

# Reciprocal Path Model of Autonomous Motivation and Motivational Regulation: Socially Shared Regulation in Intellectual Group Activities

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## Abstract

Self- and social regulation are widely expected to increase autonomous motivation; however, few empirical studies have examined the reciprocal influences of autonomous motivation and motivational regulation. This study examined the reciprocal path model between autonomous motivation and three modes of motivational regulation (self-, co-, and socially shared regulation) in intellectual group activities by comparing university students with working adults. The participants were 181 university students and 295 working adults who completed an online questionnaire consisting of psychological measurements. With respect to autonomous motivation and the three modes of motivational regulation, a bidirectional model of university students and working adults was established and statistically analyzed on the basis of two time points of data, one month apart (T1 and T2). The hypothesized path model had a good fit through a multi-group structural equation modeling analysis. Autonomous motivation at T1 positively predicted socially shared regulation, co-regulation, and self-regulation at T2, one month later, for both groups. However, the three modes of regulation did not positively or significantly predict autonomous motivation in either group. Considering the reciprocal influences of autonomous motivation and motivational regulation, we discuss the necessity of implementing these practices in universities and workplaces.

**Keywords:** autonomous motivation, bidirectional relationship, group activity, socially shared regulation, university student, working adult

## 1. Introduction

Participation in intellectual group activities can be challenging, and a lack of autonomous motivation can lead to reduced performance levels. This is because a high degree of regulation is necessary for activities to proceed smoothly; however, this is not always possible. Group activities are complex, requiring self-regulation (Winters, Greene, & Costich, 2008; Zimmerman, 2000) and social regulation functions, including interpersonal relationships (Ito & Umemoto, 2022a; Järvelä & Hadwin, 2013; Uslu & Durak, 2022). The issue of regulation in group learning is becoming increasingly important, with studies of self-regulated and socially shared regulated learning providing important theories and findings (Hadwin, Järvelä, & Miller, 2018). It is expected that these regulations will increase autonomous motivation and, therefore, be effective. However, few empirical studies have examined the reciprocal influences of autonomous motivation and motivational regulation (Goto et al., 2017). (Note 1) Autonomous motivation may play a role in increasing the energy to actively engage in learning behaviors, which may, in turn, induce effective motivational regulation toward goal attainment. Conversely, it is possible that learners effectively regulate their own motivation, which may further increase their own autonomous motivation. As a bidirectional relationship may exist, it is significant to empirically clarify which factor is more likely to precede the other in time as a psychological study. Considering the sequential nature of temporal influences, it is expected that the motivational support required in the context of educational practice will be clarified. For example, providing motivational support that enhances autonomous motivation in the prior phase may induce effective motivational regulation in the following phases.

In today's lifelong learning society, it is important to be highly autonomously motivated to engage in group activities in the context of both higher education and adult learning (Ito & Umemoto, 2022b). It is not easy to achieve superior accomplishments in the context of intellectual group activities, either at the university or in the workplace (Johnson, Johnson, & Smith, 2007; Luff, Hindmarsh, & Heath, 2000). In addition to autonomous motivation, motivational regulation is required to achieve long-term goals and solve complex and difficult problems (Engelschalk, Steuer, & Dresel, 2016; Wolters, 1998, 2003). Examining the differences between university students and working adults can provide important suggestions for practical interventions in the context of each activity (Ito & Umemoto, 2022b). Intellectual group activities vary between working adults and university students, leading to distinct characteristics in the associations between autonomous motivation and motivational regulation. For example, working adults will have many opportunities to work collaboratively with supervisors and coworkers of diverse ages in the workplace, and effective motivation regulation will be required. There may be a possibility that effective motivation regulation precedes and then facilitates the increase in autonomous motivation. If the differences in the bidirectional relationship between autonomous motivation and motivational regulation are clarified for university students and working adults, it will be possible to consider concrete educational practices from a long-term perspective, according to the context of each activity. It is essential and meaningful in psychological theory and educational practice to elucidate the bidirectional relationship between autonomous motivation and motivational regulation.

### *1.1 Autonomous Motivation and Motivational Regulation*

Autonomous motivation refers to engaging in an activity with a full sense of willingness, volition, and choice (Deci & Ryan, 2008); it is an important factor in effective and deep learning processes and has been shown to positively predict higher academic achievement among university students (Deci & Ryan, 2008; Graham & Vaughan, 2022). Moreover, Honkala, Heikkinen, Lehtovuori, and Leppävirta (2015) have indicated the possibility that autonomously motivated students benefit from collaborative learning. Autonomous motivation is an essential psychological factor for achieving desired results in both individual and group tasks. That is, it is a major driving force in situations where an individual is working independently toward an individual learning goal or in situations where members of a group work toward a common goal.

