

Tetzner, Julia; Kliegl, Reinhold; Krahe, Barbara; Busching, Robert; Esser, Günter
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**Developmental Problems in Adolescence:
A Person-Centered Analysis Across Time and Domains**

Julia Tetzner^{1, 2}

Reinhold Kliegl¹

Barbara Krahé¹

Robert Busching¹

Günter Esser¹

¹ *University of Potsdam, Germany*

² *German Institute for International Educational Research, Germany*

Correspondence concerning this article should be addressed to Julia Tetzner, DIPF | Leibniz Institute for Research and Information in Education, Warschauer Straße 34-38, 10243 Berlin, Germany. E-mail: tetzner@dipf.de

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The authors declare that they have no conflict of interest.

Highlights

- Examining co-occurrence of depression, aggression and achievement-related problems
- Three types of developmental problems: asymptomatic, depressed, aggressive type
- Girls and boys show gender-specific patterns of comorbidity
- Lower longitudinal stabilities for types with problems in two, than one, domains
- Individual characteristics predict type memberships and their progression over time

Abstract

This longitudinal study investigated patterns of developmental problems across depression, aggression, and academic achievement during adolescence, using two measurement points two years apart ($N=1,665$; age T1: $M = 13.14$; female = 49.6 percent). Latent Profile Analyses and Latent Transition Analyses yielded four main findings: A three-type solution provided the best fit to the data: an asymptomatic type (i.e., low problem scores in all three domains), a depressed type (i.e., high scores in depression), an aggressive type (i.e., high scores in aggression). Profile types were invariant over the two data waves but differed between girls and boys, revealing gender-specific patterns of comorbidity. Stabilities over time were high for the asymptomatic type and for types that represented problems in one domain, but moderate for comorbid types. Differences in demographic variables (i.e., age, socio-economic status) and individual characteristics (i.e., self-esteem, dysfunctional cognitions, cognitive capabilities) predicted profile type memberships and longitudinal transitions between types.

Keywords: adolescence, person-centered approach, depression, aggression, academic achievement

Developmental Problems in Adolescence:

A Person-Centered Analysis across Time and Domains of Functioning

Adolescence is a period of life that incorporates a host of challenges and changes (Masten, Obradovic, & Burt, 2006). Although many individuals deal with these challenges successfully, others develop difficulties that can have enduring consequences for their later functioning and well-being (Huesmann, Dubow, & Boxer, 2009). These difficulties may appear in different domains, such as internalizing, externalizing as well as learning and achievement-related problems (Masten et al., 2005). Most previous studies used a variable-oriented approach to study the manifestation and progression of developmental problems in adolescence, which has yielded many important findings (Bergman et al., 2009). Yet despite strong evidence for co-occurrence (Angold, Costello, & Erkanli, 1999), these studies tended to examine different developmental problems individually, paying less attention to their co-occurrences (Bergman, Andershed, & Andershed, 2009). A person-centered or typological methodological approach on the other hand focuses on typical patterns of developmental problems during adolescence and their progression over time (see Bergman et al., 2009).

The present study adopted a person-centered approach to examine patterns of developmental problems in three domains (i.e., depression, aggression, academic achievement) over nearly two years in adolescence, using latent profile analyses and latent transition analyses (e.g., Collins & Lanza, 2010). Each of these domains encompasses a broad range of problems that entail significant negative outcomes in the course of development (Abela & Hankin, 2008; Huesmann et al., 2009; Newcomb, Abbott, Catalano, Hawkins, Battin-Pearson, & Hill, 2002). Therefore, identifying configurations of problems in these domains and linking them to socio-demographic and individual differences correlates may contribute to a better understanding of distinct trajectories of developmental problems in adolescence. Drawing on a large longitudinal data set from Germany, we used latent profile analysis and latent transition analysis to identify characteristic patterns of developmental

problems at two data waves spanning almost two years and investigate whether the same patterns hold for different age and sex groups. We then examined the consistency of profile type membership over the two-year period. Finally, we investigated associations of patterns of developmental problems with demographic variables (i.e., age and parental socioeconomic status) and individual characteristics (i.e., low self-esteem, dysfunctional cognitions, and low cognitive capabilities), again considering possible sex differences.

Developmental Problems in Adolescence

A substantial proportion of adolescents are affected by developmental problems. National figures for Germany indicate internalizing problems in 9.7 percent of adolescents and conduct problems in 14.2 percent (Robert Koch Institut, 2008). International studies reported prevalence estimates of 5.6 percent for depression in adolescence (for an overview see Costello, Erkanli, & Angold, 2006). Epidemiological studies of achievement-related problems found that three to seven percent of adolescents have deficits in mathematics and four to nine percent in reading (American Psychiatric Association, 2013; Geary, 2011). As mentioned above, many adolescents manifest multiple developmental problems (Angold et al., 1999; Cosgrove et al., 2011). Meta-analytical results indicate that 22.7 to 83.3 percent of children and adolescents with depression also met criteria for conduct problems, whereas 8.5 to 45.4 percent of children and adolescents with conduct problems also showed symptoms of depression (Angold & Costello, 1993). Recent clinical studies found that 9.4 percent of children and adolescents with learning disorders also manifested a mood disorder (Margari et al., 2013) and 21 percent a conduct disorder (Emerson & Hatton, 2007).

Theoretical assumptions also give reason to expect co-occurrences of several developmental problems. From a meta-theoretical point of view, a holistic-interactionistic (or systemic) perspective (Cicchetti, 1993; Magnusson & Stattin, 2006) proposes that individuals function and develop as integrated and indivisible wholes by assuming ongoing processes between psychosocial (e.g., emotional stability) and behavioral components (e.g., social

behavior or academic performance) within the individual. Research also supports more specific assumptions about possible mechanisms. Thus, aggressive behavior and academic problems may constitute developmental failures for adolescents that cause feelings of guilt and shame and prompt negative feedback by parents, teachers and peers and thereby raise the vulnerability to the onset of depression (Capaldi & Stoolmiller, 1999; Leary & Baumeister, 2000; Wolff & Ollendick, 2006). Similarly, difficulties in regulating depressed emotions may contribute to increased conflicting and aggressive behavior (Wolff & Ollendick, 2006). Research has also shown that emotional problems impair intellectual functioning and cause distractibility (Eysenck & Eysenck, 1985; Rapport, Denney, Chung & Hustace, 2001) which may also invoke poorer academic outcomes. Finally, aggressive behavior may involve social rejection by classmates, which reduces adolescents' sense of belonging in school and their school motivation (Buhs, 2005; Juvonen & Knifsend, 2016) and thus compromises academic functioning.

Empirical research that addressed associations between psychopathological domains was usually based on variable-oriented methods and supported the assumption of connections between academic underachievement and externalizing problems (Hinshaw, 1992) or internalizing problems (Verboom et al., 2014), and between internalizing and externalizing problems (Hewitt et al., 1997). Longitudinal studies confirmed reciprocal relations, that is conduct problems may both precede and follow from depression (Nock, Kazdin, Hiripi, & Kessler, 2006; Wolff & Ollendick, 2006).

A Person-Centered Analysis of Developmental Problems in Adolescence

To date, only a small body of research is based on person-centered methods to investigate developmental problems during adolescence. Therefore, comparatively little attention has been paid to developmental patterns of problems co-occurring across different domains of functioning as well as their progression over time (Bergman et al., 2009). The main idea of the person-centered or typological approach to the study of developmental

psychopathology is to identify different patterns of developmental problems which are characteristic of individuals (see Eid, Langeheine, & Diener, 2003). This approach allows for a broad probabilistic categorization of persons according to which individuals in the same type are characterized by similar profiles of developmental problems and differ meaningfully from the profiles of individuals in other types. This approach can also be fruitfully used in longitudinal research (see Collins & Lanza, 2010). Instead of analyzing stabilities in rank orders or mean levels of single characteristics over time, the temporal consistency of profile type memberships is examined. Thus, a person-oriented approach incorporates the important concepts of equifinality and multifinality in developmental processes (for a discussion, see Bergman et al., 2009).

The few previous typological studies in developmental psychopathology mainly focused on specific domains. For instance, they identified specific types of individuals suffering from depression by investigating the structure of depressive symptoms in clinical (Lamers et al., 2012) or non-clinical samples (Mezuk & Kendler, 2012) of different ages; they examined types of longitudinal trajectories of depressive symptoms (Yaroslavsky, Pettit, Lewinsohn, Seeley, & Roberts, 2013), and tried to find joint patterns with anxiety (Ferdinand, Nijs, van Lier, & Verhulst, 2005). Other studies examined trajectories of physical and relational aggression over time (Cleverley, Szatmari, Vaillancourt, Boyle, & Lipman, 2012).

Few previous studies have used a latent-class approach to analyze developmental problems during adolescence across domains. For instance, Olino, Klein, Farmer, Seeley, and Lewinsohn (2012) distinguished between four types of internalizing and externalizing psychopathology in US American adolescents. In addition to a type of adolescents with low levels of psychopathology, two types were characterized by either internalizing or externalizing disorders, and one type was characterized by both.

