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Task complexity and foreign language writing emotions as predictors of EFL writing performance

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Emotions and task complexity have gained scant attention in EFL writing. This study, based on control-value theory and a positive psychology perspective, explores the relationship between task complexity, writing anxiety, writing boredom, writing enjoyment, and task complexity and writing emotions interaction on EFL writing performance among English major students in China's educational context ($N = 84$). It has been found that difficult writing tasks can result in higher writing anxiety and lower writing boredom. By 6×2 between-subject ANOVA, there is a significant interaction of task complexity and different levels of writing anxiety, writing boredom, and writing enjoyment for the dimensions of language fluency, complexity, and accuracy among English major students in China's educational context. This study is an initial step in extending the writing emotions and task complexity in the production of EFL writing, which promotes the mutual integration of emotion and cognition in EFL writing research and thus supplies suggestions for task-based EFL writing instruction.

KEYWORDS

writing enjoyment, writing anxiety, writing boredom, task complexity, writing performance

1 Introduction

As for the terrain of EFL writing, Ellis and Barkhuizen (2005) once pointed out that writing performance, including language accuracy, complexity, and fluency. And it is essential to take the EFL writing performance and emotions into consideration. In the course of EFL writing, EFL learners would induce a variety of positive or negative emotions. Furthermore, negative emotions like foreign language anxiety and foreign language boredom have been found to negatively predict the EFL writing production, while positive emotions like foreign language enjoyment have been confirmed to positively contribute to EFL writing outcomes (Teimouri et al., 2019). From the perspective of emotions and writing tasks, conducting the analysis and study of learners' language performance can contribute to a comprehensive understanding of learners' language information (Robinson, 2001). The current study, from the lens of emotions to investigate EFL writing production, would be beneficial to gain insights into how emotions, along with different writing tasks, respectively, affect the EFL writing performance.

Numerous studies have been conducted to examine the effect of task factors and cognitive factors on the dimensions of EFL writing performance. For example, the effect of different

writing tasks and different genres on the dimensions of writing performance has been reported (Qin and Uccelli, 2016), as has the effect of cognitive factors like task complexity on the measures of EFL writing performance (Robinson, 2001; Awwad and Tavakoli, 2022). However, EFL writing is a very complex process which is affected by a variety of factors, such as social environmental factors (learning environment, curriculum environment) and individual factors (cognition, affect, and working memory). For example, Grabe and Stoller (2001) not least emphasized the importance of the curriculum environment and affective factors in writing. Meanwhile, Hyland (2003) further argued that language writing should be concerned with individuals' affective factors. Indeed, learning emotions such as anxiety, boredom, and enjoyment are also factors that influence EFL writing (Mahfoodh, 2017; Zheng and Yu, 2018; Han and Hyland, 2019). Moreover, they unanimously highlighted the effect of high or low learning emotions on EFL learning and advised to further examine the interaction effect of cognition and emotion in EFL writing. This implies the importance of the integration of cognitive and affective factors into EFL writing should be elaborated. As such, the current study is to further explore the possible relations between task complexity, writing anxiety, writing enjoyment, and writing boredom and the dimensions of writing performance.

2 Literature review

2.1 EFL writing performance

Ellis and Barkhuizen (2005) stated that writing performance is composed of language complexity, language fluency, and language accuracy. The development of writing performance plays an important role in facilitating writing ability. Thus, the measurements of language complexity, language fluency, and language accuracy in EFL writing performance have long been acknowledged as a major goal of research in the development of writing ability. Numerous studies have been conducted to explore a variety of measurements of language complexity, language accuracy, and language fluency. For example, Wolfe-Quintero et al. (1998) examined more than one hundred measures of complexity, fluency, and accuracy in order to verify the characteristics of different indicators in measuring language accuracy, fluency, and complexity and the categories of these indicators. Cumming et al. (2005), based on Wolfe-Quintero's research synthesis, by statistical analysis, found that the number of words per minute (W/M) can be used to measure the fluency of language, the number of errors per T-unit (E/T) and the ratio of errors to the total number of words (E/W) can test the accuracy of language, and the ratio of word type to word token (TTR) can be used to measure lexical complexity. Similarly, Lu (2010), by the research synthesis of Wolfe-Quintero et al. (1998) and Ortega (2003), described the automatic analysis of syntactic complexity in writing performance using 14 different measures proposed in studies of second language development, facilitating and extending in EFL writing performance research.

The measurement of language complexity, accuracy, and fluency has provided the basis for further investigating EFL writing performance, and the research has begun to concern about the development of language complexity, language accuracy, and language fluency from the perspective of cognitive factors, such as task complexity, task difficulty, task types, and task genres in EFL context (Robinson, 2001; Malicka, 2020; Awwad and Tavakoli, 2022; Tao and Wang, 2022). For example, the typical study conducted by Robinson (2001), based on the research findings conducted by Widdowson (1990), Long (1998) and Skehan (1998), described a framework for examining the effects of the cognitive complexity of tasks on language performance and learner perceptions of task difficulty, with the results indicating that the significant effects of task complexity and task difficulty on the dimensions of language complexity and language accuracy. Among the previous researches, the similarity was that the dimensions of writing performance were investigated from the perspective of cognitive factors or task factors, with the results showing the significant effects of both task complexity and different tasks on writing performance. The differences were that Robinson (2001), in his study, shed light on the effects of some affective factors such as confidence, motivation, and anxiety on writing performance, with the results that motivation, as well as confidence affected the writing performance, but concurrently emphasized the important role played by classroom anxiety in writing, and appealed to supplementing the following research about the relation between affective factors such as anxiety and the dimensions of language performance by adopting more extensive and detailed instrumentation.

To sum up, the development of EFL writing performance is not only affected by cognitive factors but rather affected by learning emotions. In order to fill the gap in the studies of the three indices of EFL writing performance, the present study attempts to incorporate task complexity and the learning emotions into EFL writing performance and gain insights into how task complexity and learning emotions such as boredom, enjoyment, and anxiety may influence language complexity, language fluency, and language accuracy.

2.2 Foreign language writing emotions and EFL writing

Fehr and Russell (1984) have noted that emotion is not difficult to understand until we are asked to give its definition. Damasio (1994) defined the term emotions as changes in the body state in response to a positive or negative environment. Nowadays, emotions are considered to be the factors to direction the behavior. Oatley and Jenkins (1996) claimed that emotions are the central part of human mental life, which affects our physical well-being. Even research shows that afflictive emotions can make one ill, and positive emotions can tend to promote health (Goleman, 1997). Overall, the above definitions have presented the possible relationship between emotions, social environment, and human behaviors.

Not until positive psychology (PP) was introduced into second language learning, the new trends in the literature on emotions in SLA have emerged in the EFL educational context (Li et al., 2018; Dewaele, 2019; Li and Xu, 2019; Prior, 2019; Tsang and Lee, 2023). From the perspective of PP, the research on emotions in SLA is conducted under the theoretical framework of the broaden-and-build theory (Fredrickson, 2001) and control-value theory (Pekrun, 2006) to explore the influence of positive emotions and negative emotions on foreign language learning performance (Dewaele and Li, 2020). The broaden-and-build theory has played a part in building the "emotional

wave" (MacIntyre and Gregersen, 2012; Dewaele and MacIntyre, 2016), which holds that positive emotion and negative emotion are two types of emotions with different functions; positive emotions have positive effects on cognition, motivation, physiology, psychology, and social resources, while negative emotions shrink short-term and long-term resources and affect individuals' cognition of the environment (Fredrickson, 2001).

