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The Role of Working Memory, Emotional Intelligence, and Task Type in L2 Writing

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Abstract: This study aimed to investigate to what extent working memory capacity (WMC) and emotional intelligence (EI) contribute to second language (L2) writing as assessed through measures of syntactic and lexical complexity and linguistic accuracy. Seventy-seven adult learners of Spanish took part in the study and performed two writing tasks, one about an emotional topic and the other one about a non-emotional topic. They also completed a self-reported measure of EI, the Trait Meta-Mood Scale, and three memory tasks, the Math Span Test, the Corsi Block-Tapping Task, and the Stroop Task. The results showed a negative correlation between emotional repair and visuospatial short-term memory capacity. Attention to emotions positively contributed to linguistic accuracy in both tasks, whereas linguistic distance between the first language of the participants and their L2 appeared to play a role in linguistic accuracy but only in the emotional task. Moreover, in the emotional task, WMC and emotional repair had a cumulative but opposing contribution — positive and negative, respectively — to the subordination density. Also, the hypothesis that the writing topic would have some influence on the lexico-morphosyntactic aspects of L2 writing was partly confirmed.
Keywords: working memory capacity; attention to emotions; emotional clarity; emotional repair; linguistic distance.

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1. Introduction

The acquisition of a second language (L2) requires learners to rely on their ability to categorise, create, store, and retrieve knowledge, either new or already learned. This ability of the human brain is what we call memory and goes hand in hand with learning: there can be no learning without memory nor memory without learning (Morgado, 2014; see also Menzel, 2008). Learning also involves the emotional dimension of the brain; in fact, cognition and emotion are crucial to understanding what goes into teaching and learning and what teaching and learning require in order to be done at all (Mora, 2014; Tyng et al., 2017). According to Damasio (2001), "An emotion ... is a patterned collection of chemical and neural responses that is produced by the brain when it detects the presence of an emotionally competent stimulus—an object or situation, for example" (p. 781). The regions of the brain that detect and process emotional stimuli are closely connected to the areas where memory stores are mapped (Damasio, 2006; Phelps, 2006). This implies a *tripartite process* involving emotion, memory, and learning, each of which nourishes the others.

Despite this apparent link between emotion, cognition, and learning, surprisingly empirical evidence on the effect of both emotional and cognitive variables on L2 writing is still rather scant. L2 writing has long been studied from purely cognitivist perspectives and only recently from approaches that pay attention to affective variables while still neglecting their link to cognitive abilities. The results of the few studies conducted to date that aimed to investigate L2 writing using a more integrated approach do not always converge, and more research is needed to disentangle the interface between cognition and emotion and their impact on L2 writing.

The current study aimed to investigate the extent to which working memory capacity (WMC) and emotional intelligence (EI) contribute to L2 writing as assessed via measures of syntactic and lexical complexity and linguistic accuracy. Given that the choice of psychological assessment scales can lead to noticeable variations in the results obtained, the present study employed two working memory (WM) tasks (the Math Span Task and the Stroop Test) and a self-report scale of EI (the Treat Meta-Mood Scale), which had hardly been used in previous work on the same or similar topics, with the ultimate goal being to determine the replicability of the (few) previous findings (e.g. Mavrou, 2020, 2021). In addition, two writing tasks were used, one prompting students to write about an emotional topic and the other concerning a non-emotional topic. The rationale behind this decision was that these tasks could trigger personal experiences, which are likely to be more emotionally charged than the external visual or audio-visual stimuli used to elicit writing in some previous studies (see, for example, Mavrou, 2020). Writing about personal experiences could, in turn, contribute to variability in certain linguistic dimensions of L2 writing (see D'Mello & Mills, 2014), but it remains unclear whether this variability could be affected by individual differences in WMC and EI. Additionally, L2 learners tend to rely on and transfer their first language (L1) linguistic patterns when composing texts in an L2 (Carson et al., 1990; Cumming, 1989, among many others). Therefore, another novelty of the present study is that it used the normalised and divided Levenshtein distance, a measure that quantifies the linguistic distance between the L1 and the target language. Although widely used in other fields, to our knowledge, this measure has not been used systematically in Second Language Acquisition studies (but see Mavrou et al., 2023; Mavrou & Chao, 2023) despite the prolific evidence of the role of L1 in most — if not all — aspects of L2 learning and acquisition, including L2 writing.

