Investigating the developmental dynamics between metacognitive strategy use and English listening comprehension levels

Junko Noguchi
Jared Baierschmidt

Abstract

本研究では、自立英語学習のためのメタ認知スキルトレーニングを受ける中で、学習者の当スキルに対する認識およびその使用状況が一学期間（15 週間）でどのような変化し、相互に影響を及ぼすか調査した。本研究のパラレル潜在曲線モデルに基づいた分析結果によると、メタ認知ストラテジーに関する自己報告使用度の増加はリスニングという形で計測された英語能力の向上に影響を及ぼしていることが示された。この研究結果は、自立学習という文脈の中においても、メタ認知ストラテジー使用が言語能力向上へ影響を及ぼすことを示唆しているといえる。

Keywords

Metacognitive strategies, Self-directed learning, Latent growth curve modeling

Introduction

Self-directed learning skills have been found to be some of the most important life-long skills that can be acquired (Candy, 1991). Because technological discoveries, increased globalization, and changing demographics are rapidly introducing new ideas and systems, this is especially true for students in the 21st century. Students will not be able to rely upon institutions of higher learning to fully prepare them with the knowledge they will need in order to adapt to a constantly changing world after graduation (Du, 2013). Instead, graduates will need the ability to find resources to help them acquire new skills and knowledge to keep up with the rapidly changing social and economic landscape. Learning how to learn and managing one's own learning process are therefore crucial skills for students in the modern era.

Metacognition plays an essential role in the self-directed learning process (Flavell, 1979; Oxford, 2017). Defined by Flavell (1979) as "cognition about cognitive phenomena" (p. 906) and more commonly referred to in the research literature as thinking about thinking, metacognition is "the ability to reflect upon, understand, and control one's learning" (Schraw & Dennison, 1994, p. 460). Examples of metacognition include setting appropriate goals, choosing strategies to achieve those goals, monitoring performance during tasks, managing time efficiently, and self-evaluating progress towards goals (Baker, 2013; O'Malley & Chamot, 1990; Zimmerman, 2002).

Empirical research into metacognition has confirmed its role in academic success, particularly at the university level (Coutinho, 2007; Coutinho, & Neuman, 2008; Mytkowicz, Goss, Steinberg, & College, 2014, DiFrancesca, Nietfeld, & Cao, 2016; Scott & Berman, 2013; Young & Fry, 2012; Vrugt, & Oort, 2008). For example, Coutinho (2007) found that metacognition scores on the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) predicted the GPA of 179 college undergraduates. Young and Fry (2012) similarly found correlations between metacognitive awareness and both GPA as well as final course scores for 178 university students. Additionally, Mytkowicz, Goss, Steinberg, and College (2014) found correlations between several metacognitive subprocesses and GPA in 48 freshman university students enrolled in a strategic learning course.

Because "usual life events and traditional cultural and educational efforts do not necessarily guarantee the development of metacognition" (Cornoldi, 2010, p. 274), it is important for learning training programs to incorporate metacognitive skills training into their curricula (Schraw, 1998). A number of studies have demonstrated the teachability of metacognitive skills and strategies, which in turn resulted in significant improvement in learning (Baker, 2013; Schraw, 1998). In particular, the field of language acquisition has acknowledged the important role metacognition plays in language development and continues to empirically demonstrate how the teaching of metacognitive strategies leads to better learning outcomes (e.g. Dabarena, Renandya, & Zhang, 2014; Farokhi, Karami, & Drikvand, 2018; Nosratinia & Mohammadi, 2017). Raoofi, Chan, Mukundan, and Rashid (2014), in a meta-analysis of 33 articles investigating the relationship between metacognition and second language acquisition, found that metacognitive interventions improved learner performance in the target language.

