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The Underlying Mechanisms of the Bidirectional Relationship between Depressive Symptoms and Delinquency among Dutch Adolescents

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Abstract

Depression and delinquency among adolescents are two actual problems in the Netherlands. During adolescence, depression and delinquency can have a large influence on adolescents' lives later on. Both depressive symptoms and delinquency can lead to serious problems in life, such as a weaker school performance or a criminal record. Earlier research found a bidirectional relationship between depression and delinquency. The aim of the current study was to investigate the bidirectional relationship between depressive symptoms and delinquency, including the underlying mechanisms of cannabis use and peer rejection among Dutch adolescents. No studies have investigated the bidirectional relationship with these mediators included before. Longitudinal data from the TRacking Adolescents' Individual Lives Survey study (TRAILS) were used to answer the research questions. The data were gathered by questionnaires. Participants were 1,615 Dutch adolescents in the ages 10-18 years (M_{age} = 10.58, 46.6% boys). No support was found for the conjecture of a significant bidirectional relationship between depressive symptoms and delinquency. These results provide insight into the approach of depressive symptoms and delinquency which should be separately and sex-specific to establish a healthy and prosperous society.

Keywords: depression, delinquency, cannabis, peer rejection, adolescents

Samenvatting

Depressie en delinquentie zijn twee actuele problemen onder adolescenten in Nederland en kunnen een grote invloed hebben op het leven van adolescenten. Zowel depressie als delinquentie kunnen problemen met zich meebrengen zoals lage schoolprestaties en een strafblad. In eerder onderzoek is een bidirectionele relatie gevonden tussen depressie en delinquentie. Het doel van dit onderzoek is om de bidirectionele relatie tussen depressie en delinquentie te onderzoeken met cannabis gebruik en peer afwijzing als onderliggende mechanismes bij Nederlandse adolescenten. Voor het beantwoorden van de onderzoeksvragen is er gebruik gemaakt van de TRacking Adolescents' Individual Lives Survey studie (TRAILS). De data is verzameld aan de hand van vragenlijsten. De participanten in deze studie waren 1615 Nederlandse adolescenten in de leeftijd 10-18 jaar (M_{age} = 10.58, 46.6% jongens). Er is echter geen significant verband gevonden voor bidirectionele relatie tussen depressie en delinquentie over tijd. Gebaseerd op de resultaten is er geen bevestiging voor de hypothese, wat indiceert dat er geen relatie is tussen depressie en delinquentie. Deze resultaten geven inzicht in de behandeling van depressie en delinquentie wat verschillende en sekse-specifieke behandeling vraagt om een gezonde en welvarende maatschappij in te richten.

Kernwoorden: depressie, delinquentie, cannabis gebruik, peer afwijzing, adolescenten

The Underlying Mechanisms of the Bidirectional Relationship between Depressive Symptoms and Delinquency among Dutch Adolescents

There is an increasing number of Dutch adolescents being diagnosed with depression (Centraal Bureau voor de Statistiek, 2018). Depression rates among adolescents are high; one out of four experience depressive symptoms before they turn 18 (Trimbos Instituut, 2017). Depression refers to depressive symptoms. In parallel, the prevalence of delinquency, operationalized as minor delinquency (e.g., theft, vandalism) is the highest in adolescence (Moffitt, 1993). Thirty-four percent of Dutch adolescents aged 12-17 committed a crime in the last 12 months (Van der Laan & Goudriaan, 2016). Depressive symptoms and delinquency can lead to serious problems. For instance, depressive symptoms early in life (during adolescence) increases the chance of later depression (American Psychiatric Association [APA], 2013) and can harm school performance (Fröjd et al., 2008). Delinquency can lead to a criminal record (Rijksoverheid, z.d.), which influences adult well-being (Lanctôt, Cernkovich, & Giordano, 2007).

Importantly, only Fontaine and colleagues (2018) have found a bidirectional association between depressive symptoms and delinquency among adolescents. For both directions of the relationship, different mediators could be selected based on the current literature. While cannabis use could be a mediator in the relationship between depressive symptoms and delinquency, peer rejection could be a mediator in the relationship between delinquency and depressive symptoms. These different mediators are investigated because the current study is the first to investigate this bidirectional relationship including mediators.

Because the direct and indirect relationships between these concepts may impact lives, more insight into the underlying mechanisms is needed for prevention. Preventing depressive symptoms and delinquent behavior benefits youth health and wellbeing. Therefore, the aim of this longitudinal study is to investigate the bidirectional relationship between depressive symptoms and delinquency, including the underlying mechanisms of cannabis use and peer rejection among Dutch adolescents.

The Relationship between Depressive Symptoms and Delinquency

The acting-out theory explains the effect of depressive symptoms on delinquency (Carlson & Cantwell, 1980). This theory posits that some adolescents “discharge” by acting-out instead of talking. Quick irritability is a symptom of depression (APA, 2013). Adolescents with this symptom might experience more irritability than those without depressive symptoms. For example; an adolescent hits the door to discharge his irritability on a whim. In

this case, the adolescent acts-out by hitting the door, which could lead to unintended delinquency (Gottfredson & Hirschi, 1990).