At present, control-value theory is introduced into SLA research and expands the perspective of SLA research (Li et al., 2018; Han and Hyland, 2019). Pekrun (2006) proposed the conceptual framework of learning emotion based on this theory, and then Pekrun and Linnenbrink-Garcia (2012) defined learning emotion from three dimensions: valence (positive emotion and negative emotion), activity (emotional arousal), and orientation (arousal of emotional objects). For example, enjoyment is classified as a positive high-arousal emotion and hopelessness as a low-arousal emotion (Dewaele and MacIntyre, 2016). There have been some studies on the relationship between emotions and learning achievement. For example, the relationship between anxiety and writing achievement (Zabihi et al., 2020) and the positive emotion (foreign language enjoyment) on foreign language achievement (see Dewaele and Alfawzan, 2018; Saito et al., 2018). The above-mentioned studies shed light on the positive effect of high-level positive emotions on language achievement and the negative effect of high levels of negative emotions on language learning. However, little attention has been concentrated on how the diverse-specific state emotions like writing anxiety, writing boredom and writing enjoyment appeared in the process of writing tasks administering, and how the different levels of emotions affect the dimensions of writing performance along with the cognitive factors like task complexity. EFL writing has a complicated cognitive process, and learners are prone to produce a variety of emotions (Cotterall, 2011). The diverse-specific state emotions may arise from the writing task complexity. Robinson (2001) examined the relationship between task complexity and task difficulty in task production, suggesting the extent to which task complexity can predict the learners' stress, confidence, interest, and even motivation. Although the prior studies, in the domain of task-based instruction, paid attention to learners' different emotions in perspective of task difficulty, the research instrumentation should have been extended and detailed. For example, adding more items to the different emotion variables based on preceding studies. Additionally, the effect of multiple high- or low-specific state emotions on the dimensions of EFL writing performance and the effect of high or low emotions at different writing task complexity on EFL writing performance also needed to be considered.

2.3 Task complexity and writing performance

Task complexity is related to the attentional, memory, reasoning, and other information processing demands imposed by the structure of the task on the language learner (Robinson, 2001). Thus, it is a cognitive factor. The impact of task complexity on foreign language learning production has attracted scholars' attention in the field of SLA (e.g., Kormos and Trebits, 2011; Kuiken and Vedder, 2011; Benson, 2015). Numerous studies are based on the cognitive hypothesis (Robinson, 2001, 2011, 2015) and competition hypothesis (Skehan, 2009) as the theoretical basis for exploring the influence of task complexity on EFL learning. According to the cognitive hypothesis, the two dimensions of resource-directing and resource-depleting are important factors affecting the complexity of the task; these two dimensions have different effects on the allocation of attention resources and the resource-directing dimension by increasing the difficulty of the task, and the cognitive requirements of conceptualization can direct attention resources to language performance, resulting in more accurate and complex language output and lower language fluency. As the resource-depleting dimension increases, learners will consume more attention resources and thus pay less attention to language performance, affecting language accuracy, complexity, and fluency. According to the competition hypothesis, learners are affected by the capacity of working memory, so the increase in task complexity can only make learners pay priority to either language accuracy or complexity. Nowadays, studies have explored the relationship between task complexity and L2 writing performance, but with inconsistent results. For example, Yan and Zhang (2015) pointed out that there was not a significant main effect of task complexity on language complexity and fluency in EFL writing performance, but a significant task complexity and self-efficacy interaction on EFL writing accuracy. Wang et al. (2020), based on 616 Chinese English learners, comprehensively investigated the impact of task complexity on language complexity, with the findings indicating that task complexity has an impact on different dimensions of language complexity. The above inconsistent findings may be the ignorance of the effects of individual factors, such as learning emotions, on the dimensions of writing performance. Furthermore, Jin and Wang (2021) not least stressed that future research could explore the interaction between task complexity and different learner factors as well as cultural environment, suggesting that cognitive factors like task complexity as well as learner factors like positive and negative emotional factors should be integrated into the development of EFL writing performance.

2.4 Goals of the current study

The present study seeks to address this gap. Drawing on Pekrun's (2006) learning emotions such as anxiety, boredom, and enjoyment and Robinson's (2001) concept about task complexity, it added the assessment of L2 proficiency based on a dedicated reading and writing proficiency test as the main dependent variable. It attempts to pursue two principal objectives: first, to explore the relation between task complexity and multiple learning emotions, and second, to investigate the possible interaction effects of task complexity and diverse high or low emotions on the dimensions of EFL writing performance. Specifically, we attempt to investigate the following research questions (RQS) among English major students in a Chinese EFL context.

> *RQ1*: To what extent do writing anxiety, boredom, and enjoyment differ when attempting no tests, a simple writing task (posttest 1) and a difficult writing task (posttest 2)?

> *RQ2*: To what extent does the interaction (s) of task complexity with writing anxiety, boredom, and enjoyment respectively contribute to individual differences in language fluency, complexity, and accuracy in the EFL educational context?

To better elaborate on the preceding literature and the above research questions, we, drawing on the work by Rahimi and Zhang (2019), have synthesized the conceptual information in the current study, with the details indicated in Figure 1.

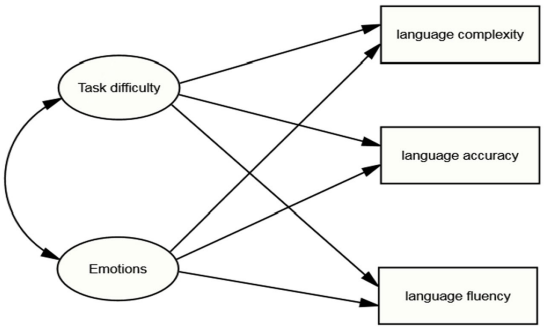


FIGURE 1
The conceptual framework of emotions, task difficulty, language complexity, accuracy, and fluency.

3 Method

3.1 Participants

By convenient sampling, the participants were 84 Chinese mainland EFL learners, 8.9% males and 91.1% females, aged 19–20, who were university students majoring in English at a university in Hubei Province, China. They were all sophomores from three different classes, with 28 students from Class 1, 10.3% males and 89.7% females, with 28 students from Class 2, 7.4% males and 92.6% females, and 28 students from Class 3, which were recruited using convenience sampling.

The number of 84 students in the present study, based on the measurement results collected by questionnaires of writing anxiety, writing boredom, and writing enjoyment among 177 students of Class 1, Class 2, and Class 3, has been divided into six subgroups. To be specific, questionnaires of writing anxiety, writing boredom, and writing enjoyment are administered in three classes at the same time; we employed the way to sort the groups suggested by Argyrous (2000), with 25% of the high score and 25% of the low score as the boundary between high score group and low score group. Finally, we confirmed six subgroups, with the subgroup information demonstrated in Table 1. The six subgroups, with high or low levels of respective writing emotions, are selected to be between-subject factors due to high- or low-specific emotions exhibiting a big influence on EFL learning achievement (Dewaele and MacIntyre, 2016).

