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Parental Support and Positive Mood Buffer Adolescents' Academic Motivation During the COVID-19 Pandemic

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School closures during the first COVID-19 lockdown in 2020 severely disrupted adolescents' lives. We used a daily diary method for 20 days, including online and physical school days, assessing daily mood, social support and conflict, and academic motivation in 102 adolescents aged 12–16 years. We found that adolescents' academic motivation was lower on online compared with physical school days. In general, positive mood was positively associated with academic motivation, and friend conflict related negatively to academic motivation. Moreover, lower levels of parental support were related to lower academic motivation on online versus physical school days. Overall, these findings identified some critical changes in adolescents' daily experiences during the COVID-19 school closure and social-emotional factors that may buffer decreases in adolescents' academic motivation.

Key words: adolescence – COVID-19 – school closure – daily diary – academic motivation – social support – social conflict – mood

To limit the spread of the COVID-19 virus, the Dutch government closed all schools in the Netherlands on March 15, 2020. Secondary schools remained completely closed for 11 weeks during which education was only given online. Schools partly reopened on June 2, 2020, allowing adolescents to go to school at least a few days per week. Besides school closure, other safety measures were introduced as well, such as social distancing and closure of restaurants, cinemas, and sports clubs (The Dutch Government, 2020). Most of these measures can be expected to drastically influence adolescents' lives and particularly their level of social interactions. Adolescence is a life phase in which an increasing amount of time is spent with peers compared with parents (De Goede, Branje, & Meeus, 2009). Experiences with real-life social interactions are thought to be crucial for adolescents to develop social skills and to form high-quality and

stable relationships with others later in life (Crone & Dahl, 2012; Keijsers & Bülow, 2021; Orben, Tomova, & Blakemore, 2020). In addition, a pandemic such as the COVID-19 crisis can be expected to influence adolescents' mental health, increasing negative moods such as anxiety, worry, and loneliness (Ellis, Dumas, & Forbes, 2020; Lee, 2020; Magnuson et al., 2020; de Miranda, da Silva Athanasio, de Sena Oliveira, & Silva, 2020; Shanahan et al., 2020; Tull et al., 2020). It is likely that these social-emotional consequences of school closure influence adolescents' motivation to do school work (Pekrun, 2009). However, few studies have directly compared online and physical (i.e., traditional face-to-face) education during the COVID-19 crisis and its influence on social interactions, mental health (e.g., mood), and academic motivation.

Motivation plays a key role in determining positive life outcomes, for instance by affecting academic achievement (Kriegbaum, Becker, & Spinath, 2018) and by fostering healthier lifestyles and higher levels of psychological well-being (Deci & Ryan, 2008). One influential precursor for motivation is thought to be *relatedness* (Ryan & Deci, 2000). In an academic context, relatedness can be

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explained as the experienced social connectedness with peers, classmates, and other school members. Earlier studies suggest that students who interacted more with peers, generally report higher motivation than students with fewer social interactions (Wentzel, 2017). Recent studies during COVID-19 closure in university students showed that they reported lower levels of academic motivation and lacked social interaction with peers (Meeter et al., 2020 *preprint*) during online education. As such, limited social interactions (i.e., changes in experienced support and conflict) with peers may also relate to changes in adolescents' motivation during online compared with physical schooling.

In addition, adolescents' relationship with their parents is likely to influence academic motivation as well (Wentzel, Russell, & Baker, 2016). Parental relations become less hierarchical and more democratic in adolescence (Doorn et al., 2011), a development that may be helped by repeated conflicts and negative interactions between parents and adolescents. Despite these changes, previous studies indicate that support from parents remains important across adolescence (Armsden & Greenberg, 1987; De Goede et al., 2009). Possibly, positive parental relations may also benefit adolescents' academic motivation through stimulating both *relatedness* and feelings of *competence* and *autonomy* (Ryan & Deci, 2000). However, home schooling may drastically influence the relationship between adolescent and parent. For instance, previous studies have found that, during the lockdown, parents became more controlling, not only introducing new rules on social distancing and hygiene, but also on doing homework (Bülow, Keijsers, Boele, van Roekel, & Denissen, 2021; Keijsers & Bülow, 2021). An open question is in what way social interactions (experienced support and conflict) with parents are related to adolescents' academic motivation during online compared with physical schooling.

School closures during a pandemic such as the COVID-19 crisis may also impact adolescent's mood and mental health. The COVID-19 crisis may lead to an increase in uncertainty, for example, with regard to academic achievements (e.g., possible grade retention, learning losses), cancellations of important events (e.g., graduation ceremonies, holidays), and health-risk-related worry (e.g., for oneself, family, and friends; Magson et al., 2020; The Lancet Child Adolescent Health, 2020). In addition, adolescents' mood and mental health may be particularly negatively affected by school closures due to their heightened need for peer interactions compared with other age groups (Orben et al., 2020).

On the other hand, studies also found decreases in mental health problems and tension and an increase in positive mood (vigor) during the COVID-19 lockdown in adolescents (van de Groep, Zanolie, Green, Sweijen, & Crone, 2020) and adults (Fried, Papanikolaou, & Epskamp, 2020). This may be due to a decrease in regular stressors (e.g., with regard to workload, performance pressure, and bullying; van de Groep et al., 2020; UNICEF Nederland, 2020). As mood is thought to affect academic motivation (e.g., Pekrun, 2009), it is particularly prominent to understand the relationships between emotional well-being and academic motivation in light of the current COVID-19 crisis.

Finally, although academic motivation may change from day to day, there are also more stable differences in what motivates individuals in general, and adolescents may be motivated to do their schoolwork for different reasons. A typical distinction in trait-level motivation is between autonomous and controlled motivation. The former relates to individuals with more volitional motives and includes forms of *identified* motivation (i.e., driven by the recognition of the importance of the behavior for one's development), and *intrinsic* motivation (i.e., driven by one's own satisfaction in learning; Ryan & Connell, 1989). In contrast, controlled motivation is characterized by individuals' external motives and includes forms of *extrinsic* motivation (i.e., driven by earning rewards or avoiding punishments) and *introjected* motivation (i.e., driven by avoiding guilt, worry or shame). It is not yet clearly understood which forms of academic motivation are most important for being able to deal with unexpected events that challenge the typical context of learning, such as school closures. Possibly, students who rely more on autonomous motivation are less affected by online learning environments, in which a higher degree of independence and self-determined motivation is required, than students who score higher on controlled motivation (Broadbent & Fuller-Tyszkiewicz, 2018).