The psychological state of motivation is never stable or changeable (Sansone, Weir, Harpster, & Morgan, 1992; Wigfield & Eccles, 2002). Depending on the situation, learners must be able to regulate their motivation to maintain or increase it. The implementation of strategies to generate and maintain motivation has been called "motivational regulation" and has been widely empirically studied (Umemoto, 2015; Wolters, 1998, 2003). In particular, regulating autonomous motivation is linked to adaptive learning behaviors (Ito & Shinto, 2003; Umemoto, 2015). In recent years, it has become apparent that self-regulation and social regulation of motivation play important roles in group and paired activities (Bakhtiar & Hadwin, 2020; Ito & Umemoto, 2022a, 2022c). This social regulation includes two modes: "co-regulation," based on bilateral relationships, and "socially shared regulation," which operates within a group (Hadwin et al., 2018; Ito & Umemoto, 2022a, 2022c). According to Järvelä and Hadwin (2013), the three modes of regulation specifically include the following contents: In the first mode, learners regulate their own learning by applying their learning strategies that monitor and evaluate their own cognitive activities. In the second mode, one learner either guides or is supported by another learner in what is called co-regulation of learning (CoRL). In the third mode, multiple learners interdependently regulate the collaborative learning process and jointly regulate their own learning processes through social interaction. Socially shared regulation of learning (SSRL) is considered the most important mode of social regulation, but it has not yet been sufficiently verified. There are many opportunities to collaborate with others, both in practical educational situations at school and in team activities at work. By evaluating and supporting the status of CoRL and SSRL, as well as self-regulation in collaborative activities, university educators and workplace supervisors can anticipate that group members are likely to perform excellently. It is thus significant, both theoretically and practically, to elucidate the psychological functions of the three modes of regulation.

### *1.2 Bidirectional Relationship between Autonomous Motivation and Motivational Regulation*

Few studies have examined the bidirectional relationship between autonomous motivation and motivational regulation. A notable exception is Goto et al. (2017), who conducted a three-point survey of junior high and high school students and found that autonomous motivation negatively predicted the subsequent extrinsic component of motivational regulation strategies, which in turn negatively predicted subsequent autonomous motivation. The extrinsic component refers to strategies to maintain or increase motivation to learn using rewards and other external means. Their study, however, suffers from the limitation that only self-regulation strategies were addressed; neither social regulation nor the regulation of autonomous motivation was examined. The current study addresses these

issues.

### 1.3 Objectives of This Study

Although previous research (Goto et al., 2017) has been conducted at six-month intervals, we expect to find clearer reciprocal influences between autonomous motivation and motivational regulation of autonomous motivation in surveys with shorter intervals. In a survey conducted at three-month intervals, Tang and Toyama (2020) demonstrated that self-regulation of autonomous motivation (i.e., enhancement of situational interest) enhanced affect-related interest in difficult learning situations. Although previous studies have focused on learning situations in which students work individually, the present study focuses on intellectual group activities. In addition to self-regulation, this study addresses two other modes of regulation: co-regulation and socially shared regulation. Considering the possibility of designing lessons for university courses and workplace training, this study was conducted at one-month intervals. A comparison between university students and working adults can also present suggestions from a longer-term perspective, that is, regarding “transitions” from higher education to adult learning in the workplace. The results of these comparisons can provide clues for ways to support the growth and development of both populations. Regarding the self-evaluation of the three modes of regulation and performance level, previous studies have shown that working adults tend to have more severe self-evaluations (Ito & Umemoto, 2022b). This self-evaluation refers to a psychometric method, whereby university students and working adults are asked to self-evaluate their degree of motivational regulation and performance level utilizing a psychological scale.

In this study, a bidirectional model is formulated, as shown in Figure 1. With respect to autonomous motivation and the three modes of motivational regulation, a bidirectional model of university students and working adults is established and statistically analyzed based on two time points of data. This is a novel exploratory study for which previous research is scarce.

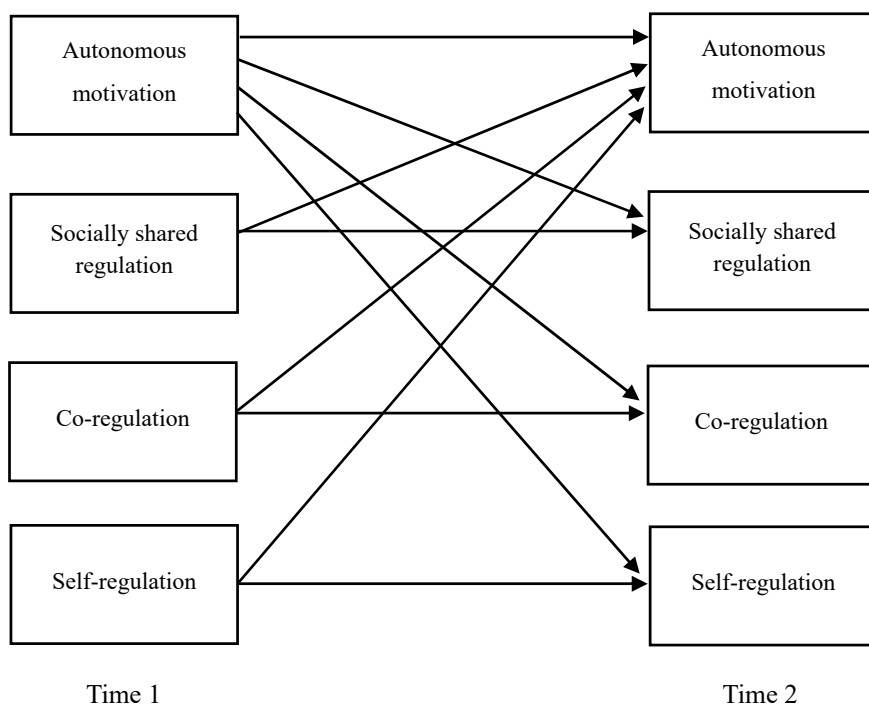


Figure 1. Hypothesized paths between autonomous motivation and motivational regulation at two time points