TABLE 1 The information of subgroups in the present study.

Code	Subgroups	Number	Male	Female	Class
1	High writing anxiety	14	2	12	1
2	Low writing anxiety	14	1	13	1
3	Low writing boredom	14	3	11	2
4	High writing boredom	14	2	12	2
5	Low writing enjoyment	14	3	11	3
6	High writing enjoyment	14	1	13	3

All participants were native Chinese speakers who shared a very similar social and cultural background. All learners, by the time of their admission into university, had learned English in primary school for 3 years and in high school for 6 years, and they were non-native English speakers, with a little concentration on spoken language use in high school education. Additionally, all the students have taken the National English Test authorized by the Chinese foreign test center, and additionally, it has been analyzed, by one-way between-subject ANOVA, that there is no significant difference in TEM-4 scores among six subgroups ($p = 0.059 > 0.05$). To further exclude the effect of other emotions on EFL writing performance between respective high or low emotions, paired-sample T-test was conducted among different emotions, indicating, between writing anxiety groups, that there is no significant difference in writing enjoyment ($p = 0.090 > 0.05$) and writing boredom ($p = 0.802 > 0.05$). Between writing enjoyment groups, there is no significant difference in writing anxiety ($p = 0.342 > 0.05$); however, there is a significant difference in writing boredom ($p < 0.05$), which needs to be further discussed. Between writing boredom groups, there is no significant difference in writing anxiety ($p = 0.135 > 0.05$) and writing enjoyment ($p = 0.464 > 0.05$).

3.2 Instruments

3.2.1 Questionnaire

The questionnaire (see Appendix A) was composed of two parts. Part A consisted of personal background information such as gender, grade, major, and years of English learning.

Part B included 19 items drawn from the work of Cheng (2004), Li et al. (2018) and Shao et al. (2019). The participants were required to select one of the possible answers on a 5-point Likert scale, ranging from 1 ("strongly disagree" on the left end) to 5 ("strongly agree" on the right end). The above items were used to measure the learning emotions in the present research, which could contribute to comparisons with the results of the preceding studies.

The questionnaire content in Part B covered the information based on the following three variables: (a) writing boredom with seven items was drawn from the study about learning emotions conducted by Shao et al. (2019); (b) writing enjoyment with six items was adapted from Li et al. (2018); (c) writing anxiety with six items consisted of the items from the study conducted by Cheng (2004). All the items demonstrated in the current study have been adapted from the previous research based on the writing education context in China, such as "English writing exercises in class really makes me bored" or "I feel enjoyable about English writing exercises in English writing class" or "Whenever I am asked to finish the English writing task in Class, I will feel nervous."

Questionnaire as an instrument can be used to obtain the quantitative data, and the reliability of the questionnaire refers to the consistency and stability of quantitative data measured by questionnaire. Nowadays, the reliability analysis of questionnaire can be employed by Cronbach's alpha to measure the internal consistency

of questionnaire, whose value varies from 0.00 to 1.00; the larger the value is, the higher the reliability will be. However, the reliability is widely accepted if the Cronbach alpha is over 0.70. The questionnaires involved in the present study were originally from the works of early researchers, in which the reliability analysis of questionnaires is as follows: (1) writing boredom (seven items, Cronbach's alpha = 0.83); (2) writing enjoyment (six items, Cronbach's alpha = 0.83); (5) writing anxiety (six items, Cronbach's alpha = 0.842).

The CFA has been conducted to measure the validity of the questionnaire, demonstrating that the fitness indexes all learning emotions involved in the present study, with the results indicated in Table 2. It is indicated, by the reliability and validity analysis, that the questionnaire involved in the present study can be accepted.

3.2.2 Writing materials of different task complexity

The experimental materials of this study are two writing tasks of high and low complexity, which are adapted from the writing tasks of different complexity in the experiments of and Kuiken and Vedder (2007) and Frear and Bitchener (2015). The materials are adapted to the Chinese cultural background, which was that an English native speaker plans to travel to China, which is presented in Appendix B. The participants are asked to help foreign tourists make a detailed travel plan (mainly including food, accommodation, and choice of tourist attractions) through emails.

Task 1 (simple task): Participants are required to write a letter to a foreign friend, which mainly introduces the tourist attractions and delicious food in China, and complete an exposition (no limit on words and time).

Task 2 (complex task): The researcher provides two restaurants and four hotels, as well as the preference information of accommodation and tourist attractions of foreign tourists, and asks the participants to choose the best tourist attraction for the tourist and choose a restaurant and hotel for the tourist as well. Since the restaurants and hotels provided could not meet the requirements completely, the participants are required to choose the restaurant and hotel which are most suitable for tourists through analysis and reasoning from the information provided by the alternative restaurants and hotels and then to complete an exposition explaining the reasons for the choice (no word limit). The completion time is 40 min.

In this study, the resource-directing dimensions (whether the processing of spatio-temporal concepts is involved, whether inference elements are involved, whether multiple task elements are involved) and the resource depletion dimensions (whether there is limited time, whether schemata knowledge is involved, and whether it is a single task) for different writing tasks have been analyzed. Based on the cognitive hypothesis proposed by Robinson (2001, 2011), we distinguished the task complexity from the above two writing tasks, with the details demonstrated in Table 3.

Task 2, in terms of resource distribution dimension, was presented with multiple elements and compound tasks (see Appendix B) and needed to be reasoned within a limited time. Accordingly, task 2 is classified as a high writing complexity task, while task 1 is a low writing complexity task in the current study.

3.3 Procedure

The investigation and the different writing tasks were administered in three classes during class time. The specific process of research was presented in the following details.

To begin with, the investigation of writing anxiety, writing enjoyment, and writing boredom is administered to the students of three classes ($N = 177$) in the first week of the Autumn semester of 2023, with the aim of finding out six different subgroups as Between-subject factors and exploring the general state of writing anxiety, writing enjoyment, and writing boredom among the three class students. Then, the administration of the writing task 1 was given to the students of three classes in the second week of this semester to obtain the data of the indicators of language complexity, language fluency and language accuracy, followed by the administration of questionnaires of writing anxiety, writing enjoyment, and writing boredom with the same items as those at the beginning of this semester. Finally, after 1 week, writing task 2 was administered to the students of three classes again to extract the quantitative data of the indicators of language complexity, language fluency, and language accuracy, followed by the same questionnaires to obtain the data of six subgroups.

Prior to the investigation, we contacted the instructors of the three class students and also got their permission to collect data in the above classes. Participation was voluntary, and anonymity was guaranteed for all the participants. Data were matched with the help of a code system in SPSS 23.