One issue in metacognitive skill and strategy training in second language learners is that not much attention has been paid to teaching metacognitive skills to support student learning beyond the classroom. Rather, most studies focus on helping students improve their ability to complete classroom tasks. Yet, English language learners, particularly those in an English as a foreign language setting, need opportunities to be exposed to and use English outside of the classroom in order to compensate for their lack of English input and output opportunities (Ellis, 1994). Therefore, this study investigates changes in students' actual use of metacognitive skills and their level of English listening comprehension in relation to changes in their self-reported use of metacognitive skills after receiving metacognition instruction and training for self-directed language learning processes outside the classroom. The specific research question is as follows:

Research question: *What kind of developmental interaction is there between English proficiency in the form of listening comprehension skills and metacognitive strategy use?*

Methodology

Participants

This study was conducted at a private, medium-sized Japanese university that specializes in language studies. The participants are 78 Japanese students (27 male and 51 female students) majoring in English. The participants for this study were recruited from three elective self-directed learning courses. In these courses, students receive explicit teaching about metacognitive skills and are given opportunities to practice using the skills in a weekly self-directed learning cycle that students co-design with help from the teacher. The courses meet twice a week for 90-minutes each session over the span of 15 weeks. The majority of participants are third-year students, with a few fourth-year students as well. Ages of the participants range from 21-23 years old. All participants have scored more than 480 on TOEFL ITP or 54 on TOEFL iBT, which are prerequisites required by the English department before students are allowed to take an elective course.

Instruments

This first instrument utilized by this study is the Metacognitive Strategies for Self-Directed Language Learning Questionnaire (MSQ), which was designed by the researchers. It is a self-report instrument developed to elicit students' perceived utilization of metacognitive strategies that are considered useful in various aspects of self-directed language learning. The items are based on the expected outcomes of the self-directed learning course. Each item was scored on a scale of 1 to 4, where 1 = *I strongly disagree / This is not like me at all* and 4 = *I strongly agree / This is so much like me*. Four sets of the items were created to construct four measures of metacognitive skills: Planning, Monitoring, Controlling, and Evaluating respectively. In addition to questions regarding the utilization of metacognitive skills, the questionnaire also asks respondents to indicate their most recent test scores on standardized tests such as TOEIC, TOEFL, and EIKEN.

The questionnaire items were created based on (a) a review of the literature in relevant fields such as self-directed learning, language learning strategies, metacognition and self-regulation, (b) feedback from the researchers' dissertation supervisors and university colleagues with a Ph.D. or Master's degree in applied linguistics who also possess many years of experience working in the self-directed learning skills training field, and (c) results from piloting the questionnaire. The validity of the instrument was tested using Rasch analysis and the results are reported later in this paper.

The second instrument-type utilized in this study was a partial listening dictation test. Three partial listening dictation tests were created and used in order to measure students' overall English listening comprehension at the beginning, middle, and end of the semester. According to Wong and Leeming (2014), a dictation test can be a reasonable replacement for the listening section of the Test of English for International Communication (TOEIC), which is often used to measure English learners' English listening comprehension level. The tests in this study are designed to match the level of the participants who possess a TOEFL ITP score of 480 or TOEFL iBT score of 54 while following the design process described in Wong and Leeming (2014). The validity of these tests was assessed through Rasch analysis and the results reported below.

Reliability of the Instruments

The reliabilities of both the Metacognitive Strategies for Self-Directed Language Learning Questionnaire (MSQ) and Listening Dictation Tests (LDT) were examined using a Rasch Model. The results are shown in Table 1.