## 2. Methods

### 2.1 Participants

Four hundred and seventy-six individuals (181 university students and 295 working adults) from Japan participated in this study. The students included 118 women and 63 men (comprising 40, 40, 55, and 46 first-, second-, third-, and fourth-year students, respectively) with a mean age of 20.77 years (standard deviation [ $SD$ ] = 1.34 years). Of these, 101 students were enrolled in private universities, and 80 were enrolled in national, prefectural, and other public universities. The 295 working adults included 77 women and 218 men (mean age = 39.58 years,  $SD$  = 6.10 years), with an average of 12.68 ( $SD$  = 7.51) years of employment. Respondents were full-time employees; company owners, executives, and part-time employees were excluded. The first survey (Time 1: T1) was conducted in February 2022 and the second (Time 2: T2) in March 2022. After informed consent was obtained, participants completed an online questionnaire through a research firm. This study was approved by the research ethics committee of the Faculty of Human-Environment Studies at Kyushu University (approval number: 2021-031). The study was conducted according to the Declaration of Helsinki for experiments involving humans.

In this survey, questions for another study purpose were included. These items were excluded from data analysis.

### 2.2 Three Modes of Regulation of Intrinsic Motivation

First, we asked the survey participants to describe the “group activities” they had experienced in the past month to confirm that they were appropriate for this analysis. “Group activities” refer to intellectual activities that primarily involve thinking and creativity such as solving problems in school education and projects in the workplace or community. Groups consisted of approximately four to eight people who met together several times.

Participants self-reported the extent of their intrinsic motivational regulation in group activities using a questionnaire. The questionnaire contained Ito and Umemoto’s (2022b) scale, which comprises five items, respectively, for self-regulation (“I try to increase my motivation by making the contents of group activities interesting,” “I try to increase my motivation by thinking that the contents of group activities are highly significant,” “I try to increase my motivation by making the contents of group activities as enjoyable as possible,” “I try to increase my motivation by recognizing that there is great value in the activities,” and “I try to increase my motivation by linking the contents of group activities with my interests”), co-regulation (“I try to support the motivation of the group member by devising ways to make the member find the contents of group activities interesting,” “I try to support the motivation of the group member by encouraging the member to consider the contents of group activities as highly significant,” “I try to support the motivation of the group member by making the contents of group activities as enjoyable as possible,” “I try to support the motivation of the group member by making the member recognize that there is great value in the activities,” and “I try to support the motivation of the group member by linking the contents of group activities with things that the member might be interested in”), and socially shared regulation (“I try to support the motivation of the entire group by devising ways to make them find the contents of group activities interesting,” “I try to support the motivation of the entire group by encouraging them to consider the contents of group activities as highly significant,” “I try to support the motivation of the entire group by making the contents of group activities as enjoyable as possible,” “I try to support the motivation of the entire group by making them recognize that there is great value in the activities,” and “I try to support the motivation of the entire group by linking the contents of group activities with things that all group members might be interested in”). Ito and Umemoto’s (2022b) scale was confirmed to have a high reliability coefficient in their study. In addition, the construct validity was examined. Items are rated on a 1–7 bipolar Likert scale, with responses ranging from “1” for “I don’t agree at all” to “7” for “I agree strongly.” The scores were used for subsequent analyses. The same is true for all the subsequent measurements. The questionnaire was administered again one month later.

### 2.3 Autonomous Motivation for Group Activities

Survey participants were asked about the average time spent per week participating in group activities. They were asked about the degree of autonomous motivation they felt at the time while engaged in the activity. Based on previous research (Hayamizu, 1997; Ryan & Connell, 1989; Vallerand & Bissonnette, 1992), an autonomous motivation for group activities questionnaire that included identified and intrinsic motivations was developed. Three educational psychology experts, i.e., the authors objectively verified the construct validity of the content. This questionnaire consists of 10 items: “I like group activities,” “I enjoy group activities,” “I find group activities interesting,” “I like to learn in group activities,” “I enjoy being able to grow through group activities,” “I like to widen my perspective through group activities,” “I think it is important to participate in group activities,” “I find it is significant to learn new things through group activities,” “I think it is important to work hard in group activities,”

and “I think it is meaningful to address difficult tasks through group activities.” These items are rated on a 1–7 bipolar Likert scale. The questionnaire was administered again one month later.

#### 2.4 Previous Performance Level and Method of Group Activities

To assess individual’s previous performance level in group activities, we asked the participants to self-evaluate the collaborative activities in the group in the past month. Based on Ito and Umemoto’s scale (Ito & Umemoto, 2022b), the following three questionnaire items were used: “I think I have been hugely successful through various group activities in the past month,” “I think I have made many achievements in various group activities in the past month,” and “I think I have played an important role in leading success in various group activities in the past month.”

Considering the COVID-19 situation, we also asked whether the group activities for the past month were mainly face-to-face or online. Participants described the activities and assigned a number to the approximate percentage of time spent on each activity, with a total of 100%. The following items were included in the questionnaire to clarify the degree of preference for face-to-face and online activities, respectively: “I think group activities are preferable in a face-to-face setting,” and “I think group activities are preferable to be done online.” These items were rated on a 1–7 bipolar Likert scale. Previous performance level, percentage of face-to-face and online activities, preference for face-to-face and online activities, and average time spent per week on group activities were used as control variables in the path model.

