Longitudinal associations between personality traits and problem behavior symptoms in adolescence

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A R T I C L E   I N F O

A B S T R A C T

In the current study, five annual wave longitudinal data were employed to examine the associations between Big Five personality traits and problem behavior (i.e., depression and aggression) in early to middle and middle to late adolescent boys and girls. Using cross-lagged panel models, we simultaneously tested two competing hypothesis: (1) a vulnerability hypothesis stating that Big Five personality traits would affect problem behavior and (2) a scar hypothesis asserting that problem behavior would affect Big Five personality traits. Results supported both hypotheses, as the effects between personality and problem behavior were bidirectional. These findings have important theoretical and clinical implications, as they suggest a transactional process.

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1. Introduction

During the last decade the development of personality has been documented extensively (e.g., Caspi, Roberts, & Shiner, 2005). Especially adolescence appears to be a period of important changes in personality (Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2009). Unfortunately, little is known about the way a developing personality is related to development in other domains, such as problem behavior. Such knowledge would be valuable, as Tackett (2006) points out that it is important to understand the extent to which personality dimensions predispose individuals to future problem behaviors in order to develop effective, targeted prevention programs. Additionally, clarifying the associations between personality and problem behavior has important etiological implications that may serve to identify specific causal influences on the development of problem behavior. It would, for example, be valuable to examine whether specific personality traits could predict the development of only one type of problem behavior (e.g., internalizing problems) or multiple types of problem behaviors (e.g., internalizing and externalizing problems). Thus, one could test for multifinality (von Bertalanffy, 1968). More important for personality research is that one could test how core traits or basic tendencies (i.e., personality traits) affect, and are affected by surface traits or characteristic adaptations (e.g., problem behavior symptoms) (Asendorpf & Van Aken, 2003; McCrae & Costa, 1999). The basic idea behind the distinction between core traits or basic tendencies and surface traits or characteristic adaptations, is that the former

(i.e., personality traits) are more stable than the latter (i.e., problem behavior symptoms), and that personality traits would therefore be better predictors of problem behavior symptoms than vice versa.

Thus, studying the influences between personality traits and problem behavior symptoms is important from a clinical and a theoretic point-of-view. Unfortunately, studies that address the longitudinal associations between children's and adolescents' personality traits and problem behavior symptoms are scarce. The current study attempts to provide more insight in the associations between personality and problem behavior, by employing five annual wave data of overlapping cohorts of early to middle and middle to late adolescents. Thereby, an age range from ages 12 to 20 is available.

In an overview, Tackett (2006) described various models explaining the associations between personality and problem behavior. First, there is the *scar* or *complication* model, which proposes that problem behavior may cause changes in personality traits. An example of this model would be that repeatedly experiencing severe anxiety symptoms could lead to a decrease in one's levels of emotional stability. Second, the *pathoplasty* or *exacerbation* perspective suggests that personality traits may affect the way problem behavior manifests itself. In this context, high levels of behavioral inhibition (which are related to low levels of Emotional Stability and Extraversion; e.g., Smits & Boeck, 2006) have been shown to be related to less severe manifestations and a better prognosis in children with conduct disorder (Kerr, Tremblay, Pagani, & Vitaro, 1997) Third, the *vulnerability* or *predisposition* model hypothesizes that certain personality characteristics may put adolescents at risk to develop problem behavior. For example, individuals with very low levels of extraversion could be overly inhibited

and might therefore be more prone to develop depressive symptoms. Fourth, the *spectrum* model proposes that personality traits and problem behavior may lie on a single continuum, with problem behavior being a more extreme manifestation of a certain personality trait. In one specific spectrum model (i.e., the tripartite model) it is stated that the relations between anxiety and depression on the one hand, and emotional stability on the other hand, are so pervasive that the constructs could share a common underlying factor (e.g., Clark, Watson, & Mineka, 1994).

In the current study we examine a sample drawn from the general population in which very few individuals reach clinical levels of problem behavior. As such, our data are not particularly suitable for examining whether personality affects the way problem behavior manifests itself (i.e., the pathoplasty or exacerbation model). In addition, with regard to the spectrum model one should ideally search for a common causal factor in personality traits and problem behavior. An example of such a factor would be genetics. Since no such factors were included in our research design, we will focus on the two models that can be tested by directly exploring longitudinal associations s between personality and problem behavior, namely (1) the scar or complication model and (2) the vulnerability or predisposition model (Krueger & Tackett, 2003; Tackett, 2006; Widiger, Verheul, & van den Brink, 1999). Until now, these models find little empirical support in childhood and adolescence, which can be solely attributed to a clear lack of studies. Since it is suggested that more direct tests of these models will help elucidate a comprehensive approach to conceptualize the association between personality and psychopathology (Tackett, 2006), we will test both models simultaneously in this study.

There are many cross-sectional studies that have established associations between Big Five personality dimensions and problem behaviors. Extraversion, which can be conceptualized as a tendency to engage in social behaviors, and experience frequent positive moods (Caspi et al., 2005), has been found to be negatively associated with internalizing problems, such as social inhibition, anxiety and depression (Asendorpf, 2003; Ehrler, Evans, & McGhee, 1999; Ozer & Benet-Martínez, 2006; Van Leeuwen, Mervielde, De Clercq, & De Fruyt, 2007). Agreeableness, indicative of an individual's sociability, empathy, and cooperativeness (Caspi et al., 2005), has been found to be negatively related to affective and anxiety disorders (Ehrler et al., 1999; Ferguson, 2000), and externalizing behaviors, such as conduct disorder, attention deficits, hyperactivity, aggressiveness, risk taking, criminal behavior and substance dependence (e.g., Asendorpf, 2003; Ehrler et al., 1999; Lounsbury, Sunstrom, Loveland, & Gibson, 2003; Ozer & Benet-Martínez, 2006; Paunonen, 1998). Conscientiousness, comprising organizational and motivational aspects of a person's behavior (Klimstra et al., 2009), was found to be negatively associated with externalizing behaviors, such as conduct disorder, substance abuse, antisocial and criminal behavior, attention deficits, hyperactivity, aggressiveness and impulsivity (e.g., Asendorpf, 2003; Caprara, Barbaranelli, & Zimbardo, 1996; Lounsbury, Steel, Loveland, & Gibson, 2004; Scher & Osterman, 2002). Neuroticism (the opposite pole to Emotional Stability), which is indicative of individual differences in the ability to deal with negative emotions (Caspi et al., 2005), was found to be positively associated with internalizing problems, such as social inhibition, affective and anxiety disorders (e.g., Ehrler et al., 1999; Krueger, 1999; Muris, Meesters, & Blijlevens, 2007; Van Leeuwen et al., 2007). Additional associations between these personality and problem behavior have been found, but there is no consensus on whether these associations are positive, negative, or absent. For example, for the fifth Big Five dimension, Openness (i.e., the way an individual seeks for and deals with new information; Klimstra et al., 2009), no consistent evidence with regard to associations with problem behavior has been provided by previous research.

Although the mentioned cross-sectional studies provide some insight into the associations between personality and problem behavior, they are not informative on the direction of effects between personality and problem behavior. As such, they do not provide evidence for the scar or the vulnerability model. Findings from the few longitudinal studies that are available can be described in accordance with these models. Several studies (Huey & Weisz, 1997; Van Leeuwen, Mervielde, Braet, & Bosmans, 2004) demonstrated that Extraversion and Emotional Stability are negative predictors of internalizing problem behavior. All these studies also found that Agreeableness was a negative predictor of externalizing problem behaviors. In addition, Van Leeuwen et al. (2004) showed that Conscientiousness was a negative predictor of externalizing problem behavior, while Huey and Weisz (1997) and found Extraversion to positively predict externalizing problems. However, the studies by Huey and Weisz (1997) and Van Leeuwen et al. (2004) do not appear to control for initial levels of problem behavior.

