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The impact of multilingualism and learning patterns on student achievement in English and other subjects in higher education

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ABSTRACT

Students' mindsets, multilingualism, learning styles and self-regulation strategies, which represent parts of their learning patterns, can affect their academic achievement in various ways. This article presents the results of a study that utilised a 185-item online questionnaire to investigate the interplay among the mindsets, learning styles, self-regulation strategies, multilingualism and achievement of 191 undergraduate students in France who were studying English as a foreign language (EFL) as part of their non-language degrees. The findings indicated that students who held growth-oriented mindsets about EFL, used concrete experiences as part of their learning style, and were proficient in multiple languages performed better in EFL. At the same time, there were no statistically significant correlations between their mindsets, learning styles, self-regulation strategies or multilingualism and their achievement in non-language subjects. Interestingly, the students reported employing similar learning styles and self-regulation strategies for both EFL and non-language subjects.

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English as a foreign language; non-language subjects; mindsets; self-regulation; multilingualism; achievement

1. Introduction

Improving learner achievement in both language and non-language subjects is an important objective of educational research. To this end, researchers have shown interest in exploring the relationship between learning outcomes and factors such as multilingualism (Nayak et al., 1990; Stephens & Moxham, 2019), growth mindsets (Lou & Noels, 2019; Yeager et al., 2019) and learning styles and self-regulation strategies (Loo, 2002; Psaltou-Joycey & Kantaridou, 2009). These factors are part of learners' learning patterns, which comprise 'a coherent whole of learning activities that learners typically employ, their beliefs about learning and their learning motivation, a whole that is characteristic of them at a particular time' (Vermunt & Donche, 2017, p. 270). Mindsets, as a learning pattern factor, are beliefs that guide people's behaviour towards

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achieving goals (Lou & Noels, 2019). They may be growth, fixed or mixed and object-bound, meaning that mindsets may change based on the goal, for example, learning a new language or achieving success in one's chosen career. Growth mindsets are associated with positive learning outcomes, while fixed mindsets can lead to maladaptive behaviour and weak progress in learners (Degol et al., 2018). Previous studies have primarily explored mindsets in isolation (see Cheng et al., 2021; Lou & Noels, 2019), such as investigating learner mindsets about language learning or intelligence, and rarely in relation to multiple disciplines in formal learning settings. Moreover, there is a dearth of research on the interplay between mindsets and multilingualism, despite the increasing significance of multilingualism in education internationally (Council of Europe, 2020; Gao & Zheng, 2019).

The present study defines multilingualism as an individual's ability to use more than one language, encompassing the cognitive, psychological and affective effects and experiences that accompany this knowledge (Jessner, 2008). While some scholars differentiate between the terms 'multilingualism' and 'plurilingualism', where the former refers to societal multilingualism and the latter to individual multilingualism (see Beacco & Byram, 2007; Marshall & Moore, 2018), we use the terms interchangeably in this study. Bilingualism, trilingualism and other variations of multilingualism are also included under this definition to avoid conceptual clutter, as they represent different degrees of the same phenomenon. Numerous studies have investigated the relationship between multilingualism and language learning (for a review, see Hirosh & Degani, 2018), though much less is known about multilingualism's effects on learning outcomes in both language and non-language subjects or how it relates to mindsets, as already mentioned. Then there are learning styles and self-regulation strategies, two other learning pattern factors that are complementary (Weinstein et al., 2011) and which, alongside multilingualism, can influence learning outcomes. Learning styles refer to individuals' preferred ways of learning and responding to various stimuli (Loo, 2002), while self-regulation strategies involve the active, conscious and informed monitoring and regulation of cognitive strategies, behaviour, time and social and physical environments to support specific goals throughout the learning process (Zimmerman & Kitsantas, 2014). Neither learning styles nor self-regulation strategies have been extensively studied in relation to multilingualism or mindsets (P. P. Sun & Zhang, 2020; Pearson, 2020; Psaltou-Joyce & Kantaridou, 2009).

As for achievement, previous research has demonstrated a positive correlation between it and self-regulation, with studies highlighting this relationship mostly among young learners (Robson et al., 2020; Seker, 2016; Skibbe et al., 2019; Zimmerman & Kitsantas, 2014). However, it remains unclear if these findings can be generalised to secondary and tertiary education. Learning styles have also been linked to achievement in both language and non-language subjects (Bailey et al., 2000; Feng et al., 2020; Komaraju et al., 2011; Wang et al., 2006), although some studies have failed to reveal statistically significant links (e.g. Harris et al., 2003). The study of learning is a complex and dynamic field that involves the interaction of multiple variables to produce specific outcomes. While investigating factors such as mindsets, learning styles, self-regulation strategies and multilingualism in isolation may be valuable, it could prove more useful to adopt a comprehensive approach that considers these elements together. At the same time, due to the many variables involved in learning, it is impossible to account for all the factors

that may affect outcomes, and there will always be some degree of bias in research findings (Davis & Sumara, 2014). The complexity of the learning process is further compounded by the fact that students in schools and universities typically learn both language and non-language subjects simultaneously. Therefore, it is crucial to investigate how learning patterns vary across different subjects and whether they consistently relate to achievement in every case. Collecting such data would provide educational institutions and teachers with valuable insights to tailor their programmes and teaching methods, leading to more effective learning outcomes.

Seeking to contribute to research on the links between learning patterns and achievement, this study investigated the relationship between students' learning patterns and their achievement in both English as a foreign language (EFL) and non-language subjects in tertiary education in France. Specifically, the study examined the relationship between their mindsets towards EFL and non-language subjects, intelligence, personality, learning ability, multilingualism and success, as well as their learning styles, self-regulation strategies and self-reported overall proficiency in multiple languages, and their achievement in EFL and non-language subjects, as measured by their exam performance.

