META-ANALYSIS



Self-Determination Theory and Language Learning: A Multilevel Meta-Analysis

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Abstract

In this meta-analysis, we examined the average correlations (weighted for sample size and corrected for measurement error) between the varied types of motivation specified within self-determination theory (SDT) and second language (L2) achievement. We also conducted moderator analyses to explore whether these relationships are influenced by age, educational level, proficiency level, aptitude, the language being learned, or participants' first language. The findings revealed a positive correlation between intrinsic regulation (r = .26, p < .001) and identified regulation (r = .16, p < .001) and L2 achievement. These two types constitute the global factor of autonomous motivation, which was also positively associated with achievement (r = .23, p < .001). In contrast, neither introjected regulation (r=-.06, p=.06) nor external regulation (r=-.01, p=.70) were related to L2 achievement, and their global factor—controlled motivation—was likewise unrelated (r = -.03, p = .24). However, specific scales used to measure controlled motivation showed some variability in their associations with outcomes. Parallel analyses of motivation and language anxiety showed that intrinsic (r = -.25,p < .001) and identified regulation (r = -.18, p < .001) were negatively associated with anxiety, while introjected (r = .23, p < .001) and external regulation (r = .12, p = .016) were positively related. At the global level, autonomous motivation was negatively associated with anxiety (r = -.23, p < .001), and controlled motivation was positively associated (r = .16, p = .001). Overall, more autonomous forms of motivation were linked to both higher achievement and lower anxiety, supporting a key proposition of SDT in L2 learning. These associations were further moderated by learners' first language, educational level, and learning context. Together, the findings put emphasis on the pivotal role of autonomous motivation in fostering better language learning outcomes.

Keywords Autonomous motivation \cdot L2 achievement \cdot L2 motivation \cdot Self-determination theory (SDT) \cdot Meta-analysis

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Introduction

Motivation in learning the second language (L2) is a key variable that relates to learning proficiency and persistence (Alamer, 2024; Alamer & Alrabai, 2023; Csizér & Kálmán, 2019; Dörnyei & Ushioda, 2021; Gardner, 2010). When L2 learners endorse more autonomous types of motivation, they are likely to be more fully engaged in the learning process (Alamer & Almaghlouth, 2024; Alamer & Lee, 2019; Dincer & Yesilyurt, 2017; Oga-Baldwin & Nakata, 2017; Noels, 2023).

The literature on *self-determination theory* (SDT: Deci & Ryan, 1985; Ryan & Deci, 2017), a broad theory of human motivation, has been actively applied within the L2 domain, and has yielded insights about the motivation of L2 learners in different language contexts such as Arabic, Japanese, French, and Spanish and different classroom settings such as in online learning, university setting, and primary school setting (Alamer, 2022, 2024; Alamer & Al Khateeb, 2023; Alamer & Almulhim, 2021; Alrabai & Alamer, 2024; Noels, 2023; Noels et al., 1999, 2019; Oga-Baldwin & Fryer, 2020; Oga-Baldwin & Nakata, 2017). Yet despite the increasing number of studies applying the SDT framework to assess L2 motivation, a comprehensive meta-analytic review of findings specific to the L2 achievement outcomes has yet to be conducted (Alamer, 2024). This gap prompted our current review.

In domains other than language learning such as health and general education, meta-analyses have clarified the cumulative effect sizes of varied SDT constructs, which, in turn, allowed researchers and practitioners to be more informed about the relevance of these variables for different contextual outcomes (e.g., Ng et al., 2012; Patall et al., 2008; Stanley et al., 2021). In this meta-analysis we focus specifically on SDT's motivational taxonomy. SDT specifies a set of motives that each have their own characteristics, but that also fall along a presumed continuum of relative autonomy, with more autonomous forms of motivation typically predicting better performance and well-being in many spheres. Understanding how these types of motivation relate to the language learning domain, an area with its own unique characteristics and dynamics, is important to both basic research and applied practice in the second language context. Detecting heterogeneity in findings is also important to help identify potential moderators of learning outcomes.

The Motivational Taxonomy of SDT

SDT posits that motivation is multidimensional and that different types of motivation differ both experientially and in terms of the quality of behavior they support (Ryan & Deci, 2000, 2020). SDT categorizes two broad types of motivation: *autonomous motivation* and *controlled motivation*. Each type has sub-types of regulations (or orientations), as illustrated in Fig. 1. Autonomous motivation involves voluntary engagement in the language learning process. At the extreme



Fig. 1 Visual representation of the SDT motivational regulations

end of this spectrum lies *intrinsic regulation*, where individuals are intrinsically motivated to engage in an activity because they find it inherently interesting or enjoyable. Intrinsic regulation takes place in L2 settings when students perceive the learning as a satisfying process in and of itself (Noels et al., 1999). Another highly autonomous form of motivation is *identified regulation* which reflects motivation based in the value and importance individuals attach to an activity. In some cases, a person might not find L2 to be interesting or fun but might still volitionally pursue learning because of its perceived importance and value to them (Alamer, 2022). In this way, intrinsic regulation and identified regulation refer to the endorsement of the activity by the learner's self.

In contrast to autonomous motivation is controlled motivation, which refers to motivation-based in forces experienced as external to the self. Two sub-types of controlled regulations have been widely studied. The first, and most controlled form of motivation in Fig. 1 is *external regulation*, in which the individual behaves in response to externally administered rewards or avoids punishments. Another controlled form of motivation is *introjected regulation*, which reflects the internally controlling pressures that may motivate an activity such as avoiding shame, guilt for failing, anxiety, or feeling pride in outperforming others. A fifth regulation that belongs to neither controlled nor autonomous motivation categorizes is called *amotivation*, which refers to a lack of energy and reasons to carry out the activity. For example, some language learners may see no reason to be involved in learning a language, or may feel incompetent at language tasks, thus losing the motivation to learn. Accordingly, amotivation is expected to be negatively associated with learning outcomes.

The publication of Noels et al. (1999) heralded the applications of SDT in the L2 domain. In that early study, Noels and colleagues presented evidence of the relations between the four above-mentioned regulations, and language learning outcomes such as expended effort, intention to continue learning the language, self-evaluation of proficiency, and students' GPA in the foreign language. In the same study Noels et al. also examined the extent to which perceiving the learning atmosphere as controlling could relate to different types of regulations. Generally, the study confirmed the positive relationship between the more autonomous types of regulations and the learning outcomes, and that controlled types of regulations were unrelated or negatively related to the outcomes. The study also introduced a new scale to assess students' motivation based on the conceptualization of SDT.