#### 2.5 Data Analysis

The data analysis in this study is explained below. First, we conducted a multi-group confirmatory factor analysis using structural equation modeling to confirm the factor structure in the two groups (university students and working adults). At this time, equality constraints were assumed for the factor loadings between the two groups and the intercepts of each item. In other words, this analysis confirmed the scalar invariance between the two groups. Next, we constructed each variable after confirming its internal consistency. Third, we used a *t*-test to examine the mean difference between university students and working adults for each variable. At the same time, factor means were compared through multi-group analysis with a mean structure using the confirmatory factor analysis model (scalar invariance model) described above. Fourth, a correlation analysis was performed to examine the relationship between each variable separately for the two groups. Finally, to verify the hypothesis in Figure 1, we performed multi-group path analysis using structural equation modeling. In this model, each coefficient was freely estimated between two groups. All statistical analyses were conducted using the statistical software package R version 4.2.0 and lavaan package.

### 3. Results

#### 3.1 Confirmatory Factor Analysis

Confirmatory factor analysis was conducted to examine the factorial validity of each scale. In the following sections, the first and second time points are denoted as T1 and T2, respectively. The parameters were estimated using the maximum likelihood method. Regarding the factor loadings and intercepts of each item, we assumed equality constraints between the two groups: university students and working adults. The goodness of fit was as follows: for autonomous motivation T1,  $\chi^2(88) = 734.766$ ,  $p = .000$ , standardized root mean squared residual (SRMR) = .064, comparative fit index (CFI) = .867; socially shared regulation T1,  $\chi^2(18) = 79.560$ ,  $p = .000$ , SRMR = .030, CFI = .971; co-regulation T1,  $\chi^2(18) = 63.283$ ,  $p = .000$ , SRMR = .030, CFI = .976; self-regulation T1,  $\chi^2(18) = 70.567$ ,  $p = .000$ , SRMR = .032, CFI = .970; autonomous motivation T2,  $\chi^2(88) = 956.845$ ,  $p = .000$ , SRMR = .065, CFI = .842; socially shared regulation T2,  $\chi^2(18) = 42.638$ ,  $p = .001$ , SRMR = .028, CFI = .989; co-regulation T2,  $\chi^2(18) = 57.200$ ,  $p = .000$ , SRMR = .030, CFI = .982; self-regulation T2,  $\chi^2(18) = 77.240$ ,  $p = .000$ , SRMR = .027, CFI = .971; and performance,  $\chi^2(4) = 5.919$ ,  $p = .205$ , SRMR = .029, CFI = .998. Although some CFI values were low, the indicators for each scale had approximately satisfactory values. Factor loadings were higher than .750 for all scales.

#### 3.2 Reliability and Descriptive Statistics

Reliability coefficients were calculated for all scales. The results are summarized in Table 1. Notably, all the values were high. As in previous studies, the mean values of the items were calculated for each scale, and the scale scores were used in subsequent analyses. Table 1 presents the mean scores, standard deviations, and reliability coefficients for each group.

Table 1. Descriptive statistics and reliability coefficients of study variables for each group and the *t*-test results

Time	Name of variable	University students (N=181)			Working adults (N=295)			<i>t</i>	<i>d</i>
		Mean	$\alpha$	$\omega$	Mean	$\alpha$	$\omega$		
Time 1	Autonomous motivation (10 items)	5.02	.96	.97	4.82	.96	.97	1.71	0.16
		1.35			1.21				
	Socially shared regulation (5 items)	4.48	.94	.96	4.58	.94	.95	-0.85	0.08
		1.41			1.28				
	Co-regulation (5 items)	4.44	.94	.95	4.68	.92	.94	-2.05*	0.19
		1.40			1.17				
	Self-regulation (5 items)	4.62	.93	.94	4.71	.92	.93	-0.77	0.07
		1.39			1.17				
	Performance level (3 items)	4.71	.95	.95	4.56	.92	.92	1.11	0.10
		1.59			1.27				
Time 2	Percentage of face-to-face	53.61			68.21			-3.88***	0.37
		41.61			38.84				
	Average time	3.59			3.60			-0.02	0.00
		8.16			5.94				
	Preference of face-to-face	5.19			4.93			1.94	0.18
		1.52			1.43				
Time 2	Preference of online	4.28			4.20			0.54	0.05
		1.71			1.43				
	Autonomous motivation (10 items)	5.05	.96	.98	4.59	.96	.98	3.57***	0.34
		1.36			1.34				
	Socially shared regulation (5 items)	4.63	.95	.95	4.41	.94	.96	1.73	0.16
		1.41			1.31				
	Co-regulation (5 items)	4.68	.94	.96	4.44	.95	.96	1.80	0.17
	1.43			1.33					
Time 2	Self-regulation (5 items)	4.77	.94	.96	4.47	.93	.95	2.32*	0.22
		1.43			1.30				

Note. Numbers below the mean indicate *SD*. Abbreviation: *SD*, standard deviation; \*\*\* $p < 0.001$ , \* $p < 0.05$ .