The findings of previous longitudinal studies have supported a positive relationship between depression and delinquency over time. For example, Fontaine and colleagues (2018) have found that depressive symptoms in mid-adolescence (15 years) were related to more delinquency in late-adolescence (17 years). Moreover, Herrera and Stuewig (2017) and Kofler and colleagues (2011) showed that depressive symptoms were associated with later delinquency among girls.

Cannabis Use as an Underlying Mechanism

Cannabis use can be an underlying mechanism that explains the relationship between depressive symptoms and delinquency. Cannabis use refers to smoking cannabis. First, depressive symptoms could lead to more cannabis use. Specifically, the self-medication hypothesis explains that adolescents with depressive symptoms might use cannabis to self-medicate and reduce negative feelings (Lintzeris et al., 2018). Symptoms of depression include a somber mood and suicidal thoughts (APA, 2013). Therefore, it is likely that those who experience these feelings self-medicate with cannabis. Several studies have indeed demonstrated a positive relationship between depressive symptoms and cannabis use. Degenhardt, Hall, and Lynskey (2003) have determined that depressive symptoms are related to the onset of cannabis use among adolescents who have not used cannabis before. In addition, Feingold, Weiser, Rehm, and Lev-ran (2015) have revealed that major depressive disorder increased the incidence rate of cannabis use among emerging adults. Furthermore, Stapinski, Montgomery, and Araya (2016) have found a relationship between depression and cannabis use among adolescents over time.

Second, cannabis use could result in delinquency. The enslavement theory (Goldstein, 1985), assumes that adolescents who use substances such as cannabis might engage in criminal behavior such as theft to finance the drugs. There is longitudinal evidence that indicates a positive relationship between cannabis use and delinquency. However, no previous studies have investigated cannabis use as a mediator between depressive symptoms and delinquency. Brook, Zhang, Rubenstone, Primack, and Brook (2016) have found that adolescents who used cannabis (varying from occasional to heavy use) were more likely to later engage in antisocial behavior. In addition, Schoeler and colleagues (2016) have demonstrated that the consequent use of cannabis predicted violent offending among males.

The Relationship between Delinquency and Depressive Symptoms

The consequences of delinquency, such as a criminal record (Rijksoverheid, z.d.) or a weaker school performance (Van der Laan, Blom, & Kleemans, 2009), might lead to depressive symptoms because they may influence well-being later in life (Lanctôt et al., 2007). Delinquency could be related to depressive symptoms because of future failure experiences (APA, 2013). Longitudinal studies have found a positive relationship between delinquency and depressive symptoms. Fontaine and colleagues (2018) have found that conduct problems in childhood (10-12 years) were related to depressive symptoms (15 years). Furthermore, Kosterman and colleagues (2010) have confirmed that conduct and other delinquency-related problems predict depression in emerging adulthood. Van der Giessen and colleagues (2013) have demonstrated that aggressive behavior, instead of general delinquency, predicts depressive symptoms.

Peer Rejection as an Underlying Mechanism

Peer rejection can be an underlying mechanism for the relationship between delinquency and subsequent depressive symptoms. Peer rejection refers to being disliked by peers more than being liked. As described in the failure theory (Patterson & Capaldi, 1990), adolescents who behave delinquently might be rejected by peers because of their outrageous, scary, or occasionally aggressive behavior. Several longitudinal studies have investigated the relationship between delinquency and peer rejection. Craun, Haight, DeCou, Babbitt, and Wong (2017) have found a positive significant relationship between peer rejection and later depressive symptoms. Di Giunta and colleagues (2017) have discovered a direct, significant, and positive relationship between delinquency and peer rejection; this relationship indicated that there was more peer rejection when delinquency increased.

The relationship between peer rejection and depressive symptoms could also be explained by the failure theory (Patterson & Capaldi, 1990), which assumes that being rejected can cause depressive symptoms because of a lack of social support. The longitudinal study of Di Giunta and colleagues (2017) have found a direct significant relationship between peer rejection and depressive symptoms. Only Kiesner (2002) investigated peer rejection as a mediator between delinquency and subsequent depressive symptoms but found only evidence for the mutual relationships and not for the mediation-effect. Nevertheless, this study is investigating this mediation because of the time difference with Kiesner's (2002) study, and the results from the study of Di Giunta and colleagues (2017).

The Current Study

This longitudinal study focuses on the central research question: "Is the relationship between depressive symptoms and delinquency bidirectional, and can these relationships be explained by the underlying mechanisms of cannabis use and peer rejection respectively?" Three sub-questions were formulated to answer this question (see Figure 1). The first sub-question is whether the relationship between depressive symptoms and delinquency is bidirectional. Hypothesis 1_a holds that more depressive symptoms predict a higher rate of delinquency. Hypothesis 1_b holds that higher rates of delinquency predict more depressive symptoms. The second sub-question is whether cannabis use mediates the relationship between depressive symptoms and delinquency. Hypothesis 2 holds that depressive symptoms are related to cannabis use, which in turn causes the increase of delinquent behavior. The third sub-question is whether peer rejection mediates the relationship between delinquency and depressive symptoms. Hypothesis 3 holds that delinquency causes an increase in peer rejection, which in turn causes an increase in depressive symptoms.