3.4 Data analysis

The present study, based on fluency, accuracy, and complexity of writing performance (Ellis and Barkhuizen, 2005), collects the indexes of language performance. Specific language performance indicators are shown in Table 4. The accuracy measurement indicator is an error-free t-unit rate (EFT/T) (Ellis and Yuan, 2004); the complexity measures include sentence complexity and lexical complexity. Sentence complexity adopts the number of T-unit clauses (C/T), the number of subordinate conjunctions used (SC/T), and the average length of t-unit sentences (MLT). Lexical complexity adopts lexical diversity (TTR) (Johnson, 2017). Fluency is measured by the number of words produced per minute (W/M) (Cumming et al., 2005). The

TABLE 2 The model fit statistics for confirmatory factor analysis for WE, WA, and WB.

Index	CMIN/DF	*p*	GFI	AGFI	CFI	RMR	RMSEA
Reference	≦5	>0.05	≧0.90	≧0.90	≧0.90	≦0.10	≦0.08
Writing enjoyment	3.78	0	0.923	0.9	0.933	0.087	0.075
Writing anxiety	2.27	0	0.913	0.917	0.902	0.029	0.064
Writing boredom	3.69	0	0.923	0.916	0.939	0.087	0.075

TABLE 3 Classification of task complexity.

Writing task	Resource-directing dimensions			Resource depletion dimensions			Task complexity
	Past Event	Reasoning	Multiple Ingredients	Planned Time	Compound Task	Schemata Knowledge	
Task 1	–	–	–	–	–	–	Low
Task 2	–	+	+	+	+	–	High

TABLE 4 Language performance measurement indicators.

Language performance	Indicators
Fluency	W/M
Accuracy	EFT/T
Sentence complexity	MLT
	C/T
	SC/T
Lexical complexity	TTR

following indicators in Table 3 are assumed to be dependent variables in the present study, the six subgroups being between-subject factors and two tasks within-subject factors.

The language complexity and fluency indexes can be measured automatically by the online sentence analysis software Coh-Metrix 3.0 (see Ye, 2013). The language accuracy index in the present study is calculated by two raters who have been teaching English for 15 years. To begin with, two raters analyzed 20 essays to collect the grammatical errors in terms of syntactic errors, morphological errors, and lexical errors (see Plakans et al., 2019). It has been found that the inter-coder and inter-rater reliability for language accuracy in terms of grammatical errors is significantly correlated (syntactic errors = 0.832; morphological errors = 0.89; lexical errors = 0.901; error-free t-unit rate = 0.82). Then, the 354 essays were distributed so that each rater got 177 essays for errors. Error-free t-unit rate (EFT/T) was, by extension, computed.

All the data analysis was conducted using SPSS 23.0 and AMOS 7.0, and the specific data analysis procedure is presented as follows. First, all the data will be submitted to SPSS 23.0 to process the missing values of the data, and meanwhile, the reliability analysis of writing anxiety, writing boredom, and writing enjoyment is demonstrated using Cronbach's alpha ($N = 177$). Then, the processed data by SPSS is imported into AMOS 7.0 to conduct the CFA of questionnaires (see Moustaki et al., 2004), with the common model fit indexes that AMOS provided in the current study presented in the Instruments section.

After the reliability and validity analysis of questionnaires, SPSS 23.0 is used to process the quantitative data of three-time questionnaires and the indicators of language complexity, language fluency, and language accuracy in different writing tasks. Following descriptive statistical analysis, repeated measures tests, and 2×6 two-factor analysis of variance are employed to shed light on the changes in writing anxiety, writing boredom, and writing enjoyment after administering the two different writing tasks, and the learning emotions and task complexity interaction on the indicators of language complexity, language fluency, and language accuracy involved in the present study.

4 Results

4.1 Main analyses

4.1.1 Research question 1. Task complexity and foreign language writing emotions

This study examines the impact of different tasks on learning emotions, such as writing anxiety, writing enjoyment, and writing boredom among English major students based on the Chinese foreign language writing context. Table 5 shows that writing anxiety was significantly varied by the task complexity. To be specific, the study indicated that, by repeated contrast tests, the writing anxiety scores were significantly lower at the end of simple writing task administering than at the beginning [F (2, 352) = 13.943, $p < 0.01$]. However, the writing anxiety scores were even significantly higher at the end of difficult writing task administering than simple writing task administering [F (2, 352) = 20.670, $p < 0.01$]. Additionally, we also found that the writing boredom scores were significantly lower at the end of difficult writing task administering than at the beginning [F (2, 352) = 4.02, $p < 0.05$].

The above-mentioned study suggested that negative learning emotions like writing anxiety and writing boredom were susceptible to change with the writing task complexity, while writing enjoyment may not change with the writing task complexity. In the present study, a simple writing task could alleviate the writing anxiety of English major students in China, while a difficult writing task could result in English major students' higher writing anxiety. Unexpectedly, the difficult writing task could cause lower writing boredom in English major students in China, and there was not a significant difference in writing enjoyment scores at the beginning, at the end of the simple writing task, and at the end of the difficult writing task.

4.1.2 Research question 2. Task complexity, foreign language writing emotions, and the dimensions of EFL writing performance

This study measured several indicators of fluency, accuracy and complexity of EFL writing performance. A 2×6 mixed design was conducted with the dimensions of language fluency, language accuracy, and language complexity as the dependent variables and task complexity (simple and difficult writing tasks) as within-subject factors and the six subgroups of learning emotions (writing anxiety, writing enjoyment, and writing boredom) as between-subject factors. The descriptive statistics and two-factor analysis of variance are shown in Figures 2–4, with the specific data indicated in Appendices I–III.

4.1.2.1 Fluency indicator

Fluency, in the current study, was measured by W/M. In Figures 2, 4, the results indicated a significant interaction effect between writing

TABLE 5 The effect of task complexity on learning emotions.

	Pretest		Posttest 1		Posttest 2		*F* (2, 352)	Repeated contrasts
	M	SD	M	SD	M	SD		
WA	3.09	0.82	2.81	0.55	3.16	0.82	13.943**	Pretest > posttest 1
	3.09	0.82	2.81	0.55	3.16	0.82	20.670**	Pretest 2 > posttest 1
WE	3.63	0.58	3.61	0.55	3.56	0.75	1.09	Pretest > posttest 1
	3.63	0.58	3.61	0.55	3.56	0.75	1.22	Pretest 2 < posttest 1
WB	2.48	0.65	2.55	0.52	2.46	0.66	2.07	Pretest < posttest 1
	2.48	0.65	2.55	0.52	2.46	0.66	4.02*	Pretest > posttest 2

WA, writing anxiety; WE, writing enjoyment; WB, writing boredom.