Obviously, these findings are in line with the vulnerability model. Some recent person-centered studies also reported findings in line with this model, as adolescents who were lower on Extraversion were more at risk for developing a depressive mood (Akse, Hale, Engels, Raaijmakers, & Meeus, 2004, 2007a; Dubas, Gerris, Janssens, & Vermulst, 2002; Van Aken, Van Lieshout, Scholte, & Haselager, 2002). In addition, adolescents who changed from an introverted and socially withdrawn personality type to a personality type that was more extraverted and less socially withdrawn, displayed decreasing levels of internalizing problem behavior, while increasing levels of internalizing problem behavior accompanied personality type changes in the opposite direction (Akse, Hale, Engels, Raaijmakers, & Meeus, 2007b).

Conversely, some studies were in favor of the scar model. Most of these studies showed that internalizing and externalizing problem behavior in childhood predicted personality disorders in adulthood (e.g., Kasen et al., 2001), but very few have examined whether problem behavior predicts normal personality traits. Shiner, Masten, and Tellegen (2002) showed that higher levels of childhood adaptation (i.e., academic achievement, rule-abiding conduct, and social competence) predicted lower levels of the Multidimensional Personality Questionnaire (MPQ) superfactor negative emotionality in emerging adulthood, even after controlling for childhood levels of negative emotionality. In another study, Ge and Conger (1999) found that psychological distress experienced during the adolescent years (7th–10th grades) was related to the MPQ superfactors of negative and positive emotionality during the final year of high school (12th grade), whereas delinquency and substance use problems experienced during the early adolescent years were primarily related to the MPQ superfactor of constraint during the final year of high school, also after controlling for initial levels of personality.

Thus, there are some studies that have examined whether personality predicts problem behavior, and there are some studies that assessed if problem behavior could predict personality. Although there are studies that have examined effects of personality traits on DSM-IV axis II personality disorders and vice versa (e.g., Warner et al., 2004), there are to our knowledge no studies in which it was examined whether adolescent personality dimensions predicted DSM-IV axis I problem behavior symptoms *and* vice versa. Thus, for DSM-IV axis I symptomatology, the vulnerability hypothesis (i.e., the influence of personality on problem behavior) and the scar hypothesis (i.e., the influence of problem behavior on personality; e.g., Krueger & Tackett, 2003; Nigg, 2006; Shiner & Caspi, 2003; Widiger & Trull, 1992) have, to our knowledge, not been tested simultaneously in the same design.

As we previously noted, problem behavior symptoms have been described as being less stable then personality traits (e.g., McCrae & Costa, 1999). However, problem behavior symptoms

(e.g., depressive symptoms) can be highly stable across time and may therefore not be susceptible to influences from other factors (Cole, Nolen-Hoeksema, Girgus, & Paul, 2006). In other words, highly stable concepts are less likely to be affected by other factors. As such, it is important to compare the stability of problem behavior symptoms and personality traits when examining the reciprocal influences between these two constructs.

A way to accomplish this is to use multi-wave cross-lagged panel models (Burkholder & Harlow, 2003) in which all concurrent, stability and prediction associations within and between concepts are estimated simultaneously over time. As such, multi-wave cross-lagged panel models are highly appropriate for disentangling the effects of personality on problem behavior and vice versa (e.g., Lehnart & Neyer, 2006; Neyer & Asendorpf, 2001). To our knowledge, these models have so far not been used to study the longitudinal associations between the Big Five personality dimensions and internalizing and externalizing problem behaviors in adolescence.

As such, the main goal of this study is to investigate the longitudinal predictions from personality dimensions to problem behaviors and vice versa using multi-wave cross-lagged panel models. It is unclear to what extent findings obtained in studies on unidirectional effects from personality to problem behavior (Huey & Weisz, 1997; Van Leeuwen et al., 2004) and problem behavior to personality (Ge & Conger, 1999; Shiner et al., 2002) can be generalized to our study on the bidirectional effects between these two constructs, especially because these previous studies employed analyses that do not control for the initial associations between personality and problem behavior. However, the cross-lagged panel models used in the current study do control for such associations. Despite these differences in the design of the current study and designs of previous studies, we still can derive some tentative hypotheses from those previous studies. Thus, we expect Extraversion to negatively predict internalizing problems and positively predict externalizing problems, Agreeableness and Conscientiousness to negatively predict externalizing problems and Emotional Stability to negatively predict internalizing problems over time. Because Ge and Conger (1999) and Shiner et al. (2002) did not use Big Five personality dimensions, we are unable to provide predictions with regard to the effect of problem behavior on specific Big Five personality dimensions. However, we do expect problem behavior to affect at least some of these dimensions. Previous studies only controlled for gender differences (Huey & Weisz, 1997; Van Leeuwen et al., 2004) or assessed gender differences in personality dimensions different from the Big Five (Ge & Conger, 1999). For that reason, we will also explore gender differences in the associations between Big Five personality dimensions and problem behavior.

2. Methods

2.1. Participants

For this study, we used the first five annual waves of data from an ongoing longitudinal research project on Conflict and Management of Relationships (CONAMORE; Meeus et al., 2006). The longitudinal sample consisted of 1313 participants divided into an early to middle adolescent cohort (n = 923; 70.3%) who were 12.4 years of age on average (SD = .59), and a middle to late adolescent cohort (n = 390; 29.7%) with an average age of 16.7 years (SD = .80) during the first wave of measurement. The early to middle adolescent cohort consisted of 468 boys (50.7%) and 455 girls (49.3%), and the middle to late adolescent cohort consisted of 169 boys (43.3%) and 221 girls (56.7%). Because both age groups were assessed during five annual measurement waves, a total age range from 12 to 20 years was available.

Sample attrition was 1.2% across waves: in waves 1, 2, 3, 4, and 5 the number of participants was 1313, 1313, 1293, 1292 and 1275, respectively. Missing values were estimated in SPSS, using the EM-procedure. Across waves 4.37% of the data was missing. Little's Missing Completely At Random Test (Little, 1988) revealed a normed χ^2 (χ^2/df) of 1.22 which according to guidelines by Bollen (1989) indicates a good fit between sample scores with and without imputation.

Before initiating the administration of the questionnaires, both students and their parents received written information describing the aims of the study and, if the students decided to participate, they were required to provide written informed consent. Less than 1% decided not to participate. Written informed consent from the participating schools was also obtained. Students filled out the questionnaires anonymously, either in their own home or at their own high school. Verbal and written instructions about the questionnaires were provided.

2.2. Measures

2.2.1. Personality

The personality dimensions Extraversion, Agreeableness, Conscientiousness, Emotional Stability and Openness to Experience were measured using the shortened Dutch version of the Big Five questionnaire (Gerris et al., 1998; Goldberg, 1992). This questionnaire contains 30 items, such as: talkative (Extraversion), sympathetic (Agreeableness), systematic (Conscientiousness), nervous (Emotional Stability), and creative (Openness to Experience). The adolescents judged whether the 30 items applied to themselves on a 7-point scale, ranging from 'absolutely agree' to 'absolutely disagree'. Internal consistencies are high with mean alphas of .83 (range: .79–.87) for Extraversion, .85 (range: .81–.88) for Agreeableness, .86 (range: .84–.89) for Conscientiousness, .82 (range: .81–.83) for Emotional Stability, and .78 (range: .77–.79) for Openness to Experience over the five waves.

2.2.2. Aggression

The aggression questionnaire of Björkqvist, Lagerspetz, and Kaukiainen (1992) is a self-report questionnaire. Reliability and construct validity have been shown to be strong in adolescent samples (e.g., Hale, VanderValk, Akse, & Meeus, 2008). The questionnaire consists of the subscales direct aggression, indirect aggression and withdrawal, but in this study only direct aggression is taken into account. This subscale contains five items. Sample items for direct aggression include: When I'm mad at a classmate, I will 'use abusive language about him/her in every situation', 'hit or kick the other' and 'try to trip him/her up'. The items are scored on a 4-point scale, ranging from 'never', 'sometimes', 'often' to 'very often'. In this study the Cronbach alphas for the direct aggression subscale were .87/.84/.83/.83/.84 for each wave respectively.