Subsequent studies have generally confirmed the hypothesized associations of motivation types with learning outcomes in different learning situations. For example, McEown et al. (2014) investigated the motivational regulations of Canadian learners of Japanese language and showed that autonomous types of motivation (i.e., intrinsic regulation and identified regulation) best predicted academic outcomes and language engagement, whereas controlled types of regulations were negatively associated or not associated with these outcomes. Dincer and Yesilyurt (2017) investigated the relations between SDT variables and different outcomes among EFL Turkish undergraduate students of English. The results indicated that identified regulation best predicted classroom engagement. The study also showed that introjected regulation positively predicted engagement, albeit weakly. Alamer and Lee's (2019) study was one of the first to apply SDT to comprehend how the basic psychological needs, motivational regulations, goal orientations, and achievement emotions collectively contribute to L2 achievement in the Middle East context, particularly in Saudi Arabia. Their findings revealed that the basic psychological needs served as antecedents to both affective and cognitive variables, while motivational regulations emerged as the most significant predictor of L2 achievement.

Oga-Baldwin and Fryer (2020) studied the motivational profiles of Japanese secondary school students learning English. The researchers also compared students' L2 (i.e., English) motivational profiles to those related to their L1 (Japanese) and found that the students can be clustered into five subgroups, each with similar profiles of motivational regulations and achievement across the two languages. Moreover, the study illustrated that each motivational regulation toward learning the L2 is strongly correlated with its counterpart in L1. For instance, students L1 identified regulation was strongly linked to L2 identified regulation (r = 0.61, p < 0.001). Hence, it can be said that students'L1 self-determined motivation profile can be transferred to their L2. This is evident in the strong correlation the researchers found between L1 achievement and L2 achievement (r = 0.76, p < 0.001).

Interventions and Dynamic Effects of SDT Orientations on L2 Achievement

Recent research has focused on interventions and longitudinal assessments of how motivational orientations, as proposed by SDT, affect L2 outcomes. For instance, Alrabai (2016) discovered that motivational strategies based on SDT, when employed by teachers of English as a L2, enhanced learners' motivation and L2 achievement. The impact of the intervention was analyzed using Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA). The intervention targeted situation-specific motivational dispositions, which were found to lead to higher achievement levels in the experimental group compared to the control group. Subsequently, Alrabai and Alamer (2024) expanded upon this experiment by employing structural equation modeling (SEM) to investigate the mediating processes (i.e., the direct and indirect effects) of the intervention on later achievement of the L2. Their study revealed that teachers' motivational practices improved students' autonomous motivation at Time 2, which, in turn, improved later L2 achievement at Time 3 (i.e., at the conclusion of the language course). A study by Kuhbandner et al. (2016)

came to a similar conclusion but focused on controlled teaching practices. It found that increased control, achieved through extrinsic monetary rewards, can adversely impact students' performance on vocabulary tests.

Alamer and Alrabai (2023) provided insight into the causal relationship between autonomous motivation and L2 achievement. They employed the random-intercept cross-lapped panel model (RI-CLPM) to assess the longitudinal association between autonomous motivation and L2 achievement. Instead of the traditional one-way view of motivation leading to language achievement, Alamer and Alrabai proposed a dynamic relationship, where not only does motivation affect achievement, but achievement also feeds back to boost motivation later. Tracking 226 language learners for 17 weeks, they found early autonomous motivation impacted L2 achievement, but L2 achievement in turn amplified autonomous motivation later. This suggests a positive cycle, where success fuels further motivation and potentially enhances long-term learning.

The Role of Motivational Orientations in Language Learning Anxiety

A growing body of literature has demonstrated that motivational orientations, as articulated within self-determination theory (SDT), are closely linked to learners' experiences of anxiety in language learning contexts. According to SDT, autonomous motivation-such as intrinsic and identified regulation-tends to foster adaptive outcomes, whereas controlled motivation-such as introjected and external regulation—is often associated with maladaptive emotional states (Ryan & Deci, 2017). Howard et al. (2021), in a large-scale meta-analysis, confirmed that autonomous motivation is systematically associated with psychological well-being across educational settings, while controlled motivation is linked to ill-being, including anxiety. In the L2 context, similar findings have been reported. Noels et al. (1999) found that learners with more autonomous motivational profiles reported lower levels of anxiety and greater enjoyment in language classes. More recently, Bang and Hiver (2016) demonstrated that intrinsic motivation negatively predicted listening anxiety among Korean learners of English. These patterns were further supported in longitudinal designs; Alamer and Lee (2021) revealed that L2 achievement reduces anxiety over time and that early motivation quality significantly influences the trajectory of anxiety. Moreover, Alamer et al., (2023a, 2023b) found that interventions promoting autonomous motivation-such as through mobile-mediated communicationled not only to enhanced language achievement but also to a significant decrease in learners' anxiety. Collectively, these studies provide converging evidence that autonomous forms of motivation serve as a protective factor against language anxiety, whereas controlled forms may exacerbate it.

Measuring the SDT Motivational Regulations

As explained earlier, Noels et al. (1999) not only introduced the conceptualization of SDT to the L2 field but also provided a scale that allowed researchers to assess students'SDT regulations. Noels et al. (1999) conducted correlational analyses to

provide preliminary evidence of scale validity and internal reliability. Subsequent research has effectively used this scale, albeit with some varied results (see Alamer & Lee, 2019). Other L2 researchers have also adapted other SDT motivation scales (e.g., Oga-Baldwin et al., 2017). Recently, Alamer (2022) examined a motivational process model linking SDT's basic psychological needs, motivational orientations, and effort to the attainment of vocabulary. Building on the work of Noels et al. (1999), the new SDT-L2 scale was validated by assessing L2 students' motivation based on four constructs (intrinsic, identified, introjected, and external orientations) with each having five items equally. A higher-order factor was employed to account for the two general factors, autonomous motivation and controlled motivation in the measurement model. This SDT-L2 scale has been further validated in (Alamer, 2021) using the exploratory structural equation modeling (ESEM) (Alamer & Marsh, 2022; Marsh & Alamer, 2024) and results were found to resonate with the theoretical underpinnings of SDT at the specific (the four orientations) and global levels (the two overarching factors).