2. Learning patterns

2.1. *Multilingualism and mindsets*

Multilingualism may potentially affect various other learning pattern factors because it involves the acquisition of diverse language and non-language skills and experiences and leads to changes in an individual's cognitive and affective states (Fielding, 2021; Jessner, 2008). The effects, however, may not always be positive. For instance, Folke et al. (2016, p. 127), in their study of monolingual and bilingual adults, found that monolinguals demonstrated 'higher metacognitive abilities compared with the bilingual group' and that differences could not be explained based on variations in 'non-verbal reasoning, working memory or age'. In another study, Tang and Calafato (2021) discovered that school language teachers who were more multilingual were less likely to promote self-regulation among their students. Despite these findings, research on the effects of multilingualism on other learning pattern factors remains limited and rarely includes achievement as a variable (e.g. Rutgers et al., 2021). Moreover, since multilingualism has been theorised to provide individuals with a range of language and non-language skills (Jessner, 2008), it would be useful to examine its impact on achievement in diverse subjects within a learning patterns framework. Studies on the relationship between multilingualism and achievement have mostly focused on immigrant multilingualism and excluded other learning pattern factors (e.g. Prediger et al., 2018), and few researchers have compared multilingualism and achievement across both language and non-language subjects. For example, Thomson (2010) found that multilingualism did not have a significant effect on student achievement in reading and mathematics, at least when compared to monolingualism.

As for mindsets, while some studies suggest that growth-oriented mindsets may positively influence self-regulation (Bai et al., 2021; Heslin & Keating, 2016), research in this area remains limited (Bai & Wang, 2023). Explaining the relationship, Heslin and Keating (2016, p. 152) argue that 'when poor performance is seen as reflecting limited

innate ability, people sometimes wonder why they should bother generating strategies to cultivate a talent that they inherently do not possess'. Apart from self-regulation, specific mindsets (e.g. intelligence mindsets) have been studied alongside motivation, resilience and achievement (Dweck & Yeager, 2019; Lou & Noels, 2019). Regarding achievement, studies indicate a positive relationship with growth mindsets, albeit not always a significant one (Lou et al., 2022; Yeager et al., 2019). At the same time, no studies have examined mindsets in relation to multilingualism, as already mentioned, despite many learners studying multiple languages in schools and even universities (Baïdak et al., 2017; Calafato, 2021), which would make it valuable to investigate their mindsets about acquiring multiple languages and how these mindsets relate to achievement. Nor is there research that has compared multiple learner mindsets across different subjects and their effects on achievement. Some studies suggest that mindsets do not affect achievement in either language or non-language subjects (e.g. Glerum et al., 2020), though they are limited in number and only considered individual mindsets without also including other learning pattern factors.

2.2. Learning styles and self-regulation

Various models have been proposed to operationalise learning styles, with Kolb's Experiential Learning Model being one of the most well-documented (Cano-Garcia & Hughes, 2000; Kolb & Kolb, 2009). The model is made up of four learning modes: concrete experience (CE); abstract conceptualisation (AC); reflective observation (RO); and active experimentation (AE). However, research has suggested that while CE and AC are distinct factors, RO and AE can be combined into a single factor (Manolis et al., 2013). Learners may prefer one or more modes over others, depending on their learning style. For example, those with an assimilating learning style prioritise logic, analysis and inductive reasoning, and rely on AC and RO, while individuals with an accommodating learning style favour intuition over logic and use AE and CE (Manolis et al., 2013). Studies on the impact of learning styles on language learning indicate that learners who incorporate CE tend to be more successful than those who do not (Castro & Peck, 2005). Some research (e.g. Vermetten et al., 1997) also suggests that learners may consistently apply the same learning style to all subjects, but it is unclear whether this consistency leads to similar outcomes in terms of achievement in each subject. Furthermore, few studies have explored how learning styles interact with other learning pattern factors, such as multilingualism (P. P. Sun & Zhang, 2020; Psaltou-Joycey & Kantaridou, 2009), mindsets (Pearson, 2020) or self-regulation (Ajisuksmo & Vermunt, 1999), and how these factors collectively correlate with achievement in both language and non-language subjects.

In their study, Psaltou-Joycey and Kantaridou (2009) found that among 1555 Greek university students, higher levels of multilingualism, based on whether participants had language proficiency certificates for two or three languages, were associated with less reliance on linear, sequential thinking and structured environments when learning foreign languages. These findings notwithstanding, the study did not examine whether students applied their learning styles consistently across different subjects or whether these styles had an impact on achievement. It is worth noting that learning styles may not predict achievement in every subject, as students 'develop learning strategies that allow

them to learn in environments that do not necessarily reflect their particular learning style preferences' over time so that 'preferring one style may not mean that an individual is "not good at" other styles' (Harris et al., 2003, p. 25). Additionally, learning styles may not always align with students' beliefs, resulting in a state of 'dissonance', which can be described as 'the absence of linkages among learning conceptions, orientations, and strategies that theoretically should be there, or as the presence of relationships among these learning components that theoretically should not be there' (Vermunt & Minnaert, 2003, p. 51). In terms of self-regulation, strategies can be directed not only at course content (Calafato, 2020; Tang & Calafato, 2021), but also at peers and teachers to support learning goals (Cho & Cho, 2017). However, research on self-regulation strategies in language and non-language learning has tended to focus mostly on content-related strategies and less on those directed at peers and teachers (Rose et al., 2018; Teng & Zhang, 2022).

2.3. Research questions

The rationale behind our study was that since students' learning patterns can have a significant impact on their academic achievement, expanding the research focus to examine how several learning pattern factors interacted and affected achievement could better inform teaching practices and provide educators and researchers with deeper insights into how students can be better equipped to succeed academically. As such, our contribution to the existing research on the relationship between learning patterns and achievement was in the form of an investigation of how learners' mindsets about studying EFL and non-language subjects, multilingualism, intelligence, personality, learning ability, success and behaviour, as well as their learning styles and self-regulation strategies, predicted their achievement in both EFL and non-language subjects. Specifically, we explored the following research questions:

- (1) How do participants' mindsets related to EFL, non-language subjects and multilingualism differ from one another?
- (2) How do participants' learning styles and self-regulation strategies when learning EFL differ from those used in non-language subjects?
- (3) Are participants' learning styles and self-regulation strategies predictive of their level of multilingualism?
- (4) To what extent do participants' mindsets, learning styles and self-regulation strategies, together with socio-biographical variables, predict their achievement in EFL and non-language subjects?