2.2.3. Depression

The Children's Depression Inventory (CDI; Kovacs, 1985) is a self-report questionnaire that captures meaningful variance in depressive symptoms for children and adolescents who either do or do not meet diagnostic criteria for the disorder. This scale has demonstrated convergent and discriminant validity, good internal consistency and adequate test–retest reliability in previous studies (e.g., Craighead, Smucker, Craighead, & Ilardi, 1998; Hodges, 1990). The CDI consists of 27 items; sample questions include 'I'm sad all the time', 'It will never end-up right for me' and 'I do everything wrong'. The items are scored on a 3-point scale, ranging from 'false', 'a bit true' to 'very true'. In this study the Cronbach alphas for the CDI were .93/.90/.91/.90/.89 for each wave respectively.
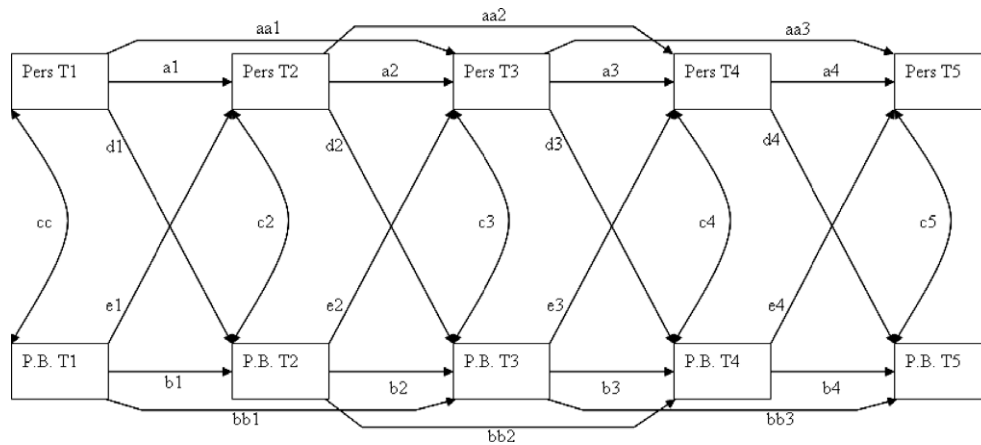
Fig. 1. Sample cross-lagged panel model of personality traits (Pers) and problem behavior (P.B.), with one-year relative stability paths (parameters a1–a4 for personality and b1–b4 for problem behavior), two-year relative stability paths (parameter aa1–aa3 for personality and bb1–bb3 for problem behavior) initial associations (parameter cc), correlated relative change (parameters c2–c5), and cross-lagged paths (parameters d1–d4 for effects of personality on problem behavior, and parameters e1–e4 for effects of problem behavior on personality).

2.3. Strategy of analyses

Longitudinal associations between Big Five traits, and aggression and depression were assessed with multigroup cross-lagged panel models by means of structural equation modeling in Mplus 5 (Muthén & Muthén, 2007). Maximum Likelihood Robust (MLR) estimation was used, as MLR has been shown to be the most accurate estimator when the distribution of scores deviates from a normal distribution (Satorra & Bentler, 1994), which turned out to be the case for the scores on our aggression and depression measures. The groups we distinguished were early to middle adolescent boys (N = 468), middle to late adolescent boys (N = 169), early to middle adolescent girls (N = 455), and middle to late adolescent girls (N = 221). Model fit was judged by assessing RMSEA's and CFI's. RMSEA's below .08, and CFI's over .95 indicate adequate model fit; relatively lower RMSEA's, and higher CFI's indicate a better fit when comparing models (Kline, 1998).

A sample cross-lagged panel model is depicted in Fig. 1. As Fig. 1 shows, our cross-lagged panel models contain one-year relative stability paths (i.e., paths a1–a4 for personality, and paths b1–b4 for problem behavior indicating to what extent the rank-order of individuals has remained stable across a one-year interval) and two-year relative stability paths (i.e., paths aa1–aa3 for personality, and paths bb1–bb3 for problem behavior).[1] The model also contains correlations between personality and problem behavior, namely concurrent correlations (i.e., association cc), and correlated relative change (i.e., associations c2–c5 between relative changes in personality and relative changes in problem behavior). Finally, the model contains cross-paths (i.e., paths d1–d4 indicating the effect of personality on problem behavior, and paths e1–e4 indicating effects of problem behavior on personality).

In a first step, we tested whether constraining equivalent paths and correlations (i.e., those parameters indicated with the same letters in Fig. 1) within groups (i.e., early to middle adolescent boys, early to middle adolescent girls, middle to late adolescent boys, and middle to late adolescent girls) had a negative impact on model fit. Thus, we compared several nested models: more parsimonious or constrained models with as much constrained

parameters as possible and less parsimonious models with all parameters freely estimated. For such comparisons, the use of multiple criteria has been advocated by Vandenberg and Lance (2000). We relied on three criteria to compare nested models: a significant chi-square difference test (Steiger, Shapiro, & Browne, 1985), a difference in CFI of >.01 (Cheung & Rensvold, 2002), and a difference in RMSEA of >.01 (Chen, 2007). Only if two of these criteria were satisfied, we would favor the less parsimonious and less constrained model over the more parsimonious model with additional constraints.

In a subsequent step, we tested for age cohort and gender cohort differences in parameter estimates. For this purpose, we compared models in which parameter estimates for early to middle adolescents and middle to late adolescents were freely estimated with more parsimonious models in which these estimates were constrained to be equal in the two age cohorts. Gender differences were tested in a similar way. That is, we compared models in which parameter estimates for boys and girls were freely estimated to models in which these estimates were constrained to be equal for boys and girls. For these model comparisons, we again used ΔCFI, ΔRMSEA, and chi-square difference tests.

In a last step, we examined whether personality was a better predictor for problem behavior, or whether problem behavior was a better predictor for personality. For that purpose, we compared models in which cross-paths from personality to problem behavior (d1–d4 in Fig. 1) and cross-paths from problem behavior to personality (e1–e4 in Fig. 1) were freely estimated, to more parsimonious models in which these paths were constrained to be equal to one another (i.e., d1–d4 were constrained to be equal to e1–e4).

3. Results

In the cross-lagged panel models we used to calculate the longitudinal associations between personality and problem behavior, five annual waves of longitudinal data on early to middle and middle to late adolescent boys and girls were employed. Means and standard deviations of personality and problem behavior are depicted in Table 1. The covariance matrices, on which the cross-lagged panel models are based, are available as Supplementary Material.

Ten sets of cross-lagged path models were run to determine the longitudinal associations of problem behavior (i.e., depression and aggression) on the one hand and each of the Big Five traits on the

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[1] To improve model fit, extra (i.e., two-year) relative stability paths were added for Big Five personality dimensions and problem behavior symptoms (i.e., T1 problem behavior ⩾ T3 problem behavior; T2 problem behavior ⩾ T4 problem behavior; T3 problem behavior ⩾ T5 problem behavior). This procedure, which leads to smaller one-year relative stability paths, has also been employed in previous studies (e.g., Cui, Donnelan, & Conger, 2007).

Table 1
Observed means and standard deviations of personality and problem behavior.