Table 1

Reliability of the Metacognitive Strategies for Self-Directed Language Learning MSQ and Listening Dictation Tests (LDT)

	Rasch Person reliability (Separation)	Rasch Item reliability (Separation)	Cronbach alpha (KR-20) student raw score "test" reliability
MSU1	.81 (2.07)	.87 (2.57)	.85
MSU2	.85 (2.41)	.44 (0.88)	.87
MSU3	.80 (2.02)	.87 (2.56)	.81
MSU1, 2, & 3	.84 (2.31)	.93 (3.63)	.87
LDT1	.53 (1.06)	.88 (2.69)	.57
LDT2	.40 (0.81)	.87 (2.61)	.52
LDT3	.55 (1.10)	.80 (1.98)	.71
LDT1, 2, & 3	.71 (1.58)	.94 (3.94)	.74

For the surveys, the Rasch person and item reliability seem to be within a reasonable range, with scores mostly greater than .8. On the other hand, it seems that the listening tests were not reliable, failing to sufficiently differetiate students in terms of their English listening comprehension levels. The Wright maps for listening test items for all three tests show that there were many items that were too easy for the participants. This may have been one of the reasons for such low reliability. The low reliability rating of the listening tests makes it more difficut to see a clear trend of participant growth in terms of their English listening comprehension and therefore required close attention when analyzing the results.

Procedure

The information about students' metacognitive strategy use, as well as their most recent English standardized test scores, was collected through the MSQ instrument three times during the semester: Week 5-6 (Time 1), Week 10-11 (Time 2) and Week 15 (Time 3). Listening dictation tests were conducted at the same time or within the same week as the surveys were conducted. The raw data were transformed into logit form through Rasch analysis. Also, data of those individuals who missed only one of the three tests and/or one of the three surveys were calculated using the multiple imputation function in SPSS 24 and included in that data to be analyzed. The average of five imputed data was used. For listening test scores, the self-reported TOEFL or TOEIC scores were also included for the imputation process to approximate the data that reflects participants' actual listening proficiency.

Analysis

Latent Growth Curve Analysis (LGC) in a structural equation modelling (SEM) framework was employed because it can model both intra-individual growth and inter-group growth simultaneously, which allows researchers to answer a variety of questions about change and stability over time (Kline, 2011). For this study, the model was designed to test the hypotheses regarding the change in students' metacognitive strategy use and English listening comprehension as well as the interactive relationship of the change. AMOS 24 was used for this analysis and the maximum likelihood method was utilized for parameter estimation.

In order to evaluate the fit of the models, three goodness-of-fit statistics were used; the chi-square test, Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA). The chi-square statistic χ^2 is a measure of whether the model is consistent with the covariance data. However, whether the model is actually correct is not determined by the test (Kline, 2011, p. 200). A non-significant result indicates that the hypothesized model is potentially suitable. The cut off value of .05 is used in this study. The comparative fit index (CFI) evaluates the relative improvement in the hypothesized model in comparison to the baseline model. The generally accepted cut off value of .90 (Kline, 2005) is used in this study. RMSEA, or root mean square error of approximation, is a value which indicates the model fit. If RMSEA ≤ .05, model fit is a close approximate. Generally accepted cutoffs for RMSEA are less than .05 for very good fit whereas values beyond .10 suggest poor fit (Kline, 2005). The value between .05 and .10 is considered ambiguous and requires careful interpretation (Asano, Suzuki, and Kojima, 2014, p. 120).

Results

The statistical analyses were performed in 2 steps. First, in the uni-construct analysis the associations between the initial level of the metacognitive strategy use (MSU) and its growth over time were analyzed by LGC models with structured means. Additionally, English listening comprehension (LC) and its growth over time were analyzed in the same manner. Finally, the uni-construct models of metacognition and LC variables were analyzed together using parallel LGC model.

The sample correlations, covariance matrixes, related means (M) and standard deviations (SD), for the observed variables are presented in Table 2. The results of correlational analysis indicate that there is no correlation between any MSU variables with LC variables. This suggests that MSU and LC are not related to each other when simply treating them as variables of singular moments.