3. Method

3.1. Research context

We employed a cross-sectional, questionnaire-based quantitative research design in our study that had both descriptive and correlational elements (Brown & Rodgers, 2002). Such a design allowed us to describe the characteristics of the sample, for example their multilingualism and EFL achievement, thereby helping to contextualise the findings and

provide a better understanding of the population being studied, while also satisfying the study's aim to examine the relationships among learning pattern factors, such as students' mindsets, learning styles, self-regulation strategies and multilingualism, and their academic achievement in EFL and non-language subjects. More broadly, we chose a quantitative research design for two reasons. Firstly, such a design can help with objectivity (Fryer et al., 2018). And, second, it can make a stronger impact on larger institutions, for instance, universities and schools, since it can document effects 'not just with a handful of subjects anecdotally, but with a broader sample of the population' (Fryer et al., 2018, p. 56).

3.2. Participants

The study recruited 191 undergraduate students at a public university in central France, made up of 118 males (61.78%), 55 females (28.80%) and 18 (9.42%) participants who selected 'other' when asked about their gender. The average age of the participants was 19.25 ($Mdn = 19.00$; $SD = 2.50$). They were pursuing undergraduate degrees in various programmes, including Big Data Management and Analytics (BDMA) ($n = 7$; 3.67%), Industrial Production Management (IPM) ($n = 17$; 8.90%), Information Technology (IT) ($n = 40$; 20.94%), Law ($n = 58$; 30.37%) and Materials Science and Engineering (MSE) ($n = 77$; 40.31%). None of the participants were pursuing a language degree. Regarding their level of multilingualism, participants reported advanced proficiency in one language ($n = 54$; 28.27%), two languages ($n = 84$; 43.98%) or three or more languages ($n = 44$; 23.04%), while nine participants reported not having advanced proficiency in any language. The definition of the term 'language' used in this study and communicated to the participants prior to their completing the questionnaire covered both standard varieties and dialects. For example, a participant who reported advanced proficiency in Maghrebi and Levantine Arabic was considered to have advanced proficiency in two languages. The languages mentioned by participants included Arabic (Maghrebi, Levantine, and Standard), Armenian, Breton, Dutch, English, French, Haitian Creole, Italian, Kabyle, Kurdish, Malagasy, Occitan, Portuguese, Russian, Shimaore, Spanish, Swedish, Tamazight and Turkish. Of the participants, 126 (65.97%) came from mono-ethnic families, 58 (30.37%) came from multi-ethnic families, and seven declined to provide any information about their backgrounds. The university where the study was conducted has a student population of over 30,000 and mandates that all students, irrespective of their degree programme, study EFL as part of the curriculum. This made the university an appropriate setting for analysing the relationships between learning patterns and academic achievement in both language and non-language subjects.

3.3. Measures

We utilised an online 185-item questionnaire that was available in both English and French to gather data for the study. The questionnaire collected participants' socio-biographical data, including gender, age, level of multilingualism, family background and degree programme. Additionally, data were collected on participants' mindsets regarding personality, intelligence, behaviour, learning ability and overall success, adapted from Walker and Plomin's (2005) study, as well as their mindsets about EFL and non-language

subjects, using the mindsets inventory from Lou and Noels (2019). We also investigated participants' mindsets regarding multilingualism to determine whether they viewed multilingualism as a fixed trait and static resource, or a compounding, acquirable and dynamic state that impacted individuals linguistically, psychologically, cognitively and affectively. To gain a deeper understanding of how participants viewed the practical applications of their studies, they were queried about their motivations for studying EFL and their degree programmes, as well as the transdisciplinary value they saw in them. We explored participants' self-regulation strategies, using the self-regulation measure from Cho and Cho (2017), and their learning styles in both EFL and non-language subjects, utilising the shortened Kolb Learning Style Inventory from Manolis et al. (2013). To measure achievement, we collected participants' scores from the three most recent exams they had taken in EFL and their non-language subjects, with scores being marked out of 20 and a composite score used for analysis. An overview of the questionnaire's different sections, including the number of items, item types, reliability, RMSEA (Root Mean Square Error of Approximation), TLI (Tucker-Lewis Index) scores and example items, can be found in Table 1.

Reliability was calculated via McDonald's omega (ω) using confirmatory factor analysis estimation, which is a more reliable indicator of internal consistency than Cronbach's alpha (α) (Dunn et al., 2014). The results indicated that each of the measures and their subscales had satisfactory internal consistency.

3.4. Procedure

We obtained all necessary ethical clearances prior to administering the questionnaire. The questionnaire was distributed to participants through EFL teaching staff at the university, who shared it with their students via a link. Before commencing the questionnaire, participants were presented with an electronic consent form that informed them that participation was voluntary, that they could withdraw from the study at any time (via email), and that their data would be encrypted, password protected and securely stored, with access limited to the authors of the study. Participants were asked to signal their consent by selecting the appropriate checkbox at the end of the form (i.e. 'I agree' or 'I do not agree'), after which they were taken to the questionnaire if they had provided their consent. The data collection period lasted one month, after which access to the questionnaire was disabled. Given the length of the questionnaire, participants were allowed to complete it over multiple sessions: responses per participant were saved on the online platform hosting the questionnaire and they were able to return to them later.

3.5. Data analysis

The data analysis was conducted using JASP and SPSS 28. To determine statistically significant differences between participants' mindsets regarding EFL and non-language subjects, as well as their composite exam scores, Mann-Whitney U, Kruskal-Wallis and paired sample tests were performed. Results include effect size (Hedge's g) and achieved power (post-hoc power) for all statistically significant findings, with an alpha level of .05 for all significance testing. Linear regression was conducted in two instances. Firstly, it was performed to explore the relationship between participants'



Table 1. Overview of the questionnaire.