Nonetheless, despite this increasing interest in how these different types of regulations relate to language learning outcomes such as final grades, vocabulary knowledge and proficiency, to the best of our knowledge, no meta-analytic study has yet examined these associations. However, McEown et al., (2014) provided a starting point for this effort with a comprehensive review of the area. Their primary objective was to contrast major theories of L2 motivation which, consequently, led them to include a summary of the key studies that applied these theories, including those utilizing SDT. McEown, et al.'s (2014) review compiled the results of previous studies in SDT and L2, describing their methodologies, participant characteristics, the foreign/second language being learned, and the country where research occurred. Nevertheless, a meta-analysis is warranted to quantify the relative importance of each type of regulation so as to evaluate how each influences the L2 learning process, as well as to update the findings in this literature. For example, some studies have shown that external regulation may be negatively linked to language outcomes while others found no substantial correlation. Similarly, some studies found that identified regulation is a better predictor of engagement than intrinsic regulation, while others show the opposite. Accordingly, there is a need to clarify the relations between SDT's motivational constructs and language outcomes in a meta-analytic perspective. Recently, Noels (2023) provided a well-rounded overview of the application of SDT in language learning while focusing on valuable insights into factors that drive and sustain learners. The overview suggested that SDT principles can be used to design language learning environments that are self-directed, challenging yet achievable, and promote positive relationships among learners and teachers. Al-Hoorei et al. (2022) delved deeper into the development of SDT and examined each of its six mini-theories through a comprehensive systematic review. Their findings revealed that certain mini-theories were widely adopted in the field, while others received relatively less attention. Our focus here is on organismic integration theory (OIT, Ryan & Deci, 2017) which concerns the intrinsic and internalized motives that may influence learning and achievement.

Domains outside language learning have examined the effects of the SDT factors on various outcomes such as in health (e.g., Ng et al., 2012), physical activity (e.g., Hagger et al., 2003) and organizational (e.g., Slemp et al., 2018) Perhaps the most relevant

meta-analysis to the present study is Howard et al. (2021). These authors investigated the influence of different types of SDT motivational orientations on performance, wellbeing, goal orientation, and persistence-related students' outcomes across educational contexts and subject matters. Drawing from 344 samples, they showed that autonomous motivations were substantially related to students' success and well-being whereas controlled motivation is associated with ill-being, and not associated with performance or persistence. Howard et al. (2021) concluded that autonomous types of regulations (i.e., intrinsic and identified) are particularly relevant to adaptive school outcomes.

Generally, there has been a consistent pattern of findings in these prior meta-analyses outside of the language domain: autonomous motivation (and its sub-constructs of intrinsic regulation and identified regulation) are associated with more positive, adaptive, and healthier outcomes. In contrast, controlled motivation (and its sub-constructs of external regulation and introjected regulation) is either negatively or unrelated to the outcomes. Hence, in the present study we hypothesize a similar pattern of findings within the domain of language learning, although the strength and heterogeneity of the findings remain open questions.

While Howard et al. (2021) provided a comprehensive meta-analytic overview of SDT-based motivation across various educational contexts, our study distinguishes itself by concentrating exclusively on L2 achievement. This focus is crucial because, as Gardner (2010) and Dörnyei and Ushioda (2021) have elucidated, motivation in L2 learning encompasses unique domain-specific factors that are not entirely translatable to other educational subjects. Alamer (2024) and Gardner (2010) emphasized the importance of integrative motivation (a unique facet of intrinsic motivation tied to L2 learning), which refers to a learner's desire to learn a language in order to integrate into a different cultural or social group. In this way, L2 motivation involves socio-cultural dimensions that are inherently tied to the target language an individual is learning. This goes beyond mere academic or career-related reasons and taps into personal identity and social belonging, which, distinguishes L2 motivation from other educational subjects. Furthermore, achievement in the L2 is different from other educational subjects due to key factors. Above the socio-educational factor mentioned earlier, language is, in fact, a tool for communication, making its learning inherently interactive. Success in language acquisition is often measured by the ability to engage in meaningful conversations, understand nuanced expressions, and participate in social interactions. In addition, learners often come to classrooms with varied exposure and experience with the taught language, making predictions of achievement more complex. Collectively, these factors distinguish L2 learning from other educational subjects and reinforce the importance of specialized meta-analyses into L2 learning.

Method

Search Strategy and Selection Criteria

Using the PRISMA Statement 2020 Version as a guide (Page et al., 2021), we conducted a thorough search of electronic databases using a range of search terms and phrases according to our predefined PICOS framework on November 2022. The

search strategy included: ("Self-Determination Theory"OR"SDT"OR"autonomous motivation"OR"controlled motivation"OR"intrinsic motivation"OR"extrinsic motivation"OR"autonomy support"OR"competence"OR"relatedness") AND learning"OR"second language acquisition"OR"foreign ("language language education"OR"language proficiency"OR"language learners"OR"EFL"OR"ESL") AND"motivation"OR"student engagement"OR"language achievement"OR"English grammar learning"OR"English vocabulary learning"OR"learning satisfaction"). Databases searched included ERIC, PsycINFO, PubMed, Scopus, Web of Science, JSTOR, ProQuest, ScienceDirect, Taylor & Francis Online, SpringerLink, Wiley Online Library, Oxford Academic, Cambridge Core, and Google Scholar.

Coding of Study Characteristics

To ensure accurate study codification, rating, and data organization, we used Rayyan (www.rayyan.ai), a web and mobile application specifically designed for screening and data management of systematic reviews. In the initial phase, all studies and associated bibliographic information were exported to Rayyan. After applying inclusion and exclusion criteria, the studies were independently screened by the first and second authors. During the subsequent screening phase, 761 studies were excluded based on eligibility criteria, leaving 118 full-text articles for review by all three authors. Any disagreements between reviewers were resolved through discussion to reach a consensus Fig. 2.

Calculation of Effect Sizes and Meta-analytic Procedures

For the present study, we used the Comprehensive Meta-Analysis software (CMA, version 4; @2022, Biostat, Inc., Englewood, NJ), STATA Version 18 and SPSS Version 29 to conduct effect size calculations and meta-analytic procedures. Pearson's r correlation coefficients were used to estimate the main effect sizes, with field-specific benchmarks for interpretation based on Cohen (1988). Accordingly, correlation (*r*) close to 0.10, 0.30, and 0.50 are considered small, medium and large, respectively. To calculate Pearson's r correlation coefficients, Fisher's z correlations were used after all collected effect sizes were transformed. Additionally, all Fisher's z correlations were weighted against the sample size of the studies to account for sampling errors.

In this review, the majority of studies included multiple dependent outcomes, resulting in more than one effect size per study. This violates the assumption of independence required for traditional univariate meta-analysis (Borenstein et al., 2009). As a result, a multilevel meta-analysis was utilized as an extension to the univariate method (Van Vaerenbergh et al., 2014; Van den Noortgate, 2013; Jackson et al., 2013) to handle multiple dependent effect size estimates nested within studies.

Assink and Wibbelink (2016) identified three sources of variance distributed over three levels: sampling variance for each effect size (Level 1), differences in effect sizes within studies (Level 2), and between-study variance (Level 3). To



Fig. 2 Study retrieval process using PRISMA (Page et al., 2021)

account for the dependency among effect sizes and obtain less biased estimates, we employed a multilevel model. If significant variance within or between studies was present, it indicated heterogeneity in effect size distribution. Therefore, moderator analyses were conducted to calculate the effects of other variables, such as proficiency level, participants' characteristics, and language learningteaching context.