To our knowledge, only one study to date has used latent profile analysis to investigate externalizing, internalizing, and achievement-related problems in combination.

Orpinas, Raczynski, Peters, Colman, and Bandalos (2015) used teacher ratings of maladaptive behavior (i.e., internalizing problems, externalizing behavior) as well as assets (e.g., academic and social skills) of sixth graders and identified seven types. In addition to two normative types (i.e., well-adapted and average), they found one type characterized by internalizing problems, one type characterized by externalizing problems, one type with externalizing problems and school problems, one type with a social skills deficit, and one comorbid type characterized by severe problems in all domains. Orpinas and colleagues (2015) did not examine the longitudinal stability of type membership but demonstrated the prospective significance of the identified types. There were significant associations with school dropout rates six years later, with the lowest dropout rate for the well-adapted type and the highest dropout rate for the type with severe problems in all domains.

Age and Sex as Moderating Variables

In examining patterns of developmental problems, an important question is whether these patterns vary between different groups of individuals, for example as a function of age. Since adolescence comprises extensive and simultaneous changes in cognitive, biological, psychological, and social domains, this life period is especially vulnerable for the onset of developmental problems (Lerner & Galambos, 1998; Masten et al. 2006). One age-specific aspect may be that adolescents become increasingly concerned with being accepted by peers (Brown, 2011). Simultaneously, adolescence is a key period for identity development (Erikson, 1968) and social feedback and academic success constitute important sources of information on which adolescents build their self-concept (Harter, 2012). Thus, problems with peers, academic failure, and emotional problems gain importance during this life period.

Hence, developmental problems tend to increase in prevalence during adolescence. For example, mean levels in depression were found to rise during adolescence (Garber, Keiley, & Martin, 2002). Aggression shows an age-normative decline from middle childhood onwards but some children remain at a high level throughout adolescence and are at risk of

showing a life-course persistent pattern of aggressive behavior (Moffitt, 2007). Using a person-centered approach, Cleverly et al. (2012) followed a large sample of 10- to 15-year olds over three data waves one year apart and found that 33 percent of participants showed little or no aggression across the three waves, 52 percent showed a decline from a moderate starting level, and 15 percent showed an increase from a high starting level. Considering patterns of developmental problems, studies indicated that the co-occurrence of internalizing and externalizing problems increases in prevalence until middle adolescence (Beyers & Loeber, 2003). A study by Emerson and Hatton (2007) showed that students with learning disabilities were also more likely to manifest an emotional disorder during adolescence than during childhood.

Sex has also been linked to developmental problems but the direction of sex differences varies between domains. Evidence from Germany indicated that internalizing problems are more common in girls, whereas conduct problems are more common in boys (Robert Koch Institut, 2008). Studies from the United States also found higher rates of depression in girls than in boys from adolescence onward (Piccinelli & Wilkinson, 2000). Physical aggression is higher in boys than in girls but evidence of sex differences in relational aggression is inconclusive (Archer & Coyne, 2005). In the domain of academic achievement problems, there is no evidence for sex differences in mathematics and natural sciences (e.g., Lindberg, Hyde, Petersen, & Linn, 2010) but small disadvantages in reading skills can be found for boys (Logan & Johnston, 2010). Sex may also moderate the connections between developmental problems. Research demonstrated that externalizing problems are more likely to co-occur with internalizing problems in males than in females (Keiley et al., 2003). In a review, Zoccolillo (1992) reported that the co-occurrence of conduct problems and depression is most likely for boys in preadolescence, but for girls in mid-adolescence. Summing up, age and sex may influence connections between developmental problems during adolescence. However, it is unclear whether the structure of observed patterns is

affected or whether the number of adolescents changes who are allocated to the same patterns.

Risk Factors of Developmental Problems

Developmental problems are often preceded by several risk factors that compromise the handling of age-salient challenges, impede adaptive functioning and thus precipitate maladaptive emotions and behavior (Keyes, 2004). Since empirical and theoretical approaches emphasized the important roles of persons and their environments in shaping developmental processes (Bronfenbrenner, 1979), these risk factors can involve individual characteristics of children and adolescents (e.g., low self-esteem, dysfunctional cognitions, low cognitive capabilities) as well as contextual influences (e.g., socioeconomic conditions). Although the question whether and how these factors increase the risk for problems in single domains has frequently been addressed, little is known about their relations to patterns of different developmental problems.

Socioeconomic status. Beneficial socioeconomic circumstances (e.g., high household income, low household size, high parental education) are associated with many resources in the environments of children and adolescents (e.g., advantageous parenting style, better communication with parents, better financial resources) that generally promote adaptive functioning (Hackman & Farah, 2009; Hansen & Chen, 2007; Hoff, Laursen & Tardif, 2002). Conversely, less advantaged socioeconomic conditions can represent risky environments by depriving adolescents of useful resources. Various studies confirmed low socioeconomic status as a risk marker for a broad range of outcomes, including aggression, academic failure, and depression (Benner, Boyle & Sadler, 2016; Goodman, Slap, & Huang, 2003; McLaughlin et al, 2012). According to research, poor socioeconomic conditions may foster the co-occurrence of developmental problems. For example, Emerson and Hatton (2007) found co-occurrences of learning problems with emotional problems or conduct problems more often in adolescents from households with income poverty and parental unemployment.

Individual characteristics. Researchers have also examined individual characteristics associated with developmental problems, particularly focusing on the impact of evaluations of the self and the environment, such as self-esteem and dysfunctional cognitions, and on indicators of cognitive capabilities. Self-esteem (defined as the overall value people place on their selves; Rosenberg, Schooler, Schoenbach, & Rosenberg, 1995) plays an important role in guiding human cognitions and behavior, leading individuals to seek and evaluate experiences according to their views about themselves (Swann, Chang-Schneider, & Larsen McCarty, 2007). Thus, low self-esteem is a predictor of depression (Orth, Robins, Widaman, & Conger, 2014), externalizing problems (Donnellan, Trzesniewski, Robins, Moffitt, & Caspi, 2005), and lower academic achievement (Trautwein, Lüdtke, Köller, & Baumert, 2006). Similarly, dysfunctional cognitions describe generalized negative attitudes toward the self, the world, and the future that bias information interpretation and constitute cognitive vulnerabilities for the emergence of developmental problems (Beck & Freeman, 1990). The role of dysfunctional cognitions was established mainly with regard to depression (Lakdawalla, Hankin, & Mermelstein, 2007). In one of the few studies that addressed relations with externalizing problems, Trembley and Dozois (2009) reported a link between maladaptive schemata and aggression in college students. Low cognitive capabilities were also mentioned as vulnerabilities for developmental problems, potentially by impairing the handling of complex challenges (Koenen et al., 2009). A deficit in cognitive capabilities, such as basic cognitive processing efficiency, was especially linked to academic failure (e.g., Deary, Strand, Smith, & Fernandes, 2007; Smedt et al., 2009). Other studies indicated that lower cognitive functioning may also be associated with externalizing problems (McQuade, Murray-Close, Shoulberg, & Hoza, 2013), depression, and the co-occurrence of mental health disorders (Koenen et al., 2009).

The Present Study

Our study goes beyond previous research in several ways: It examines configurations of developmental problems in a person-centered approach, using state-of-the-art statistical techniques, adopting a longitudinal design, and relying on a large non-clinical sample of adolescents. Whereas variable-oriented methods usually address linear relations between risk factors and outcomes, we adopted a typological approach to relate potential risk factors to distinct patterns of developmental problems and their change over time. This design and analysis enabled us to discriminate empirically existing configurations of developmental problems in a non-clinical sample rather than basing classifications on clinically relevant criteria. We were moreover able to distinguish whether a factor is associated with the emergence of different patterns of developmental problems and/or whether it predicts their persistence or decline. This study thereby facilitates a holistic and integrative view on the occurrence and progression of developmental problems during adolescence and on factors that should be considered for maintaining adaptive functioning.

In particular, our study addressed four issues: (1) First, we determined the number and characteristics of profile types that best represented the empirical configurations of developmental problems in our data. Because we studied a non-clinical sample of students, we expected a large number of asymptomatic individuals characterized by low scores in depression and aggression and at least average academic achievement. We also expected types that represent single developmental problems: a type with depression, a type with aggression, and a type with low academic achievement. Consistent with previous research on comorbidities (e.g., Wolff & Ollendick, 2006) and assumptions regarding mutual relations between areas of developmental problems (e.g., Rapport et al., 2011), we further expected to find individuals belonging to the types characterized by several combinations of these developmental problems (i.e., individuals that are characterized by depression and/or aggression and/or low academic achievement). However, we treated the number and specificity of the empirically discriminable combinations as an open question.