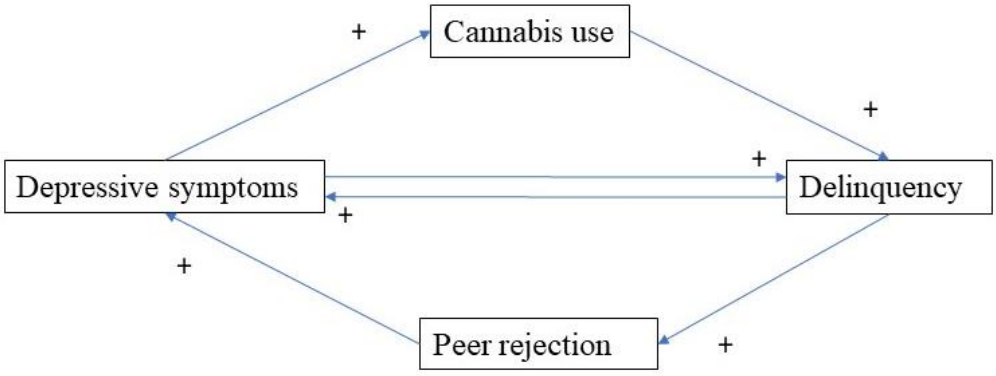

Figure 1. Research model about the underlying mechanisms of the bidirectional relationship between depressive symptoms and delinquency.

Method

Procedure

The longitudinal data used in this study is part of the TRacking Adolescents' Individual Lives Survey study (TRAILS). The TRAILS study has been approved by the Central Dutch Medical Ethics Committee (Huisman et al., 2008). The data were collected from five municipalities in the north of the Netherlands that provided information of all inhabitants born between October 1989 and September 1991. School participation was a condition for adolescents and their parents to be invited. At the start of the study, the

adolescents were in primary schools, and those schools received a letter that contained information about TRAILS. If the schools decided to participate, the parents were invited by telephone and received a brochure with information. In addition, an employee of TRAILS visited the schools to inform the adolescents about the study. The adolescents and their parents were followed for the past 15 years. The parent(s) and adolescents signed an active informed consent form at each measurement. At each wave, the adolescents filled in a questionnaire at school under the supervision of a TRAILS employee. The parents were interviewed and filled in a questionnaire at home.

Participants

This study used the first three waves of TRAILS (2001-2007). At the first wave (March 2001 – July 2002), 2,230 adolescents participated, at the second wave (September 2003 - December 2004), 2,148 adolescents participated, and at the third wave (September 2005 – August 2007), 1,818 adolescents participated. Due to drop-outs from the study, an attrition analysis was conducted, which demonstrated that boys, adolescents with a lower socioeconomic status (SES), and adolescents with relatively poor school performance were more likely to drop out (Huisman et al., 2008). After adolescents with missing values for either depressive symptoms or delinquency were excluded, the final sample consisted of 1,615 adolescents. Due to missing values, different sample sizes were used. For Hypothesis 1 on the bidirectional relationship between depressive symptoms and delinquency, 1,615 adolescents were included (M_{age} = 10.58, SD_{age} = 0.64, 46.6% boys) because 615 adolescents had missing values on either W_1 or W_3 for depressive symptoms or delinquency. For Hypothesis 2 on the mediation effect of cannabis use, 1,566 adolescents were included (M_{age} = 13.03, SD_{age} = 0.60, 47% boys) because 664 adolescents had missing values on W_2. For Hypothesis 3 on the mediation effect with peer rejection, 782 adolescents were included (M_{age} = 15.73, SD_{age} = 0.74, 46% boys) because not every school participated in the peer nomination scales, and 225 adolescents had missing values. Of the 1,615 adolescents, 89.00% had a Dutch ethnicity. In terms of educational level, 1.50% of the adolescents were in special primary education, 11.70% of the adolescents were in primary school, and 86.70% of the adolescents were in high school.

Measurements

Depressive symptoms (W_1 and W_3). Depressive symptoms are defined as symptoms that are orientated by the DSM and are measured by a sub-scale of Achenbach's (1991) Youth Self Report (YSR) questionnaire. This sub-scale measures how often adolescents experience depressive symptoms and includes 13 items. One example item is, "I feel worthless or

inferior." Items could be answered with a three-point scale, from 0 (*not at all*) to 2 (*clear or often*). The scores of the adolescents were calculated into sum scores (both α = .78). A higher score means more depressive symptoms.

Delinquency (W_1 and W_3). Delinquency is defined as minor crime, including vandalism and theft, and is measured by Moffitt and Silva's (1988) self-reported Antisocial Behavior Questionnaire (ASBQ). Seven items from the scale were not included in this study: three items pertained to substance use, two items pertained to walking away, one item pertained to police contact, and one item pertained destroying objects. These items were removed because they were not measured on either the first or third wave. The scale uses 25 items to measure how often the adolescents behaved delinquently. One example item is, "Have you ever purposely damaged or destroyed anything?" Items could be answered with a five-point scale, from 0 (*no, never*) to 4 (*7 times or more*). The scores of the adolescents were calculated into sum scores (both α = .87). A higher score indicated more delinquency.