The Current Study

Taken together, the aim of this study was, first, to examine to what extent online compared with physical school days during the COVID-19 pandemic influenced adolescents' (12–16 years) academic motivation, social interactions (i.e., support from and conflict with both friends and parents), and mood (positive and negative). Second, we aimed to examine in what way social support and

conflict, mood, and individual differences in academic trait motivation were associated with daily academic motivation in the COVID-19 pandemic during online and physical school days. This study was preregistered on the open science framework (OSF) before the analyses were conducted (see <https://osf.io/dufgk/>). Our deviations from the preregistration are also uploaded on the OSF.

To this end, we used a daily diary method for 20 days, including both online and physical school days, assessing daily mood, daily social support and conflict, and daily academic motivation in 102 high school students. This study was conducted during the first wave of the COVID-19 pandemic, spanning May-June 2020. Over the course of the study, the severity of the COVID-19 crisis decreased and measures were slowly released, which is shown in Figure 1. Figure 1 also denotes the number of online and physical school days that participants experienced during this time period. Whereas most online school days were at the beginning of this study and most physical school days were at the end of this study, the occurrence of the different types of school days was often mixed given that schools only partially reopened. While our analyses focus on a comparison of online and physical school days, we also include the day of study as a continuous variable. This allowed us to examine changes in social interaction, mood, and academic motivation over the

course of the COVID-19 pandemic in this period of time.

First, based on previous findings on the effects of social isolation during the COVID-19 crisis, we expected social support (from parents and friends), positive mood, and academic motivation to be on average lower on online compared with physical school days (Ellis et al., 2020; Magson et al., 2020; Meeter et al., 2020 *preprint*; Orben et al., 2020; Wentzel, 2017; Zaccoletti et al., 2020). Similarly, we expected parental conflict, friend conflict, and negative mood to be on average higher on online compared with physical school days (Ellis et al., 2020; Magson et al., 2020).

Second, based on previous studies on emotional and social factors that affect academic motivation, we expected that adolescents' social interactions and mood would relate to adolescents' daily academic motivation. Particularly, we hypothesized that parental support, friend support, and positive mood would be positively associated with academic motivation. Similarly, we hypothesized that parental conflict, friend conflict, and negative mood would be negatively associated with academic motivation (Pekrun, 2009; Ryan & Deci, 2000; Wentzel et al., 2016). Finally, given the unprecedented nature of the co-occurrence of both physical and online schooling during the COVID-19 crisis, we exploratively examined whether the strength of the relationships between measures of social

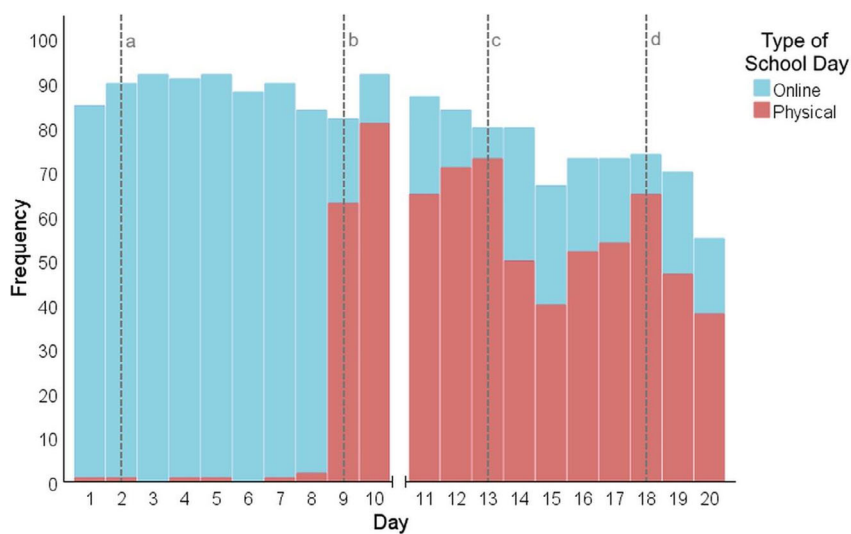


FIGURE 1 Distribution of online and physical school days across the data collection. This figure demonstrates the situational circumstances in the Netherlands at the time of the study, displaying the frequency of participants reporting having online and physical school days on each data collection day, starting exactly 8 weeks after schools were closed. Dotted gray lines indicate the timing of the impactful events that occurred across this data collection period: (a) the announcement of high schools partially reopening, (b) the partial reopening of high schools, (c) the announcement of less COVID-19 restrictions before summer, and (d) the removal of the 1.5 m distance rule among adolescents under the age of 18.

interaction, mood, and motivation differed between online and physical school days. We expected that particularly social support from friends and parents may buffer academic motivation during online compared with physical schooling (Deci & Ryan, 2020; Orben et al., 2020).

Third, we expected that autonomous forms of trait-level academic motivation would relate positively to adolescents' daily reported academic motivation. Also, we hypothesized that autonomous trait-level motivation may buffer changes in adolescents' academic motivation on online versus physical school days (Broadbent & Fuller-Tyszkiewicz, 2018; Hagger et al., 2016).

METHODS

Participants

Participants were recruited from an ongoing longitudinal study and from a database with participants who registered to be approached for new studies. From these databases, only participants attending high school were approached for the current daily diary study. Of the 246 adolescents that were approached, 140 adolescents took part in this study. All procedures were approved by the local ethics committee.