Table 2

The Correlations and Covariance Matrixes and Means and Standard Deviations

	MSU1	MSU2	MSU3	LC1	LC2	LC3	M	SD
MSU1	2.43	.43**	.19	-.04	-.11	-.19	-1.09	1.56
MSU2	.96	2.04	.80**	.07	.07	-.04	-.29	1.43
MSU3	.38	1.46	1.63	.05	.15	.00	.11	1.28
LC1	-.58	.09	.06	0.89	.71**	.65**	1.57	.95
LC2	-.14	.08	.15	.55	0.67	.73**	1.48	.82
LC3	-.35	-.07	.00	.74	.72	1.43	1.87	1.20

*$p < .01$. **$p < .001$.

Single Latent growth curve models

In order to investigate the extent to which the level of metacognitive strategy use (MSU) and the level of English listening comprehension (LC) would be associated with the developmental trends of the same variables at the uni-construct level, a model of two growth factor components, the intercept growth factor (Level) and the linear growth rate (Linear Trend), were estimated separately for metacognition and LC variables. The model was constructed by fixing the loading of the observed variables across Time 1, Time 2, and Time 3. The estimated parameters (standardized) are shown in Table 5 and each of the models are presented in Figure 1 and 2. The results will be discussed in the sections below.

Table 3

Estimated Unstandardized Parameters for Latent Growth Curve Model for MSU and LC (standard errors in parentheses).

Parameters	Model 1: MSU only	Model 2: LC only
Mean intercept $\bar{\alpha}_1$	-0.98 (0.17) *	1.39 (0.10)*
Mean slope $\bar{\alpha}_2$	0.49 (0.09) *	0.12 (0.06) *
Intercept variance $\bar{\Psi}_{11}$	1.49 (0.40) *	0.31 (0.13) *
Slope variance $\bar{\Psi}_{22}$	0.83 (0.17) *	-0.16 (0.09)
Intercept/slope covariance $\bar{\Psi}_{21}$	-0.57 (0.17) *	0.24 (0.10) *
Disturbance variance θ_1	0.92 (0.35) *	0.61 (0.16)
Disturbance variance θ_2	0.87 (0.18) *	0.04 (0.06) *
Disturbance variance θ_3	-0.94 (0.30) *	0.86 (0.21) *

$*p < .01$.

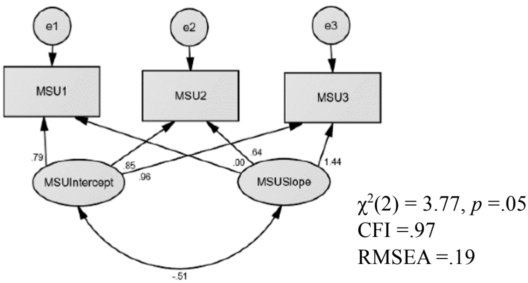
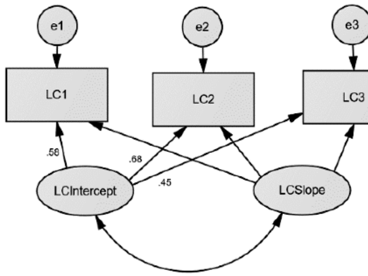


Figure 1. Model 1: Univariate model for metacognitive strategy use (with standardized results)

The results of LGM analysis for MSU indicated that there was a significant growth over the semester (α_2 = 0.49, $p < .01$). In addition, the intercept and slope seem to negatively covary at a significant level (Ψ_{21} = -0.57, $p < .01$). It was also shown that there was a significant individual variability among the participants both in the initial levels (Ψ_{11} = 1.49, p < .01) and in the rates of change (Ψ_{22} = 0.83, p < .01) for MSU in Time 1, Time 2 and Time 3 (θ_1 = 0.92, θ_2 = 0.87, θ_3 = -0.94, p < .01, respectively). The model appears to fit with the population estimate ($\chi^2(1)$ = 3.77, p = .052), and thus is likely to be generalized beyond the sample of 78 learners in this study. Also, the CFI of .97 suggests that there are few missing paths. However, the RMSEA of .19 indicates a poor fit of this model to data.



