



Supporting interest in a study domain: A longitudinal test of the interplay between interest, utility-value, and competence beliefs[☆]



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ARTICLE INFO

Keywords:

Interest
Utility-value
Competency beliefs
SEM
LPTA

ABSTRACT

The current study used a longitudinal design to model initial interest and utility-value as antecedents of developing interest and course proficiency. Using measures from four time points across one academic year and competency assessed at the beginning of the previous year, we examined direct and mediated contributions of utility-value, self-efficacy, and self-concept for the development of domain interest. Japanese tertiary students ($n = 614$; Female = 129) undertaking a compulsory year-long study of English as a foreign language participated. Students reported motivation (interest, utility-value and competence beliefs of self-efficacy and self-concept) for studying English as a foreign language. In addition, the design allowed detection of reciprocal effects: the forward effect of interest on competence beliefs and in turn the forward effects of competence beliefs on interest. Initial domain interest indicated direct and/or mediated effects for all constructs, while self-efficacy indicated a reciprocal relationship with domain interest. Profile analyses (LPA) identified 3 motivation profiles that were stable across two semesters. Testing a mover-stayer model (LPTA) indicated some movement between the low and medium intensity profiles of motivation.

1. Introduction

Interest in specific learning domains is both a means and important outcome for formal education. Research on the development of interest is yielding an increasingly complex picture of how interest in a domain grows through provision of supportive contexts based on understanding how interest interacts with a range of related motivational constructs (Ainley, Hidi, & Berndorff, 2002; Krapp, 2002; Renninger & Hidi, 2011; Schiefele, 2009). Across one year of university study, the current research investigated how the interconnections between constructs known to be associated with interest; namely, self-concept, self-efficacy, utility-value and competence, together contribute to continuing interest in the domain, in this case learning of English as a foreign language.

Reviews over the last two decades have drawn attention to the overlap between commonly researched motivation constructs (see e.g., Murphy & Alexander, 2000). In a later review, Wigfield and Cambria (2010) drew attention to the work of Pintrich, Marx, and Boyle (1993) who distinguished individuals' motivation-related beliefs about their abilities to do tasks, for example, efficacy and competence beliefs, from their reasons for doing tasks or for choosing study domains. When faced

with a learning activity, reasons for doing a task along with salient competence beliefs function as drivers for the cognitive processing required to perform the learning activity. In the current research reasons for study are represented by interest and utility-value constructs, while competence beliefs are represented by self-efficacy and self-concept constructs. Hence, it is expected that there will be forward predictive links between these constructs as they develop across a course of instruction. For example, interest for a course of study will activate feelings of efficacy for the tasks presented in that course of study, which in turn will support continuing interest in the domain. Utility-value and self-concept are also expected to contribute to the motivation system that plays out across the course of the year of study to impact on students' further interest in the domain. Hence, motivation processes acting as drivers for the cognitive processing required to enact activities in the domain of study, contribute to students' proficiency as assessed by standardised performance measures.

Identifying patterns of relations among motivation constructs within a study domain requires a longitudinal data set modelled using analytic procedures that can separate the predictive effects and reciprocal connections between latent constructs as they contribute to future interest in the study domain and achievement at the end of the

[☆] The first author's contributions was partially supported by a Thomas and Ethel Mary Ewing Scholarship.

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course (see Marsh, Trautwein, Ludtke, Koller, & Baumert, 2005; Denissen, Zarrett, & Eccles, 2007). Hence, the current study modelled the longitudinal direct and mediated effects of a set of latent constructs over one year of a compulsory, English as a foreign language course. In this way we sought to extend the understanding of reciprocal links among motivation constructs as they contribute to continuing interest and to increasing language proficiency.

Utilising a variable-centred approach, the links between and relative impact of important variables can be assessed. However, to examine the shared role of beliefs and motivations beyond the average student and examine the pattern of students' development, cross-sectional and longitudinal person-centred perspectives are also necessary. Therefore the present study combines these analytical approaches toward enhancing our understanding of interest and proficiency development.

1.1. The nature and development of interest

Interest is a complex, domain specific construct involving a combination of affective experiences such as enjoyment (Ainley & Hidi, 2014), perceptions of value (Krapp, 2002), knowledge components (Renninger & Hidi, 2002) and a desire for repeated engagement with the domain (Renninger & Hidi, 2011). The Four-Phase Model of Interest Development (Hidi & Renninger, 2006) describes how interest develops across phases of triggered and maintained situational interest, emerging and well-developed individual interest. Research findings suggest that individual interest in a domain predicts persistence, effort, and the progress of learning reflected in students' perceived competence and actual achievement in the domain (Renninger & Hidi, 2002; Schiefele, 2009). Individual interest in the study domain is an important outcome of learning experiences. In addition, individual interest contributes to students' decisions regarding future participation in the study domain (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002). Hence, in the current study we examined the longitudinal predictive power of individual interest in the study domain for course-end interest and actual proficiency in the domain.

1.2. Value and interest development

Beyond the immediate influence of interest in a domain on later interest and participation, knowledge of the direct and mediated effects on interest of related constructs such as value, self-concept, and self-efficacy are critical for understanding interest development.

Value functions as a key motivation for students' interest in a range of study domains (Brophy, 1999, 2008; Wigfield & Eccles, 2002) and has been researched extensively in domains such as science (e.g., Ainley & Ainley, 2011), mathematics (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012), and psychology (Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Hulleman, Durik, Schweigert, & Harackiewicz, 2008). The value component in much of this research is based on Expectancy-Value Theory where Eccles et al. (1983) defined task-value as the perceived importance of a task. Eccles et al. distinguished four components of task-value: utility-value or the usefulness of the task for the achievement of future goals, intrinsic or interest value, attainment value or the importance of the task for identity and self-beliefs, and cost. It should be noted that one of the components of task-value as defined by Eccles et al. is intrinsic or interest value. There are strong similarities between this component and interest as defined by Hidi and Renninger (2006). Simultaneously, the construct of individual interest as defined by Hidi and Renninger (2006) and by other interest researchers (e.g., Krapp, 2002; Schiefele, 2009), has a strong value component.

In this research we focus on utility-value, which past research has shown to be related to the development of interest in a course, or study domain (e.g., Harackiewicz, et al., 2008; Hulleman et al., 2008). For example, Hulleman, Godes, Hendricks, and Harackiewicz (2010) designed an intervention testing whether stimulating students' utility-

value for a domain would affect interest and performance. The intervention had significant direct predictive effects for achievement and for both situational and maintained interest. Indirect effects of initial interest on later interest were mediated through utility-value. In addition, this intervention was particularly effective for low competence students, suggesting that competence and value interact to influence future interest and achievement. Therefore, we expect that utility-value will contribute to the development of interest in a study domain, and in this research we test whether utility-value measured early in a course makes an independent contribution to the prediction of interest measured at the end of the course.