After data collection, participants who completed less than 5 out of the 20 daily diaries (i.e., <25% of diaries; $N = 13$) were excluded because this number was considered to be insufficient to provide a meaningful insight into day-to-day changes in our variables of interest. Additionally, we excluded participants who reported having more free days than school days (i.e., days on which it was not possible to attend classes either online or physically; $N = 3$), who were not aged between 12 and 16 years (i.e., grade 1–4 of secondary school; $N = 1$), and who reported having no or only one online or physical school day ($N = 21$). These criteria were applied in order to obtain a more homogeneous sample representing students who experienced different types of school days (i.e., the combination of online and physical) during the COVID-19 crisis. This resulted in a final sample of 102 participants, who completed between 6 and 20 diaries each, $M = 16.00$, $SD = 3.61$. Fifty-nine (57.8%) participants identified as female, 39 (38.2%) as male, and 4 (3.9%) as other. Participants were between 12 and 16 years of age (11.97–16.06 years) on the first day of the study (May 18, 2020), $M_{\text{age}} = 13.55$, $SD = 0.79$. Participants mostly attended higher and preuniversity

education within the Dutch school system (2% pre-vocational education, 34% higher general education, 63% preuniversity education, and 1% missing). Participants' estimated socioeconomic status (SES) was based on the reported highest level of parental education (e.g., Achterberg, Dobbelaar, Boer, & Crone, 2021). Participants were mostly raised in families with middle to high SES (8% low SES, 55% middle SES, 31% high SES, and 6% missing). Self-reported home situation (e.g., having a place to learn and study, having help with school work available) in this sample is described more in detail in Appendix S1.

All participants, and parents of minors (<16 years), provided informed consent at the beginning of the study. Participants received €0.50 for each completed daily diary that was submitted on time (i.e., on the correct days after 6 p.m. but before 12 p.m. on the next day).

Procedure

The online daily diaries were collected through Qualtrics questionnaires. Adolescents were asked to complete a total of 20 days of daily diaries, divided into two periods of approximately two weeks (10 school days). Data collection days were consecutive days as much as possible, excluding weekends and holidays. On data collection days, adolescents received an SMS with a link to the online questionnaire at approximately 6.30 p.m. and an automatic reminder around 8 p.m. Only diaries that were filled out on the correct days after 6 p.m. but before 12 p.m. on the next day, were considered to be valid. Diaries that were started during this time frame but finalized too late were also considered as valid. The data collection period started on Monday, May 18 (8 weeks after the schools were closed) and ended on Friday, July 3, 2020. A break was included between Thursday, June 4, 2020 and Monday, June 22, 2020. This break in the data collection was incorporated to be able to cover a larger part of the school year with more diverse experiences during the COVID-19 pandemic, while minimizing participants' burden. Also, at the start of this study, it was unsure when and in what way specific COVID-19 measures would be lifted. See Figure 1 for the distribution of the online and physical school days across the data collection period.

Each daily diary had an estimated duration of approximately three minutes and included daily measures of, among others, mood, school activities, academic motivation, social support, and social

conflict. In the daily diaries, adolescents also reported their daily worry about the COVID-19 virus (see Appendix S1 for a breakdown of the worries reported by the participants). Additionally, prior to the data collection period, adolescents were asked to fill out the Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989). This measure was also included at the end of the final daily diary questionnaire. Figure 2 displays the variation over time for each daily measure (Figure 2a–e) and the averaged distribution of the scores of academic trait motivation (Figure 2f) per subscale. Finally, participants also answered some general questions about demographics and their home-schooling situation (see Appendix S1).

Materials

Daily diaries. *Academic motivation.* The daily academic motivation was measured through one item on a 5-point Likert scale that required participants to indicate how motivated they felt that day to do schoolwork (1 = *barely or not at all motivated* to 5 = *extremely motivated*). Only for visualization purposes, this scale was recoded to 0–4.

Type of school day. The variable for the type of school day was computed as a binary daily variable (0 = *online school day*; 1 = *physical school day*) based on a question about daily school activities.

Social support and conflict. Daily parental and friend support and conflict were measured through 4 items on a 5-point Likert scale (1 = *completely disagree* to 5 = *completely agree*) that required participants to indicate to what extent they agreed with the statement about feeling supported that day by either parents or friends (e.g. ‘*Today I felt supported and understood by my parents*’; ‘*Today I felt supported and understood by my friends*’) and about having had a conflict that day with either parents or friends (e.g. ‘*Today I argued with (one of) my parents*’; ‘*Today I argued with (one of) my friends*’). Individual item scores were used as measures for daily parental support, daily friend support, daily parental conflict, and daily friend conflict. Only for visualization purposes, these scales were recoded to 0–4.

Mood. The daily mood was assessed through 15 items on a 9-point scale. The measure consisted of 3 items for each of the 5 subscales: *happiness* (‘glad’, ‘happy’, ‘cheerful’), *vigor* (‘lively’, ‘full of energy’, ‘active’), *anxiety* (‘afraid’, ‘anxious’, ‘worried’), *sadness* (‘sad’, ‘down’, ‘dreary’), and *anger* (‘angry’, ‘cross’, ‘short-tempered’). All items, except

for the 3 items of the *vigor* subscale, were based on the daily mood device (DMD; Hoeksma et al., 2000). Participants had to indicate to what extent, on that day, they experienced each emotion on a 9-point scale (1 = *not glad, not angry, not afraid...* to 9 = *glad, angry, afraid...*). For the *vigor* subscale, three items were taken from the profile of mood states (POMS; Wald & Mellenbergh, 1990) and presented in the same format as the DMD items. Daily mood scores for each of the five subscales were after first recoding the items to obtain a range from 0 to 8. Daily mood scores for each of the five subscales were calculated by taking the sum of the three related items for each subscale, as is done in other studies using the DMD (e.g., Neumann, Van Lier, Frijns, Meeus, & Koot, 2011).

These mood scales can be considered to reflect both positive and negative mood states. The positive and negative mood are typically found to cluster together (Watson & Clark, 1994). To evaluate whether we could combine subscales as well, we conducted a multilevel factor analysis (Huang, 2017) using lavaan (Rosseel, 2012). Our findings show that two-factor model (positive mood and negative mood) was a good fit for the data (TLI = 0.96, CFI = 0.98, RMSEA = 0.08), in which the positive mood scales (happiness, vigor) and negative mood scales (anxiety, sadness, and anger) were combined. The two-factor model resulted in a sufficiently reliable factor for both positive mood (Cronbach’s $\alpha = .83$, $\omega_1 = .84$) and negative mood (Cronbach’s $\alpha = .65$, $\omega_1 = .70$). To confirm these results, we also inspected a one-factor structure of the mood scales and found that a one-factor model for mood was a poor fit to the data (TLI = 0.56, CFI = 0.78, RMSEA = 0.25). Since the reliability of our negative mood scale was somewhat lower than that of the positive mood scale, we explored different three-factor models separating out one of the negative mood scales (anger, anxiety, or sadness). None of these comparisons significantly improved reliability. In the context of parsimony, we, therefore, decided to limit the number of predictors and to maintain our two-factor model.

