

Motivational Beliefs and Positive Achievement Emotions During COVID-19: A Person-Environment Fit Perspective in Higher Education

Charlott Rubach¹, Luise von Keyserlingk², Sandra D. Simpkins³ & Jacquelynn S. Eccles⁴

Abstract

Guided by the person-environment fit approach, this study is focused on the fit between students' perceived feedback and their need for feedback (need-supply fit) in college courses. The need-supply fit was examined in students' most important and most difficult courses during the COVID-19 pandemic. Furthermore, we asked to what extent students' competence beliefs and subjective task value beliefs mediated the relations between instructor feedback and the need-supply fit related to feedback and students' positive achievement emotions. Using a diverse sample of 225 undergraduates (31% males), we found that more than 50 percent of students experienced a fit or a small misfit between their need for feedback and the feedback perceived from instructors in their most important and difficult courses. The overall misfit was lower in students' most important courses than in their most difficult ones. In the most difficult course, both the need-supply fit and the perceived feedback were related to students' competence beliefs and subjective task values. In the most important course, the need-supply fit was associated with students' subjective task values, whereas perceived feedback was related to students' competence beliefs and subjective task values. Also, instructor feedback was associated with higher positive achievement emotions through students' subjective task values in both courses. Finally, we discuss the study's relevance in the context of higher education, e. g., the importance of feedback as an instructional strategy for students' positive academic development.

Keywords

competence beliefs; subjective task values; person-environment-fit theory, higher education, COVID-19 pandemic

1 School of Education, University of California, 401 E. Peltason Drive, 3200 Education Bldg., Irvine, CA 92697, USA; ORCID: 0000-0003-0451-6429

2 Affiliation 1: Center for Research on Education and School Development, TU Dortmund University, Vogelpothsweg 78, 44227 Dortmund; Affiliation 2: School of Education, University of California, 401 E. Peltason Drive, 3200 Education, Irvine, CA 92697, USA; ORCID: 0000-0002-0229-874X

3 School of Education, University of California, 401 E. Peltason Drive, 3200 Education Bldg., Irvine, CA 92697, USA; ORCID: 0000-0002-6053-4827

4 School of Education, University of California, 401 E. Peltason Drive, 3200 Education Bldg., Irvine, CA 92697, USA; ORCID: 0000-0002-6405-9330

Corresponding author: Charlott Rubach (crubach@uci.edu)



1 Introduction

Instructional quality in classrooms is central for students' positive academic development (Helmke, 2009). That was true before and during the COVID-19 pandemic, and we assume that it will continue to matter after the COVID-19 pandemic. Theorists postulate that teachers' behaviors, e. g., their instructional quality, influence students' motivational beliefs and achievement emotions (Eccles et al., 1983; Pekrun, 2006). However, does the concept of instructional quality imply that it is equally positively meaningful to all students' motivational beliefs and achievement emotions?

Throughout the COVID-19 pandemic, some instructors and students at universities were satisfied with the instructional quality during the pandemic, whereas others reported lower satisfaction (Weidlich & Kalz, 2021). However, satisfaction with instructional quality does not always imply a high average of instructional quality. In the context of instructional quality research, person-environment fit (PEF) theorists emphasize that the fit between students' needs for instructional quality and the perceived instructional quality in class (need-supply fit) explains students' satisfaction and their positive academic development (Fraser & Fisher, 1983).

Feedback is one central element of instructional quality (Klieme, 2019; Praetorius et al., 2018). Instructors' feedback helps students become aware of their (lack of) competence and aims to improve students' competence development and motivation. Thus, feedback might help to improve students' learning success (Forsythe & Johnson, 2017). In this paper, we focus on college students and ask whether instructor feedback per se or the fit between instructor feedback and students' need for feedback matters for students' positive academic development? We are particularly interested in the mediating role of students' motivational beliefs in the association of instructor feedback, fit between instructor feedback and students' need for feedback and students' positive achievement emotions.

1.1 Feedback as Indicator of Instructional Quality

Instructors' behaviors help to explain students' academic development and success in class by creating a learning environment with multiple learning opportunities (Helmke, 2009; Klieme, 2019; Lipowsky, 2015). Teachers who adjust their instructional behavior based on the class context and create learning environments that offer classroom management, cognitive activation, and student support provide effective learning opportunities (Klieme et al., 2006, 2019; Pianta & Hamre, 2009).

Variations in the instructional quality of *student support* help explain students' competence experiences, sense of autonomy, and feelings of social relatedness (see Deci & Ryan, 2000; Praetorius et al., 2018). The nature of individualized feedback is a key component of student support. Multiple scholars have highlighted the impact of feedback on college students' positive academic development. Informal talks with instructors, instructor

learning advice, and individual feedback for students are associated with higher college students' involvement, interest, and performance (Gruber et al., 2010; Núñez-Peña et al., 2015; Plecha, 2002; Remedios & Lieberman, 2008). Similarly, general student support, and individualized feedback are positively associated with students' learning processes, academic motivational beliefs, and emotional well-being in college (Duchatelet & Donche, 2019; Sakiz, 2012; Şenel & Şenel, 2021).

Though students rated feedback from their instructors as a motivating factor for their learning success in class (Şenel & Şenel, 2021; Sogunro, 2015), feedback can also have either no or negative impacts on students' achievement emotions or motivational beliefs (Agricola et al., 2020; Forsythe & Johnson, 2017). Feedback from instructors can cause anxiety when students do not perceive feedback from instructors as useful (see Núñez-Peña et al., 2015). Forsythe and Johnson (2017) indicated that the impact of feedback depends on students' mindset, i. e., if students have the attitude that their mind is fixed or able to grow. In summary, prior research has indicated no, positive and negative effects of feedback. Different associations might be explained by students' heterogeneous needs for feedback.