Finally, a sensitivity analysis was conducted using the one-study-removed method in CMA to determine that outliers did not heavily affect the average effect size.

Table 1 Eligi	bility criteria	
Inclusion		Exclusion
Participant	Language learners, including various ages, proficiency levels, and edu- cational settings in second language acquisition (EFL, ESL) or foreign language contexts	Studies that focus solely on first-language (L1) acquisition. Studies on language learning for clinical populations if the focus is not on general academic language acquisition
Intervention	Application of Self-Determination Theory (SDT) principles within lan- guage learning contexts	Studies that did not specifically employ SDT principles or measure SDT- related constructs
Comparison	Different types or levels of SDT-related motivation (e.g., autonomous vs. controlled, intrinsic vs. extrinsic) or absence of SDT-based interventions	Studies with no clear motivational or comparison groups or unrelated to SDT components
Outcomes	Language learning achievement outcomes, such as vocabulary acquisition, general language proficiency, overall GPA in language courses; and/or measures of psychological well-being/ill-being, such as anxiety within studies also containing an achievement outcome	Outcomes unrelated to language learning, such as general academic perfor- mance, cognitive skills, or personality traits
Study design	Experimental, quasi-experimental, longitudinal, cross-sectional, and observational designs	Non-empirical studies (e.g., theoretical reviews, editorials, or opinion picces) Qualitative-only studies without any quantitative outcomes relevant to lan- guage acquisition or SDT components Studies lacking statistical data that allows for effect size calculation
Other		Non-English studies

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Fig. 3 Funnel plot of the included studies on for regulation types



Correlation

Fig. 4 Funnel plot of the included studies on for regulation subgroups

	Number	Effect Size	Std. Error	Z	Sig. (2-tailed)	95% Co dence Ir	nfi- nterval
						Lower	Upper
Observed	102	0.092	0.021	4.17	< 0.001	0.048	0.135
Observed + Imputed ^a	102	0.092	0.021	4.17	< 0.001	0.048	0.135

Table 2 Duval and Tweedie's trim and fill test of publication bias estimation

^aNumber of imputed studies: 0

Publication Bias

To address potential publication bias, researchers commonly use a technique that involves analyzing small-study effects through a funnel plot and adjusting the final estimate using the trim-and-fill method. This type of plot displays the effect sizes of individual studies on the x-axis and their corresponding standard errors on the y-axis. An uneven distribution in the plot may suggest publication bias, as studies in non-significant regions of the plot may have been excluded (Borenstein et al., 2009). The second method we employed was the trim-and-fill technique, developed by Duval and Tweedie in 2000, which identifies and eliminates studies that cause funnel plot asymmetry. It then estimates a bias-corrected effect size by imputing missing studies. To further strengthen our results, we also conducted a failsafe test, which calculates the number of missing studies with an average z-value of zero that would have to be added to make the combined effect size statistically insignificant. (Rosenthal et al., 1994). Our analysis, including Trim and Fill, funnel plots (see Table 1 as well as Figs. 3 and 4), and the fail-safe N (Nfs = 5524), all suggest that publication bias was not detected and that we can be confident in the accuracy of the findings.

Results

Overall Meta-Analysis Results

Out of 21 primary studies from 1999 to 2024, comprised of 24,470 participants, 85 weighted correlations (r) were extracted for this meta-analysis. Table 2 and Figs. 5–6 show the results of the average weighted r, the 95% prediction intervals, the Q-test for heterogeneity, the two-tailed test of null, the between-study variance, and the percentage of variation between studies due to heterogeneity rather than sampling error. As seen in Fig. 3, the effect sizes vary considerably from -0.33 to 0.70. The overall effect size for SDT motivational regulations and their two global constructs, autonomous and controlled motivation, in a bottom-up fashion, are represented independently to demonstrate the complete picture of all dimensions.

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	Forest Plot
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-0.21 0.06 -0.34 -0.08 0.00 20.30 1.00	
-0.17 0.05-0.26-0.08 0.00 21.13 1.04	
-0.17 0.05-0.26-0.06 0.00 21.13 1.04 -0.04 0.07-0.17 0.09 0.55 20.14 0.99	
. 0.01 0.12-0.22 0.24 0.93 17.09 0.84 . 0.12 0.11-0.10 0.34 0.29 17.20 0.84	
0.14 0.05 0.05 0.23 0.00 21.11 1.04 0.16 0.07 0.07 0.07 0.07 0.01 0.02 0.01 0.023	
0.17 0.07 0.04 0.30 0.01 20.24 0.99	
0.25 0.04 0.17 0.35 0.00 21.20 1.04 0.29 0.05 0.17 0.41 0.00 20.44 1.00	
0.38 0.06 0.27 0.49 0.00 20.64 1.01 sup Overall -0.03 0.06-0.15 0.10 0.64	
0.14.0.00	
model	0.0 0.5 1.0

whole: nanowimelects modern Heterogeneity: Q = 1730.37, df = 101, p-value = 0.00 Test of overall effect aize: t = 4.18, df = 101, p-value = 0.00 Test of overall effect aize: t = 4.18, df = 101, p-value = 0.00

Overall 0.09 0.02 0.0



							Effect size	
Study	К						with 95% CI	p-value
Motiva	tion							
IM	33					•	0.27 [0.21, 0.32]	0.000
IDR	14				•		0.16 [0.09, 0.22]	0.000
IRJ	14		-				-0.06 [-0.13, 0.00]	0.056
ER	24	•		-			-0.02 [-0.10, 0.06]	0.704
Test of	group differences: $Q_b(3) = 69.73$, p = 0.00							
Global	Constructs							
СМ	38						-0.03 [-0.09, 0.02]	0.243
AM	47				+		0.23 [0.19, 0.28]	0.000
Test of	group differences: $Q_b(1) = 53.06$, p = 0.00							
Overal	I			•			0.12 [0.07, 0.16]	0.000
Hetero	geneity: τ ² = 0.04, I ² = 92.84%, H ² = 13.96							
Test of	$\theta_i = \theta_j$: Q(84) = 1336.16, p = 0.00							
		-0.10 0	00	0.10	0.20	0.30		
Random	-effects REML model							

Fig. 6 Forest plot summarizing the correlation (r) of SDT constructs with language achievement. Note: k =number of effect sizes, CI = confidence interval, Z = Z value, p = p value, Q = Cochran's heterogeneity test; df = degrees of freedom, $\tau 2$ = between-study variance; I^2 = percentage of variation between studies that is due to heterogeneity rather than sampling error. ER = external regulations, IRJ = introjected regulation, IM = intrinsic motivation, IDR = identified regulation, CM= controlled motivation, AM = autonomous motivation, H2 = the ratio of the variance of the estimated overall effect size from a random-effects meta-analysis compared to the variance from a fixed-effects meta-analysis (Lin et al., 2017)