2. Working Memory and Emotions

WM comprises a set of neural mechanisms which are responsible for maintaining and processing a limited amount of information during a short time while individuals perform a specific or several other tasks (Baddeley, 2007). Individuals rely on their WMC to engage in a proactive conversation and understand and write texts either in their L1 or in their L2 (Baddeley, 2003). According to Kane et al. (2007), WM holds "the synergy of 'attentional' and 'memorial' processes in maintaining and recovering access to information that is relevant to ongoing tasks and in blocking access to task-irrelevant information" (p. 23). This synergy generates a temporal link between these ongoing tasks (Morgado, 2014), which leads to mental coherence that would not be possible without the intervention of WM and attention (Damasio, 2006).

Although cognitive processes that are carried out automatically would involve little or no WM resources, this mechanism comes into play when the requirements of a task are incompatible with automatic processes. Thus, WM would be needed in order to control and maintain the focus of attention while performing novel tasks and to inhibit distraction generated by automatic processes or other external and internal interferences (Unsworth & Engle, 2007). Individual differences in WMC are also manifested in tasks requiring searching and retrieving relevant information from long-term memory (Unsworth et al., 2011). This WM function is particularly important because it applies to almost all contexts of L2 comprehension and production.

Empirical evidence supports the existence of a nexus between amygdala activity during conscious reappraisal of negative scenes and brain regions linked to executive functions and WM located in the left lateral prefrontal cortex (Smith & Jonides, 1999). For instance, it has been argued that one of WM functions is the inhibition of emotional reactions activated in the amygdala by emotional scenes (Ochsner et al., 2002; Smith & Jonides, 1999). Barrett et al. (2004) also pointed out that WM has a fundamental role in creating and managing modular emotional responses, such as fear or anger. In order to understand how WM affects these emotional responses, it should first be noted that people store conceptual and categorical knowledge about emotions in their memory. This process is triggered by the evaluation that people make of external (environment, events, objects, or another person) or internal (one's own physiological or emotional states) cues. WM would be involved in the attentional control of this emotional knowledge to manage modular emotional responses strategically and consciously (Barrett et al., 2004). Following this proposal, low WMC individuals are likely to have less attentional resources to manage emotional responses, whilst those with high WMC would use this ability to inhibit modular responses and replace them with more flexible ones. However, these extra attentional resources could also be employed to keep and recycle negative information in mind (negative thoughts in a loop), leading individuals with high WMC to discard positive information that would be understood as distracting (Barrett et al., 2004).

Neuroscientific accounts further suggest not only that emotions influence memory when the emotinal load of the stimuli is high but also that the brain stores emotional information about each event that individuals face daily (Frazzetto, 2013). Damasio (2003) defends this omnipresence of emotions in multiple cognitive processes:

> As far as I can fathom, few if any perceptions of any object or event, actually present or recalled from memory, are ever neutral in emotional terms. Through either innate design or by learning, we react to most, perhaps all, objects with emotions, however weak, and subsequent feeling, however feeble. (p. 93)

Damasio's (2003) statement contributes to the new lines of research that argue that cognitive and emotional mechanisms are so interrelated in every stage of information processing that their limits are extremely diffuse (Phelps, 2006). Thus, we would expect WM to be involved in the searching and retrieving of linguistic information from long-term memory in order to narrate personal experiences but its role in L2 (writing) production might be more obvious when those experiences are emotionally charged.

3. Emotional Intelligence and Emotions

In 1990, Salovey and Mayer were the first to introduce formally the concept of emotional intelligence (EI), which they reformulated in 1997 in order to include the ability to reason about emotions and feelings:

> Emotional intelligence involves the ability to perceive accurately, appraise, and express emotion; the ability to access and/or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth. (Mayer & Salovey, 1997, p. 10)

This definition was the starting point for the development of a four-branch ability model organised according to increasing cognitive complexity (Mayer & Salovey, 1997; Salovey & Mayer, 1990).

