Applied Linguistics 2022: XX/XX: 1–22
https://doi.org/10.1093/applin/amac035

The Causal Relationship between Learner Motivation and Language Achievement: New Dynamic Perspective

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It is well known that successful second language (L2) learners are motivated individuals. Accordingly, L2 researchers have tested the predictive power of different motivational constructs on language learning outcomes. However, this perspective appears to neglect the assessment of achievement as a predictor of future motivation. To assess this possibility, we first employed the latent growth curve model (LGCM) to evaluate the initial values and growth rates of the two variables. We further applied a newly developed statistical method, the random-intercept cross-lagged panel model (RI-CLPM), to study the causal relationship. A total of 226 language students were monitored for 17 weeks at three time points. The analysis showed an increasing trend in the association between the growth levels of both variables. However, students' autonomous motivation at Time 1 appears to affect achievement at Time 2. Further, the second wave of the RI-CLPM illustrated that achievement at Time 2 impacted autonomous motivation at Time 3, while motivation failed to predict scores on achievement at Time 3.

INTRODUCTION

Motivation is one of the key factors that determine the efficiency of L2 learning. This factor has been acknowledged to be a prerequisite that provides the primary impetus to initiate L2 learning and, subsequently, the driving force necessary to sustain the long-term goals of language learning (Dörnyei 1998; Dörnyei and Ryan 2015; Dörnyei and Ushioda 2021). In such a long and tedious process, motivation has been found to determine the extent to which students are actively engaged in L2 learning (Noels et al. 2019, Alamer 2022c), persistence, and resilience in language learning (Kim et al. 2017; Alamer 2021b), and, most importantly, succeed in L2 learning (Alamer 2022a; Elahi Shrivan and Alamer 2022).

Previous studies have identified motivation as a highly significant positive predictor of L2 achievement (Mercer et al. 2012; Dörnyei and Chan 2013; Alrabai 2016; Alamer and Lee 2019), even during difficult times such as in the COVID-19 pandemic (Alamer 2022b). However, this perspective appears to be just one side of the coin. The inverse relationship (i.e. whether higher L2 achievement leads to increased motivation for learning an L2 at a given point in time) has yet to be examined. Accordingly, this study has two main goals. The first is to assess the longitudinal dynamic association between L2 motivation and achievement through the application of parallel-process LGCM. Although LGCM is useful in understanding the relationship from a longitudinal perspective, it cannot provide details about causality between variables. Thus, the second aim is to determine the causal precedence of the relationship between motivation and L2 achievement over time by employing RI-CLPM (Hamaker et al. 2015) which is an extension of the standard cross-lagged panel (CLP) analysis. Given the fluctuations that gender may exhibit with regard to language learning and motivation (You and Dörnyei 2016), this study investigates how the established causal relationship between motivation and achievement varies across the two genders as a possible time-invariant predictor of change.

LITERATURE REVIEW

L2 motivation: conceptualization, significance, and types

Motivation for learning an L2 is commonly defined as 'the combination of effort plus desire to achieve the goal of learning the language plus favourable attitudes toward learning the language' (Gardner 1985, p. 10). Learners who are sufficiently motivated are usually seen successful in learning the language. Likewise, Gardner (2010) argues that a person who is motivated demonstrates better engagement in the relevant activities, higher levels of motivational intensity and persistence in learning, more focus on learning tasks, a stronger desire to achieve the goal of learning, and greater enjoyment of learning than those who are less motivated. Conversely, L2 students with low (or even a lack of) motivation may not have enough persistence to accomplish their long-term goals of language learning (Huang et al. 2015; Alamer and Lee 2019; Noels et al. 2019; Elahi Shrivan and Alamer 2022; Alamer 2022c). Within the self-determination theory (SDT), two types of motivation have been recognized (Ryan and Deci 2017). The theory begins by describing autonomous motivation, which entails learning an L2 because the learner finds it interesting, fun, and enjoyable (intrinsic orientation), or because learning an L2 is considered important and meaningful for the learner (identified orientation). The other type of L2 motivation is controlled motivation, which refers to the desire to learn an L2 due to the demands of external regulators, such as the teacher, family, or society (i.e. introjected orientation), or to obtain a reward or to avoid punishment (i.e. external orientation). The theory has shown successful theoretical and pedagogical applications in the L2 domain (see Noels et al. 2001, 2019; McEown

et al. 2014; Oga-Baldwin et al. 2017; Alamer and Lee 2019; Alamer and Al Khateeb 2021; Alamer 2021a, 2022a). In the present study, we use autonomous motivation as drawn from SDT to conceptualize students' motivation in all substantive analyses.

Motivation as a predictor of L2 achievement

Motivation is considered an important direct and indirect predictor of L2 achievement and proficiency (Gardner 2010; Mercer et al. 2012; Dörnyei and Ryan 2015; Alrabai 2016; Alamer 2021a, 2021b). For example, Alamer and Lee (2019) utilized a motivational process model that included major psychological factors from achievement emotion theory (Pekrun et al. 2009) such as hope, pride, happiness, anger, shame, and fear, as well as constructs from goal-orientation theory (Murayama and Elliot 2019) such as mastery, performance approach, and avoidance, and from the basic psychological needs and SDT motivational orientations (Ryan and Deci 2017) to explain L2 achievement. They found that autonomous motivation mediated the relationship between language emotions and L2 achievement, showing that motivation might not only directly influence learner L2 achievement but could also account for the role played by other factors (e.g. emotions) in the process. Oga-Baldwin et al. (2017) longitudinally investigated the motivation of young Japanese students of English. Using structural equation modelling (SEM), the researchers established the positive effect of motivation and perceptions of the learning situation on engagement and teacher assessment. Specifically, it was found that autonomous motivation predicted teachers' positive assessment of their students after a year, thus offering sufficient evidence of the longitudinal impact of autonomous motivation on L2 achievement. A recent study also examined the inter-relationship between motivation and language class anxiety and the results indicated that although they did not negatively correlate, they were lined with students' language self-competency differently (Alamer and Almulhim 2021).