The findings of the meta-analysis showed that under the random-effects model, the summary estimate of the correlation between intrinsic regulation and language achievement was 0.26, with a 95% CI [0.21,0.32], a z-value for a test of the null of 9.35, and a corresponding p-value of less than 0.001. Also, the test of heterogeneity was significant, demonstrating that there was substantial variability between the studies (Q = 333.02, df = 32, p < 0.001, $I^2 = 87.83$). These variations were accounted for via meta-regression moderator analysis. Furthermore, the overall mean correlation between identified regulation, the second construct of autonomous motivation, and language achievement was significant (r = 0.06, p < 0.001, 95% CI [0.09,0.22], Q = 60.14, df = 13, p < 0.001 $I^2 = 80.69$). The summary estimate for introjected regulation was not significant (r = -0.06, p = 0.06, 95% CI [-0.212,-0.00], Q = 82.81, df = 32, $I^2 = 78.39$), as was that for external regulation, the second construct under controlled motivation (r = -0.01, p = 0.70, 95% CI [-0.09,-06], Q = 202.02, df = 23, $I^2 = 90.45$).

Based on the general framework of SDT, the results for the two global constructs of SDT, autonomous motivation, and controlled motivation, are presented separately.

For autonomous motivation, a combination of intrinsic and identified regulation, the results (r = 0.23, p < 0.001, 95% CI [0.18,0.28], Q= 434.66, df = 46 I² = 87.92) showed a medium, positive, and significant association with language achievement. For the other global construct of SDT, controlled motivation, the overall effect was not significant (r = -0.03, p = 0.24, 95% CI [-0.08,0.02], Q= 288.73, df = 37 I² = 88.11). The results of heterogeneity tests (Fig. 6) show significant unexplained differences at all levels of motivation dimensions and global constructs. As such, we conducted moderator analyses to account for these variations. Detailed information of the included studies can be found in the supplementary files Fig. 7.

Furthermore, to broaden the examination in line with the comprehensive nature of SDT, a parallel meta-analysis was conducted on the relationship between these motivational constructs and anxiety, drawing data from a subset of the included studies. As depicted in Fig. 8, under the random-effects model, findings indicated a distinct pattern compared to achievement. Autonomous forms of motivation were significantly negatively associated with anxiety; both intrinsic regulation (r = -0.25, 95% CI [-0.38, -0.13], p < 0.001) and identified regulation (r = -0.18, 95% CI [-0.27, -0.10], p < 0.001) showed negative correlations. Conversely, controlled forms of motivation were significantly positively associated with anxiety. Introjected regulation (r = 0.23, 95% CI [0.12, 0.34], p < 0.001) and external regulation (r = 0.12, 95%

Study	К			Effect size with 95% CI	n-value
Motivati	on				r
IM	3	_		-0.25 [-0.38, -0.13]	0.000
IDR	2	_		-0.18 [-0.27, -0.10]	0.000
IRJ	2		_	0.23 [0.12, 0.34]	0.000
ER	2			0.12 [0.02, 0.21]	0.016
Test of gro	oup differences: $Q_b(3) = 54.45$, $p = 0.00$)			
Global C	onstructs			0.16[0.06_0.26]	0.001
AM	5	_		-0.23 [-0.32, -0.15]	0.000
Test of gro	oup differences: $Q_b(1) = 35.29$, $p = 0.00$)		. / .	
Overall Heteroger	neity: $\tau^2 = 0.04$, $I^2 = 91.90\%$, $H^2 = 12.34$			-0.07 [-0.21, 0.07]	0.331
Test of θ_i	$= \theta_{j}$: Q(8) = 121.87, p = 0.00	-0.40 -0.20	0.00 0.20 (0.40	

Random-effects REML model

Fig. 7 Forest plot summarizing the correlation (r) of SDT constructs with anxiety within studies also targeting acheivement. Note: k =number of effect sizes, CI = confidence interval, Z = Z value, p = p value, Q = Cochran's heterogeneity test; df = degrees of freedom, $\tau 2$ = between-study variance; I²= percentage of variation between studies that is due to heterogeneity rather than sampling error. ER = external regulations, IRJ = introjected regulation, IM = intrinsic motivation, IDR = identified regulation, CM= controlled motivation, AM = autonomous motivation, H2 = the ratio of the variance of the estimated overall effect size from a random-effects meta-analysis compared to the variance from a fixed-effects meta-analysis (Lin et al., 2017)

Study	К					Effect siz with 95%	ze CI	p-value
Dimension								
Autonmous	47	-				0.23 [0.19,	0.28]	0.000
Test of group differe	ences: Q _b (0) = -0.00, p = .							
Scales								
Alamer (2021)	15					0.29 [0.21,	0.36]	0.000
Noels et al. (1999)	19		_			0.16 [0.10,	0.22]	0.000
Author-made	5			•		0.34 [0.14,	0.54]	0.001
SRQ-A (1989)	4					0.14 [0.10,	0.19]	0.000
Jang and Kim (2014	4) 4			•	-	0.40 [0.33,	0.47]	0.000
Test of group differe	ences: $Q_b(4) = 45.93$, p = 0.0	00						
Overall						0.23 [0.19,	0.28]	0.000
Heterogeneity: T ² =	0.02, I ² = 87.92%, H ² = 8.28							
Test of $\theta_i = \theta_j$: Q(46)) = 434.66, p = 0.00							
	(0.10 0.2	20 0.30	0.40	0.50			
Study	K					Effect s with 95%	ize % Cl	p-value
Dimension								
Controlled	38					-0.03 [-0.09	, 0.02	.] 0.243
Test of group diffe	rences: $Q_b(0) = 0.00$, p = .							
Scales								
Alamer (2021)	7					-0.18 [-0.24	, -0.12	.0000
Noels et al. (1999)	22	-				-0.05 [-0.10	, 0.00	0.076
Author-made	5		•			0.07 [-0.17	, 0.30	0.576
SRQ-A (1989)	2					0.05 [-0.08	, 0.17] 0.463
Jang and Kim (202	14) 2				•	0.35 [0.26	, 0.44	0.000
Test of group diffe	rences: $Q_b(4) = 93.40$, p = 0.	00						
Overall Heterogeneity: τ^2 = Test of $\theta_i = \theta_i$: Q(3)	0.02, I ² = 88.11%, H ² = 8.41 7) = 288.73, p = 0.00		•			-0.03 [-0.09	, 0.02] 0.243
		-0.20	0.00	0.20	0.40			

Random-effects REML model

Fig. 8 Forest plot for scales measuring L2 autonomous/controlled motivation and language achievement