(2) Second, we investigated the longitudinal stabilities of profile type membership across the two-year period. As the majority of adolescents do not manifest developmental problems, we expected to find high stabilities in the asymptomatic type. However, we also expected to find a notable number of initially asymptomatic participants to change to a symptomatic type as well as participants who changed from a symptomatic to the asymptomatic group.

(3) Third, we investigated predictors of both type membership and transitions in type membership from T1 to T2. In accordance with research reviewed above, we expected to find more girls than boys in the internalizing type and more boys than girls in the externalizing type (e.g., Robert Koch Institut, 2008). We also expected developmental problems and their co-occurrences to increase in the course of the particularly vulnerable period of adolescence (Garber et al., 2002; Beyers & Loeber, 2003). Although we expected sex and age to influence mean levels of developmental problems during adolescence, we advanced no a priori hypotheses whether sex and age would influence the observed empirical patterns or whether they would modify the number of adolescents assigned to the same patterns.

(4) Finally, we assumed that low socioeconomic status, low self-esteem, high dysfunctional cognitions, and lower basic cognitive processing efficiency would pose risk factors for developmental problems (e.g., Goodman et al., 2003; Orth et al., 2014). Hence, they would be more likely to occur in the symptomatic types at T1 and predict the move from the asymptomatic type at T1 to a symptomatic type at T2.

Method

Participants and Procedure

We used data from the last two measurement points of a 4-wave longitudinal study on intrapersonal developmental risk factors in childhood and adolescence conducted in Germany, which comprised a total of four waves. Although the data waves included in the present analysis represent T3 and T4 of the full study, we refer to them as T1 and T2 in this

paper for the sake of clarity. Data for the third measurement (henceforth referred to as T1) were mainly collected between 10/2011 and 7/2012, and data for the fourth measurement (henceforth referred to as T2) were mainly collected between 2/2013 and 2/2014. The period between both waves was almost two years ($M = 609.56$ days, $SD = 121.96$). Participants were recruited from 149 schools in the federal state of Brandenburg, Germany. At both waves, data were collected during a two-hour individual testing session by trained doctoral students or research assistants. Most data collection sessions took place in participants' schools, in some cases sessions were scheduled to take place outside the school setting. The study and all materials were formally approved by the Ethics Committee (IRB) of the University of Potsdam and the Ministry of Education of the federal state of Brandenburg.

The sample of the initial wave of the study consisted of 3,451 participants, of whom 2,515 participated at the second data wave and 1,489 participants participated at the third data wave (our T1 wave). Of these, 1,126 participants (75.6%) took part in the final data wave (our T2 wave). In addition, the T2 sample included 176 participants who had not been present in the preceding wave, bringing the total number of T2 participants to 1,302 and the total number of participants that participated at T1 or T2 to 1,665. These 1,665 participants (49.3% female) represent 47% of the initial sample of the four-wave study and form the sample of the present analysis.

At T1, participants had a mean age of $M = 13.14$ ($SD = 1.94$) with a range from 9 to 19 years. 31.8 percent attended primary schools, 68.2 percent secondary schools. Since the majority of our sample (more than 95 percent) fell into the age bracket of 10 to 16 years, we refer to our findings as covering the age period from late childhood to late adolescence¹. The sample comprised adolescents with a relatively high socioeconomic status, as defined by

¹ To ensure that the wide age range did not bias our findings, we conducted additional analyses that omitted participants that were older than 16 and younger than 10 years.

parents' educational status (i.e., 70.5 percent of parents [father and/or mother] had at least a university entrance diploma).

Attrition analyses between our sample and the full sample at the first data wave of the four-wave study revealed slight differences. Specifically, participants no longer in the sample we used in the present analyses were older ($d = 0.43$; $p < .001$), had a lower socioeconomic status ($d = 0.26$; $p < .001$) and showed lower academic performances (German grades: $d = 0.33$; $p < .05$; Math grades: $d = 0.46$; $p < .001$) and a slightly higher amount of psychopathological problems ($d = 0.14$; $p < .01$; measured by the total difficulty score of the Strength and Difficulties Questionnaire; Goodman, 1997). Dropout likelihood was unrelated to participants gender ($d = 0.02$).

Attrition analyses for the two waves in the present analyses revealed some small selectivity effects. Specifically, participants that no longer participated in T2 were older ($d = 0.51$; $p < .001$) and had a lower socioeconomic status ($d = 0.21$; $p < .05$). They scored higher on depression ($d = 0.15$; $p < .05$) and aggression ($d = 0.23$; $p < .001$) and showed lower academic achievement ($d = 0.35$; $p < .001$). They reported higher dysfunctional cognitions ($d = 0.22$; $p < .001$) and had lower basic cognitive information processing ($d = 0.26$; $p < .001$). Dropout likelihood was unrelated to sex ($\chi^2 [1, N = 1465] = .20, p = .66$) and self-esteem ($d = 0.13$). In such cases, the current literature recommends estimating missing data by using imputation-based procedures (Schafer & Graham, 2002). All participants that took part in the third wave (T1) were included in the sample, and we used the full-information maximum likelihood (FIML) estimator to handle missing data.² Although FIML does not rule out parameter bias entirely, it reduces the risk of biased parameter estimations and maximizes test power (Schafer & Graham, 2002).

The 176 participants from the fourth wave (T2) who had not participated in the third wave (T1) were slightly older ($d = 0.30$; $p < .001$), reported lower levels of self-esteem ($d =$

² We also conducted analyses using listwise deletion, yielding the same pattern of results.

0.23; $p < .05$) and had lower basic cognitive information processing skills ($d = 0.53$; $p < .001$), but reported no statistically significant differential depression ($d = 0.18$), aggression ($d = 0.04$), academic achievement ($d = .10$), dysfunctional cognitions ($d = 0.14$) or parental socioeconomic status ($d = 0.13$) compared to those members of the T2 sample who had been present at T1. We used FIML to include these participants in our longitudinal analyses ($N = 1665$). Since no data existed for these participants for T1, they were not included in our cross-sectional analyses resulting in a slightly reduced sample size ($N = 1489$).

Instruments

Developmental problems. To assess depression, we used two subscales (Dysphoria/Self-esteem: $\alpha_{t1} = .88$, $\alpha_{t2} = .76$; Tiredness/Autonomic response: $\alpha_{t1} = .89$, $\alpha_{t2} = .77$) of the Depression Test for Children (Depressionstest für Kinder; Rossmann, 2005). Children were instructed to respond in a forced-choice format (*yes* vs. *no*) to 39 questions (example item: “Do you often feel worthless?”). For our analyses, we calculated a global score of depression by aggregating responses across all items and z-standardizing the resulting sum scores, based on good internal consistencies ($\alpha_{t1} = .89$, $\alpha_{t2} = .89$).

To assess aggression, we used a self-report measure by Krahé and Möller (2010) that included five items measuring physical aggression since the last summer holidays (example item: “I have kicked another person”; $\alpha_{t1} = .75$, $\alpha_{t2} = .72$), and five items about relational aggression (example item: “I have dissed someone in front of others”; $\alpha_{t1} = .65$, $\alpha_{t2} = .64$). One further item measured verbal aggression (“I have insulted or sworn at someone”). All items were measured on a 5-point Likert-type scale (1 = *never* to 5 = *very often*). We also calculated a global score of aggression ($\alpha_{t1} = .80$, $\alpha_{t2} = .77$) by summing all items. Finally, we z-standardized the resulting score.

To operationalize achievement-related problems, we combined three indicators. First, to assess mathematical ability, we used the subtest “Arithmetic Thinking” of the German version of the Wechsler Intelligence Scale for Children (HAWIK III; Tewes, Rossmann, &

Schallberger, 2000). Second, to assess reading ability, we used the Salzburg Reading and Spelling Test (SLRT II; Moll & Landerl, 2010). Third, we used participants' self-reported grades in Mathematics, German, and English from their last report card (grading scale from 1 = *very good* to 6 = *unsatisfactory*) and averaged them into an overall score. To compute a global score of academic achievement, we z-standardized our three indicators and then averaged them ($\alpha_{t1} = .69$, $\alpha_{t2} = .68$).

Individual characteristics and demographic variables. We operationalized self-esteem using the 4-item subscale of the revised questionnaire for assessing Health-Related Quality of Life in Children and Adolescents (KINDL-R, Ravens-Sieberer & Bullinger, 1998; example item: "During the last week, I have felt pleased with myself"; $\alpha_{t1} = .56$) on a 5-point Likert-type scale (1 = *at no time* to 5 = *always*).