1.3. Self-efficacy, self-concept, and interest development

Self-efficacy is concerned with people's beliefs in their capabilities to produce given attainments (Bandura, 2006). Self-efficacy is generally defined as an individual's belief in his/her ability to effect actions necessary to successfully complete a future task or achieve a goal (Bandura, 1997). However, Bandura (2011) has also stated that self-efficacy is not limited to a single task: i.e., "Judgments of self-efficacy for pursuits like academic achievement, organizational productivity, entrepreneurship, and effecting social change encompass activities of broad scope, not just an isolated piece of work. Moreover, strength of self-efficacy is measured across a wide range of performances within an activity domain, not just performance on a specific item." (p.17).

In the context of a specific course of tertiary studies, for example, self-efficacy refers to students' beliefs that they will be consistently successful in the various demands presented by their course, that is, in the specific tasks they encounter in their English language classes. Self-concept on the other hand, refers to an individual's retrospective (Marsh, Martin, Yeung, & Craven, 2016), general domain-specific sense of competence (Marsh & Shavelson, 1985). In the context of tertiary study, self-concept refers to students' perceptions of past achievement and present competence in the domain.

While a substantial body of research has established the clear divergent construct validity of self-concept and self-efficacy (see Bong & Skaalvik, 2003), little research has examined their shared and discrete roles for interest development and learning outcomes. A recent meta-analysis indicated that in the context of tertiary education, self-efficacy is the stronger correlate and in fact one of the strongest correlates of achievement (Richardson, Abraham, & Bond, 2012). In addition, Parker, Marsh, Ciarrochi, Marshall, and Abduljabbar (2014) reported that both self-efficacy and self-concept predicted choice of university entrance. However, only self-efficacy predicted actual university entry and only self-concept predicted students choosing STEM (science, technology, engineering and mathematics) studies.

With respect to the relation between competence beliefs and interest, research has indicated that self-concept has a small to moderate predictive effect for future interest in the same domain (e.g. Denissen et al., 2007; Fryer, 2015; Viljaranta, Tolvanena, & Nurmi, 2015). Others have explored the theoretical and empirical relation between interest and self-efficacy for writing tasks (Ainley, Buckley, & Chan, 2009; Hidi, Ainley, Berndorff, & Del Favero, 2006). Cross-lagged modelling across multiple data points suggested that the association between interest and self-concept over time, while small, is reciprocal (Marsh et al., 2005). More recently Fryer, Ainley, and Thompson (2016) monitored interest for specific tasks across a full semester and reported different predictive effects of self-efficacy and self-concept measured at the beginning of the course on interest measured in relation to specific course tasks. Self-concept predicted to the initial measure of task interest whereas self-efficacy also predicted to specific task interest much later in the course. However, self-efficacy and self-concept were only measured at the commencement of the course and so it was not possible to determine whether there were reciprocal relations between interest and competence beliefs of self-efficacy and self-concept as suggested by a number of researchers (e.g., Hidi & Ainley, 2008; Marsh et al., 2005).

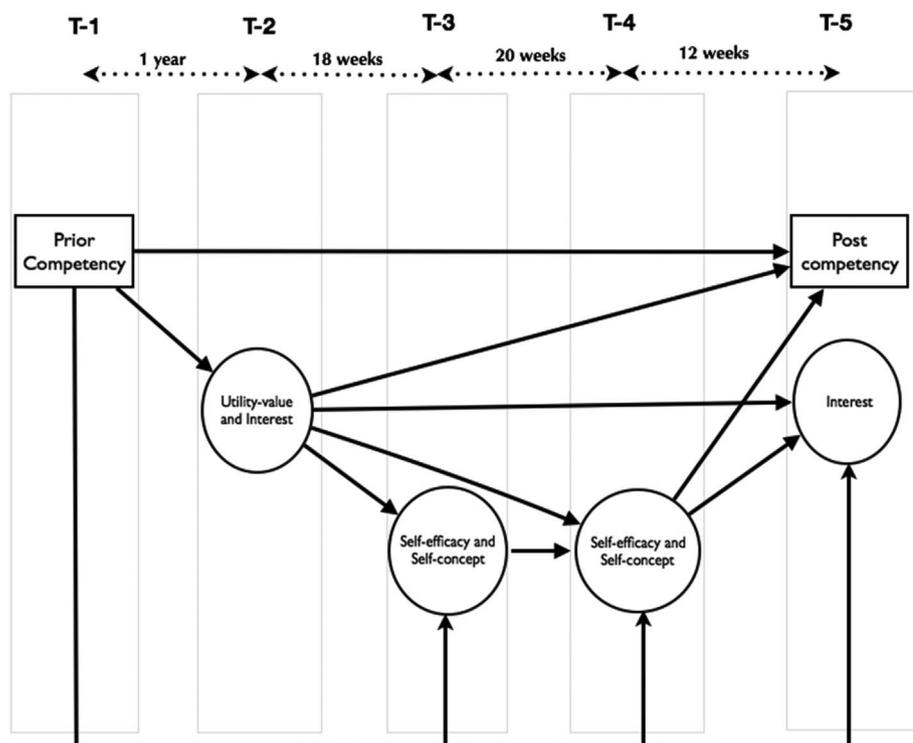


Fig. 1. Hypothesised fully-forward longitudinal model of competency, utility-value/interest, self-efficacy/self-concept.

Therefore, in the current research we included a sequence of measures that allowed us to detect reciprocal effects between interest and competence belief measures.

Furthermore, expectancy-value theory also emphasizes the role of students' perceived competence in relation to task performance thereby implicating students' perception of their general competence in relation to the domain, that is, self-concept (Trautwein et al., 2012), as well as their sense of efficacy for specific tasks, that is, self-efficacy (Conley, 2011). Therefore, the sequence of measures included in the design of the current research also allowed evaluation of the longitudinal role of utility-value for competence belief measures of self-efficacy and self-concept.

1.4. Interest in learning a foreign language

Due to the considerable persistence necessary to learn a foreign/second language, the importance of interest is clear. However, very little research has examined foreign/second language learning through this motivational lens. Motivational research in the area of language learning has classically focused on the role of socio-cultural (e.g., Gardner, 1988) or language acquisition specific (e.g., Ushioda, 2012) models. More recent research (e.g., McEown, Noels, & Saumure, 2014; Oga-Baldwin, Nakata, Parker, & Ryan, 2017) have begun to examine the implications of broader psychological frameworks such as self-determination theory. The small amount of recent research that has examined interest within foreign/second language learning has either not undertaken fully longitudinal modelling of essential variables (Fryer, 2015; Fryer et al., 2016) or focused exclusively on interest and not examined the reciprocal role of other important constructs such as actual competence, ability-beliefs and utility-value (Fryer, Ainley, Thompson, Gibson, & Sherlock, 2017).