CI [0.02, 0.21], p = 0.016) both demonstrated positive correlations. Reflecting these specific regulations, the global construct of autonomous motivation was significantly negatively associated with anxiety (r = -0.23, 95% CI [-0.32, -0.15], p < 0.001), whereas the global construct of controlled motivation was significantly positively associated with anxiety (r = 0.16, 95% CI [0.06, 0.26], p = 0.001). Significant

Dependent variable	z	К	r	95% CI	Test of null			Hetero	geneity		
					z	d	Q	df	d	τ^2	$\mathbf{I}^{2\%}$
Dimensions (Level 2)											6.98
IM	8614	33	0.26	[0.21, 0.32]	9.35	< 0.001	333.02	32	0.00	0.02	87.83
IDR	4771	14	0.16	[0.09, 0.22]	4.63	< 0.001	60.14	13	0.00	0.01	80.69
IRJ	4771	14	-0.06	[-0.12, -0.00]	-2.05	0.06	82.81	13	0.00	0.01	78.39
ER	6314	24	-0.01	[90.0,00.06]	-0.38	0.70	202.02	23	0.00	0.03	90.45
Global constructs (Level 3)											86.22
AM	13385	47	0.23	[0.18, 0.28]	10.01	< 0.01	434.66	46	0.00	0.02	87.92
CM	11085	38	-0.03	[-0.08, 0.02]	-1.17	0.24	288.73	37	0.00	0.02	88.11
Overall	24470	85	0.12	[0.07, 0.16]	5.06	< 0.01	1336.16	84	0.00	0.04	92.84
N total number of participants, dfdegrees of freedom, τ^2 = bet tions, IRJ = introjected regulati	k number of ween-study v ion, <i>IM</i> intrir	effect size /ariance, I /sic motiva	es, $r = correls$ ² = percentag	ation coefficient as efficient as efficient of variation betwee identified regulation,	fect size, <i>CI</i> c en studies tha <i>CM</i> controlle	confidence inter t is due to hete ed motivation, /	rval, ZZ value, rogeneity rathe 4 <i>M</i> autonomou	<i>p</i> p value er than sar s motivati	, Q Cochran npling errol on	's heteroge r. <i>ER</i> extern	neity test, al regula-

Table 3 Results of random-effects meta-analyses of STD constructs on language achievement

Moderators	Z	К	r	95%CI	\mathbf{t}^{r}	4	H*	Ŷ	df	<u>,</u>
Target L2								10.49	1	0.00
English	11,297	39	0.26	[0.21, 0.31]	0.02	87.73	8.15			
Other languages	2088	8	0.10	[0.03, 0.18]	0.00	66.65	3.00			
Place								32.63	8	0.00
Saudi Arabia	4869	16	0.30	[0.23, 0.38]	0.02	88.92	9.02			
Korea	890	5	0.33	[0.23, 0.44]	0.00	67.29	3.06			
China	639	5	0.33	[0.13, 0.53]	0.04	88.15	8.44			
Canada	1312	8	0.11	[0.02, 0.21]	0.01	67.67	3.09			
UAE	246	2	0.08	[-0.04, 0.20]	0.00	0.00	1.00			
Jordan	332	2	0.11	[0.00, 0.22]	0.00	0.00	1.00			
Japan	4060	9	0.14	[0.11, 0.18]	0.00	24.69	1.00			
NS	932	2	0.14	[0.07, 0.20]	0.00	0.00	1.00			
Philippine	105	1	0.10	[-0.09, 0.29]	0.00	0.00	0.00			
Participant's age								0.44	1	0.50
Eighteen and above	9325	34	0.22	[0.17, 0.27]	0.02	86.96	7.67			
Below eighteen	4060	13	0.26	[0.16, 0.35]	0.02	90.16	10.17			
Participants' educational level								0.16	1	0.69
University	10,018	39	0.24	[0.18, 0.29]	0.02	87.95	8.30			
High school	3367	8	0.22	[0.12, 0.30]	0.01	86.52	7.42			
Language abilities								6.55	2	0.03
Vocabulary	1102	4	0.32	[0.20, 0.44]	0.01	84.25	6.35			
Listening	1500	3	0.14	[0.06, 0.22]	0.00	0.01	1.00			

59 Page 18 of 29

heterogeneity was also present across these analyses (Overall $I^2 = 91.90\%$, p < 0.001), suggesting variance that may require further investigation.

Moderator Analyses

The moderating variables were chosen based on the data available from the studies included in the analysis. Distinct sets of characteristics were employed to conduct meta-regression analyses for each group of moderating variables independently. To determine the significance of a specific variable as a moderator, Q-tests were utilized. Multilevel analyses were conducted on the SDT constructs at three levels, namely level one for individual studies, level two for motivation dimensions, and level three for autonomous and controlled motivation, as presented in Tables 3–4.

Moderator Analysis for Autonomous Motivation

Our findings on autonomous motivation as presented in Table 3, show that metaregression analyses yielded significant results for the L2 target language (Q = 10.49, df = 1, p = 0.00). This indicates that the association between autonomous motivation and language learning outcomes was significantly stronger for language learners who were learning English as a second language, compared to those learning other languages as their L2. As for the place of the studies, our next moderator had a significant moderating effect (Q = 32.63, df = 8, p = 0.001). The results showed that Chinese, Korean, and Saudi Arabian learners have a stronger link between autonomous motivation and language learning in comparison to learners from the USA, Jordan, and UAE. However, the number of studies for this moderator requires cautious interpretation. Additionally, the participants' age and educational level did not significantly affect the correlation between autonomous motivation and language learning achievement (Q = 0.44, df = 1, p = 0.50 and Q = 0.16, df = 1, p = 0.69). Lastly, the correlation between autonomous motivation and language learning skills (such as vocabulary and listening) was moderated by the type of skill being taught (Q = 6.55, df = 2, p = 0.03). Vocabulary learning showed the strongest association while listening had the weakest.