The first component, *perception, evaluation, and expression of emotions*, implies identifying emotions in one's physiological states and thoughts and perceiving emotions in other people and objects through language (verbal and non-verbal), sound, appearance, or behaviour. It also includes the ability to express the emotions that are experienced and the needs that arise with them. *Emotional facilitation of thinking* is the second component and refers to the awareness of how an emotion facilitates or hinders specific mental or physical processes, assuming that said emotion directs attention to specific thoughts. Emotional facilitation would help individuals counteract this shift by generating emotions that promote reasoning, memory, and redirection of attention to relevant information. The third component, *understanding and analysing emotions and employing emotional knowledge*, concerns the ability to name feelings and emotions and to recognise that just as emotions vary in intensity along a continuum, the semantics and, hence, the lexicon used to refer to emotions also change. It also implies the ability to understand the relationship between specific events and the emotions they trigger and to recognise simultaneous and complex emotions, which resemble a *cocktail*, as well as emotional transitions. *Reflective regulation of emotions to promote emotional and intellectual growth* is the fourth component and encompasses more complex cognitive skills, such as the ability to be open-minded and accept the flow of emotions that everyone constantly experiences. It also includes the emotional meta-experience that is divided into meta-evaluation and meta-regulation. The former refers to the attention we use to control emotions in ourselves or others and, in this way, to be aware of how clear, appropriate, or influential moods are, whilst meta-regulation involves emotion management for boosting, mitigating, or ignoring emotional states (Mayer & Salovey, 1997).

Emotion regulation reveals the other side of the cognition-emotion binomial. According to Thompson (1994), "Emotion regulation consists of the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals" (pp. 27–28). The processing and management of emotional behaviours and the inhibition of negative emotional states are of great importance in L2 learning and, by extension, in L2 writing. The former is in charge of keeping under control those behaviours that are detrimental to L2 production or understanding. The ability to inhibit negative stimuli facilitates concentration because it can help cancel out or push aside those stimuli from the focus of attention (e.g. inhibit feelings of frustration because of the cognitive load that implies writing in an L2, thus helping students take full advantage of their linguistic repertoire). Consequently, it allows students to get rid of ruminant thoughts that could interfere with L2 task performance (Nolen-Hoeksema, 2004).

4. Working Memory, Emotional Intelligence, and Writing

In contrast to theories that focused language on form, information, or abstraction, Maynard (2002), in her theory of linguistic emotivity, stated that the most relevant linguistic functions are extrinsically linked to emotional expression and that negotiation of meaning includes not only information but also feelings. As an example of this, writing has been used in the field of psychology as a means to investigate the influence of emotions on different cognitive processes (memory or strategy use) since writing about emotionally charged memories can induce specific emotions. However, it has been shown that the induction of a particular emotion is usually followed by unwanted thoughts (Mills & D'Mello, 2014). Similarly, the writing process could decrease the cognitive load on WM, at least when the processes involved in writing have been automatised to some degree (Kellogg, 1996). In addition, the writing process could help to clarify and order the flow of thoughts, reduce stress, and contribute to both emotional regulation and expression (Rimé et al., 1998).

WM has emerged as an important factor in many L2 writing studies, suggesting that it positively relates to writing quality (Mavrou, 2018a, 2018b; Révész et al., 2017) and specific linguistic dimensions such as syntactic complexity (Bergsleithner, 2010; Mavrou, 2020), linguistic accuracy (Bergsleithner, 2010; Mavrou, 2020; Zalbidea, 2017), and fluency (Révész et al., 2017). However, this positive influence seems to be modulated by the type of tasks and their cognitive complexity (Michel et al., 2019), as well as participants' L2 proficiency level (Kormos & Sáfár, 2008; Michel et al., 2019), which may turn out to be a more decisive factor in L2 writing compared to WMC (Lu, 2010; Mavrou & Bustos-López, 2019).

With regards to EI, several cross-sectional and experimental studies found that it is positively related to L2 writing (Abdolrezapour, 2013; Genç et al., 2016; Ghasemi et al., 2013; Korpi & Farvardin, 2016; Shao et al., 2013). Ghasemi et al. (2013) concluded that the higher the EI, the higher the text quality since students show more persistence in their writing when they feel that they can manage their emotions. However, this link seems to be shaped by task type and discursive genre. Karimi (2012) used an expository task, which was objective and impersonal, and hypothesised that the text quality on this task would have a null or low relationship with EI. She also employed an argumentative — and subjective — task that required students to write about their emotions, thus involving their EI. Both hypotheses were confirmed. Karimi's (2012) study highlights that choosing tasks of specific discursive genres demands different affective-cognitive resources from the student.