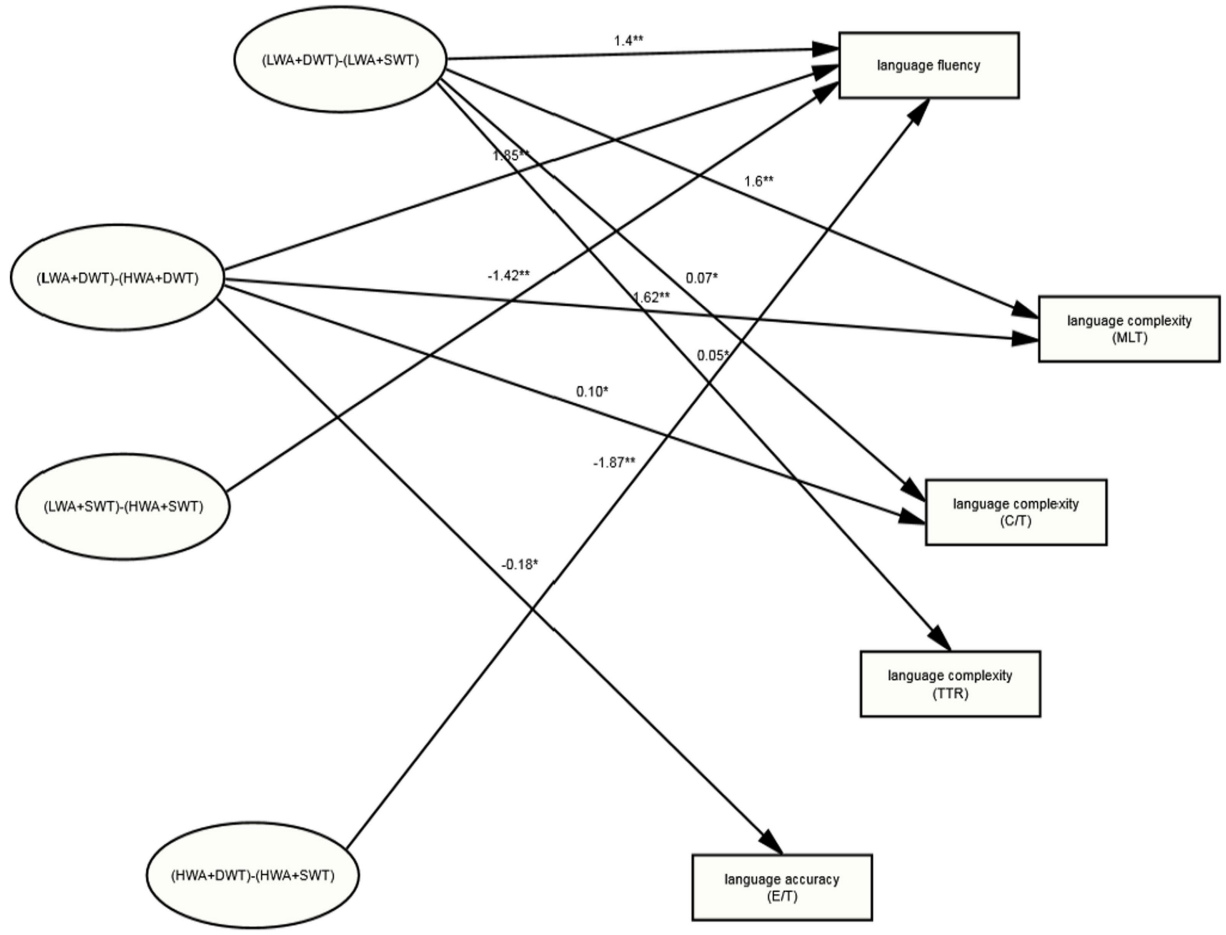


FIGURE 2
The significant difference of high or low writing anxiety groups in different writing tasks at language fluency, complexity, and accuracy. LWA + DWT = low writing anxiety + difficult writing task; LWA + SWT = low writing anxiety + simple writing task; HWA + DWT = high writing anxiety + difficult writing task; HWA + SWT = high writing anxiety + simple writing task.

anxiety, writing enjoyment, and writing task complexity, respectively. However, we have not found significant writing boredom and task complexity interaction for the fluency indicator.

Specifically, for the writing anxiety and task complexity interaction in fluency indicator [F (3, 52) = 11.492, $p < 0.01$], it is indicated, in Figure 2, that English major students in China with low levels of writing anxiety can result in more fluency of language in difficult writing task than those with low level of writing anxiety in simple writing task (MD = 1.4, $p < 0.05$); however, the students with a high level of writing anxiety can produce less fluency in difficult writing task than those in simple writing task (MD = 1.87, $p < 0.05$). In addition, we have also found that students with a low level of writing anxiety in the difficult writing task can have more fluency than those with a high level of writing anxiety in the difficult writing

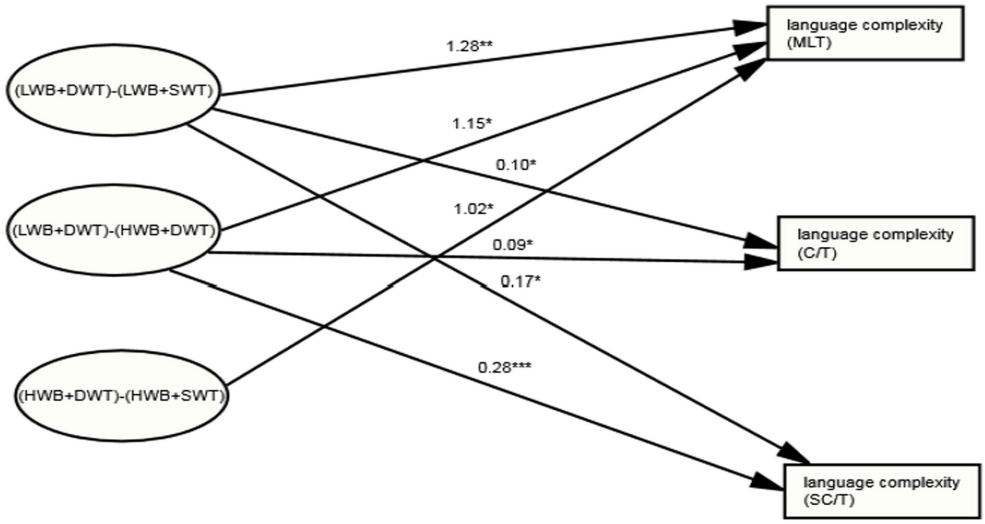


FIGURE 3
The significant difference of high or low writing boredom groups in different writing tasks at language complexity. LWB + DWT = low writing boredom + difficult writing task; LWB + SWT = low writing boredom + simple writing task; HWB + DWT = high writing boredom + difficult writing task; HWB + SWT = high writing boredom + simple writing task.

task (MD = 1.85, $p < 0.05$), while the students with low writing anxiety can produce less fluency in simple writing task than those with high writing anxiety in simple writing task (MD = 1.42, $p < 0.05$).

As for the significant writing enjoyment and task complexity interaction for language fluency [F (3, 52) = 22.303, $p < 0.01$], it is demonstrated, in Figure 4, for those students with a low level of writing enjoyment, that there was no significant difference in language fluency production between difficult writing task and simple writing task (MD = 0.03, $p > 0.05$), while for those with high-level writing enjoyment, there was a significant difference in language fluency production between difficult writing task and simple writing task (MD = 1.67, $p < 0.05$), suggesting that students with high-level writing enjoyment can produce more language fluency in difficult writing task. For those students in the difficult writing task, there was a significant difference between high writing enjoyment and low writing enjoyment (MD = 2.07, $p < 0.05$), while for those in simple writing task, there was no significant difference between high writing enjoyment and low writing enjoyment (MD = 0.37, $p > 0.05$), indicating that those students with high-level writing enjoyment can produce more language fluency in difficult writing task.