We used a German translation of the Dysfunctional Attitudes Scale for Children by D'Alessandro and Burton (2006) to measure dysfunctional cognitions in participants aged 13 years or younger (originally 22 items). For adolescents older than 13 years, an adapted version with 20 items was used (Keller, Kirchner, & Pössel, 2010). For the purposes of the present analysis, only the nine items that were identical in both versions were used to achieve a better comparability across age groups (example item: "I can only be happy if people like me"; $\alpha_{t1} = .71$; for details on the parallelization, see Sahyazici-Knaak, 2014; for a similar procedure, see Lewinsohn, Allen, Seeley & Gotlib, 1999). Responses were made on a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

Basic cognitive processing efficiency was measured by the subtest "coding" of the German version of the Wechsler Intelligence Scale for Children (HAWIK IV; Petermann & Petermann, 2000). This test has been shown to tap into processing speed as well as executive control processes in working memory (e.g., Cepeda, Blackwell, & Munakata, 2013). Adolescents were asked to transcribe a digit-symbol code in a time-limited task. The resulting score was scaled in line with the manual (Petermann & Petermann, 2000) based on

participants' age on a comparable metric where a value of $M = 50$ and $SD = 10$ characterizes the reference population.

To operationalize participants' socioeconomic background, we used the father's and the mother's current occupation, as reported by parents. Occupational status was coded following an established classification (0 = *unemployed* to 4 = *managers, professionals and engineers*; Blossfeld, 1987; Schimpl-Neimanns, 2003). For our analyses, we used the highest occupational status by either parent in each family.

Statistical Analyses

To examine the structure and consistency of developmental problems, we conducted latent profile analyses (LPA) and latent profile transition analyses (LTA), using the software *Mplus* 6.11 (Muthén & Muthén, 1998-2011). To account for the hierarchical data structure with students nested in schools, we estimated the models with robust standard errors using the analysis option `type = complex` (with school as cluster variable).

Latent profile analyses. The main aim of the Latent Profile Analysis (LPA; e.g., Collins & Lanza, 2010) was to identify an appropriate number of types to describe combinations of developmental problems. Contrary to other forms of profile analysis (e.g., cluster analysis), LPA uses a model-based methodology by estimating a latent categorical variable, taking measurement error into account. Estimated types can be described in terms of type-specific mean levels of developmental problems (i.e., type-specific profiles) and in terms of their proportional sizes (i.e. the relative number of adolescents assigned to each profile). Participants can be assigned to the most likely type based on their individual patterns of values on the observed variables (here: any configuration of depression, aggression, academic achievement). Thus, LPA was used to estimate a categorical latent variable to explain associations between depression, aggression, and academic achievement problems.

Latent profile transition analysis. We used latent profile transition analysis (LTA; Collins & Lanza, 2010) to estimate longitudinal stabilities of type memberships. Types of

developmental problems were modeled simultaneously at both data waves, and latent transition probabilities were estimated between types across time as an indicator of stability and change in type membership.

The analyses were conducted in five steps: Using latent profile analyses (LPA), we (1) identified the number and characteristics of profiles in developmental problems in the T1 data, (2) estimated multiple-group LPAs to test for measurement invariance across sex and age groups, and (3) investigated the relation of type membership with sex, age, socioeconomic status, self-esteem, dysfunctional cognitions, and basic cognitive processing efficiency. Latent profile transition analyses (LTA) were used with both T1 and T2 data to (4) investigate the stability of type membership over the two-year period, and (5) examine associations of changes in type membership with sex, age, socioeconomic background, self-esteem, dysfunctional cognitions, and basic cognitive processing efficiency.

Results

Descriptive Statistics and Correlations

Descriptive statistics and correlations for developmental problems, demographic variables, and individual characteristics for males and females are presented in Table 1. Significant sex differences were found for depression and basic cognitive processing efficiency (i.e., higher in girls) as well as aggression and self-esteem (i.e., higher in boys). Almost all bivariate correlations were significant for girls and boys. Dysfunctional cognition and depression showed only moderate correlations ($r_{t1} = -.36$ for girls and $-.41$ for boys), which indicate that the two measures capture distinct underlying constructs despite some overlap in item content. This was also true for the conceptual distinction between cognitive processing efficiency and academic achievement ($r_{t1} = -.36$ for girls; $-.37$ for boys).

Cross-Sectional Analyses

Identification of types. To determine the number of empirical profiles, we estimated a series of latent profile analyses with differing numbers of latent types (2 to 7) and compared

them in terms of model fit and interpretability, as shown in Table 2. Although the Bayesian Information Criterion (BIC) is commonly used to identify the appropriate number of types (i.e., lower values indicating better model fit), this can lead to an overextraction of types, particularly in large samples (Nylund, Asparouhov, & Muthén, 2007). Reflecting this problem, the BIC value decreased in our study with each additional type. We therefore based our evaluation of the different solutions on the Entropy index, the Lo, Mendell, Rubin Test, and the Bootstrap-Likelihood-Ratio-Difference-test³, considering interpretability and parsimony as additional criteria (see Meeus, Van de Schoot, Rens, Klimstra, & Branje, 2011; Nylund et al., 2007). The Entropy index evaluates the distinctiveness of the identified groups, with scores higher than .80 indicating adequate separation between latent types (see Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005). Although almost all of our models showed an Entropy index above this critical value, the three-type solution provided the highest value, indicating the most appropriate classification of individuals. The Lo, Mendell, Rubin Test, and the Bootstrap-Likelihood-Ratio-Difference-test both quantify comparisons between models with different class solutions. Therefore, significance tests indicate whether each solution should be favored over a solution with one fewer class (e.g., Lo, Mendell, & Rubin, 2001). Whereas the Lo, Mendell, Rubin Test also favored the three-type solution, the Bootstrap-Likelihood-Ratio-Difference-test indicated statistically significant improvements for all tested solutions.

Finally, we evaluated the interpretability and parsimony of our solutions. Mean-level profiles for all solutions are presented in Figure A1 in the appendix. The two-type solution provided two types differing in mean levels, but not in their shapes. One type was characterized by high scores in depression, aggression, and achievement-related problems

³ To our knowledge, it is not possible to estimate the Bootstrap-Likelihood-Ratio-Difference-test (BLRT) in *Mplus* by using the analysis option `type = complex`. To report a meaningful estimation of the BLRT, we reran the models without the cluster variable, which should result in a comparable model fit.

and one type by low scores in all three constructs. Therefore, this solution did not meet the requirement of distinct profile shapes and did not provide sufficient information on configurations of developmental problems. By contrast, the three-type solution resulted in three distinct profiles that differed not only in mean levels, but also in shapes and therefore provided a meaningful solution. The four-type solution resulted in the same profiles as the three-type solution but divided one profile into two smaller types. The five-type solution reproduced a similar pattern to the four-type solution plus one small additional type (including only 2.6 percent of students) characterized by high scores on depression and aggression. The six-type and seven-type solutions provided the same patterns as the five-type solutions but in each case one type was divided into two small types. For this reason, we decided to stop our exploration with the seven-type solution.

Considering all criteria, in combination, we decided to accept the three-type solution as the best model because it provided meaningful and parsimonious distinct profiles with an appropriate number of participants and could be justified by the comparative evaluation of fit indices. Although the Bootstrap-Likelihood-Ratio-Difference-test demonstrated significant improvements for each additional type, even beyond seven types, the Entropy index as well as the Lo, Mendell, Rubin Test suggested the three types to be the best fitting solution (see Table 2).

Based on the three-type solution, we identified one asymptomatic type with lower than average scores on depression and aggression as well as at least average scores on the achievement measure (see Table 3). This type comprised the large majority of our sample (79.7 percent). The two other types were characterized as symptomatic (i.e., higher scores on depression, aggression and/or achievement-related problems). Specifically, the second type (6.4 percent of the sample), identified as depressed, had higher scores on depression (i.e., more than 1.5 *SD* above the mean) and slightly higher scores in aggression and achievement-related problems. The third type (13.9 percent), identified as aggressive, had considerably

higher scores on aggression (i.e., more than 2 *SD* above the mean), slightly higher scores on depression (around 0.5 *SD* above the mean), and average scores on academic achievement.

Measurement invariance across age and sex. We conducted multiple-group LPAs to test measurement invariance (MI) of the extracted types across sex and age groups. For this purpose, we divided our sample into three almost equally sized age groups, covering a range of two to three years each (< 12 years: $N = 450$, 12-13 years: $N = 474$, > 14 years: $N = 565$). In LPA, MI refers to the similarity of shapes (i.e., mean-level profiles in depression, aggression, and academic achievement) across different groups (Eid et al., 2003). Thus, if MI is confirmed, the same latent types are assumed to hold across groups. We tested a series of multiple-group LPAs with three age groups by two sex groups. The following stepwise procedure evaluated the BIC for four models: the most restrictive model with mean levels of dependent variables constrained to be equal across all six groups (Model 1) was compared with models (2a and 2b) in which the dependent variables were allowed to differ between some of the groups. In Model 2a, they were constrained to be equal across age groups and allowed to differ between girls and boys, whereas in Model 2b they were constrained to be equal across sex and allowed to differ between age groups. Finally, we estimated the least restrictive Model 3 in which variables were allowed to differ between all six groups.

