of a socio-emotional outcome most closely reflect a hypothesized mechanism. Similarly, theory should guide whether non-linear and interaction effects should be expected. For predictive purposes, the choice of predictor variables as well as non-linear and interaction terms that are included in a statistical model may be based on the additional amount of variance that they explain (Mõttus et al., 2020).

To summarize, research on the interplay between personality and social relationships in adolescence may be advanced by assessing social relationships on different levels and time scales, by incorporating non-linear and interaction effects into statistical models, and by measuring and analyzing personality and socio-emotional outcomes in a detailed manner. At the same time, these requirements for methodology need to be balanced with practical considerations concerning computational power and data collection, as well as communicability and utility. Of note, some of these implications are of a more general nature. Accordingly, they may also apply to research on older age groups despite being based on findings observed in middle and late adolescence.

5.4. Implications for Supporting Positive Social Experiences in Adolescence

Beyond providing conceptual and methodological insights into the interplay between personality and social relationships in adolescence, the results of this dissertation form a basis to derive practical implications. Specifically, findings highlight at least three possible directions for supporting positive social experiences in adolescence. Given the relevance of satisfying social relationships for good mental and physical health (e.g., S. Cohen, 2004; Diener & Seligman, 2002; Hawkley & Cacioppo, 2010), these implications may help to support adolescents' well-being even beyond the social context.

First, the findings of this dissertation can help to identify adolescents who are at high risk for having negative social experiences and thus may require additional social support. As demonstrated by the results of all three studies, personality is an important contributor to adolescents' social relationships, with mainly detrimental effects of neuroticism and beneficial effects of extraversion and agreeableness. Specifically, adolescents with higher neuroticism, lower extraversion, or lower agreeableness appear to be more vulnerable to experiencing lower momentary social satisfaction, more negative and variable momentary affect, and higher loneliness. Therefore, it might be worthwhile to pay particular attention to adolescents with corresponding trait levels to enable early preventative steps and offer social support. In this context,

two findings of Study 3 require further attention: First, by showing that individual differences in loneliness are most pronounced at the higher end of neuroticism and at the lower end of extraversion, prevention programs should focus on these areas of each trait's spectrum. Second, by revealing that higher neuroticism and lower extraversion seem to reinforce each other's association with higher loneliness, results support the importance of considering trait combinations instead of independent effects of personality traits when identifying adolescents who may require additional social support. Third, by showing that adolescents with higher neuroticism were not only at higher risk for current experiences of higher loneliness levels but also for subsequent increases in loneliness, results suggest that neuroticism may be a particularly relevant predictor of adolescents' long-term experiences in the social context. Moreover, the findings of this dissertation can be interpreted in light of normative personality development (Caspi et al., 2005; Klimstra et al., 2009). More specifically, longitudinal studies tracking the Big Five over the course of adolescence have reported temporary increases in neuroticism and temporary decreases in agreeableness, although findings were partly mixed and may vary across gender (Aldinger et al., 2014; Borghuis et al., 2017; Göllner et al., 2017; Van den Akker et al., 2014). Accordingly, adolescence might be a vital but vulnerable phase during which the risk for negative social experiences associated with higher neuroticism and lower agreeableness is increased.

Second, the results of Studies 1 and 3 provide initial indications for prevention and intervention strategies to support adolescents' establishment of satisfying social relationships. In Study 1, the micro-level associations of neuroticism, extraversion, and agreeableness with momentary satisfaction during social interactions corresponded to broader personality-social relationship associations demonstrated in previous research (e.g., Harris & Vazire, 2016; Mund et al., 2016). This finding is in line with theoretical assumptions on the long-term development of social relationships Thibaut & Kelley, 1978) and suggests that the multiple positive experiences at the micro level of social interactions can accumulate into higher relationship satisfaction at the meso and macro level. Given that the effects of personality on momentary social satisfaction were mediated by perceptions of expressive and communal behavior, these types of interpersonal behavior may be key for the establishment of satisfying social relationships. Furthermore, Study 3 highlighted the particular relevance of higher extraversion for lower social loneliness. This finding suggests that extraverted behavior, such as acting outgoing, might be especially crucial for adolescents' mastery of the developmental task of finding a social group outside the family context (Eschenbeck & Knauf, 2018; Havighurst, 1948; also see Buecker et al., 2020). As a practical implication, the findings of Studies 1 and 3 may be used to support adolescents'