Moderator Analysis for Controlled Motivation

We examined whether the target language moderated the relationship between controlled motivation and language learning achievement (Table 4). The results showed no significant difference between English L2 learners and learners of other languages in this association (Q = 0.02, df = 1, p = 0.89). However, place of study was a significant moderator (Q = 18.00, df = 7, p = 0.01). Specifically, controlled motivation had different effects on learning outcomes for Chinese language learners compared to those from Saudi Arabia, Japan, and the U.S. Age also played a moderating role (Q = 4.42, df = 1, p = 0.03). Younger learners showed a small positive

Target L2EnglishEnglishOther languagesOther languages2088PlaceSaudi ArabiaKorea9704	-0.04					000		00 0
English 8997 30 English 2088 8 Other languages 2088 8 Place 2804 8 Korea 970 4	-0.04						_	
Engusti Other languages 2088 8 Place 2804 8 Saudi Arabia 2804 8 Korea 970 4	-0.04		0.02	00.05	1003		•	
Other languages 2088 8 Place 2804 8 Saudi Arabia 2804 8 Korea 970 4		[cn:n_'n1:n_]	cn.n	0.06	C601			
Place Saudi Arabia 2804 8 Korea 970 4	-0.03	[-0.07, 0.01]	0.00	0.00	1.00			
Saudi Arabia 2804 8 Korea 970 4						18.00	Ζ	0.01
Korea 970 4	-0.15	[-0.21, -0.09]	0.00	64.54	2.82			
	0.09	[-0.23, 0.41]	0.10	96.74	30.66			
China 429 5	0.07	[-0.16, 0.30]	0.06	85.31	6.81			
Canada 1312 8	-0.03	[-0.08, 0.02]	0.00	0.01	1.00			
UAE 246 2	0.04	[-0.07, 0.17]	0.00	0.00	1.00			
Jordan 332 2	0.02	[-0.08, 0.12]	0.00	0.00	1.00			
Japan 4060 6	-0.05	[-0.17, -0.07]	0.02	93.96	16.55			
US 932 2	-0.02	[-0.08, 0.03]	0.00	0.00	1.00			
Participant's age						4.42	1	0.03
Eighteen and above 7094 25	-0.08	[-0.13, -0.03]	0.01	73.57	3.78			
Below eighteen 3991 13	0.06	[-0.06, 0.18]	0.04	93.44	8.41			
Participants' educational level						1.87	1	0.17
University 7523 30	-0.06	[-0.11, -0.00]	0.01	80.52	5.22			
High school 3562 8	0.05	[-0.10, 0.20]	0.04	95.40	21.72			
Language abilities						2.35	7	0.30
Vocabulary 1102 4	0.12	[-0.14, 0.38]	0.6	95.38	21.65			
Listening 1800 4	-0.13	[-0.31, 0.04]	0.03	93.61	15.66			

association between controlled motivation and language achievement, while adult learners showed a small negative association. In contrast, educational level was not a significant moderator (Q = 1.87, df = 1, p = 0.17). Finally, the type of skill being taught (e.g., vocabulary, listening) did not significantly influence the relationship between autonomous motivation and language learning outcomes (Q = 2.35, df = 2, p = 0.30) Table 5.

The Types of Scales

In our included studies, we identified four established scales that were used to measure autonomous and controlled motivation. As depicted in Fig. 8, autonomous motivation were positively correlated with L2 achievement regardless of the scale used. The Jang and Kim (2014) scale yielded the highest correlation (r = 0.40), while the SRQ-A scale (Ryan & Connell, 1989) showed the lowest correlation (r = 0.14). In contrast controlled motivation as measured by different scales produced quite varied results. Specifically, the correlation calculated using the Jang and Kim (2014) scale showed a positive relation of controlled motivation with performance (r = 0.34), whereas the correlations between controlled motives and performance for three other tools—SRQ-A (Ryan & Connell, 1989), Noels et al. (1999), and author made—were small and non-significant. Finally, the correlation coefficient for studies that use the SDT-L2 scale by Alamer (2022) showed negative and significant associations of controlled motives with L2 achievement (r = -0.18).

Discussion

In the present meta-analysis, we examined the relations between the different types of motivation defined by SDT and outcomes related to language achievement defined by actual achievement, vocabulary knowledge, or GPA in language courses. In line with the theoretical underpinning of SDT (Ryan & Deci, 2022) and in L2 in specific (Alamer, 2022), the relationship between language achievement and autonomous motivation was positive and moderately strong in magnitude, while it was negative but nonsignificant with controlled motivation. Language achievement was most positively associated with intrinsic regulation, followed by identified regulation with a positive but small effect size. In fact, the overall pattern of data showed a graded set of correlations with achievement (i.e., r values of 0.26, 0.16, -0.06, -0.01), which provides evidence from the language learning domain supporting the continuum of self-determination (see Fig. 1). Furthermore, the global constructs, autonomous and controlled motivation seem to function in the expected positive and negative ways. These patterns of associations align well with the existing literature in L2 motivation research (Alamer, 2021, 2022, 2024; Alamer et al., 2023a; Al-Hoorie et al., 2022; Marsh & Alamer, 2024; McEown & Oga-Baldwin, 2019; Noels et al., 1999; Noels, 2023).

A key finding that emerged from this meta-analysis is that intrinsic regulation represents a uniquely important type of motivation for L2 learners, as suggested by the random-effect correlation results (see Table 2 and Fig. 5). This result is not surprising giving the importance attached to intrinsic regulation for optimum language learning process (Alamer & Al Khateeb, 2023; Alamer & Alrabai, 2023; Alrabai & Alamer, 2024; Marsh & Alamer, 2024; Noels, 2001, 2023; Noels et al., 1999, 2001; Oga-Baldwin & Fryer, 2020; Oga-Baldwin & Nakata, 2017). This finding also resonates with meta-analyses conducted outside language learning domain such as Howard et al. (2021) Ntoumanis (2021), and Stanley et al., (2021). In general, this result is in line with the SDT which highlights the key role intrinsic regulation plays in explaining learning outcomes (Deci & Ryan, 1985; Ryan & Deci, 2017). Further, identified regulation was also positively related to the language achievement, in line with the SDT perspective. Identified regulation may be particularly important when learners have to negotiate some of the less enjoyable aspects of mastering a new language, (Alamer, 2022; Alamer et al., 2023a, 2023b; Leeming & Harris, 2022; Noels et al., 2001) which found to be also associated with lower levels of anxiety to learn the language (Alamer & Almulhim, 2021; Alrabai, 2016; Noels, 2023).

In contrast, less-determined forms of motives were either unrelated or negatively associated with language learning outcomes. Our finding that controlled motivation was negatively but weakly associated with L2 achievement aligns with the metaanalysis findings reported in Howard et al. (2021) for education more generally and supports the view that prompting inner pressure or relying on external controls to motivate are strategies that are less likely to yield positive outcomes in language learning (Dincer & Yesilyurt, 2017; Noels et al., 2001).

Moreover, our analysis provided further evidence that motivational orientations are not only linked to achievement outcomes but also to learners' emotional experiences, particularly anxiety. In studies targeting achievement that also assessed anxiety, the analysis revealed that autonomous motivation, especially intrinsic and identified regulation, is associated with lower levels of language learning anxiety. In contrast, learners driven by controlled forms of motivation, such as external pressure or internalized guilt, tend to report higher anxiety. These findings are consistent with prior research (Alamer & Lee, 2021; Alamer et al., 2023b; Bang & Hiver, 2016; Howard et al., 2021; Noels et al., 1999), which has shown that autonomous motivation supports psychological well-being, while controlled motivation can be detrimental to emotional outcomes. This highlights that the quality of learners' motivation has significant implications not only for academic performance but also for their emotional adjustment in the language learning process.