1.2 Does Instructional Quality Need to Fit Heterogeneous Student Needs?

Multiple theoreticians argue that instructional behaviors and instructional quality indirectly affect student achievement emotions⁵ through students' competence beliefs⁶ and value beliefs⁷ (e.g., expectancy-value theory, Eccles et al., 1983; control-value theory, Pekrun, 2006). Multiple scholars have investigated the direct impact of instructional quality on students' motivational beliefs, achievement emotions and performance in school and higher education (Fauth et al., 2014; Dorfner et al., 2018; Rubach et al., 2022). However, scholars also claim that teachers need to create learning environments with different learning opportunities for heterogeneous student needs within their classes. Teachers can challenge the situation to teach students with heterogeneous learning needs and preconditions by adaptive teaching (Helmke & Weinert, 1997). Adaptive teaching is a concept that involves teaching subject knowledge while taking into account the heterogeneous preconditions of students through different instructional strategies that are beneficial to the development of each student according to the situation (Hardy et al., 2019; Vogt & Rogalla, 2009). Heterogeneous preconditions and needs are defined by demographic characteristics (e. g., students' socio-economic status, ethnicity/race, gender, age), functional skills (e. g., abilities, cognitive or behavioral disorders), and academic attitudes

5 Achievement emotions refer to students' emotional experience in academic and achievement-related situations and outcomes, including tests, learning processes, or success/failure (Pekrun, 2006).

6 Competence beliefs refer to one's perceptions of their abilities and skills (Muenks et al., 2018; Pekrun, 2006).

7 Value beliefs, including subjective task values, refer to the degree of perceived importance, interest, and utility of an action, task, or outcome (Eccles & Wigfield, 2020).

(e. g., subject-related motivation, Hamre & Pianta, 2005; Vock & Gronostaj, 2017). Previous studies have focused on the association between the extent of instructional quality and students' academic development explained by demographic and functional risk factors (Rubach et al., 2022; Fauth et al., 2014; Wenger et al., 2020). However, to our knowledge, few scholars have investigated whether the extent of instructional quality is associated with students' academic development by considering the extent to which instructional strategies meet students' need for instructional quality. This research interest is grounded in person-environment fit theories.

1.3 Person-Environment Fit Theories in the Context of Instructional Quality

Person-environment fit (PEF) theorists aim to explain interindividual differences in human development, especially in individuals' motivational beliefs, satisfaction, emotions, and performance (Holland, 1997). PEF theories emphasize that the interaction between a person (P) and the environment (E) determines individuals' behavior ($B = f(P, E)$; summarized in Holland, 1997 and Eccles et al., 1993). The theoretical approach is widely used in the context of organizational psychology (e. g., fit between employees and vocation or companies, e. g., Kristof-Brown et al., 2005), developmental psychology (e. g., stage-environment fit theory, Eccles et al., 1993) and in educational psychology (e. g., fit between instructors' value for teaching and their faculty value for teaching, e. g., Smart & Umbach, 2007; fit between students' values and their major, e. g., Schelfhout et al., 2019; or fit between students' ability and the demands of their program, e. g., Bohndick et al., 2018).

Across fields, two general types of PEF have been differentiated, namely the supplementary and complementary types. The supplementary type of fit describes whether an individual and the environment have similar or coinciding characteristics, e. g., value congruence (Kristof, 1996). The complementary types fit within the view that a "weakness or need of the environment is offset by the strength of the individual, and vice versa" (Muchinsky & Monahan, 1987, p. 271). The complementary fit can be further differentiated into the demands-abilities fit and the need-supply fit. The demand-ability fit focuses on how individuals' skills and abilities match the requirements of the environment (Cable & DeRue, 2002). The need-supply fit focuses on how individuals' needs are met by supplies offered in their environment (Cable & DeRue, 2002). In the educational context, the demand-ability fit of college students and the program they are enrolled in explains college students' satisfaction and performance (Bohdick et al., 2018; see Eccles et al., 1993 for similar findings in junior high school). The supplementary fit between all enrolled students' average interest and their chosen major explained the average academic success of students in enrolled college programs (Milsom & Coughlin, 2017; Schelfhout et al., 2019). However, studies did not find that the fit between students' interest and the programs they were enrolled in predicted their individual performance (Schelfhout et al., 2019).

During the COVID-19 pandemic, empirical research emphasized the importance of instructional quality. College students who were satisfied with the instructional quality in courses also reported higher motivational beliefs, satisfaction, emotional well-being and lower stress or depression (Aristovnik et al., 2020; Kim et al., 2020). Indeed, satisfaction with instructional quality does not always imply a high average of instructional quality. According to the PEF approach, students' positive academic development is impacted by the fit between perceived instructional quality and each student's needs for instructional quality (i. e., need-supply fit).

However, no study to our knowledge has investigated whether the instructional quality itself or the fit between students' need for instructional quality and their perceived instructional quality (i. e., need-supply fit) is positively associated with students' motivational beliefs and positive achievement emotions in higher education. We found one intervention study focusing on feedback. The authors investigated if requested written or verbal feedback impact students' achievement emotion (test anxiety) and motivational beliefs (self-efficacy) differently than feedback that students got without requesting it (see Agricola et al., 2020). However, this study focused on verbal and written feedback and not the intensity and quantity of feedback. Our study builds on this research lack.

1.4 The Present Study

In this study, we focused mainly on the instructional strategy of feedback. We investigated the associations between (a) feedback and (b) the need-supply fit regarding feedback with college students' subsequent positive achievement emotions. Guided by Eccles and colleagues (1983) and Pekrun (2006), we were, furthermore, interested in potential mediated effects through students' motivational beliefs, i. e., competence beliefs and subjective task values.

We used survey data from a longitudinal study at a large public university in Southern California. Participating students completed weekly surveys in the academic quarter of spring 2020 with course-specific questions about a broad range of behavior and experiences. It was the quarter in which instruction at this university switched to Emergency Remote Teaching (ERT), i. e., a distant, online form due to the COVID-19 pandemic.

Two types of courses were examined in our study in order to test the relevance of feedback and the need-supply fit regarding feedback for students' achievement emotions through their motivational beliefs. Students selected two different courses, i. e., one they perceived as their most difficult and one that they considered their most important course of all enrolled courses in spring 2020. Students explained why they selected the particular courses as the most difficult and most important (see Rubach et al., 2022). Using two different courses as reference allows examining intraindividual differences across courses, rather than using only one course for generalization. We chose to compare the most important and the most difficult course because we assumed that instructors' feedback and, in par-

ticular, needs-supplies fit have different implications for students in these courses. For the most difficult course, it might be even more relevant that the feedback offered by instructors meets the needs of students for most effective help in a challenging learning environment. Students reported that the course is perceived as difficult because, for example, content and assignments are perceived as overwhelming, and students have low competence beliefs in these courses. In such situations, needed feedback from instructors at the perfect intensity level could help students to overcome such challenges. In previous studies, for example, feedback helped students in these situations to identify and overcome such challenges (Kalinina et al., 2016; Paris & Oka, 1989).