Cannabis use (W_2). Cannabis use is defined as smoking cannabis (hashish/weed) and is measured at W_2 by one item: "Frequency of cannabis use over the past 12 months." The question measured how often the adolescents have smoked cannabis, with a score ranging from 0 (*0*) to 13 (*40 times or more*). A higher score means more cannabis use.

Peer rejection (W_2). Peer rejection is defined as being disliked by peers. The adolescents were asked to score at a dyadic level whether they liked or disliked their classmates (Dijkstra, Lindenberg, & Veenstra, 2007). Proportion scores were used; the more the adolescents were nominated as disliked, the more they were rejected.

Covariates (W_1). Sex, age, and SES were included as control variables because earlier research has found a relationship between depressive symptoms and delinquency. For sex, studies have demonstrated that boys are more likely to behave delinquently than girls, and girls are more likely to experience depressive symptoms than boys (Van der Laan & Blom, 2011). Sex was measured by asking the parents whether their child was a boy or a girl (reference category = girls). For age, research indicated more delinquency at an older age because delinquent behavior peaks around the age of 17 (Moffitt, 1993), and older adolescents experience more depressive symptoms than younger adolescents (De Looze et al., 2014). Age was included as a continuous variable. Earlier research has demonstrated that adolescents with a low SES demonstrated more depressive symptoms (Roberts & Duong, 2013) and delinquency (Gault-Sherman, 2013). Socioeconomic status comprised the profession of the parents and income and was divided into low, middle, and high (reference category = middle).

Data-analysis

The IBM SPSS Statistics 25 program was used to conduct the analysis. Before analysis was conducted, the variables of depressive symptoms, delinquency, cannabis use, and peer rejection, were checked for outliers with the Mahalanobis Distance. Outliers were found for each variable and were inspected as important cases; they were therefore not removed from the analyses. Descriptive statistics (*M* and *SD*) were investigated, and Pearson correlations between the variables were conducted. The Kolmogorov-Smironov test was used to examine the normal distribution and indicated a significant deviation of the normal distribution on depressive symptoms (W_3) $D(1639) = .161$, $p = <.001$, delinquency (W_3) $D(1639) = .225$, $p < .001$, cannabis use (W_2) $D(1586) = .518$, $p < .001$, and peer rejection (W_2) $D(793) = .206$, $p < .001$. However, a deviant distribution can be used with a large sample (Field, 2013). In addition, the bootstrap option was explored to compensate for the violated normal distribution but indicated no compensation.

The Baron and Kenny method (1986) was used for testing the mediation effect and involves three linear regression analyses (see Figure 2). At first, the direct relationship between the variables of depressive symptoms and delinquency was tested (path $c_{1\&2}$ [$H1_{a\&b}$]). A direct effect was necessary to test for mediation (H2 and H3). The second step was to test the relationship between depressive symptoms at Wave 1 and cannabis use (path a_1) and between delinquency at Wave 1 and peer rejection (path a_2). Third, the relationship between cannabis use and delinquency at Wave 3 was tested and controlled for the first measurement of depressive symptoms (path b_1). Also, the relationship between peer rejection and depressive symptoms at Wave 3, controlled for the first measurement of delinquency, was tested (path b_2). When path a or b were not significant, no mediation could occur. For each regression analysis, the effect size was measured in R^2. The significance level was set on p <.05 for the statistical tests.

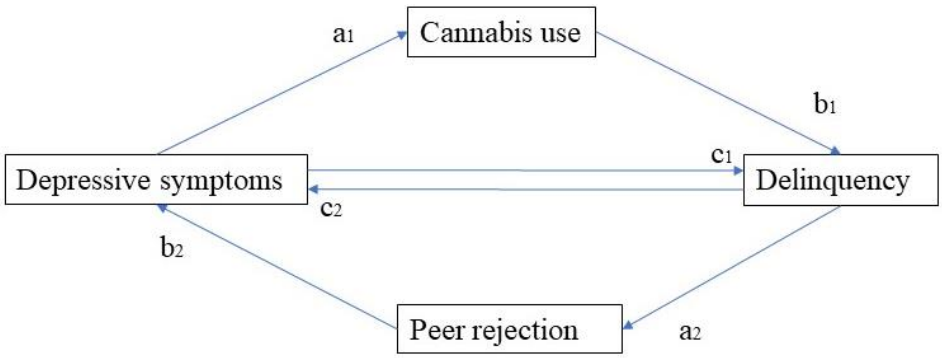

Figure 2. Research model based on the Baron and Kenny method for examining the hypotheses.