Intra-class correlations. For each daily diary measure, we assessed intra-class correlation coefficients (ICCs; see Appendix S2). ICC values were computed by estimating a null model including a random intercept for each participant. Next, the variance of the intercept was divided by the sum of the variance in intercept and residual variance. Higher ICC values reflect a more stable measurement between time points. ICCs for parental

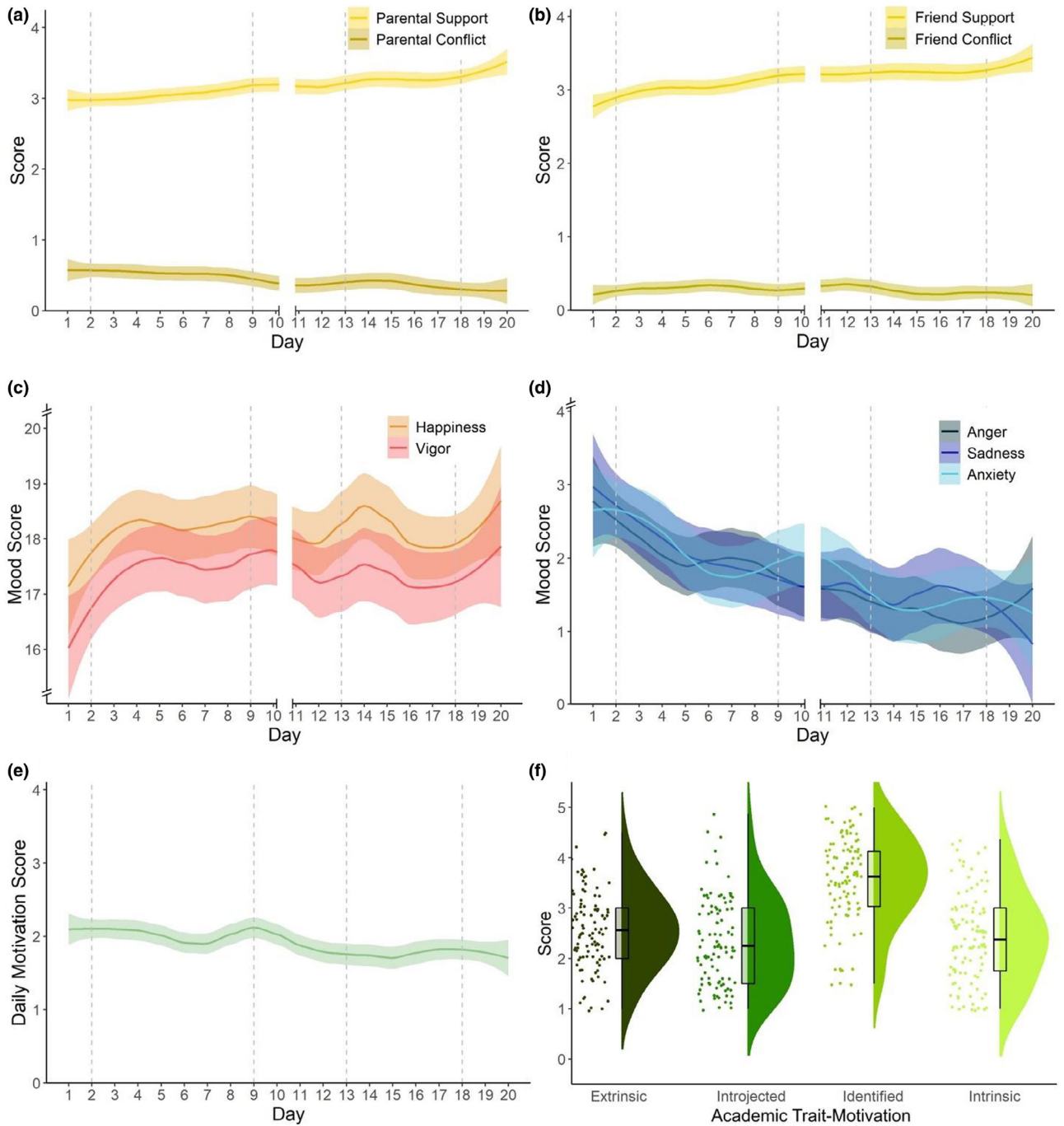


FIGURE 2 Changes in social interactions, mood, and academic motivation over time and distribution of trait-level academic motivation scores. This figure demonstrates the changes over the days of the study in (a) parental support and conflict, (b) friend support and conflict, (c) positive mood scales, (d) negative mood scales, and (e) daily academic motivation, as well as displaying (f) the distribution of scores of academic trait motivation as measured with the SRQ-A (using R-code from Allen et al., 2021). Panels a–e were created with the ggplot2 R-package (Wickham, 2016), and a loess span parameter of 0.4 was used to improve comprehensibility of the figure. The light gray dotted lines (in a–e) refer to the societal events as displayed in Figure 1.

conflict, friend conflict, and daily academic motivation were lowest (.27 –.34), meaning that a larger part of the variance in these variables is potentially

explainable by situational characteristics (i.e., within-subject effects). Other ICCs ranged between .45 and .66, indicating a larger part of the variance

in these variables is explainable by between-subject individual differences.

Questionnaire. *Academic trait motivation.* In addition to the daily diary measures, we administered a questionnaire on academic trait motivation. Academic trait motivation was assessed with the validated Academic Self-Regulation Questionnaire (SRQ-A; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009), which is an adapted version of the Self-Regulation Questionnaire (Ryan & Connell, 1989). The SRQ-A consists of 16 items on a 5-point Likert scale (1 = *completely disagree* to 5 = *completely agree*). Each item reflects a possible reason for which *in general* one could do schoolwork. These items can be subdivided into four subscales of academic motivation: *intrinsic*, *identified*, *introjected*, and *extrinsic* motivation, in which the former two (intrinsic and identified) relate to more autonomous academic motivation and the latter (introjected and extrinsic) more to controlled academic motivation. Autonomous motivation stems from volitional motives (e.g., personal interest), whereas controlled motivation is characterized by an external perceived locus of causality (e.g., pressure from parents; Vansteenkiste et al., 2009). An example item of the introjected subscale is 'I am studying because others (parents, friends, etc.) oblige me to.' Each of the four subscales consists of 4 items that are averaged. Most participants ($N = 80$) filled out the SRQ-A twice (once at the beginning, T1, and once at the end of the study, T2). The subscale scores at T1 all showed moderate-to-strong correlations with the corresponding subscales at T2, $r > .51$, $p < .001$. Reliability of the subscales was found to be good for both T1 and T2, with Cronbach's α 's ranging between .772 and .923. The average of T1 and T2 on each subscale of the SRQ-A ($N = 80$), or the single score ($N = 22$) was taken, as an individual difference measure of trait-level academic motivation.