The data favored a model that was invariant across age groups but allowed for differences in mean levels between boys and girls, as indicated by the lowest BIC (Measurement Invariance [MI] for age and sex: $BIC = 17531.06$, $aBIC = 17410.34$; MI for age, but not sex: $BIC = 17494.99$, $aBIC = 17345.68$; MI for sex, but not age: $BIC = 17560.28$, $aBIC = 17382.38$; No MI for age and sex: $BIC = 17593.09$, $aBIC = 17358.01$) and also shown by the different profiles in Figure 1. Although the overall patterns were comparable (i.e., similar peaks in profiles for boys and girls), there were differences in mean levels (see Table 3). The *asymptomatic type* had lower than average or average mean levels of depression, aggression, and achievement-related problems in girls and boys. This type only

showed slight mean-level differences between boys and girls, who were represented equally in this type (80.7 percent of girls, 77.4 percent of boys). By contrast, the two symptomatic types revealed sex-specific profiles. Regarding the *depressed type*, boys had lower scores in depression than girls (differing by more than 0.5 *SD*). In addition, whereas girls showed average aggression scores, boys scored about 0.5 *SD* above the grand mean. Finally, whereas girls in this type showed significantly lower academic achievement (0.3 *SD* below the grand mean), boys had average scores. Regarding the *aggressive type*, boys had higher aggression scores than girls. Specifically, boys scored almost 2.5 *SD* above the grand mean; girls' scores were around 1.5 *SD* above the grand mean. In addition, girls in the aggressive type were more depressed (i.e., close to 1.5 *SD* above the grand mean) than boys, who scored about average. Academic achievement was about average for girls and boys in this type. To conclude, the results indicated measurement invariance across the three age groups, but differences in profile types between girls and boys. Therefore, we analyzed girls and boys separately in all subsequent analyses.

Associations of types with demographic variables and personality characteristics.

We examined cross-sectional relations of demographic variables and individual characteristics with membership of different types of developmental problems in each sex group. As our analyses confirmed MI of profile types between age groups, we additionally tested whether the different age groups were represented differently in the three types. We calculated Bonferroni-adjusted pairwise comparisons to test for statistically significant mean-level differences in age, socioeconomic background, self-esteem, dysfunctional cognitions, and basic cognitive processing efficiency between latent types. Participants were not assigned categorically to their most likely type but received weighted values using their probability score of membership of each type. Corresponding means, standard deviations and the standardized mean-level differences are presented in Table 4.

Girls. Girls in the depressed type had a slightly lower socioeconomic status, substantially lower self-esteem, and higher dysfunctional cognitions than girls in the asymptomatic type. Girls in the aggressive type were slightly older, had lower self-esteem and higher dysfunctional cognitions, and also scored lower on basic cognitive processing efficiency compared to the asymptomatic type. None of the variables discriminated between girls in the two symptomatic types.

Boys. The strongest predictors of membership of the depressed and the aggressive types as compared to the asymptomatic type were lower self-esteem and higher dysfunctional cognitions. In addition, self-esteem was significantly lower for boys in the depressed than in the aggressive type. Age, socioeconomic status, and basic cognitive processing efficiency were not significantly associated with type membership among boys.

The associations of self-esteem and dysfunctional cognitions with type membership were remarkably similar for boys and girls, which provides strong evidence for the replicability of the core results in these cross-sectional analyses.

Longitudinal Analyses

Stability of profile type membership. The stability of type membership across the two-year period was examined through latent profile transition analyses (LTA). Given the violation of MI for the two sex groups in the cross-sectional analyses, we again estimated separate models for girls and boys. As a first step, we tested the MI of our three-type solution across time (i.e., consistency of the type structure) by modelling latent types simultaneously at both measurement points. Specifically, we used the BIC to compare restrictive models with type-specific mean-level profiles constrained to be equal over time with nonrestrictive models based on free estimations. For girls and boys, the model fit indices favored the restrictive model assuming longitudinal invariance of profile structures (girls: MI: BIC = 10902.395, No MI: 11011.338; boys: MI: BIC = 10923.727, No MI: 11008.401). This result allowed us to evaluate changes in type membership across time.

In a second step, we investigated stabilities and changes in type membership as indicated by latent transition probabilities. Specifically, latent transition probabilities estimate, for each latent type, the average likelihood of staying in the same type over time or of moving to any other type. Table 5 shows the estimated latent transition probabilities across time, separately for girls and boys. Overall, the stability of type membership across the two years was high for both sex groups. More than 90 percent of adolescents who were categorized as asymptomatic at T1 were also classified as asymptomatic two years later but some adolescents changed from the asymptomatic type to one of the symptomatic types. For the two symptomatic types, the majority of participants also remained in their respective types at T2, but a substantial proportion changed to the asymptomatic group.

Among *girls*, 5.3 percent moved from the asymptomatic to the depressed type and 2.7 percent moved from the asymptomatic to the aggressive type. There was also high stability in the depressed type (i.e., 90.8 percent), with only a few girls moving from the depressed to the aggressive type (i.e., 6.1 percent). Regarding the aggressive type, 60.1 percent of girls who were categorized into the aggressive type at T1 were estimated to stay in this type. A relatively large proportion of 39.9 percent of girls in the aggressive type at T1 was classified as asymptomatic at T2.

Among *boys*, the corresponding values for the transition from the asymptomatic to the depressed and aggressive types were 2.7 percent and 2.9 percent, respectively. Longitudinal stability of membership in the depressed type was 59.6 percent, and all boys who left the depressed category became asymptomatic at T2. The stability of membership of the aggressive type was lower compared to the asymptomatic type, but still high at 75.0 percent. Again, those who changed type membership almost all moved to the asymptomatic type (i.e., 23.8 percent).

Associations with demographic variables and individual characteristics. In the final set of analyses, we investigated to what extent the covariates predicted the transitions

between the three profiles. The demographic variables (i.e., age, socioeconomic background) and personal characteristics (i.e., self-esteem, dysfunctional cognitions, and basic cognitive processing efficiency) were included as covariates. The base group was always the asymptomatic group. Since prior analyses had shown nearly no transitions between the two symptomatic types, the basic probability was fixed to slightly above 0 and the influence of the covariates was fixed to $b = 0$ for these two transitions to avoid singular matrices. These restrictions precluded any inference about changing patterns between the two groups, but allowed us to investigate the patterns of transition from the asymptomatic group to one of the symptomatic groups and vice versa. For girls, it was also necessary to exclude the transition from the depressed to the asymptomatic group, since this cell was nearly empty. Significant effects are denoted with superscripts in Table 5.

Girls. Younger girls had a higher risk ($b = -0.410, t = -3.38, p = .001, OR = 0.664$) and girls with a lower socioeconomic status had a marginally higher risk ($b = -0.761, t = -1.80, p = .071, OR = 0.467$) of moving from the asymptomatic to the aggressive type than older girls and girls with a higher socioeconomic status. Additionally, girls with a higher level of dysfunctional cognitions were more likely to move from the asymptomatic group to the aggressive group ($b = 0.884, t = 2.60, p = .009, OR = 2.421$) than those with a lower level of dysfunctional cognitions. None of the variables significantly predicted the transition from the asymptomatic to the depressed group. Girls with a lower level of basic cognitive processing efficiency had a higher probability of moving from the aggressive group to asymptomatic group ($b = 1.025, t = 2.731, p = .006, OR = 2.787$) than girls with a higher level of basic cognitive processing.

Boys. The transition from the asymptomatic to the depressed group was predicted by a lower socioeconomic status ($b = -0.736, t = -2.15, p = .032, OR = 0.479$). Similarly, boys with a higher level of basic cognitive processing efficacy were more likely to move from the asymptomatic to the depressed group ($b = 0.468, t = 2.042, p = .041, OR = 1.597$). None of

the variables predicted the transition from the asymptomatic to the aggressive type or any of the two symptomatic groups to the asymptomatic group (all $ps > .10$).

To ensure that the wide age range did not bias our findings, we conducted additional analyses that excluded participants who were older than 16 and younger than 10 years. These analyses produced the same pattern of results as presented for the total sample.

Discussion

The present study examined the co-occurrence of developmental problems and their correlates in adolescence in three broad domains of functioning: depression, aggression, and academic achievement. Moreover, we investigated their emergence, persistence, or decrease by following participants over almost two years.

The Structure of Developmental Problems

As expected, the majority of participants - just under 80 percent - in this non-clinical sample were classified as asymptomatic, that is they showed low levels in each of the three domains of depression, aggression, and achievement-related problems. However, about 20 percent of participants were classified into one of the two symptomatic groups at T1, characterized by high levels of depression and aggression, respectively. The depressed group was twice as large as the aggressive group. The findings from this overall analysis are consistent with national and international prevalence estimates (e.g., Costello et al., 2006; Robert Koch Institut, 2008).