All survey questions about instructional quality and motivational beliefs referred to these courses. We, therefore, investigated the associations between the course-specific need-supply fit, feedback, course-specific motivational beliefs, and general (course-unspecific) positive achievement emotions.

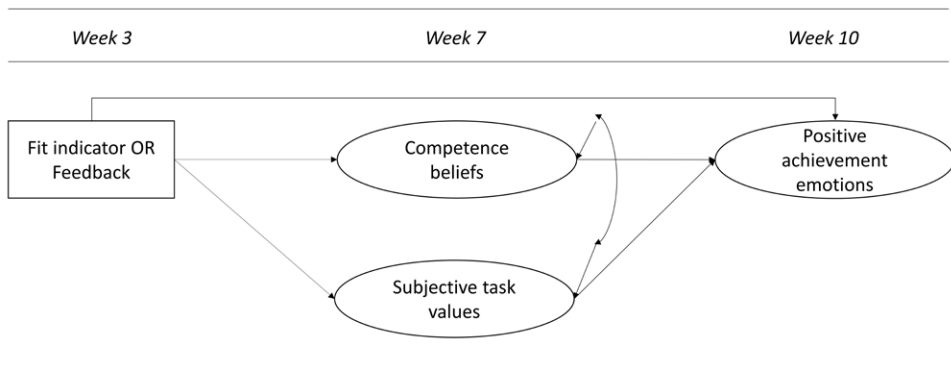


Figure 1: Theorized model for college students' most important and difficult course

Thus, we examined the following research questions (see hypothesized associations in Figure 1):

RQ1: To what extent do students report a need for feedback, and what is the fit between students' need for feedback and students' perceived feedback (need-supply fit) in their most important and most difficult course in the first quarter of the COVID-19 pandemic?

RQ2: To what extent are (a) perceived feedback and (b) the need-supply fit regarding feedback in the most important and difficult course related to students' positive achievement emotions mediated by students' competence beliefs and subjective task values?

Guided by the PEF theories, we hypothesized that college students who (a) perceived high individualized feedback in class and (b) have the need-supply fit between their need for feedback and perceived feedback would also be more likely to report being motivated, i. e., higher competence and subjective task value beliefs. We assumed that feedback, especially the fit between students' learning-related need for feedback and their experienced feedback in their enrolled courses (i. e., need-supply fit), would explain college students' motivational beliefs and achievement emotions during the COVID-19 pandemic (Eccles et al., 1993).

We also hypothesized that higher competence and subjective task value beliefs in college students' most important and difficult courses are associated with higher positive achievement emotions in college. Finally, guided by Eccles et al. (1983) and Pekrun (2006), we assumed that course-specific individualized feedback and the need-supply fit regarding feedback are associated with students' positive achievement emotions through students' course-specific competence beliefs and subjective task values.

2 Methods

2.1 Research Design

Data were used from the ongoing *Next Generation Undergraduate Success Measurement Project* (Arum et al., 2021) with a longitudinal and multi-cohort design at the public University of California, Irvine (UCI), as well as a parallel project *Improve Teaching, Motivational Beliefs, and Well-Being in Higher Education* (Rubach et al., 2019–2021; see <https://www.researchgate.net/project/IMPROVE-Teaching-Motivational-Beliefs-and-Well-Being-in-Higher-Education> [02.02.2022]). The *Next Generation Undergraduate Success Measurement Project* is investigating undergraduate student experiences and success in college. The parallel project *Improve Teaching, Motivational Beliefs, and Well-Being in Higher Education* was particularly focusing on student experiences in college courses and to what extent instructors' teaching behavior influences college students' positive academic growth. Both projects were approved by the Institutional Review Board (IRB) of the university.

Data collection with the first cohort started in September 2019 with 1,249 freshmen and junior students. 353 students of this full sample completed weekly surveys across the fall, winter, and spring quarters in the academic year 2019/20 (see the timeline in Figure 2). The weekly surveys assessed different experiences of students every week, i. e., their motivational beliefs, perceived instructional quality, achievement emotions, and academic behavior. Participating students received course credits every quarter they completed the weekly surveys. In this study, we used data from the spring quarter of 2020. All UCI courses had shifted to an online format due to the COVID-19 pandemic in the spring

quarter of 2020, which started on March 25th. The information that UCI moving its classes online was announced on March 10th, 2020. The stay-at-home order was issued in California started March 19th.

Week	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
Date	3/25-3/29	3/30-4/5	4/6-4/10	4/13-4/17	4/20-4/24	4/27-5/1	5/4-5/8	5/11-5/15	5/18-5/22	5/25-5/29	6/1-6/5	6/8-6/12
Event	Quarter starts	Begin of instructions									Instruction ends	Quarter ends & Finals
Assessment of constructs			Needs for instructional quality	Perceived Instructional quality			Competence beliefs Value beliefs *				Achievement emotions	

Figure 2: Timeline of the project in the academic quarter of spring 2020

2.2 Sample

We used data from n = 225 undergraduates who (a) participated in weekly surveys and (b) completed the surveys related to their needs for instructional quality and motivational beliefs. Eighty percent of the subsample were students in their freshman year (20% were juniors), 31% were male students, and 52% were first-generation college-going students. The sample was racially/ethnically diverse (48% Asian; 32% Hispanic; 13% White; 17% others). Students were enrolled in various majors (e. g., 29% Life Science, 17% STEM majors, 39% Social Sciences, 5% Humanities and Arts).

2.3 Instruments

An overview of all items, factor loadings, and internal consistency for each construct is provided in Table 1.