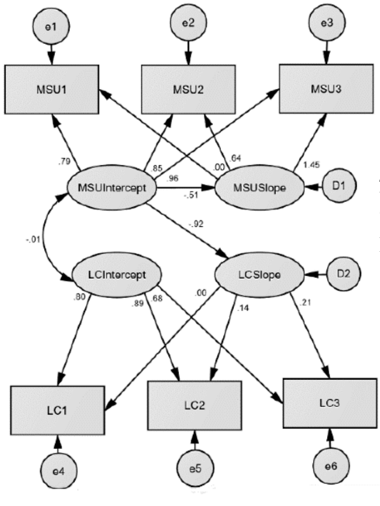
$\chi^2(1)$ = 12.13, p =.000
CFI = .90
RMSEA = .38

Figure 2. Model 2: Univariate model for English listening comprehension (with standardized results)

The result of the analysis using LGM for listening tests indicated that there was a significant growth over a semester (α_2 = .12, p < .01). It was also shown that the covariance between the intercept and slope was significant (Ψ_{21} = .24). In addition, there was a significant individual variability among the participants in the initial levels (Ψ_{11} = -.22, p < .01) and LC in Time 1 and Time 3 (θ_1 = .86, p < .01, θ_3 = 042, p < .01). However, the model appears not to fit well with the population estimate ($\chi^2(1, 78)$ = 12.13, p = .000), and thus is unlikely to be generalized beyond the sample of 78 learners in this study. Also, the CFI of .90 suggests that there are some missing paths. The RMSEA of .38 also indicates a poor fit of this model to data. As discussed earlier, reliability estimates of the listening tests were low, indicating that the tests do not seem to be sensitive enough to detect individual differences. This low reliability may be the possible cause of the poor model fit.

Parallel model

Next, Model 1 and Model 2 described above were put together to investigate whether there would be multi-construct associations between the level and trend components of MSU and LC. It was hypothesized that initial level of MSU will covary with the change over time in both MSU and LC. Also, it was assumed that initial level of MSU covaries with that of LC. The hypothesized relationships are presented in Figure 3, and estimated unstandardized parameters and standard errors for both models are shown in Table 6.



$\chi^2(10, 78) = 27.41$, $p = .002$
CFI = .92
RMSEA = .15

Figure 3. Model 3: Hypothesized parallel model (with standardized results)

The results indicated that the Intercept of MSU and the Slope of the listening test do not significantly vary. Also, covariance between intercepts was not significant. Furthermore, the model appears not to fit well with the population estimate ($\chi^2(10, 78) = 27.41$, $p = .002$), and thus is unlikely to be generalized beyond the sample of 78 learners in this study. Also, the CFI of .92 suggests that there are some missing paths. The RMSEA of .15 indicates a poor fit of this model to data.

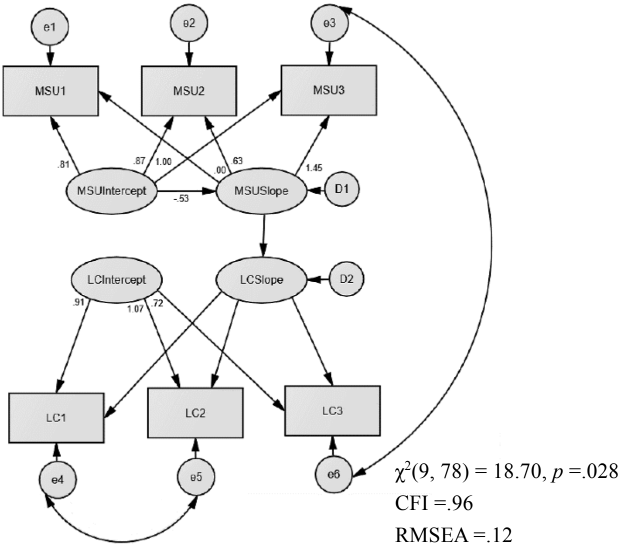


Figure 4. Model 4: Modified parallel model (with standardized results)

The model was modified based on the results of the hypothesized model, taking out the path from Intercept MSU to Slope LC as well as the covariance between the intercepts (See Figure 4). Instead, in order to test the significance of an indirect path from the Intercept of MSU to the Slope of LC, a path from Slope MSU to Slope LC was added. In addition, using the results of the covariances of error terms, the covariance was added to the two pairs of error terms (i.e. θ_4 & θ_5 and θ_3 & θ_6).