Notably, scales used to measure less self-determined motives (controlled motivation) exhibited significantly different associations with L2 achievement. Specifically, Jang and Kim's (2014) scale of controlled motivation was positively associated with L2 achievement, which contradicts the theoretical argument of SDT. In contrast, studies using the SDT-L2 scale developed by Alamer (2022) revealed a negative correlation with L2 achievement while the remaining scales showed non-significant relationship. It should be noted that the result from Kang and Jim's scale were derived from a single article. Consequently, further investigation is warranted to explore this particular issue.

Another set of findings unique to this meta-analysis relates to moderation effects. While the relationship between autonomous motivation and achievement appeared relatively consistent across some moderators, such as learner age, proficiency level, and aptitude, our findings revealed significant moderation effects for other variables. Specifically, the relationship between autonomous motivation and achievement was stronger for learners of English as a second language compared to those learning other languages. This nuanced finding highlights the importance of considering the specific L2 target language in this context. Furthermore, the learners' place of study significantly moderated the relationship. Learners from some Asian countries (China, Korea, and Saudi Arabia) demonstrated a stronger link between autonomous motivation and language learning compared to learners from the USA, Jordan, and UAE. It is important to acknowledge that the interpretation of this finding is tempered by the varying number of studies contributing to each group, requiring cautious consideration. While the initial hypothesis anticipated a moderating effect of educational level, the results indicated no significant moderation. Similarly, participant age did not significantly moderate the relationship. Finally, the type of language skill being learned (e.g., vocabulary, listening) moderated the relationship with vocabulary learning demonstrated the strongest association, while listening had the weakest.

Two moderators emerged as significant for the relation between controlled motivation and L2 achievement, namely place of study and age. It appears that the effects of controlled motives were weakly positive for Korean and Chinese studies, and null or negative for other places of study. This moderation needs cautious interpretation given the variations in scales used to measure controlled motives, as noted above. Age also mattered, with younger learners showing a small positive association of controlled motives and L2 achievement, and adults showing a negative association, regardless of educational level or skill type. This result especially warrants further study as it suggests some performance in younger learners may be driven by more controlling motives.

Limitations

All meta-analyses are limited by the scope of literatures they summarize. In our case these limitations are several. First, in most of the studies we reviewed participants were learning English as a second language, with only 2 of the 20 studies targeting other languages. Given the dozens of widely taught languages, these results should be generalized beyond English learning with caution, although based on SDT we would predict this pattern of correlations to hold across language targets. In addition, our search was limited to publications in English. Future reviews might include non-English journals and unpublished studies. Also, we did not include language learning context (i.e., a foreign language, second language, or minority language setting) as a moderator variable in this meta-analysis due to the small number of studies available across the three categories.

Educational Implications

The results of this meta-analysis hold substantial pedagogical implications for language teaching, learning, and optimal classroom practices. First, our findings unambiguously suggest the importance of autonomous motivations in language achievement and thus suggest that people around the language learners (including language teachers, principals, and parents) focus on supporting a sense of autonomy. For example, language teachers can develop interesting tasks and emphasize opportunities for learners to enjoy language tasks (targeting intrinsic regulation), as well as help cultivate students' meaning and value for learning of the second language (targeting identified regulation). Teachers can achieve this by employing autonomy supportive teaching strategies (Alrabai, 2016; Alrabai & Alamer, 2024; Reeve et al., 2022), including eliciting and understanding student perspectives, providing choice where possible, minimizing controlling and evaluative feedback, and scaffolding tasks so that intrinsic motivation and internalization can occur. Additionally, allowing students to reflect on the value of learning the L2, and providing rationales for activity can help enhance identification with the sometimes challenging L2 learning experience. Previous research, including meta-analyses, have shown the ability of these techniques to enhance students' autonomous motivation (Alamer et al., 2023a, 2023b; Alrabai, 2016; Alrabai & Alamer, 2024; Dincer & Yesilyurt, 2017; Ng et al., 2012; Patall et al., 2008).

Beyond achievement, the current findings also underscore the emotional benefits of fostering autonomous motivation. Specifically, autonomous orientations were found to be negatively associated with language learning anxiety, suggesting that autonomy-supportive environments not only enhance academic outcomes but also may provide a buffer against negative emotional experiences. This is particularly relevant in L2 contexts, where anxiety can significantly hinder participation and performance. Supporting learners' autonomy can thus serve as a dual mechanism for promoting both achievement and emotional well-being in language classrooms. Furthermore, our findings have implications for the impact of controlling motives on students' sense of anxiety and, ultimately, their language achievement. Controlled types of motivation were most typically either negatively correlated or unrelated to L2 achievement. Even a null relationship is noteworthy in this domain, especially given how often controlling incentives and pressures are used to "motivate" language learning. The evidence linking controlled motivation with heightened anxiety reinforces the need to minimize the use of external motivators and reduce controlling instructional practices. However, because the measures used to assess controlled motives in the L2 domain have yielded varied outcomes, future research should continue refining the psychometric tools used to capture this construct accurately.

Overall, our results suggest that both actively supporting autonomy and employing less controlling teaching strategies will help L2 students experience more autonomous motives, leading to more optimal functioning and positive language learning outcomes. (Alamer, 2024; Alamer & Al Khateeb, 2023; Alamer & Lee, 2019, 2021; Marsh & Alamer, 2024; McEown et al., 2014; Noels, 2001; Noels et al., 2019).

Conclusion

This meta-analysis sheds light on the overall strength of correlations between the specific types of motivation articulated by SDT (Ryan & Deci, 2017) and language achievement. Primarily, we found that language achievement is positively associated with autonomous motivations such as intrinsic and identified regulations (effect size was r = 0.23). whereas less self-determined forms of motivation such as introjected and external regulations were uncorrelated with language achievement (effect size was r = -0.03). We discovered that variation in the scales employed to assess the SDT framework of motives can influence the outcomes. Notably, one less-validated scales yielded results that contradicted the theory, while more well-established scales supported the anticipated relationships. Studies that utilized the SDT-L2 scale (Alamer, 2022) demonstrated a negative association between controlled motivation and L2 achievement (r = -0.18) while the remaining scales presented nonsignificant relationship with the outcome.

Together, the findings put emphasis on the pivotal role of autonomous motivations in fostering better language learning outcomes. Language teachers, as the principal agents in the ecology of a foreign language class, should consider methods that boost students' interest in and values for learning instead of using methods characterized by controlling behaviors.

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Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Conflict of Interest The authors declare no competing interests.

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