2.3.1 Perceived Feedback

Students’ perceived feedback was assessed in the two courses students selected as their most important and most difficult courses in the third week of the spring quarter of 2020. The item development was guided by the three dimensions of instructional quality (classroom management, cognitive activation, students support; Klieme et al., 2006; Klieme, 2019). Students perceived feedback was assessed with one item “To what extent does the instructor provide feedback that helps you understand your strengths and weaknesses in *course name of most important/difficult course*”. The response scale ranged from 1 = *not at all* to 7 = *very much*).

2.3.2 Need for Feedback

Students' needs for instructional quality were assessed with nine items in the first week of the spring quarter 2020. We asked each student to rate the importance of teaching strategies related to the three dimensions of instructional quality for their successful learning in college courses on a seven-point Likert scale with 1 = *not at all important* to 7 = *extremely important*. Students' need for feedback was assessed via one item "How important is it that you receive detailed feedback from the instructor?"

2.3.3 Need-Supply Fit

Guided by the PEF approach, we calculated the need-supply fit in students' most important and difficult courses (see Cable & DeRue, 2002). The literature describes multiple ways to assess and calculate fit: (a) subjective fit and (b) objective fit (see Greguras et al., 2014). The subjective fit captures only the person's perception in both the person (P) and the environment (E) and is further differentiated into direct and indirect fit. The direct fit captures individuals' judgment on the fit on a topic in their environment. The indirect fit can be calculated by judging a topic that occurs in the person (P) and the environment (E). The objective fit included both the person's and environment's perspectives. Indeed, the indirect and objective fit were both calculated with two indicators. In this study, the indirect fit was calculated ($\text{fit} = \text{need} - \text{supply}$) based on two indices reported by college students: (a) students' need for feedback and (b) students' perceived feedback in class.

The indirect fit can be calculated using three different mathematical approaches: (a) the algebraic differences ($\text{fit} = \text{need} - \text{supply}$), (b) the absolute difference ($\text{fit} = |\text{need} - \text{supply}|$), and (c) the squared difference ($\text{fit} = (\text{need} - \text{supply})^2$) (see Bohndick et al., 2018). The distinction between absolute and squared difference is that the squared difference weights the misfit higher and assumes that a higher misfit has higher negative impacts on students' academic indices. In this study, all three approaches were calculated with the goal to test two underlying assumptions:

Hypotheses A: The misfit ($\text{need} \neq \text{supply}$; absolute and squared difference) is negatively associated with various students' academic indicators. Hence, smaller misfits should be related to more positive student academic outcomes, i. e., higher subjective task values, competence beliefs, and positive achievement emotions.

Hypotheses B: The relationship between fit and students' academic development is linear (algebraic differences). The fit ($\text{needs} = \text{supply}$) or the misfit of higher feedback than needs ($\text{needs} < \text{supply}$) are positively associated with students' academic outcomes, i. e., higher subjective task values, and competence beliefs. However, the (mis)fit of receiving less feedback than needed ($\text{need} > \text{supply}$) is negatively associated with students' academic outcomes, i. e., lower subjective task values, competence beliefs, and positive achievement emotions.

In the following, we use the term misfit to indicate the numerical difference from the fit, where the fit has the value of zero.

2.3.4 Competence Beliefs

Guided by the expectancy-value approach (Eccles et al., 1983), three items were used to assess students' competence beliefs in their most important and difficult course (see Table 1). Students were asked to rate how good they were at learning new material in their most difficult/important course a) over time, b) compared to other subject areas, and c) compared to their peers. This study used students' competence beliefs measured after they received their midterm grades, i. e., after weeks five to seven of the spring 2020 quarter (see Figure 1). The response scale ranged from 1 = *not at all good* to 7 = *extremely good*. Reliabilities were strong (important course: $\omega = .94$; difficult course: $\omega = .90$).

2.3.5 Subjective Task Values

Five items assessed students' subjective task values (interest, utility, attainment) in their most important and difficult course after receiving their midterm grade (Eccles & Wigfield, 1995) (see Table 1). This study used students' subjective task value measured after they received their midterm grades, i. e., after weeks five to seven of the spring 2020 quarter (see Figure 1). The response scale ranged from 1 = *not at all* to 7 = *very much*. Reliabilities were strong (important course: $\omega = .91$; difficult course: $\omega = .91$).

2.3.6 Positive Achievement Emotions

Five self-developed items assessed students' positive emotions in academic situations in the last week of the spring quarter 2020 (Arum et al., 2021) (see Table 1). We asked students about their excitement, interest, happiness, and feelings of being welcome that they have experienced at the university and academic activities during the last weeks of the quarter. A slider from 0 = *not at all* to 100 = *very much* was used to rate these items. However, for this study, the scale was adjusted with items ranging from 1 to 7. The reliability of the scale was strong ($\omega = .86$).

Table 1: Overview of items, factor loadings, and internal consistency for each construct

Nr.	Items	λ (important course)	λ (difficult course)
Competence beliefs			
1	Over the last few weeks, how good do you think have you been at learning the new material in your difficult/important course?	.93	.83
2	Compared to other subject areas, how good have you been at learning things in your difficult/important course?	.92	.98
3	Compared to your peers in this course, how good have you been at learning things in your difficult/important course?	.89	.75
	Internal consistency (omega)	$\omega = .94$	$\omega = .90$
Subjective task values			
1	Based on your experiences in this term, how much is your difficult/important course useful in everyday life?	.77	.79
2	Based on your experiences in this term, how much is your difficult/important course interesting to you?	.85	.85
3	Based on your experiences in this term, how much is your difficult/important course intellectually challenging in a positive way?	.83	.85
4	Based on your experiences in this term, how much is your difficult/important course important to you personally in terms of your values and identities?	.83	.86
5	Based on your experiences in this term, how much is your difficult/important course useful in terms of your long-term goals?	.83	.75
	Internal consistency (omega)	$\omega = .91$	$\omega = .91$
Positive achievement emotions			
1	In the past two weeks how often have you felt happy with academic activities?	.64	
2	In the past two weeks how often have you felt excited about learning?	.93	
3	On the past two weeks how often have you felt interested in what you are learning in courses?	.92	
4	In the past two weeks how often have you felt welcomed by your professors or Teacher Assistants?	.54	
5	In the past two weeks how often have you felt excited about being at UCI?	.62	
	Internal consistency (omega)	$\omega = .86$	

