College students' motivation and study results after COVID-19 stay-at-home orders

Meeter, M.*, Bele, T., Den Hartogh, C.F., Bakker, T., De Vries, R.E. & Plak, S.

Vrije Universiteit Amsterdam

* m.meeter@vu.nl

Abstract

Due to the COVID-19 pandemic, many institutions of higher education had to close their campuses and shift to online education. Here, we investigate how stay-at-home orders impacted students. We investigated results obtained by 15,125 bachelor students at a large Dutch research university during a semester in which the campus was closed and all education had shifted online. Moreover, we surveyed 166 students of the bachelor of psychology program of the same university. Results showed that students rated online education as less satisfactory than campus-based education, and rated their own motivation as having gone down. This was reflected in a lower time investment: lectures and small-group meetings were attended less frequently, and student estimates of hours studied went down. Lower motivation predicted this drop in effort. Moreover, a drop in motivation was related to fewer credits being obtained during stay-at-home orders. However, on average students reported obtaining slightly more credits than before, which was indeed found in an analysis of administered credits. In a qualitative analysis of student comments, it was found that students missed social interactions, but reported being much more efficient during online education. It is concluded that whereas student satisfaction and motivation dropped during the shift to online education, increased efficiency meant results were not lower than they would normally have been.

Introduction

Following the outbreak of the COVID-19 pandemic, many governments worldwide introduced a lockdown to contain it. This entailed closing most non-essential businesses and venues, and ordering people to stay at home. In most countries this included educational institutions (e.g., Hirsch 2020; Crawford et al., 2020). Universities in the Netherlands and elsewhere were abruptly forced to close their doors. Students and faculty personnel were ordered to stay at home, which meant moving the lectures and other academic activities from physical classrooms to an online environment using videoconferencing. Students had to adapt in a short amount of time to a drastically changed situation. They could not attend physical lectures or study and interact on campus.

Such drastic changes have a major impact on people. It is already clear that sudden stay-at-home orders due to a pandemic like COVID-19 has consequences on people's mental health. For example, Tull et al. (2020) found that being under a stay-at-home order was associated with greater levels of health anxiety, financial worry and loneliness. Similarly, Gonzales-Sanguino et al. (2020) saw an increase of symptoms in depressive, anxiety and post-traumatic stress disorders. These stay-at-home orders also puts a strain on student, peer, and faculty interaction. It is not unlikely that this has consequences for students beyond their mental wellbeing. For example, Goodenow (1993) found that a sense of classroom belonging and teacher support is linked to motivation in early adolescence. This makes it plausible that the consequences of COVID-19 and stay-at-home orders extend to student's motivation and their results as well. To date, there are very few studies of the effects of sudden stay-at-home orders on university students' motivation and results.

The aim of this study then, is to explore the relation between the sudden stay-at-home order on university students' motivation, effort, and results.

Theoretical framework

Motivation is an essential element in academic performance. High levels of motivation are associated with good academic performance (Kusurkar, Ten Cate, Vos, Westers & Croiset, 2013). Highly motivated students tend to expend more effort in learning, leading to better results (e.g., Gottfried, Marcoulidis, Gottfried & Oliver, 2013). Several factors in turn underlie high motivation. In an influential model of student dropout, Tinto (1975) suggested that academic integration, an attachment of the student to intellectual life of the college or university, is a crucial factor in student retention. That is, the more students feel their intellectual needs are met at college, and the more they identify with it, the more likely students will persist (Tinto, 1975, see Tinto 1998).

A second factor in Tinto's model is social integration, the social relations students have with peers and faculty members. Without social integration, students find it more challenging to persist in their studies. This is in line with self-determination theory, which posits that the need for relatedness is a key precursor of motivation (Deci & Ryan, 2000). Indeed, students

who interact more with their peers and faculty members generally report higher satisfaction and motivation than students who have less social interaction (Wentzel 2017, Trollian et al., 2016).

Stay-at-home orders can be expected to strongly affect feelings of social integration, since such orders lead to a strong reduction in social interactions with fellow students and faculty members. This leads us to hypothesize that students with higher levels of social integration will report a decrease in their academic motivation after stay-at-home orders. This may be especially the case for students who score high on the character trait extraversion, who tend to look forward to social interaction (e.g., Duffy et al, 2018). Social interaction may have partly persisted online, though. Studies on Massive Open Online Courses (MOOCs) have demonstrated that frequent online social interaction in the course is related to learning engagement and MOOC completion (Fang et al, 2019; Sunar et al., 2016). We therefore hypothesized that continuing social interaction during online educational activities may buffer against a drop in motivation and effort.

There is less reason to believe that students' experience of academic integration would change due to a stay-at-home situation. Unlike social interaction, intellectual exchange may still occur, albeit via different communication methods, and therefore identification may remain unchanged. High levels of academic integration, on the other hand, should continue to support academic persistence, even during a stay-at-home situation.

The decrease in social interaction was not the only change to occur with the stay-at-home orders. The closure of university campuses also meant that education moved to a model of distance education where students have to work more on their own, and plan and pace themselves to a larger extent (Bol & Garner, 2011). How much of a burden this is may depend on the resources available to students. Shapiro et al. (2017) examined experiences of students in MOOCs, and identified lack of resources, such as poor internet connectivity, as barriers to a positive MOOC experience. Similarly, whether students' resources and facilities are suited for online education may play an important role in students' motivation and effort after the stay-at-home orders.

Moreover, working at home may also place new demands on the skills of students. Students with better self-regulation skills generally outperform their peers who possess less self-regulation skills (for review see Duckworth, 2019). Such skills may be even more crucial in distance education (Bol & Garner, 2011) and thus in the stay-at-home situation. In particular, academic procrastination, which impairs academic performance in normal college settings (e.g., Balkis, 2013; Kim & Seo, 2015), may be more strongly related to performance during closure of universities, in which normal routines of lectures and seminars stop being a trigger for study activities, thus leading to more opportunities for procrastination. Furthermore, conscientiousness, which is a personality trait often found to predict academic performance (e.g., Furnham, Nuygards, & Chamorro-Premuzic, 2013) may be more crucial in situations that require working alone rather than studying on campus.

In summary, we believe that several factors may lead to a drop in academic motivation of university students after stay-at-home orders.

- Most notably, the drop in social interaction may lead students relying on social integration for their motivation to experience lower motivation after stay-at-home orders. The same may hold for students scoring high on extraversion.
- We expect this lower motivation to translate into fewer hours spent studying and lower academic results.
- Moreover, conscientiousness and procrastination may affect effort more strongly after stay-at-home orders than before. Since low conscientiousness and high tendency to procrastinate may make studying at home a more frustrating experience, we also expect them to lead to a drop in motivation.
- Experiences during the lockdown, notably the social interaction that remains online and the resources available to a student for online learning, may also affect motivation.