Results

Descriptive Statistics

Means (*M*) and Standard Deviations (*SD*) were calculated for the dependent, mediating and control variables. As displayed in Table 1, there were significant differences between boys and girls on the dependent variables. Girls scored significant higher on depressive symptoms and boys scored significant higher on delinquency. There was no significant result between boys and girls on the mediating and control variables. In general, the adolescents scored low on depressive symptoms at both waves which means that adolescents experienced slight depressive symptoms. The adolescents scored low for delinquency at both waves which indicates slight delinquent behavior. The adolescents scored low on the mediating variables, this means that adolescents barely used cannabis and experienced slight peer rejection.

Table 1

Descriptive Statistics of Depressive symptoms, Delinquency, Cannabis use, Peer Rejection, and the control variables by Sex.

	Girls	*Boys*	*Total*		
Variables	*M (SD)*	*M (SD)*	*M (SD)*	*t*	*p*
Depressive symptoms W_1	4.68 (3.58)*	3.80 (3.33)*	4.27 (3.49)	5.19	<.001
Depressive symptoms W_3	4.92 (4.15)*	2.51 (2.76)*	3.80 (3.77)	14.01	<.001
Delinquency W_1	5.56 (5.68)*	11.16 (10.05)*	8.17 (8.49)	-13.12	<.001
Delinquency W_3	4.13 (5.81)*	7.35 (8.70)*	5.63 (7.47)	-8.71	<.001
Cannabis use W_2	0.18 (1.10)	0.16 (0.99)	0.17 (1.05)	0.54	.587
Peer rejection W_2	-0.10 (0.93)	0.02 (1.04)	-0.05 (0.99)	-1.70	.090
SES	0.06 (0.77)	0.05 (0.80)	2.08 (0.71)	0.14	.893
Age	10.58 (0.65)	10.58 (0.63)	10.58 (0.64)	-	-

Note. * Difference is significant for $p < .05$, *M* = mean, *SD* = standard deviation.

Correlations

Pearson correlations were examined to see how the research variables were related. The results are displayed in Table 2. There was a notably insignificant relationship ($r = -.010$) between depressive symptoms at W_1 and delinquency at W_3, which indicates no significant relationship between these two variables. Besides, the first mediator cannabis use at W_2 only

correlated significantly with delinquency (W_1: r = .122. p <.001; W_3: r = .073, p = .004). This means that adolescents with depressive symptoms were not using cannabis, but adolescents who used cannabis were behaving delinquently. The second mediator peer rejection at W_2 only correlated significantly with depressive symptoms at Wave 1 (r = .079, p = .026), which is not an investigated relationship in this study.

Table 2

Pearson Correlation Matrix between Depressive Symptoms, Delinquency, Cannabis Use, Peer Rejection, and the control variables.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Depressive symptoms W_1	-								
2. Depressive symptoms W_3	.371**	-							
3. Delinquency W_1	.121**	-.074**	-						
4. Delinquency W_3	-.010	-.020	.380**	-					
5. Cannabis use W_2	.016	.010	.122**	.073**	-				
6. Peer rejection W_2	.079*	.038	.026	.022	.021	-			
7. Age	-.038	.004	.089**	-.032	.052*	-.020			
8. Sex	-.127**	-.320**	.329**	.216**	-.014	.061			
9. SES	-.015	-.009	-.089**	-.118**	.038	-.073*			

Note. *p < .05, **p < .01, ***p < .001.

The Bidirectional Relationship between Depressive Symptoms and Delinquency

Linear regression analyses were conducted to test the direct relationships between the variables of depressive symptoms and delinquency (Hypothesis $1_{a\&b}$). For the relationship between depressive symptoms at W_1 and delinquency at W_3 (Hypothesis 1_a), a significant model was found, R^2 = .165; F(6, 1608) = 54.16, p <.001. This indicated that the model includes a significant predictor. The results are depicted in Table 3. Contrary to expectations, depressive symptoms at W_1 were not a significant predictor of delinquency at W_3, $b1$ = -0.09, t = -1.74, p = .083. Moreover, the negative direction of depressive symptoms at W_1 was contrary to expectations. The control variable sex was the best predictor of subsequent delinquency.

Table 3

Linear Regression Analysis between Depressive Symptoms at W_1 and Delinquency at W_3 (N = 1615).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	11.69	2.84		4.12	<.001
Depression W_1	-0.09	0.05	-.04	-1.74	.083
Age	-0.85	0.27	-.07	-3.17	.002
Sex (0 = girls)	1.38	0.36	.09	3.78	<.001
SES low	1.22	0.44	.07	2.78	.005
SES high	-0.66	0.40	-.04	-1.67	.095
Delinquency W_1	0.31	0.02	.35	14.33	<.001

Note. [a]Dependent variable: for the prediction of delinquent behavior W_3. $F = 54.16$, $R^2 = .168$, *Adjusted* $R^2 = .165$.

Similarly, a significant model was found, $R^2 = .210$; $F(6, 1608) = 72.53$, $p < .001$, for the relationship between delinquency at W_1 and depressive symptoms at W_3 (Hypothesis 1_b), which indicated that the model includes a significant predictor. The results are displayed in Table 4. No significant relationship was found between delinquency at W_1 and depressive symptoms at W_3, $b1 = -0.012$, $t = -1.14$, $p = .255$. Only the control variables sex and previous depressive symptoms were significant predictors of depressive symptoms at W_3. Besides, the negative direction of the relationship between delinquency at W_1 and depressive symptoms W_3 is not line with Hypothesis 1_b.