2.4 Statistical Analysis

The analysis was undertaken using SPSS version 26 and Mplus version 8.1 (Muthén & Muthén, 1998–2016). For research question one, we calculated the algebraic, absolute, and squared fit indicators to understand the distribution of the need-supply fit and misfit for feedback across the most important and most difficult courses (see for more details, section 3.3.3). For research question two, we used structural equation modeling and specified two models for each student’s most important and most difficult course. The first model specified the indirect associations between fit indicator (week 3), competence beliefs and subjective task values (week 7), and students’ positive achievement emotions (week 10). The second model included perceived feedback as a predictor instead of the fit indicator (week 3), as well as students’ competence beliefs, subjective task values (week 7), and positive achievement emotions (week 10). We did not include the need-supply fit regarding feedback and perceived feedback simultaneously in one model because of their strong intercorrelation ($-.83 \geq r \geq -.72$). We furthermore tested which of the three fit indicators (algebraic, absolute, squared fit) best fit the data (see Bohndick et al., 2018).

The hierarchical data structure (important/difficult courses) was taken into account within Mplus (Type = complex, cluster = important-course ID, difficult-course ID). We evaluated the goodness of model fit using cut-offs based on Brown (2015) and Kline (2010): Comparative Fit Index (CFI) ≥ 0.90 , Tucker–Lewis Index (TLI) ≥ 0.90 , and root mean square error of approximation (RMSEA) ≤ 0.08 for an acceptable model fit and CFI ≥ 0.95 , TLI ≥ 0.95 , and RMSEA ≤ 0.06 for a good model fit. Missing data were addressed using full-information maximum likelihood (FIML) estimation.

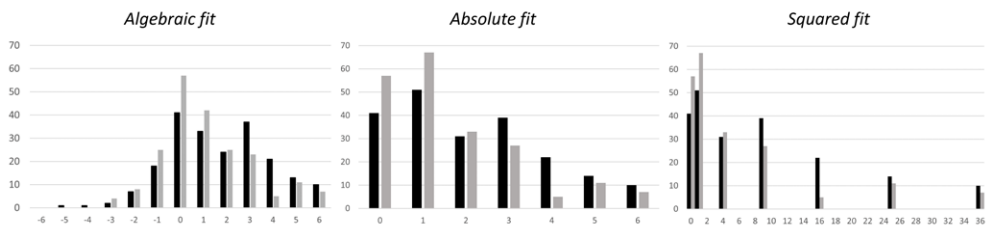


Figure 3: Distribution and path of the three fit indices for students’ need for feedback and their perceived feedback for the most important and most difficult course for n = 225 college students

Note: The y-axis represents the number of cases (n), while the x-axis indicates the fit/misfit values. Black bars = difficult course, grey bars = important course

3 Results

3.1 Need-Supply Fit Regarding Feedback (RQ1)

On a scale from 1 (not at all important) to 7 (very important), students on average reported that individualized feedback from instructors is highly important for their own learning success ($M = 5.85$, $SD = 1.20$) in their courses. Furthermore, students experiencing higher feedback in their most difficult course ($M = 4.18$, $SD = 1.95$) compared to their most important course ($M = 4.77$, $SD = 1.85$, $t(213) = -3.73$, $p < .05$).

Figure 3 presents the three fit indicators in students' most difficult and important courses in the first three weeks of the spring quarter of 2020. Results show that 19.7% of the students experiencing a level of feedback that fit their needs (difference = 0) in their most difficult course and 27.5% in their most important course ($t(205) = 3.71$, $p < .05$).

In the most difficult course, the algebraic fit indicated that 13.9% of students experienced a higher level of feedback than what they needed, whereas 50.4% of the students experienced a lower level of feedback than what they needed. The absolute and quadratic fit indicated a dropping left-step trend, with most of the students (59.1%) experiencing no or a small misfit ($\Delta_{\text{need} - \text{supply}} \leq 1$).

In the most important course, the algebraic fit indicated that 17.9% of students experienced a higher level of feedback than what they needed, whereas 54.6% of the students experienced a lower level of feedback than what they needed. The absolute and quadratic fit indicated a dropping left-step trend, with most of the students (59.9%) experiencing no or a small misfit ($\Delta_{\text{need} - \text{supply}} \leq 1$).

Descriptively, the mean of the algebraic fit in the most important course was positive and higher than in the most difficult course (see Table 2). These results indicate that the likelihood was higher for students in the most important course to experience fit or experience more feedback than they needed.

3.2 *Associations Between Perceived Feedback, Need-Supply Fit Regarding Feedback, Motivational Beliefs, and Achievement Emotions (RQ2)*

Descriptive statistics are provided in Table 2. Descriptively, students' competence beliefs were lower than their subjective task values in both courses. Furthermore, competence beliefs and subjective task values were higher in the most important course than in the most difficult course.

Correlations indicated that all three fit indicators strongly correlated with the amount of feedback students perceived in both courses ($-.83 \geq r \geq -.72$). In the most difficult course, the fit indicators correlated negatively with college students' competence beliefs and subjective task values. Only the absolute fit correlated with students' subjective task values in the most important course. Perceived feedback positively correlated with competence beliefs, subjective task values, and positive achievement emotions in both courses. Furthermore, competence beliefs and subjective task values in both courses were positively associated with positive achievement emotions.

Comparing the final models with the three fit indicators suggests that the absolute fit best matches the data (see Table 3). Therefore, only the absolute fit was further examined as a predictor for students' academic outcomes. Below, results for the most difficult course are described first, followed by results for the most important course. Model fits of all models are shown in Table 3.

Difficult course. The final models are presented in Figure 4. Students' perceived feedback (week 3) was positively but weakly associated with students' competence beliefs and subjective task values in students' difficult course (week 7). Furthermore, students who reported higher subjective task values in their most difficult course (week 7) also reported higher positive achievement emotions at the end of the quarter (week 10). However, competence beliefs (week 7) were not associated with students' positive achievement emotions (week 10). The association between students' perceived feedback on students' positive academic emotions was mediated through students' subjective task values ($\beta_{\text{ind}} = .12, S.E. = .04, p = .01; 95\% CI [.03; .20]$) but not through competence beliefs ($\beta_{\text{ind}} = .05, S.E. = .04, p = .22; 95\% CI [-.03; .13]$).

