

Psychopathology

Manuscript:	PSP-0-0-0 (INVITED)
Title:	Developmental Trajectories of Other, Self-, and Dual-Harm across Adolescence: The Role of Relationships with Peers and Teachers
Authors(s):	Annekatriin Steinhoff (Corresponding author), Denis Ribeaud (Co-author), Manuel Eisner (Co-author), Lilly Shanahan (Co-author)
Keywords:	Adolescence, Risk factors, Self-injurious behaviours, Social functioning, Violence
Type:	Research Article

Contribution to Special Issue:

“The Significance of Relationships in Developmental Psychopathology and Youth Mental Health”

edited by Helen Minnis, Anna Fuchs, and Michael Kaess

Research Article

***Developmental Trajectories of Other, Self-, and Dual-Harm across
Adolescence: The Role of Relationships with Peers and Teachers***

Annekatriin Steinhoff^a, Denis Ribeaud^a, Manuel Eisner^{a,b}, Lilly Shanahan^{a,c}

^a Jacobs Center for Productive Youth Development, University of Zurich, Switzerland

^b Institute of Criminology, University of Cambridge, UK

^c Department of Psychology, University of Zurich, Switzerland

Short Title: Other, self-, and dual-harm trajectories

Corresponding Author:

Annekatriin Steinhoff

Jacobs Center for Productive Youth Development

University of Zurich

Andreasstrasse 15

8050 Zurich, Switzerland

Tel: + 44 634 06 92

E-mail: steinhoff@jacobscenter.uzh.ch

Number of Tables: 1

Number of Figures: 2

Word count: 3075

Keywords: Self-harm, violence, dual-harm, adolescence, developmental transitions.

Abstract

Introduction: The development of other or self-harm (i.e., single harm), and the combination of both (i.e., dual-harm), is not well understood. We investigated the longitudinal course of, and intra-individual transitions between, single and dual-harm between the ages of 13 and 20. We also examined the role of relationships with peers and teachers in shaping these trajectories.

Methods: Data came from a community-representative longitudinal study ($N = 1,482$). Harm was self-reported at ages 13, 15, 17, and 20. Bullying victimization, school class cohesion, and the teacher–student bond were assessed at 13 and 17. Transition probabilities between no, other, self-, and dual-harm over time were estimated using latent Markov chain models. Relationship experiences were included as covariates of the emergence of single or dual-harm and the maintenance of harm thereafter.

Results: Dual-harm typically emerged early in adolescence and was followed by sex-specific channeling to single-harm (i.e., female adolescents mostly transitioned to self-harm and males to other harm). Youth reporting dual-harm in mid-adolescence had a lower likelihood of harm cessation than those with initial other or self-harm ($p < 0.05$). Relationship experiences were associated with the emergence of all forms of harm. A positive teacher–student bond was associated with an increased likelihood of single harm cessation.

Conclusion: Engagement in harm, especially dual-harm, signals a high risk of harm maintenance. To prevent prolonged trajectories of harm and associated burdens for individuals and communities, interventions need to target young people’s resources to cope with adverse relationship experiences and raise opportunities for positive experiences.

Introduction

Other and self-harm involving physical injury typically emerge during adolescence [1, 2] and are often a response to severe interpersonal stress and emotion dysregulation [3]. Each of these behaviors is considered a serious public health concern in the Western world [4-6]. Recent evidence has shown that a substantial proportion of youth (~5% in the community) engage in both behaviors (i.e., dual-harm) either concurrently or sequentially [7]. These adolescents have been characterized as a unique high-risk group, with even more severe psychological, physical, and social impairments than those with single harm [3, 7, 8].

To date, a developmental perspective on the emergence and maintenance of single versus dual-harm is largely missing from the literature, which is based primarily on cross-sectional or retrospective data on single versus dual-harm [9]. Consequentially, the potential factors of risk and resilience and also sex differences involved in single or dual-harm development are largely unknown. Although existing evidence shows that childhood social adversity in and outside the parental home increases the risk of subsequent other, self-, and especially dual-harm [7; Steinhoff et al., unpublished], little is known about how current social relationships in adolescence shape intra-individual longitudinal trajectories (e.g., maintenance and cessation) of harm. This paucity of knowledge hampers the development of interventions that meet the specific needs of youth with single versus dual-harm.

During the adolescent period, peer and school contexts gain significance for individual development and mental health [10-12]. Accordingly, stressful peer experiences, such as bullying victimization, and stress at school have been identified as proximal risk factors for harm [10, 13]. On the other hand, research has shown that a positive teacher–student relationship can safeguard against the emergence of internalizing and externalizing symptoms [14], which are well-established correlates of other and self-harm [15]. However, prior research has not unraveled the role of relationship experiences in the emergence and maintenance of single versus dual-harm.

Our aim was to contribute novel insights into the longitudinal trajectories of single and dual-harm

across the adolescent period, and into the role of social relationships in these trajectories. We leveraged data from a community-representative longitudinal study and examined, first, the average age-related course of single and dual-harm between the ages of 13 and 20, to identify periods when different forms of harm are prevalent. Second, we investigated intra-individual transitions between no, single, and dual-harm in participants over time, and sex differences in these transitions, to understand how single and dual-harm unfold over the individual lifespan. Third, we examined the association of bullying victimization and supportive bonds with classmates and teachers with the emergence, maintenance, and cessation of harm. We hypothesized that adverse social experiences, and lack of positive ones, are associated with an increased risk of harm emergence and maintenance, and explored whether these associations differ between groups with initial single versus dual-harm.