Taken together, these findings demonstrate that there was no bidirectional relationship between depressive symptoms and delinquency[1], and that the control variable sex was more important to explain variation in later delinquency and later depressive symptoms.

[1] The bidirectional relationship between depressive symptoms and delinquency is also tested with the sub-samples ($N = 1566$; $N = 782$) and showed indeed no significant relationships.

Table 4

Linear Regression Analysis between Delinquency at W_1 and Depressive Symptoms at W_3 (N = 1615).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	2.34	1.39		1.68	.093
Delinquency W_1	-0.01	0.01	-.03	-1.14	.255
Age	0.10	0.13	.02	0.75	.453
Sex (0 = girls)	-1.98	0.18	-.26	-11.04	<.001
SES low	-0.28	0.22	-.03	-1.29	.196
SES high	-0.27	0.19	-.03	-1.38	.167
Depression W_1	0.37	0.02	.34	15.01	<.001

Note. [a]Dependent variable: for the prediction of depressive symptoms W_3. $F = 72.53$, $R^2 = .213$, *Adjusted* $R^2 = .210$.

Mediators Cannabis Use W_2 and Peer Rejection W_2

The results demonstrated no relationships between depressive symptoms at W_1 and delinquency at W_3, and delinquency at W_1 and depressive symptoms at W_3. Thus, no bidirectional relationship was confirmed. Nevertheless, the mutual relationships between depressive symptoms at W_1 and cannabis use at W_2, and cannabis use at W_2 and delinquency at W_3 were tested. Similarly, the relationships between delinquency at W_1 and peer rejection at W_2, and peer rejection at W_2 and depressive symptoms at W_3 were tested. These relationships were tested to determine whether the conjecture of Hypotheses 2 and 3 were correct.

The indirect relationship between depressive symptoms at W_1 and delinquency at W_3 through cannabis use at W_2 was tested (Hypothesis 2). First, the relationship between depressive symptoms at W_1 and cannabis use at W_2 was examined. No significant model was found, $R^2 = .003$; $F(5, 1560) = 1.87$, $p = .097$, this indicates that there was no relationship between depressive symptoms and later cannabis use. However, the positive direction of depressive symptoms at W_1 is in line with expectations. The results are presented in Table 5.

Table 5

Linear Regression Analysis between Depressive Symptoms at W_1 and Cannabis Use at W_2 (N = 1566).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	-0.74	0.44		-1.67	.096
Depression W_1	0.01	0.01	.02	0.71	.477
Age	0.08	0.04	.05	1.94	.053
Sex (0 = girls)	-0.02	0.05	-.01	-0.44	.661
SES low	0.03	0.07	.01	0.40	.687
SES high	0.13	0.06	.06	2.10	.036

Note. [a]Dependent variable: for the prediction of cannabis use W_2. $F = 1.87$, $R^2 = .006$, *Adjusted* $R^2 = .003$.

The relationship between cannabis use at W_2 and delinquency at W_3 was tested and thereby controlled for previous depressive symptoms. The linear regression analysis produced a significant model, $R^2 = .162$; $F(7, 1558) = 44.34$, $p < .001$, which indicates a significant predictor. Cannabis use at W_2 was, however, not a significant predictor of delinquency at W_3, $b1 = 0.30$, $t = 1.80$, $p = .072$, but this relationship was in the expected direction. This means that delinquency at W_3 was not predicted by cannabis use. Similar to the findings on the relationship between depressive symptoms at W_1 and delinquency at W_3, the same control variables were significant. The results are displayed in Table 6. Overall, the analyses suggest no significant mutual relationships between the dependent variables and cannabis use.

Table 6

Linear Regression Analysis between Cannabis Use at W_2 and Delinquency at W_3 (N = 1566).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	11.80	2.87		4.12	<.001
Depression W_1	-0.09	0.05	-.04	-1.71	.087
Cannabis use W_2	0.30	0.17	.04	1.80	.072
Age	-0.86	0.27	-.07	-3.18	.002
Sex (0 = girls)	1.41	0.37	.10	3.80	<.001
SES low	1.19	0.45	.07	2.66	.008
SES high	-0.69	0.40	-.04	-1.72	.086
Delinquency W_1	0.30	0.02	.34	13.56	<.001

Note. [a]Dependent variable: for the prediction of delinquency W_3. $F = 44.34$, $R^2 = .166$, *Adjusted* $R^2 = .162$.

The indirect relationship between delinquency at W_1 and depressive symptoms at W_3 through peer rejection at W_2 was also tested (Hypothesis 3). First, the relationship between delinquency at W_1 and peer rejection at W_2 was tested with a linear regression analysis. No significant model was found, $R^2 = .003$; $F(5, 776) = 1.30$, $p = .208$, although the positive direction of delinquency at W_1 was in line with expectations. Nevertheless, these results indicated no relationship between delinquency and later peer rejection. The results are presented in Table 7.

