No adolescent is an island: conceptualizing the family system in adolescent depression with the network approach

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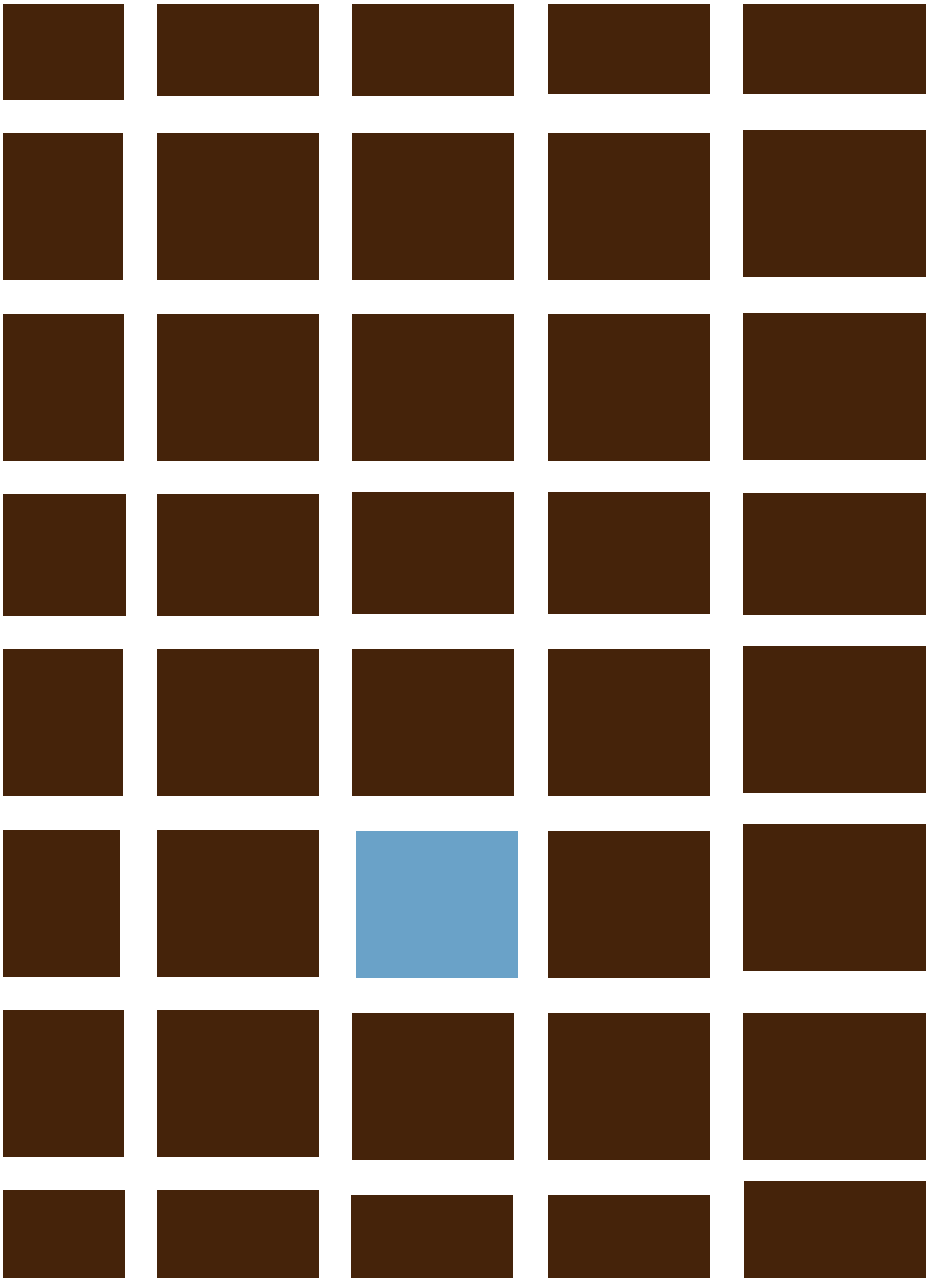