Materials and Methods

Participants and Procedures

Data came from the Zurich Project on Social Development from Childhood to Adulthood (z-proso; [16]). In 2004, 1,675 children from 56 primary schools were randomly selected from 90 public schools in Zurich, Switzerland's largest city, to constitute the target sample. Sample stratification accounted for school sizes and the socioeconomic backgrounds of the school districts. The sample was largely representative of first-graders attending public school in Zurich. Participants were followed until they were 20 years old (in 2018). We used data from those who participated at least once between 13 and 20, when other and self-harm were assessed ($n = 1,482$, 52% male). Consistent with Zurich's diverse population, the parents of the participants had been born in > 80 different countries (50% of the adolescents had two parents born abroad), and 91% of the participants were born in Switzerland. In 26% of the families, at least one parent held a university degree. Data were collected in classroom-based settings with paper-and-pencil questionnaires for participants up to age 17 and in a computer laboratory with computer-administered surveys at age 20. Completing the surveys took ~90 minutes. Participants received a cash incentive, which increased from ~\$30 at age 13 to \$75 at age 20.

Variables

Indicators of Harm

The present study focused on harm involving physical injury. *Self-harm* was self-reported at ages 13, 15, 17, and 20 using one item indicating how often adolescents had injured themselves on purpose during the previous month [17]. Example behaviors provided were “cut my arm,” “tore open wounds,” “hit my head,” and “tore out my hair.” Answers were recorded on a five-point scale (0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = very often) and were dichotomized (0 = no self-harm, 1 = any self-harm). *Other harm* was also self-reported at ages 13, 15, 17, and 20 using an indicator of assault taken from a broader delinquency scale developed by the z-proso team. Adolescents indicated whether they had “purposely hit, kicked, or cut someone, and injured him or her in the process” in the previous year and, if so, how often (open question). Potential victims included familiar and unfamiliar peers and adults. We used a dichotomous variable (0 = no other harm, 1 = at least one incidence of other harm) here as well.

Dual-harm was coded in two ways. First, to analyze the *average longitudinal course* of single versus dual-harm, adolescents were assigned to a dual-harm group when they reported both other and self-harm in the same assessment. Adolescents who reported self-harm and did not report other harm were assigned to a self-harm-only group. Conversely, adolescents who reported other harm but not self-harm were assigned to an other-harm-only group. All others were assigned to a no-harm group.

Second, to analyze *intra-individual trajectories* of harm, we combined the age 13 and 15 assessments to represent harm during early and mid-adolescence (for readability, we call this period mid-adolescence), which is the typical onset period of severe other and self-harm [2, 18]. In turn, we also combined the age 17 and 20 assessments to represent periods of harm maintenance versus cessation, or late-onset harm, in late adolescence. Adolescents who reported other and self-harm, either concurrently or sequentially, between ages of 13 and 15 (or 17 and 20, respectively) were assigned to the dual-harm group; single and no harm were coded accordingly.

100 Indicators of relationship experiences were measured at ages 13 and 17, the respective onset ages of
 101 the assessment periods that we distinguished in harm trajectories (i.e., mid- and late adolescence).
 102 *Bullying victimization* was assessed with four items at ages 13 (Cronbach's $\alpha = .77$) and 17 ($\alpha = .69$)
 103 from the Zurich Brief Bullying Scale [19]. For example, the respondents reported how often other
 104 people ignored or excluded them, laughed at, mocked, or insulted them during the previous 12
 105 months (1 = never, 6 = almost every day; $M = 1.70$ [$SD = 0.77$] at age 13, $M = 1.45$ [$SD = 0.57$] at age
 106 17). The *relationship with classmates* and the *teacher-student relationship* were assessed with two
 107 three-item scales, created by the z-proso team (relationship with classmates: e.g., "we have a really
 108 good sense of community within the class," $\alpha = .77$ at age 13, $\alpha = .75$ at age 17; relationship with the
 109 main teacher: e.g., "my teacher treats me fairly," "I get along with my teacher," $\alpha = .77$ at age 13, $\alpha =$
 110 $.78$ at age 17). Ratings were provided on a four-point Likert-scale (1 = fully untrue, 4 = fully true). We
 111 recoded the scales with higher values indicating less positive experiences to ease interpretation of
 112 the results (i.e., all relationship indicators were coded so that higher values indicated more negative
 113 or less positive experiences; M [classmates] = 1.71 [$SD = 0.61$] at age 13, $M = 1.67$ [$SD = 0.56$] at age
 114 17; M [teacher] = 1.85 [$SD = 0.65$] at age 13, $M = 1.85$ [$SD = 0.59$] at age 17). Seventeen-year-olds
 115 who did not attend educational training after examining from compulsory school (7%) were kept in
 116 the main models (see below for information on handling of missing data), and the results were
 117 replicated based on the sub-sample limited to participants currently attending school (i.e., high
 118 school [30%], vocational training [54%] or other training, such as apprenticeships [10%]).

119 Our models controlled for sex (0 = female, 1 = male) and household socio-economic background
 120 (SES). The latter was assessed using the International Socio-Economic Index of Occupational Status
 121 (ISEI) [20], which is based on occupation-specific income and required educational level. Scores
 122 ranged from 16 (e.g., unskilled worker) to 90 (e.g., judge; $M = 45.74$ [$SD = 19.24$]). We also tested
 123 whether academic achievement (grade point average [GPA] at age 13, calculated as mean of teacher-

reported grades in math and language, and type of school [high school, vocational, other] at 17) confounded associations between the teacher–student bond and harm.