Covariates. *Age.* As changes in our measures of interest may be subjected to age-related differences, age on the first day of the daily diary study was included as a covariate in all analyses.

Day. As academic motivation is expected to change over the course of the school year (Corpus, McClintic-Gilbert, & Hayenga, 2009; Maulana, Opdenakker, & Bosker, 2016; Opdenakker, Maulana, & den Brok, 2012), the day of assessment (1–20) was used as a covariate in all analyses to account for changes in academic motivation and other measures of interest (mood, social support,

and conflict) over time. For each dependent measure (see Figure 2a–e), we assessed whether adding a nonlinear change across time (using a linear and quadratic polynomial) improved model fit, as evaluated by a log-likelihood ratio test.

Gender. Finally, gender differences may occur in our measures of interest, including academic motivation (e.g., Bugler, McGeown, & St Clair-Thompson, 2015). Therefore, we assessed for each dependent measure (see Figure 2a–e) whether adding gender further improved model fit, as evaluated by a log-likelihood ratio test.

ANALYSIS PLAN

For all our research questions, we used linear mixed models (LMMs) as implemented in the *nlme* package (Pinheiro et al., 2017) in R version 3.6.3 (R Core Team, 2020), using a first-order continuous-time autoregressive covariance structure (corCAR1). In these models, we included a random intercept varying over participants, and random slopes (varying over participants) for all our fixed (main) effects of interest and covariates (where appropriate). To ease interpretation, predictors were grand-mean centered and scaled, where applicable. p Values were computed using the ANOVA() function from the *car* package (Fox & Weisberg, 2019) using a Wald χ^2 . All models were fitted with maximum likelihood. Based on the number of LMMs we performed, we used a Bonferroni correction adjusting for correlating variables (Quantitativeskills; e.g., van de Groep et al., 2020). We performed nine LMMs, in which our dependent variables had an average correlation of .38, resulting in an adjusted significance level of $\alpha = .013$.

First, we examined whether adolescents' social interactions (i.e., parental support, parental conflict, friend support, and friend conflict), mood (i.e., positive mood and negative mood), and academic motivation differed between online and physical school days. In addition, we examined whether these measures of interest changed during the course of the daily diary study. On the best fitting model, we examined whether nonlinear changes across days of assessment improved model fit significantly (i.e., including a linear and quadratic polynomial). Improvements in model fits were assessed with a log-likelihood ratio test. Thus, in separate LMMs (one per dependent variable), we included the type of school day (online and physical), day of assessment (1–20; linear polynomial), and age (linear) as fixed main effects. In addition,

we tested whether adding gender further improved model fit. Gender did not significantly improve model fit in any of these models.

Second, to examine to what extent daily social interactions with parents and friends and self-reported positive and negative mood were associated with adolescents' academic motivation on online and physical school days, we used a LMM with daily academic motivation as the dependent variable. In this model, we aimed to examine the relation of within-subject (i.e., state or situational deviations from each participant's mean) and between-subjects effects (i.e., the trait or stable component of this participant) of daily assessed variables to daily academic motivation. Therefore, we calculated a person-mean centered variable (examining state-effects on daily academic motivation) and a variable representing each participant's mean (examining between-subject effects on daily academic motivation) for parental support, parental conflict, friend support, friend conflict, positive mood, and negative mood. The type of school day (online and physical) and all interactions of the predictors of interest with the type of school day were included in the model. In addition, age (linear) and day of assessment (1–20; linear polynomial) were included as fixed main effects.

Third, to examine whether subscales academic trait motivation were associated with daily academic motivation on online and physical school days, we performed a final LMM. Fixed effects included the different subscales of academic motivation (intrinsic, identified, introjected, and extrinsic) as measured with the SRQ-A, type of school day (online and physical), and all interactions between the type of school day (online and physical) and participants' trait-level academic motivation. Age (linear) and day of assessment (1–20; linear polynomial) were included as fixed main effects.

The complex random effect structures of these models may lead to convergence warnings in *nlme*. In case the model did not converge, we tried using a different optimizer ('optim' instead of the default 'nlminb'). The multilevel notation of the different models is included in Appendix S3. The R model code for all LMMs is uploaded on our OSF page.

RESULTS

Changes in Social Interactions, Mood and Motivation

First, we examined whether daily academic motivation, social interactions (support and conflict),

and mood differed between physical and online school days. As expected, adolescents reported higher levels of academic motivation on physical compared with online school days ($b = 0.10$, $\chi(1) = 7.57$, $p = .006$; see Figure 3a and Appendix S4). However, none of the other measures of interest (i.e., support, conflict, and mood) differed significantly between physical versus online school days.

In addition, we examined changes across study duration in academic motivation, social interaction, and reported positive and negative mood as presented in Figure 2. As the daily diary study progressed, participants reported a linear increase in parental support ($b = 4.46$, $\chi(1) = 19.64$, $p < .001$; Figure 2a), a nonlinear increase in friend support (linear: $b = 5.60$, quadratic: $b = -1.95$, $\chi(2) = 27.57$, $p < .001$; Figure 2b), a nonlinear decrease in negative mood (linear: $b = -13.42$, quadratic: $b = 5.94$, $\chi(2) = 20.23$, $p < .001$; Figure 2d), and a linear decrease in academic motivation ($b = -7.80$, $\chi(1) = 29.13$, $p < .001$; Figure 2e). Positive mood, friend conflict, and parental conflict did not change significantly across days.

Age was not significantly related to any of the dependent variables when correcting for multiple comparisons. Full model output is displayed in Appendix S4. Distribution of all dependent variables on online and physical school days is displayed in Appendix S5.