Chapter 1

General introduction

Over the years, there has been an alarming trend in increased reports of adolescent depressive symptoms (Centraal Bureau voor de Statistiek [CBS], 2023; Wilson and Dumornay, 2022; World Health Organization [WHO], 2024), such as elevated sadness, guilt, and problems with sleep and concentration (American Psychiatric Association, 2013). It has been estimated that one in seven adolescents worldwide experiences mental health problems, with 1.4% of 10 to 14-year-old adolescents and 3.5% of 15 to 19-year-old adolescents experiencing depression (WHO, 2024). The elevation of adolescent-reported depression symptoms has been related to the COVID-19 pandemic (Barendse et al., 2023; Bignardi et al., 2021; Magson et al., 2021; Racine et al., 2021). Since the pandemic, it has been estimated that one in four adolescents has experienced inflated depressive symptoms (Racine et al., 2021). Although this increase due to the COVID-19 pandemic appears to have somewhat normalized, there is still a global increase in adolescent depressive symptoms compared to years before (Rijksinstituut voor Volksgezondheid en Milieu [RIVM], 2024).

Depressive symptoms during adolescence often go hand in hand with social issues (Schwartz-Mette et al., 2020), problems at school (Fröjd et al., 2008; Quiroga et al., 2013), and comorbidities such as suicidality (e.g., Gijzen et al., 2021; Kandel et al., 1991), anxiety and eating disorders (e.g., Avenevoli et al., 2015; Santos et al., 2007). Adolescence is a sensitive developmental phase for the rest of adult life (Dahl et al., 2018). So has adolescent depression been associated with depression and suicidality in adulthood, and with socioeconomic problems such as unemployment (Clayborne et al., 2019; Johnson et al., 2018). Therefore, it is important to understand how we can best guide and support adolescents experiencing depression to enlighten the short and long-term effects.

The family system

Adolescents are sensitive to their environment, and their well-being and behavior depend on interactions with friends and family (Bronfenbrenner, 1977; Furman & Buhrmester, 1992; Sheeber et al., 1997; Yap et al., 2014). The interactions within the environment are defined as a *system* (Meadows, 2008). Adolescents are part of many different layers of systems (Bronfenbrenner, 1977). According to the ecological systems theory by Bronfenbrenner (1977, 1986), the most direct layer is the microsystem, consisting of environments that directly affect the adolescent, such as friends and family. The relations between the direct environments form, in turn, the mesosystem. For example, the family could encourage the child to meet their friends by inviting them

to their house or restrict the child from seeing some other friends. The family itself can also be considered a system (Bowen, 1966). According to Bowen's family system theory (1966), the family consists of interrelated parts, such that a problem or change for any family member affects all others within the family. Kullberg (2022) compares the family system to a mobile by the American sculptor Alexander Calder: each component keeps the other components in balance, and a movement of one component results in a movement of the other components. We call this bidirectional characteristic of a system *interrelatedness* (Bronfenbrenner, 1977, 1986; Meadows, 2008). The interrelatedness of the family system entails that the actions or well-being of one family member, say the adolescent, result in responses from the parents, followed by responses from the adolescent or siblings, and so on. The interactions between members of the family within the family system have also been referred to as *family dynamics* (e.g., Schermerhorn & Cummings, 2008), and have been intensively studied on the topic of adolescent depression, with a key focus on parenting behavior (e.g., Yap & Yorm, 2015) due to the important mitigatory role parents play in the system (Furman & Buhrmester, 1992; Sheeber et al., 2001). Even though there are many relevant family interactions (e.g., including siblings), because of the important role of parents, this dissertation will focus on the interrelatedness between adolescents and their parents.

From parent to adolescent: parental criticism and warmth

Parents can influence and possibly support adolescents within the family system with their parenting behavior (Abidin, 1992; Power, 2013). Previous studies on parenting behaviors and adolescent depression found two aspects of importance: 1) parental criticism and 2) parental warmth (e.g., Bolton et al., 2009; McLeod et al., 2007; Rapp et al., 2021; Silk et al., 2009; Soenens et al., 2008; Yap & Yorm, 2015). Parental criticism can be defined as expressing negativity and being controlling toward the child (Harris & Howard, 1984). More parental criticism has been associated with more depressive symptoms (Soenens et al., 2008). Parental warmth has been considered at the other end of the dimension and can be defined as expressing positivity toward the child by listening and understanding (Gladstone & Parker, 2005; Kendler et al., 1997; Power, 2013)). In contrast to parental criticism, parental warmth is considered a protective factor of adolescent depression (Fang et al., 2023; Yap & Jorm, 2015). Parenting behavior has also been related to adolescent affective well-being. For example, when parents were considered warm and supportive, adolescents reported less sadness (Arslan et al., 2024; Bai et al., 2017; Janssen et al., 2021a).