Analytic Strategy

The average longitudinal course of single and dual-harm was examined based on descriptive statistics and binary logistic regression models to estimate sex differences, conducted in SPSS. Intra-individual transitions between the four harm groups in mid-adolescence (i.e., 13–15 years) and thereafter (i.e., 17–20 years) were examined using latent Markov chain models, which analyze within-person change in qualitative status (i.e., categorical variables) over time [21]. They were specified in MPlus, using a maximum likelihood estimator with robust standard errors (MLR). Missing data were handled with full information maximum likelihood [22]. Because small cell sizes in some transition patterns rendered model estimation with covariates impossible when differentiating all four harm groups in late adolescence, we analyzed predictors of transitions from the four groups to *any versus no harm*. In these models, relationship experiences were predictors of harm group membership in mid-adolescence (model *part A*) and of the maintenance of any harm in late adolescence, depending on initial harm group membership (*part B*; supplementary Fig. S1 provides an illustration of model specification). Time-invariant covariates (i.e., sex, SES) were predictors of initial group membership and of within-group differences in transition probabilities [23]. Indicators of relationship experiences were entered as time-varying covariates. To assess the impact of change in relationships (e.g., change in bullying victimization), the effects of the age-17 experiences were conditioned on respective age-13 experiences.

Results

Average Longitudinal Course of Single and Dual-Harm

In a previous paper, we reported the prevalence of self-harm in z-proso [17], but we did not differentiate between single- and dual-harm. In the present study, the past-month prevalence of

dual-harm decreased between the ages of 13 and 20 (Fig. 1). There were few or no changes in the prevalence of other and self-harm only between ages 13 and 15, but both forms of harm declined thereafter. Sex differences in single-harm emerged at each assessment: females were more likely to engage in self-harm only, and males were more likely to engage in other harm only (Fig. 1). Male adolescents also had a higher risk of engaging in dual-harm at age 13 but not thereafter.

Intra-individual Trajectories of Single and Dual-Harm

The transition models (Fig. 2) revealed that mid-adolescents reporting dual-harm had a higher risk of maintaining any harm in late adolescence than all other groups (comparison to other harm only: $p = 0.002$, self-harm only: $p = 0.013$, no harm: $p < 0.001$). The most common transition was from dual-harm to self-harm only. Youth with other or self-harm had a similar risk of maintaining any harm ($p = 0.384$). However, the stability of single harm differed depending on the type of harm. One in three adolescents with initial self-harm remained in the self-harm group, whereas one in six adolescents with initial other harm remained in that group. One in eight mid-adolescents with no harm transitioned to single or dual-harm in late adolescence, possibly indicating later onset of harm.

Inspection of sex-specific transitions (Fig. 2) revealed that females with initial dual-harm mostly transitioned to self-harm only (58%), whereas males mostly transitioned to no harm or other harm (26%). Self-harm was relatively stable in males (22%) and females (38%). Other harm was often stable in males (21%), whereas females who maintained any harm after engaging in other harm mostly transitioned to self-harm (29%). After reporting no harm in mid-adolescence, the most likely transition to harm, if any, was toward other harm in males (9%) and self-harm in females (10%).

Predictors of Initial Harm Group Membership and Subsequent Maintenance of Any Harm

Results of *part A* of our models with covariates revealed that bullying victimization and a lack of positive relationship experiences with classmates and the main teacher were associated with an increased probability of being in the groups with harm, compared to no harm (Tab. 1). Adverse

experiences in peer relationships also increased the risk of engaging in dual- versus other harm and were marginally associated with a higher risk of dual- versus self-harm (supplementary Tab. S1).

In *part B* of the models, predictors of any harm (versus no harm) were assessed, taking into account initial harm group membership. Females reporting dual-harm or self-harm only in mid-adolescence had a higher risk of subsequent harm maintenance than males from these groups. Relationship experiences did not predict harm maintenance after engaging in dual-harm. In the groups with single harm, worsening of the teacher–student bond was associated with an almost three times (self-harm) and more than four times (other harm) higher risk of harm maintenance than cessation. In other words, a supportive teacher–student relationship was associated with a higher likelihood of harm cessation. Supplementary Table S2 and Table S3 show the replication of these results when taking educational achievement into account. Worsening of relationships with class mates was moderately associated with an increased likelihood of transitioning from no to any harm; bullying victimization had a marginal effect in the same direction.

Discussion

To prevent the burden of adolescent other, self-, and dual-harm for individuals and communities, a better understanding is needed of the longitudinal course that these behaviors take and of the influence that everyday social relationship experiences can have. Our community-representative longitudinal study shows that two out of three adolescents who engage in dual-harm during their early and mid-adolescent years maintain harmful behavior thereafter, a number that exceeds maintenance rates in groups with initial single self-harm (two out of five) and other harm (two out of six). Adverse social relationship experiences were consistently associated with the emergence of harm, but only select experiences were also associated with the continuity of harm.

Our findings show that dual-harm typically has its onset in or by early adolescence, as was reported in prior research on self-harm [24, 25] and other harm [1, 17, 26]. The typical developmental trajectory thereafter is from dual- to single harm, but not the other way round. Thus, dual-harm may

be a manifestation of early adolescents experimenting with different ways of dealing with overwhelming stress. Subsequent sex-specific channeling toward single self-harm (females) or other harm (males) may represent an increasing adherence to gender stereotypes, since other harm is usually conceived of as a masculine behavior [27], whereas the example behaviors given in our self-harm assessment may over-represent female-typical self-harm [28].

The low likelihood of transitioning to no harm after engaging in dual-harm reveals a strong need for effective intervention mechanisms tailored especially for the dual-harm group, which tends to come with several unique psychological characteristics, such as low self-control [7]. Our study shows that strengthening adolescents' capacities to cope with the challenges inherent in everyday social relationships, and counteracting bullying victimization, may be promising avenues to prevent the *emergence* of all forms of harm, especially dual-harm, before it becomes chronic. This aligns with conceptualizations of harm as a behavioral response to overwhelming interpersonal stress [3], and prior evidence showing the strong impact of victimization experiences on dual-harm in particular [7].