Daily Associations between Academic motivation and Social Interactions and Mood

Next, we examined whether within-subject (state) and between-subject (trait) differences in social interactions and mood related to adolescents' academic motivation. All significant associations are displayed in Figure 3. The full model output is displayed in Appendix S4.

The within-subject effects allow to examine relations on a day-to-day basis, whereas between-subject effects allow to examine average individual differences. Adolescents' daily positive mood (within-subject) was found to be positively associated with daily reported academic motivation ($b = 0.16$, $\chi(1) = 33.65$, $p < .001$; Figure 3b). This indicated that adolescents reported higher levels of academic motivation on days when their positive mood was higher than average. No other within-subject variables were associated with daily academic motivation.

In addition, adolescents' average positive mood ($b = 0.25$, $\chi(1) = 15.17$, $p < .001$; Figure 3c) and average friend conflict ($b = -0.25$, $\chi(1) = 8.91$,

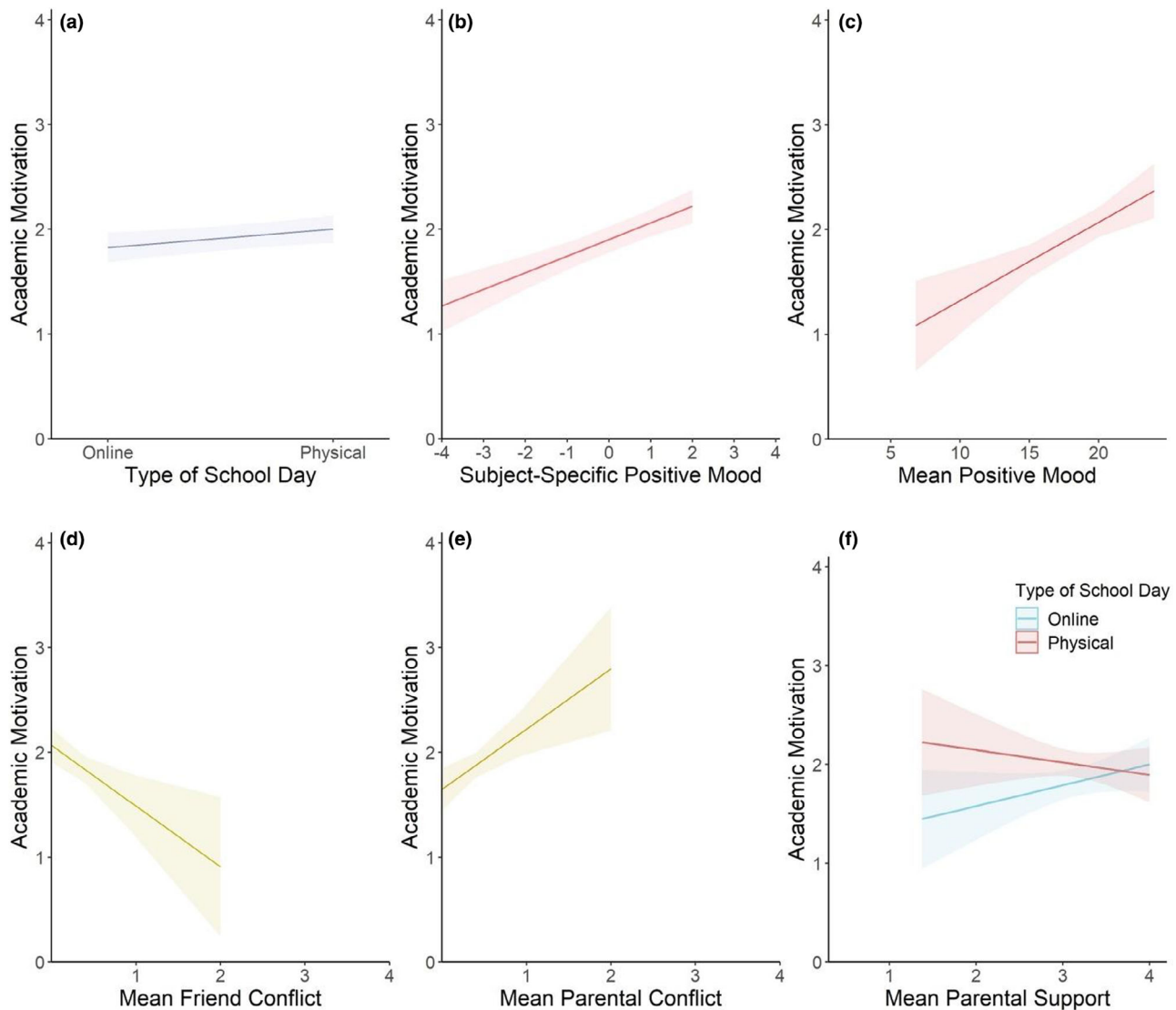


FIGURE 3 Relationship between daily academic motivation and type of school day, mood, and social interactions. This figure demonstrates the relationship between daily academic motivation and (a) type of school day (physical or online), (b) within-subject (state) positive mood, (c) between-subjects (trait) positive mood, (d) between-subjects (trait) parental conflict, (e) between-subjects (trait) friend conflict, and (f) between-subjects (trait) parental support in interaction with the type of school day (online vs physical). Graphs were created with the *ggplot2* (Wickham, 2016) and *effects* (Fox & Weisberg, 2019) R-packages.

$p = .003$; Figure 3d) related, respectively, positively and negatively to adolescent's academic motivation. This indicated that adolescents with higher levels of positive mood and lower levels of friend conflict reported higher levels of motivation for school. Unexpectedly, higher levels of parental conflict were also positively related to academic motivation ($b = 0.28$, $\chi(1) = 9.92$, $p = .002$; Figure 3e).

As seen in the previous analysis, academic motivation was higher on physical school days as compared to online school days ($b = 0.09$, $\chi(1) = 6.3$, $p = .012$; Figure 3a). Interestingly, adolescents'

reported parental support significantly interacted with the type of school day ($b = -0.10$, $\chi(2) = 7.29$, $p = .007$; Figure 3f). This interaction indicated that the relation between parental support and academic motivation differed for online and physical school days. Follow-up tests showed that adolescents with low levels of parental support (-1 SD) reported lower academic motivation on online compared with physical school days ($b = 0.22$, $\chi(1) = 7.2$, $p = .007$). For adolescents with relatively high levels of parental support ($+1$ SD), motivation for school did not differ between online and

physical school days ($p = .373$). No other variables significantly interacted with the type of school day.