### 3.3 Comparison of Average Scores between University Students and Working Adults

To examine the mean differences in the variables between the groups, a *t*-test was conducted (Table 1). The *t*-test was adopted to make it possible to compare the results with those of previous studies. Although the effect sizes were small, some of the results were statistically significant. Simultaneously, we tested the above model with the mean structure using multiple-group structural equation modeling. Therefore, the goodness of fit of each analysis below was similar to that of the confirmatory factor analysis. The results show that the differences in means were similarly significant: co-regulation at T1 ( $z = -1.998, p = .046$ ), autonomous motivation at T2 ( $z = 3.624, p = .000$ ), and self-regulation at T2 ( $z = 2.301, p = .021$ ). The results revealed that the average scores of autonomous motivation T2 and self-regulation T2 in university students were significantly higher than those in working adults. The average co-regulation T1 score in working adults was higher than that in university students.

### 3.4 Results of Correlation Analysis

The results of calculating the correlation coefficients between autonomous motivation, socially shared regulation,

co-regulation, self-regulation, previous performance level, percentage of face-to-face and online activities, average time spent per week on group activities, and preferences for face-to-face and online activities are presented in Tables 2 and 3.

Table 2. Correlation analysis between autonomous motivation, motivational regulation, and the control variables in university students

Time	Name of variable	1	2	3	4	5	6
Time 1	Autonomous motivation						
	Socially shared regulation	.76***					
	Co-regulation	.66***	.87***				
	Self-regulation	.70***	.80***	.78***			
	Performance level	.70***	.64***	.54***	.58***		
	Percentage of face-to-face	.01	.03	.03	-.05	.04	
	Average time	.05	.00	-.03	.05	-.02	.04
	Preference of face-to-face	.58***	.42***	.39***	.45***	.37***	.04
	Preference of online	.35***	.44***	.43***	.42***	.35***	-.16*
Time 2	Autonomous motivation	.83***	.70***	.60***	.64***	.56***	.05
	Socially shared regulation	.65***	.76***	.67***	.70***	.58***	.05
	Co-regulation	.66***	.77***	.66***	.66***	.51***	.08
	Self-regulation	.62***	.70***	.63***	.70***	.62***	.02
Time	Name of variable	7	8	9	10	11	12
Time 1	Autonomous motivation						
	Socially shared regulation						
	Co-regulation						
	Self-regulation						
	Performance level						
	Percentage of face-to-face						
	Average time						
	Preference of face-to-face	.10					
	Preference of online	-.06	.01				
Time 2	Autonomous motivation	.04	.54***	.31***			
	Socially shared regulation	-.07	.36***	.43***	.78***		
	Co-regulation	-.03	.39***	.43***	.74***	.86***	
	Self-regulation	.01	.36***	.45***	.70***	.87***	.82***

Note. \*\*\* $p < 0.001$ , \* $p < 0.05$ .

Table 3. Correlation analysis between autonomous motivation, motivational regulation, and the control variables in working adults

Time	Name of variable	1	2	3	4	5	6
Time 1	Autonomous motivation						
	Socially shared regulation	.72***					
	Co-regulation	.72***	.83***				
	Self-regulation	.75***	.77***	.80***			
	Performance level	.74***	.79***	.68***	.66***		
	Percentage of face-to-face	.00	.01	.00	.01	-.04	
	Average time	.04	.07	.05	.03	.10	-.11
	Preference of face-to-face	.60***	.51***	.54***	.61***	.48***	.11
Preference of online	.30***	.35***	.34***	.32***	.40***	-.17**	
Time 2	Autonomous motivation	.72***	.57***	.57***	.59***	.57***	-.07
	Socially shared regulation	.57***	.62***	.59***	.59***	.55***	-.03
	Co-regulation	.55***	.59***	.57***	.56***	.53***	-.04
	Self-regulation	.60***	.54***	.56***	.62***	.50***	-.05
Time 1	Autonomous motivation						
	Socially shared regulation						
	Co-regulation						
	Self-regulation						
	Performance level						
	Percentage of face-to-face						
	Average time						
	Preference of face-to-face	-.07					
Preference of online	.14*	.05					
Time 2	Autonomous motivation	.03	.44***	.24***			
	Socially shared regulation	.06	.44***	.27***	.80***		
	Co-regulation	.06	.38***	.27***	.79***	.91***	
	Self-regulation	-.01	.44***	.23***	.81***	.84***	.87***

Note. \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

### 3.5 Path Model Analysis

We hypothesized a path model in which the three modes of motivational regulation and autonomous motivation at T1 predicted the three modes of motivational regulation and autonomous motivation at T2. Covariance was assumed between errors for each variable simultaneously. Previous performance level, percentage of face-to-face and online activities, preference for face-to-face and online activities, and the average time spent per week on group activities were included as control variables. The hypothesized model was verified using multigroup structural equation modeling. In this model, free estimation was performed without placing equality constraints on each coefficient between two groups. The goodness of fit index of the model was satisfactory with  $\chi^2(12) = 82.245$ ,  $p = .000$ , SRMR = .028, CFI = .986. The results of this analysis are presented in Table 4 and Figure 2.