	Early to middle adolescence										Middle to late adolescence									
	T1		T2		T3		T4		T5		T1		T2		T3		T4		T5	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Boys																				
Ex	4.87	.98	4.75	.97	4.89	.98	4.88	1.06	4.96	1.08	4.63	1.20	4.66	1.08	4.78	1.01	4.87	1.08	4.93	1.13
Ag	4.93	1.16	5.05	1.03	5.00	.94	5.14	.96	5.31	.78	5.17	.98	5.49	.71	5.58	.58	5.58	.59	5.68	.60
Co	4.05	1.13	4.16	1.18	3.93	1.13	3.89	1.16	4.01	1.19	4.10	1.20	4.18	1.21	4.22	1.10	4.23	1.12	4.32	1.18
ES	4.70	1.16	4.60	1.10	4.78	.97	4.81	.99	4.89	1.00	4.58	1.11	4.56	1.02	4.68	1.02	4.85	.94	4.77	.99
Op	4.38	1.14	4.56	1.10	4.40	1.00	4.45	1.04	4.57	1.01	4.72	1.08	4.90	.89	4.89	.82	4.87	.93	4.95	.85
Dep	1.16	.29	1.16	.24	1.15	.22	1.15	.21	1.14	.19	1.22	.31	1.17	.19	1.16	.22	1.15	.21	1.10	.15
Aggr	1.65	.67	1.69	.60	1.68	.56	1.63	.56	1.62	.54	1.68	.65	1.45	.47	1.42	.46	1.35	.45	1.36	.42
Girls																				
Ex	4.95	1.05	4.93	1.14	4.91	1.17	4.83	1.18	4.91	1.14	4.62	1.21	4.78	1.18	4.82	1.20	4.79	1.14	4.77	1.18
Ag	5.20	.97	5.37	.91	5.33	.89	5.47	.74	5.57	.67	5.50	.74	5.67	.57	5.66	.61	5.73	.56	5.73	.55
Co	4.23	1.09	4.29	1.14	4.25	1.16	4.28	1.17	4.35	1.19	4.38	1.21	4.47	1.22	4.54	1.22	4.64	1.24	4.71	1.19
ES	4.57	1.08	4.36	1.12	4.40	1.14	4.39	1.08	4.36	1.08	4.09	.98	4.04	1.00	4.21	.97	4.22	1.05	4.24	1.04
Op	4.40	1.01	4.60	1.04	4.57	1.07	4.75	.96	4.83	.94	4.83	.88	4.97	.84	4.91	.87	4.97	.82	4.87	.86
Dep	1.16	.21	1.19	.22	1.21	.24	1.23	.26	1.21	.24	1.24	.26	1.22	.22	1.21	.24	1.20	.21	1.19	.23
Aggr	1.38	.46	1.41	.49	1.41	.48	1.32	.39	1.29	.39	1.27	.36	1.21	.32	1.16	.26	1.14	.27	1.21	.30

Note: E = Extraversion; A = Agreeableness; C = Conscientiousness; ES = Emotional Stability; O = Openness; Dep = Depression; Aggr = Direct Aggression.

other hand. For all models of the Big Five dimensions and problem behavior, correlated relative change coefficients, cross-paths from personality to problem behavior, and cross-paths from problem behavior to personality were constrained to be equal across measurement waves within groups (i.e., early to middle adolescent boys, early to middle adolescent girls, middle to late adolescent boys, and middle to late adolescent girls) because at least two out of three fit criteria indicated that adding such constraints did not result in a worse model fit (ΔCFI's ranged from −.003 to .007, indicating an insignificant improvement (for negative values) or deterioration (for positive values) of model fit, ΔRMSEA's ranged from .000 to −.015 indicating no change (if ΔRMSEA > −.010) or an significant improvement (if ΔRMSEA < −.010) of model fit). In addition, cross-paths, concurrent correlations, and correlated relative change, were constrained to be equal across gender and age cohorts (i.e., early to middle adolescent boys, early to middle adolescent girls, middle to late adolescent boys, and middle to late adolescent girls) as at least two out of three fit criteria indicated that adding such constraints did not affect model fit (ΔCFI's ranged from −.001 to .010, indicating an insignificant improvement (for negative values) or deterioration (for positive values) of model fit, ΔRMSEA's ranged from −.004 to .005 indicating an insignificant improvement (for negative values) or deterioration (for positive values) of model fit). Even though the longitudinal associations were not different across measurement waves or for age and gender cohorts, at least two of the three criteria for measuring differences in model fit indicated that the relative stability paths for personality and problem behavior were different across time within gender and age cohorts in 50% of the models (with regard to these model comparisons, all chi-square difference tests were significant ($p < .05$) and ΔCFI's were >.010 (range: .011–.012), both indicating a significant deterioration of model fit). For reasons of consistency, we decided to not constrain relative stability paths to be equal across time in any of the models. In addition, relative stability paths were also different for either the age cohorts (i.e., for the aggression models; all chi-square difference tests were significant ($p < .05$) and ΔCFI's were >.010 (range: .014–.019), both indicating a significant deterioration of model fit) or gender cohorts (i.e., for the depression models; all chi-square difference tests were significant ($p < .05$) and ΔCFI's were >.010 (range: .024–.043), both indicating a significant deterioration of model fit). More specifically, relative stability of aggression was higher among middle to late adolescents than among early to middle adolescents, and

relative stability of depression was higher in girls than in boys. As a result, relative stability paths were only constrained to be equal across age cohorts in the depression models, and across gender cohorts in the aggression models. The fit statistics of the resulting models were adequate, and are depicted in Table 2.

The models will now be discussed for each Big Five dimension. We will first compare the stability of Big Five personality traits and problem behavior (i.e., Depression and Aggression). Second, we will pursue our primary research goal by examining the associations between Big Five traits and problem behavior.

3.1. Stability of personality traits and depression

In the models concerning the associations between personality and depression, the relative stability paths were different for girls and boys. Therefore, we will discuss comparisons between the stability of specific personality traits and depression for boys and girls, separately.

As Table 3 suggests, chi-square difference tests indicated that depressive symptoms were less stable across time than Extraversion, Conscientiousness, and Openness for boys ($p < .05$). However, depressive symptoms were equally stable when compared to Agreeableness and Emotional Stability.

Chi-square difference tests indicated that depressive symptoms were equally stable than four of the Big Five traits (i.e., Extraversion, Conscientiousness, Emotional Stability and Openness) in girls

Table 2
Fit statistic of the final cross-lagged panel models.

	χ^2	df	CFI	RMSEA
Depression and Extraversion	238.184[***]	148	.973	.049
Depression and Agreeableness	240.008[***]	148	.955	.049
Depression and Conscientiousness	257.381[***]	148	.969	.053
Depression and Emotional Stability	253.549[***]	148	.964	.052
Depression and Openness	238.364[***]	148	.968	.049
Aggression and Extraversion	222.035[***]	148	.978	.044
Aggression and Agreeableness	224.704[***]	148	.963	.045
Aggression and Conscientiousness	188.733[*]	148	.989	.033
Aggression and Emotional Stability	240.770[***]	148	.967	.049
Aggression and Openness	180.098[*]	148	.989	.029

[*] $p < .05$.
[**] $p < .01$.
[***] $p < .001$.

Table 3
Longitudinal associations and relative stability of personality and depression in boys (Standardized Estimates).