In addition, the role of relationships with classmates and teachers in adolescent single and dual-harm mirrors the relevance of the school context to adolescents' daily lives. However, our study design is not suitable to infer causality, and the associations between harm and social relationship experiences can be of reciprocal nature [29]. Still, the link between recent changes in peer relationships and the *onset* of any harm in late adolescents who had no prior history of harm further supports the conclusion that adverse peer group dynamics are precursors of harm emergence.

Finally, our study adds a new dimension to the existing knowledge of harm by providing insights into the role of social relationships in the *intra-individual trajectory* of harm. While peer relationships were mainly involved in the emergence of harm, the association between a supportive teacher–student bond and single harm cessation (but not onset) in late adolescence testifies to the relevance of adolescent–adult relationships in overcoming a mental health problem, such as other or self-harm. A positive teacher–student bond may encourage adolescents to disclose their mental health

problems and encourage the teacher to facilitate access to (professional) support systems [30].

Positive teacher–student bonds could also increase adolescents’ sense of self-worth, self-efficacy and belonging in the school context, which, in turn, could decrease the urge to other or self-harm.

The lack of an association between the teacher–student bond and harm maintenance in youth reporting initial dual-harm could indicate specific needs of adolescents with this severe pattern of harm. However, the small group sizes in the transition analyses may also have resulted in a lack of power to detect within-group differences in this group. Future research with larger dual-harm groups is needed to identify the precursors of harm maintenance versus cessation among these adolescents.

Other limitations of our study include the assessments of other and self-harm with single-item self-reports, which may be prone to social desirability. The one-month time frame of the self-harm assessment may have resulted in an underestimation of the prevalence of some groups, including the initial dual-harm group. Three-year time intervals between some assessments may also cause an underestimation of the rates of harm maintenance and of the strength of the associations with the covariates measured at the beginning of each assessment period. Moreover, reverse causation cannot be ruled out, and associations between (changes in) social relationships and (changes in) harm could also result from (changes in) unobserved confounders, such as self-regulation skills.

However, our findings demonstrate that the majority of adolescents reporting dual-harm, and many of those reporting single harm, are on a trajectory toward prolonged maintenance of harm. Poor relationships in peer and school contexts signal a high risk of harm emergence and maintenance. Interventions that counteract social adversity and raise opportunities for particular positive social experiences, for example with teachers, may be able to prevent and even interrupt these trajectories.

Statements

Acknowledgements

We are grateful to all the participants who provided data for the z-proso study and to the research assistants involved in data collection.

Statement of Ethics

All procedures complied with the Helsinki Declaration of 1975, as revised in 2008. The study was approved by the ethics committee of the Faculty of Arts and Social Sciences, University of Zurich.

Adolescents provided written informed consent at each wave, and parents of children aged under 15 could choose not to have their children participate in the study.

Conflict of Interest Statement

During the previous three years, DR, ME, and LS received funding for independent research from the Swiss National Science Foundation.

Funding Sources

Funding for independent fundamental research was received from the Swiss National Science Foundation (100014_132124, 100014_149979, 10FI14_170409, #10531C_189008, #10FI14_198052 / 1) and the Jacobs Foundation (2010-888, 2013-1081-1). The content presented here is solely the responsibility of the authors and does not necessarily represent the views of the above foundations.

Author Contributions

AS and LS conceived of the paper. ME and DR designed the z-proso study and collected the data. AS analyzed the data. AS conceptualized and drafted the manuscript, with critical input from LS. All authors critically revised the manuscript for important intellectual content.

Data Availability Statement

The datasets generated for this study will not be made publicly available due to sensitive personal information. Requests from scientists for re-analysis can be directed to the first author.

References

1. Plener PL, Schumacher TS, Munz LM, Groschwitz RC. The longitudinal course of non-suicidal self-injury and deliberate self-harm: a systematic review of the literature. *Borderline Personality Disorder and Emotional Dysregulation*. 2015;2:2.
2. Loeber R, Hay D. Key issues in the development of aggression and violence from childhood to early adulthood. *Annual Review of Psychology*. 1997;48(371-410).
3. Shafti M, Taylor PJ, Forrester A, Pratt D. The Co-occurrence of Self-Harm and Aggression: A Cognitive-Emotional Model of Dual-Harm. *Frontiers in Psychology*. 2021;12(415).
4. Wolf A, Gray R, Fazel S. Violence as a public health problem: an ecological study of 169 countries. *Social Science and Medicine*. 2014;104:220-7.
5. Monto MA, McRee N, Deryck FS. Nonsuicidal Self-Injury Among a Representative Sample of US Adolescents, 2015. *American Journal of Public Health*. 2018;108(8):1042-8.
6. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R. World report on violence and health. Geneva: World Health Organization; 2002.
7. Richmond-Rakerd LS, Caspi A, Arseneault L, Baldwin JR, Danese A, Houts RM, et al. Adolescents Who Self-Harm and Commit Violent Crime: Testing Early-Life Predictors of Dual Harm in a Longitudinal Cohort Study. *American Journal of Psychiatry*. 2019;176(3):186-95.
8. Steeg S, Webb RT, Mok PLH, Pedersen CB, Antonsen S, Kapur N, et al. Risk of dying unnaturally among people aged 15–35 years who have harmed themselves and inflicted violence on others: a national nested case-control study. *The Lancet Public Health*. 2019;4(5):e220-e8.
9. O'Donnell O, House A, Waterman M. The co-occurrence of aggression and self-harm: systematic literature review. *Journal of Affective Disorders*. 2015;175:325-50.
10. Steinhoff A, Bechtiger L, Ribeaud D, Eisner M, Shanahan L. Stressful Life Events in Different Social Contexts Are Associated With Self-Injury From Early Adolescence to Early Adulthood. *Front Psychiatry*. 2020;11:487200.