In addition to correlational and longitudinal studies, motivation has also been found to empirically predict L2 achievement, as established by experimental research (Alqahtani 2015; Alrabai 2016). These two studies have emphasized that motivation-promotion interventions in the language classroom not only result in enhanced L2 motivation, as established by past interventions (Moskovsky et al. 2013), but also account for learners' EFL achievement as well. For example, Alqahtani (2015) conducted a two-month experimental intervention with 189 EFL learners using specific strategies to promote learners' motivation in the language classroom. The findings revealed that the use of classroom motivational strategies by teachers led to an increase in learners' motivation and subsequent language acquisition in the experimental group. Similarly, Alrabai (2016) utilized a motivation-promotion experimental intervention targeting the situation-specific motivational disposition of learners in a treatment group of 220 EFL students for 10 weeks. The results showed that motivational intervention in the experimental group led to increased learner motivation, which in turn

led to higher L2 achievement levels for learners in the experimental group than in the control group. The results of the mediation analysis in Alrabai's (2016) study showed that the relationship between teachers' motivational practices and learner L2 achievement was fully mediated by learner L2 motivation in that the significant effect of teacher behaviour on learner achievement statistically disappeared after controlling for learner motivation variable. A recent study (Alamer 2022c) has evaluated a long-term perspective of interest, a key component of motivation, through a newly presented construct of autonomous single language interest (ASLI). The study found that motivation (expressed through ASLI) was positively associated with L2 achievement after a whole year. Alamer (2022c) reported that the effect becomes positive when the interest is autonomously formulated and negative if it is formulated in a controlled manner.

Despite the valuable theoretical and empirical conclusions of earlier studies on the relationship between L2 motivation and achievement, empirical evidence is needed for the in-depth investigation of such a relationship. This is because of the dynamic nature of the concept of motivation in language learning and the notion of multi-causality of a variety of variables in initiating and sustaining learner motivation. In this regard, it is acknowledged that motivation is a multi-determined concept in that no single element, input or force can control or solely cause change in student motivation (Gardner 2010). Motivation is rather determined by multi motivational elements, processes and outcomes that are softly assembled and jointly interacted in different ways depending on different determinants such as the teacher, task, and learning experience to control for learner motivation. This postulation is supported by the fundamentals of the dynamic systems theory which emphasizes the need to abandon the notion of single and linear causality and to adopt a kind of mutual causality in which change in one system leads to change in another system connected to it (Larsen-Freeman and Cameron 2008). In addition to the notion of multi-causality and dynamicity of motivation, most earlier studies were correlational in nature, and even with those that claimed causality through experimental research design used first-generation analyses such as linear regression, *t*-test, and ANOVA (Shao et al. 2022). Second-generation statistical analyses such as LGCM and RI-CLPM are better suited to evaluate more accurate causality between these two variables in terms of both significance and direction. In addition, although some studies (particularly experimental studies) have analyzed their data adequately and offered a substantive finding about the causal effect of motivation on achievement (e.g. Alrabai 2016), they have concentrated on one side of the coin, and neglected the other side, as discussed in the following section.

Achievement as a predictor of L2 motivation

While the power of motivation in predicting L2 achievement is well established, as highlighted by the literature discussed earlier, the inverse relationship (i.e. whether language achievement could causally account for learner L2 motivation) has received less attention. Such a relationship has not been examined

in almost all the studies reviewed in this paper, which poses certain challenges for researchers to study such a possibility; the lack of investigation of this possibility of causal relationships is surprising given assumptions about the likelihood of such directionality. However, this possibility should not be closed off without testing. For example, contingent path theory (e.g. Raynor and Roeder 1987), which was developed based on the principles of the original achievement motivation theory by Atkinson and Raynor (1974), indicates that successful achievement in one task is necessary to maintain the motivation to continue performing subsequent tasks. In this regard, Ellis (2008) hypothesizes that it is likely that the relationship between motivation and achievement in L2 learning is an interactive system, in that motivation stimulates L2 learning and, at the same time, perceived success in achieving language learning goals can also help in maintaining existing motivation and even in creating new kinds of motivation. In addition, the notion of motivational velocity, according to Carver and Scheier (2017), illustrates that while insufficient progress in achieving learning goals causes negative affect (e.g. anxiety or frustration), successful achievement usually results in positive affect such as satisfaction and enjoyment. Similarly, the theory of psychological momentum (see for example, Guenther and Kokotajlo 2017; Hubbard 2017) holds the principle of the 'success-breeds-success spiral,' i.e. success in a given task can promote motivation, which in turn can mediate the relationship between early and subsequent success. According to Dörnyei (2020), the notion of psychological momentum is similar to the concept of directed motivational currents (DMSs) in EFL in that an individual might succeed in a task within an action sequence that will ignite powerful motivational drives that promote the likelihood of success on a similar consequent task.

These assumptions are unequivocally important in emphasizing the complex and dynamic relationship between L2 motivation and achievement in the course of L2 learning. However, they remain abstract theoretical conclusions that need to be validated through empirical and rigorous analyses. For instance, one could postulate that successful progress in the language learning journey may increase students' subsequent motivational disposition. From our experience as language teachers, we see students who start learning with uncertainty and levels of anxiety, but when we monitor these students over time, we sometimes notice that they start to reformulate their motivational perspective optimally and meaningfully (see for example, Alamer 2021b, 2022c; Elahi Shrivan and Alamer 2022) and, as a result, gain motivation and better understand the difficulties inherent to learning. One of the best methods available to examine the causal relationship between variables in an exploratory approach is perhaps cross-lagged panel (CLP) analysis (see Alamer and Lee 2021 for an example in exploring the causal relationship between anxiety and achievement).