	Model									
	Early to middle adolescence					Middle to late adolescence				
	Ex	Ag	Co	ES	Op	Ex	Ag	Co	ES	Op
Relative Stability Personality T1–T2	.43***	.31***	.54***	.40***	.46***	.49***	.36***	.56***	.41***	.56***
Relative Stability Personality T2–T3	.45***	.44***	.57***	.46***	.51***	.47***	.46***	.59***	.44***	.48***
Relative Stability Personality T3–T4	.48***	.44***	.55***	.43***	.47***	.49***	.44***	.56***	.42***	.47***
Relative Stability Personality T4–T5	.51***	.32***	.47***	.41***	.49***	.52***	.26***	.48***	.41***	.52***
Relative Stability Personality T1–T3	.18***	.14**	.20***	.12*	.18***	.21***	.17**	.21***	.12*	.21***
Relative Stability Personality T2–T4	.30***	.26***	.25***	.22***	.32***	.32***	.27***	.26***	.21***	.30***
Relative Stability Personality T3–T5	.21***	.28***	.31***	.29***	.27***	.21***	.22***	.33***	.28***	.28***
Relative Stability Depression T1–T2	.29***	.30***	.29***	.29***	.29***	.34***	.34***	.33***	.34***	.34***
Relative Stability Depression T2–T3	.37***	.38***	.37***	.37***	.38***	.40***	.40***	.40***	.38***	.41***
Relative Stability Depression T3–T4	.33***	.34***	.33***	.33***	.34***	.29***	.31***	.30***	.30***	.30***
Relative Stability Depression T4–T5	.40***	.41***	.41***	.39***	.41***	.44***	.47***	.46***	.43***	.46***
Relative Stability Depression T1–T3	.09	.10*	.10	.08	.10	.11	.13*	.13	.10	.13
Relative Stability Depression T2–T4	.25***	.28***	.27***	.25***	.27***	.24***	.26***	.26***	.23***	.26***
Relative Stability Depression T3–T5	.16*	.19**	.18*	.15*	.19**	.16*	.20**	.18*	.15*	.19***
T1 Correlation	−.27***	−.11***	−.05*	−.23***	.03	−.25***	−.15***	−.06*	−.29***	.05
Correlated Relative Change T2	−.12***	−.05***	−.03***	−.14***	−.01	−.15***	−.10***	−.04***	−.12***	−.01
Correlated Relative Change T3	−.13***	−.05***	−.03***	−.15***	−.01	−.17***	−.11***	−.05***	−.23***	−.01
Correlated Relative Change T4	−.13***	−.06***	−.04***	−.17***	−.01	−.16***	−.10***	−.05***	−.22***	−.01
Correlated Relative Change T5	−.13***	−.06***	−.04***	−.16***	−.01	−.17***	−.10***	−.06***	−.24***	−.01
Cross-Lagged Associations										
T1 Personality ⩾ T2 Depression	−.05***	.02	−.04**	−.08***	−.03	−.07***	.02	−.04**	−.08***	.02
T2 Personality ⩾ T3 Depression	−.05***	.02	−.04**	−.08***	−.03	−.06***	.01	−.04**	−.08***	.02
T3 Personality ⩾ T4 Depression	−.06***	.02	−.04**	−.08***	−.03	−.06***	.01	−.04**	−.08***	.02
T4 Personality ⩾ T5 Depression	−.06***	.02	−.04**	−.08***	−.03	−.07***	.02	−.04**	−.08***	.03
T1 Depression ⩾ T2 Personality	−.05**	−.04**	−.03**	−.09***	−.01	−.05**	−.06***	−.04**	−.11***	−.01
T2 Depression ⩾ T3 Personality	−.04**	−.04**	−.03**	−.09***	−.01	−.04**	−.05**	−.03**	−.09***	−.01
T3 Depression ⩾ T4 Personality	−.04**	−.03**	−.03**	−.09***	−.01	−.03**	−.04***	−.03**	−.08***	−.01
T4 Depression ⩾ T5 Personality	−.03**	−.03**	−.03**	−.07***	−.01	−.04**	−.04***	−.03**	−.08***	−.02

Note: Ex = Extraversion; Ag = Agreeableness; Co = Conscientiousness; ES = Emotional Stability; Op = Openness; T = Time.
* p<.05.
** p<.01.
*** p<.001.

(see Table 4 for the parameter estimates). The fifth trait, Agreeableness, was less stable across time than depressive symptoms.

3.2. Longitudinal associations between personality and depression

Because longitudinal associations between personality and depression were constrained to be equal across gender and age cohorts, we are able to discuss these findings for all cohorts together.

3.2.1. Extraversion and Depression
T1 levels of Depression were negatively associated with T1 levels of Extraversion, and changes in Depression were negatively associated with changes in Extraversion (see Tables 3 and 4 for parameter estimates of boys and girls, respectively). Finally, high levels of Extraversion were predictive of relatively lower levels of Depression, and high levels of Depression predicted lower levels of Extraversion.

3.2.2. Agreeableness and Depression
Initial levels and changes in Agreeableness and Depression were negatively associated with one another (see Tables 3 and 4). Significant cross-paths from Depression to Agreeableness indicated that high levels of Depression predicted relatively lower levels of Agreeableness. Cross-paths from Agreeableness to Depression did not reach significance.

3.2.3. Conscientiousness and Depression
Initial levels and changes in Conscientiousness and Depression were negatively associated with one another (see Tables 3 and 4). Significant cross-paths indicated that higher levels of Conscien-

tiousness were predictive of relatively lower levels of Depression, whereas higher levels of Depression were predictive of lower levels of Conscientiousness.

3.2.4. Emotional Stability and Depression
Both initial levels and changes in Emotional Stability and Depression were negatively associated with one another (see Tables 3 and 4). Significant cross-paths from Emotional Stability to Depression indicated that higher levels of Emotional stability predicted relatively lower levels of Depression. Cross-paths in the inverse direction also reached significance and indicated that high levels of Depression predicted relatively lower levels of Emotional Stability.

3.2.5. Openness and Depression
Initial levels and changes in Depression and Openness were not associated with one another (see Tables 3 and 4). In addition, none of the cross-paths between Depression and Openness reached significance.

3.3. Stability of personality and aggression

In the models involving the associations between personality and aggression, the relative stability paths were different for the two age cohorts (i.e., early to middle adolescents and middle to late adolescents). Therefore, we will discuss comparisons between the stability of specific personality traits and aggression for early to middle adolescents and middle to late adolescents, separately.

For early to middle adolescents, chi-square difference tests revealed that aggression was equally stable as the Big Five personal-

Table 4
Longitudinal associations and relative stability of personality and depression in girls (Standardized Estimates).

	Model									
	Early to middle adolescence					Middle to late adolescence				
	Ex	Ag	Co	ES	Op	Ex	Ag	Co	ES	Op
Relative Stability Personality T1–T2	.59***	.46***	.66***	.48***	.60***	.67***	.52***	.73***	.48***	.63***
Relative Stability Personality T2–T3	.59***	.46***	.53***	.58***	.45***	.57***	.41***	.54***	.58***	.46***
Relative Stability Personality T3–T4	.52***	.41***	.55***	.48***	.47***	.56***	.38***	.56***	.47***	.45***
Relative Stability Personality T4–T5	.66***	.53***	.60***	.51***	.58***	.65***	.54***	.63***	.52***	.60***
Relative Stability Personality T1–T3	.18***	.16**	.26***	.09*	.25***	.20***	.16**	.30***	.09*	.27***
Relative Stability Personality T2–T4	.29***	.25***	.26***	.21***	.29***	.30***	.21***	.27***	.21***	.28***
Relative Stability Personality T3–T5	.18***	.12*	.25***	.24***	.23***	.19***	.11*	.26***	.24***	.23***
Relative Stability Depression T1–T2	.56***	.59***	.58***	.54***	.57***	.67***	.68***	.68***	.65***	.68***
Relative Stability Depression T2–T3	.51***	.52***	.51***	.51***	.52***	.59***	.61***	.60***	.59***	.62***
Relative Stability Depression T3–T4	.48***	.50***	.49***	.46***	.49***	.50***	.54***	.53***	.50***	.53***
Relative Stability Depression T4–T5	.44***	.46***	.45***	.43***	.45***	.41***	.42***	.42***	.40***	.42***
Relative Stability Depression T1–T3	.13**	.14**	.15**	.13**	.14**	.18*	.19**	.20**	.18**	.19**
Relative Stability Depression T2–T4	.19***	.19**	.18**	.18***	.19***	.24***	.23**	.23**	.24***	.24***
Relative Stability Depression T3–T5	.33***	.33***	.33***	.32***	.34***	.33***	.33***	.33***	.32***	.33***
T1 Correlation	−.37***	−.17***	−.08*	−.39***	.05	−.29***	−.20***	−.07*	−.35***	.05
Correlated Relative Change T2	−.11***	−.06***	−.04***	−.16***	−.01	−.12***	−.10***	−.04***	−.17***	−.01
Correlated Relative Change T3	−.11***	−.06***	−.03***	−.15***	−.01	−.13***	−.10***	−.04***	−.18***	−.01
Correlated Relative Change T4	−.10***	−.06***	−.03***	−.13***	−.01	−.13***	−.10***	−.04***	−.18***	−.01
Correlated Relative Change T5	−.10***	−.05***	−.03***	−.13***	−.01	−.12***	−.08***	−.04***	−.17***	−.01
Cross-Lagged Associations										
T1 Personality ⩾ T2 Depression	−.06***	.02	−.04**	−.08***	.02	−.06***	.01	−.04**	−.06***	.02
T2 Personality ⩾ T3 Depression	−.06***	.02	−.04**	−.08***	.02	−.06***	.01	−.04**	−.08***	.02
T3 Personality ⩾ T4 Depression	−.06***	.01	−.04**	−.07***	.02	−.06***	.01	−.04**	−.08***	.02
T4 Personality ⩾ T5 Depression	−.06***	.01	−.04**	−.07***	.02	−.05***	.01	−.03**	−.07***	.02
T1 Depression ⩾ T2 Personality	−.03**	−.03**	−.02**	−.06***	−.01	−.04**	−.06***	−.03**	−.09***	−.01
T2 Depression ⩾ T3 Personality	−.03**	−.04**	−.03**	−.07***	−.01	−.04**	−.06***	−.03**	−.09***	−.01
T3 Depression ⩾ T4 Personality	−.03**	−.04**	−.03**	−.08***	−.01	−.04**	−.05***	−.03**	−.08***	−.01
T4 Depression ⩾ T5 Personality	−.04**	−.04**	−.03**	−.09***	−.01	−.04**	−.05***	−.03**	−.08***	−.01

Note: Ex = Extraversion; Ag = Agreeableness; Co = Conscientiousness; ES = Emotional Stability; Op = Openness; T = Time.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

ity traits (see Table 5 and 6 for parameter estimates). Chi-square difference tests revealed that four of the Big Five personality traits were more stable across time than aggression for middle to late adolescents ($p < .05$). Agreeableness was equally stable as aggression.