Section	Description	Item(s)	Type	ω	RMSEA	TLI	Example items
Sociobiographical	Degree programme	1	Open	-	-	-	-
	Gender	1	Open	-	-	-	-
	Age	1	Open	-	-	-	-
	Multilingualism	1	Open	-	-	-	-
	Family background	1	Open	-	-	-	How would you describe your family? Is it multiethnic and/or multilingual? How?
	Friends background	1	Open	-	-	-	What percentage of your friends are multiethnic and/or multilingual?
Mindsets	Motivation	2	Open	-	-	-	Why are you studying English? Please give as many reasons as you have.
	English NLS	18 18	Likert Likert	.89 .86	.02 .03	.97 .98	I can always improve my English language ability. In studying for my programme, if I work hard, I will get better.
Transdisciplinary value	Multilingualism	22	Likert	.71	.04	.90	Everybody can learn many languages well.
	Personality	1	Likert	-	-	-	Is personality a product of genetics or the environment?
	Intelligence	1	Likert	-	-	-	Is intelligence a product of genetics or the environment?
	Behavior	1	Likert	-	-	-	Is behaviour a product of genetics or the environment?
	Learning ability	1	Likert	-	-	-	Is learning ability a product of genetics or the environment?
	Success	1	Likert	-	-	-	Is success a product of genetics or the environment?
	English NLS	8 8	Likert Likert	.94 .89	.05 .06	.97 .93	My knowledge of English benefits me in other areas of study I use the knowledge gained from my programme in various aspects of my life.
	English (ROAE)	7	Likert	.89	.07	.93	When I learn English, I like to think about ideas.
Learning styles	English (AC)	5	Likert	.78	.02	.93	I learn English best when I trust my hunches and feelings.
	English (CE)	5	Likert	.85	.07	.98	When I learn English, I like to watch and listen.
	NLS (ROAE)	7	Likert	.89	.02	.97	"
	NLS (AC)	5	Likert	.80	.04	.96	"
	NLS (CE)	5	Likert	.85	.05	.99	"
	English (Content)	11	Likert	.93	.07	.93	Before starting an assignment, I plan out my work.
	English (Teacher)	9	Likert	.93	.05	.98	I do not hesitate to share concerns about my progress with the teacher.
	English (Student)	9	Likert	.90	.07	.94	I seek assistance from other students if I need it.
	NLS (Content)	11	Likert	.89	.06	.96	"
	NLS (Teacher)	9	Likert	.89	.06	.94	"
Achievement	NLS (Student)	9	Likert	.87	.05	.94	"
	English	3	Open	-	-	-	-
	NLS	3	Open	-	-	-	-

NLS = Non-language subjects; RMSEA = Root Mean Square Error of Approximation; TLI = Tucker-Lewis Index; CE = Concrete experience; AC = Abstract conceptualisation; ROAE = Reflective observation and active experimentation.

exam scores for EFL and non-language subjects and their mindsets, gender, age, level of multilingualism, degree programme, use of self-regulation strategies, learning styles and beliefs about the transdisciplinary value of their studies. Secondly, we sought to determine if participants' level of multilingualism, as determined by their self-reported advanced proficiency in one or more languages, was predicted by their learning styles and use of self-regulation strategies in both EFL and non-language subjects. The data were examined for outliers, score distribution, multicollinearity and autocorrelation during statistical testing.

4. Findings

Figure 1 presents the descriptive statistics for participants' EFL-, non-language subject- and multilingualism-related mindsets. The data indicated that their mindsets were mostly growth-oriented, though less so concerning multilingualism.

Paired sample t-test results revealed that participants' non-language subject-related mindsets were statistically significantly more growth-oriented than were either their EFL- [$t(189) = 3.15, p = .002, g = .23, 1-\beta = .93$] or multilingualism-related mindsets [$t(190) = 18.66, p < .001, g = 1.35, 1-\beta = 1.00$]. Their mindsets about EFL, meanwhile, were statistically significantly more growth-oriented than their multilingualism-related mindset [$t(189) = 16.76, p < .001, g = 1.21, 1-\beta = 1.00$]. In other words, participants felt most strongly that they could achieve success in non-language subjects through effort, whereas

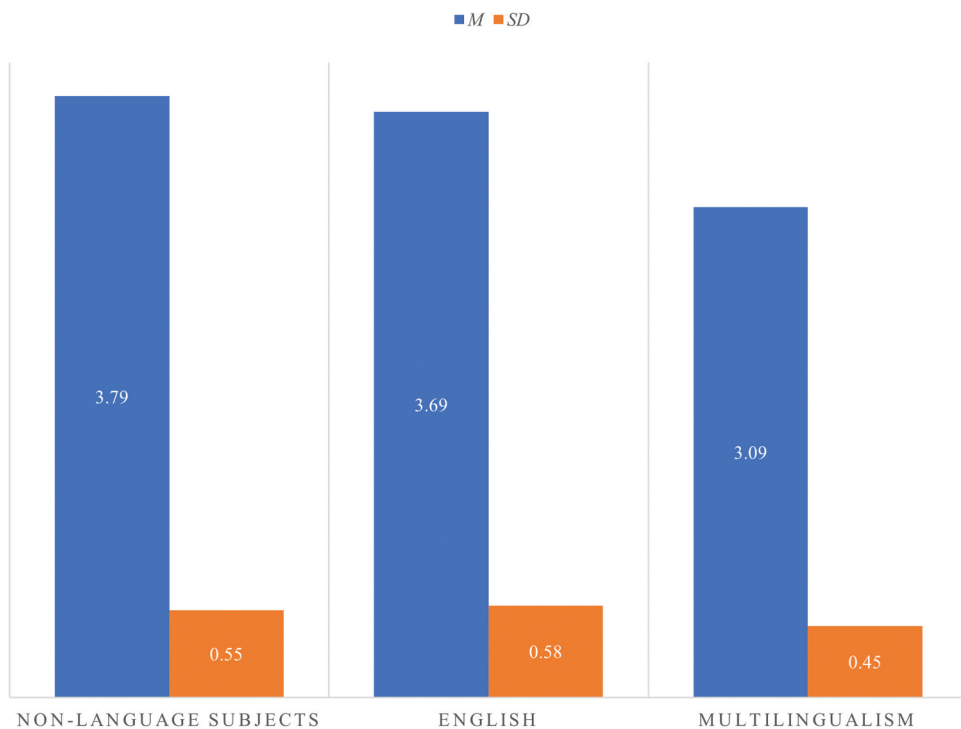


Figure 1. Participants' mindsets regarding their EFL, non-language subjects and multilingualism. Note. Likert scale = 1 – Completely disagree; 5 – Completely agree