The results showed that both of the hypothesized paths, the path from MSU

Intercept to MSU slope and the path from Slope MSU to Slope LC, were significant. However, the growth of both intercepts was not significant, indicating that there was no significant change over a semester in either group mean of MSU or LC, which contradicts the results from single latent growth model. The insignificant individual variability of LC also implies that there may be no significant change on the individual level either. On the other hand, there was significant individual variability in MSU. Among the occasion-specific disturbances, covariance for error terms for Time 3 (i.e. θ_3 & θ_6) was significant ($\Theta_{\varepsilon 36}$ = -.184.1, p < .05), indicating that the timing of data collection itself may affected the individuals' MSU and LC at that time. This may make sense given that Time 3 was after participants' 8-week self-directed learning training and occurred immediately after their winter vacation, providing more opportunities for the students to demonstrate their particular trends. Some students may have continued their self-directed English learning over the break while others may have engaged in other activities unrelated to English learning.

The model appears to fit with the population estimate ($\chi^2(9) = 18.70$, $p < .05$), and thus is likely to be generalized beyond the sample of 78 learners in this study. Also, the CFI of .96 suggests a relatively good fit. However, RMSEA of .12 indicates a poor fit of this model to data. Furthermore, the existence of the negative error variances suggests that the ML estimates may not be reliable, and therefore the significance tests must be regarded with caution (Bollen & Curran, 2006).

Table 4

Estimated Unstandardized Parameters for Latent Growth Curve Model for Model 3 and 4 (standard errors in parentheses).

	Model 3	Model 4
MSU		
Mean intercept $\bar{\alpha}_1$	-0.98 (0.17)***	-1.00 (0.17)
Mean slope $\bar{\alpha}_2$	0.11 (0.09)	0.15 (0.09)
Intercept variance $\bar{\Psi}_{11}$	1.50 (0.40)***	1.57 (0.40)***
LC		
Mean intercept $\bar{\alpha}_3$	1.46 (0.10)***	1.40 (0.10)***
Mean slope $\bar{\alpha}_4$	0.02 (0.08)	0.04 (0.60)
Intercept variance $\bar{\Psi}_{33}$	0.57 (0.11)***	0.76 (0.20)***
Curve covariances		
MSU intercept / LC intercept covariance	-0.01 (0.15)	
MSUIntercept/MSUslope covariances	-0.39 (0.07)***	-0.38 (0.06)***
MSUIntercept/LCslope covariance	-0.09 (0.05)	
MSUSlope/LCSlope covariance		0.12 (0.06)***
Disturbance variances		
θ_1	0.90 (0.34)***	0.85 (0.33)**
θ_2	0.88 (0.18)***	0.86 (0.18) ***
θ_3	-0.97 (0.29)***	-0.90 (0.28)**
θ_4	0.32 (0.08)***	0.15 (0.10)
θ_5	0.14 (0.05)***	-0.06 (0.10)
θ_6	0.6 (0.13)***	0.84 (0.20) ***
D1	0.63 (0.12)***	0.60 (0.12) ***
D2	0.00 (0.04)	-0.05 (0.05)

*$p < .01$. **$p < .001$. ***$p < .0001$.

Discussion

The results from the LGC model approach in the present study indicate that the final best fit model is represented by Model 4. The model suggests that the earlier level of college students' metacognitive strategy use (MSU) inversely affects the rate of change of MSU later on. In other words, those students with initial low self-rating in their MSU demonstrated greater improvement in MSU compared to those with initial high self-rating in their MSU. One possible reason for this finding could be that even though metacognitive strategies, like most learning strategies, are characterized by their deliberate, planful, intentional nature (Flavell, 1979), strategy use over time typically moves toward automaticity such that learners can use strategies with a minimum of conscious effort (Samuels, Ediger, Willcutt, & Palumbo, 2005).