establishment of satisfying social relationships. One possible approach for such interventions would be to equip adolescents with a behavioral repertoire that is helpful in certain social contexts. This could be done in the form of psycho-education such as teaching adolescents about the relevance of certain types of interpersonal behavior (e.g., acting communally) for the positive development of social interactions. Going one step further, desired interpersonal behaviors could be actively trained, for example through role-play or other forms of arts education during school lessons, especially in early adolescence (Aspin, 2000; Grosz et al., 2022). Training for older adolescents could involve digital coaching apps that offer conversations with a chatbot in combination with micro-interventions that have been successfully used in recent personality intervention studies with adult participants (Olaru et al., 2022; Stieger et al., 2021). It is important to recognize, however, that such interventions are not free from ethical concerns because they can provide strong norms for behavior in social interactions. Instead of universally promoting certain types of interpersonal behaviors in all adolescents, it is important to tailor interventions toward individual social needs (Bleidorn et al., 2019).

Third, interventions to support adolescents' establishment of satisfying social relationships cannot only target individuals and their interpersonal behavior but also target their social environment. As such, an alternative approach for prevention and intervention strategies would be to create and change social environments in a way that matches adolescents' personalities and makes it easier for them to connect socially. For example, initial empirical research using adult samples provides support for the relevance of such a personality-environment fit by suggesting that individuals with higher neuroticism benefit more from social interactions with friends compared to other interaction partners (Mueller et al., 2019) and more from interactions in physical compared to digital contexts (Kroencke et al., 2022). Likewise, adolescents with higher neuroticism may also have more positive experiences in social environments, such as school lessons or leisure activities, which allow for interactions with close peers and face-to-face interactions. As another example, adolescents who are low in extraversion or agreeableness may benefit particularly from participating in cooperative team sports that have a clear assignment of roles may foster social contact and group identification (see Browne et al., 2004; Méndez-Giménez et al., 2015). As summarized by Asendorpf et al. (2017b), there are no universal rules for optimal social relationships, instead, relationships need to match a person's personality.

Altogether, the findings of this dissertation emphasize the relevance of social relationships for adolescents' well-being in general and the key role of personality in particular. The acquired knowledge can help to identify adolescents who might be in the need of increased

social support. Moreover, the findings may be used to help adolescents develop the social skills needed for the successful formation and maintenance of social relationships or to change the social environment to match it with adolescents' personalities.

5.5. Limitations and Outlook

The current dissertation provides new insights into the dynamic interplay between personality and social relationships in adolescence. When interpreting the findings, however, a number of conceptual and methodological limitations need to be considered. In addition, the present work represents a starting point for several directions of future research, which I point out in the following as well.

First, while this dissertation extends previous research about the role of personality for social relationships in adolescence, naturally it was not possible to capture all socio-emotional outcomes and all social contexts that are relevant for adolescents' social experiences. Aiming for an integrative picture, the association between personality and social relationships in adolescence was investigated with respect to three specific socio-emotional outcomes, which reflect significant social experiences at different relationship levels: momentary social satisfaction at the micro level, momentary affect at the meso level, and loneliness at the macro level. Despite this diverse consideration of concepts, adolescents' experiences in social relationships include a much wider range of socio-emotional outcomes, which require consideration in future research. For example, different aspects of relationship quality, such as interpersonal insecurity, conflict, and emotional closeness represent relevant social experiences in adolescence (e.g., Deventer et al., 2019; Parker et al., 2012; Wagner et al., 2014) and pose interesting outcomes for future studies on underlying processes and more complex patterns. Regarding the social context, I focused on adolescents' experiences in the context of social relationships in general and in the context of romantic relationships specifically. Besides romantic relationships, however, other specific relationship types that are relevant for the achievement of developmental tasks in adolescence (Havighurst, 1948) should also be considered. For example, studying the role of personality for conflict might be particularly interesting within the context of adolescents' transforming relationships with parents (Branje, 2018; Smetana et al., 2006). The factors contributing to social inclusion and popularity, in contrast, should be investigated in the specific context of their intensifying relationships with peers (Lösch & Rentzsch, 2018; Rubin et al., 2006). Altogether, more research on the association between personality and social relationships in adolescence is needed to examine which patterns generalize or differ across socio-emotional outcomes and relationship contexts.