The current study

Here, we investigated these hypotheses in a sample of graduate bachelor of psychology students of a large Dutch research university. Students were asked to rate their motivation, effort, and academic results during the stay-at-home orders, and compare them to the pre-COVID-19 period. We then investigated whether these ratings were related to measures of social and academic integration, procrastination, and personality traits. We analyzed comments provided by students to find factors that they linked to motivation or demotivation during online learning. In addition, we checked using administrative data whether results of all bachelor students at the same university had suffered from lower progress through their program during the crisis.

Methods

Participants

Students from three bachelor years of psychology were contacted. All 933 first-year, 244 of 503 second-year and 149 of 384 third-year bachelor of psychology students were contacted (for second- and t hird-year students, only those were contacted that had given prior consent to follow-up studies using their first-year personality data). A total of 166 students participated (75% female, mean age 22). Of these, 88 were first-year students, 52 second-year and 16 third-year participated in the study. Participation of first-year students was incentivized with course credit. This incentive was not available for later years – for these we organized a raffle for online store credit. All gave their informed consent before participating. The survey was evaluated by a local ethics committee, while the analysis of administrative data conformed to the Code of Conduct set by the university board for such analyses. The study was performed in accordance with the Helsinki Declaration.

Materials

The following standardized questionnaires were used in the study and all were administered via internet.

- The HEXACO-PI-R is a personality inventory consisting of 208 questions, measuring the traits that form the HEXACO acronym, i.e., Honesty-humility, Emotionality, eXtraversion, Agreeableness, Conscientiousness, and Openness to experience, each with 32 items (plus 16 additional items that measure two interstitial traits, i.e., Altruism and Proactivity; De Vries et al., 2016; Lee & Ashton, 2006).
- The PASS (Solomon & Rothblum, 1984) is a 12-question procrastination questionnaire.
- The Track and Field Social and Academic Integration Survey (TFSAIS; Lyons, 2007) is a 30-question inventory of experienced social and academic integration.

The Motivated strategies for learning questionnaire (MSLQ, Pintrich & de Groot, 1990) was administered during the follow-up survey, but will not be reported since only a minority participated in this follow-up survey.

A further self-developed questionnaire of COVID-19 related experiences was used to measure

- academic results so far, and expectations for results during online education
- retrospective motivation and effort during standard university education
- motivation and effort expended during the experienced online education
- experiences within online education regarding online interaction and camera use
- facilities available to the student for online education

To be able to summarize these items in scales capturing online interaction, online camera use, and home facilities for online education, we performed a principal component analysis (PCA) on each set of items. Results are reported in Appendix 2.

The questionnaire also contained two open-ended questions: "What are for you motivating and demotivating elements in online education?" and "What changes could psychology make to make the online program work better for you?"

Procedure

All participants had filled out the HEXACO personality inventory for a first-year course. After completing the HEXACO, students were asked whether they could be contacted for further research using HEXACO scores. For first-year students, HEXACO administration occurred in the same weeks with the current study, while for second- and third-year students it had occurred in their first year. Students had to give their consent twice for HEXACO data to be used in this study: once during the informed consent procedure of the current study and once at the end of HEXACO administration. For second- and third-year students, only those that had already consented at the end of HEXACO administration were contacted.

Students were sent an information email and asked to click on a link if they wanted to participate. The survey was open from April 29 to May 15. They were then led to an informed consent form that they could read at their ease. At the end of the form they were asked for their consent with participation, and separately again for use of their HEXACO scores. If they then consented to participation, they were further led to a Qualtrics questionnaire that contained, in order, the COVID-19 related experiences questionnaire, the TFSAIS and PASS. At the end of the questionnaire, students were asked whether they would like to participate in a follow-up measurement a month later, and were asked to leave their university ID code so that HEXACO scores could be linked to their other data, and so that credits could be handed out (giving student ID was not mandatory).

In the follow-up survey, the COVID-19 related experiences questionnaire and the MSLQ were presented to the participants. The follow-up survey was accessible from June 22 to July 6 (which coincided with the end of the semester). Just 46 participants also responded to the follow-up questionnaire. We therefore only report on the data from this follow-up questionnaire in our checks on the consistency of the responses.

Statistical analyses of questionnaire data

Three dependent variables were of main interest:

- The difference between self-reported motivation during online education and retrospective motivation during preceding education.
- The difference between self-reported effort during online education and retrospective motivation during preceding standard education
- Self-reported credits obtained during online education

For all three, we fit a linear model with semester (pre- and post-Corona) as repeated factor and as predictors HEXACO trait scores, PASS score, TFSAIS subscale scores (where we took together interactions with students and faculty as *social integration*, and *faculty concern* and *academic development* as *academic integration*), and experiences in online education. Here, taking into account our scale analyses (reported in Appendix 2), we used online interaction, having cameras on during online lectures (camera use), and two separate items ('quiet place to study' and 'good internet') as predictors. Moreover, we used motivation and motivation drop (post minus pre) as predictors for effort and results. We tested the following hypotheses:

- For *motivation,* we expected main effects of conscientiousness, academic and social integration. We expected an *interaction with semester* for social integration, extraversion, online interaction, home facilities and PASS procrastination scores. These interactions would reflect a drop in motivation in the online situation because of a drop of social interactions (social integration, extraversion, online interaction, camera use), and a stronger reliance on self-regulated learning the online situation (home facilities and procrastination).
- For *effort*, we expected main effects of conscientiousness, of pre-COVID-19 motivation, of social and academic integration, and of procrastination (with negative

sign). We expected an *interaction with semester* for motivation drop, social integration, extraversion, experiences of online interaction, home facilities and procrastination. These interactions would reflect a drop in effort in the online situation because of a drop of social interactions (social integration, extraversion, experiences of online interaction), and a stronger reliance on self-regulated learning in the online situation (home facilities and procrastination).

- For *self-reported credits obtained*, we expected main effects of effort and of motivation, and an *interaction with semester* for motivation drop and the effort drop. We thus expected the switch to online learning to affect results through effects on motivation and effort.