11. Prinstein MJ, Giletta M. Peer Relations and Developmental Psychopathology. In: Cicchetti D, editor. *Developmental Psychopathology* 2016. p. 1-53.
12. Nelson EE, Leibenluft E, McClure EB, Spine DS. The social re-orientation of adolescence: a neuroscience perspective on the process and its relation to psychopathology. *Psychological Medicine*. 2005;35:163-74.
13. Karanikola MNK, Lyberg A, Holm A-L, Severinsson E. The Association between Deliberate Self-Harm and School Bullying Victimization and the Mediating Effect of Depressive Symptoms and Self-Stigma: A Systematic Review. *BioMed Research International*. 2018;2018:4745791.
14. Murray AL, Obsuth I, Speyer L, Murray G, McKenzie K, Eisner M, et al. Developmental Cascades from Aggression to Internalizing Problems via Peer and Teacher Relationships from Early to Middle Adolescence. *J Youth Adolesc*. 2021;50(4):663-73.
15. Nock MK, Joiner TE, Jr., Gordon KH, Lloyd-Richardson E, Prinstein MJ. Non-suicidal self-injury among adolescents: diagnostic correlates and relation to suicide attempts. *Psychiatry Research*. 2006;144(1):65-72.
16. Ribeaud D, Eisner M. Risk factors for aggression in preadolescence: risk domains, cumulative risk, and gender differences: results from a prospective longitudinal study in a multiethnic urban sample. *European Journal of Criminology*. 2010;7(6):460-98.
17. Steinhoff A, Ribeaud D, Kupferschmid S, Raible-Destan N, Quednow BB, Hepp U, et al. Self-injury from early adolescence to early adulthood: age-related course, recurrence, and services use in males and females from the community. *European Child & Adolescent Psychiatry*. 2020.
18. Plener PL, Kaess M, Schmahl C, Pollak S, Fegert JM, Brown RC. Nonsuicidal self-injury in adolescents. *Deutsches Ärzteblatt International*. 2018;115:23-30.
19. Murray AL, Eisner M, Ribeaud D, Kaiser D, McKenzie K, Murray G. Validation of a brief self-report measure of adolescent bullying perpetration and victimization. *Assessment*. 2019.

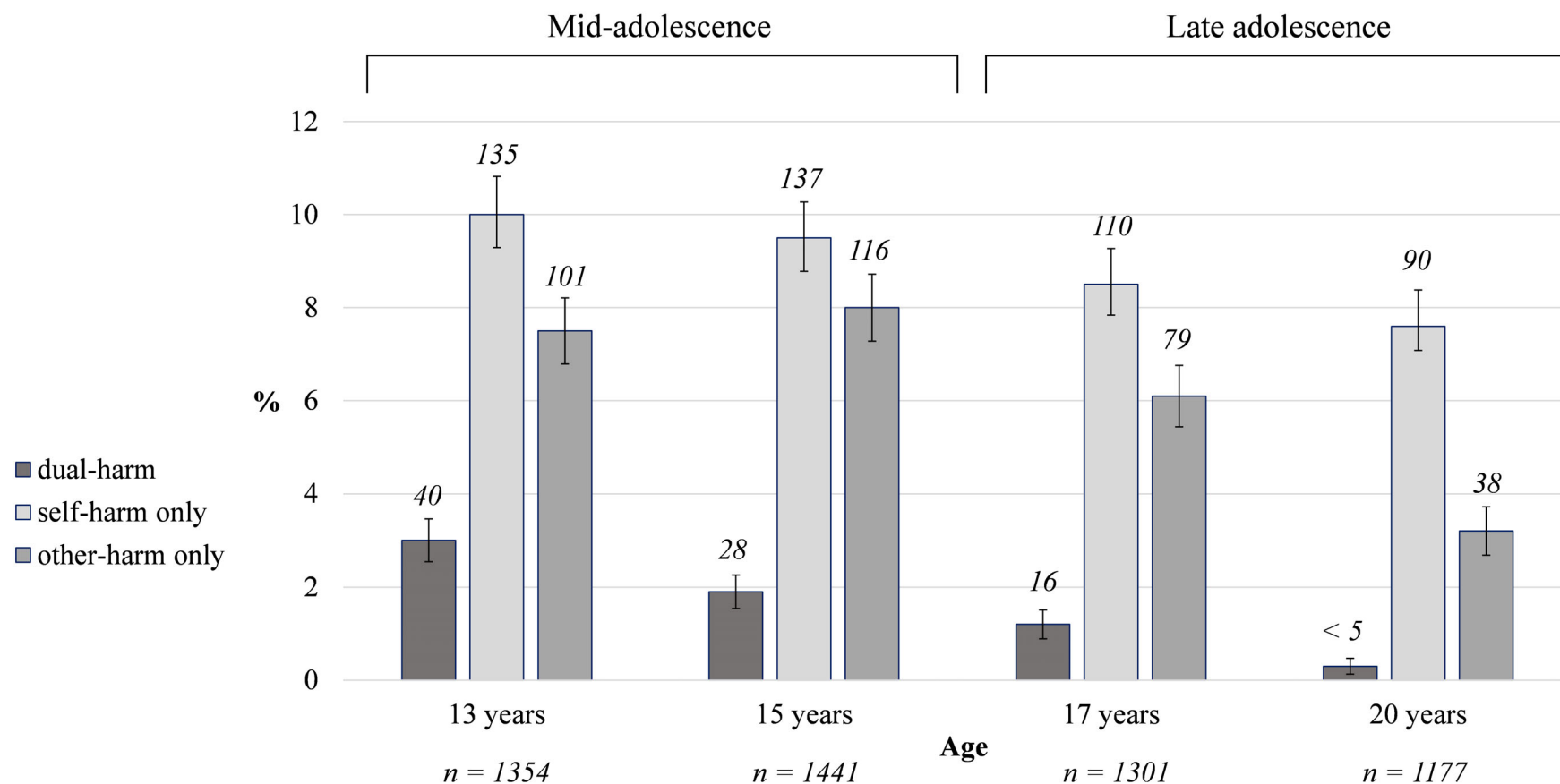
20. Ganzeboom HBG, De Graaf PM, Treiman DJ, De Leeuw J. A standard international socio-economic index of occupational status. *Social Science Research*. 1992;21:1-56.
21. Kaplan D. An overview of Markov Chain Methods for the study of stage-sequential developmental processes. *Developmental Psychology*. 2008;44(2):457-67.
22. Schafer JL, Graham JW. Missing data: our view of the state of the art. *Psychological Methods*. 2002;7(2):147-77.
23. Muthen BO, Asparouhov T. LTA in Mplus: transition probabilities influenced by covariates. 2011.
24. Brown RC, Plener PL. Non-suicidal Self-Injury in Adolescence. *Current Psychiatry Reports*. 2017;19(3):20.
25. Muehlenkamp JJ, Xhunga N, Brausch AM. Self-injury Age of Onset: A Risk Factor for NSSI Severity and Suicidal Behavior. *Arch Suicide Res*. 2019;23(4):551-63.
26. Shulman EP, Steinberg LD, Piquero AR. The age-crime curve in adolescence and early adulthood is not due to age differences in economic status. *J Youth Adolesc*. 2013;42(6):848-60.
27. Fleming PJ, Agnew-Brune C. Current trends in the study of gender norms and health behaviors. *Current Opinion in Psychology*. 2015;5:72-7.
28. Sornberger MJ, Heath NL, Toste JR, McLouth R. Nonsuicidal self-injury and gender: patterns of prevalence, methods, and locations among adolescents. *Suicide and Life-Threatening Behavior*. 2012;42(3):266-78.
29. Burke TA, Hamilton JL, Abramson LY, Alloy LB. Non-suicidal self-injury prospectively predicts interpersonal stressful life events and depressive symptoms among adolescent girls. *Psychiatry Research*. 2015;228(3):416-24.
30. Halladay J, Bennett K, Weist M, Boyle M, Manion I, Campo M, et al. Teacher-student relationships and mental health help seeking behaviors among elementary and secondary students in Ontario Canada. *Journal of School Psychology*. 2020;81:1-10.