However, we are aware of very few studies in L2 motivation research that have applied CLP analysis to determine causality between the two variables (see Rotgans and Schmidt 2017; Noels et al. 2019; Alamer and Lee 2021). For instance, Noels et al. (2019) investigated the causal relationship between autonomous types of motivation, namely intrinsic orientation and identified

orientation, based on the SDT perspective and students' engagement in learning. They monitored 162 students for a semester to determine whether autonomous motivation could predict an increase in engagement. The results showed that, contrary to expectations, more engagement at Time 1 predicted greater autonomous motivation at Time 2, and Time 2 autonomous motivation predicted Time 3 engagement. Significant correlation at the same time point was observed between engagement and autonomous motivation, indicating that these two variables relate to each other positively at a given time point. Although the results of Noels et al. (2019) provided insight into the causal relationship between the two variables, it included self-reporting of engagement. The field still lacks important information about how motivation is causally related to a key language learning outcome, i.e. actual achievement. Another important addition that the present study offers is that it uses a newly developed technique, RI-CLPM, that overcomes some of the drawbacks of standard cross-lagged panel analysis (Mulder and Hamaker 2021; Mund et al. 2021).

Another attempt to test the causal relationship between motivation and acquisition is the work of Rotgans and Schmidt (2017), who examined how individual interest and knowledge acquisition are causally related. Using the cross-lagged panel model among 186 students, the researchers were able to explore the causality of the association and offer new insights in the field. One of the many interesting findings was that the increased interest in school subjects was a consequence of the students' growing knowledge rather than an antecedent. In other words, interest in learning (which is an important component of motivation) was predicted by the growth in participants' knowledge acquisition in a given test (i.e. achievement). Rotgans and Schmidt's (2017) study, however, concerned school education and not the EFL domain. Thus, it did not investigate the causality between learners' achievement and particular L2 motivation orientations (e.g. autonomous types of motivation).

There are contrasting views regarding the role of gender in learner L2 motivation and EFL achievement. In this regard, some earlier studies (e.g. Csizér and Dörnyei 2005; You and Dörnyei 2016; Oga-Baldwin and Fryer 2020) emphasize the role of this variable claiming that female students usually tend to be more motivated to learn a L2 than males and generally demonstrate higher levels of EFL achievement (Henry and Cliffordson 2013; Oga-Baldwin and Nakata 2017). Other investigations, however, have reported no gender differences in learner L2 motivation (Bacon 1992; Niaz et al. 2018) as well as language achievement (Bacon 1992; Główka 2014).

THE CURRENT STUDY

While previous studies have usefully identified measurement characteristics, mediation and moderation relations, and outcomes between L2 motivation and achievement, more empirical and experimental investigations are needed to test whether L2 motivation variables and achievement fluctuate over time

concomitantly or independently of each other. One way to empirically evaluate the dynamic causal relationship between L2 motivation and achievement is by observing the variables over multiple time points and assessing temporal precedence (Hamaker et al. 2015; Mulder and Hamaker 2021); whether a change in one variable shows a tendency to precede a change in another, which presents details about causal directionality, is one method for recognizing causality (Mund et al. 2021). The aim of the present study was to extend research on L2 motivation and achievement by examining changes in autonomous motivation and language achievement at three time points over 17 weeks among Saudi undergraduate students of English. Three research questions guided this study.

RQ1: To what extent do EFL learners' motivation and achievement dynamically change over time?

RQ2: Which variable (i.e. motivation or achievement) affect the other over time?

RQ3: Would the results hold after controlling for gender differences?

METHODS

Participants

The sample for this research comprised Saudi EFL students enrolled in the Department of English at a university in Saudi Arabia. The participants were 64% male and 36% female Saudi students aged 18–20 years (M_{age} = 19.1, SD = .33). The sampling strategy used was convenience, and the participants were contacted three times. At Time 1, the participants were in their first grade of the English language program. The admission requirement for the program involves students' high school grades and the Saudi General Aptitude Test (GAT). In essence, students could start the undergraduate program in the Department of English at this university only after completing foundation year. Students who fail in the foundation year are given the choice to transfer to another major that is not taught in English (i.e. majors that are mainly taught using Arabic). Students have been typically exposed to English in their school curriculum for at least seven years (starting from year 4 in elementary school). In their first level in the Department of English, students have to take L2 courses such as reading, writing, listening, and speaking, but they can also take other collective L1 courses. Nonetheless, in the current research, the students were only assessed for their L2 courses.

Procedure

Students completed a 15-min online questionnaire during regular class hours at the university across the three time points, and their participation was matched at these time points based on their university ID number. Participating students were informed that participation was voluntary, and they were given assent to withdraw from the study at any time. Data collection took place before the COVID-19 pandemic. Time 1 data collection took place in the second week of the beginning of

Semester 1, and Time 2 data collection was conducted towards the end of the same semester (week 12). Finally, Time 3 data collection took place around the second week of the following semester (17 weeks after Time 1 data collection). There was roughly a 1 week break between the two semesters. At the three time points, the same students were followed and assessed based on the same language skills using the same course book (which is explained under 'Language Achievement' section below). Therefore, although Time 3 is a new semester, no substantial changes occur for most if not all students. Although Time 1 and Time 3 appear to be in the first weeks of the semester, students continued with the same teachers who are usually encouraged to administrate a test to evaluate students' language levels before they dive into the course. It is believed that a 17-week interval is sufficient to observe fluctuations in both achievement and motivation among these students.

Around 41 participants failed to complete the second wave and 25 participants failed to complete the third wave. The study was approved by the university board, which is based on recommendations from the board of the Department of English.