The need-supply fit regarding feedback (week 3) was weakly related to students' competence beliefs in the middle of the quarter in the most difficult course (week 7). The smaller the misfit between perceived feedback and students' need for feedback, the higher students reported on their competence beliefs. The same association holds for students' subjective task values. The association between the absolute need-supply fit regarding feedback on students' positive achievement emotions was mediated through students' subjective task values ($\beta_{\text{ind}} = -.07, S.E. = .04, p = .04; 95\% CI [-.14; -.002]$) but not through competence beliefs ($\beta_{\text{ind}} = -.03, S.E. = .03, p = .21; 95\% CI [-.08; .02]$).

The final step was to examine the R^2 (Cohen, 1988) and to answer whether the need-supply fit regarding feedback or the feedback itself is meaningfully associated with students' competence beliefs and subjective task values. Both the R^2 of the prediction of the need-supply fit ($.03 \leq R^2 \leq .04$) and students' perceived feedback ($.09 \leq R^2 \leq .12$) on students' competence beliefs and subjective task value indicated small associations.

Important Course. Students' perceived feedback (week 3) was positively but weakly associated with students' competence beliefs as well as positively and moderately associated with subjective task values in the most important course (week 7). Furthermore, students who reported higher subjective task values in their most important course (week 7) also reported higher positive achievement emotions at the end of the quarter (week 10). However, competence beliefs (week 7) were not associated with students' positive achievement emotions (week 10). The association between students' perceived feedback on students' positive academic emotions was mediated through students' subjective task values ($\beta_{\text{ind}} = .14$, $S.E. = .05$, $p = .003$; 95% CI [.05; .24]) but not through competence beliefs ($\beta_{\text{ind}} = .02$, $S.E. = .02$, $p = .49$; 95% CI [-.03; .06]).

The absolute need-supply fit regarding feedback (week 3) was weakly related to students' subjective task values but not to students' competence beliefs in the middle of the quarter (week 7). A smaller misfit between perceived feedback and students' need for feedback was associated with higher subjective task values. The association between the need-supply fit regarding feedback and students' positive academic emotions was mediated through students' subjective task values ($\beta_{\text{ind}} = -.09$, $S.E. = .04$, $p = .03$; 95% CI [-.18; -.01]) but not through competence beliefs ($\beta_{\text{ind}} = -.01$, $S.E. = .01$, $p = .51$; 95% CI [-.04; .02]).

Again, the final step was to examine whether the need-supply fit regarding feedback or the feedback was more strongly associated with students' competence beliefs and subjective task values. As an indicator, we used the R^2 (Cohen, 1988). The need-supply fit regarding feedback was weakly associated with competence beliefs ($R^2 = .01$) and weakly associated with subjective task values ($R^2 = .05$). In comparison, students' perceived feedback was weakly associated with competence beliefs ($R^2 = .06$) and moderately associated with subjective task value ($R^2 = .16$).

Table 2: Means, standard deviations and bivariate correlations among all included variables for the most difficult course (above the diagonal) and most important course (below the diagonal)

	Difficult course		Important course		1	2	3	4	5	6	7	
	M	SD	M	SD								
1	FIT.algebraic (week 3)	-1.67	2.19	1.10	1.99	1	.78***	.77***	-.83***	-.21**	-.23**	-.11
2	FIT.absolute (week 3)	2.14	1.74	1.61	1.60	.78***	1	.95***	-.79***	-.19**	-.21**	-.02
3	FIT.squared (week 3)	7.60	9.62	5.14	8.52	.79***	.94***	1	-.73***	-.15*	-.16	.02
4	Feedback (week 3)	4.18	1.95	4.77	1.85	-.80***	-.77***	-.72***	1	.31***	.35***	.18*
5	Competence beliefs (week 7)	3.85	1.38	4.67	1.48	-.12	-.11	-.05	.22*	1	.46**	.32**
6	Subjective task values (week 7)	4.29	1.58	5.04	1.47	-.17	-.25*	-.21	.40**	.41**	1	.41***
7	Positive academic emotions (week 10)	4.01a	1.35	4.01a	1.35	-.10	-.09	-.05	.21*	.24*	.41**	1

Note: $N = 225$ college students, ^a no course-specific factor, FIT.algebraic = algebraic fit indicator; FIT.absolute = absolute fit indicator; FIT.squared = squared fit indicator, * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3: Comparison of model indices for the three fit conceptions for the most difficult and important course

	Difficult course			Important course				
	Algebraic fit ^a	Absolute fit	Squared fit ^a	Feedback (no fit indicator)	Algebraic fit ^a	Absolute fit	Squared fit ^a	Feedback (no fit indicator)
χ^2	131.45	135.15	132.24	133.86	118.00	117.10	119.08	119.99
df	72	72	72	72	72	72	72	72
CFI	.95	.95	.95	.95	.97	.97	.97	.97
TLI	.94	.94	.94	.94	.96	.96	.96	.96
RMSEA	.06 95% CI [.04; .08]	.06 95% CI [.05; .08]	.06 95% CI [.04; .08]	.06 95% CI [.05; .08]	.055 95% CI [.04; .07]	.05 95% CI [.04; .07]	.05 95% CI [.04, .07]	.06 95% CI [.04; .07]
SRMR	.05	.05	.05	.05	.05	.05	.05	.05
AIC	9710.46	9619.12	10313.26	9675.37	9443.87	9350.92	10027.26	9418.89
BIC	9870.81	9779.47	10473.61	9835.93	9604.01	9511.05	10187.40	9579.24

Notes: ^aThe models with the algebraic and squared fit were not reported as the model with the absolute fit as predictors fits the data best.