1.5. The current study

The current study used a longitudinal design to model initial domain interest and utility-value as antecedents of developing interest and language proficiency based on measures from tertiary students'

participating in a year-long study of English as a foreign language. Identification of the specific patterns of relations between the set of latent variables was modelled within a longitudinal simultaneous latent structural equation model to highlight direct and mediated effects.

Four specific issues were addressed.

First, we examined the direct and mediated contributions of utility-value, self-efficacy, and self-concept for the development of interest in a learning domain.

Second, the design allowed for detecting reciprocal effects and so we tested the forward effect of initial domain interest on competence beliefs and in turn the forward effect of competence beliefs on later domain interest.

However, longitudinal antecedent modelling will only provide information about the average student in the study. In addition, we were keen to identify whether there are different trajectories and patterns of relations between the modelled factors for subgroups of students (e.g., Schwinger, Steinmayr, & Spinath, 2016).

Third, at two time points we applied latent profile analysis (LPA), an approach that is sensitive to differences in students' experiences, to identify different trajectories of motivation across the course.

Fourth, the LPA was followed up with latent profile transition analysis (LPTA) to detect whether there were changes in subgroup membership across the course.

A compulsory language-learning course provided an ideal context for testing the relations described above. First, rather than an achievement test of course curricula or teacher assigned semester grades, we employed a standardised test of language skill proficiency (180 questions, Listening and Reading; see Stewart, Gibson, & Fryer, 2012). An achievement test based on teacher assigned semester grades can include teacher biases and is as much about completing course curricula as about gains in actual domain competence. On the other hand, a standardised skill proficiency test, which is not directly connected to course curricula, when administered both prior to and on completion of a course, can provide an important measure of actual increases in competence across the year of study. Second, because the course is compulsory, there was a range of abilities, self-perceptions and goals among the participants thereby ensuring that problems

associated with ceiling effects as described by Silvia (2003), are less likely to interfere with estimated predictive effects. Finally, there is relatively little research into how these motivational factors support foreign language learning and so the current research is timely.

In short, the current study used a longitudinal design to model antecedents of further interest in the study domain and course competence. Direct and mediated contributions of utility-value, self-efficacy and self-concept for the development of interest in a learning domain over the course of one academic year were modelled and potential reciprocal effects identified. Fig. 1 presents the hypothesised cross-lagged model which includes longitudinal measures of competence, interest, self-concept and self-efficacy. In addition, latent profile analysis (LPA) was used to identify profiles of subgroups within the sample for both Semester 1 and Semester 2 measures. Finally, latent profile transition analysis (LPTA) was used to examine movement between subgroups, that is, to identify students whose profiles differed when Semester 1 and Semester 2 subgroups were compared. Year-end foreign language competence was also explored as an important observed outcome.

2. Methods

2.1. Participants

Participants were second year students ($n = 614$; Female = 129) from one mid-sized private university in Japan. Students were from six faculties (International Culture, Business, Economics, Fine Arts, Engineering, Computer Science) and studying English as a foreign language for compulsory foundation credits within a coordinated curriculum. Students were allocated to classes by the administration. All classes followed the same attendance and assessment policies and employed common teaching materials (Fryer et al., 2010), weekly e-learning assignments (Bovee & Fryer, 2011), term tests and final exams (see Stewart et al., 2012). Students' participation in the research was voluntary. The information sheet students received assured them that if they chose to participate, anonymity would be preserved and any self-reported information would have no connection to their grades.

2.2. Measures and procedures

As indicated in Fig. 2 students' competence in the English language was assessed across students' first 2 years at university, at T1 and T5, using a standardized listening/reading test with a score range from 0 to 180 (see Stewart, Fryer, & Gibson, 2013). The test at T1 occurred at the beginning of students' first year at university, one year prior to the commencement of the study and then again at T5, the end of their second year.

Students' perceptions of course utility-value and interest were recorded at T2 and interest again at T5. Utility-value was assessed with three items from Hulleman et al. (2010), for example, "The English I study at university is useful to me", and interest was assessed with 3 items from Ichihara and Arai (2004), for example, "English arouses my curiosity". At T3 and T4 the self-efficacy and self-concept measures

were administered. Self-efficacy was measured using five items from the Patterns of Adaptive Learning Scales (Midgley et al., 2000), for example, "I can do almost all the work in this class if I don't give up", and self-concept was measured with four items from Ichihara and Arai (2004), for example, "I could understand my English classes". A full list of all scale items are presented in the supplementary materials (Table B).

All of the self-report measures involved Likert scales where 1 = "totally does not match me" to 7 = "totally matches me", except at T2 when the utility-value and interest scales at T2 were on a 6 point scale with 6 = "totally matches me". For all analyses these T2 scales were linearly transformed (SPSS., 2010) to a seven-point scale allowing easy comparison between of means for all measures (see Table 1). The self-concept and self-efficacy scales were completed online prior to students completing online class assignments, which were identical across all classes (Bovee & Fryer, 2011). The interest (T5) items were completed on paper, as were the year-end English language competence tests (Year 1 at T1 and Year 2 at T5).

2.3. Analyses

2.3.1. Predictors of interest development and competence

All latent analyses were conducted with Mplus (7.0) (Muthén & Muthén, 1998–2013), employing the Maximum Likelihood Robust (MLR) algorithm. MLR was used to obtain robust estimations of standard errors and to account for non-normality of observations, which are common within Likert data. Missing data (5.4%) was handled by employing Full Information Maximum Likelihood (FIML). FIML is generally held to be the most effective means of dealing with reasonable amounts of missing data (Enders, 2010).

First a confirmatory factor analysis of all variables was conducted to assess their convergent and divergent validity. This was followed by invariance testing for the longitudinal measurement of interest (T2/T5); self-efficacy and self-concept (T3/T4). A lagged structural equation model (SEM) based on Fig. 1 was then constructed and tested. Fit was assessed employing multiple indices. Root Mean Square Error of Approximation (RMSEA) values < 0.08 and < 0.05 indicated acceptable and good fit respectively (Browne & Cudeck, 1992). Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values > 0.90 and > 0.95 also indicated acceptable and good fit respectively (e.g., Marsh, Balla, & McDonald, 1988). To interpret SEM findings β coefficients were used following Keith's (2015) suggested guidelines for interpretation of beta coefficients in research on influences on learning. Betas below 0.05 are interpreted as "too small to be considered meaningful"; those above 0.05 but less than 0.10 are considered "small but meaningful"; those above 0.10 but less than 0.25 are considered "moderate"; and those above 0.25 are considered "large".