Individual Differences in Academic Trait Motivation and the effect of School Closure

Finally, we examined the relation between adolescents' trait-levels of academic motivation as measured with the SRQ-A and reported daily academic motivation. We observed that higher identified (e.g., recognizing the importance of learning) motivation ($b = 0.19$, $\chi(1) = 6.64$, $p = .010$) was associated with higher daily academic motivation. This relationship did not differ between online and physical school days. The associations between the other subscales of the SRQ-A (extrinsic, introjected, and intrinsic) were not significant or did not survive multiple comparison correction. The full model output is displayed in Appendix S4.

DISCUSSION

The aim of this study was to investigate (1) to what extent daily social support and conflict, daily mood, and academic motivation of Dutch adolescents (12–16 years) differed between online and physical school days during the first wave of the COVID-19 pandemic, and (2) which factors may buffer changes in adolescents' academic motivation during this pandemic. For a total of 20 days during the first months of the COVID-19 pandemic crisis (May–June 2020), we assessed adolescents' social interactions (support and conflict), mood, and academic motivation on both online school days and physical school days by means of a daily diary method.

We observed several key findings. First, as expected, academic motivation was found to be higher on physical compared with online school days. More continuous changes over the course of this study were observed in increasing parental and friend support, as well as in decreasing negative mood. Second, we found that both within-subjects and between-subject differences in positive mood were positively related to adolescents' academic motivation. Individual differences in reported conflict related both negatively (friends) and positively (parents) to academic motivation. Individual differences in parental support also related to academic motivation and interacted with the type of school day. Specifically, adolescents with lower levels of parental support reported lower academic motivation on online compared with physical school days, a pattern that was not observed for adolescents with higher levels of

parental support. Finally, daily academic motivation was positively associated with trait levels of autonomous (identified) academic motivation. However, in contrast to our expectations, this relation did not differ between physical and online school days. The discussion is organized alongside these main findings.

Changes in Academic Motivation

As expected, we observed that adolescents' academic motivation was lower on online compared with physical school days. In addition, we observed that adolescents' academic motivation decreased over the course of our study. These findings seem to suggest that both societal, or time-related changes, and daily differences in the type of school attendance are associated with academic motivation. Previous studies in 'non-COVID' times have shown that motivation of high school students declines during the school year (Corpus et al., 2009; Maulana et al., 2016; Opdenakker et al., 2012), which may be reflected in our results as well. Nonetheless, decreased academic motivation on online school days may seriously affect adolescents' learning. That is, schools and teachers have been struggling to adopt online-based solutions for instruction (Kuhfeld et al., 2020), and data gathered so far suggest a drop in time spent learning during online schooling in various countries (Grätz & Lipps, 2021; Grewenig, Lergetporer, Werner, Woessmann, & Zierow, 2020) and learning losses during school closure (Engzell, Frey, & Verhagen, 2021). A recent analysis by Engzell et al., (2021) indicated that across different school subjects (math, spelling, and reading), primary school children learned less during lockdown than in a typical year. Adolescents participating in our study also expressed worries of falling behind on school work (see Appendix S1), and recent studies suggest that these effects may be even larger for students from disadvantageous home situations (Bol, 2020 *preprint*; Engzell et al., 2021; Ravens-Sieberer et al., 2021). Taken together, lower academic motivation may be a risk marker for substantial learning losses during school closures. Future work should, therefore, examine whether the decrease in academic motivation on online compared with physical school days also related to decreases in learning results.

Changes in Social Interactions and Mood

The COVID-19 crisis is an unprecedented experience in which schools closure resulted in many

changes in adolescents' lives. Besides possible changes in academic motivation, school closure may be related to higher levels of social isolation and to changes in mental well-being, as indicated by reported mood.

In contrast to our expectations, we observed no direct effect of having a physical or online school day on social support and reported positive or negative mood. However, when assessing changes over time (i.e., day of assessment), we observed that over the course of our daily diary study levels of social support from parents and friends increased, while levels of negative mood, including anxiety, depression, and anger, decreased over time. Possibly, these effects of time indicate that societal changes, including the reopening of schools, contributed to experienced friend and parental support and general well-being (mood) more prominently than the daily experience of an online versus physical school day. That is, at the beginning of the daily diary study, in May 2020, COVID-19 restrictions were quite severe, and adolescents were prescribed to stay at home, which may have led to feelings of social isolation. Over the following weeks (see Figure 1), measures were slowly released, and adolescents were again allowed to physically go to school for some days per week and to physically meet up with friends. The positive developments of the COVID-19 pandemic in this phase (May-June 2020) and the slow return to normality may have reduced feelings of anxiety, depression, and anger, and increased feelings of social support.

The quick changes in mood and social support at the beginning of this daily diary study (see Figure 2) over time may indicate that adolescents' experienced levels of social support and mood, may quickly bounce back when unfavorable societal restrictions are lifted. However, the potential long-term psychological stress associated with the continuing COVID-19 pandemic is yet unknown and warrants further investigations of mood and internalizing and externalizing symptoms over longer periods of time (Orben et al., 2020; The Lancet Child Adolescent Health, 2020). Adolescence may be a particular sensitive period for building social relations, as well as for the development of psychological disorders (Kessler et al., 2005). Taken together, future studies need to consider long-term impact of the COVID-19 pandemic on adolescent mental health across both younger (Asscheman, Zanolie, Bexkens, & Bos, 2020 *preprint*) and older (Stevens et al., *preprint*) adolescents.

Associations between Daily Social Interactions, Mood, and Academic Motivation

Our second research question focused on the relation between social interactions and mood with academic motivation during online and physical school days. As expected, we observed that positive mood (both within- and between-subject) was positively related to academic motivation. In other words, day-to-day variations in individuals' positive mood were associated with day-to-day variations in academic motivation, and adolescents that on average reported higher positive mood levels compared with others, were generally more motivated for school. Additionally, adolescents who reported lower levels of friend conflict (between-subject) reported higher levels of academic motivation. In contrast to our expectations, we observed that higher levels of parental conflict (between-subject) related to higher levels of reported academic motivation. Although the effects of conflict in social interactions are of interest to understanding academic motivation, the overall levels of reported friend and parental conflict were low in this sample, and future research is necessary to replicate this finding in a more diverse population. Additionally, future research should disentangle when and which type of conflict may be particularly harmful to academic motivation, which could shed light on the unexpected relation between parental conflict and adolescents' academic motivation.