4.1.2.2 Accuracy indicator

T-unit grammar error rate index (E/T) was used to measure the language accuracy in the current study. It is indicated, in Figures 2, 4, that there was significant writing anxiety and task complexity interaction [F (3, 52) = 4.534, $p < 0.05$], writing enjoyment and task complexity interaction [F (3, 52) = 31.935, $p < 0.05$] in language accuracy.

Figure 2 demonstrated the details that, for those students in difficult writing tasks, there was a significant difference between high-level writing anxiety and low writing anxiety in language accuracy (MD = 0.18, $p < 0.05$), while for those students in the simple writing task, there was no significant difference between high writing anxiety and low writing anxiety (MD = 0.04, $p > 0.05$), suggesting that those students with high writing anxiety are likely to company with less language accuracy production. For the students with high writing anxiety or low writing anxiety, there was no significant difference between difficult writing tasks and simple writing tasks in language accuracy production.

Additionally, Figure 4 indicated for those students with low-level writing enjoyment, that there was a significant difference between difficult writing task and simple writing tasks in language accuracy production (MD = 0.15, $p < 0.05$), while for those with high-level writing enjoyment, that there was no significant difference between difficult writing task and simple writing task in language accuracy production (MD = 0.04, $p > 0.05$), suggesting that those students with low-level writing enjoyment may have more language accuracy production in simple writing task. For those students in difficult writing tasks or simple writing tasks, there was a significant difference between high writing enjoyment and low writing enjoyment in language accuracy production, indicating that those students with high writing enjoyment can produce more language accuracy in either difficult writing tasks or simple writing tasks.

Unexpectedly, we have not found significant writing boredom and task complexity interaction in language accuracy production [F (3, 52) = 1.077, $p > 0.05$], with the data indicated in Figure 3.

4.1.2.3 Complexity indicators

The dimensions of language complexity consisted of MLT, C/T, and SC/T in the present study, and the following presented the details about how task complexity and learning emotions explained the variance of the dimensions of language complexity. Figures 2–4 demonstrated the interaction of writing anxiety and task complexity, writing boredom and task complexity, and writing enjoyment and task complexity in language complexity indicators, respectively. The following contents will indicate the details of the different writing emotions and complexity interaction in specific complexity indicators.

As for the writing anxiety and task complexity interaction in language complexity, the results, shown in Figure 2, indicated that there was significant writing anxiety and task complexity interaction in language complexity production [F (3, 52) = 12.335, $p < 0.05$]. For further comparison among the subgroups of writing anxiety and task complexity, the students with low writing anxiety can produce more

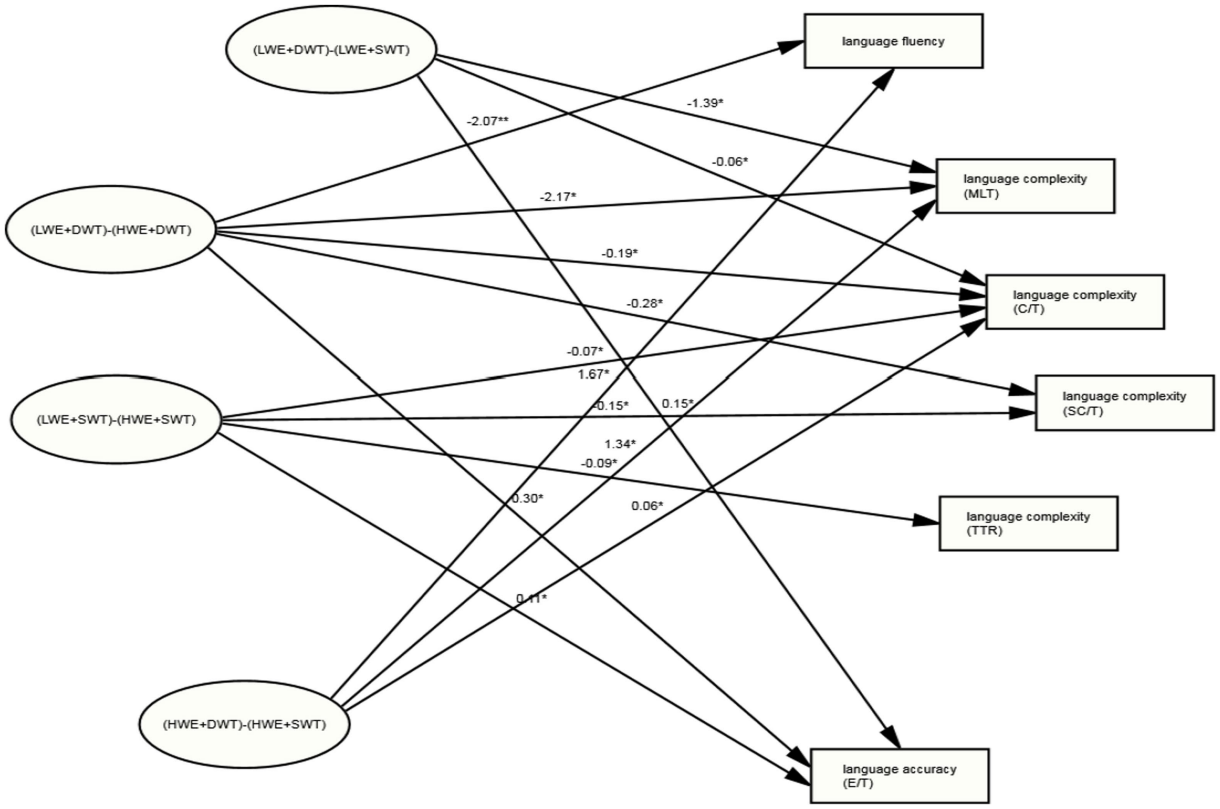


FIGURE 4
The significant difference of high or low writing enjoyment groups in different writing tasks at language fluency, complexity, and accuracy. LWE + DWT = low writing enjoyment + difficult writing task; LWE + SWT = low writing enjoyment + simple writing task; HWE + DWT = high writing enjoyment + difficult writing task; HWE + SWT = high writing enjoyment + simple writing task.

MLT in difficult writing tasks than in simple writing tasks (MD = 1.6, $p < 0.05$), while those with high writing anxiety have no significant difference in MLT between difficult writing task and simple writing task. For the students in difficult writing tasks, the students with low writing anxiety can produce more MLT than those with high writing anxiety (MD = 1.62, $p < 0.05$). It is the same case with another language complexity indicator, C/T production, while we have not found any significant difference in SC/T production among the subgroups of writing anxiety and task complexity [F (3, 52) = 1.492, $p > 0.05$]. In addition, the students with low anxiety can have more lexical complexity in difficult writing tasks than in simple writing tasks.