Figure Legends

Fig. 1. Longitudinal course of single and dual-harm between ages 13 and 20 in the overall sample and sex differences in the point prevalence (results from logistic regression analyses).

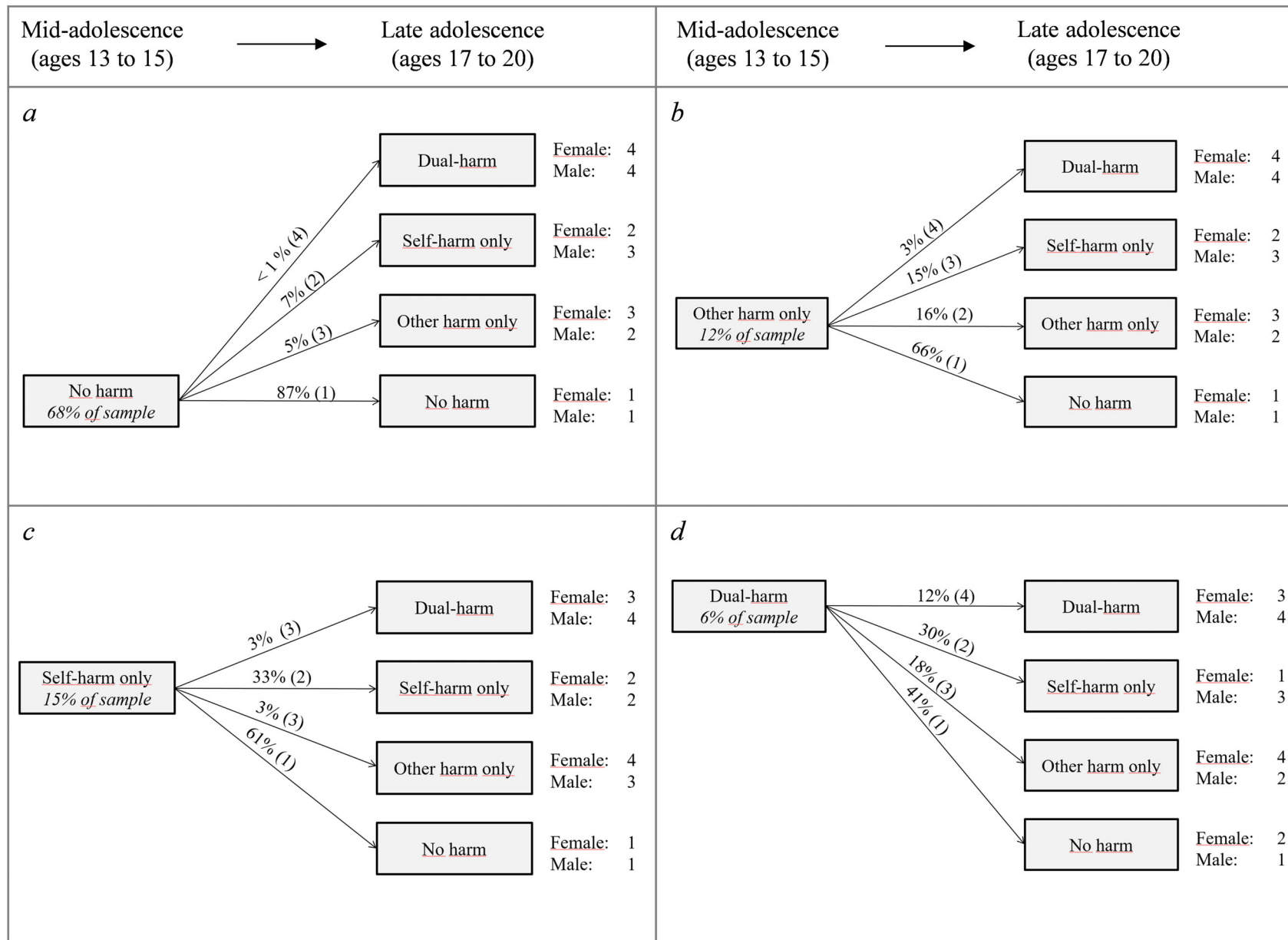
Fig. 2. Latent transition probabilities between harm groups in mid- and late adolescence based on the estimated model; rank orders of transitions are given for the overall sample (in parentheses) and for female and male sub-samples, with 1 indicating the most likely and 4 indicating the least likely transition ($n = 1,407$, n [male] = 720, n [female] = 687; including respondents with valid assessments at 13 and 15 or at 17 and 20).