they were least in agreement with effort helping to develop their multilingualism. Kruskal-Wallis test results indicated that there were no statistically significant differences in participants' multilingualism- ($H = 4.12$, $df = 4$, $p = .391$), EFL- ($H = 2.48$, $df = 4$, $p = .651$) or non-language subject-related ($H = 4.03$, $df = 4$, $p = .402$) mindsets based on their degree programmes. Mann-Whitney U test results revealed that gender differences, too, were not statistically significant concerning participants' multilingualism- ($U = 3013.50$, $p = .450$), EFL- ($U = 3125.50$, $p = .842$) or non-language subject-related ($U = 3474.50$, $p = .454$) mindsets. According to the results of a one-way ANOVA, participants' level of multilingualism did not lead to statistically significant differences in EFL- [$F(2, 178) = 2.10$, $p = .125$], non-language subject- [$F(2, 179) = .86$, $p = .424$] or multilingualism-related [$F(2, 179) = 1.32$, $p = .269$] mindsets. Levene's test showed that the variances in this regard were roughly equal for EFL- [$F(2, 178) = .47$, $p = .629$], non-language subject- [$F(2, 179) = .28$, $p = .754$] and multilingualism-related mindsets [$F(2, 179) = 2.50$, $p = .085$].

Figure 2 provides the descriptive statistics for participants' responses regarding their learning styles and use of self-regulation strategies in EFL and non-language subjects. Generally, their learning styles and self-regulation strategies appeared to be quite similar across subjects, although they seemed to engage less in abstract conceptualisation (AC)

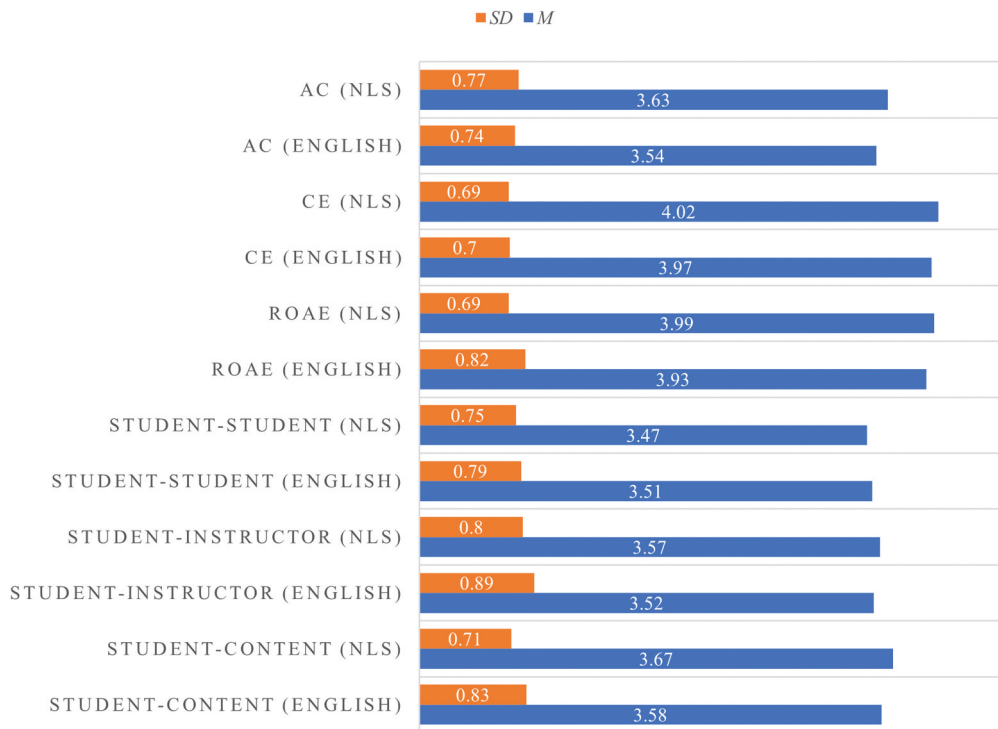


Figure 2. Participants' learning styles and self-regulation strategies for EFL and non-language subjects. Note. Likert scale = 1 – Completely disagree; 5 – Completely agree; CE = Concrete experience; AC = Abstract conceptualization; ROAE = Reflective observation and active experimentation; NLS = Non-language subjects

overall than they did in concrete experiences (CE) and reflective observation and active experimentation (ROAE).

Paired sample t-test results indicated that there were no statistically significant differences in participants' AC [$t(166) = 1.51, p = .133, g = .12$], CE [$t(168) = .59, p = .557, g = .05$], or ROAE [$t(167) = 1.32, p = .189, g = .10$] based on whether they were studying EFL or non-language subjects; nor were there any statistically significant differences in their use of peer- [$t(167) = .60, p = .547, g = .05$], teacher- [$t(167) = 1.41, p = .160, g = .11$] or content-focused [$t(173) = 1.77, p = .079, g = .13$] self-regulation strategies in this respect. A linear regression was performed to determine whether participants' level of multilingualism was predicted by their learning styles and self-regulation strategies for EFL and their non-language subjects. Participants who reported advanced proficiency in three or more languages were selected as the reference category. The data were checked for outliers and found to be acceptable (Std. Residual Min = -1.64 , Std. Residual Max = 1.89). The results indicated that there was a statistically significant association between participants' multilingualism, learning styles and self-regulation strategies [$\chi^2(24) = 36.64$, Nagelkerke $\rho^2 = .24, p = .048$]. Individual predictors revealed that possessing advanced proficiency in only one language versus three or more languages was linked to statistically significantly reduced learning via CE (i.e. less active learning through tangible, concrete experiences) [$B = -2.48, OR = .08, p = .005, 95\% CI (.01, .48)$] and stronger use of content-focused self-regulation strategies [$B = 1.43, OR = 4.16, p = .040, 95\% CI (1.07, 16.19)$] among participants.