From adolescent to parent: parental worry and self-efficacy

Although the impact of parents on adolescent well-being has been extensively investigated, far less is known about the factors influencing parenting behavior. Parenting behavior might be situation-dependent (e.g., influenced by adolescent affective states or behaviors). Adolescent depression affects parents of adolescents with depression (Armitage et al., 2020; Stapley et al., 2016), but the influence of adolescent depression on parents and parenting behavior has been understudied. To better understand how parenting behavior could support adolescents with depression, we need to understand what in daily life triggers certain parenting behaviors. Studies on the influence of adolescent depression on parents highlight two concepts: parental worry and self-efficacy (Armitage et al., 2020; Stapley et al., 2016).

Parental worry can be defined as the concerns of parents about their child with depression. The few studies that exist on parental worry are qualitative studies that found that parents specifically worry about their child's negative mood and mood variations, (changes in) behavior (e.g., withdrawal, self -harm, and suicide), and future (Armitage et al., 2020; Stapley et al., 2016). As this parental worry specifically focuses on the child, it is different from concepts such as parental rumination and stress that focus more on stress related to parenting in general (Fang et al., 2024; Louie et al., 2017). So far, it is unclear what the effects of parental worry are, for instance, in terms of parenting behavior.

Qualitative studies also point to struggles of parental self-efficacy among parents with an adolescent with depression (Armitage et al., 2020; Stapley et al., 2016). We define parental self-efficacy as the confidence in the role of a parent (Wittkowski et al., 2017). In qualitative studies, problems with parental self-efficacy were expressed by parents' hopelessness and questioning of their parenting strategies. Parental self-efficacy and, in particular, the relation between parental self-efficacy and parenting behaviors, has also been quantitatively studied among parents in general (Albanese et al., 2019; Shumow & Lomax, 2002). A review by Albanese et al. (2019) showed, for example, that greater parental self-efficacy was related to less parental criticism and more parental warmth towards the child. However, little is known about fluctuations in the self-efficacy of parents of adolescents with depression and the relations with parental worry and parenting behavior in daily life. Following the family system theory, one might expect that parental worry and self-efficacy are affected by adolescent depression, but few studies have focused on this and on how parental worry and low self-efficacy can, in turn, affect the adolescent.

A matter of perspective

When studying the family system in adolescent depression, we must consider that the family is multifaceted, unique, and dynamic. What do we mean by that?

Within-family perspective

First, the family is multifaceted because it comprises multiple individuals, such as parents and siblings, who tend to have different experiences in the same situation (e.g., De Los Reyes et al., 2019). When highlighting only one perspective (e.g., the experience of mothers; Phares, 1992; Sheeber et al., 2001), this yields a limited view of the family system and adolescent depression as a whole, which could hinder adolescent access to health care and treatment progress (Logan & King, 2002; Orchard et al., 2019; Reardon et al., 2017). The differences between the perspectives of adolescents and their parents could highlight issues in the family dynamic that affect adolescent depression symptoms (Hou et al., 2018; Nelemans et al., 2016; Zheng & Chen, 2025). Therefore, considering within-family perspectives will provide a more holistic picture of adolescent depression and adolescent psychopathology more broadly (Dirks et al., 2012; De Los Reyes et al., 2015).