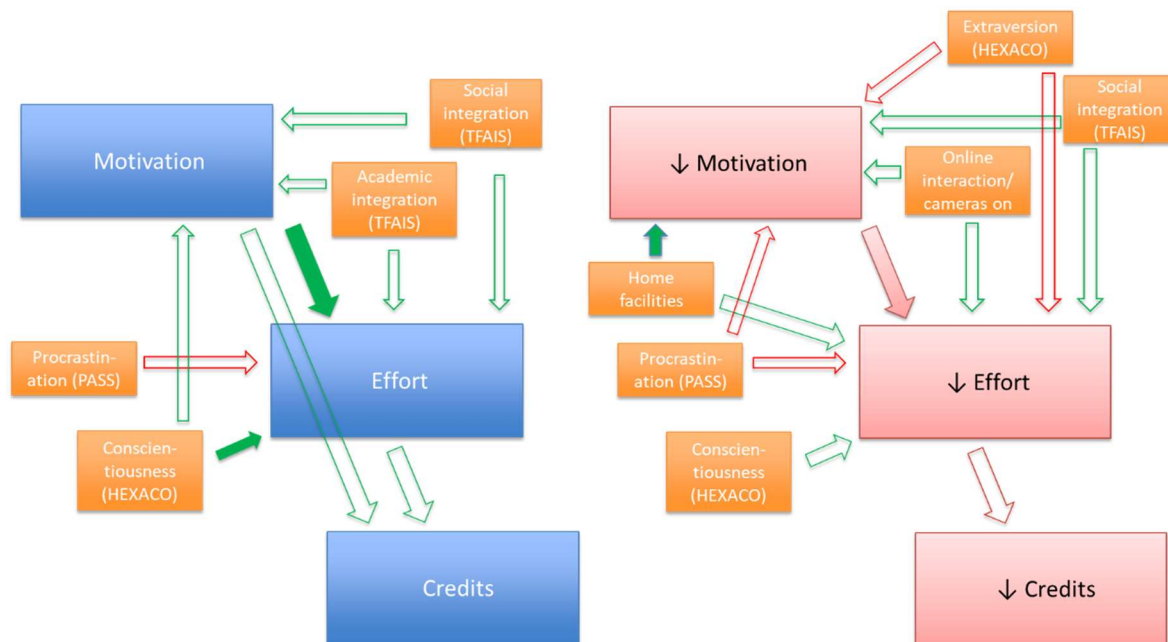Figure 1 presents a summary of all hypotheses.

Figure 1: Visualization of the hypotheses tested. Left: how included variables are hypothesized to affect motivation, effort and obtained credits. Right: how the same variables are hypothesized to affect changes in motivation, effort and credits during stay-at-home orders. Abbreviations denote instruments used to measure particular variables. Green arrows denote positive relations, red ones negative relations. Full-color arrows reflect relations that were supported by the data, outlined ones relations that did not receive support from the results.

Power analysis

For simplicity, a power analysis was performed using an ANOVA model with a within-between factor interaction, an effect size of 0.15, a power of 80%, a .2 correlation between measurements, and an alpha of 0.05. This yielded that at least 142 participants were required for the study.

Qualitative analysis of open-ended questions

Most students volunteered one or more comments to the two open questions, resulting in 435 codable comments from 137 students. To analyze these, two research assistants coded the first thirty via open coding, and then coalescing around a common set of codes. This set of 14 codes was assessed by one author (MM), who checked the codes and how they were applied to the set of 30 comments. After agreement, the research assistants each independently coded 276 comments, of which 148 overlapped. The overlapping comments were used to compute interrater agreement. Cohen's kappa was computed to be 0.95, which signifies very high agreement.

Analysis of administrative data

In parallel, we performed an analysis of registered student results for all bachelor's programs of Vrije Universiteit Amsterdam. Data on the progress of 15,125 bachelor students in the spring semester of 2020 was compared to progress of 36,832 students in the spring semesters of 2017, 2018 and 2019. Spring semester at Vrije Universiteit runs from February to June, with exams scheduled at the end of March, May and June. All courses in the spring semester of 2020 were thus affected by the stay-at-home orders, which started on March 12 in the Netherlands. We performed a regression analysis with second-semester course grades (i.e., scores on individual course exams) as dependent measure, and as predictors:

- first-semester GPA,
- student controls; known student-level predictors of student progress (prior qualifications, age, gender, and early vs late registration for the program),
- Whether stay-at-home orders were in place (coded 1 for 2020, 0 for the other years). We refer to this predictor as *COVID-19 semester*.

We tested four models. Model 1 included just first-semester GPA and *COVID-19 semester* as predictors. Model 2 added an interaction term between these two. Model 3 included the student-controls but no interactions, and model 4 included both student controls and interactions with *COVID-19 semester*. A total of 190421 exam scores was entered in the analysis.

Results

Online education: Exploring student attendance and satisfaction

Figure 1 shows the means to questions related to meetings attended, satisfaction with meetings, motivation, hours worked in addition to attending meetings, and credits that they expected to obtain. During the COVID-19 crisis, students attended fewer small-group meetings, $t(160) = 7.51$, p<.001, were less satisfied with lectures, $t(150) = 6.51$, p<.001, and with small-group meetings, $t(150) = 3.31$, p = .001, felt less motivated, $t(150) = 8.25$, p<.001,

were less active in small-group meetings, $t(150) = 5.50$, p<.001 and spent fewer hours studying, $t(148) = 4.00$, p<.001. There was a trend towards fewer lectures attended, $t(160) = 1.88$, p = .062. However, they expected to obtain more course credits during the COVID-19 crisis than the semester before, $t(148) = 3.00$, p = .003.
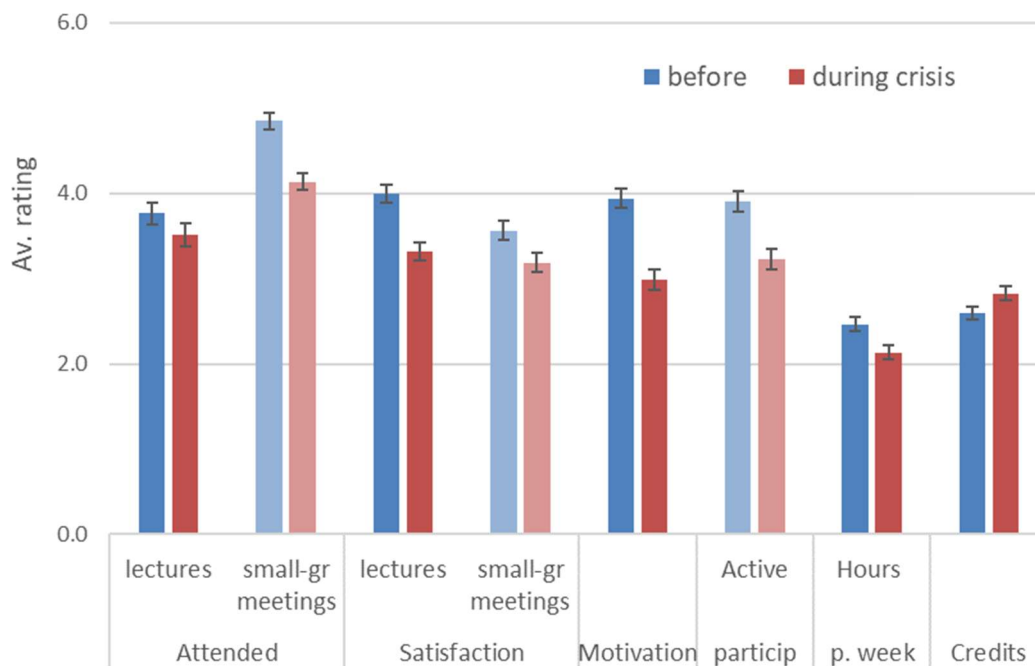