Table 7

Linear Regression Analysis between Delinquency at W_1 and Peer Rejection at W_2 (N = 782).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	0.18	0.56		0.33	.745
Delinquency W_1	0.00	0.00	.00	0.12	.906
Age	-0.02	0.05	-.02	-0.45	.651
Sex (0 = girls)	0.10	0.07	.05	1.39	.165
SES low	0.04	0.10	.02	0.44	.661
SES high	-0.14	0.08	-.07	-1.85	.065

Note. [a]Dependent variable: for the prediction of peer rejection W_2. $F = 1.30$, $R^2 = .009$, *Adjusted* $R^2 = .003$.

Next, the relationship between peer rejection at W_2 and depressive symptoms at W_3 was tested and controlled for previous delinquency. The linear regression analysis yielded a significant model, $R^2 = .193$; $F(7, 774) = 27.77$, $p < .001$, which indicates a significant predictor for depressive symptoms at W_3. The positive direction of peer rejection at W_2 is in line with expectations, but there was no significant relationship found between peer rejection at W_2 and depressive symptoms at W_3, $b1 = 0.10$, $t = 0.75$, $p = .456$. Only two control variables (sex and previous depressive symptoms) were significant predictors of depressive symptoms at W_3. Overall, the analyses indicated no significant mutual relationships between the dependent variables and peer rejection. The results are displayed in Table 8.

Table 8

Linear Regression Analysis between Peer Rejection at W_2 and Depressive Symptoms at W_3(N = 782).

	Coëfficiënts[a]				
Variables	*B*	*SE B*	*β*	*t*	*p*
(Constant)	1.70	1.99		0.86	.393
Delinquency W_1	0.01	0.02	.02	0.59	.557
Peer rejection W_2	0.10	0.13	.02	0.75	.456
Age	0.15	0.19	.03	0.78	.436
Sex (0 = girls)	-1.99	0.26	-.27	-7.71	<.001
SES low	-0.38	0.38	-.04	-1.12	.264
SES high	-0.15	0.27	-.02	-0.55	.581
Depression W_1	0.35	0.04	.32	9.83	<.001

Note. [a]Dependent variable: for the prediction of depressive symptoms W_3. $F = 27.77$, $R^2 = .201$, *Adjusted* $R^2 = .193$.

Additional Analyses Differences between Boys and Girls

Hypothesis $1_{a\&b}$ were tested separately for boys and girls because there are differences between boys and girls regarding depressive symptoms and delinquency. Boys are expected to behave more delinquently than girls, and girls are expected to experience more depressive symptoms than boys (Van der Laan & Blom, 2011). There is some first evidence there is no gender-based difference for the relationships between depressive symptoms and subsequent delinquency and between delinquency and later depressive symptoms.

The bidirectional relationship between boys' depressive symptoms and delinquency was tested. In both cases, a significant model was found, R^2 = .178; F(5, 746) = 33.622, p <.001, for delinquency at W_3 as the dependent variable, and R^2 = .125; F(5, 746) = 22.554, p <.001, for depressive symptoms at W_3 as the dependent variable. However, previous depressive symptoms were not significant for the prediction of delinquency at W_3, $b1$ = -0.161, t = -1.866, p = .062. In addition, earlier delinquency was not a significant predictor of depressive symptoms at W_3, $b1$ = -0.010, t = -1.040, p = .299.

Subsequently, the same analyses were conducted for girls. Both models were found to be significant, R^2 = .043; F(5, 857) = 8.819, p < .001, for delinquency at W_3 as the dependent variable, and R^2 = .124; F(5, 857) = 25.332, p < .001, for depressive symptoms at W_3 as the dependent variable. However, previous depressive symptoms were not significant for the prediction of delinquency at W_3, $b1$ = 0.011, t = 0.193, p = .847. Earlier delinquency was also not significant for the prediction of depressive symptoms at W_3, $b1$ = -0.016, t = -0.685, p = .494.

Discussion

This longitudinal study investigated if the possible bidirectional relationship between depressive symptoms and delinquency could be explained by the mediators of cannabis use and peer rejection among Dutch adolescents. Overall, the results indicated no significant bidirectional relationship between depressive symptoms and delinquency. Although no mediation effect could occur, the relationships between depressive symptoms and delinquency and between cannabis use and peer rejection were examined. However, depressive symptoms were not related to subsequent cannabis use, and cannabis use was not related to subsequent delinquency. Delinquency was not related to subsequent peer rejection, and peer rejection was not related to later depressive symptoms.

The Bidirectional Relationship between Depressive Symptoms and Delinquency

There was no significant bidirectional relationship between depressive symptoms and delinquency (Hypothesis $1_{a\&b}$). Moreover, the opposite direction, which indicated a decrease of delinquency in tandem more depressive symptoms was found. One explanation for the insignificant result is that the relationship between depressive symptoms and delinquency over time is tested among adolescents between 10-15 years, while Fontaine and colleagues (2018) have investigated this relationship among adolescents between 15-17 years. The concepts of depressive symptoms and delinquency may have different meanings at different stages of life. Adolescence is known as a period of change and of identity forming, which

may influence the perceptions of the subjects (Arnett & Hughes, 2012). Further research should examine whether the stage of adolescence matters in the relationship between depressive symptoms and delinquency. An explanation for the insignificance of the association between delinquency and subsequent depressive symptoms is that Fontaine and colleagues (2018) used conduct disorder as a form of problem behavior instead of delinquency. Due to a different measurement, insignificance could occur.