Table 4. Multi-group structural equation modeling analysis on the path model for autonomous motivation and motivational regulation

Criterion Predictor	University students					
	<i>B</i>	<i>SE</i>	<i>95%CI</i>	$\beta$	<i>p</i>	
<b>Autonomous motivation</b>						
Autonomous motivation	0.79	0.08	0.64	0.94	.78	0.000
Socially shared regulation	0.08	0.08	-0.08	0.23	.08	0.342
Co-regulation	-0.03	0.07	-0.16	0.10	-.03	0.624
Self-regulation	-0.05	0.06	-0.17	0.06	-.05	0.382
Performance level	-0.05	0.05	-0.14	0.05	-.05	0.371
Percentage of face-to-face	0.00	0.00	0.00	0.00	.04	0.333
Average time	0.00	0.01	-0.01	0.01	.00	0.928
Preference of face-to-face	0.10	0.05	0.01	0.19	.11	0.032
Preference of online	0.05	0.04	-0.03	0.12	.06	0.226
<i>R</i> <sup>2</sup>					.70	
<b>Socially shared regulation</b>						
Autonomous motivation	0.25	0.09	0.08	0.43	.25	0.004
Socially shared regulation	0.28	0.05	0.17	0.38	.29	0.000
Performance level	0.13	0.06	0.01	0.25	.15	0.035
Percentage of face-to-face	0.00	0.00	0.00	0.01	.06	0.203
Average time	-0.01	0.01	-0.03	0.00	-.07	0.136
Preference of face-to-face	0.05	0.06	-0.06	0.16	.06	0.372
Preference of online	0.15	0.05	0.06	0.24	.19	0.001
<i>R</i> <sup>2</sup>					.56	
<b>Co-regulation</b>						
Autonomous motivation	0.44	0.09	0.26	0.62	.43	0.000
Co-regulation	0.18	0.06	0.08	0.29	.18	0.001
Performance level	0.01	0.07	-0.11	0.14	.01	0.849
Percentage of face-to-face	0.00	0.00	0.00	0.01	.10	0.063
Average time	-0.01	0.01	-0.03	0.01	-.05	0.350
Preference of face-to-face	0.07	0.06	-0.05	0.19	.07	0.253
Preference of online	0.18	0.05	0.08	0.27	.21	0.000
<i>R</i> <sup>2</sup>					.53	
<b>Self-regulation</b>						
Autonomous motivation	0.18	0.09	0.00	0.35	.17	0.048
Self-regulation	0.21	0.05	0.10	0.31	.20	0.000
Performance level	0.26	0.06	0.13	0.38	.29	0.000
Percentage of face-to-face	0.00	0.00	0.00	0.01	.05	0.325
Average time	0.00	0.01	-0.02	0.02	.01	0.889
Preference of face-to-face	0.06	0.06	-0.06	0.18	.07	0.299
Preference of online	0.18	0.05	0.09	0.28	.22	0.000
<i>R</i> <sup>2</sup>					.55	

Criterion Predictor	Working adults					
	<i>B</i>	<i>SE</i>	<i>95%CI</i>	$\beta$	<i>p</i>	
<b>Autonomous motivation</b>						
Autonomous motivation	0.74	0.08	0.59	0.89	.67	0.000
Socially shared regulation	-0.01	0.06	-0.13	0.12	-.01	0.919
Co-regulation	-0.03	0.06	-0.16	0.10	-.03	0.639
Self-regulation	-0.01	0.06	-0.13	0.11	-.01	0.899
Performance level	0.09	0.07	-0.05	0.23	.08	0.221
Percentage of face-to-face	0.00	0.00	-0.01	0.00	-.07	0.113
Average time	0.00	0.01	-0.02	0.02	-.01	0.901
Preference of face-to-face	0.02	0.05	-0.08	0.12	.02	0.649
Preference of online	0.01	0.04	-0.08	0.09	.01	0.879
<i>R</i> <sup>2</sup>					.52	
<b>Socially shared regulation</b>						
Autonomous motivation	0.26	0.08	0.10	0.41	.24	0.002
Socially shared regulation	0.17	0.04	0.08	0.25	.17	0.000
Performance level	0.16	0.08	0.01	0.31	.16	0.037
Percentage of face-to-face	0.00	0.00	0.00	0.00	-.03	0.512
Average time	0.00	0.01	-0.02	0.02	.02	0.708
Preference of face-to-face	0.13	0.05	0.03	0.24	.14	0.014
Preference of online	0.06	0.05	-0.03	0.15	.07	0.183
<i>R</i> <sup>2</sup>					.40	
<b>Co-regulation</b>						
Autonomous motivation	0.29	0.09	0.13	0.46	.27	0.001
Co-regulation	0.14	0.04	0.06	0.23	.13	0.001
Performance level	0.19	0.08	0.04	0.34	.18	0.013
Percentage of face-to-face	0.00	0.00	0.00	0.00	-.02	0.638
Average time	0.00	0.01	-0.02	0.02	.02	0.726
Preference of face-to-face	0.06	0.06	-0.05	0.17	.07	0.272
Preference of online	0.06	0.05	-0.03	0.16	.07	0.196
<i>R</i> <sup>2</sup>					.36	
<b>Self-regulation</b>						
Autonomous motivation	0.39	0.08	0.24	0.55	.37	0.000
Self-regulation	0.21	0.05	0.11	0.30	.19	0.000
Performance level	0.07	0.07	-0.07	0.22	.07	0.298
Percentage of face-to-face	0.00	0.00	-0.01	0.00	-.06	0.207
Average time	-0.01	0.01	-0.03	0.01	-.04	0.424
Preference of face-to-face	0.07	0.05	-0.04	0.17	.07	0.225
Preference of online	0.02	0.05	-0.07	0.11	.02	0.722
<i>R</i> <sup>2</sup>					.41	

Note. Abbreviations: *SE*, standard error; *95%CI*, 95% confidence interval.