Also, metacognitive strategies are utilized for the purpose of achieving a goal, which is often to accomplish a task or solve a problem. This means that the better learners get at using metacognitive strategies, the less conscious they will become of using them or the less they will have the need for them. Samuels, Ediger, Willcutt, and Palumbo (2005) discuss how reading skills as well as metacognitive strategies to solve any reading comprehension problems can be trained so that using metacognition becomes automatic. This may apply to metacognition in managing the self-directed learning process. For instance, one of the strategies included in the metacognitive strategy survey is to "Keep a record of what I study on a regular basis" and the participants were required to keep a weekly learning journal. This strategy is designed for awareness-raising by assisting leaners to be more conscious of what they do for their learning and to be able to evaluate the process in a realistic way while using actual data. However, once they become more consciously aware of their self-study habits and mentally keeping a record of their learning activities becomes second nature to them, they may find keeping a written record both unnecessary and time-consuming. Therefore, they may decide to stop utilizing the strategy, which is actually a wise decision from a cost-performance point of view.

The results further suggest that the rate of the change of MSU affects the rate of the improvement of English listening comprehension (LC) as measured by partial listening dictation tests. This implies that participants who improved their metacognitive strategy usage had corresponding growth in their listening comprehension ability. Perhaps those students who used more metacognitive strategies for their self-directed learning process also improved their weekly English learning activities in terms of quantity and/or quality, leading to increased English proficiency as measured by the listening dictation tests.

The parallel LGC model analysis results also suggest that there was a significant individual variability in MSU. This indicates that there is a significant amount of individual differences that group mean trajectory is not precisely capturing. There may be significant differences in the amount of change that individual students have made over the semester. Even the direction of the change might have varied significantly among individuals with some students increasing their proficiency in MSU while others experienced decreased proficiency.

Overall, one interesting observation in the parallel LGC model is that even though the initial levels of MSU and LC did not show any relationship, the growth of MSU had an influence on LC growth. This implies that as long as students learn how to use metacognitive strategies, they will see improvement in their language proficiency. These results also seem to highlight the importance of investigating the learning trajectory longitudinally. The relationship between the growth of MSU and growth of LC would not have been discovered if the relationship between the two were only analyzed at a single point in time as opposed to multiple repeated measures.

Conclusion

The current study contributes to the understanding of how the growth in use of metacognitive strategies for managing self-directed learning process is associated with actual English language proficiency gains. The analysis of the change in metacognitive strategy usage over the semester using single latent growth modeling demonstrated that there was growth over time, which aligns with the results of other previous studies that found the effectiveness of training on the use of metacognitive strategies (Baker, 2013; Schraw, 1998). However, participant growth in listening comprehension was not detected by the parallel latent growth model, most likely due to the relatively small number of participants. Overall, consistent with other research findings (e.g. Dabarena, Renandya, & Zhang, 2014; Farokhi, Karami, & Drikvand, 2018; Nosratinia & Mohammadi, 2017), the results support the view that metacognition plays an important role in language development and that the teaching of metacognitive strategies leads to better learning outcomes not only on a language-task level but also in the larger context of managing self-directed language learning outside the classroom.

Still, the results of this study should be interpreted cautiously due to limitations including the validity of the listening-dictation tests, the relatively small sample size, and the limited time frame in which data was collected. The findings of this study should be confirmed in future studies which address these issues. As the results of this study show that there was significant individual variability in metacognitive strategy usage, which indicates that not all learners follow the same pattern, qualitative methods such as analysis of learning journal entries or interviews should be used to explore in more depth the unique paths learners take on their journey to master the target language.

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