Data regarding participants' mindsets about personality, intelligence, general behaviour, learning ability and overall success in life indicated that they thought that personality ($M = 3.31, SD = .96$), general behaviour ($M = 3.64, SD = .99$) and success ($M = 3.59, SD = 1.00$) were mostly a result of environmental factors, whereas they were somewhat less certain about learning ability ($M = 2.97, SD = 1.00$) and intelligence ($M = 2.98, SD = .88$) being primarily a product of environmental factors. In terms of the transdisciplinary value of EFL ($M = 3.99, SD = .82$) and their non-language subjects ($M = 4.04, SD = .64$), participants generally viewed both as having a high value. The exam scores for EFL ($M = 13.85, SD = 3.17$) and their non-language subjects ($M = 14.57, SD = 2.93$) indicated a slight variance. Paired sample t-test results revealed that participants scored statistically significantly higher in exams for non-language subjects than those for EFL [$t(115) = -2.92, p = .004, g = .27$]. Kruskal-Wallis test results indicated that there were no statistically significant differences between participants concerning their EFL exam scores ($H = 5.38, p = .251$) based on their degree programmes. Meanwhile, there were statistically significant differences between participants regarding non-language subject exam scores ($H = 12.08, p = .017$) based on their degree programmes, but only between the MSE ($M = 13.85, SD = 2.86$) and IPM ($M = 17.88, SD = 2.85$) groups ($p = .013, g = 1.41, I-\beta = .97$).

Table 2 lists the results of a linear regression that was conducted to ascertain the extent to which participants' EFL exam scores were predicted by their EFL- and multilingualism-related mindsets, as well as their mindsets about personality, intelligence, behaviour, learning ability and success, use of self-regulation strategies when studying EFL, learning styles concerning EFL, beliefs about the transdisciplinary value of EFL, their degree programme, gender, age and level of multilingualism. The results indicated that the regression model statistically significantly outperformed the null model [$\chi^2(18) = 3.61$, Nagelkerke $\rho^2 = .39, p$

Table 2. Regression results for variables predicting participants' EFL exam scores.

		<i>B</i>	β	<i>t</i>	<i>p</i>	95%CI LB	95%CI UB	Tol.	VIF
	(Constant)	5.09		1.51	.135	-1.61	11.78		
	Degree programme	.38	.13	1.33	.187	-.19	.95	.61	1.65
	Transdisciplinary value of English	.82	.21	1.96	.052	-.01	1.65	.53	1.88
Mindsets	English	1.46	.27	2.40	.018	.25	2.67	.48	2.08
	Multilingualism	.43	.07	.62	.538	-.95	1.80	.54	1.86
	Personality	.67	.21	2.15	.034	.05	1.28	.63	1.58
	Intelligence	-.22	-.06	-.69	.494	-.86	.42	.68	1.48
	Behaviour	-.10	-.03	-.33	.741	-.72	.51	.58	1.71
	Learning ability	.12	.04	.43	.669	-.44	.68	.63	1.60
	Success	-.15	-.05	-.48	.633	-.76	.47	.64	1.56
Self-regulation strategies for English	Content	-.66	-.18	-1.61	.110	-1.48	.15	.50	1.99
	Teacher	1.36	.38	2.75	.007	.38	2.34	.30	3.28
	Peers	-1.12	-.29	-2.32	.023	-2.08	-.16	.38	2.62
Sociobiographical variables	Gender	.60	.09	.98	.331	-.62	1.81	.79	1.27
	Age	-.22	-.14	-1.38	.170	-.54	.10	.59	1.70
	Multilingualism	.79	.18	2.20	.030	.08	1.50	.86	1.16
Learning styles for English	ROAE	-1.62	-.35	-2.24	.027	-3.06	-.19	.25	4.08
	CE	1.80	.38	2.31	.023	.26	3.35	.22	4.53
	AC	-.12	-.03	-.25	.805	-1.12	.87	.40	2.49

Dependent variable: English exam scores; CI = Confidence interval; LB = Lower bound; UB = Upper bound; VIF = Variance Inflation Factor; CE = Concrete experience; AC = Abstract conceptualisation; ROAE = Reflective observation and active experimentation; Tol. = Tolerance.

< .001], that there were no outliers (Std. Residual Min = -2.93, Std. Residual Max = 2.28) and that the data were neither autocorrelated (Durban-Watson statistic; $d = 2.00$) nor was multicollinearity an issue (see Table 2).

In terms of individual predictors, participants' EFL exam scores were statistically significantly and positively predicted by their EFL-related mindset, teacher-focused self-regulation strategies, level of multilingualism, the belief that personality was a result of the environment and not genetics, and emphasis on learning through concrete experiences. Their scores were also statistically significantly and negatively predicted by their use of peer-focused self-regulation strategies and emphasis on learning EFL via reflective observation and active experimentation. Put another way, 1) the more participants thought that they could improve their EFL through effort, 2) the more they believed that personality was malleable, 3) the greater their level of multilingualism, 4) the more they relied on concrete experiences rather than reflective observation and active experimentation when learning, and 5) the stronger their use of self-regulation strategies that drew on their teachers as a resource, the higher their EFL exam scores were.

Table 3 contains the results of a linear regression that we performed to ascertain the extent to which participants' non-language subject exam scores were predicted by their mindsets, learning styles, self-regulation strategies, beliefs about the transdisciplinary value of non-language subjects, degree programmes and socio-biographical variables. Here, the results revealed that the regression model did not statistically significantly outperform the null model [$\chi^2(18) = .84$, Nagelkerke $\rho^2 = .17$, $p = .654$] and none of the variables statistically significantly predicted participants' exam scores for non-language subjects. There were no outliers (Std. Residual Min = -3.03, Std. Residual Max = 2.01) nor were the data autocorrelated (Durban-Watson statistic; $d = 2.02$).