3.4. Longitudinal associations between personality and aggression

3.4.1. Extraversion and Aggression
Initial levels and changes in Extraversion and Aggression were not associated. Furthermore, none of the cross-paths reached significance (see Table 5 for boys' parameter estimates, and Table 6 for girls' parameter estimates).

3.4.2. Agreeableness and Aggression
Initial levels and changes of Aggression and Agreeableness were negatively associated with one another (see Tables 5 and 6). Significant cross-paths from Agreeableness to Aggression indicated that higher levels of Agreeableness were predictive of lower levels of Aggression, and significant cross-paths in the inverse direction indicated that higher levels of Aggression predicted lower levels of Agreeableness.

3.4.3. Conscientiousness and Aggression
Initial levels and changes in Conscientiousness were negatively associated with initial levels and changes in Aggression (see Tables 5 and 6). Furthermore, significant cross-paths from Conscientiousness to Aggression indicated that higher levels of Conscientiousness predicted relatively lower levels of Aggression. Cross-paths in the inverse direction (i.e., from Aggression to Conscientiousness) were not significant.

3.4.4. Emotional Stability and Aggression
Initial levels of Emotional Stability and Aggression were negatively associated with one another, just like changes in these two variables (see Table 5 and 6). Furthermore, significant cross-paths indicated that high levels of Aggression predicted relatively lower levels of Emotional Stability. Cross-paths from Emotional Stability to Aggression did not reach significance.

3.4.5. Openness and Aggression
Initial levels of Openness and Aggression were not associated with one another, but changes in Openness and Aggression were found to be negatively associated (see Tables 5 and 6). In addition, significant cross-paths indicated that higher levels of Openness predicted relatively lower levels of Aggression. Cross-paths from Aggression to Openness did not reach significance.

3.5. Head-to-head comparisons of the predictive properties of personality and problem behavior

In a subsequent step, chi-square difference tests were used to test whether Big Five personality dimensions were better predictors of problem behavior or the other around. These tests were only run for models in which cross-paths from personality to problem behavior, from problem behavior, or in both directions reached significance. Since 2 of the 10 models we ran contained no significant cross-paths in either direction, we just did eight comparisons with chi-square difference tests. Only one test turned out to be significant, and another one almost reached significance. These tests indicated that Depression was a better predictor of Agreeableness than the other way around ($p < .05$). Our results suggested that Aggression was a better predictor of Emotional Stability, but chi-square tests were just not significant ($p = .06$).

Table 5
Longitudinal associations and relative stability of personality and aggression in boys (Standardized Estimates).

	Model									
	Early to middle adolescence					Middle to late adolescence				
	Ex	Ag	Co	ES	Op	Ex	Ag	Co	ES	Op
Relative Stability Personality T1–T2	.48***	.39***	.54***	.42***	.48***	.67***	.46***	.69***	.59***	.67***
Relative Stability Personality T2–T3	.48***	.48***	.52***	.48***	.46***	.63***	.47***	.69***	.63***	.60***
Relative Stability Personality T3–T4	.47***	.46***	.57***	.44***	.48***	.58***	.30***	.52***	.52***	.39***
Relative Stability Personality T4–T5	.55***	.42***	.48***	.45***	.53***	.64***	.44***	.64***	.55***	.56***
Relative Stability Personality T1–T3	.21***	.10*	.25***	.13***	.24***	.16**	.24***	.18***	.12	.16*
Relative Stability Personality T2–T4	.32***	.17**	.20***	.24***	.26***	.27***	.45***	.38***	.22***	.42***
Relative Stability Personality T3–T5	.16***	.17**	.29***	.26***	.19***	.20***	.16**	.22***	.26***	.32***
Relative Stability Aggression T1–T2	.50***	.50***	.49***	.50***	.50***	.46***	.46***	.46***	.45***	.46***
Relative Stability Aggression T2–T3	.41***	.41***	.41***	.41***	.41***	.45***	.44***	.44***	.45***	.44***
Relative Stability Aggression T3–T4	.43***	.42***	.43***	.43***	.43***	.35***	.35***	.36***	.35***	.35***
Relative Stability Aggression T4–T5	.50***	.49***	.49***	.49***	.50***	.37***	.36***	.36***	.37***	.36***
Relative Stability Aggression T1–T3	.21***	.21***	.20***	.20***	.21***	.26***	.26***	.27***	.25***	.26***
Relative Stability Aggression T2–T4	.20***	.19***	.19***	.20***	.20***	.31***	.32***	.31***	.31***	.32***
Relative Stability Aggression T3–T5	.22***	.22***	.22***	.22***	.22***	.36***	.36***	.36***	.35***	.36***
T1 Correlation	.00	−.05*	−.06*	−.06**	.02	.00	−.07*	−.06*	−.08**	.02
Correlated Relative Change T2	−.01	−.02***	−.02***	−.04***	−.01*	−.01	−.04***	−.02***	−.05***	−.02*
Correlated Relative Change T3	−.01	−.03***	−.02***	−.04***	−.01*	−.01	−.05***	−.03***	−.06***	−.02*
Correlated Relative Change T4	−.01	−.03***	−.02***	−.04***	−.01*	−.01	−.04***	−.02***	−.05***	−.02*
Correlated Relative Change T5	−.01	−.02***	−.02***	−.04***	−.01*	−.01	−.04***	−.03***	−.06***	−.02*
Cross-Lagged Associations										
T1 Personality ⩾ T2 Aggression	.00	−.03*	−.03***	−.01	−.03*	.00	−.03*	−.04***	−.01	−.03*
T2 Personality ⩾ T3 Aggression	.00	−.04*	−.03***	−.01	−.03*	.00	−.03*	−.05***	−.01	−.03*
T3 Personality ⩾ T4 Aggression	.00	−.04*	−.03***	−.01	−.03*	.00	−.03*	−.04***	−.01	−.03*
T4 Personality ⩾ T5 Aggression	.00	−.03*	−.03***	−.01	−.03*	.00	−.03*	−.05***	−.01	−.03*
T1 Aggression ⩾ T2 Personality	.02	−.03*	−.02	−.05***	−.01	.01	−.04*	−.02	−.06***	−.01
T2 Aggression ⩾ T3 Personality	.02	−.03*	−.02	−.06***	−.01	.01	−.04*	−.02	−.05***	−.01
T3 Aggression ⩾ T4 Personality	.02	−.03*	−.02	−.06***	−.01	.01	−.04*	−.01	−.05***	−.01
T4 Aggression ⩾ ⩾ T5 Personality	.02	−.03*	−.02	−.06***	−.01	.01	−.03*	−.02	−.05***	−.01

Note: Ex = Extraversion; Ag = Agreeableness; Co = Conscientiousness; ES = Emotional Stability; Op = Openness; T = Time.
* *p* < .05.
** *p* < .01.
*** *p* < .001.