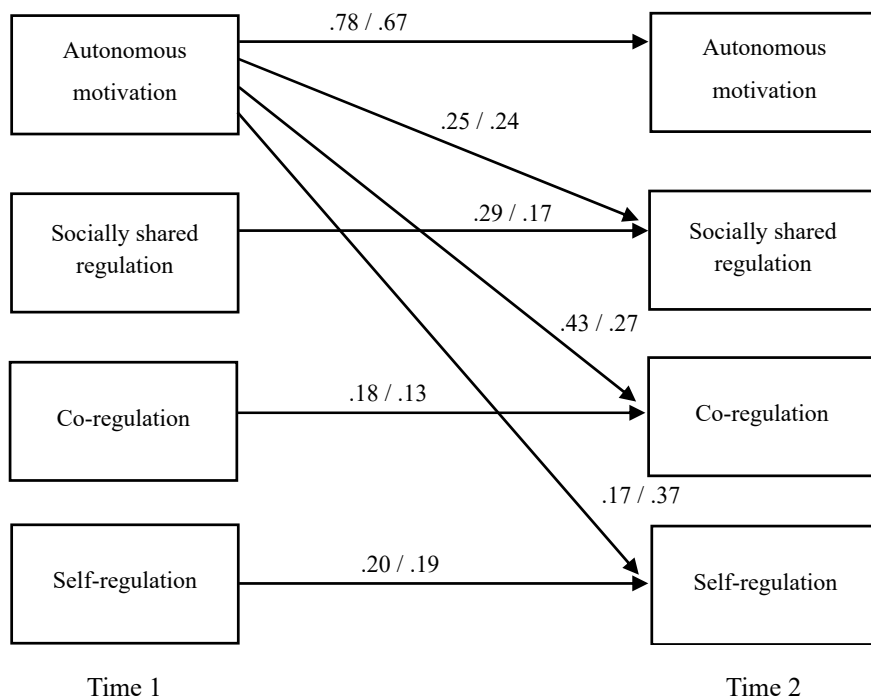


Figure 2. Path analysis of autonomous motivation and the three motivational regulation modes at two time points  
*Note.* Paths significant at  $p < .05$  are indicated by arrows, and coefficient values ( $\beta$ ) indicate university students on the left and working adults on the right.

First, the positive paths from autonomous motivation in T1 to T2 were significant for both university students and working adults. The positive path from the preference for face-to-face activities to autonomous motivation T2 was significant for university students. Second, the positive paths from autonomous motivation at T1, socially shared regulation at T1, and previous performance level to socially shared regulation at T2 were significant for both groups. The positive path from preference for online activities to socially shared regulation at T2 was significant for university students. The positive path from preference for face-to-face activities to socially shared regulation at T2 was significant for working adults. Third, the positive paths from autonomous motivation at T1 and co-regulation at T1 to co-regulation at T2 were significant in both groups. The positive path from a preference for online activities to co-regulation in T2 was significant for university students. The positive path from the previous performance level to co-regulation at T2 was significant for working adults. Fourth, the positive paths from autonomous motivation at T1 and self-regulation at T1 to self-regulation at T2 were significant in both groups. Positive paths from previous performance levels and preference for online activities to self-regulation at T2 were significant for university students.

## 4. Discussion

### 4.1 The Differences between University Students and Working Adults

The  $t$ -test results showed no significant differences between university students and working adults on most scales, with significant differences for only three scales. Consistent with the results of a previous study (Ito & Umemoto, 2022b), university students' self-evaluations of autonomous motivation at T2 and self-regulation at T2 were optimistic. Only co-regulation at T1 was higher in working adults than in university students. This finding may reflect the importance of successful relationships with one's partners in the workplace.

### 4.2 The Path Model between the Two Points of Autonomous Motivation and Three Modes of Motivational Regulation

This study examined a path model between two points of autonomous motivation and three modes of motivational regulation by comparing university students and working adults. Only autonomous motivation at T1 predicted autonomous motivation at T2 in both groups. Perhaps autonomous motivation is prone to change over time, and the effects of motivational regulation at T1 did not extend for one month into the future. Among the control variables, the degree of preference for face-to-face activities predicted autonomous motivation at T2 for university

students. This may be due to the COVID-19 pandemic, which has restricted face-to-face activities at universities. During this period, some survey data (e.g., Uchida & Kurosawa, 2021) have shown that Japanese university students tended to prefer face-to-face classes.

However, autonomous motivation at T1 predicted socially shared regulation at T2 one month later in both groups. As a result, socially shared regulation at T1 predicted socially shared regulation at T2. When autonomous motivation is high, it can be a driving force, promoting the social regulation of motivation. According to Deci and Ryan (2008), previous research has shown that autonomous motivation predicts persistence and adherence and is advantageous for effective performance, especially regarding complex or heuristic tasks that involve deep information processing or creativity. The finding that autonomous motivation predicts social regulation of motivation is novel. Simultaneously, the previous performance level predicted socially shared regulation at T2, one month later. In both groups, high performance levels may have been essential for regulating autonomous motivation in group intellectual activities. Particularly, a high degree of competence may be required to encourage a whole group. For the control variables, the significant paths differed between university students and working adults. That is, when university students had a stronger preference for online activities and working adults had a stronger preference for face-to-face activities, both groups indicated superior socially shared regulation at T2, one month later. During the COVID-19 pandemic, university students tended to take classes mostly online, while working adults tended to continue their activities, mainly face-to-face. They had experienced many of these activities and formed a positive image of them, either face-to-face or online, which may have influenced their propensity to perform socially shared regulation.