Note. For sex-specific transitions, we do not provide exact numbers because of the small cell sizes ($n < 5$) in some cases to avoid reporting potentially identifying information. Select probabilities of relatively frequent transitions are given in the text.



Sex differences at each age: OR (95% CI), *p*

Dual-harm (male vs. female)	2.54 (1.26—5.13), 0.009	1.08 (0.51—2.29), 0.841	1.27 (0.47—3.44), 0.635	---
Self-harm only (female vs. male)	1.57 (1.10—2.25), 0.014	3.09 (2.09—4.56), < 0.001	3.26 (2.09—5.08), < 0.001	2.27 (1.43—3.60), < 0.001
Other-harm only (male vs. female)	2.62 (1.67—4.11), < 0.001	2.90 (1.89—4.45), < 0.001	6.69 (3.50—12.77), < 0.001	3.00 (1.44—6.23), 0.003



Tab. 1. Predictors of initial group (i.e., latent class) membership and subsequent transitions to any versus no harm (odds ratios with 95% confidence intervals in parentheses, p-values in second row).

Covariates	Part A Outcome: harm group membership at ages 13–15, reference group: no harm			Part B Outcome: any harm (reference: no harm) at ages 17–20, effects of covariates depending on initial harm group			
	Dual-harm	Self-harm only	Other-harm only	Dual-harm	Self-harm only	Other-harm only	No harm
Sex (male)	2.02 (1.20–3.38) 0.008	0.55 (0.40–0.77) 0.001	2.47 (1.69–3.60) < 0.001	0.25 (0.06–0.95) 0.042	0.35 (0.16–0.79) 0.011	1.03 (0.45–2.40) 0.938	0.95 (0.59–1.51) 0.813
Socio-economic status	0.98 (0.97–1.00) 0.020	0.99 (0.98–1.00) 0.002	0.99 (0.98–1.00) 0.043	0.99 (0.96–1.01) 0.288	1.02 (1.00–1.04) 0.055	1.00 (0.98–1.02) 0.980	1.00 (0.99–1.02) 0.689
<i>Bullying victimization</i>							
Age 13	2.26 (1.76–2.91) < 0.001	1.79 (1.45–2.21) < 0.001	1.43 (1.15–1.79) 0.002	1.29 (0.66–2.53) 0.454	1.00 (0.69–1.45) 0.983	1.09 (0.65–1.85) 0.738	0.97 (0.67–1.39) 0.858
Age 17	--	--	--	1.11 (0.50–2.46) 0.800	1.07 (0.63–1.81) 0.801	1.43 (0.69–2.96) 0.342	1.39 (0.96–2.01) 0.081
<i>Poor relationship with classmates</i>							
Age 13	2.10 (1.49–2.96) < 0.001	1.64 (1.26–2.12) < 0.001	1.42 (1.06–1.90) 0.019	1.84 (0.62–5.43) 0.271	0.82 (0.46–1.47) 0.501	1.74 (0.89–3.43) 0.108	0.96 (0.64–1.44) 0.834
Age 17	--	--	--	1.22 (0.36–4.11) 0.753	1.71 (0.89–3.29) 0.109	1.57 (0.78–3.14) 0.207	1.72 (1.12–2.65) 0.014
<i>Poor relationship with teacher</i>							
Age 13	2.28 (1.58–3.28) < 0.001	1.53 (1.19–1.97) 0.001	1.60 (1.24–2.05) < 0.001	1.60 (0.54–4.72) 0.392	0.66 (0.39–1.10) 0.113	1.15 (0.50–2.65) 0.741	1.08 (0.73–1.59) 0.701
Age 17	--	--	--	1.18 (0.36–3.87) 0.786	2.86 (1.42–5.75) 0.003	4.52 (1.76–11.63) 0.002	1.19 (0.78–1.82) 0.429

Note. Covariates from each domain were entered into the model separately; all models controlled for sex and socio-economic background.

Bold print indicates significant effects at $p < 0.05$, and bolded italics indicate marginal effects at $p < 0.10$.