MEASURES

Autonomous motivation

To assess students' autonomous motivation in L2 learning, we used the SDT-L2 Scale (Alamer 2022a) which is attached to this paper in Supplementary Appendix A. Participants were asked to answer the question, 'Why are you learning English?' and then indicate the extent to which they agree with the statements that followed. There was a total of 10 items for autonomous motivation, comprising two orientations: intrinsic orientation and identified orientation (an example item: 'I enjoy learning English'). All items were scored on a 5-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Previous research has established the construct validity of this scale (see for example, Alamer 2021a). The scale demonstrated good internal consistency of reliability as well as composite reliability, α = .86 and ω (also called CR) = .89.

Language achievement

Language achievement in English was measured using scores in listening, speaking, reading, and writing. Further details are provided in Supplementary Appendix B.

STATISTICAL ANALYSIS

This study employs two statistical methods based on a structural equation modelling (SEM) approach to evaluate longitudinal data. To assess any model in SEM, different goodness-of-fit values should be reported and evaluated. First, we evaluated the chi-square statistic, χ^2. However, χ^2 tends to show spuriously significant values when sample size increases. Thus, we considered goodness-of-fit

values based on traditional indices that are reasonably independent of sample size (RMSEA = root mean square error of approximation with its 90% confidence interval; CFI = confirmatory fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual). Following Hu and Bentler (1999) and Marsh et al. (1988), CFI and TLI values in the region of .95 indicate a good model fit, but values around .90 can be acceptable. Both RMSEA and SRMR should be equal to or lower than .07 or .05 to acceptable and good model fits, respectively. Because our data appear to deviate from normality (particularly with regard to skewness values) (see Supplementary Appendix C), we controlled for this issue by applying a 5000- bias-corrected bootstrap confidence intervals (Kline 2016; Muthén and Muthén 1998–2017). Bias-corrected bootstrap is helpful because it takes non-normality of the parameter estimate distribution into account (Muthén and Muthén 1998–2017). The analyses were conducted using Jamovi 2.0 and Mplus 8.1 and Maximum likelihood (ML) estimation was selected for the SEM analyses. To interpret the results of path coefficients, we adopt the L2 guidelines (Hair & Alamer, 2022) such that values ranging from 0 to .10, .11 to .30, .30 to 50, and > .50 are indicative of weak, modest, moderate, and strong effect sizes.

Missing values, outliers, and normality

As indicated earlier, the current study entailed 41 and 25 missing sets of data at Time 1 and Time 2, respectively. These were handled using a multiple imputation approach, because full-information maximum likelihood (FIML) assumes that the data are normally distributed (which is not the case in our study). Research shows the robustness of using this approach in educational settings and illustrates that it yields results comparable to or even better than FIML when the data are non-normal and missing at random (see Shi et al. 2020). No outliers were observed in the data. The normality of the data was assessed using the +2, -2 guideline for skewness and kurtosis. The results show that some variables exceeded these guidelines, thus justifying the use of the bootstrap to account for the observed non-normality.

LATENT GROWTH CURVE MODELS (LGCM)

The LGCM is a statistical method that is capable of observing changes over time by modelling a latent trajectory for each participant on three occasions (Kline 2016). Data at each time point were used as indicators of the trajectory. LGCM comprises two substantive assessments: the 'within-person', which reflects individual change over time, and 'between-person', which represents inter-individual differences in changes of the variables. The analysis incorporates the assessment of mean and covariance structures for more than one domain/construct in the analysis, which is the case in the present study (i.e. we estimate the correlation between motivation and achievement both within- and between-person). An illustration of LGCM with gender as a controlling variable is shown in Figure 1.

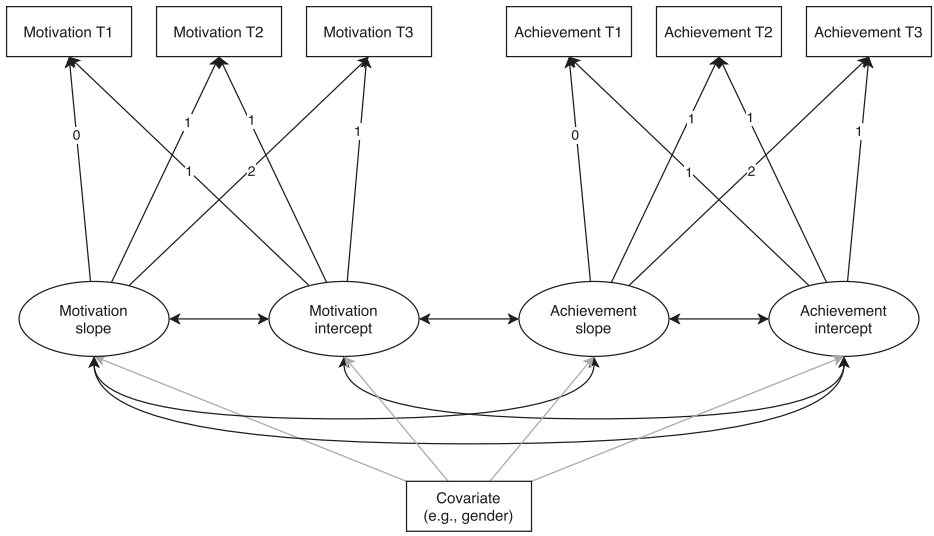

Figure 1: A latent growth curve model for two domains with covariate included.

RANDOM-INTERCEPT CROSS-LAGGED PANEL MODEL (RI-CLPM)

The random-intercept cross-lagged panel model (RI-CLPM; Hamaker et al. 2015; Mulder and Hamaker 2021) is an extension of the standard cross-lagged panel analysis. Cross-lagged panel analysis helps researchers to test the directional relationship between two or more variables measured over time. Three observations can be evaluated in this panel: (i) a significant correlation between the two variables at the same time point, (ii) a significant prediction of one variable for the other for the next time point, and (iii) reciprocal associations between the two variables over time (see Alamer and Lee 2021 for greater detail). These three observations are independent of each other. The RI-CLPM expands on this idea and includes the assessment of the stable between-person (i.e. trait-like) differences that are ignored in the standard cross-lagged panel analysis; RI-CLPM postulates that each person has a specific, rather stable, mean on any given variable and occasion (Mund and Nestler 2019). These stable, trait-like differences were included in the model as a latent intercept factor for each of the variables involved. In our case, this stable factor (i.e. the random-intercept) could reflect unobserved differences among learners, such as learning style or learning experience. Accounting for these trait-like differences allows the panel to assess the effects of within-unit in lagged paths (e.g. from M1 to A2 in Figure 2) more accurately (Mulder and Hamaker 2021). As suggested in recent research (e.g. Mund et al. 2021), including time-invariant covariates in the RI-CLPM is useful to ensure that the observed effects are not due to confounding variables. An illustration of the RI-CLPM with covariates is shown in Figure 2.