2.4. Latent profile analysis (LPA) and latent profile transition analysis (LPTA)

The same dataset was employed to identify distinct subgroup

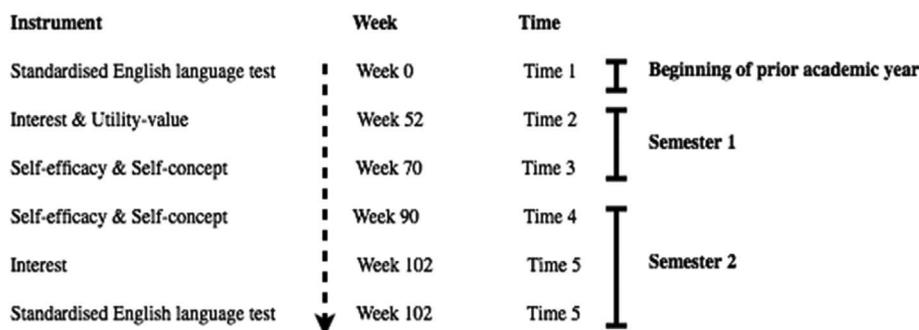


Fig. 2. Two year timeline for data collection.

Table 1
Latent Correlations, means, standard deviations and Raykov's Rho for all variables modelled.

	T1 Competence	T2 Interest	T2 Utility-value	T3 Self-efficacy	T3 Self-concept	T4 Self-efficacy	T4 Self-concept	T5 Interest	T5 Competence
T1 Competence	1.00								
T2 Interest	0.17**	1.00							
T2 Utility-value	0.05	0.63**	1.00						
T3 Self-efficacy	0.13*	0.59**	0.45**	1.00					
T3 Self-concept	0.14**	0.50**	0.26**	0.76**	1.00				
T4 Self-efficacy	0.16**	0.57**	0.43**	0.68**	0.51**	1.00			
T4 Self-concept	0.18**	0.49**	0.32**	0.59**	0.64**	0.77**	1.00		
T5 Interest	0.11*	0.60**	0.55**	0.50**	0.38**	0.57**	0.48**	1.00	
T5 Competence	0.69**	0.26**	0.14*	0.19**	0.18**	0.24**	0.20**	0.24**	1.00
Raykov's Rho		0.92	0.87	0.89	0.86	0.89	0.93	0.91	
Mean	103.24	3.44	4.25	3.86	3.21	3.96	3.57	3.25	116.28
SD	16.72	1.13	0.95	1.25	1.28	1.32	1.23	1.05	15.46

Note: * $p < 0.01$, ** $p < 0.001$.

profiles within the sample. All scale and competence scores were transformed to Z-scores. The first LPA employed T2 interest and T3 self-concept and self-efficacy as the Semester 1 profiling measures. The same three variables as measured at T4 and T5 were used as the profiling measures for Semester 2. Fit was assessed using six fit indexes: two likelihood ratio tests and four information criterion indexes. The Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (Vuong, 1989) and Lo-Mendell-Rubin Likelihood Ratio Test (Lo, Mendell, & Rubin, 2001) both provide a test of whether a solution with one group less than the identified set of latent groups, is a better fit. Akaike's Information Criterion (AIC; Akaike, 1987), the Bayesian Information Criterion (BIC; Schwartz, 1978) and the sample size-adjusted BIC model all stipulate that lower values indicate the preferred model. Finally, an entropy criterion, which is a summary statistic of all posterior probabilities derived by the model, was also utilised (Celeux & Soromenho, 1996). Entropy is interpreted as incremental, with numbers closer to one representing better classification of a sample into subgroups. No concrete cut-off heuristics are available for this criterion, which is generally employed as a supplementary *ad hoc* signal for the quality of the finalised classification (Nylund, Muthén, Nishina, Bellmore, & Graham, 2006). Relative size of the groups and their theoretical meaningfulness also guided decisions regarding the optimal number of groups. Once the cross-sectional subgroups were resolved, Latent Profile Transition Analysis (LPTA) was conducted. Latent profile analysis (LPA) is a latent variable mixture analysis (Magidson and Vermunt, 2004) conducted with continuous cluster indicators. Latent profile transition analysis (LPTA) is an extension to LPA. LPTA integrates auto-regressive (a variable predicting itself in the future) modelling (see Nylund et al., 2006) to examine group membership over time. LPTA simultaneously estimates group membership at multiple time points and the transition between these subgroups between time points. LPTA thereby estimates which subgroup individuals belong to according to the first data set, where they are located in the second data set, and also provides probability estimates for subgroup memberships and transitions between subgroups. LPTA can therefore provide a precise description of changes in subgroup membership over time, referred to as a mover-stayer model.

For LPTA only three Information Criteria (i.e., AIC, BIC, and sample

sized adjusted BIC) are available to assess fit to these data. In the current study comparing profiles from Semester 1 and Semester 2, LPTA generated profiles for students who were located in the same subgroup (stayers), and students who were located in a new subgroup (movers).

3. Results

Prior to conducting the main analyses a test for gender effects was undertaken. No significant gender effects were observed and so gender has not been included in the following analyses. The latent correlations, means, standard deviations and composite reliability coefficients (Raykov's Rho) are presented in Table 1. Means on all of the self-report scales were around the midpoint of the seven point scales (3.21–4.25). In terms of reliability for the self-report scales, all of the coefficients were well above what is considered to represent acceptable reliability (Rho = 0.84 - 0.92). Of particular significance were the high but still acceptable correlations between self-concept and self-efficacy (T3: $r = 0.76$, T4: $r = 0.77$). All correlations were less than 0.90, which is considered to be the point beyond which multicollinearity issues need to be considered (Tabachnick & Fidell, 2007). For utility-value and interest the correlation was also high (T2: $r = 0.63$).

With regard to change over the course of the year, there was a small but significant decrease in mean interest (T2: $M = 3.44$, T5: $M = 3.25$; $t = -4.35$, $p < 0.01$); a small but significant increase in mean self-concept (T3: $M = 3.21$, T4: $M = 3.57$ $t = -3.93$, $p < 0.001$), and no significant change in mean self-efficacy. The two years of study resulted in a significant increase in mean competence level (T1: $M = 103.24$ T5: $M = 116.28$ $t = 25.34$, $p < 0.01$, $d = 1.12$).

3.1. SEM: predicting interest development and competence

Variable-centred modelling of these data proceeded in three steps: configural and then invariant confirmatory factor analyses were used to establish the construct validity of the scales, and finally the SEM test of the hypothesised model (Fig. 1). Table 2 presents fit indices for each model tested. CFI and the RMSEA are suitable for assessing the adequacy of invariance assumptions (Marsh, Nagengast, & Morin, 2013). Chen (2007) suggests that if CFI does not change more than 0.01 and

Table 2
SEM fit statistics for confirmatory scale analyses and full model.