Between-families perspective

Second, families are unique. In psychology, we are often unable to directly translate findings at the group level to individual families (Molenaar, 2004). Conclusions based on group findings might result in issues such as Simpson's paradox (i.e., wrongly concluding that general findings translate to subgroups; Kievit et al., 2013) and ecological fallacies (i.e., wrongly concluding that general findings hold for individuals; Frijns et al., 2020; Hamaker, 2012). The same holds for studies on the family system. For example, in a study by Jansen et al. (2021b) of parenting behavior and adolescent affect, a positive relation was found between parental support and positive adolescent affect (e.g., happy and relaxed). However, this did not hold for all families, and in some families, even the reverse association was found. In line with Jansen et al. (2021b), Boele et al. (2023b) concluded that the relation between parenting behavior and adolescent affective well-being was unique per family.

Time perspective

Third, families are dynamic (Bowen, 1966), and adolescents' moods and behaviors change frequently. This also means that variables within the family system, such as parenting behaviors, and their associations can fluctuate over time (Keijsers & van Roekel, 2018). Hence, considering time is especially important in terms of measurement. For example, Boele et al. (2023a) found that adolescent-perceived parental support was not related to adolescent depressive symptoms on a short time scale (i.e., days, weeks, and months), but was on a longer biannual timescale. Moreover, among adolescents with depression, adolescents retrospectively reported increasingly negative parental behavior when asked about parenting behavior during the past two weeks compared to reports at the end of the day (Janssen et al., 2024a). This shows how measurement timing can impact the relation between variables and the reports. Therefore, it is recommended to consider the time perspective when studying the family system.

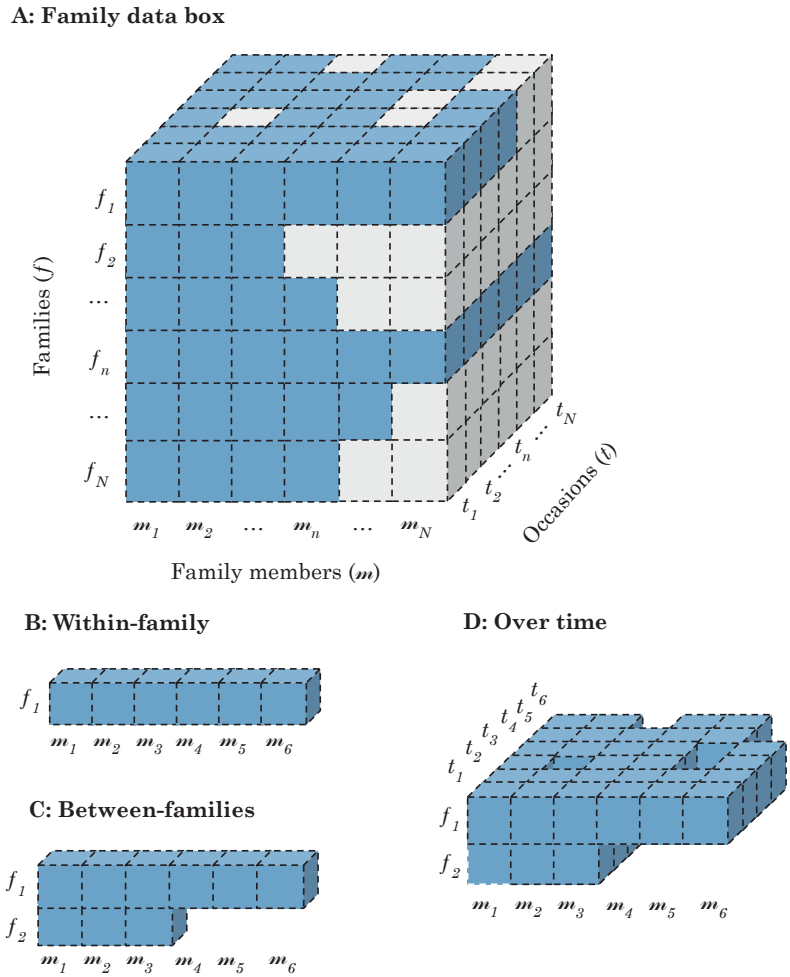
The within-family, between-families, and time perspectives are further illustrated in Figure 1.1 and *Chapter 2* of this dissertation.