Table 3. Regression results for variables predicting participants' non-language subject exam scores.

		<i>B</i>	β	<i>t</i>	<i>p</i>	95% CI LB	95% CI UB	Tol.	VIF
(Constant)		13.04		3.04	.003	4.50	21.59		
Degree programme		.61	.25	1.73	.087	-.09	1.31	.52	1.91
Transdisciplinary value of non-language subjects		.27	.06	.50	.617	-.81	1.35	.67	1.50
Mindsets	Non-language subjects	-1.20	-.22	-1.46	.148	-2.82	.43	.49	2.03
	Multilingualism	1.06	.17	1.23	.221	-.65	2.78	.56	1.77
	Personality	-.12	-.04	-.32	.752	-.87	.63	.61	1.65
	Intelligence	.07	.02	.16	.876	-.80	.94	.57	1.76
	Behaviour	.09	.03	.23	.815	-.70	.89	.51	1.97
	Learning ability	.27	.10	.73	.469	-.47	1.02	.54	1.84
Self-regulation strategies for programmes	Success	-.28	-.10	-.75	.453	-1.02	.46	.65	1.54
	Content	.23	.06	.39	.699	-.95	1.41	.52	1.94
	Teacher	.53	.15	.93	.353	-.59	1.65	.44	2.30
Sociobiographical variables	Peers	-.61	-.16	-.98	.328	-1.85	.63	.43	2.32
	Gender	.76	.12	.94	.350	-.86	2.38	.71	1.40
	Age	-.15	-.10	-.75	.454	-.53	.24	.58	1.73
Learning styles for programmes	Multilingualism	.33	.09	.75	.457	-.55	1.21	.81	1.24
	ROAE	.54	.13	.55	.585	-1.43	2.51	.19	5.16
	CE	.18	.04	.21	.831	-1.52	1.89	.28	3.56
	AC	-.55	-.15	-.95	.344	-1.71	.60	.42	2.36

Dependent variable: non-language subject exam scores; CI = Confidence interval; LB = Lower bound; UB = Upper bound; VIF = Variance Inflation Factor; CE = Concrete experience; AC = Abstract conceptualisation; ROAE = Reflective observation and active experimentation; Tol. = Tolerance.

5. Discussion

The present study investigated the mindsets of university students in France concerning EFL, their non-language subjects and multilingualism, as well as their learning styles and use of self-regulation strategies. In addition, we examined how these factors, along with socio-biographical variables, related to their achievement in both EFL and non-language subjects.

5.1. Mindsets related to EFL, non-language subjects and multilingualism

Regarding the first research question, the study found that participants exhibited predominantly growth mindsets towards studying English and non-language subjects, meaning that they strongly believed that they could make good progress in English and non-language subjects if they put in the effort. This aligns with recent research indicating that participants generally possess growth mindsets about studying languages and non-language subjects, even prior to researchers implementing interventions (Lanvers, 2020; X. Sun et al., 2021). Some studies (e.g. Horwitz, 1988) show that essentialist views about language learning have been prevalent among students in some countries, such as the United States, though this was not the case here. What distinguishes this study from previous research is that participants' mindsets towards studying English and non-language subjects were more growth-oriented than their mindsets towards acquiring multilingualism, which has not been explored before. In other words, participants believed that while their progress in English and non-language subjects could be enhanced through effort, multilingualism, which involves learning and using multiple languages, as well as acquiring non-language skills and various psychological, affective and cognitive changes in the

individual (Jessner, 2008), was more challenging to attain through investment. Participants' responses suggest that they would be less receptive to investing in multilingualism and all that it entails, with implications for language education in countries in Europe and elsewhere, where language education is linked to developing multilingual and multiculturally competent citizens (see ; Baïdak et al., 2017; Council of Europe, 2020).

5.2. Learning styles and self-regulation strategies for EFL and non-language subjects

Regarding the second research question, which concerned differences between participants' learning styles and self-regulation strategies for EFL and non-language subjects, the findings indicated that participants utilised similar approaches irrespective of subject. These results are consistent with Vermetten et al.'s (1997) longitudinal study, which found that university students remained consistent in their behaviour across programmes. The results are also surprising given the dissimilar qualities of the degree programmes pursued by the participants in this study. For example, information technology, which some of the participants were studying, may require learning styles that involve more visual and spatial learning strategies, while materials science might need more experiential learning strategies (e.g. laboratory experiments). Law, on the other hand, can entail more analytical and critical thinking skills, such as interpreting legal texts and applying them to real-world scenarios. Similarly, different self-regulation strategies might be required depending on the subject area. For instance, a student studying law may need to spend more time on content, that is, reading and research, while a student studying foreign languages would benefit from spending more time practising them with their peers. In this study, participants generally preferred a mix of CE and ROAE (reflective, observational and affective engagement) over AC, indicating that they were primarily accommodators or divergers (Manolis et al., 2013), relying on intuition and creativity to consider a situation from multiple perspectives. These learning styles have been found to be effective for language learning (Castro & Peck, 2005), but not necessarily for non-language subjects, as demonstrated in this study. Furthermore, participants' self-regulation strategies were evenly distributed across the content, teacher and peer domains, indicating that they utilised each of these domains equally.

5.3. The relationship between multilingualism, learning styles and self-regulation strategies

The study found that participants' level of multilingualism was significantly predicted by their learning styles and self-regulation strategies. Specifically, individuals who were more multilingual tended to employ concrete experience (CE) as a learning mode and relied less on content-focused self-regulation strategies. This finding aligns with previous research by Psaltou-Joycey and Kantaridou (2009), who discovered that multilingualism positively correlated with a preference for real-world experiences over structured learning environments and that proficiency affected how frequently multilingual learners used learning strategies. The researchers found that trilingual learners with advanced proficiency in their languages used such strategies more frequently than trilingual learners

who were less proficient and were, moreover, less dependent on a structured learning format when compared to bilinguals. Psaltou-Joycey and Kantaridou observed that the more proficient participants were in their languages, the more they practised the FL effectively 'by speaking to native speakers, watching foreign programmes, reading foreign texts and writing in the FL' and tried 'consciously to develop all four language skills in naturalistic contexts which require authentic use of the target language' (p. 469). Linked to this, our study's findings also indicated that greater multilingualism was associated with less dependence on content-focused self-regulation strategies, which are often emphasised in formal, structured learning settings like schools and universities, where textbooks can play a central role across subjects. Regarding the positive correlations observed between multilingualism and CE in this study, one can refer to Castro and Peck (2005), who noted that learners who incorporate CE into their learning styles have more successful language learning outcomes, implying that participants who were more multilingual would have better learning outcomes in EFL.