Our results thereby point to connections between different areas of developmental problems by showing that severe problems in one area were associated with significantly greater problems in other developmental areas. Thus, girls assigned to the aggressive type were characterized by above-average levels of depression, boys in the depressed type showed above-average levels of aggression, and most adolescents in the symptomatic types were characterized by lower levels of academic achievement. This finding is in line with a holistic-interactionistic perspective (e.g., Magnusson & Stattin, 2006) and more specific theoretical

assumptions that connect different areas of developmental problems (e.g., Juvonen & Knifsend, 2016; Rapport et al., 2001; Wolff & Ollendick, 2006). It is also consistent with previous research that found associations between developmental problems (Hewitt et al., 1992; Hinshaw, 1992; Verboom et al., 2014). It might be particularly important to identify these connections for adolescence, a period in life when academic achievement, social relationships with peers, and identity development represent crucial development challenges with important implications for adulthood (Masten et al., 2005).

Our results deviate from previous findings in that we found no comorbid group in the overall sample (e.g., Olinio et al. 2012; Orpinas et al., 2015). However, our results indicated gender-specific comorbid groups (see below). Similarly, we did not find a latent profile that characterized adolescents with specific problems in academic achievement. These results are at odds with epidemiological studies that reported mathematical disabilities in three to seven percent and reading deficits in four to nine percent of adolescents (e.g., American Psychiatric Association, 2013) and showed a considerable prevalence of comorbid groups (e.g., Angold et al., 1999). One explanation may be that families with a relatively high socioeconomic status (SES) and students with higher academic achievement were overrepresented in our study. Since previous research emphasized parental SES as a main predictor of developmental problems (Goodman et al., 2003), which may also foster comorbidity (Emerson & Hatton, 2007), the composition of our sample may have reduced the occurrence of learning problems and comorbidity. To rule out that the use of a composite achievement score (including standardized reading and math tests, and school grades) might have failed to detect more specific deficits, we re-ran our analyses by including each indicator individually with virtually the same pattern of results.

Age and Sex as Moderating Variables

Our results indicated different patterns of developmental problems for girls and boys. Most importantly, they point in the direction of gender-specific comorbid types by indicating

that aggressive behavior seems to be accompanied by depression in girls whereas depression seems to co-occur with aggression in boys. More precisely, girls in the depressed type were mainly characterized by high depression scores, whereas boys in this type additionally showed heightened levels of aggression. Boys in the aggressive type were uniquely characterized by high aggression scores, whereas girls additionally showed almost equally high depression scores. These results correspond to previous findings with variable-oriented methods that also found higher levels of depression in girls and higher levels of aggression in boys (e.g., Almanasa et al., 2011, Piccinelli & Wilkinson, 2000). They are also consistent with empirical findings on the comorbidity between internalizing and externalizing problems (e.g., Wolff & Ollendick, 2006) and exemplify the usefulness of a person-centered approach. Although cross-sectional correlations revealed similar associations between aggression and depression in girls and boys (cf. Table 1), the latent class approach provided incremental information by revealing these different patterns of comorbidity for girls and boys. This gender specificity may be explained by gender stereotypes. Thus, aggressive behavior may be more likely to be accompanied by depression in girls because it is viewed as less socially acceptable for girls.

Contrary to our expectations, our results indicated only small age effects for the age range under consideration. We found no age specificity in profile shapes. However, girls in the aggressive type were slightly older than girls in the asymptomatic type. Previous research especially found increases in depression during adolescence (Garber, Keiley, & Martin, 2002). Although our cross-sectional correlations (cf. Table 1) also indicated a small-sized association with age, age was not related to adolescents' membership in the depressed group.

The Stability of Developmental Problems

To our knowledge, this is the first study to use latent profile transition analyses to simultaneously study the progression of internalizing, externalizing, and achievement-related developmental problems. As expected, we found that the vast majority of the asymptomatic

participants (i.e. no problems in all three domains) remained in this type two years later. In the depressed type, the stability over time was substantially higher for girls than for boys suggesting that a high level of depression in girls is likely to persist over time. This is in line with previous studies reporting higher levels of depression in girls than in boys (Piccinelli & Wilkinson, 2000) and may indicate that adolescent depression may have especially long-standing implications for the developments of girls. About two thirds of the girls and three quarters of the boys who were members of the aggressive profile type at T1 stayed in this type at T2. These results are in line with previous studies that identified groups with persistently high aggression in adolescence (e.g., Cleverly et al., 2012) and may point to the risk of persistent patterns even into adulthood.

Beyond potential gender specificity, these findings may also point to lower stabilities of comorbid symptoms (i.e. the aggressive group for girls and the depressed group for boys) compared to groups that are characterized by one developmental problem (i.e. the depressed group for girls and the aggressive group for boys) suggesting that there may be less reason to expect spontaneous improvement if adolescents show symptoms in only one domain compared to multiple problems. They therefore provide incremental information over the predominant variable-centered perspective.

Moreover, our findings indicated that transitions between symptomatic groups are rare, at least in the age group considered in the present study. Instead, transitions are most likely to occur from the symptomatic types toward the asymptomatic group.

Predicting Types of Developmental Problems

Finally, by examining correlates of both type membership at T1 and transitions over time, a person-centered analysis sheds light on possible markers of different probabilities in the emergence, persistence, or decline of developmental problems, which may be used for prevention efforts. Overall, we found demographic and individual characteristics to be associated with membership in different types of developmental problems and with

longitudinal transitions between types. Our findings are consistent with previous research that indicated associations between these factors and developmental problems (e.g., Goodman et al. 2003; Lakdawalla et al., 2007; McQuade et al., 2014; Orth et al., 2014).

Focusing on the socioeconomic background, our results revealed only small cross-sectional relations to the membership in a symptomatic type, exclusively showing that girls in the depressed group had a lower socioeconomic status. However, an interesting pattern was revealed regarding its association with longitudinal transitions between types. For both gender groups, a low socioeconomic status predicted the emergence of comorbid developmental problems in depression and aggression, but did not predict transitions to symptomatic groups that showed problems in only one of these domains, i.e. either depression or aggression. This result is in line with a large number of previous studies that confirmed low socio-economic status to be a risk marker for a broad range of outcomes (Goodman et al., 2003) and also with research that associated a low socio-economic status with co-occurrences of emotional and conduct problems (Emerson & Hatton, 2007). The finding that the socio-economic background may be especially predictive of simultaneous occurrences of more than one developmental problem also demonstrates the usefulness of a person-centered approach. One explanation for this finding may be that a low socioeconomic status is a rather distal variable that is associated with a range of risk conditions and mechanisms in adolescents' environments that often co-occur and accumulate their influences (e.g., Goodman et al., 2003). These risk environments may be more likely to challenge adolescents' adaptation in more than one area, instead of impairing their emotional or social or academic adjustment.

In line with our hypotheses, we also found associations with self-esteem and dysfunctional cognitions. Girls and boys in both symptomatic types showed lower self-esteem and higher dysfunctional cognitions than their counterparts in the asymptomatic type. Dysfunctional cognitions were also associated with the transition from an asymptomatic

profile to a comorbid profile in girls (i.e. aggressive type, characterized by high aggression, high depression and average academic achievement), but predicted no profile transitions in boys. These findings are in line with previous research describing dysfunctional cognitions and low self-esteem as risk factors for developmental problems (e.g., Beck & Freeman, 1990; Orth et al., 2014). Although our findings may also point to gender specificity in the impact of dysfunctional cognitions, our results cannot disentangle this effect from gender specificity in profile shapes or transition probabilities.

In line with our hypotheses and previous research (McQuade et al., 2013), girls in the aggressive group scored lower on basic cognitive processing efficiency compared to girls in the asymptomatic group. However, two additional, unexpected findings emerged: boys with high cognitive functioning efficiency were more likely to move from the asymptomatic to the depressed type than those scoring low on this construct. Girls with low cognitive functioning efficiency were more likely to move from the aggressive to the asymptomatic type than those scoring high on this construct. It is especially difficult to explain the results given the lack of evidence of a simultaneous effect of age for these transitions. We refrain from a post-hoc explanation until the effects have been replicated.

The person-centered approach provides information for disentangling influences that contribute to the emergence of developmental problems from influences that contribute to their reduction. For example, our results indicated that higher dysfunctional cognitions and a lower socioeconomic status may serve as risk factors for the occurrence of developmental problems. At the same time, we found no empirical evidence that more favorable values on these factors also predict the removal of developmental problems. Since the number of adolescents that were assigned to the asymptomatic and symptomatic groups differed significantly, it is not clear whether this result can be interpreted meaningfully or whether it is produced by differential test power.

Strengths and Limitations

Our study has considerable strengths: it is based on a large non-clinical sample of almost 1,500 participants attending a diverse range of community schools, it included two data waves covering a time span of two years, and it used state-of-the-art latent profile and latent transition analyses to demonstrate the value of a person-centered approach to analyzing developmental problems in adolescents. At the same time, several limitations must be acknowledged.