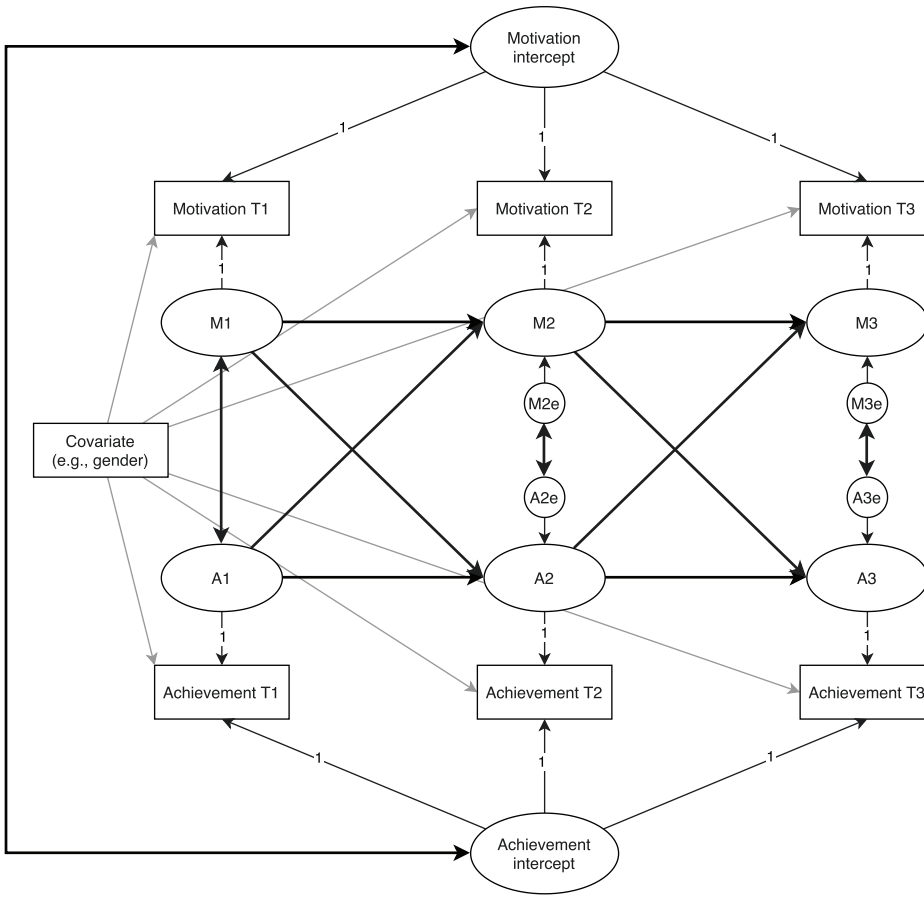

Figure 2: A random-intercept cross-lagged panel model with covariate included. *M*, motivation; *A*, achievement.

RESULTS

Table 1 presents descriptive statistics, including the means, standard deviations, and zero-order correlations based on Spearman's rho (ρ). We then turn to the main analyses of this study.

Observing changes over time (LGCM)

The LGCM offers a robust assessment of intra-individual changes across the sample in both L2 motivation and achievement. The model provided an excellent fit to the data (i.e. $\chi^2 = 10.13$, $df = 9$, $p = .34$; CFI = 1.00; TLI = .99, IFI = 1.00; RMSEA = .03, RMSEA 90% CI = [.00, .09]; SRMR = .02). The results of the LGCM are illustrated in Table 2 for the parallel-process modelling (i.e. LGCM

Table 1: Descriptive statistics and correlation of the study variables using Spearman's rho (ρ)

	1.	2.	3.	4.	5.	6.
1.Achievement T1	1					
2.Motivation T1	.33***	1				
3.Achievement T2	.77***	.32***	1			
4.Motivation T2	.33***	.69***	.41**	1		
5.Achievement T3	.73***	.27***	.84***	.40***	1	
6.Motivation T3	.33***	.51***	.51***	.61***	.52***	1
Skewness	-.23	-1.38	-.29	-.70	-.16	-.1.75
Kurtosis	-.55	2.89	-.03	-.06	-.30	5.53
Mean	13.34	4.47	14.78	4.49	15.70	4.53
Standard Deviation	5.02	.49	4.32	.39	3.10	.40

$^{**}p < .01$; $^{***}p < .001$.

Table 2: Results of the parallel-process LGCM of L2 achievement and motivation

	Intercept		Growth		Covariance				
	M	Var	*M*	Var		I-A	I-M	S-A	S-M
Motivation	4.46*	1.69*	.03	.02	I-A	–			
Achievement	14.60*	.81*	1.03*	.06*	I-M	.16*	–		
					S-A	−.12*	−.03*	–	
					S-M	−.02	−.04*	.02*	–

M, mean; *Var*, variance; *I-A*, intercept of achievement; *I-M*, intercept of motivation; *S-A*, slope of achievement; *S-M*, slope of motivation.
$^{*}p < .05$.

in two domains: L2 motivation and achievement). Specifically, the results for the motivation trajectory indicated that whereas students' motivation did not significantly increase over time (M_{Slope} = .03, p = .09), they were at variance with their initial endorsement of autonomous motivation ($Var_{Intercept}$ = 1.69, $p < .001$), as indicated in Table 2. In addition, students' weak growth in motivation was quite stable across the groups (Var_{Slope} = .02, p = .232). Nonetheless, the results of within-domain covariance in motivation illustrated that the covariance between the slope and intercept was -.04 and statistically significant ($p < .001$), suggesting that students whose motivation was low at the beginning of the semester demonstrated a higher growth rate over time.