5.4. Learning patterns and achievement in EFL and non-language subjects

Concerning the fourth research question, the study found that participants' EFL achievement was positively predicted by their growth-oriented mindsets towards studying EFL, the belief that personality is a product of the environment, use of teacher-focused self-regulation strategies, and level of multilingualism (but not their mindsets about multilingualism). The findings concerning growth-oriented mindsets towards studying EFL having a positive relationship with EFL achievement align with previous research where a similarly strong relationship between growth-oriented mindsets and language learning achievement was demonstrated (e.g. Eren & Rakıcioğlu-Söylemez, 2020). As for multilingualism's positive links with achievement, one could claim that participants with advanced proficiency in multiple languages had developed effective language learning strategies that they applied to learning EFL, which then translated into better exam performance. This finds support in the study by Psaltou-Joycey and Kantaridou (2009), where trilinguals with advanced proficiency used learning strategies more frequently and effectively than those with less proficiency. Proficiency in multiple languages also meant that participants were likely exposed to different language structures and patterns (Jessner, 2008), which provided them with a deeper understanding of how languages work and ultimately led to better exam results. The study also found that participants' use of peer-focused self-regulation negatively predicted their English exam scores, similar to the RO and AE learning modes. In terms of learning styles, only the participants' use of CE positively predicted their exam scores. This finding is consistent with the observations made by Castro and Peck (2005), who noted that learning styles that incorporate CE, such as accommodating and diverging styles, lead to more successful language learning outcomes.

At the same time, the study found that participants' mindsets, learning styles, self-regulation strategies and socio-biographical variables like age and level of multilingualism did not predict their non-language subject-related achievement. This may be because mindsets do not always correlate with achievement, as X. Sun et al. (2021) found in their study of Chinese and US students. Similarly, studies on learning styles have yielded mixed results regarding their link to achievement (An & Carr, 2017), possibly due to students not always employing their preferred learning styles (Harris et al., 2003) or

experiencing dissonance between their learning styles and beliefs (Vermunt & Minnaert, 2003). The technical nature of many of the degree programmes in which participants were enrolled may have also influenced the findings. For example, the emphasis on acquiring technical knowledge may have required participants to engage in *memorising* substantial amounts of information, which was not explored as a variable in this study, but which might have proved more predictive of their exam performance in their non-language subjects than learning styles or self-regulation. Previous studies (e.g. Burke & Gandolfi, 2014) on educational practices in technical disciplines report a strong emphasis on rote memorisation, with less attention accorded to other learning strategies. As for participants' level of multilingualism not statistically significantly predicting their achievement in non-language subjects, it bears mentioning that the benefits of multilingualism have primarily been documented in relation to learning languages (Hirosh & Degani, 2018), making it difficult to draw strong conclusions. One reason for the lack of correlation could be the highly technical language and terminology and complex concepts that participants encountered in their non-language subjects, which limited the cross-linguistic benefits that multilingualism provided to them.

6. Implications, recommendations and limitations

There are several conclusions that one can draw from the study's findings. First, they reveal that students do not see multilingualism as being fully obtainable through effort, which underscores the need for teachers and researchers to engage more deeply with them about language learning being a component of something much larger and attainable (i.e. multilingualism). This engagement may take the form of short discussions between teachers and students where they talk about multilingualism or visits by researchers to classrooms where they present and discuss their project's findings, among other activities. Ultimately, should students continue to feel that acquiring multilingualism is challenging to obtain through effort, they may not invest the resources needed to learn multiple languages effectively. This would, in turn, have negative consequences for the education policies implemented by a growing number of countries around the world, including France, that seek to develop citizens who are proficient in more than one foreign language and can use these in diverse contexts. Second, the findings suggest that language teachers should help their students develop growth-oriented mindsets vis-à-vis the target language and place greater emphasis on the use of teacher-oriented self-regulation strategies if they want to boost their learning outcomes. Indeed, self-regulation strategies that focus on content or peers may not be able to provide the same level of expert knowledge, customised feedback, motivation and real-time language practice that teachers offer, despite still being beneficial to the extent that they can promote learner autonomy. Third, teachers should strive to identify the learning styles employed by their students to determine the extent to which these styles incorporate CE elements and so that they can develop personalised approaches to teaching that nurture those learning modes that are most conducive to learning languages.

The abovementioned implications notwithstanding, our study is not without its limitations in that it relied exclusively on a questionnaire to gather data from participants, whereas the addition of interviews would have shed more light on their mindsets, especially regarding multilingualism. The data were also cross-sectional in nature, meaning that students' mindsets, learning styles and self-regulation strategies may change in the future. Moreover, our

participant sample came from one university in France, and students at other universities in the country may have mindsets, learning styles and self-regulation strategies that differ considerably from those reported here.

In terms of recommendations for future research, then, additional studies on the relationships between multiple mindsets, learning styles, multilingualism and self-regulation strategies and learning outcomes in language and non-language subjects are needed. These studies could target languages other than English and take place in contexts outside of Europe, such as in the Middle East, Central Asia or China, where little research has been done in this respect. Moreover, while this study's participants were only learning one foreign language, students frequently study two or more foreign languages concurrently in schools and universities internationally, often alongside a national language that can differ from their first language. As such, it would provide us with deeper insights if we expanded the study of the interplay between learning patterns and outcomes to encompass the learning of multiple languages simultaneously.

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