Model	χ^2	Comparative Fit Index (CFI)	Root Mean Square Error Index of Approximation (RMSEA)
Configural model test	1032.04(344)	0.935	0.057 (CI 90% 0.053-0.061)
Interest invariance	1032.59(346)	0.935	0.057(CI 90% 0.053-0.061)
Self-concept invariance	1033.80(347)	0.935	0.057(CI 90% 0.053-0.061)
Self-efficacy invariance	1040.29 (348)	0.935	0.057(CI 90% 0.053-0.061)
SEM full model test	1002.56(341)	0.937	0.056(CI 90% 0.052-0.060)

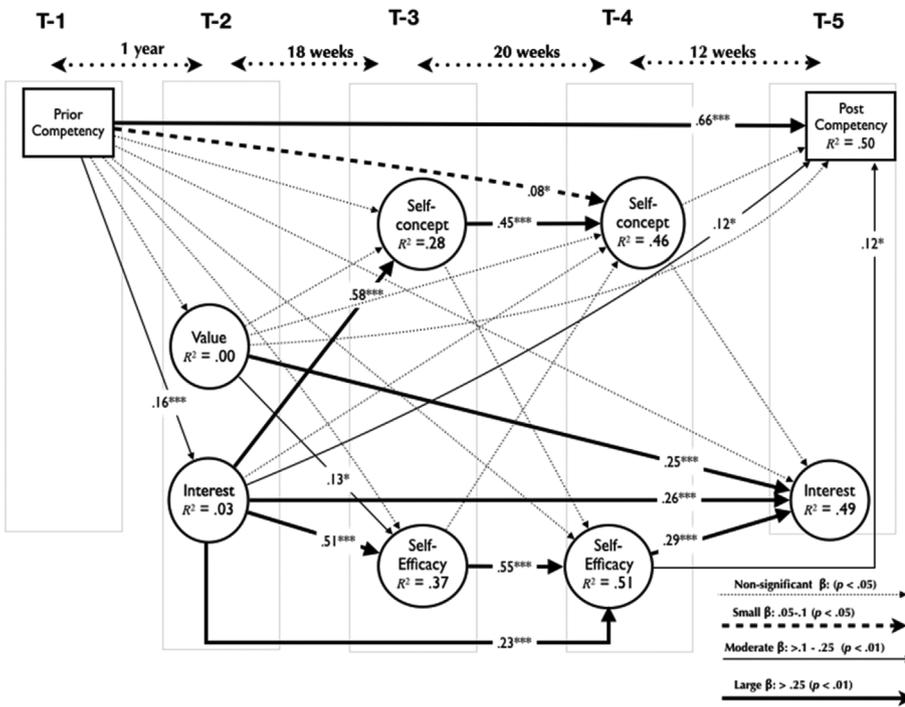


Fig. 3. A longitudinal model of interest, utility-value and competence. Note: The model was tested as presented in Fig. 1 with no adjustments. Only significant β s ($p < 0.05$) are presented. Significance is presented as * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

the RMSEA increases by less than 0.015 for an invariance model when compared with the configural model, the assumption of invariance is tenable. The test of invariance for this study's longitudinal constructs met these criteria (Table 2).

Both the confirmatory factor analysis of all variables modelled and the longitudinal SEM resulted in acceptable fit (Table 2). The factor loadings for all latent constructs were acceptable (0.67 - 0.89), suggesting appropriate construct validity and supporting use within the current study's longitudinal analyses. The longitudinal modelling results are presented in Fig. 3 and will be reported focusing first on the strong predictors of interest at T5. This will be followed by a description of the predictors of post competence also measured at T5.

There were a number of significant predictive paths for interest at T5: a direct path from interest at T1 ($\beta = 0.26, p < 0.001$), a mediated path through self-efficacy T3 and T4, and a direct path from utility-value T2 ($\beta = 0.25, p < 0.001$). The mediated path consisted of T2 interest predicting T3 self-efficacy ($\beta = 0.51, p < 0.001$), which was then predictive of T4 self-efficacy ($\beta = 0.55, p < 0.001$). In addition, there was a smaller direct predictive path from T2 interest to T4 self-efficacy ($\beta = 0.23, p < 0.001$). The final step in the mediated relation consisted of a significant path from T4 self-efficacy to T5 interest ($\beta = 0.29, p < 0.01$).

T2 interest was strongly predictive of T3 self-concept ($\beta = 0.58, p < 0.001$), and mediated through T3 self-concept, was predictive of T4 self-concept. Post competence was directly predicted by prior

competence ($\beta = 0.66, p < 0.001$). After accounting for prior competence, the only other direct predictive relationship with post competence was a small effect from T2 interest ($\beta = 0.12, p < 0.05$).

This pattern of β s resulted in substantial variance explained both within the model (R^2 at T3: self-efficacy = 0.37, self-concept = 0.28, and T4: self-efficacy = 0.51, self-concept = 0.46), and for the two outcome components (T5: post-competence = 0.50, interest = 0.49).

3.2. Differentiating trajectories of interest and competence beliefs

Two LPAs were conducted. The first, Semester 1 – LPA1, was conducted from the four variables of T2 interest, T3 self-efficacy and self-concept, the second, Semester 2 – LPA2, was constructed from T4 self-efficacy and self-concept, and T5 interest. Two, three, four and five profile solutions were tested and for both LPAs three subgroups emerged as the best fit to the sample. For both the Semester 1 and 2 LPAs both likelihood ratio tests (Vuong-Lo-Mendell-Rubin and Lo-Mendell-Rubin) suggested that a four subgroup solution was not significant providing support for a three subgroup solution. Furthermore BIC in particular, presented a clear levelling out or “elbow” between two and four subgroups. Both of these results supported a three subgroup model as the best fit. Indices for each of these analyses are shown in Table 3. The profiles generated for Semester 1 and Semester 2 are shown in Fig. 4 are labelled as Low, Mid and High reflecting the overall level of motivation reported.

Table 3 Fit indexes for Semester 1 and Semester 2 Latent Profile Analyses.

Fit Criterion	Semester 1 (LPA1)				Semester 2 (LPA2)			
	Two groups	Three groups	Four groups	Five groups	Two groups	Three groups	Four groups	Five groups
Akaike Information Criterion (AIC)	10713.33	10525.17	10483.10	10454.01	10222.00	9979.42	9943.57	9919.61
Bayesian Information Criterion (BIC)	10770.79	10604.73	10584.76	10577.77	10279.46	10058.98	10045.23	10043.37
Sample-Size Adjusted BIC	10729.52	10547.58	10511.74	10488.88	10238.19	10001.83	9972.21	9954.47
Entropy	0.70	0.83	0.74	0.80	0.70	0.86	0.79	0.79
Likelihood Ratio Tests	0	0	0.061	0.060	0.013	0	0.004	0.024
Vuong-Lo-Mendell-Rubin	0	0	0.070	0.064	0.015	0	0.005	0.027
Lo-Mendell-Rubin	0	0	0	0	0	0	0	0