Regarding the results of achievement trajectory, it appears that while students had strong interindividual differences at the beginning of the semester apropos language performance ($Var_{Intercept}$ = .81, $p < .001$), they showed a significant increase in achievement over time (M_{Slope} = 1.03, $p < .001$). However, the observed growth was not the same among all students (Var_{Slope} = .06, p = .004). In addition, the results of within-domain covariance in achievement demonstrated

that the covariance between the slope and intercept was -.12, which was statistically significant ($p < .001$), indicating that students whose achievement was high at the beginning of the semester showed a lower growth rate over time. The between-domain covariance (i.e. motivation and achievement) results are reported in Table 2 as well. The analysis illustrates that the covariance between motivation and achievement intercept is positive and significant (.16, $p < .001$), demonstrating that higher endorsement in motivation is associated with higher L2 achievement at the beginning of the semester. Furthermore, the covariance between the slope in the two domains shows positive and significant result (.02, $p = .004$), indicating that the slight growth in students' motivation from the beginning of the semester through the next semester was associated with an increase in achievement as well. Finally, we modelled the covariate (i.e. gender) to assess the extent to which the LGCM results hold across the two genders. The analysis indicated that the covariate had a non-significant ($p > .05$) effect on all components in the LGCM, suggesting that the analysis was not influenced by gender differences. Overall, the LGCM yielded key patterns of the longitudinal association between the two variables, but it is unable to determine cause-and-effect between the two variables, which we will examine using RI-CLPM in the following section.

Observing causal relations over time (RI-CLPM)

The RI-CLPM was applied to examine which variable values are dependent on the other over time, thus providing details of causality. The results of RI-CLPM are shown in Figure 3. First, the solution fitted the data well (i.e. $\chi^2 = .02$, $df = 1$, $p = .91$; CFI = 1.00; TLI = 1.03; RMSEA = .00, RMSEA 90% CI = [.00,.08]; SRMR = .00). Turning to the local assessment, the RI-CLPM found a significant positive contemporaneous correlation between motivation and achievement at all time points. Moreover, the test of random-intercept was non-significant (variance of motivation was .03, CI 95% [-.34, .11], $p > .05$, and variance of achievement was .38, 95% CI [-.61, .65], $p > .05$). These results suggest that the analysis is quite invariant even after controlling for stable between-person (i.e. trait-like) differences in the students. Furthermore, the covariance between the two intercepts was non-significant (−.02, CI 95% [-.71, .11], $p > .05$), suggesting their independence. Hence, the findings of RI-CLPM can be considered stable after controlling for confounding factors.

The substantive parameters of interest in the RI-CLPM are the cross-lagged paths, which can be understood as predicting changes at the within-person level. The analysis indicated that motivation at Time 1 positively predicted an increase in achievement at Time 2, while achievement at Time 1 failed to predict increased scores in motivation at Time 2. Further, the results illustrated that achievement at Time 2 positively led to an increase in motivation at Time 3, while motivation at Time 2 failed to predict higher scores in achievement at Time 3 according to the L2 guidelines (Hair & Alamer, 2022) the effect from motivation at Time 1 to motivation at Time 2 was relatively moderate, whereas

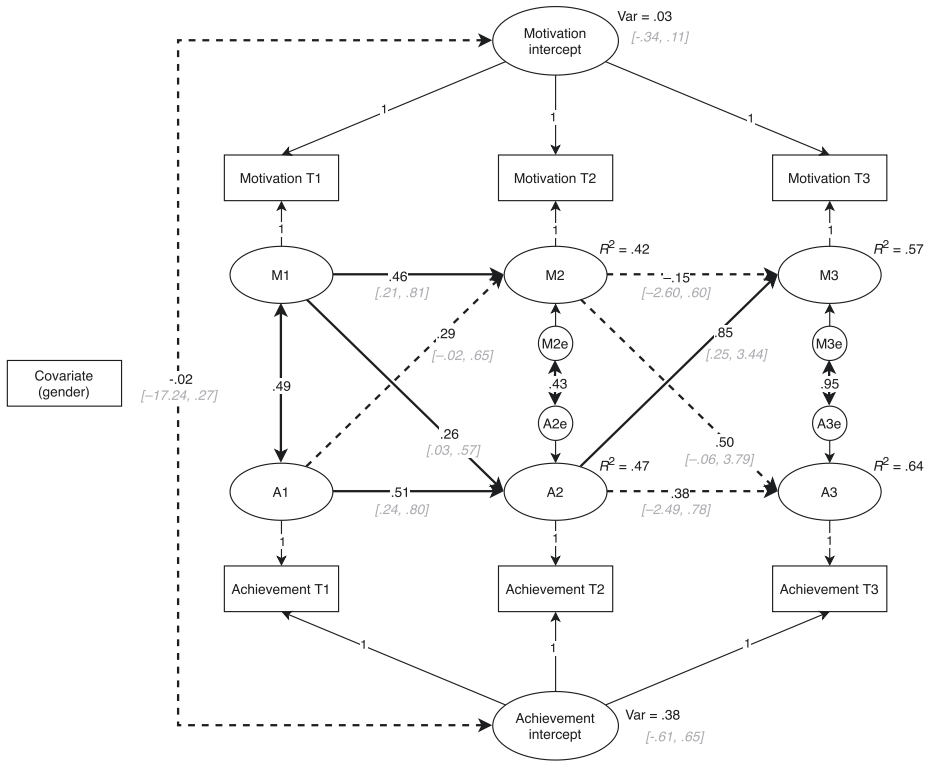

Figure 3: RI-CLPM of L2 motivation and achievement. Paths from the covariate have been removed for ease of reading; dashed line = non-significant path; grey and italic values are the 95% bias-corrected confidence intervals; *M*, motivation; *A*, achievement; *Var*, variance; *$p < .05$.

the effect of achievement at Time 2 on motivation at Time 3 was large in size. The RI-CLPM solution was able to explain the large variance in Time 3 variables; approximately 57% of the variance is explained by the model for motivation and 64% of variance is explained by the model for achievement. Lastly, we run the RI-CLPM after including 'gender' as a covariate, and the results indicate a trivial effect of this variable on all factors involved in the model, suggesting that gender differences do not play a significant role between these relations.