Regarding the writing boredom and task complexity interaction in language complexity indicators in the present study, Figure 3 demonstrated that, for those students with low writing boredom, the students in difficult writing tasks can produce more MLT, C/T, and SC/T than in simple writing task, and for those students with high writing boredom, the students in difficult writing task can produce more MLT than in simple writing task, however, produce no significant difference of other complexity indicators. For those students in the difficult writing task, the students with low writing boredom resulted in more MLT, C/T, and SC/T than those with high writing boredom, while for those students in the simple writing task, there was no significant difference in the production of MLT, C/T, and SC/T between students with high writing boredom and those with low writing boredom.

In terms of the writing enjoyment and task complexity interaction in language complexity indicators in the current study, the results, demonstrated in Figure 4, indicated that there was significant writing enjoyment and task complexity interaction in MLT [F (3, 52) = 7.317, $p < 0.05$], C/T [F (3, 52) = 34.638, $p < 0.05$], SC/T [F (3, 52) = 14.535, $p < 0.05$], and TTR [F (3, 52) = 12.306, $p < 0.05$].

For further comparison among the subgroups of writing enjoyment and task complexity, the students with low writing enjoyment can produce more MLT and C/T in simple writing tasks than in difficult writing tasks, and those with high writing enjoyment can significantly produce more MLT and C/T in difficult writing task than in simple writing task. For those students in difficult writing tasks, the students with high writing enjoyment result in more MLT, C/T, and SC/T than those with low writing enjoyment, and for those students in simple writing tasks, the students with high writing enjoyment still significantly produce more C/T, SC/T, and even TTR. The findings of writing enjoyment and task complexity interaction demonstrated the essential roles played in the language complexity of EFL writing performance.

5 Discussion

5.1 Task complexity and foreign language writing emotions

In line with the previous studies on the effect of task complexity on learners' perception of task difficulty, the first research question explores the effects of task complexity on learning emotions. The

findings indicated, in Table 5, that the cognitively defined difficult writing task involved in the present study can lead to greater writing anxiety, while simple writing tasks can lessen writing anxiety, suggesting that English major students in China may demonstrate greater writing anxiety with more difficult writing tasks. The result of the present study corresponds with the study conducted by Robinson (2001), who concluded that the difficult task could result in higher stress significantly, causing, by extension, anxiety in L2 writing. Additionally, L2 writing itself is a very complicated cognitive process; learners often have a certain degree of writing anxiety, including fear and aversion, as well as anxiety behavior out of cognitive thinking obstruction (Jalili and Shahrokhi, 2017), thus, that is understandable, given that the simple writing task needs few resource depletion for learners to finish the writing task easily, difficult writing task would no doubt bring the learners some stress out of more cognitive load in achieving the task, and this stress, by extension, would result in writing anxiety. Meanwhile, in the present study, we unexpectedly found that English major students in China who were given difficult writing tasks significantly induced less writing boredom, and this result can be illustrated in the prior literature. According to the definition of foreign language boredom proposed by Li et al. (2023a), foreign language boredom, as a negative emotion with extremely low activation, arises from activities that are over-challenging or under-challenging. Without hesitation, writing boredom, as a specific negative emotion in writing, can be affected by the writing tasks. Writing tasks, whether they are over-simple or over-difficult, may induce writing boredom. Additionally, writing boredom can be affected by individuals' L2 writing competence, which is evidenced by the empirical study conducted by Li et al. (2023b). Due to the difficult writing task in the present study not over-challenging for English major students in China, the students may have less writing boredom while engaging in the appropriately difficult writing task. However, we have not found that task complexity had an impact on writing enjoyment, suggesting that the learners, as writing tasks increase in cognitive complexity, may finish the writing task without the loss of foreign language enjoyment, which is more or less consistent with the previous study by Robinson (2001), who proposed that task complexity was not related to the interest or motivation. Overall, the findings, by comparison with the research conducted by Robinson (2001) and Li et al. (2023b), presented evidence that negative emotions like writing anxiety and writing boredom are likely to arise from writing difficult tasks in EFL writing education, the extent to which it can extend the scope of the research about the mechanism of how the different writing task complexity affects the learning emotions.

5.2 Task complexity, foreign language writing emotions, and the dimensions of EFL writing performance

This present study examines the effects of task complexity and foreign language writing emotions' interaction on the dimensions of EFL writing performance. In order to examine the task complexity and writing emotions interaction on the dimensions of EFL writing performance, we have divided the learning emotions of writing anxiety, writing enjoyment and writing boredom into six subgroups as between-subject factors and task complexity as within-subject variables. Then, A 2 × 6 between-in-subject ANOVA analysis, shown in Figures 2–4, found significant task complexity and learning emotions interactions on the dimensions of language fluency, language accuracy, and language complexity, respectively.

For task complexity and writing anxiety interaction on the dimensions of language fluency, language complexity, and language accuracy, we have found that English major students in China with low writing anxiety can lead more production of language fluency, language complexity, and language accuracy than any other subgroups in the current study, and these findings once further confirmed the essential effects of writing anxiety and task difficulty on EFL writing achievement, which has also been evidenced by the prior studies, for example, for the effect of task complexity on language achievement (see Kuiken and Vedder, 2008; Ong and Zhang, 2010), and for the effect of writing anxiety on language achievement (see Cheng, 2004; Rahimi and Zhang, 2019; Tahmouresi and Papi, 2021; Li et al. 2023b). However, compared with the previous studies, we looked at an investigation of writing anxiety and task complexity interaction and found there was significant writing anxiety and task complexity interaction for language fluency, language complexity, and language accuracy, respectively. To be specific, writing anxiety and task complexity interaction for language complexity dimensions is aligned with the work by Rahimi and Zhang (2019), who suggested that writing anxiety in highly complex writing tasks could negatively predict the effect on the production of language syntactic complexity. Additionally, the current study found high writing anxiety in difficult writing tasks could significantly lead to lower language accuracy, and this finding seemed to be inconsistent with the results obtained by Rahimi and Zhang (2019). The inconsistent results are due to the lack of consideration about the possible effect of different writing anxiety levels combined with different writing complexity tasks on language performance in their study. The components of writing anxiety and writing task complexity were used by Rahimi and Zhang (2019), while our study considered the effect of different writing anxiety levels (high writing anxiety and low writing anxiety) on language performance, which can also be evidenced negative effect of writing anxiety on language achievement in the previous study (Zabihi et al., 2020). Regarding the writing anxiety and task complexity interaction for language fluency, we also found writing task complexity could predict language fluency when the students have the same writing anxiety level. For example, students with low levels of writing anxiety can produce more fluency of language in difficult writing tasks than those in simple writing tasks; however, students with high levels of writing anxiety can perform less fluency in difficult writing tasks than those in simple writing tasks. The findings that the predictive effect of difficult writing tasks and simple writing tasks on language fluency was presented to be significantly different in terms of different writing anxiety levels support the work by Johnson (2017). Based on the previous studies (see Ellis and Yuan, 2004; Ishikawa, 2007; Johnson, 2017), increasing the resource-directing dimensions or decreasing the resource depletion dimensions in writing tasks has been confirmed to lead to more language fluency production, which can be explained the different predictive effect of writing tasks on language fluency in the present study. For instance, students with highly difficult writing tasks, due to the multiple elements, sufficient

time available or low anxiety level, achieve higher language fluency. Thus, this finding does not only further complement the effect of task complexity or writing anxiety on language achievement but also verifies the interaction effect of writing anxiety and task complexity on writing performance.