A network approach

The *system* is a widely used term, and the theoretical and statistical tools of network science can help make these systems palpable and subject to empirical studies (Barabási, 2012; Borsboom et al., 2021a). In other words, a *network approach* can be useful to study the family system in adolescent depression. The network approach focuses on the impact of variables with their relations to other variables within a system (Borsboom et al., 2021a). Systems can be conceptualized as networks, where variables are represented by nodes and the relations between variables are shown by edges (see Figure 1.2 for example networks). For instance, Network I of Figure 1.2 could represent a family, showing that family member A talked to family members B, C, and D. With interrelatedness as its core concept (Barabási, 2012), the network approach can regard the within, between, and over time of family members.

The network approach has become increasingly popular in psychology, and network theories have been developed, and statistical methods have been translated into the approach, resulting in applied network studies (Borsboom et al., 2021a). Similarly to theories of the family system that argue that it is the interrelation between family members that matters (e.g., Bowen, 1966), the network theory of psychopathology argues that rather than a common cause resulting in depressive symptoms, a depressive

Figure 1.1. *The Family Data Box Representing the Within-Family, Between-Families, and Time Perspectives.*



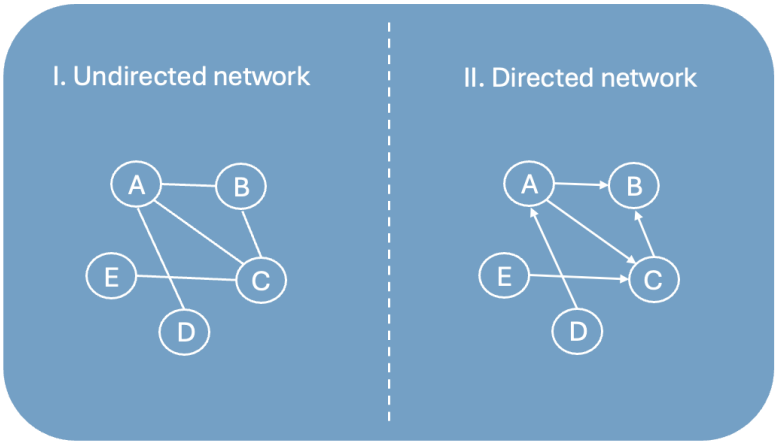
Note. Panel A shows the family data box that is inspired by and adapted from Cattell's tridimensional data box (1952). The blue-colored boxes represent complete observations for a member (m) of a family (f) on one occasion (t). Panels B to D contain a part of the data box. Panel B shows data on one measurement occasion from six family members of the family f_1, representing the within-family perspective. Panel C shows that family f_2 has three fewer family members compared to family f_1, illustrating the between-families perspective. Panel D shows that there are more observations for some family members in family f_1 than for others, illustrating the time perspective. For example, family f_1, family member m_1 has data on six occasions, whereas family member m_2 has data on five occasions.

state appears due to the *interrelation* between symptoms (Borsboom, 2017; Borsboom & Cramer, 2013; Cramer & Borsboom, 2015; Cramer et al., 2010; Fried & Cramer, 2017). In addition, there is an increasing number of applied network studies (Robinaugh et al., 2020) that, for instance, investigate interrelated processes or symptoms that are at play. Network studies on adolescent depression, for example, show the interrelatedness among depression symptoms (Manfro et al., 2023; Mullarkey et al., 2019; Opsahl et al., 2010), the relation between depression and anxiety symptoms during the COVID-19 pandemic (Cai et al., 2022), and the relation between depression symptoms and suicidality (Gijzen et al., 2021), treatment response (Schweren et al., 2018), and family risk factors (Wang et al., 2023).

Psychological networks

In contrast to networks in other fields, such as social networks where the nodes represent people and the edges represent the communication between them (e.g., Freeman, 2004), the relation between psychological nodes cannot be directly observed, but needs to be estimated based on data acquired by, for example, questionnaires (Epskamp et al., 2018a). To estimate the relation between nodes, statistical methods have been translated to the network approach for different types of data. One type of data is single-measurement data. With single measurement data, we refer to data consisting of one measurement per person (Epskamp, Hoekstra, et al., 2022). This could be cross-sectional data, where there is one measurement at a specific time. Depending on the way nodes are measured, specific network models can be used. For example, for binary nodes (e.g., presence or absence of a symptom), the Ising model based on logistic regression can be applied (Marsman et al., 2018). More common is the use of the Gaussian graphical model (GGM; Epskamp et al., 2018a) for continuous variables. In these networks, edges represent partial correlations and, therefore, show how nodes are related while correcting for the other nodes in the network (Epskamp & Fried, 2018b). A GGM network, for instance, can show the type of partial correlations between depression symptoms. For example, a positive partial correlation between lack of concentration and fatigue indicates that when there are increases in lack of concentration, there are also increases in fatigue, when considering other depression symptoms in the network. However, as these networks are based on correlations, we cannot draw any conclusions on the direction of the effect; hence, the edges in these networks are undirected.