Abdolrezapour (2013) found higher scores in L2 writing among the female participants of the experimental group of her study who had been previously introduced to Goleman's EI theory so that they would be aware of people's emotional traits. Shao et al. (2013) conducted an experiment almost identical to Abdolrezapour's (2013) with Chinese university students and reached similar conclusions. Shao et al. (2013) attributed writing improvement among the students of the experimental group to the continuous and intensive exposure to material and activities with emotional content and regarded their findings as evidence that EI can be modified if the student is motivated and actively involved in the writing process. On the other hand, Mavrou and Bustos-López (2019) found a negative correlation between emotional regulation and L2 writing quality and concluded that L2 learners' emotional regulation and L2 writing production might have entered a competition for cognitive resources, creating a trade-off scenario.

Regarding the relation between EI and complexity, accuracy, and fluency in L2 writing, the few studies conducted to date point to discrepancies. Whereas Korpi and Farvardin (2016) found statistically significant positive correlations between independence and syntactic complexity, problem-solving and syntactic complexity, and flexibility and fluidity, Mavrou (2020) did not find any significant correlation between trait EI and the aforementioned linguistic dimensions. As is the case in many L2 writing studies that adopt an individual differences approach, these discrepancies may be attributed to the research design (experimental versus correlational), the tools used to measure individual difference variables (e.g. the variety of self-report measures of EI based on different theoretical accounts) and task type, among others.

In L2 writing studies, task types have long been assumed to be descriptive, narrative, argumentative, or academic. However, some scholars have highlighted the need to consider the emotional nature of the writing topics and thus have used emotional tasks in order to examine how these tasks influence students' writing quality. For instance, D'Mello and Mills (2014) observed that the more involved their participants felt with the writing topic, the better the overall quality of their essays was. These participants retrieved personal experiences from long-term memory more easily and described their stories in more detail. Therefore, it seems reasonable to argue that retrieving information from long-term memory relies not only on WMC but also on some emotional dimensions. However, better performance on writing tasks does not directly depend on remembering emotional experiences but rather on the effective retrieval of linguistic resources to translate these memories into text. Clachar (1999), in turn, questioned the idea that L2 writing about an emotionally charged topic requires different writing processes. She pointed out that there is a neuropsychological basis that guides writing about topics that are emotional in nature; therefore, emotional writing does not only involve purely linguistic dimensions or memory functions but also emotional factors, all these processes being closely connected and concurrently taking place in the brain.

5. The Current Study

Writing is both a cognitive and an emotional phenomenon (Brand, 1987), hence the need to consider both elements together when investigating writing processes and performance. As cognition and emotion are broad concepts, the present study focuses on two key individual difference variables related to these concepts, namely, WMC and EI, and it examines their influence on syntactic and lexical complexity and linguistic accuracy in L2 writing. The study further seeks to explore to what extent these linguistic dimensions are influenced by the topic of writing (emotional versus non-emotional). Based on the scant empirical evidence, we hypothesised that writing about an emotional topic would trigger knowledge and personal experiences from long-term memory. This would lead to more linguistically elaborate texts, that is, texts with greater lexical variation and syntactic complexity, but perhaps at the cost of accuracy. In turn, these linguistic dimensions could benefit from a higher WMC or EI (or both). Drawing on previous findings in L2 writing research, we expected that WMC would contribute to linguistic accuracy and syntactic complexity (Bergsleithner, 2010; Mavrou, 2020; Zalbidea, 2017), while EI would account for variability in lexical variation (Barrett, 2017; Mavrou, 2021). Additionally, the study examined Spanish L2 writing by learners whose L1 were different. Therefore, we controlled L1 influence by using the normalised and divided Levenshtein distance which quantifies the linguistic distance between the L1 and the target language (Spanish in this study). This measure derives from the Automated Similarity Judgment Program (ASJP) developed by the German Max Planck Institute for Evolutionary Anthropology and consists of an algorithm that compares the phonetic similarity of a core set of 40 words (Swadesh list) referring to common things and environments from different languages (see Chiswick & Miller, 2015, and Isphording & Otten, 2013, 2014, for detailed explanations, and Mavrou & Chao, 2023, for working examples). Specifically, the study addressed the following research questions:

(1) Is there a link between three main functions of WMC, namely, simultaneous processing and storage capacity, inhibition, and visuospatial-short term memory capacity, and EI, operationalised in this study as attention to emotions, emotional clarity, emotional repair?