Online Supplement

***Developmental Trajectories of Other, Self-, and Dual-Harm across Adolescence: The Role of Relationships with
Peers and Teachers***

Annekatriin Steinhoff, Denis Ribeaud, Manuel Eisner, & Lilly Shanahan

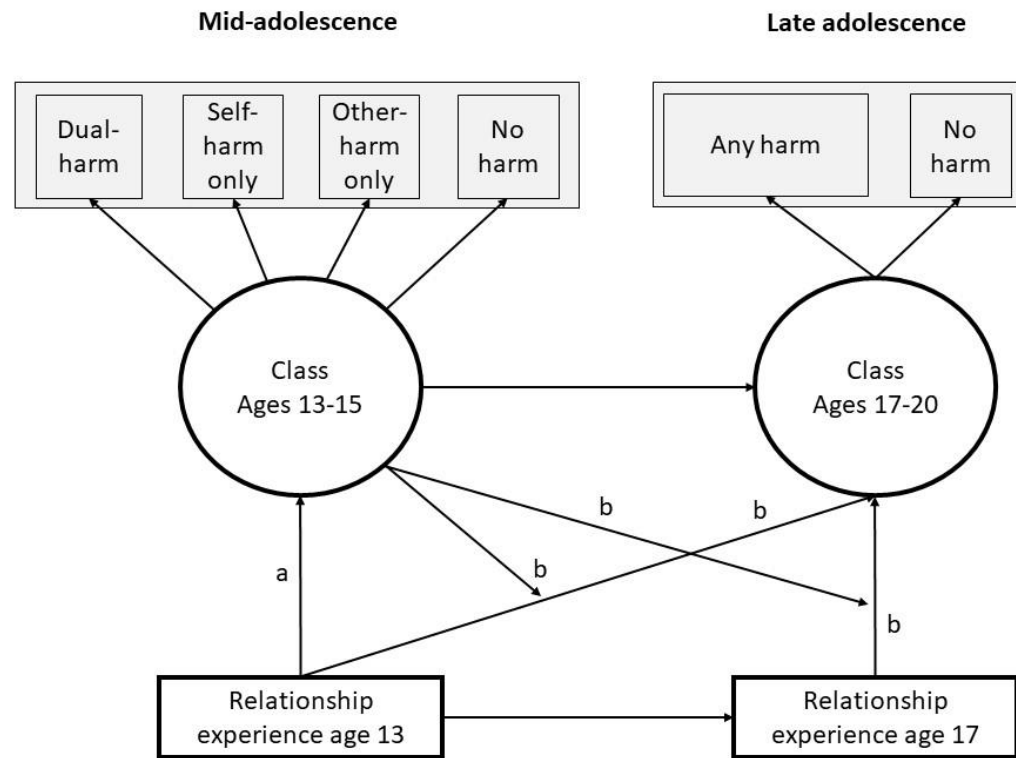


Fig. S1. Simplified illustration of latent Markov chain models including time-varying covariates. Paths of model part A refer to prediction of harm group membership in mid-adolescence, those of part B refer to prediction of transitions to any versus no harm in late adolescence, depending on initial harm group membership.

Tab. S1. Predictors of initial class membership, direct comparisons between groups with other, self-, and dual-harm (odds ratios with 95% confidence intervals in parentheses, p-values in second row).

Covariates	Outcome: harm group membership at ages 13—15		
	Dual-harm vs. self-harm only	Dual-harm vs. other-harm only	Self-harm only vs. other-harm only
Sex (male)	3.65 (2.03—6.55) < 0.001	0.82 (0.44—1.51) 0.519	0.22 (0.14—0.36) < 0.001
Socio-economic status	1.00 (0.98—1.01) 0.748	0.99 (0.98—1.01) 0.399	1.00 (0.98—1.01) 0.494
Bullying victimization, age 13	1.26 (0.96—1.66) 0.093	1.58 (1.19—2.09) 0.001	1.25 (0.96—1.62) 0.097
Poor relationship with classmates, age 13	1.28 (0.87—1.89) 0.207	1.48 (0.99—2.23) 0.059	1.15 (0.81—1.65) 0.428
Poor relationship with teacher, age 13	1.49 (0.98—2.25) 0.060	1.43 (0.96—2.13) 0.081	0.96 (0.70—1.32) 0.798

Note. Covariates from each domain were entered into the model separately, all models controlled for sex and socio-economic background.

Bold print indicates significant effects at $p < 0.05$, bolded italics indicate marginal effects at $p < 0.10$.

Tab. S2. Associations between the teacher-student bond and initial group membership, controlling for GPA at age 13 (odds ratios with 95% confidence intervals in parentheses, p-values in second row).

Covariates	Outcome: harm group membership at ages 13—15, reference group: no harm		
	Dual-harm	Self-harm only	Other-harm only
Poor relationship with teacher, age 13	2.39 (1.66—3.45) < 0.001	1.52 (1.16—1.99) 0.002	1.62 (1.26—2.09) < 0.001
Low GPA at age 13	2.12 (1.34—3.35) 0.001	1.27 (0.94—1.72) 0.118	1.33 (0.95—1.87) 0.100

Note. Bold print indicates significant effects at $p < 0.05$.

Tab. S3. Associations between the teacher-student bond and transitions in the sub-sample, including only adolescents who attended school at age 17, and controlling for educational track (odds ratios with 95% confidence intervals in parentheses, p-values in second row).

Covariates	Outcome: any harm (reference: no harm) at ages 17—20, effects depending on initial harm group membership			
	Dual-harm	Self-harm only	Other-harm only	No harm
Poor relationship with teacher				
Age 13	1.83 (0.66—5.11) 0.247	0.65 (0.39—1.10) 0.107	1.14 (0.52—2.51) 0.744	1.08 (0.74—1.59) 0.689
Age 17	0.94 (0.28—3.20) 0.919	2.46 (1.30—4.65) 0.006	3.84 (1.30—11.28) 0.015	1.22 (0.82—1.81) 0.335
Educational track at age 17				
High school*	0.47 (0.06—3.78) 0.473	1.32 (0.37—3.95) 0.751	0.19 (0.03—1.45) 0.109	0.56 (0.24—1.27) 0.163
Vocational training*	0.73 (0.12—4.51) 0.736	0.85 (0.28—2.64) 0.783	0.27 (0.04—1.86) 0.184	0.79 (0.36—1.71) 0.547

Note. Bold print indicates significant effects at $p < 0.05$.

*Reference: other education, such as apprenticeships.