Figure 1.2. *Network Visualization*



Note. This figure shows two different networks with nodes A, B, C, D, and E: I) an undirected and II) a directed network. The nodes could be stations, people, or other variables. In this dissertation, the nodes represent variables of different family members, such as adolescent - reported parental criticism and parent-reported parental criticism. In *Chapters 4* and *5*, we used models resulting in undirected networks, while in *Chapter 3* we used a model resulting in an undirected and directed network.

To obtain more insight into the direction of relations within the family system while considering the time perspective, there are also network methods for longitudinal data that result in directional networks. With longitudinal data, we refer to the data of a person or a group of people measured over time. This could be data over years, days, or moments within a day. The models result in a contemporaneous and temporal network (Epskamp et al., 2018c). The temporal network contains relations over time (i.e., temporal relations) visualized by directed edges. An example of a positive temporal relation could be that adolescents report a greater lack of concentration when they report more fatigue on the previous measurement occasion. Contemporaneous relations are interpreted as relations at the same time, or as faster or slower temporal relations than the ones captured by the temporal network. They are depicted as undirected edges. For example, adolescents report feeling more sad when they report a greater lack of interest in activities. Temporal and contemporaneous networks can be estimated with vector autoregressive (VAR) models (Epskamp et al., 2018d). When measuring a group of people over time with relatively more time between the measurement occasions, referred to as panel data (Burger et al., 2022a), one could use a panel latent variable graphical VAR model (Epskamp, 2020; Burger et al., 2022a).

Some networks allow for the consideration of individual differences (e.g., the between-families perspective). One possibility is to apply graphical VAR models to individuals separately, resulting in contemporaneous and temporal networks for that individual (Epskamp et al., 2018d). However, this method requires a lot of data per person (Mansueto et al., 2023), which can be challenging to obtain in clinical samples. In addition, with individual networks, it becomes more difficult to make group conclusions (Burger et al., 2022a). Another possibility is to use a multilevel vector autoregressive model (mlVAR; Bringmann et al., 2013) that estimates, next to a temporal and contemporaneous network of the group, an individual temporal and contemporaneous network by borrowing information from the group. As this method uses group information, the model requires less data. However, the model uses group information and can be less sensitive in picking up individual differences (Burger et al., 2022a). Therefore, other networks that use an individual-to-group method, such as Group Iterative Multiple Model Estimation (GIMME; Beltz & Gates, 2017), have been proposed.

However, the complexity of collecting enough powered data to perform these methods, in combination with their inability to draw direct causal conclusions and discussions on suitability for clinical practice (e.g., Bringmann, 2021), have resulted in the development of other types of networks, such as perceived causal relations (PCR) networks (Burger et al., 2024; Frewen et al., 2012; Klintwall et al., 2023). PCR networks visualize the causal relation between nodes in a network. These networks have been applied, in particular, to symptoms to illustrate which depression symptoms caused another depression symptom according to patients. They, for example, show that a patient reported stress as a cause of overthinking (Burger et al., 2024). As PCR networks illustrate the patient perspective, they have been considered insightful during the first phase of treatment (Andreasson et al., 2023).