Both relationships (Hypotheses $1_{a\&b}$) were tested separately for boys and girls. Contrary to expectations, both expectations were not confirmed in this study. This could be explained by the results of Herrera and Stuewig (2017) and Kofler and colleagues (2011) which have found a significant result for depressive symptoms as predictor among delinquently behaving girls.

The Mediating Role of Cannabis Use and Peer Rejection

The results demonstrated no significant bidirectional relationship between depressive symptoms and delinquency. Therefore, there was no need to examine cannabis use and peer rejection as mediators. However, the mutual associations between depressive symptoms, cannabis use, and delinquency were nonetheless investigated (Hypothesis 2). The mutual associations between delinquency, peer rejection and, depressive symptoms were also examined (Hypothesis 3).

With respect to Hypothesis 2, no significant relationship was found between depressive symptoms and subsequent cannabis use. Therefore, the self-medication hypothesis is rejected. In contrast, the studies of Feingold and colleagues (2015) and Stapinski and colleagues (2016) have investigated an older-aged sample; respectively, (young) adults and adolescents aged 14. Also, Feingold and colleagues (2015) used major depressive disorder as a predictor, whereas this study used depressive symptoms. Due to a difference in the sample and concepts, no significant result was found in this study. The relationship between cannabis use and later delinquency was tested and controlled for previous depressive symptoms. Cannabis use was not a significant predictor of subsequent delinquency. One explanation is that in the current study only a few respondents actually used cannabis (N = 74) which might be a too small sample to investigate whether cannabis use is related to subsequent delinquency. It is recommend to repeat the investigation of the relationship between cannabis use and subsequent delinquency with a larger sample of cannabis users.

As for Hypothesis 3, the relationship between delinquency and subsequent peer rejection was not significant, which means that delinquency was not related to more peer rejection. Peer relations such as peer rejection are more actual in new formed groups of

adolescents according to Cillessen and Mayeux (2004). At Wave 2, when peer rejection was measured, there were probably no new formed groups. This explanation can clarify the insignificant result. Next, no association was found between peer rejection and subsequent depressive symptoms. An explanation might be that Di Giunta and colleagues (2017) have combined depressive symptoms with anxiety symptoms as one variable. It might be possible that peer rejection is a predictor of anxiety symptoms instead of depressive symptoms. Therefore, it would be interesting to investigate the difference between those two concepts and their relationship with peer rejection.

Strengths and Limitations

The leading strength of this study is the longitudinal design, which consists of three measurement timepoints. The longitudinal design provided the opportunity to test these relationships over time and therefore yielded more insight into the direction of the relationships than a cross-sectional design. Another strength of this study is the large sample of adolescents. The original sample consisted of 2,230 adolescents, and subsamples used in this study varied from 1,615 to 782 adolescents. A large sample is useful for generalizing the data to the Dutch population of adolescents.

Despite these strengths, there are several limitations that should be mentioned. First, the data was gathered in the north of the Netherlands, which might affect the generalizability to all Dutch adolescents. Second, the data from the first wave was gathered in 2001-2002, which was 17 years ago. Further research should use a more recent and nationwide sample because that would be more generalizable and reliable. Third, self-reported questionnaires were used which may have led to inaccurate reporting because of the sensitivity of the topics. However, the scales were proven to be reliable. The last limitation is the skewed distribution of the variables. The bootstrap option during the analyses was explored but did not compensate for the violated assumption.

Conclusions and Implications

This study provided insight into the relationship between depressive symptoms and delinquency and into the mutual relationships with cannabis use and peer rejection. This study does not confirm the conjecture of a bidirectional relationship between depressive symptoms and delinquency. Therefore, cannabis use and peer rejection could not explain that relationship as mediators.

There are two implications from the results of this study. First, more research is needed into the bidirectional relationship between depressive symptoms and delinquency. Earlier research has found evidence for the existence of that bidirectional relationship. The

current study did not find such evidence, which might be the result of using older data (2001-2007) that was gathered in the north of the Netherlands. Therefore, the bidirectional relationship should be examined again with a more recent and nationwide sample. This study also provides information that can be applied to depressive symptoms and delinquency among Dutch adolescents. Based on these results, depressive symptoms and delinquency should be approached separately because these two variables are seemingly unrelated.

Furthermore, sex-specific attention is needed for the approach to depressive symptoms and delinquency because this study confirmed that girls are more familiar with depressive symptoms than boys and that boys are more acquainted with delinquency. Due to the increase of depression, and the high prevalence of delinquency among adolescents, it is important to keep investigating these two concepts and to provide better care to establish a healthy and prosperous society.

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