DISCUSSION

The key objectives of this study were to examine the changes in learner L2 motivation and achievement over time and to test directional causality in the relationship between these two variables. Although the general stream in the field assumes that motivation impacts language achievement, the inverse relationship has not been investigated in past studies. We began the investigation

with the LGCM analysis, which showed that learners' motivation did not significantly change over time, whereas achievement did. The insignificant changes observed in the growth of students' motivation could be interpreted in light of the idea of sensitive dependence on initial conditions that comes from the propositions of the Complex Dynamic Systems Theory as it views second language acquisition as a dynamic, complex, non-linear process that is sensitive to initial conditions and that the changes a construct may undergo are sensitive on the initial conditions of this construct (Hiver et al. 2021). In light of this theory, it seems that the insignificant growth in student motivation in our case could be attributed to the fact that the trajectory of system behaviour tends to be dependent on the initial condition of the system in that the high initial endorsement of motivation exhibited at the beginning of the semester (wave 1) did not allow much change to take place at subsequent stages (i.e. waves 2 and 3). This finding seems not to be unique for the present study but rather consistent with the findings of past research in the same EFL context of the present study such as that of Moskovsky et al. (2013) and Alrabai (2016). In these two longitudinal experimental interventions, EFL learners have demonstrated high levels of motivation orientations (e.g. motivational intensity and motivational attributions) at T1, limiting room for significant changes to take place in these orientations at subsequent stages of the intervention (e.g. at T2).

We note that although Time 3 data collection was on the subsequent semester, the gap between the two semesters was around a week. Also, students continue the study with the same course books and teachers. Accordingly, the stability of growth in motivation across the three time points can be understandable. In addition, this stability is similar to what has been reported by earlier studies (e.g. Noels et al. 2019) which found that students' levels of identified orientation remained high across the semester. The stability of student motivation in our study can be justified. According to Ryan and Deci (2017), autonomous motivation, the self-determined form of motivation, shows greater stability over time and across situations. It appears that, in our case, when students initially perceived themselves as autonomously motivated to learn the L2, this motivational profile persisted through time. It should be noted, however, that students who started the semester with low autonomous motivation demonstrated a higher growth rate over time; it is likely that less autonomous students at early stages started to appreciate the instruction and values of learning the language, thus catching up on high-profile counterparts. This has also been noted in earlier studies (e.g. Moskovsky et al. 2013; Alqahtani 2015; Alrabai 2016), where lower-scoring motivational variables at the beginning of the semester showed higher growth over time than the initially higher-scoring variables.

Although there was significant inter-individual variability at the baseline (wave 1) levels of achievement, a significant increase in students' L2 achievement over time was detected. The significant growth in learner language achievement due to instruction is well acknowledged by correlational and experimental studies (c.f., Alqahtani 2015; Alrabai 2016; Alamer 2022c). However, students' baseline levels were associated with their rate of change across the semester (i.e.

students starting the semester with higher achievement demonstrated a lower growth in achievement across the semester). Such variability in the growth rate of student achievement over time could be linked to the growth rate of their motivation. We found that the rate of growth in students' motivation was related to the growth in their L2 achievement, such that low growth in student motivation was accompanied by low growth in L2 achievement rates as well. Such findings resonate with the well-known association established between L2 motivation and achievement (see e.g. Gardner 2010; Mercer et al. 2012; Dörnyei and Ryan 2015; Alrabai 2016; Alamer 2021a, 2021b, 2022a, 2022c) and extend our knowledge by showing how the growth rates of the two variables are longitudinally related.

Further, this study utilized an RI-CLPM that allowed time-sequenced assessment of the causal associations between L2 motivation and language achievement. The RI-CLPM showed that L2 motivation and achievement were positively correlated with each other simultaneously at all three time points. This resonates with and extends the LGCM findings by showing the specific associations at each time point (also called the correlated change), which are in line with many previous findings of the beneficial impact of motivation on L2 achievement and suggest that motivation is an important immediate resource for students to proceed (Alrabai 2016; Oga-Baldwin et al. 2017; Noels et al. 2019; Alamer and Almulhim 2021; Alamer 2022a, 2022b; Elahi Shrivan and Alamer 2022). Despite the immediate correlation between motivation and achievement, the RI-CLPM suggested that these variables predicted each other over time differently. Motivation at wave 1 positively predicted achievement at wave 2, suggesting that motivation levels of students at the beginning of the semester reciprocally contribute to level differences in their achievement by mid-semester (wave 2). This finding is consistent with the vast body of past research (Gardner 2010; Mercer et al. 2012; Dörnyei and Ryan 2015; Alrabai 2016; Oga-Baldwin et al. 2017; Alamer and Lee 2019; Alamer 2021a, 2021b) and suggests that earlier motivation levels are expected to positively predict higher levels of subsequent achievement in the language course.