Thus, problem behavior and personality did not predict one another in 2 out of 10 cross-lagged panel models, and had equal predictive properties in 7 out of 8 of these models. In only 1 out of the 8 models problem behavior was a better predictor of personality than the other way around, and in none of the models personality was a better predictor of problem behavior than the other way around.

4. Discussion

The purpose of the present study was to examine longitudinal associations between the Big Five personality dimensions and problem behavior (i.e., Depression and Aggression) symptoms during adolescence, using cross-lagged panel models. Based on studies that used different models, we formulated the tentative hypothesis that personality could predict problem behavior (Huey & Weisz, 1997; Van Leeuwen et al., 2004), but also that problem behavior could predict personality over time (Ge & Conger, 1999).

Several Big Five personality traits were found to predict problem behavior. In line with previous studies (Huey & Weisz, 1997; Van Leeuwen et al., 2004), levels of Extraversion and Emotional Stability negatively predicted internalizing problem behavior (i.e., Depression). In addition, Conscientiousness was found to negatively predict internalizing problem behavior as well. Externalizing problem behavior (i.e., Aggression) was negatively predicted by Agreeableness and Conscientiousness. These findings are in line with those from previous studies (Huey & Weisz, 1997; Van Leeuwen et al., 2004). Different from these previous studies, we also found that Openness was a negative predictor for externalizing problems. Overall, Big Five personality traits predicted both internalizing problems and externalizing problems.

Problem behavior was also found to predict Big Five personality traits. Extraversion, Agreeableness, Conscientiousness, and Emotional Stability were negatively predicted by internalizing problems. These findings were to a large extent comparable to results obtained by Ge and Conger (1999), who found that the MPQ superfactor of Positive Emotionality (which contains traits comparable to Extraversion and Agreeableness) was negatively predicted by psychological distress (i.e., internalizing problems), while the MPQ superfactor of Negative Emotionality (which can be perceived as being the opposite of Emotional Stability) was positively predicted by psychological distress. However, Ge and Conger (1999) found no associations of internalizing problems with the MPQ superfactor Constraint, which is comparable to the Big Five trait Conscientiousness.

Externalizing problems were found to negatively predict Agreeableness and Emotional Stability. The finding that Emotional Stability was negatively predicted by externalizing problems was comparable to Ge and Conger's (1999) findings, as they found that externalizing problems (i.e., delinquent behaviors) positively predicted Negative Emotionality.

Thus, our finding with regard to Big Five traits predicting problem behavior, and problem behavior predicting Big Five traits were to a large extent comparable to findings obtained in previous studies. As an important goal of the current study was to test whether our results favored the vulnerability hypothesis (i.e., personality as a predictor of problem behavior) or the scar hypothesis (i.e., problem behavior as a predictor personality) (e.g., Krueger & Tackett, 2003; Tackett, 2006; Widiger et al., 1999), we tested whether personality was a better predictor of problem behavior or whether problem behavior was a better predictor of personality. Our results did not clearly favor the vulnerability or the scar hypothesis, as for

Table 6
Longitudinal Associations and Relative Stability of Personality and Aggression in Girls (Standardized Estimates).

	Model									
	Early to middle adolescence					Middle to late adolescence				
	Ex	Ag	Co	ES	Op	Ex	Ag	Co	ES	Op
Relative Stability Personality T1–T2	.49***	.39***	.56***	.42***	.51***	.69***	.48***	.77***	.56***	.63***
Relative Stability Personality T2–T3	.49***	.46***	.49***	.46***	.41***	.62***	.39***	.67***	.62***	.59***
Relative Stability Personality T3–T4	.46***	.49***	.56***	.41***	.50***	.61***	.31***	.51***	.50***	.38***
Relative Stability Personality T4–T5	.63***	.40***	.51***	.48***	.56***	.66***	.51***	.67***	.56***	.56***
Relative Stability Personality T1–T3	.22***	.10*	.25***	.12***	.23***	.16**	.21***	.19***	.11	.15*
Relative Stability Personality T2–T4	.32***	.17**	.19***	.22***	.24***	.28***	.39***	.36***	.21***	.41***
Relative Stability Personality T3–T5	.18***	.17**	.30***	.27***	.21***	.22***	.20**	.23***	.26***	.32***
Relative Stability Aggression T1–T2	.43***	.43***	.43***	.44***	.43***	.43***	.43***	.43***	.43***	.44***
Relative Stability Aggression T2–T3	.39***	.39***	.39***	.39***	.40***	.44***	.44***	.43***	.44***	.44***
Relative Stability Aggression T3–T4	.48***	.47***	.47***	.47***	.47***	.39***	.38***	.40***	.39***	.39***
Relative Stability Aggression T4–T5	.48***	.47***	.47***	.48***	.48***	.28***	.28***	.28***	.28***	.27***
Relative Stability Aggression T1–T3	.18***	.18***	.17***	.17***	.17***	.24***	.24***	.24***	.23***	.24***
Relative Stability Aggression T2–T4	.21***	.21***	.21***	.21***	.21***	.34***	.35***	.34***	.35***	.35***
Relative Stability Aggression T3–T5	.23***	.23***	.24***	.23***	.23***	.30***	.30***	.31***	.30***	.31***
T1 Correlation	.00	−.08*	−.09*	−.10**	.03	−.01	−.14*	−.11*	−.15**	.05
Correlated Relative Change T2	−.01	−.04***	−.03***	−.05***	−.02*	−.02	−.09***	−.04***	−.08***	−.04*
Correlated Relative Change T3	−.01	−.04***	−.03***	−.05***	−.02*	−.02	−.09***	−.04***	−.09***	−.04*
Correlated Relative Change T4	−.01	−.04***	−.03***	−.05***	−.02*	−.02	−.08***	−.04***	−.08***	−.03*
Correlated Relative Change T5	−.01	−.04***	−.03***	−.05***	−.02*	−.02	−.07***	−.04***	−.07***	−.03*
Cross-Lagged Associations										
T1 Personality ⩾ T2 Aggression	.00	−.04*	−.04***	−.01	−.03*	.00	−.05*	−.07***	−.02	−.04*
T2 Personality ⩾ T3 Aggression	.00	−.04*	−.04***	−.01	−.03*	.00	−.04*	−.07***	−.02	−.05*
T3 Personality ⩾ T4 Aggression	.00	−.04*	−.04***	−.01	−.04*	.00	−.04*	−.07***	−.02	−.05*
T4 Personality ⩾ T5 Aggression	.00	−.04*	−.04***	−.01	−.03*	.00	−.04*	−.06***	−.02	−.04*
T1 Aggression ⩾ T2 Personality	.01	−.03*	−.02	−.04***	−.01	.01	−.03*	−.01	−.03***	−.01
T2 Aggression ⩾ T3 Personality	.01	−.03*	−.02	−.05***	−.01	.01	−.03*	−.01	−.03***	−.01
T3 Aggression ⩾ T4 Personality	.01	−.03*	−.02	−.04***	−.01	.01	−.02*	−.01	−.03***	−.01
T4 Aggression ⩾ T5 Personality	.01	−.03*	−.02	−.04***	−.01	.01	−.02*	−.01	−.03***	−.01

Note: Ex = Extraversion; Ag = Agreeableness; Co = Conscientiousness; ES = Emotional Stability; Op = Openness; and T = Time.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

87.5% (i.e., 7 out of 8) of the models in which we found cross-paths in either direction, comparisons indicated that the predictive properties that personality and problem behavior exerted on one another were equivalent. Because we already noted that personality traits were significant predictors of problem behaviors, and problem behaviors were significant predictors of personality, both the vulnerability and the scar hypothesis were supported by our data. Hence, it is not only the presence of existing personality characteristics that increases the probability of the occurrence of specific problem behaviors, the presence of specific problem behaviors also complicates or 'scars' an individual's personality (Krueger & Tackett, 2003). These findings underscore the importance of using multi-wave cross-lagged panel models in future research, because these models allow to simultaneously test the vulnerability and the scar hypothesis, while correcting for previous associations between personality and problem behavior. As such, these models are more accurate in predicting the reciprocal associations between personality and problem behavior than ordinary regression analyses are.