System to network

Most psychological network studies to date have focused on symptoms of one person or a group of people (e.g., adolescents with depression). However, in the case of family systems, we aim to take into account variables from multiple perspectives, from parents and child(ren), for example, on parental criticism perceived by adolescents *and* their parents. In line with the aim of the consortium *New Science of Mental Disorders* (NSMD; Roefs et al., 2022) that this dissertation is part of, *Chapters 3* to *5* address the question if and how we can use the network approach, while including the three perspectives, to study the family system in adolescent depression. We applied and evaluated the use of the network approach by focusing on three different networks to

study the family system. First, we evaluated the use of the mlVAR network to visualize family dynamics to elucidate the relation between adolescent and parent affective well-being (*Chapter 3*). This was followed by a cross-sectional Gaussian graphical network to study parenting behaviors (*Chapter 4*). As the replicability of networks has been questioned (e.g., Borsboom et al., 2017, 2018; Bringmann, 2021; Forbes et al., 2017; Forbes et al., 2021), we tried to replicate this network within this dissertation on another sample (*Chapter 5*). Lastly, we created a frequency network of parental worry and self-efficacy inspired by PCR networks (*Chapter 5*).

Family data

To study the family system in adolescent depression, we need data that take into account the three perspectives and allow the application of a network approach. In this dissertation, we made use of *Ecological Momentary Assessment* (EMA; Larson & Csikszentmihaly, 1983; Stone & Shiffman, 1994) from two different sources, i.e., from the RE-PAIR study and *Samen Sterk*.

RE-PAIR

The first source is the RE-PAIR study (Janssen, 2022; Van Houtum, 2023, Wentholt et al., 2024; Wever, 2024). The RE-PAIR study aimed to gain more insight into the bidirectional relation in adolescent-parent interaction in the context of adolescent depression. Eighty adolescents and their 151 parents of the control sample and 35 adolescents and their 62 parents of the depression sample participated. The ages of the adolescents ranged from 11 to 17 years. Adolescents and their parents went through four study phases. In the first phase, they received online questionnaires. The second phase consisted of social tasks in the lab. In the third phase, adolescents and their parents participated in an EMA. In the EMA, adolescents and their parents rated affect states and parenting variables four times a day for 14 days. The fourth phase consisted of fMRI research. Six months after the lab tasks, adolescents and their parents received online questionnaires again as a follow-up. For this dissertation, we used data from the first phase (i.e., online questionnaires), third phase (i.e., EMA), and follow-up (i.e., online questionnaires).

Samen Sterk

The second source of data used for this dissertation comes from a collaboration with the training for parents of adolescents with depression, *Samen Sterk* (translated '*Stronger*

Together'; Elzinga et al., 2022). The training has an online version and an in-person version. Both versions of the training are eight weeks long, with one group session per week. In the first weeks of the training, parents receive psycho-education on adolescent depression and suicidality. This is followed by sessions on their parenting. This includes, for example, expressing warmth to the adolescent, diminishing parental criticism, and strengthening the parent-child bond. Fourteen Dutch-speaking parents (eight mothers and six fathers) who participated in the training were willing to partake in the study from December 2023 to July 2024. Of the parents, six mothers and fathers formed a married couple. Twelve parents participated in the online training (i.e., in two groups with the same trainer). The parents lived with their child aged 12 to 18 years, who was experiencing depressive symptoms at the time of participation. During the training, parents rated their worry, self-efficacy, parental criticism, and parental warmth daily using EMA. In addition to quantitative items, parents provided daily reports of their reasons for parental worry and self-efficacy.

Outline

This interdisciplinary dissertation investigated the question of how we can study the family system in adolescent depression using a multiperspective and network approach.

In *Chapter 2*, we illustrate the importance of considering within-family, between-families, and the time perspective when studying family dynamics in the context of adolescent depression using data from the RE-PAIR study.

In *Chapter 3*, we focus specifically on the relation between the affect states of adolescents and parents using data from the control sample of the RE-PAIR study and evaluate the temporal network method, mlVAR, to study family dynamics while considering differences between families.

Chapter 4 focuses on adolescent-parent contact by investigating the relation between adolescent affect, parenting behaviors, parental worry, and parental self-efficacy using cross-sectional networks, also based on data from the RE-PAIR study.

In *Chapter 5*, we focus on parental worry, self-efficacy, criticism, and warmth and show how a mixed-method approach can provide insight into the experience of parents raising adolescents with depression, using data from *Samen Sterk*.

Finally, *Chapter 6* discusses the findings of this dissertation and proposes recommendations for clinical practice and future studies on the family system in adolescent depression.