Regarding the writing boredom and task complexity interaction for EFL writing performance, we only found significant writing boredom levels and task complexity interaction for some dimensions of language complexity, such as MLT, C/T, and SC/T, presented in Figure 3, indicating that those students majoring in English in China with low writing boredom are likely to produce more language complexity dimension scales in the difficult writing task, except for TTR of lexical complexity. This finding is in line with the results obtained by Li et al. (2023a), which gained insights into the significant negative relationship between writing boredom and writing achievement and showed the predictive power of writing boredom on writing achievement. Compared with the study by Li et al. (2023a), we investigated the different writing boredom levels and task complexity interaction for language fluency, language complexity, and language accuracy, presenting that different writing boredom levels combined with different writing complexity led to a significant difference in language complexity, despite no significant effect on language fluency and language accuracy. This finding further extends the EFL writing literature by integrating task complexity.

As for writing enjoyment and task complexity interaction for language fluency, language complexity, and language accuracy, there are significantly different writing enjoyment levels and task complexity interaction for language fluency, language complexity, and language accuracy, respectively, with the data shown in Figure 4, suggesting that those students majoring in English in China with high writing enjoyment are likely to produce more language fluency, language complexity, and language accuracy, not least in difficult writing task. What needs to be noted is that there is a significant difference in writing boredom between high writing enjoyment and low writing enjoyment groups; that is, the positive effect of high writing enjoyment on language fluency, language complexity, and language accuracy is likely to be affected by low writing boredom. However, according to the work by Li (2022), foreign language enjoyment is presented to be significantly and negatively related to foreign language boredom. Thus, high writing enjoyment may accompany low writing boredom, and meanwhile, low writing enjoyment may go with high writing boredom. Regarding the positive effect of high foreign language enjoyment and low foreign language boredom on language learning, the findings in the current study can still explain the effect of writing enjoyment on language fluency, accuracy, and complexity.

As for the predictive effect of high writing enjoyment together with high-difficulty writing tasks on language complexity and accuracy, the finding can be illustrated by preceding studies (Robinson, 2001, 2011; Johnson, 2017), who unanimously shed light on the positive effect of task complexity increased by resource-directing dimensions on syntactic or lexical complexity and accuracy. However, the writing enjoyment and writing task complexity interaction for language fluency counters with the work by Robinson (2001, 2011), who claimed that increasing task complexity would direct the L2 learners to engross in the linguistic form such as syntactic or lexical complexity, language accuracy. Thus, writing task complexity increased by recourse directing dimensions seems to play no role in language fluency. However, the effect of the writing task and writing enjoyment interaction on language fluency can highlight the salience of writing enjoyment on language fluency in L2 writing. There are a few studies examining the relationship between foreign language enjoyment and language fluency (Bielak, 2021), reporting that high enjoyment could even contribute to processing the writing materials, and then producing the language fluency.

We have also found the students in the high writing enjoyment and difficult writing task subgroup present even more language fluency, language complexity, and language accuracy than any other subgroups in the current study, indicating greater predictive power of writing enjoyment on EFL writing achievement than anxiety and boredom, and this finding has been confirmed by Dewaele and Alfawzan (2018), Tahmouresi and Papi (2021) and Li et al. (2023b). Compared to the prior studies, the present study examined the interaction effect of task complexity and different writing enjoyment levels on language fluency, complexity and accuracy of EFL writing, so we have found how different writing enjoyment levels with different task complexity presented significant differences in language fluency, complexity, and accuracy. Additionally, objective linguistic measures such as the dimensions of language fluency, complexity, and accuracy are used in the present study, so that we can further gain insights into such possible mediated variables as language fluency, complexity, and accuracy between writing enjoyment interacted with different writing task and writing achievement.

Above all, the research findings demonstrated the predictive power of positive and negative emotions like writing enjoyment, anxiety, and boredom on writing achievement in specific writing task complexity. Not least, the findings can still be theoretically illustrated by the control-value theory of educational psychology (Pekrun, 2006). Based on the control-value theory of educational psychology, writing enjoyment can be assumed as a positive high-arousal emotion, accompanied by boosted engagement and more access to cognitive resources. When it is combined with difficult writing tasks, learners with high writing enjoyment can access cognitive resources from difficult writing tasks to contribute to linguistic development, such as language fluency, complexity, and accuracy. While writing, boredom and anxiety can result in disengagement and less access to cognitive resources (Li et al., 2023a). When they are combined with difficult writing tasks, the learners with high writing anxiety or writing boredom, due to less access to cognitive resources from difficult writing tasks, present less language fluency, complexity, and accuracy.

6 Conclusion

This study examined the relationship between task complexity and foreign language writing emotions, and it explained the effect of task complexity and emotional interaction on the dimensions of language fluency, complexity, and accuracy in writing performance in the Chinese educational context. Results showed the task complexity was related to certain foreign language writing emotions, not least difficult writing tasks could result in the appearance of writing anxiety and writing boredom; however, it had no impact on the foreign language writing enjoyment involved in the present study. That is, more difficult writing tasks would accompany higher writing anxiety and writing boredom. Additionally, results also showed that task complexity and writing emotions interaction could significantly explain the variance of the dimensions of language accuracy, complexity, and accuracy.

This is a quantitative study, with English major students in China as the participants. The present findings, due to female students far outnumbering male students, maybe susceptible to be affected by the imbalance of gender. For example, male students may produce different language complexity, accuracy, and fluency compared to female students even if they lie in the same level of foreign language emotions. Given this, the research results also need to be supported by more subsequent quantitative and qualitative studies. For example, recruiting more male students as participants should be conducted to compare the difference between foreign language writing emotions and the possible effect of emotions on language complexity, accuracy, and fluency. However, the implications of this study lie in the following aspects. First, the introduction of objective linguistic measures into the research field of emotions consequently extends the research perspective of emotions; for example, both negative and positive emotions can be used to explain the development of language fluency, complexity, and accuracy. Second, the research on the interaction between different writing task complexity and different levels of specific emotions in EFL writing can provide an in-depth understanding of the individual factors such as writing anxiety, boredom, and enjoyment in the cognitive process of EFL writing, which, for teachers with task-based instruction, contributes to focusing on the roles of different levels of writing emotions played in different writing task complexity, for instance, creating the enjoyable EFL writing environment in difficult writing task or appropriately increase writing anxiety in simple writing task to result in high-qualified language production. Meanwhile, further research needs to examine the features of specific levels of writing emotions in different writing tasks to gain insights into which factors implied in the specific level of writing emotions may affect the language production in different writing tasks. Additionally, we call for more indexes of language fluency, complexity, and accuracy to justify the effect of learning emotions on learning achievement.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

LW: Conceptualization, Formal analysis, Software, Writing – original draft. HH: Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1323843/full#supplementary-material

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