Second, as a limitation in measures, all studies of this dissertation exclusively relied on self-reports. Importantly, self-reports are indispensable to capturing adolescents' subjective experiences within social contexts as reflected in self-reported socio-emotional outcomes (see Sullivan, 1953). Moreover, personality measured via self-reports provides important insights into the role of adolescents' self-concepts (see Back et al., 2009). From a methodological point of view, however, the single use of self-reports introduces the possibility that the observed associations are partly based on shared method variance (Podsakoff et al., 2003). Therefore, as one possible extension, future research could also use other-reports on adolescents' personalities provided by parents or teachers. Since self- and other-reports both rely on questionnaires and consequently still share method variance, another option would be to replace adolescents' self-reports on personality with computational personality assessment, such as mobile sensing or digital footprints from social media (Osterholz et al., 2022; Stachl et al., 2021). Although these new technologies represent promising paths for future research, it is important to note that they still need to be validated in different populations, including adolescent samples (see Bleidorn & Hopwood, 2019). At least in the near future, questionnaires consequently remain an important instrument to measure adolescents' personalities. From a conceptual point of view, it is also relevant to consider that social relationships always consist of at least two people (Asendorpf et al., 2017a; Hinde, 1979) and thus include the social experience of more than one individual. This provides an interesting starting point for future research: Besides examining how adolescents' personality relates to their own experiences in social relationships (i.e., *actor effects*), it is also possible to examine how their personality relates to other people's social experiences in their relationship with adolescents (i.e., *partner effects*; Cook & Kenny, 2005). Importantly, previous research on different socio-emotional outcomes such as perceived closeness and conflict (Berry et al., 2000), or warmth and criticism (Janssen et al., 2021), has shown that how the relationship is experienced can differ considerably between relationship partners. Accordingly, future studies could examine whether the findings of this dissertation generalize to socio-emotional outcomes reported by adolescents' parents, peers, or romantic partners.

Third, all findings in this dissertation were based on correlational data and therefore do not allow for causal interpretations. While certain prerequisites for causal inference were given such as that all hypotheses were based on theory and the required temporal ordering of predictor and outcome measures was ensured in most cases, alternative explanations such as unobserved confounding third variables (Morgan & Winship, 2015) cannot be excluded. Given the complexity of the interplay of personality and social relationships, the involvement of multiple, bidirectional influences and processes is likely (Chaplin, 1997; Yarkoni, 2020). To approach

causal explanations concerning mechanisms in social interactions, laboratory studies that allow for systematic manipulation of social situations and behaviors (e.g. Blum et al., 2018; Kurzius et al., 2022) are required. In real-life settings, experience sampling studies that are combined with experimental manipulations, such as the instruction of certain interaction behaviors (e.g., Margolis & Lyubomirsky, 2020; Stieger et al., 2021) represent another promising path for establishing causality. Other aspects of this interplay, such as adolescents' personality traits or their actual social relationships (e.g., romantic relationship status), in contrast, cannot be easily manipulated in an experimental setting in the face of practical and ethical reasons (Grosz et al., 2020; Wagner et al., 2015). In this context, normative life transitions that have been related to personality change, such as the transition out of high school (see Lüdtke et al., 2011) or the transition to the first romantic relationship (see Wagner et al., 2015) may function as natural experiments. In addition, multimethod designs that combine short-term (e.g., momentary) with long-term (e.g., yearly) measurements allowing for a distinction between within- and between-person differences are recommended to bolster evidence of causal effects (Costantini & Perugini, 2018; Mõttus et al., 2020). Along these lines, while the studies in this dissertation included assessments at different relationship levels and timelines, they captured only a relatively short period of adolescents' development. To further deepen the understanding of explanatory mechanisms linking personality and social relationships, future studies that track adolescents across several years and combine insights at the micro-level of social interactions with longitudinal changes at the meso- and macro-level of social relationships are required (for an illustration of such a study design, see Hutteman et al., 2015; Quintus et al., 2021). Importantly, such studies would also be an important step toward understanding the short- and long-term meaning of within-person variability (see Back et al., 2023).

Fourth, some of the observed effects in this dissertation were small and the power to detect them was limited. This was especially critical concerning interactions between neuroticism and relationship quality observed in the smaller sub-sample in Study 2 and interactions between neuroticism and extraversion observed in Study 3. Therefore, these effects should be interpreted with caution. At the same time, it is important to note that all hypotheses and analyses in this dissertation were preregistered or clearly marked as exploratory, thereby significantly reducing the risk of false-positive findings (Campbell et al., 2014; Simmons et al., 2011). Moreover, small effects measured at one point, such as effects of the interplay between relationship quality and neuroticism on adolescents' current variability of momentary affect, can accumulate when occurring repeatedly over time and have important implications for the individual (Funder & Ozer, 2019). In the particular case of interaction effects, finding rather small

effect sizes is a common problem in personality psychological research (e.g., Mueller et al., 2019; Mund & Neyer, 2014). This may be partly rooted in the complexity of human behavior, which makes the existence of multiple interacting effects almost certain, while the respective effect sizes of specific interactions are likely small (Chaplin, 1997). Moreover, higher measurement error and the reduced statistical power after accounting for first-order effects make it particularly hard to detect interaction effects (J. Cohen et al., 2003). Consequently, even small but significant interactions can be relevant for enhancing our understanding of the interplay between personality and social relationships. Nonetheless, the interaction effects reported in this dissertation should be seen as initial evidence that should be replicated in future studies with larger samples.