In addition, autonomous motivation at T1 predicted co-regulation at T2 one month later in both groups. Co-regulation at T1 predicted co-regulation at T2. When autonomous motivation was high, both university students and working adults effectively regulated their partners' autonomous motivation in an activity group. For working adults, the previous performance level predicted co-regulation at T2, one month later. It has been noted that Japanese workplaces are becoming increasingly difficult to foster collaboration owing to a lack of communication (Nakamura, Shiomi, & Takagi, 2010). A high level of interpersonal skills within an organizational group is required to build collaborative relationships with workplace partners. However, group activities in which university students engage may build on existing friendships within the university classroom. Similar to the results for socially shared regulation at T2 as a subsequent variable, the degree of preference for online activities predicted co-regulation at T2 for university students.

Moreover, both autonomous motivation and self-regulation at T1 predicted self-regulation at T2 in both groups. Self-regulation at T1 predicted self-regulation at T2. When autonomous motivation was high, both university students and working adults effectively regulated their autonomous motivation through group activities. For university students, the previous performance level predicted self-regulation at T2. In university group activities, the ability to self-regulate motivation may be considered adaptive. In particular, classmates at Japanese universities are usually of the same age and generation. Tasks and human relationships that are engaged in groups at universities are less complex than those engaged in by working adults. Therefore, self-regulation is more likely to be effective. Similar to the results for co-regulation at T2 as a subsequent variable, the degree of preference for online activities predicted self-regulation at T2 for university students. During the COVID-19 pandemic, positive images of online activities may have promoted self-regulation. These results indicate that while there are common features between university students and working adults in the bidirectional relationship between autonomous motivation and motivational regulation in intellectual group activities, there are also some meaningful differences.

#### *4.3 Practical Implications and Limitations*

Clarifying which factor—autonomous motivation or motivational regulation—precedes others in time can provide suggestions on how to proceed with educational practice. The results of this study suggest that autonomous motivation is a significant antecedent of the three modes of motivational regulation for both university students and working adults. In both universities and workplaces, guidance and support to increase autonomous motivation during group activities are key and can encourage the three modes of motivational regulation. However, both university education practitioners and personnel/staff training officers in the workplace should consider that it is difficult to influence autonomous motivation one month later by promoting the three modes of motivational regulation. Practical interventions based on the fact that socially shared regulation of motivation improves as the level of performance in group activities increases are also important for both groups. Working adults may particularly require support to improve co-regulation of motivation by increasing the level of performance of group activities. Specifically, guidance to increase the level of performance in group activities for university students may be effective in developing self-regulation of motivation. In the future, attempts at practical interventions based

on the path model will provide additional practical implications and further clarify the bidirectional relationships between these factors.

The limitations of this study and directions for future research are as follows. First, this study attempted to examine causality at two time points one month apart. Future studies are required to examine the causality at multiple time points. Examinations over a longer time span and verification using data over a shorter time span are required to aid in the design of educational practices from both long- and short-term perspectives. Second, one of the control variables was the level of performance, which was self-evaluated and could have been influenced by subjectivity. This needs to be verified by other evaluations and behavioral indicators. Other control variables, including the level of social skills and motivational factors, such as self-efficacy and value, should be considered (Pintrich, 1999). Third, a detailed analysis of the group's intellectual activities is required. If the qualitative differences in the activities of university students and working adults can be clarified, more concrete suggestions for the transition from higher education to adult learning can be made.

Despite these limitations, this study provides novel insights into the bidirectional relationship between autonomous motivation and the three modes of motivational regulation. In the past, this research topic has mostly been examined using cross-sectional data. The importance of autonomous motivation as an antecedent factor can be clarified from a new perspective, and the results of this study can provide a direction for future educational practices in higher education and the workplace.

#### 4.4 Conclusion

The bidirectional relationship between autonomous motivation and motivational regulation has not been adequately demonstrated. In the previous studies, only self-regulation strategies were addressed; neither social regulation nor the regulation of autonomous motivation was examined. This study examined a reciprocal path model between autonomous motivation and three modes of motivational regulation (self-, co-, and socially shared regulation) in intellectual group activities, by comparing university students with working adults. As a result, it is significant that autonomous motivation was shown to be an antecedent factor for the three modes of motivational regulation one month later in both groups. This is a novel contribution to the psychological research on motivation. In addition, the results of the analysis provided suggestions for the possibility of practical interventions based on the reciprocal path model.

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#### Informed Consent

Obtained.

#### Provenance and Peer Review

Not commissioned; externally double-blind peer reviewed.

#### Data Availability Statement

The data that support the findings of this study are available on request.

#### Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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## Notes

Note 1. As discussed below, self-determination theory (Ryan & Deci, 2000) describes autonomous motivation as the “regulatory styles.” To avoid confusion, the term “regulation” will be used in this paper exclusively under self-regulated learning theory. Autonomous motivation represents the very psychological state of learning from enjoyment and importance.

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