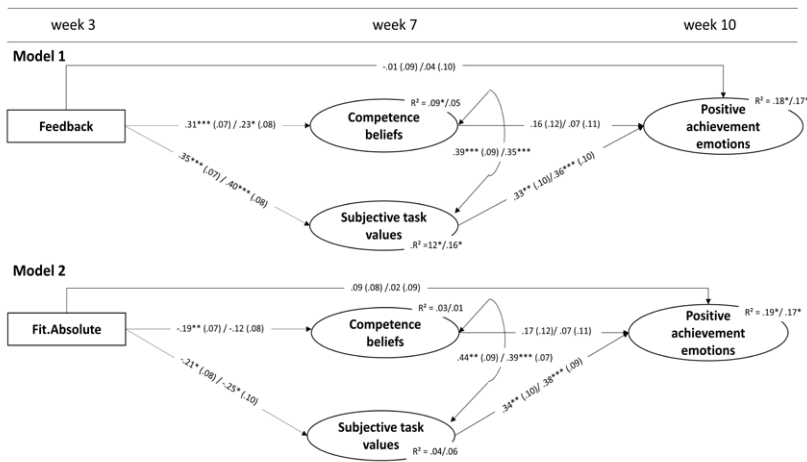


Figure 4: Final models with standardized coefficients for both fit indicators (Model 1) and feedback as predictor (Model 2) for both the most difficult course (coefficients before the slash) and most important course (coefficients after the slash)

Note: $N = 225$ college students, FIT.Absolute = absolute fit indicator; Feedback = perceived feedback during the first three weeks, reported are standardized β effects before parentheses and standard errors in parentheses, * $p < .05$; ** $p < .01$, *** $p < .001$.

4 Discussion

In this study, we investigated the extent to which feedback and the related need-supply fit were associated with students' positive achievement emotions in their most important and most difficult course. We further investigated whether these associations were mediated by students' course-specific competence beliefs and subjective task values. We addressed these research questions shortly after the transition to Emergency Remote Teaching in response to the COVID-19 pandemic. This was a particularly challenging time in which students' learning-related needs were of major interest for the discourse among researchers, practitioners, and the public. In the following, we discuss findings in detail.

First, in line with previous research, our results showed that students reported a high need for individualized feedback from instructors for their learning success in college courses (see also Şenel & Şenel, 2021; Sogunro, 2015). This result supports Klieme's assumption (2019) that feedback is an essential high-quality instructional strategy for students' learning.

We also found that more than 50 percent of students experienced a fit or only a small misfit ($\Delta_{\text{need} - \text{supply}} \leq 1$) between their need for feedback and their perceived feedback from instructors in their most important and difficult course. Interestingly, a higher percentage of students experienced a fit or only a small misfit ($\Delta_{\text{need} - \text{supply}} \leq 1$) in their most important course compared to their most difficult course. This result was because,

on average, feedback by instructors was perceived as higher in students' important courses in the first three weeks of the academic quarter compared to their most difficult course. Relevant to ask is whether instructors offer more feedback in courses students perceive as important or students' interpretation of feedback is related to students' course judgment (difficult versus important).

Second, this study demonstrated that the need-supply fit regarding feedback and students' perceived feedback were associated with students' motivational beliefs. However, differences occurred between the most important and difficult courses as the need-supply fit regarding feedback was not associated with students' competence beliefs in their most important courses. Guided by Cohen (1988) and the interpretation of the R^2 , we see that in the most difficult course, both the need-supply fit regarding feedback and the perceived feedback were weakly related to students' motivational beliefs. In the most important courses, the need-supply fit regarding feedback was weakly associated with students' motivational beliefs, whereas perceived feedback was weakly to moderately related to students' motivational beliefs. It might be that the need-supply fit regarding feedback was particularly important for students' motivational beliefs in courses they believe are difficult and challenging. As stated above, it might be that especially in a situation in which students struggle with courses' content and tasks (that was one reason why students' defined courses as difficult, see Rubach et al., 2022), instructors' feedback and the fit with students need for feedback provides sources to cope with such challenges. In our study, however, we did not know how the teachers provided feedback, which is a question that needs to be answered to understand underlining psychological mechanisms. It should be taken into account that there were four weeks between the surveys to assess the need-supply fit and the motivational beliefs. This time difference may explain the low correlation between these constructs. It is also possible that the fit has a particularly situational effect on students' motivational beliefs in courses.

We did not confirm our hypotheses that the need-supply fit regarding feedback was more important for students' motivational beliefs than the perceived feedback itself. However, Eccles et al. (1983) and Holland (1997) described that individuals choose by default the environment that matches their values and needs. It could be that the evaluation of feedback by students in both courses already considers students' need for feedback. In detail, it would be possible that students self-select their courses and instructor regarding their own needs, and that the subjective judgment of instructional quality thus takes into account students' needs. Supporting this, we found a strong correlation between students' reported feedback and the calculated need-supply fit ($-.83 \geq r \geq -.72$). Future scholars can consider these assumptions by using objective rankings of feedback in order to calculate a fit. As described above, the need-supply fit regarding feedback can be calculated using the direct, indirect, and objective approach to calculate the fit. It might be that the indirect fit that we have used to assess the need-supply fit did not fully capture the actual fit. Important for future studies is to assess all three fit approaches (direct, indirect, and ob-

jective approach) and examine the impact of various fits on college students' academic development (see for the direct fit approach, Pelikan et al., 2021). As raised above, the time differences between students' experienced fit and students' motivational beliefs should be decreased to investigate the situated nature of investigated associations (see Eccles & Wigfield, 2020).

Interesting is the question of whether the need-supply fit regarding feedback might be associated with changes in motivational beliefs. Thus, feedback may be positively related to all students' motivational beliefs, but the fit, in particular, might contribute to an increase in students' motivational beliefs. Furthermore, it would be possible that the fit, as shown, is not only associated with competence beliefs and subjective task values but influences other aspects, such as performance, the perception of psychological costs, procrastination, persistence, or negative achievement emotions (see Bohndick et al., 2018; Pelikan et al., 2021). These hypotheses could be tested in future studies.