Finally, some constraints on generalizability concerning the sample should be considered. Although data from three different original data sets were used, all samples were collected in Germany and an above-average proportion of participants were female and attended high school. Whereas findings likely generalize to adolescents with similar sociodemographic backgrounds in other Western societies, they may not generalize to adolescents from non-Western countries (Henrich et al., 2010) or to male adolescents and those from lower school tracks. Given the positive association between individualism and extraversion (McCrae & Terracciano, 2005), for instance, the trait may have different interpersonal implications for adolescents living in countries with a collectivistic culture. Accordingly, more research is needed that investigates the interplay between personality and social relationships among adolescents with more diverse cultural and sociodemographic backgrounds. Furthermore, in this dissertation, I focused on middle and late adolescence, leaving unknown whether findings generalize to early adolescence. Restricting research to middle- and late adolescence allowed for a reliable measurement of personality which is less clearly the case with younger individuals (Brandt et al., 2020; Soto et al., 2008; Soto & John, 2014). Moreover, since puberty and thus the biologically defined beginning of adolescence differ profoundly across individuals (Collins & Steinberg, 2006; Lehmiller, 2017), early adolescence is rather heterogeneous regarding age which makes research on this period of life particularly challenging. Nevertheless, future research should broaden the age range of participants to investigate the interplay between personality and social relationships in early adolescence, too.

5.6. Conclusion

To conclude, this dissertation used three samples to elucidate the association between personality and social relationships in middle and late adolescence. The results generally support the beneficial role of lower neuroticism, higher extraversion, and higher agreeableness for positive social experiences. Beyond that, they highlight that the link between personality and social relationships in adolescence is characterized by a dynamic interplay at different levels. At the micro level of adolescents' social interactions, this dissertation identifies perceptions that mediate the association between personality and momentary social satisfaction. At the meso level of adolescents' romantic relationships, neuroticism can be regarded as the most important contributor to momentary affect, yet interactions between personality and relationship variables might be vital to the variability of momentary positive affect. At the macro level of adolescents' multiple relationships, non-linear and interaction effects add to the linear main effects of neuroticism and extraversion on loneliness. By revealing underlying mechanisms and more complex patterns, the current findings represent a starting point to extend existing theoretical models on personality and social relationships and may inspire future research to investigate this link in a more nuanced and integrative manner. Whereas the findings may also help to support positive social experiences in adolescence, future research needs to consider causal processes more closely and combine measurements on shorter and longer time scales.

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Declarations

Attached declarations:

- Erklärung gemäß § 5 (4d) der Promotionsordnung des Instituts für Psychologie der Universität Hamburg vom 20.08.2003
- Eidesstattliche Erklärung nach § 9 (1c und 1d) der Promotionsordnung des Instituts für Psychologie der Universität Hamburg vom 20.08.2003

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Erklärung gemäß *(bitte Zutreffendes ankreuzen)*

☐ **§ 4 (1c) der Promotionsordnung des Instituts für Bewegungswissenschaft der Universität Hamburg vom 18.08.2010**

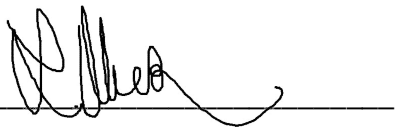
☒ **§ 5 (4d) der Promotionsordnung des Instituts für Psychologie der Universität Hamburg vom 20.08.2003**

Hiermit erkläre ich,

Larissa Wieczorek (Vorname, Nachname),

dass ich mich an einer anderen Universität oder Fakultät noch keiner Doktorprüfung unterzogen oder mich um Zulassung zu einer Doktorprüfung bemüht habe.

Hamburg, 03.04.2023
Ort, Datum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Eidesstattliche Erklärung nach *(bitte Zutreffendes ankreuzen)*

☐ **§ 7 (4) der Promotionsordnung des Instituts für Bewegungswissenschaft der Universität Hamburg vom 18.08.2010**

☒ **§ 9 (1c und 1d) der Promotionsordnung des Instituts für Psychologie der Universität Hamburg vom 20.08.2003**

Hiermit erkläre ich an Eides statt,

1. dass die von mir vorgelegte Dissertation nicht Gegenstand eines anderen Prüfungsverfahrens gewesen oder in einem solchen Verfahren als ungenügend beurteilt worden ist.
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