Our study is not the first to suggest interplay between personality and problem behavior, instead of the unidirectional effects theorized in the vulnerability and the scar hypothesis. The corresponsive principle (e.g., Roberts & Caspi, 2003; Roberts, Caspi, & Moffitt, 2003) explains personality development from two mutually supportive processes: 'social selection' in which an individual selects an environment that corresponds to his or her personality traits, and 'social influence' in which experiences in the environment of one's choice further shape one's personality. In the current study, the corresponsive principle could be responsible for the reciprocal effect between Extraversion and Emotional Stability on the one hand, and internalizing problems on the other hand. More specifically, individuals low on Extraversion and Emotional Stabil-

ity are described as being prone to developing internalizing problem behaviors, such as depression and anxiety (i.e., 'psychopathological selection'). In turn, this could lead to avoidance of public places, which leads to enhancing their problem behavior, consequently deepening their introverted and neurotic characteristics (i.e., 'psychopathological influence'). The reciprocal effects between Agreeableness and externalizing problems (i.e., Aggression) can be explained accordingly. Thus, less agreeable individuals could be prone to select more hostile social environments (i.e., deviant peer groups with high tolerance of Aggression), and the hostility experienced there could lead to a further decrease in their levels of Agreeableness. It should, however, be noted that this explanation of our finding is speculative. Therefore, future studies should aim to provide more direct tests of the corresponsive principle.

Overall, we found no differences between reciprocal influences of personality on problem behavior between boys and girls, or early to middle and middle to late adolescents. However, girls exhibited higher levels of relative stability in the depression models when compared to boys, whereas middle to late adolescent exhibited higher levels of relative stability in the aggression models when compared to early to middle adolescents. Even though differences in relative stability are generally thought to affect the magnitude of cross-lagged associations (e.g., Cole et al., 2006), the gender and age cohort differences in relative stability paths we found do not seem to have a significant effect on cross-lagged associations.

We also found differences in the relative stability of personality and problem behavior. Boys' depressive symptoms were less stable than Extraversion, Conscientiousness, and Openness, but equally stable as Agreeableness and Emotional Stability. In girls, depressive symptoms were equally stable as Extraversion, Conscientiousness,

Emotional Stability, and Openness, and even more stable than Agreeableness. One of the main differences between basic tendencies or core personality traits such as the Big Five, and characteristic adaptations or surface traits such as problem behavior symptoms, should theoretically be their relative stability (Asendorpf & van Aken, 2003; McCrae & Costa, 1999), with personality traits being more stable than problem behavior symptoms. As such, our results suggest that depressive symptoms seem to be more dispositional or closer to the core of personality in girls than in boys. With regard to aggression, another interesting pattern emerges. In early to middle adolescence, aggression and personality traits are equally stable, but in middle to late adolescence almost all Big Five traits, except for Agreeableness, are more stable then aggression. Thus, a distinction between Big Five traits as core traits or basic tendencies versus problem behavior symptoms as surface traits or characteristic adaptations only emerges in middle to late adolescence, at least with regard to differences in relative stability. Overall, our findings suggest that one should consider gender and age as variables that can affect the distinction between personality traits and problem behavior symptoms.

4.1. Strengths and limitations of the present study

An important strength of this study is that we were able to simultaneously test the vulnerability hypothesis (by testing the effects of the Big Five personality dimensions on problem behavior), and the scar hypothesis (by testing the effects of problem behavior on the Big Five personality dimensions; Krueger & Tackett, 2003; Tackett, 2006; Widiger et al., 1999), using cross-lagged panel models. A second strength is that we tested these hypotheses in a large sample of adolescents drawn from the general population. Furthermore, because we had five annual waves of longitudinal data available on a cohort of early to middle adolescents and a cohort of middle to late adolescents, we were able to show that the reciprocal effects between personality dimensions and problem behavior remained similar throughout adolescence. Finally, we explicitly assessed whether associations between the Big Five personality dimensions and problem behavior were different or similar for boys and girls separately, instead of previous studies that just controlled for gender differences (Huey & Weisz, 1997; Van Leeuwen et al., 2004).

However, several limitations of the present study should also be addressed. The first limitation is that our findings on personality and problem behaviors were solely based on adolescent self-reports, which could result in biased answers and in shared method variance. Obviously, collecting data from multiple informants would improve our understanding of the associations between personality and problem behavior. However, since personality and internalizing behaviors might be more difficult to observe by others (e.g., Achenbach, McConaughy, & Howell, 1987; Muris et al., 2007), we were specifically interested in the feelings and opinions of adolescents themselves.

A second limitation is that we used questionnaires on personality and problem behaviors which could account for a certain amount of (item-) content overlap in both concepts. However, Prinzie, Onghena, and Hellinckx (2005) found that the associations between initial levels and changes in personality traits and externalizing problems of children did not change when overlapping items of personality and problem behavior scales were removed. Thus, longitudinal associations between personality and problem behavior are at least not due to content overlap with regard to the items included in the measures. Still, individual differences in socially desirable responding or extremity of responding could inflate concurrent correlations between personality and problem behaviors. By using cross-lagged path analyses in which we controlled for initial associations between personality and problem behavior, we probably reduced the shared method variance at least to some extent (e.g., Neyer & Asendorpf, 2001).

Third, cross-paths between personality and problem behavior and those in the opposite direction might seem rather weak at first sight. Previous studies (Ge & Conger, 1999; Huey & Weisz, 1997; Van Leeuwen et al., 2004) generally found stronger associations. However, it should be noted that these studies used statistical analyses that are much less strict than the cross-lagged panel models that were used in the current study. In the estimation of cross-lagged paths in cross-lagged panel models, associations between initial levels (i.e., T1 associations), changes of personality and problem behavior (i.e., correlated relative change), and relative stability paths of personality and problem behavior are controlled for. Thus, there is less variance left to be explained by cross-paths (Cui et al., 2007). Hence, cross-paths are likely to be much weaker than in studies in which these strict cross-lagged panel models were not employed. Even studies relating highly similar constructs to one another, such as depression and self-esteem (Orth, Robins, & Roberts, 2008), found standardized coefficients for cross-paths of only .04–.20.

Possibly, potential reciprocal effects between problem behavior and personality may have been small because of a fourth limitation, directly related to our use of cross-lagged panel models. In cross-lagged panel models, one controls for relative stability paths of included variables (i.e., personality and problem behavior). However, personality traits or problem behavior symptoms may turn out to be so stable that little variance remains left to be explained by other variables. To overcome this problem, Cole et al. (2006) applied Trait-State models to depression data in which a perfectly stable component (i.e., trait) and the part of the construct that does change (i.e., state) are distinguished. With this approach, Cole et al. (2006) showed that the effects of negative events on depression became much stronger once the trait component was statistically controlled for. It would have been valuable to apply Trait-State models to our data, but these models are very demanding as they require ideally eight waves of data on at least 500 participants assuming at least moderate occasion factor stability (Cole, Martin, & Steiger, 2005). The dataset employed in the current study does not match these demands.

Fifth, only subclinical levels of problem behaviors were assessed. Although the data reported here can be used as a baseline for clinical populations, they do not meet clinical criteria and the results of this study should not be equated with those from studies of adolescents with psychiatric disorders (e.g., Gjerde, Block, & Block, 1988; Kim & Smith, 1998).

A sixth limitation concerns the evidence we obtained for the vulnerability model. The vulnerability model is not the only model that could explain why personality predicts problem behavior. Tackett (2006) has argued that findings explained from a vulnerability perspective might as well be explained by the spectrum model. Thus, findings suggesting that personality traits predict problem behavior could also be perceived as evidence for specific kinds of problem behavior being more extreme manifestations of certain personality traits. For example, depression could be perceived as a very low level of Emotional Stability. Future work should employ innovative study designs to disentangle vulnerability and spectrum model explanations for why personality predicts problem behavior.

Despite the mentioned limitations, the present study provides an important insight into the longitudinal associations between Big Five personality dimensions and problem behavior in early to middle and middle to late adolescent boys and girls. Our results clearly indicated that it is not only personality that affects problem behavior, but it is also problem behavior that affects personality.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jrp.2010.02.004.

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