Figure 2 Average rating (on a scale from 1 to 7) for lectures and small-group meetings attended, satisfaction with lectures and small-group meetings, self-rated academic motivation, active participation in small-group meetings, hours worked in addition to attending meetings, and expectation for attained credits, all assessed for the time period during the COVID-19 crisis and retrospectively the period before. Error bars give the standard error for the difference *between the mean before and during the crisis (i.e., the within-participant difference score).*

Measurement checks

To ascertain that responses from students were consistent, we compared expected credits in the second semester reported in the first questionnaire with those reported in the follow-up questionnaire, when students had already obtained most credits. There was no significant difference (mean 0.065 higher, $t(45) = 0.573$, $p = .569$). The two credit estimates were correlated, although imperfectly so ($r = 0.311$, $p = .035$). To check the reliability and stability of the retrospective measurements of motivation and effort, we computed correlations between these items measured at the first questionnaire and the follow-up. The correlation between the two ratings was high for both motivation (motivation before the COVID-19 crisis r=0.61, during: r=0.59, both $p < .001$), and effort (before the crisis r=0.73, during r=.81, both $p < .001$). The MSLQ administered only during the follow-up

questionnaire included an intrinsic motivation scale. We examined the correlation between that scale and the follow-up questionnaire ratings of motivation before and during the COVID-19 crisis. Both correlations were positive (Before crisis: $r = 0.311$, $p = .038$; during: $r = 0.206$, $p = .174$).

Models including HEXACO Data

Several hypotheses concerned personality traits, measured with the HEXACO. Due to participants' missing HEXACO data or non-consent to use this data this led to the loss of 41 participants who would otherwise have been included in the data set. We fit models including HEXACO variables to the remaining 101 participants. Since most hypotheses regarding personality traits were not supported, we here only report the parameters involving HEXACO variables and below report results for the other variables from models that did not include personality variables.

With regard to motivation, we did not find effects of Extraversion ($b = -.004$, $se = .115$, $p>.10$) nor of Conscientiousness ($b = .135$, $se = .090$, $p>.10$). Extraversion did not, as hypothesized, interact with semester ($b = -.024$, $se = .146$, $p>.10$). With regard to effort, we did find that high conscientiousness was related to more effort ($b = .203$, $se = .081$, $p = .013$), but there was no main effect of Extraversion ($b = -.030$, $se = .088$, $p>.10$), nor did it interact with semester ($b = .140$, $se = .090$, $p>.10$).

Motivation

Out of the 166 participating students, 24 did not fill out one or multiple items of the questionnaire relevant for testing our hypotheses regarding motivation. Hence, 142 participants were included in the analysis. To test all our hypotheses about main effects and interaction effects on motivation, we fitted a linear model in R using the generalized least squares (gls) function from the nlme package (version 3.1-149; Pinheiro et al., 2020) using maximum likelihood estimation. This allowed us to treat the two motivation measurements (retrospective before the COVID-19 crisis and during the COVID-19 crisis) as repeated measures by accounting for this within-person correlation structure. All predictors were centered.

The results of the motivation analysis are presented in Table 1. In line with our expectations, we found a reduction in motivation as reflected by the main effect of semester. Additionally, the expected interactions between semester and the home environment variables suited computer and internet connection for online education, and a quiet place to study at home were found. These results imply that students with a computer and internet connection suited for online education and a quiet place to study had a less steep motivation drop than students with worse facilities.

Contrary to our expectations, we did not find main effects for academic integration or social integration. Furthermore, we did not find interaction effects between semester

(i.e., the drop in motivation) and social integration, online collaboration, online interaction, frequency of online interaction, camera use, or procrastination.

Unexpectedly, we did find a main effect of online interaction on motivation. Students who indicated there was a lot of interaction during their online meetings tended to report higher motivation before the crisis hit, as compared to those who indicated not a lot of interaction took place in their online meetings.

Table 1. *Motivation Results: Coefficient Estimates and Standard Errors Given in Parentheses (N = 142).*

	Coefficient	(se)
Intercept	3.934***	(0.087)
Semester	-0.892***	(0.110)
Social integration	-0.042	(0.092)
Academic integration	-0.142	(0.077)
Online collaboration	-0.076	(0.089)
Online interaction	0.232**	(0.087)
Frequency of online interaction	-0.023	(0.089)
Online camera use	-0.022	(0.094)
Computer and internet suited for online edu	-0.036	(0.093)
Quiet place to study at home	-0.029	(0.096)
Procrastination	0.150	(0.090)
Semester*Social integration	0.054	(0.111)
Semester*Online collaboration	-0.011	(0.114)
Semester*Online interaction	-0.091	(0.112)
Semester*Frequency of online interaction	-0.144	(0.114)
Semester*Camera use	0.187	(0.120)
Semester*Computer and internet suited for online edu	0.292*	(0.118)
Semester*Quiet place to study at home	0.242*	(0.121)
Semester*Procrastination	0.069	(0.115)

Note. */**/*** denote significance at a 5/1/0.1 percent confidence level (two-sided).

Effort

We used the same estimation procedure as in the motivation analysis, with again 142 participants being included. The results of the effort analysis are presented in Table 2. In line with our expectations, we found that the COVID-19 crisis reduced effort as reflected by the main effect of semester. Additionally, we found that a stronger motivation was related to more effort (main effect of motivation). As hypothesized, we found an interaction between semester and motivation decrease, indicating that students whose motivation decreased during the crisis also reduced their effort, while students with less of a drop in motivation also reduced their effort less.

Against our expectations, we found no main effects for academic and social integration. Moreover, we did not find interaction effects between semester and social integration, online collaboration, online interaction, frequency of online interaction, camera use, computer and internet suited for online education, quiet place to study, or procrastination.

Table 2. Effort Results: Coefficient Estimates and Standard Errors Given in Parentheses (N = 142).

	Coefficient	(se)
Intercept	2.443***	(0.065)
Semester	-0.340***	(0.066)
Motivation before	0.394***	(0.071)
Motivation decrease	0.070	(0.083)
Social integration	0.018	(0.070)
Academic integration	-0.069	(0.066)
Online collaboration	-0.004	(0.068)
Online interaction	-0.023	(0.068)
Frequency of online interaction	0.114	(0.068)
Online camera use	-0.131	(0.072)
Computer and internet suited for online edu	-0.054	(0.072)
Quiet place to study at home	0.007	(0.073)
Procrastination	0.008	(0.069)
Semester*Motivation decrease	-0.632***	(0.074)
Semester*Social integration	-0.002	(0.066)

	Coefficient	(se)
Semester*Online collaboration	0.067	(0.068)
Semester*Online interaction	-0.038	(0.067)
Semester*Frequency of online interaction	-0.032	(0.068)
Semester*Camera use	0.116	(0.071)
Semester*Computer and internet suited for online edu	-0.134	(0.071)
Semester*Quiet place to study at home	-0.027	(0.073)
Semester*Procrastination	0.116	(0.068)

Note. */**/*** denote significance at a 5/1/0.1 percent confidence level (two-sided).