Although we studied a large sample, the prevalence of developmental problems was relatively low, resulting in a small proportion of participants in the symptomatic groups. Owing to these small group sizes, we were not able to investigate the predictability of individual variables for all transitions or to investigate whether these associations vary by age. Further studies should therefore use large samples (>5,000) or especially recruit high-risk samples to be able to detect associations in these relatively small, but important, groups of adolescents with specific constellations of developmental problems. An additional limitation concerns the generalizability of our results. Students with a high socio-economic status were overrepresented in our sample. This reduction in variability may explain at least partly why SES only slightly predicted patterns of developmental problems. Limitations also concerned the measures. Whereas this study examined patterns of aggression, depression, and academic achievement on a global level, future studies should further investigate this issue on a more specific level, e.g., by differentiating physical, verbal and relational aggression or subject-specific academic performance. Our SES measure addressed parental occupational status, and future studies should additionally use measures that represent other aspects of socioeconomic backgrounds, such as parental education or income. The internal consistency of the items that measured self-esteem was relatively weak and also lower than reported by Ravens-Sieberer and Bullinger (1998). Future studies should test whether this influences the pattern of results. A further limitation refers to the reliance on participants' self-reports to

assess aggressive behavior. In developmental aggression research, self-reports are an established means of assessment (e.g., Barker et al., 2007), nevertheless we suggest that future studies should employ additional measures, such as peer nominations or teacher ratings, to validate the findings (e.g., Temcheff et al., 2008). Moreover, although we conceptualized individual variables (e.g., self-esteem, dysfunctional cognitions) as predictors of changes in developmental problems, these variables themselves may also change considerably during adolescence, for instance as a result of developmental problems. Future longitudinal studies should therefore address bidirectional relations between these variables and patterns of developmental problems. Finally, we had no information about any treatment our participants may have had to address their problems in the course of our study. Therefore, the question whether psychological treatment accounts for some of the transitions between groups is an issue for future research.

Conclusions and Implications

Beyond adding to the theoretical understanding of configurations of developmental problems, their predictors, and their changes over time, our findings have implications for educators, counselors, and other professionals working with adolescents. They revealed that in a non-clinical sample, about 20 percent of students were identified as having developmental problems in terms of elevated levels of depression or aggression. These problems and their co-occurrences appeared to be gendered, with boys showing either aggressive behavior or depression accompanied by aggressive behavior and girls having either high levels of depression or high levels of aggression accompanied by depression. Low self-esteem, more dysfunctional cognitions and a low socioeconomic status were identified as significant predictors of membership in and transitions to the symptomatic types of profiles. Our analyses thereby indicate the need to distinguish between risk factors of the emergence of developmental problems from factors that contribute to their attenuation. Moreover, our longitudinal findings revealed that high levels of depression in girls and high levels of

aggression in boys seem to be relatively stable across time, whereas girls and boys showing a co-occurrence of both symptoms at T1 seemed to be more likely to move to the asymptomatic type. Taken together, this knowledge may help practitioners to identify at-risk individuals and recognize signs of problematic courses of development in these domains early on, enabling them to provide appropriate guidance and support.

In sum, our findings demonstrated advantages of using a person-centered approach and uncovered new questions for variable-oriented research. We therefore argue for a fruitful combination of person-centered and variable-oriented methods in future research on developmental problems in adolescence.

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Table 1

Descriptive Statistics and Correlations for Developmental Problems, Demographic Variables, and Individual Characteristics by Sex

| Construct | <i>M (SD)</i> | | | Correlations | | | | | | | | | | |
|-----------------------------------|---------------|--------------|----------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|--------|--------|
| | <i>Girls</i> | <i>Boys</i> | <i>d</i> | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 Depression T1 | .26 (.18) | .20 (.15) | .34*** | - | .31*** | .06 | .11** | -.15*** | -.33*** | .36*** | -.05 | .53*** | .20*** | .08* |
| 2 Aggression T1 | 1.48 (.41) | 1.64 (.48) | -.35*** | .37*** | - | .04 | .18*** | -.05 | -.14*** | .28*** | -.02 | .25*** | .52*** | .03 |
| 3 Academic achievement (rec.) T1 | .01 (.70) | -.01 (.72) | .03 | .19*** | .03 | - | .10* | .29*** | -.06 | .02 | -.36*** | .04 | .02 | .85*** |
| 4 Age T1 | 13.43 (1.99) | 13.34 (2.01) | .05 | -.02 | .14*** | .09* | - | .04 | -.06 | -.46*** | -.07* | .07 | -.09* | .15** |
| 5 Socioeconomic background T1 | 3.16 (.88) | 3.21 (.82) | -.07 | -.02 | .04 | .24*** | -.01 | - | .09* | .07 | .09* | -.12** | -.04 | .30*** |
| 6 Self-esteem T1 | 3.60 (.54) | 3.77 (.52) | -.32*** | -.35*** | -.17*** | -.12** | .04 | .01 | - | -.14*** | .02 | -.16*** | -.08 | -.05 |
| 7 Dysfunctional cognitions T1 | 1.83 (.53) | 1.89 (.54) | .06 | .41*** | .33*** | .11** | -.38*** | .05 | -.26*** | - | -.06 | .24*** | .21*** | .03 |
| 8 BCPE T1 | 53.83 (8.35) | 49.16 (7.85) | .58*** | -.11** | -.04 | -.37*** | -.11** | .09* | .07 | -.10** | - | -.01 | .01 | -.33 |
| 9 Depression T2 | .24 (.18) | .16 (.13) | .54*** | .62*** | .19*** | .13** | .11** | -.05 | -.28*** | .25*** | -.11** | - | .33*** | .04 |
| 10 Aggression T2 | 1.42 (.36) | 1.57 (.42) | -.37*** | .27*** | .49*** | .05 | .00 | -.03 | -.15*** | .21*** | -.05 | .37*** | - | .01 |
| 11 Academic achievement (rec.) T2 | .27 (.70) | -.02 (.72) | .07 | .19*** | .04 | .83*** | .16*** | .21*** | -.12** | .11** | -.31*** | .16*** | .09* | - |

Note. $N = 1,665$; * $p < .05$; ** $p < .01$; *** $p < .001$; Correlations for girls above the diagonal, correlations for boys below the diagonal; BCPE: Basic cognitive processing efficiency; rec.= Scores of academic achievement were inversely recoded so that higher scores indicate lower achievement; $N = 1,665$; Missing cases: Depression T2 = 24.4 percent, Aggression T2 = 24.4 percent, Academic achievement T2 = 27.6 percent, Socioeconomic background T1 = 13.4 percent, Self-esteem T1 = 0.1 percent, dysfunctional cognitions T1 = 0.1 percent, BCPE T1 = 0.6 percent.

Table 3

Mean Levels for the Three-Type Solutions at T1 in the Overall Sample and Separately for Girls and Boys

| <i>Construct</i> | Separated by sex | | | | | | | | | | | |
|------------------|---------------------------------|----------------|-----------------|-------------------------|----------------|-----------------|------------------------|----------------|-----------------|--|----------------|-----------------|
| | Total sample (<i>N</i> = 1489) | | | Girls (<i>N</i> = 739) | | | Boys (<i>N</i> = 750) | | | Differences in mean levels (Girls-Boys) | | |
| | Asymp- tomatic | De- pressed | Agg- ressive | Asymp- tomatic | De- pressed | Agg- ressive | Asymp- tomatic | De- pressed | Agg- ressive | Asymp- tomatic | De- pressed | Agg- ressive |
| <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>M (SE)</i> | <i>d</i> | <i>d</i> | <i>d</i> | |
| Depression | -.35 (.03) | 1.74 (.12) | .58 (.18) | -.21 (.04) | 1.99 (.30) | 1.33 (.37) | -.51 (.04) | 1.39 (.15) | .23 (.11) | .30*** | .60 | 1.10* |
| Aggression | -.25 (.04) | .31 (.12) | 2.28 (.28) | -.38 (.07) | -.01 (.23) | 1.75 (.66) | -.13 (.05) | .54 (.16) | 2.49 (.23) | -.25** | -.55 | -.74 |
| Achievement | -.08 (.09) | .31 (.11) | .19 (.20) | -.12 (.09) | .37 (.14) | .37 (.36) | -.03 (.11) | .10 (.13) | .28 (.25) | -.08 | .27 | .10 |
| <i>N</i> | 1186.42 | 206.86 | 95.72 | 596.0 | 106.29 | 36.69 | 580.62 | 111.88 | 57.51 | | | |
| Proportions | 79.7 | 13.9 | 6.4 | 80.7 | 14.4 | 5.0 | 77.4 | 14.9 | 7.7 | | | |

Note. Mean levels, standard deviations and mean-level differences are reported in standardized units; scores of academic achievement were inversely recoded so that higher scores indicate lower achievement. *N* reflects proportional sizes, i.e. the accumulated estimated likelihoods of all participants for being assigned to each profile.