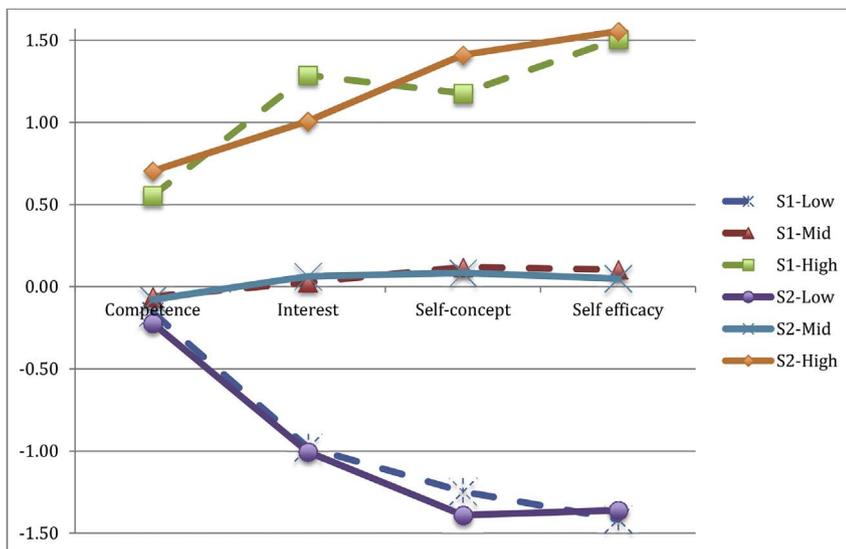


Fig. 4. Latent Profile Analyses for Semester 1 and Semester 2 presenting three profiles each: Low, Mid and High motivation profiles.

Significant separation ($p < 0.001$) between the profiles within each semester was confirmed by the results of ANOVAs (Bonferroni adjusted) and pair-wise comparisons (Tukey's HSD) for each profiling variable across both sets of three profile groups (see [Supplementary materials Table A](#) for all means and statistical results). Of particular note between semester one and semester two, is the increased separation between sub-groups' self-concept (included in profiling; $R^2 = 0.48$ and $R^2 = 0.61$) and achievement (a covariate to the profiled subgroups; $R^2 = 0.05$ and $R^2 = 0.08$). These results are consistent with the overall mean growth in proficiency ($d = 1.12$) across the study.

We then proceeded with Latent Profile Transition Analysis which was conducted using interest, self-efficacy and self-concept data points from both semesters. Based chiefly on BIC changes showing an elbow in its decrease between two and four subgroups thereby supporting the LPA evidence for a three subgroup fit to the sample at both Semester 1 and Semester 2 ([Table 4](#)). Consistent with subgroups from the LPAs, the three subgroups identified by the LPTA were labelled Low, Mid and High motivation profiles.

Six potential transitions were tested by the LPTA: individuals in any of three initial subgroups could potentially move to one of the other two groups between Semester 1 and Semester 2, or could stay in the current subgroup. Six potential mover groups along with the three stayer groups (individuals staying in their group) meant that a total of nine subgroups could have resulted from the LPTA. As [Fig. 5](#) illustrates most students were stayers and only one student moved between the two extreme groups (Low to High). If we disregard the single student moving from the Low to the High group, four transitions were observed. A MANOVA was conducted to examine the variance explained by the mover-stayer model's seven subgroups. The three stayer and four mover subgroups model explained a total of 68% of the variance in all the variables presented in [Figure A](#) (Wilks' Lambda = 0.32, $F = 13.62$ $df = 54$, $p < 0.001$). The profiles for each of the three stayer and five mover subgroups are presented in supplementary materials ([Figure A](#)).

The pattern presented by the mover subgroups, despite their small size, is informative. [Figs. 6 and 7](#) present the Semester 1 and Semester 2 profile means for the larger mover subgroups: Low to Mid ([Fig. 6](#)) and

Mid to Low ([Fig. 7](#)) to highlight the changes in profiled variables from Semester 1 to Semester 2. The students whose scores increased, that is, they moved from the Low subgroup to the Mid subgroup ($n = 23$) had higher scores in Semester 2 than Semester 1 for all three motivation variables. The increases were higher for self-efficacy and self-concept than for interest. On the other hand, differences between Semester 1 and Semester 2 scores for those students transitioning from the Mid subgroup to the Low subgroup ($n = 20$) showed large decreases on all three measures with especially large decreases in self-concept and self-efficacy scores. Only very small numbers of students transitioned between the Mid and High groups, in both directions. It is clear from [Figs. 6 and 7](#) that the largest changes in motivation scores from Semester 1 to 2 were for students' reported competence beliefs.

4. Discussion

The current study's longitudinal, variable-centred modelling of interest, utility-value, self-efficacy, self-concept and competence provides an enhanced understanding of the role of personal factors for students' continuing interest in a domain of study.

We found evidence of a strong reciprocal relationship between self-efficacy and interest across the academic year. There was also some evidence of a small reciprocal relationship between competence and interest over the time between the two measures of language proficiency. Interest measured at the beginning of the year was connected to all prior and forward modelled constructs, suggesting that interest is a crucial component of the learning experience.

Longitudinal person-centred modelling identified three subgroups of students distinguished by their reported motivation profiles (Low, Mid, High). These subgroups were relatively stable across the year. However, there were a small number of students who transitioned between the Mid and Low subgroups and the major changes were in their competency belief scores.

4.1. Interest in a domain of study

All of the interconnections within the set of motivation variables modelled in the current study took place against the backdrop of a small, but significant decrease in domain interest at the end of the course. As expected, prior interest in the domain had a strong predictive relation with interest measured at the end of the course. After accounting for prior interest, two variables, self-efficacy and utility-value, presented moderate, consistent contributions to the maintenance of interest in the domain, across the year of study. Utility-value, in

Table 4
Fit for latent profile transition analyses.

	2 subgroups	3 subgroups	4 subgroups
Bayesian Information Criterion (BIC)	20879.11	20337.62	20222.45
Akaike Information Criterion (AIC)	20998.45	20514.42	20465.55
Sample-Size Adjusted BIC	20912.74	20387.42	20290.94

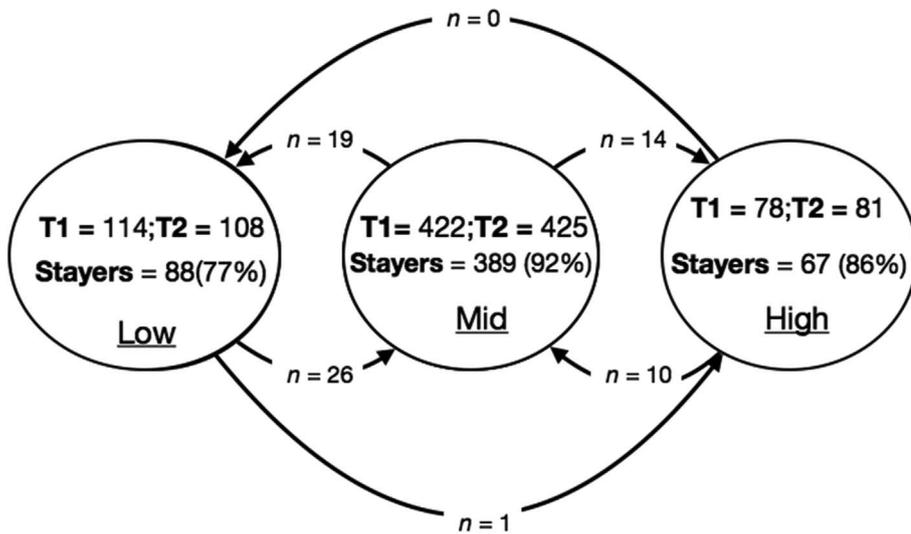


Fig. 5. Mover-Stayer Model: Latent transitions between three groups across time points.

addition to direct effects on later interest, also had a small indirect or mediated effect, through its relation with self-efficacy.