Self-Reported Obtained Credits

Seventeen students did not fill out one or multiple items of the questionnaire relevant for testing our hypotheses regarding obtained credits; 149 participants were thus included in this analysis. We employed a similar estimation process as for motivation and effort.

The results regarding our hypotheses are displayed in Table 3. Contrary to our hypotheses, we found a positive main effect of semester, indicating an increase in self-reported course credits: Students expected to obtain more credits in the COVID-19 crisis semester than they reported to have obtained in the first semester. In line with our expectation, we found an interaction between drop in motivation and semester, indicating that a higher drop in motivation was associated with less increase in credits.

Contrary to our expectations, we found no main effects for motivation or effort on credits, and no interaction between the reduction in effort and the increase in self-reported credits. Unexpectedly, we did find main effects for the motivation decrease, demonstrating that a strong decrease in motivation is associated with higher self-reported credits in both semesters and a high effort decrease is associated with lower self-reported credits in both semesters. Since we have no evidence supporting one causal direction over the other, these effects can also be interpreted as that motivation decreased more for students who obtain many credits, while these same students reduced their effort less strongly during the COVID-19 crisis than other students.

Table 3. Self-Reported Credits Results: Coefficient Estimates and Standard Errors Given in Parentheses (N = 149).

	Coefficient	(se)
Intercept	2.593***	(0.068)
Semester	0.232**	(0.076)

Motivation before Covid		0.046	(0.072)
Effort before Covid		0.106	(0.073)
Motivation decrease		0.193*	(0.094)
Effort decrease		0.204*	(0.092)
Semester*Motivation decrease		-0.286**	(0.098)
Semester*Effort decrease		0.071	(0.097)

Note. */**/*** denote significance at a 5/1/0.1 percent confidence level (two-sided).

Open-ended questions

Table 4 shows the nine categories used to code answers to the question of motivating and demotivating elements in online education. For each of the codes, the number of comments belonging to the category defined by the codes is given, and two sample answers. Answers giving motivating elements could be clearly distinguished from demotivating elements (denoted with '+' or '-' in the table). Figure 3 shows the proportion of comments that either described motivating or demotivating elements, and fell within each of the nine categories.

Table 4 categories in which comments to the question "What are for you motivating and demotivating elements in online education?" were coded, with number of comments in the category and for each two sample comments. Whether these were motivating (+) or demotivating (-) was also coded.

Category	N	Motiv?	Example comments
Changed organization of education	41	+	Tutors and lecturers do their best to make it work, most students actively participate. (95)
		-	It's like you don't get education, it's just self-study (40)
Digital discomforts	32	-	Sometimes it doesn't work quite well (wifi, or not technical professors) (50)
		-	Higher threshold to ask questions in lectures/tutorials is higher and online proctoring for exams is stressful and invasive (122)
Distractions	29	+	Better concentration (without friends around) (63)
		-	It is hard to concentrate when you are sitting infront of your laptop the whole day. (77)
Personal motives	37	+	Motivating because I can finally live in my home town, with my friends, family and boyfriend. That makes me happier and therefore, more motivated. (118)
		-	I also find it more difficult to move enough during the day, as I don't cycle to uni or walk from one lecture hall to the other. (110)
Planning	46	+	No more travel time, so more time to study (57)

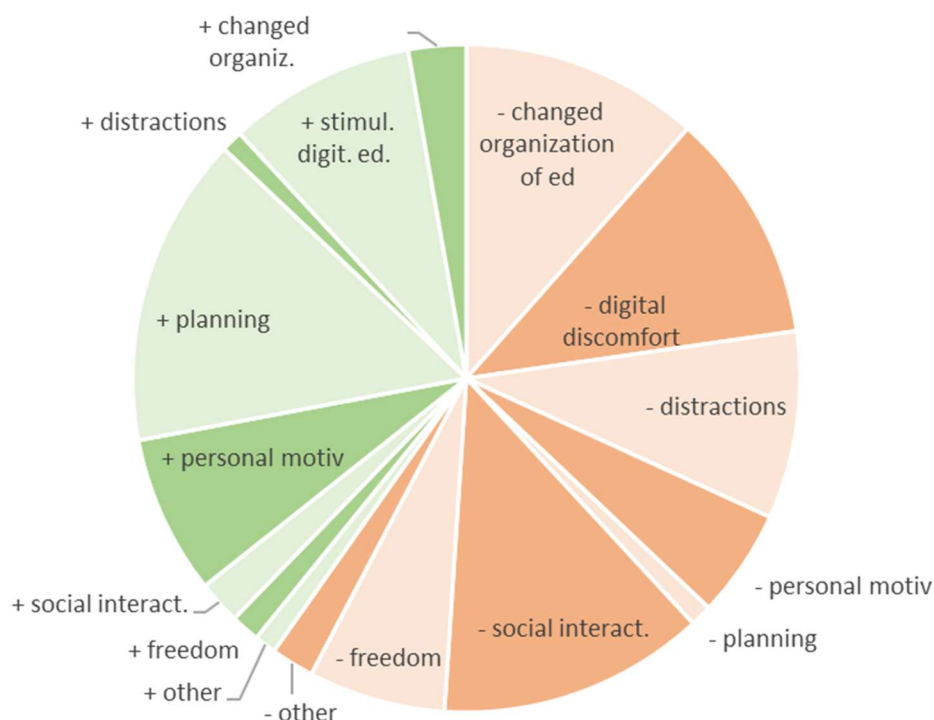|			
		-	Loss of structure and planning, i cant separate work time and free time (93)
Social interaction	43	-	I miss the presence of other students in tutorials (online workgroups make students more anonymous and sometimes things don't go smoothly) (37)
		+	Less formal, less social anxiety (100)
Stimulating digital education	26	+	No more mandatory workgroups. I still attend the same amount of workgroups but I don't grudge the fact that "I have to". And I can listen and relisten to lectures and classes anytime I want (58)
		+	Small assignments/projects which are sometimes in groups; (mostly) regular schedule; zoom lectures with interaction (chat function, menti, etc.) (69)
Freedom	23	+	I can decide for myself when I want to work. (116)
		-	Tutorials aren't mandatory and I don't have to wake up and go to lecture but only watch it when it suits me (and I somehow conclude that is never) (42)
Other	9	+	No public transport costs (63)
		-	Its boring (151)

Figure 3. Number of comments given to the question "What are for you motivating and demotivating elements in online education?", which fell within one of the nine categories listed in Table 4. A student's answer sometimes contained comments in multiple categories. Comments giving demotivating element are labeled with "-"and colored with a red shade,

In line with the quantitative survey results, more comments related to demotivating than to motivating factors. Social interaction was the category that elicited most negative comments. Most described a *lack* of social interaction due to the shutdown, such as "No interaction/ not really seeing someone in real life". A few comments either described that seeing others was still motivating (e.g., "Motivation is to see classmates"), and one comment (shown in Table 4) suggested that no social interaction was an improvement. Many comments also fell into categories that described negative attitudes towards online education – these were coded under *changed organization of education* if they referred to the new forms of education or under *digital discomfort* when they described either technical problems or a dislike of following an online lecture or seminar. Some comments in these categories referred to specific, local issues, such as the scheduling of exams ("Underlying stress, more exams in one week than used to") or personal tools ("My bad internet connection"). Most, however, were more generic and applied to online education in general (see sample items in Table 4).