(2) What is the contribution of WMC and EI to linguistic complexity and accuracy in two writing tasks about different topics (emotional versus non-emotional)?

(3) To what extent does the writing topic (emotional versus non-emotional) influence linguistic complexity and accuracy?

5.1. Participants

Seventy-seven students of Spanish L2 took part in the study, 14 males and 63 females, aged between 17 and 38 years (M = 21.12, SD = 3.54), with a mean onset of Spanish acquisition of 16.36 years (SD = 4.83). Most of them were from the United States (n = 38) and Thailand (n = 21), while the remaining participants had the following nationalities: Chinese, Dutch, Japanese, Korean, Russian, Turkish, French, Filipino, and

Syrian. All of them were users of English either as L1 or L2. Twenty-three participants had an A2 level in Spanish, while 54 were at the B1 level according to the Common European Framework of Reference for Languages (Council of Europe, 2020). Their proficiency level in Spanish was established based on the scores they received in an exam they took on the first day of the course or because they had passed the previous A2 level course. The participants were studying Spanish language and culture in a summer study-abroad program in Madrid, Spain.

5.2. Tasks

5.2.1. Treat Meta-Mood Scale

EI was measured with the Treat Meta-Mood Scale (TMMS; Salovey et al., 1995), which is a self-report measure of EI. The TMMS consists of 30 statements, and participants must indicate their level of agreement using 5-point Likert scales. These statements tap into the three dimensions of emotional meta-knowledge: attention to emotions, emotional clarity, and emotional repair. The TMMS has high internal consistency (Cronbach's α of .86, .88, and .82, for the dimensions of attention, clarity, and regulation, respectively) and does not yield a final total score of the sum of its items but rather three individual scores, one for each dimension (Salovey et al., 1995). It is based on a solid theoretical framework (Salovey & Mayer, 1990), which has been validated by decades of research in diverse academic fields (Fernández-Berrocal & Extremera, 2008; see also de-Torres García et al., 2022; Domínguez-García & Fernández-Berrocal, 2018; Fernández-Berrocal et al., 2017; Gómez-Leal et al., 2018; Pérez-Fernández et al., 2021). Another advantage of the TMMS is that it focuses on core EI abilities leaving aside other independent variables such as optimism, empathy, impulsivity, or happiness which have their own separate research lines. In the present study, the TMMS was administered in English.

5.2.2. Math Span Test

The Math Span Test (MST; Shahnazari-Dorcheh & Roshan, 2012) measures the simultaneous processing and storage capacity of WM and has been used in previous studies in applied linguistics (e.g. Lin, 2009; Mizera, 2006). It consists of 60 simple mathematical equations (30 additions and 30 subtractions) distributed equally in three sets of 2, 3, 4, 5 and 6 mathematical problems. The mathematical problems have the form of X + Y = ? and X − Y = ? where X and Y are digits between 1 and 9. In addition to solving the problem verbally (processing component), participants had to retain the second digit of each mathematical equation for later recall (storage component) and had between 4 and 12 seconds to retrieve the target digits. The time was determined by the number of digits that the participants had to retrieve. In the present study correct answers were considered only those for which participants solved the mathematical operations and also recalled the corresponding target digit correctly, with 60 being the maximum score that they could obtain. For mathematical problem solving, a level of accuracy of 85% was established (Conway et al., 2005).

5.2.3. Stroop Test

The Stroop Test (Golden, 2007; Stroop, 1935) measures the ability to guide and redirect attention to a given stimulus and inhibit the interference of distractors. The version used in this study was an adaptation of the original Stroop Test (Stroop, 1935) and Golden's version (2007) provided by the Department of Psychology of the University of Granada. Three lists of 100 words in English referring to colours (brown, red, purple, blue, green) were used. The first list was printed in black and white, the second was in colour where the ink colour matched the written word, and the third list presented the words written in incongruous colours. Participants had to read each list in one minute, with 10 seconds in between. The test was administered in printed format and was assessed by assigning one point to each correct answer in the third list. The minimum score that could be obtained was zero and the maximum 100 points.