Of particular interest in these findings was the evidence of a reciprocal relation between self-efficacy and interest demonstrating how these two components of the learning process work together. Interest in the study domain influences self-efficacy which in turn supports continuing interest in the domain. This reciprocal connection has previously been proposed within a self-regulation framework (Hidi & Ainley, 2008) and some empirical results support this proposition (Ainley et al., 2009). The present study, however, extends these findings with a larger sample and provides evidence on the latent structure of these interconnections.

The findings we have reported are consistent with proposals advanced in the Four-Phase Model of Interest Development (Hidi & Renninger, 2006; Renninger & Hidi, 2011) as well as findings from educational interventions pointing to the essential role of utility-value within interest development such as those reported by Hulleman et al. (2008, 2010).

On the other hand, although prior interest was a significant predictor of self-concept there was no forward prediction from self-concept to later interest, a finding that is not consistent with past cross-sectional learning research (Fryer, 2015) and longitudinal math

research (Marsh et al., 2005). However, the fact that the present findings did not provide evidence of reciprocal relations between self-concept and interest, may reflect differences between the two studies. Unlike Marsh et al. (2005), the modelling in the current study included both self-efficacy and self-concept as predictor variables.

A further note on the relation between self-concept and self-efficacy is warranted. Despite strong correlations between these two factors in the current study, there were no significant cross-lagged connections. In addition, self-concept did not significantly predict proficiency. This finding seems to contradict evidence suggesting a reciprocal relation between self-concept and achievement (Marsh et al., 2005) and a predictive relation between self-efficacy and achievement (Lee, Lee, & Bong, 2014). One potential source of these inconsistent findings may be located in the different forms of competency assessment across these studies and requires further investigation.

In sum, the range of longitudinal pathways from prior interest in the study domain represented in the current research highlight the essential role of initial interest in the study domain for the maintenance of domain interest. Furthermore, evidence of reciprocal connections between interest and self-efficacy and their shared longitudinal role within proficiency development situates self-efficacy as a central component within domain interest and students' broader learning experience.

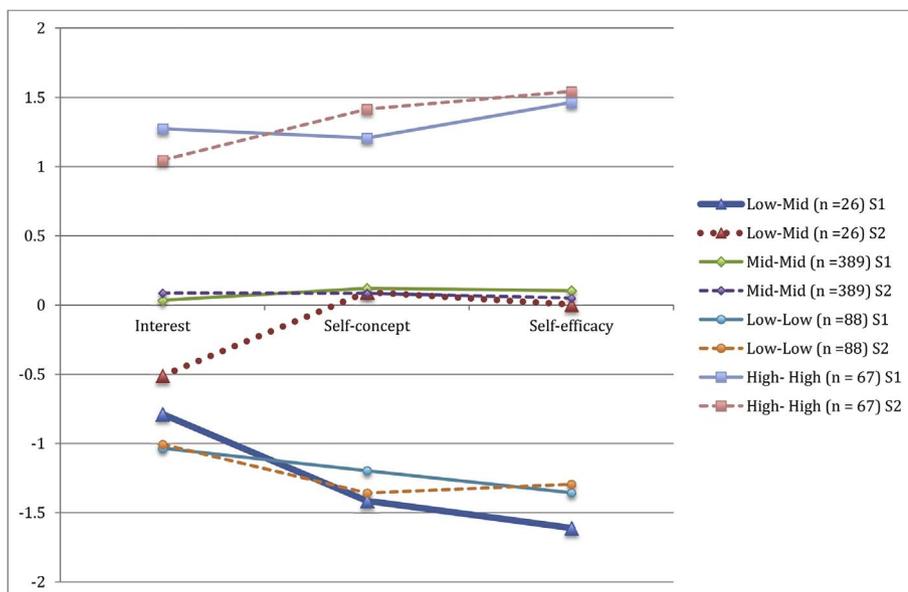


Fig. 6. Profiled variables means for Semester 1 and Semester 2 for movers: Low to Mid subgroup.

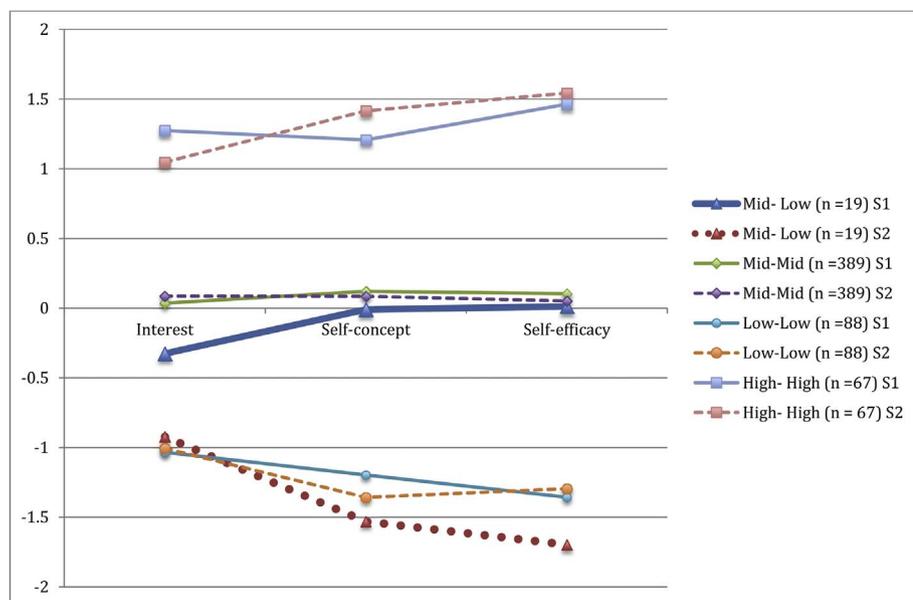


Fig. 7. Profiled variables means for Semester 1 and Semester 2 for movers: Mid to Low subgroup.