The two next-largest categories of demotivating elements referred to having to motivate oneself. The category "distractions" contained comments about the ease of getting distracted at home (see sample items in Table x), while the comments under *freedom* mostly referred to *too much freedom*: having less structure, the ease with which lectures can be skipped, but also seeing fellow students not participate ("Less people are present so it is easier to not attend").

The largest category of motivating elements related to planning. These mostly consisted of time being saved by not having to commute, and being able to plan everything themselves ("everything in own time", "I watch all the lecutures [sic] when i want to / when i have time"). *Stimulating digital education* consisted of elements of online education that were appreciated ("Having good, fast and central access to all the study materials/lectures, quality of recordings"; "Motivating elements is the breakout rooms"). Under *personal motivation*, comments were coded that referred to personal reasons to be motivated or not. Some of these were generic ("I want to learn as much as possible, looks good on my CV"), others specific to the online situation ("What is also nice is that I sit in my own vibe; I don't always like the vibe in the classroom, which tends to drain my energy"). Most described motivating elements but some also demotivating elements ("I think study is the only thing you can do now but I Miss studying in the university library").

Comments elicited by the second question, about the changes the program could make, were coded into five categories (see Table 5 for the number of comments in each category, and sample comments). Most comment were either in the *better organization* or *better pedagogics* category. In the first fell comments related to deadlines (either to strict or too few, as in the example comment in Table 5), the number and pacing of meetings and exams, and the provision of information to students. In the better pedagogics category comments

focused on more interaction in small groups e.g. "a bit more tutor-student interaction", or "support students to actively participate and encourage each other during the zoom meetings."), and about better use of assignments ("More group assignments and discussions"). Quite a few students expressed that no change was needed, and that they were satisfied (see sample comments in Table 5).

Comments in the *online lectures* category were for a large part calls for lectures to switch from asynchronous, pre-recorded format to synchronous ("The lectures I've had since the crisis were all recorded. I would prefer that the lectures were 'live', and that there was more contact between students and professors."). However, some students commented that they liked the asynchronous format. Some comments were about the quality of the online lectures ("Lecturers should follow a different approach of making videos for their students. More short and concise videos in a higher frequency instead of translating a lecture to a video") r asked for increased speed ("My tutor/teacher speaks in a v e r y   s l o w voice. If there was an option to play the recorded lectures at 1.5x or 2x speed I would love that").

Comments coded as *other* were calls for more social interaction or personal assessments of online education ("The online program is fine but it just doesn't work for me. If uni is still online for next semester, i'll most likely drop out").

Table 5: categories in which comments to the question "What changes could psychology make to make the online program work better for you?" were coded, with number of comments in the category and for each two sample comments.

Category	N	Example comments
Better organisation	42	More deadlines, because with ADD I need some structure and now there just isn't really any. (48)
		Less homework, spread out the exams. (89)
Better pedagogics	48	for small group meetings, i would give other assignments. no presentations via zoom. And tutors have to be well prepared so they can use the time we have for the meeting. Sometimes the meetings take more time than planned. (103)
		Have more material on canvas with good descriptions on how to do certain assignments (149)
No changes needed	29	There isn't really something Psychology can do since my problems are not study related. (45)
		I dont know, im pretty satisfied with the way things are (166)
Online lectures	22	Maybe to have the normal lectures again on set times with participation in a group instead of watching just videos (49)
		For the recorded lectures: use a video format with a button to adjust the speed since a lot of lecturers talk very slowly and I would save a lot of time with increased speed. (126)
Other	8	Introduce ways to get to know your fellow students and provide options to keep up social contacts between students (52)
		Take into account that there is added stress and anxiety; (142)

Administrative data

To ascertain that students' claims of obtaining normal or better-than-normal results and more credits during the COVID-19 semester, we analyzed registered exam results stored within the administrative data from the university. Table 6 summarizes the results from the analyses. Most importantly, in all four models grades were *higher* in the semester in which stay-at-home orders were in place than in comparable earlier years. Importantly, this effect interacted with first-semester GPA, showing that especially students with lower first-semester GPA (who tend to also receive lower grades in the second semester) did better during the semester with COVID-19 than they would otherwise have. These results also held when student controls were included in the model (models 3 and 4).

These results confirm the survey answers from the students. Follow-up analyses, not shown here, confirmed that higher grades also resulted in more pass grades (i.e., more credits obtained by the students), the results held for exams administered in March and in May, though not those administered in June where results had apparently returned to normal (p>0.05 for both *COVID-19 semester* and its interaction with 1st semester GPA).

Table 6. Results from the regression analyses performed on administrative data, with exam grades as dependent variable and the listed variables as predictors. Reported parameters are standardized regression coefficients (beta), with level of significance (***= p<.001). Model 3 and 4 included student controls, model 2 and 4 interactions between COVID-19 semester (N=51,957).

	Model 1	Model 2	Model 3	Model 4
COVID-19 semester	0.06***	0.24***	0.06***	0.25***
1st -semester GPA	0.42***	0.44***	0.42***	0.41***
Interaction COVID-19 sem. /1st sem. GPA		-0.19***		-0.18***
student-level controls			V	v
BIC	631035	630940	629854	629940
# fitted parameters	4	5	32	61

Discussion

In line with our expectations, we found that students reported being less motivated than before the COVID-19 pandemic. This drop in motivation was related to a drop in effort; students reported spending less time on their studies than before, and attending fewer lectures and small-group meetings. Nevertheless, self-reported obtained credits *increased* in the COVID-19 semester compared to the semester before. This surprising increase was

indeed found in administration data. A smaller drop in motivation was related to a higher increase in credits, but effort was unrelated to obtained credits.

In both their closed-question answers and in comments, students expressed an appreciation for online lectures and small-group meetings that was lower than it was for offline ones. In their written comments they described online education as lacking the social aspect, causing discomfort because of technical failures, or just "not real education".

A lack of social interaction was the largest category in students' comments on factors that negatively affected their motivation. Contrary to our expectations, however, we did not find a relation between motivation on the one hand, and either social integration, extraversion or social interactions during online education on the other hand. This lack of associations between motivation and measures reflecting social interaction seems to contrast with student's comments that flagged lack of social interaction as a demotivating factor. One explanation that may reconcile these findings is that lack of social interaction is demotivating for all student equally, and not in stronger fashion for either students reporting high levels of social integration beforehand or students high in extraversion. Supporting this idea, while persons low on extraversion do not look forward to social interactions as much as others, they enjoy them just as much when they do happen (Duffy et al, 2018).