Interestingly, only parental support affected the relationship between academic motivation and type of school day (online versus physical). That is, adolescents that reported lower levels of parental support also reported lower academic motivation on online versus physical school days. In contrast, for adolescents with higher levels of parental support, the difference in academic motivation between online and physical school days was less prominent. This finding suggests a buffering factor of parental support for online schooling during the COVID-19 crisis, which was overall associated with lower levels of motivation. Speculatively, adolescents' parental support is especially important in online learning environments, as parental help with school work may stimulate adolescents' feelings of relatedness and competence in their school work. In this way, parental support may directly benefit aspects that are thought to underlie motivation (i.e., relatedness and competence; Ryan & Deci, 2000). On the other hand, parental support may also influence academic motivation indirectly, for instance through effects on mental health and

mood. That is, parental support may evoke positive mood and, in this way, improve academic motivation. In this study, we did not investigate mediation or bidirectional effects between measures of social support and mood that are likely to occur (Chung, Flook, & Fuligni, 2011; Timmons & Margolin, 2015). Future studies optimized to examine these lagged and bidirectional effects may include larger sample sizes and specific handling of missing data (e.g., multiple imputation).

Individual Differences in Trait-level Academic Motivation and the Effect of School Closure

Confirming our hypotheses on trait-level academic motivation, we found that adolescents with higher autonomous academic motivation (i.e., who are driven by the recognized importance and personal relevance of learning) reported higher levels of daily academic motivation. When controlling for multiple comparisons, these relations were not observed for intrinsic academic motivation or any of the controlled academic motivation scales. The SRQ-A is a well-validated measure of academic motivation. Most of the subscales of the SRQ-A related to daily academic motivation as expected, although not all these relations survived multiple comparison corrections. Therefore, these findings seem to support the validity and usage of our one-item question in daily asking about experienced daily motivation in general.

In contrast to our expectations, trait-level autonomous or controlled levels of academic motivation did not relate differently to changes in academic motivation on online versus physical school days. Future studies should examine whether possible long-term effects of school closure on daily academic motivation differ between adolescents with different levels of academic trait motivation. Alternatively, other factors, such as the ones we identified here (e.g., parental support), maybe more important in buffering adolescents' daily levels of motivation during the COVID-19 pandemic than their academic trait motivation.

Strengths, Limitations, and Future Directions

This study has several strengths. First, this study was promptly set up when the Dutch government closed schools in March 2020 (The Dutch Government, 2020), allowing to examine the effects of this unprecedented and unexpected crisis already two months after the crisis arose. As a consequence, we were able to compare academic motivation, social

interactions, and mood both over the course of the rapidly changing COVID-19 crisis as by directly comparing online and physical school days, which, to the best of our knowledge, had not yet been examined in other studies. Second, we used daily diary assessments to study the effects of school closure. There were two main advantages of this approach: (a) We reduced the bias that comes with retrospective ratings of emotions and events (Bolger, Davis, & Rafaeli, 2003; Sato & Kawahara, 2011), and (b) we captured day-to-day fluctuations in response to the rapidly developing and unpredictable changes of the COVID-19 crisis. Finally, our study focused on daily variations in academic motivation. While often academic motivation is treated as a stable trait, multiple studies have shown that context considerably affects academic motivation (Martin et al., 2015; Neugebauer, 2013; Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). Future studies should, therefore, take into account that academic motivation is context-dependent.

However, this study also has a few limitations and opens pathways for future research. First, this sample was a convenience sample, which predominantly included adolescents attending higher or pre-university secondary education. Our results may, therefore, not generalize to adolescents in vocational secondary education. Also, some adolescents may be even more affected by school closure due to a lack of home-schooling resources, lower levels of social support, higher levels of social conflict, and lower levels of academic motivation (Ravens-Sieberer et al., 2021; van der Veen & Peetsma, 2009). In our sample, between 85 and 98% of the participants reported usually or always have adequate home-schooling resources, such as an own room and a good Internet connection, at their disposal. This may be related to the fact that participants mainly came from families with middle to high SES. Additionally, our sample reported overall (very) low levels of friend and parental conflict and high levels of friend and parental support (e.g., Figure S2).

Second, due to the study design, we did not have baseline measures of social support, mood, and academic motivation prior to the COVID-19 crisis. Although we controlled for changes over the course of the diary assessments, a baseline measure before the COVID-19 crisis would have helped to disentangle changes resulting from societal changes as a result of the improving COVID-19 crisis from general changes that occur during the (school) year (e.g., Opdenakker et al., 2012). Finally, this study was conducted at the end of the first COVID-19 peak, when the number of daily new COVID-19

cases was considerably lower compared with both earlier and later in the year (Worldometer, 2020). Our results may, therefore, not generalize to the effects of school closure on adolescents at the beginning of the COVID-19 crisis or during the second school closure in December 2020 (The Dutch Government, 2020). Future studies should focus on potential distinct effects of different periods of school closure on academic motivation, social support, social conflict, and mood.

Conclusion

In conclusion, this study identified some critical changes in adolescents' daily experiences following the unprecedented school closure during the COVID-19 crisis. Our results suggest that positive mood and parental support may buffer decreases in adolescents' motivation for school during online school days. Further research is needed to examine long-term effects of school closure on both adolescents' academic motivation and their well-being. Although the difficult decision to close schools helped to limit the spread of COVID-19, the findings of this study shed light on the negative impact of this decision. Since school closure was associated with unfavorable changes in adolescents' feelings of social support, mood, and academic motivation, these possible consequences should not be overlooked when similar decisions about education have to be made in the future.

CONFLICTS OF INTEREST

The authors report no conflict of interest, financial, or otherwise.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Sample characteristics.

Appendix S2. Intra-class correlations.

Appendix S3. Model specifications.

Appendix S4. Summary tables of the Linear Mixed Models.

Appendix S5. Distribution of scores of social interaction, mood, and academic motivation.