5.2.4. Corsi Block-Tapping Task

The Corsi Block-Tapping Task forward (hereinafter Corsi Task; Corsi, 1972) assesses visuospatial short-term memory capacity. A computer version available on the PsyToolKit website (Stoet, 2010, 2017) was used. Participants were presented with nine cubes arranged randomly on the screen. These cubes changed colour in less than 1 second, and participants had 10 seconds to click on the cubes that had changed colour in the same order. If the participants reproduced the sequence correctly, they could move on to the next level of the task; if they made a mistake, another sequence with the same number of blocks was generated. The test ended when participants either reached the ninth level or failed to provide the correct answer in two consequent trials with the same number of blocks. The number of correct trials defined the block span, which could range from 0 to 9 points.

5.2.5. Writing Tasks

Two writing tasks were administered, one about an emotional topic (T1) and the other about a non-emotional topic (T2). T1 intended to induce memories and thus elicit deep emotions in our participants by asking them to recall and narrate a special night in their lives. This task was based on an activity extracted from the didactic materials available on the website of the *Consejería de Educación del Ministerio de Educación, Cultura y Deporte en China y Japón*

(Chapado & López Tapia, 2012). The original version of the task is addressed to students at the B2 Spanish level. Therefore, the time allotted for completing the task and the word length were adjusted following the requirements of the writing task 2 of the Diploma of Spanish as a Foreign Language (DELE) level B1.

With regard to T2, we tried to create an emotionally neutral task and, following Karimi (2012), we chose an expository essay topic. Since participants had different proficiency levels (A2 and B1), we decided to use two different topics. Participants at the A2 level had to describe their ideal house — a task encouraging a type of narrative that was less eventful. Participants at the B1 level were asked to write about a typical day at school or high school. This topic was designed based on non-emotional topics (e.g. time spent in high school) proposed by D'Mello and Mills (2014). The rationale behind this choice was that low-intermediate level students who had already been exposed to vocabulary and grammar related to routines (time, school vocabulary, etc.) would focus on the linguistic — rather than other affective — aspects of the task. Selecting these tasks enabled a comparative and fair approach as each task aligned with participants' language proficiency. It is also worth noting that, unlike previous studies that used tasks to elicit specific emotions (D'Mello & Mills, 2014; Mills & D'Mello, 2014), the writing tasks employed in this study sought to trigger memories that varied in their degree of emotionality. For both tasks, participants were asked to produce texts of 130–150 words and had 30 minutes for the completion of each task. All texts were assessed using the measures of syntactic and lexical complexity and linguistic accuracy that are summarised in Table 1.

Table 1. *Linguistic measures used to assess L2 writing*

Linguistic dimensions	Measures
Syntactic complexity	Subordination index: Clauses/T-units Mean length of t-unit: Words/T-units Mean length of clause: Words/Clauses
Lexical variation	Lexical types/Lexical tokens
Linguistic accuracy	Lexical and morphosyntactic errors per 100 words

5.3. Procedure

All the participants completed the TMMS (n = 77), while memory tasks were carried out by 56 participants, 23 from the A2 level and 33 from the B1 level. Similarly, all the participants performed the task about the emotional topic, while the neutral task was carried out by all the participants at the A2 level (n = 23) and 35 at the B1 level. This is because some students decided to opt out from those tasks due to time limitations. Participants performed T1 first, followed by T2. Afterwards, they were given the TMMS in printed format and were asked to complete it at their best convenience, within or outside class hours, and deliver it back before the last day within a week which coincide with the last day of their course. The WM tasks were administered outside class hours, in individual sessions that lasted approximately 40 minutes. The study was conducted in accordance with the ethical guidelines of the American Psychological Association and obtained approval from the Research Ethics Committee of Nebrija University (Reference number: UNNE-2020-006).