Another category of demotivating factors listed by students was *digital discomforts*- the technical imperfects that mar online education. Indeed, the drop in motivation after stay-at-home orders was associated with not having the resources suited for online education, such as a quiet place to study and proper internet connectivity. Although the study design does not allow for any causal claims, the results suggest students might benefit when provided these resources. Students also often commented on technical formats, suggesting for example that pre-recorded lectures could better be presented synchronously (i.e., broadcasted at some scheduled time, and only watchable then). However, it is fully possible that if that had been the dominant pattern, similar numbers of comments would have suggested switching to asynchronous presentation of lectures.

Students reported obtaining more credits (i.e., passing more exams) during the COVID-19 semester than in the first semester. This was supported by our analysis of administered grades, which showed that grades were *higher* in the second semester of 2019-20, instead of lower as hypothesized. At least one other study, although not yet peer-reviewed, has found a positive effect of COVID-19 on results of university students in Spain (Gonzalez et al, 2020). Students' comments suggested that online education was more efficient than typical university education, with no need for transportation and fewer attendance rules in place. Gonzalez et al. (2020) had access to digital traces in online learning systems, and reported that students seemed to study more regularly than before.

These results contrast with those obtained in typical distance learning universities, which tend to suffer from relatively high dropout rates, typically linked to a lack of social integration (e.g., Gregori et al., 2018). Similarly, MOOCs tend to suffer from massive dropout, which can be ameliorated through frequent online social interaction in the course

(Fang et al., 2019; Sunar et al., 2016). One possibility is that the social integration already obtained before universities were forced to close their campuses (i.e., in Fall semester and previous years) was sufficient to sustain successful learning in universities. The improvement in results seen in the first months of the lockdown seemed to be wearing off in June/July, when results returned to what is seen in other years. It is therefore an open question whether this will be sustained in the future, when social relations fray through continuing isolation.

Limitations

Several features limit the generalizability of the current results. First of all, the survey was only performed after stay-at-home orders were in place. All ratings of standard education were therefore retrospective, which can introduce well-known biases. Results from our follow-up questionnaire showed that the ratings were stable, but this does not show that they were unbiased. Moreover, motivation and effort ratings were self-report data, and in that regard also open to, for example, social desirability biases.

Moreover, no data was available on typical differences between fall and spring semester. It is possible that some drop in motivation occurs each year, and is not related to COVID-19 or stay-at-home orders. However, our analysis of student comments would argue against this, as students articulated factors clearly related to stay-at-home orders and online education as motivating and demotivating factors.

Also, the sample was not very large. It is possible that our null findings reflect false negatives more than truly absent effects. However, our power analysis suggests that the sample was large enough to detect medium sized-to-large effects, suggesting that mostly small effects would have been missed.

Finally, our survey data only included psychology students from one Dutch research university (although our analysis of student results included all bachelor programs). Our results would have to be replicated in other samples to obtain some generality.

Conclusion

University students appreciated online education less than they did traditional college education, felt less motivated and reported spending fewer hours on their studies. Decreases in motivation could be linked to less optimal facilities for online education, while a lack of social interaction was a factor in dissatisfaction with online education. Nevertheless, results did not suffer, they were even somewhat better than they would otherwise have been. It remains to be seen whether results remain at a higher level with continuing isolation.

References

Balkis, M. (2013). Academic procrastination, academic life satisfaction and academic achievement: the mediation role of rational beliefs about studying. *Journal of Cognitive & Behavioral Psychotherapies, 13*, 57-74.

Bol, L., & Garner, J. K. (2011). Challenges in supporting self-regulation in distance education environments. *Journal of Computing in Higher Education*, *23*, 104-123.

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., ... & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching, 3*, 1-20.

Deci, E.L., & Ryan, R.M. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry, 11*, 227–268.

De Vries, R. E., Wawoe, K. W., & Holtrop, D. (2016). What is engagement? Proactivity as the missing link in the HEXACO model of personality. *Journal of Personality, 84*, 178-193.

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-control and academic achievement. Annual Review of Psychology, 70, 373-399.

Duffy, K. A., Helzer, E. G., Hoyle, R. H., Fukukura Helzer, J., & Chartrand, T. L. (2018). Pessimistic expectations and poorer experiences: The role of (low) extraversion in anticipated and experienced enjoyment of social interaction. *PloS One*, *13*, e0199146.

Fang, J., Tang, L., Yang, J., & Peng, M. (2019). Social interaction in MOOCs: The mediating effects of immersive experience and psychological needs satisfaction. *Telematics and Informatics*, *39*, 75-91.

Furnham, A., Nuygards, S., & Chamorro-Premuzic, T. (2013). Personality, assessment methods and academic performance. *Instructional Science, 41*, 975-987.

Goodenow, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. *Journal of early adolescence, 13*, 21-43.

González-Sanguino, C., Ausín, B., ÁngelCastellanos, M., Saiz, J., López-Gómez, A., Ugidos, C., & Muñoz, M. (2020). Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain, Behavior, and Immunity, 87,* 172-176.

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement in students' performance in higher education. *arXiv preprint* arXiv:2004.09545.

Gottfried, A.E., Marcoulides, G.A., Gottfried, A.W., & Oliver, P.H. (2013). Longitudinal pathways from math intrinsic motivation and achievement to math course accomplishments and educational attainment. *Journal of Research on Educational Effectiveness, 6,* 68–92.

Gregori, P., Martínez, V., & Moyano-Fernández, J. J. (2018). Basic actions to reduce dropout rates in distance learning. *Evaluation and program planning, 66,* 48-52

Hirsch, C. (2020). Europ's coronavirus lockdown compared. *Politico Europe*, 31-3-2020. https://www.politico.eu/article/europes-coronavirus-lockdown-measures-compared/

Kim, K. R., & Seo, E. H. (2015). The relationship between procrastination and academic performance: A meta-analysis. *Personality and Individual Differences*, *82*, 26-33.

Kusurkar, R. A., Ten Cate, T. J., Vos, C. M. P., Westers, P., & Croiset, G. (2013). How motivation affects academic performance: a structural equation modelling analysis. *Advances in health sciences education*, *18*, 57-69.

Lee, K., & Ashton, M. C. (2006). Further assessment of the HEXACO Personality Inventory: Two new facet scales and an observer report form. *Psychological Assessment, 18,* 182-191.

Lyons, A. L. (2007). *Assessment of Social and Academic Integration Among Track and Field Student-Athletes of the Atlantic Coast Conference.* Internal report, retrieved from https://fsu.digital.flvc.org/islandora/object/fsu:169186/datastream/PDF/download/citation.pdf

Pinheiro, J., Bates, D., DebRoy, S., Sarkar, D., Heisterkamp, S., & Van Willigen, B. (2020). *Package 'nlme': Linear and nonlinear mixed effects models*. Available at: https://cran.r-project.org/web/packages/nlme/nlme.pdf

Pintrich, P.R., & de Groot, E.V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*, 33–40.