While previous studies have strongly implied that learners' motivation may ultimately lead to improvement in their L2 achievement, our analysis showed strong evidence suggesting an impact of learners' achievement at wave 2 on their subsequent motivation at wave 3. This new piece of information implies that end-of-semester achievement contributes to differences in learner motivation by the beginning of the next semester, but the reverse does not occur. This counterintuitive finding suggests that higher achievement precedes motivation in the middle stages of learning. This impact may be explained by contingent path theory (e.g. Raynor and Roeder 1987), the motivational velocity of Carver and Scheier (2017) and the theory of psychological momentum (Guenther and Kokotajlo 2017; Hubbard 2017). According to these approaches, successful achievement of learning tasks can promote motivation to pursue and achieve subsequent tasks. Hence, while the findings of the cross-lagged paths did not support the longer-term effect of language motivation on learners' achievement,

they may indicate that the factors' roles swaps over time; that is, motivation can be an important resource for language learning at the outset, and once students proceed with the language, they consequently gain motivational momentum and appreciate the meaning of the language learning journey. Another possibility for the effect of achievement on subsequent motivation can be taken from SDT perspective in which students' sense of competence can lead to an increase in motivation in subsequent learning (e.g. Alamer 2022a), though this hypothesis has not been explicitly tested in the present study.

Overall, this interchange in the roles of motivation and achievement that emerged from observing the variables over multiple time points while assessing their respective temporal precedence constitutes a verification of the dynamic causal relationship between the variables (Ellis 2008; Dörnyei 2020; Dörnyei and Ushioda 2021). Hence, it does not seem that motivation is always a stable predictor of subsequent language achievement, but attaining more language skills can provide further resources for students to enjoy and value the learning process.

Gender as a covariate appeared to play no role in the LGM and RI-CLPM. This lack of a significant effect contrasts with several earlier studies that acknowledge that female students are generally more motivated to learn a foreign language than males (e.g. Csizér and Dörnyei 2005; You and Dörnyei 2016; Oga-Baldwin and Fryer 2020) and usually outperform them in language learning (Henry and Cliffordson 2013; Oga-Baldwin and Nakata 2017). However, the lack of insignificant effect of gender on learner motivation and achievement in this study corporates other studies that have reported no gender differences in learner L2 motivation (Bacon 1992; Niaz et al. 2018) or language achievement (Bacon 1992; Główka 2014). This finding indicates that female and male participants in the present study exhibited similar levels of L2 motivation and achievement over time despite the longitudinal nature of the study. The conclusion further substantiates the contrasting views discussed earlier in that the gender variable could inconsistently affect learners' motivation and achievement in a L2.

CONCLUSION

Going beyond cross-sectional data analysis to analyze longitudinal data through parallel-process LGCM and RI-CLPM, the current study provides new insights and advances the field in understanding how motivation and L2 achievement are causally related from a long-term standpoint. We found that autonomous motivation was relatively stable among students over four months. However, low-motivated students were able to reach higher levels of motivation over time. Language achievement has been found to be significantly growing among the students, and such growth was associated with the growth in motivation, thus pointing to the idea of an 'immediate resource' that each variable depends on at a given time point. More importantly, when the causal relation between motivation and achievement is taken into

consideration through RI-CLPM, the findings showed that motivation preceded achievement early in the language course. After the effect of motivation manifested, language achievement appeared to predict higher scores on motivation for the following occasion. The findings of LGCM and RI-CLPM were stable even after including gender as a controlling variable, thus demonstrating the stability of the effects across genders. Methodologically, the researchers have applied advanced and modern statistical techniques that are based on the property of SEM (Shao et al. 2022), and followed the most recent guidelines to estimate accurate and valid solutions. Thus, we hope that this longitudinal study has provided unique information about the causal relation between L2 motivation and achievement for the field, which should be of interest to practitioners and researchers.

LIMITATIONS AND FUTURE RESEARCH

The present study offers a new understanding of the causal effects between motivation and achievement among L2 students over a period of 17 weeks. This study provided an example of a thorough analysis of observational and longitudinal data using two advanced statistical approaches, LGCM and RI-CLPM. The measures of achievement and motivation were psychometrically sound in past studies (c.f., Alamer 2021a, 2022c; Alamer and Lee 2021) and the sample involved is from a socio-economically typical university setting. By using a 5000 bias-corrected bootstrap procedure, we believe that the results can be applied to similar learning socio-educational contexts. This study adds to the large body and growing literature on the relationship between L2 motivation and language achievement and responds to the call to study the dynamics of these two key variables by taking an asset-based approach (Dörnyei 2020; Alamer and Almulhim 2021).

Alongside the assets of the study, we need to acknowledge some limitations. First, we only examined the interchange in effects between motivation and achievement over 17 weeks. Given that motivation can be stable at some time points but fluctuate rapidly at others (Dörnyei and Ryan 2015), including more time points would be fruitful in subsequent research. This could involve shorter timeframes (e.g. monitoring students weekly) and delayed assessment (e.g. monitoring students over an academic year or more). With these two suggestions in mind, we might obtain expandable findings that can confirm or offer further understanding of the established causal links. Second, although the sample size meets the statistical requirement, the modest size may prevent us from detecting statistical significance in the relationships and may result in sampling error. Nevertheless, we bootstrapped the analyses to account for the moderate sample size and non-normal distribution. We believe that reporting the bias-corrected bootstrap confidence intervals has helped us significantly avoiding biased results. Using the bootstrap and confidence intervals should be taken as an example for L2 researchers wanting to model complex relationships in

SEM applications in moderate and non-normal data. Third, although RI-CLPM is a rigorous statistical technique that can determine the directionality of effects between the variables, future studies could apply an experimental research design, both qualitative and quantitative, to confirm the effect of achievement on future motivation. Overall, the study offers empirical opportunities for future studies on this topic, and an experimental research design with achievement increase future motivation could be considered.

SUPPLEMENTARY DATA

Supplementary material is available at *Applied Linguistics* online.

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NOTES ON CONTRIBUTOR

Using advanced statistical methods, Abdullah's main interest lies in research with second language motivation, and psychological factors associated with success in language learning.
Recent publication

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