Third, this study highlighted the importance of instructors in various courses as we found that feedback provided by instructors was associated with students' positive achievement emotions through students' course-specific subjective task values. We found that students who perceived feedback from their instructors in the first third of the quarter reported higher interest, attainment, and utility in their course in the middle of the quarter and reported about higher positive achievement emotions at the end of the academic quarter. These results highlight the intercorrelation of students' academic and personal environment, i. e., that instructors might impact students' well-being (see also Gilbreath et al., 2011). These results might also support the theoretical assumption that instructors matter for students' achievement emotions through subjective task values (Eccles et al., 1983; Pekrun, 2006). As highlighted in the situated expectancy-value theory (SEVT, see Eccles & Wigfield, 2020), students' subjective task values might be relevant drivers of students' successful and healthy academic development. However, the bi-directional links between achievement emotions, motivational beliefs, feedback and need-supply fit regarding feedback need to be investigated as we know that the perception of instructional quality depends on students' emotional well-being (see Rubach et al., 2022).

The question that arises is how to develop a feedback culture in college courses? First of all, colleges need to provide a protected and respectful learning environment in which students get timely, accessible, dialogical, individualized, specific, and constructive feedback (Forsythe & Johnson, 2017; Nicol, 2010). Students may be introduced to the perspective that feedback is beneficial to become aware of their competence and use it as a learning opportunity to grow in their competence. We recommend to (a) offer mentoring and coaching to challenge students' maladaptive behaviors and dispositions related to learning growth and feedback, (b) provide learning opportunities with different intensity levels where students learn to regulate positive and negative achievement emotions related to feedback, (c) actively offer feedback and encourage feedback-seeking and (d) introduce

students early in their studies to feedback theories, practices, and goals (Forsythe & Johnson, 2017). Furthermore, verbal feedback was perceived as higher qualitatively and more useful feedback than written feedback (Agricola et al., 2020). Verbal feedback also provides the opportunity to have a dialogue about learning growth with instructors (Elbow & Sorcinelli, 2011).

5 Limitations and Future Steps

There are several limitations to this study that warrant discussion as a function of testing the person-environment fit approach.

First, estimating the fit between students' need for feedback and the feedback they perceived is captured by the differences on both items (see also Gilbreath et al., 2011). We asked students to rate the importance of feedback for their successful learning in courses with a scale from 1 = *not at all important* to 7 = *extremely important*. Students also reported their perceived feedback from instructors on a scale from 1 = *not at all* to 7 = *very much*. The question arises whether the calculated difference of both items provides the most accurate information on the fit. We used a ratio scaling approach and assumed that the interpretation of the used rating scale is the same for both items. It might be relevant to ask students directly about the fit between the need for instructional quality and perceived instructional quality (subjective fit) or use different scaling approaches on the need and instructional quality, e. g., assess the frequency and quality of the feedback. Furthermore, the wording of the items is not completely identical, which might impact the fit calculation. For future studies, it might be beneficial to use various approaches to calculate the fit between the need for instructional quality and perceived instructional quality, i. e., the direct, indirect, and objective fit, and investigate the associations between all types of fit calculation.

Second, the need-supply fit regarding feedback was calculated with data from the beginning of the quarter. We were interested in whether the fit would be essential after the transition into Emergency Remote Teaching and students and instructors reported uncertainty in this situation. However, it might be that students do not receive much feedback in the first weeks of the quarter and that a misfit between needs and supplies does not become salient early in an academic quarter. Therefore, we ran additional analyses with data on perceived feedback in students' most important and difficult courses measured in weeks three and eight of the academic quarter. These additional results showed no meaningful changes in students' perceived feedback over the quarter in their most important (Time 1: $M = 4.19$, $SD = 1.98$, Time 2: $M = 4.36$, $SD = 1.91$, $t(197) = 1.51$, $p > .05$) and most difficult course on the same instructor (Time 1: $M = 4.77$, $SD = 1.90$, Time 2: $M = 4.57$, $SD = 2.01$, $t(199) = -1.14$, $p > .05$).

Third, this study focused on students' positive achievement emotions as these decreased with the COVID-19 pandemic's start (Prasath et al., 2021). Our study did not investigate students' negative achievement emotions in the academic context. It is also relevant to note that achievement emotions were assessed across all enrolled courses. One goal of the *Next Generation Undergraduate Success Measurement Project* was to investigate how course-specific experiences impact students' college experiences (see Arum et al., 2021). Future studies need to investigate the association between course-specific motivational beliefs and course-specific (positive and negative) achievement emotions for a robustness check. Also, it would be promising to investigate the impact of motivational beliefs for different types of positive and negative emotions such as hope, pride, enjoyment (positive emotions) or anger, anxiety and frustration (negative emotions). The same might be true for students' subjective task values. To understand underlying psychological mechanism in detail, we suggest to investigate students' subjective task values, i. e., interest, attainment, utility and also cost value, separately. It might be that feedback or the need-supply fit are more strongly related to some value components (e. g., perceived interest or cost values) than to other value components. Future studies need to take this into account.

Furthermore, we used some new instruments that were adapted to the context of higher education. Feedback, for example, was assessed with one item in order to calculate the fit (see above). We assessed if students received feedback on strengths and weaknesses from their instructors. Related to the content validity, we did not assess various dimensions of feedback. Future studies might investigate the importance of different aspects of feedback and their fit with students' needs on students' positive academic development (see for example Agricola et al., 2020).

Lastly, our study used data from one university in the United States. We want to encourage future scholars to replicate our findings with other samples, e. g., students from different universities or across countries.

In summary, we found that the need-supply fit regarding feedback was not more strongly associated with students' competence beliefs and subjective task values than the feedback from instructors overall. However, it might be that the need-supply fit related to other strategies of instructional quality matter for students' positive academic development during the COVID-19 pandemic. Especially at the beginning of the quarter, the need-supply fit regarding classroom management might be important for college students' course-specific motivational beliefs. Furthermore, it might be important to investigate whether the course format, i. e., synchronous, asynchronous, or hybrid courses, moderates the influence of instructional quality or the related need-supply fit regarding students' motivational beliefs and emotions. For example, feedback might have a stronger association with students' academic development in courses with limited social interactions compared to courses with more interactions between students and instructions. Overall, we see it as a relevant question whether high instructional quality matters for all students

in a college course or if the fit is even more relevant? However, based on our results, it might be that the need-supply fit is only beneficial for specific groups of students, e. g., students who struggle in courses.

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Open Science practices

The project *Improve Teaching, Motivational Beliefs, and Well-Being in Higher Education* was pre-registered on osf (<https://osf.io/jfzud/>). Instruments are provided in Table 1.

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