4.2. Distinctive motivation profiles and the maintenance of interest

The mover-stayer modelling approach added another layer to our understanding of the longitudinal interaction between the key interest covariates modelled. Beyond the predictive findings of SEM already discussed, the person-centred model provides a sense of how students change across the study. The patterns presented in our mover-stayer model suggested relative stability across a year-long course of study for the three motivation subgroups identified. According to these data most of the students were located in the same motivation subgroup for both Semester 1 and Semester 2. Only one student moved between the Low and High subgroups suggesting that where changes occurred they were moderate changes. However, four small “mover” subgroups were identified pointing to a small number of students transitioning between the Mid and High subgroups in both directions. The most frequent transitions were between the Mid and Low subgroups and the largest changes in motivational profiles underpinning these transitions were in students’ competence beliefs: both self-concept and self-efficacy. Considered alongside the variable-centred modelling, it is clear that self-concept and self-efficacy are important mediators for the maintenance and development of interest in the domain. The relatively large change in self-competence beliefs for students who transitioned between the Low and Mid subgroups suggests that changes in self-competence beliefs might signal both adaptive and maladaptive transitions over time. At the same time the variable-centred longitudinal modelling of the set of motivational variables indicates the interdependence of interest, utility-value and competence beliefs across a course of study.

4.3. Implications for practice: the pervasive importance of interest

The current study lends support to what common sense and a rich tradition of theory and empirical research are confirming: interest in a domain of study is an important driver activating competence beliefs. In our longitudinal model, initial interest in the study domain had either a direct or mediated effect on all of the constructs in the model. If educators are interested in enhancing student’s value-based motivation and their proficiency in the domain under study, then supporting student interest is essential. However, the critical issue for practice concerns how to trigger and maintain interest in the study domain.

The current results suggest two important pathways toward enhancing student interest in a study domain: developing and supporting utility-value, and building on the reciprocal relation between interest

and self-efficacy. The practical effectiveness of the first pathway is well supported by a growing body of value intervention-orientated research. Through student writing (e.g., Hulleman, et al., 2010) and parental involvement (e.g., Harackiewicz, et al., 2012) utility-value research has consistently pointed to ways of generating and maintaining students’ perceptions that the learning domain has personal value for them. Parallel research within self-determination theory supports these conclusions by demonstrating that the impact of something as simple as framing goals for specific tasks in an internally regulated or personalized manner (e.g., Vansteenkiste, Lens, & Deci, 2006) increases students’ perception of the value of learning tasks, which can in turn support interest in the domain of study.

The second pathway implicates building on the reciprocity between interest and self-efficacy. Our results suggest that there is likely to be practical value in addressing issues to do with students’ interest and self-efficacy together. Past research has suggested that interest, by supporting engagement, provides opportunity for students to develop self-efficacy (Hidi & Ainley, 2008, pp. 77–109). The current study supports this theory and also demonstrates how it then feeds back into further interest in the study domain.

These implications for practice are only a small part of the bigger picture of how to trigger, maintain and develop students’ interest in a particular study domain (Renninger & Hidi, 2011). By focusing on the longitudinal relations between reasons for study in terms of interest and utility-value and competence beliefs in the form of self-efficacy and self-concept, our findings add some finer-grain detail to propositions about the importance of triggering and maintaining interest to support students’ developing proficiency in a domain.

For post-secondary educators, the current study, and the research it is built on, supports efforts to integrate interest development within university course goals. The present study highlighted the importance of students’ valuing the study materials. Past research such as Vansteenkiste et al. (2006) provides evidence of straightforward means by which this value might be enhanced during the course of instruction, even embedded within written instructions.

Furthermore, our evidence supporting the reciprocal role of self-efficacy for future interest suggests that instructors, even in large lecture halls, need to consider how self-efficacy might be supported. Socio-cognitive theory suggests two means that might be effective in these contexts (Bandura, 1997). Clear modelling through teacher instruction or peer learning and regular opportunities for mastery experiences are both practices that might be incorporated into a course, even large-

scale lecture-based instruction. Regarding course-based direct support for interest development beyond what is described in the four-phase model of interest development (e.g., Hidi & Renninger, 2006), we can only add that in past research (Fryer et al., 2016) we have presented evidence that interest in tasks, supports interest in the course, which in turn supports interest in the domain of study. For post-secondary instructors this mediated chain in the development of interest for a study domain emphasises that each and every task prescribed for students, matters. Every task has implications for the development of students' domain interest. Through domain interest and its linked beliefs and motivations, these tasks can in turn fuel and support students' meta-/cognitive processes.

5. Limitations and future directions

Despite the longitudinal design and use of latent modelling, it is important to stress that prediction and causation are not the same. Given the importance of supporting student interest within formal education at all levels, future research in this area needs to be undertaken across study domains, across cultural contexts and at other levels of education to add to and test the external validity of the findings presented here. Interventions using quasi- and fully experimental methods are also necessary if these findings are to be used to guide classroom practice and curriculum development.

It is important that future studies modelling relations between student motivation and performance include a range of cognitive processing and metacognitive components. Models that include these components will provide a more complete picture of how motivation drives strategic behaviour and the forms of cognitive processing required for successful performance in the study domain. Further modelling of motivation along with the cognitive and metacognitive processes required for successful performance in a study domain will refine the findings presented in the current study. Examples of important additional components to be included in future studies are depth of processing and metacognitive processes such as effort regulation.

Person-centred motivation research has grown from early analyses using relatively simple cluster analysis techniques (e.g., Ainley, 1993; Meece & Holt, 1993) to increasingly sophisticated analyses using LPA techniques (e.g., Lee, Wormington, Linnenbrink-Garcia, & Roseth, 2017). However, the use of longitudinal person-centred techniques such as LPTA and the synergistic use of person- and variable-centred analyses are not yet common. For theory and practice to advance both perspectives must be employed to understand the ways that motivation promotes student learning. We rarely identify the links whereby the connections between our research constructs generate changes in students that will enrich their learning. We therefore call for more research to simultaneously consider both variable and person perspectives in areas targeting how and why students are motivated to learn. As presented in the current study, mover subgroups can highlight initial and increasing differences in important beliefs such as self-concept and self-efficacy, which are not clear from either sample or cross-sectional profile means.

6. Conclusion

Interest research is a quickly growing field. While substantial advances have been made in understanding the development of interest, further research is needed to understand how individual differences across a range of motivation constructs contribute to this development. The current study supports the broad importance of students' initial interest in a domain of study for key motivational and proficiency outcomes. Consistent with evidence from utility-value interventions and research, our findings emphasise the strong role of prior value, in this case utility-value, for the study domain. Finally, longitudinal modelling presented clear support for a reciprocal relation between interest and self-efficacy as they contribute to maintaining interest and

the development of proficiency. Putting these findings into practice requires provision of sufficient opportunity through the structuring of course content and modes of course delivery for students to develop positive reasons such as interest and utility-value, for engaging in particular study domains, together with appropriate competence beliefs in the form of self-efficacy and self-concept.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.learninstruc.2017.11.002>.

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