Romano, J., Wallace, T. L., Helmick, I. J., Carey, L. M., & Adkins, L. (2005). Study procrastination, achievement, and academic motivation in web-based and blended distance learning. *The Internet and Higher Education, 8*, 299-305.

Shapiro, H. B., Lee, C. H., Roth, N. E. W., Li, K., Çetinkaya-Rundel, M., & Canelas, D. A. (2017). Understanding the massive open online course (MOOC) student experience: An examination of attitudes, motivations, and barriers. *Computers & Education*, *110*, 35-50.

Solomon, L. J., & Rothblum, E. D. (1984). Academic procrastination: Frequency and cognitive-behavioral correlates. *Journal of Counseling Psychology, 31*, 503-509.

Sunar, A. S., White, S., Abdullah, N. A., & Davis, H. C. (2016). How learners' interactions sustain engagement: a MOOC case study. *IEEE Transactions on Learning Technologies*, *10*, 475-487.

Tinto, V. (1998). Colleges as communities. Taking research on student persistence seriously. Review of Higher Education, 21(2), 167–177.

Trolian, T.L., Jach, E.A., Hanson, J.M., & Pascarella, E.T. (2016). Influencing Academic Motivation: The Effects of Student–Faculty Interaction. *Journal of College Student Development 57*, 810-826.

Tull, M. T., Edmonds, K. A., Scamaldo, K., Richmond, J. R., Rose, J. P., & Gratz, K. L. (2020). Psychological Outcomes Associated with Stay-at-Home Orders and the Perceived Impact of COVID-19 on Daily Life. *Psychiatry research*, *289*, 113098.

Wentzel, K. R. (2017). Peer relationships, motivation, and academic performance at school. In A. J. Elliot, C. S. Dweck, & D. S. Yeager (Eds.), *Handbook of competence and motivation: Theory and application* (p. 586–603). The Guilford Press.

Appendix 1: questionnaire Corona education

We start with questions on the current online study program. How often do you have online tutorials, seminars or working group meetings per week? [we'll call these small-group meetings from now on]

Do you usually have your camera on during online tutorials or working group meetings?

Do other students usually have their camera on during online small-group meetings?

How many students typically participate in online small-group meetings that you attend?

Before corona, what percentage of lectures did you approximately attend?

Now in the crisis, what percentage of online lectures do you follow?

Before corona, what percentage of small-group meetings did you attend?

Now in the crisis, what percentage of online small-group meetings do you attend?

Before corona, there was a lot of interaction in small-group meetings

Now in the crisis, there is a lot of interaction during online small-group meetings

Before corona, I often actively participated in small-group meetings

Now in the crisis, I often actively participate in small-group meetings

Now in the crisis, I feel less motivated to participate when others have turned off their camera

Before corona, I was satisfied with most lectures I received

Now in the crisis, I am satisfied with most lectures I follow

Before corona, I was satisfied with most small-group meetings I attended

Now in the crisis, I am satisfied with most small-group meetings I attend.

Before corona, I was highly motivated for my studies

Now in the crisis, I am highly motivated for my studies

Before corona, my tutor / small-group leader expected a lot of work from me

Now in the crisis, my tutor / small-group leader expects a lot of work from me

Now in the crisis, there are many assignments on which we have to collaborate during small-group meetings

During small-group meetings, we are often separated into small breakout groups to collaborate or discuss

How many hours per week do you typically spend on your studies? (including time attending lectures and small-group meetings - Before corona

How many hours per week do you typically spend on your studies? (including time attending lectures and small-group meetings - Now in corona

How many people live at the place where you now reside during the work week?

Do you currently reside in the Netherlands?

Are your computer and internet connection well-suited for online education?

Do you have a quiet place to study and work at your home?

Will you pass the courses you are currently following?

How many course credits did you earn in the first semester (so Sept-Jan - regular is 30)

How many course credits do you intend to earn in the second semester (so Feb-June - regular is 30)

What are for you motivating and demotivating elements in online education?

What changes could psychology make to make the online program work better for you?

Online Interaction

Four statements were intended to measure online interaction: *"How often do you have online tutorials, seminars or working group meetings per week?"*, *"Now in the crisis, there is a lot of interaction during online small-group meetings"*, *"Now in the crisis, there are many assignments on which we have to collaborate during small-group meetings"* and *"During small-group meetings, we are often separated into small breakout groups to collaborate or discuss"*.

The PCA results of the online interaction scale are presented in Table S1. Only the first component has an eigenvalue above 1, implying that according to the Kaiser criterion only that component should be retained. However, the first component explains less than half of the total variance in the variables, which we consider too low. Based on the eigenvalues and a cumulative explained variance of higher than 70%, we retained the first three components.

Table S.1. *Eigenvalues, Explained Variance, and Cumulative Explained Variance for the Four Principal Components of Online Interaction Scale.*

	Eigenvalue	% Variance explained	Cumulative % explained
Component 1	1.791	44.769	44.769
Component 2	0.897	22.422	67.191
Component 3	0.855	21.386	88.577
Component 4	0.457	11.423	100

The loadings of the four items on the three components are presented in Table S2. The bottom two items load most strongly on the first component. Given the overlap in the content of these two items, we interpret the first component to reflect 'online collaboration'. The second item loads most strongly on the second component, which thus reflects 'online interaction' during meetings. Lastly, the first item loads most strongly on the third component, which therefore reflects the 'frequency of online interaction'.

Table S.2 *Loadings of the Four Online Interaction Items on the Components.*

	Component 1	Component 2	Component 3
How often online meetings	-0.385	0.423	-0.818
Lot of interaction	-0.346	-0.890	-0.298
Many collaboration assignments	-0.599	0.102	0.389
Often separated into small groups to collaborate	-0.611	0.136	0.302

Online Camera Use

Two items aimed to measure online camera use: *"Do you usually have your camera on during online tutorials or working group meetings?"* and *"Do other students usually have their camera on during online small-group meetings?"*.

The results of a PCA on these two items revealed that the first component with an eigenvalue of 1.432 explained 71.59% of the total variance. We consider this an acceptable large percentage, and therefore combined these two items into one 'online camera use' score.

Home Facilities Suited for Online Education

Two items aimed to measure whether students' home facilities were suited for online education: *"Are your computer and internet connection well-suited for online education?"* and *"Do you have a quiet place to study and work at your home?"*.

The results of a PCA on these two items demonstrated a first component with an eigenvalue of 1.303, and a second component with an eigenvalue of 0.696. Furthermore, the first component explained 65.18% of the total variance. Based on this explained variance, we decided to not reduce these two items into one score, because we would lose a considerable part of the information captured by the two original items. Hence, the original items were included in our analyses.