Table 4

Mean Levels of Demographic Variables and Individual Characteristics by Sex and Latent Type

| | Girls (N = 739) | | | | | | Boys (N = 750) | | | | | |
|-----------------------------------|------------------------|------------------------|------------------------|---------------------------|-------------------|----------|------------------------|------------------------|------------------------|---------------------------|-------------------|----------|
| | Type | | | Differences between types | | | Type | | | Differences between types | | |
| | Asymp- tomatic | Depressed | Aggressive | Asymp- tomatic | Asymp- tomatic | Depr. | Asymp- tomatic | Depressed | Aggressive | Asymp- tomatic | Asymp- tomatic | Depr. |
| | <i>M</i> (<i>SD</i>) | <i>M</i> (<i>SD</i>) | <i>M</i> (<i>SD</i>) | <i>d</i> | <i>d</i> | <i>d</i> | <i>M</i> (<i>SD</i>) | <i>M</i> (<i>SD</i>) | <i>M</i> (<i>SD</i>) | <i>d</i> | <i>d</i> | <i>d</i> |
| <i>Demographic variables</i> | | | | | | | | | | | | |
| Age | 13.37 (2.01) | 13.68 (1.96) | 13.95 (1.80) | -.16 | -.31* | -.14 | 13.32 (2.00) | 13.08 (2.04) | 13.69 (1.82) | .11 | -.20 | -.32 |
| SES | 3.22 (.84) | 2.92 (.93) | 2.97 (1.10) | .15** | .13 | -.03 | 3.22 (.80) | 3.17 (.90) | 3.22 (.94) | .02 | .00 | -.03 |
| <i>Individual characteristics</i> | | | | | | | | | | | | |
| Self-esteem | -.04 (.93) | -.75 (1.10) | -.51 (1.11) | .70*** | .46** | -.21 | .29 (.90) | -.45 (1.13) | .00 (.91) | .72*** | .32* | -.44* |
| Dysfunctional cognitions. | -.19 (.88) | .56 (1.17) | .60 (.96) | -.76*** | -.87*** | .04 | -.14 (.90) | .58 (1.13) | .65 (1.16) | -.73*** | -.79*** | .06 |
| BCPE | .33 (.98) | .14 (.87) | .03 (1.05) | .21 | .30* | .12 | -.25 (.94) | -.39 (.96) | -.34 (.83) | .15 | .10 | -.06 |

Note: N = 1489; BCPE: cognitive processing efficiency. Self-esteem, dysfunctional cognitions and cognitive processing efficiency are reported in standardized units; SES: socioeconomic status; * p

< .05; ** p < .01; *** p < .001

Table 5

Latent Transition Probabilities by Sex

| Type at T1 | Type at T2 | | | | | |
|--------------|-------------------------|-----------|---------------------|------------------------|--------------------|------------|
| | Girls (<i>N</i> = 826) | | | Boys (<i>N</i> = 839) | | |
| | Asymp- tomatic | Depressed | Aggressive | Asymp- tomatic | Depressed | Aggressive |
| Asymptomatic | .920 | .053 | .027 ^{ads} | .944 | .027 ^{cs} | .029 |
| Depressed | .032 | .908 | .061 | .404 | .596 | .000 |
| Aggressive | .399 ^c | .000 | .601 | .238 | .012 | .750 |

Note: *N* = 1,665; Superscripts indicate moderation by age (a), cognitive processing efficiency (c), dysfunctional cognitions (d), and socio-economic status (s).

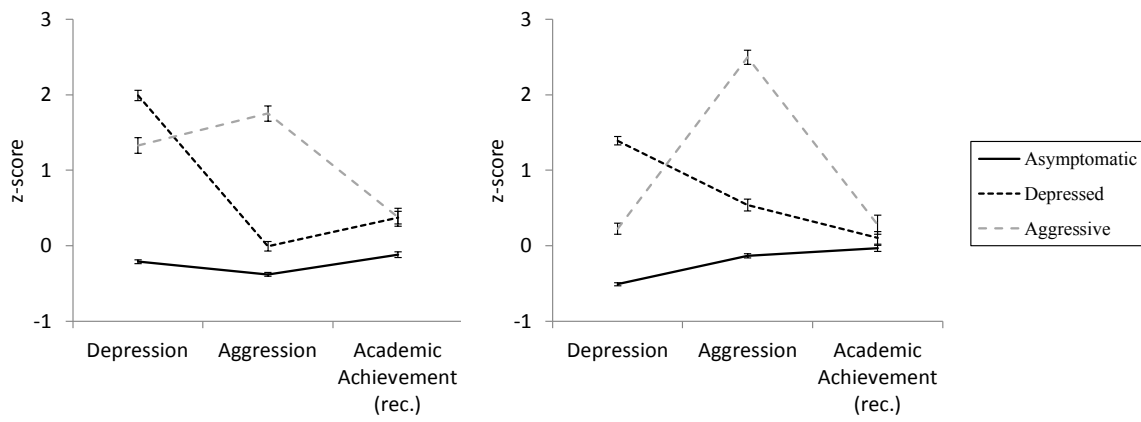


Figure 1. Mean-level profiles of the three-type solution by sex.

Note. $N = 1489$; Error bars reflect standard errors. Mean levels were standardized relative to T1. Plots only include T1 data; rec.: Academic achievement was recoded so that higher scores indicate lower achievement.

Appendix

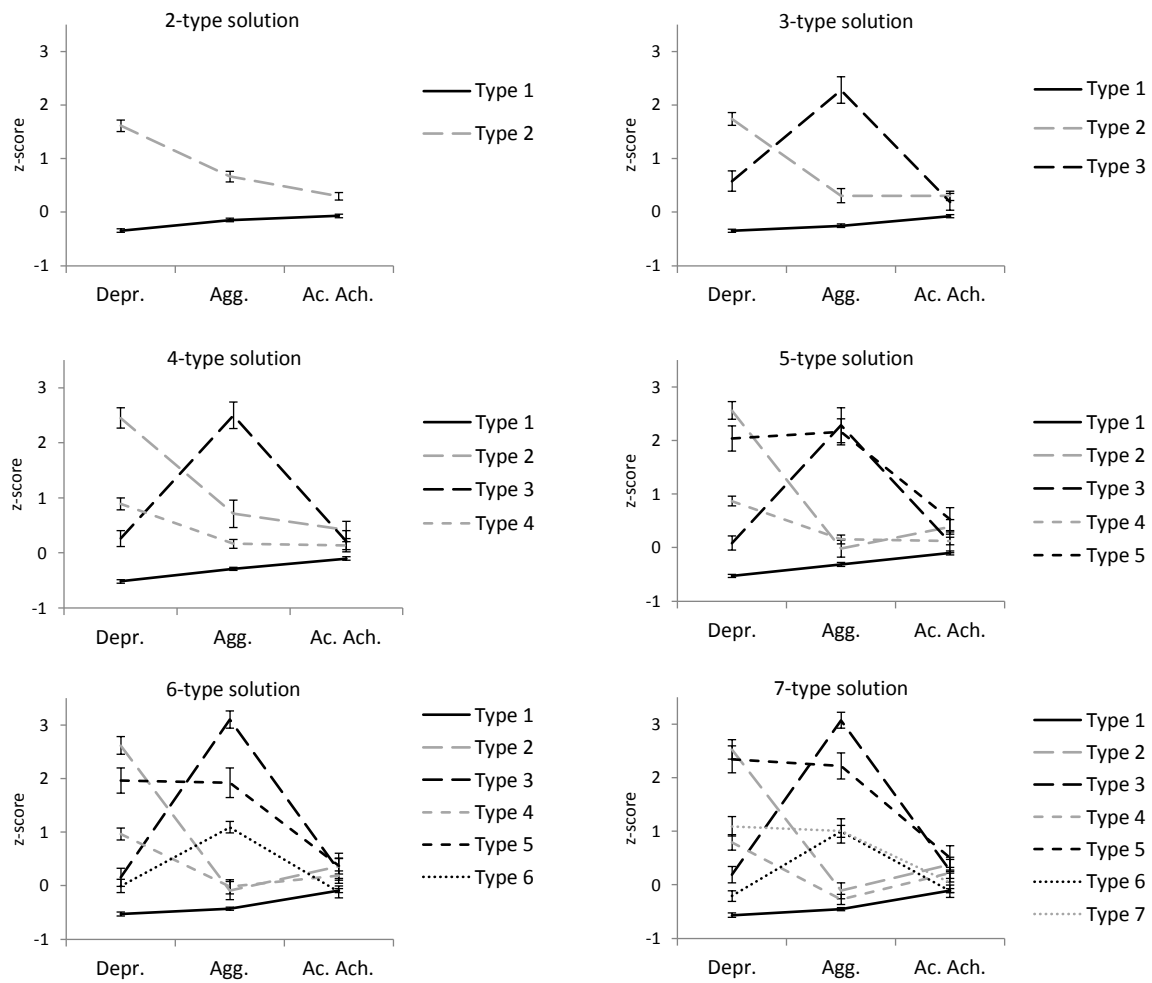


Figure A1. Mean-level profiles for two to seven types.

Note. $N = 1489$; Depr. = depression; Agg. = aggression; Ac. Ach. = academic achievement (inversely recoded); Mean levels were standardized relative to T1.