6. Results

As L2 proficiency level plays a role in L2 writing, we first compared the scores obtained by the participants at the A2 and B1 levels on the measures of syntactic and lexical complexity and linguistic accuracy. The results showed no statistically significant differences except for syntactic complexity in T2, where students at the B1 level wrote texts with more subordination density (t = –3.105, p = .003), whilst students at the A2 level used longer t-units (t = 2.914, p = .005) and longer clauses (t = 3.652, p < .001). Therefore, proficiency level was not taken into account in subsequent analyses that included all the writing measures in the case of T1, as well as linguistic accuracy and lexical variation in T2. It should also be noted that the results of a series of independent samples t-tests did not reveal statistically significant differences between the two groups with respect to their age (t = 0.232, p = .818), nor in their scores on TMMS (Attention to emotions: t = 0.749, p = .456; Emotional clarity: t = –0.064, p = .949; Emotional repair: t = –0.893, p = .375) and on the WM tasks (Corsi task: t = –1.689, p =. 097; Stroop test: t = –0.708, p = .482; MST: t = –1.578, p = .120). Descriptive statistics are summarised in Table 2. Except for a few exceptions (mean length of t-unit and mean length of clause), skewness and kurtosis values were quite low, ensuring that the assumption of normal distribution was met.

Table 2. *Descriptive statistics for the variables of the study*

	M	SD	Skewness	Kurtosis
Attention to emotions	47.94	8.45	-0.52	1.00
Emotional clarity	34.39	3.69	-0.40	1.23
Emotional repair	22.84	4.57	-0.47	0.47
Corsi	5.68	1.08	0.42	0.48
Stroop	68.54	14.64	-0.72	0.59
MST	27.20	10.73	0.66	0.31
T1 Subordination index	1.28	.133	-0.07	-0.69

		M	SD	Skewness	Kurtosis
T1 Mean length of t-unit		8.19	1.56	1.65	7.30
T1 Mean length of clause		6.454	1.26	1.66	4.69
T1 Lexical variation		0.67	.084	-0.10	-0.59
T1 Linguistic accuracy		76.48	8.81	-0.68	0.04
T2 Subordination index	A2	1.06	0.09	1.29	1.10
	B1	1.15	0.12	1.21	1.37
	Total	1.12	0.12	1.28	1.75
T2 Mean length t-unit	A2	10.66	4.02	2.40	11.12
	B1	8.48	1.54	0.53	-0.23
	Total	9.34	2.97	3.56	19.05
T2 Mean length clause	A2	10.11	4.11	3.11	11.85
	B1	7.38	1.35	0.83	0.12
	Total	8.46	3.07	3.83	20.67
T2 Lexical variation		0.69	0.09	-0.44	-0.87
T2 Linguistic accuracy		78.65	11.29	-0.87	0.66

Pearson-product moment correlations between WMC and EI, as well as partial correlations with age as the control variable, were computed. The results revealed a statistically significant and positive correlation between emotional repair and scores on the Corsi task (r = .295, p = .027; pr = .296, p = .028). Moreover, subordination density in the emotional task correlated negatively with emotional repair (r = —.229, p = .045) and positively with MST (r = .281, p = .036); emotional repair correlated positively with mean length of clause in the same task (r = .243, p = .033), as did attention to emotions with linguistic accuracy in the non-emotional task (r = .286, p = .030). For mean length of t-unit and mean length of clause in T2 — variables that presented a deviation from normality — Spearman correlations were also conducted, revealing a statistically significant and negative correlation between mean length of clause and MST (r = —.386, p = .003). When the same analyses were computed for participants at each proficiency level, correlations turned out to be statistically significant only for those students at the B1 level. That is, mean length of t-unit and mean length of clause were negatively correlated with scores on the Stroop task (r = —.417, p = .016 and r = —.383, p = .028, respectively; n = 35).

Table 3. *Correlations between EI and WMC*

	1	2	3	4	5
1. Attention to emotions	–				
2. Emotional clarity	.202 (.010)	–			
3. Emotional repair	.064 (-.055)	.316**(.410**)	–		
4. Corsi	.076 (.042)	.001 (-.026)	.295*(.296*)	–	
5. Stroop	-.040 (-.073)	-.082 (-.104)	.189 (.189)	.162 (.154)	–
6. MST	-.072 (-.054)	-.211 (-.202)	.172 (.172)	.420**(.430**)	.374** (.381**)

Note. Partial correlations (control variable: age) are provided in brackets.
*$p \leq .05$. **$p \leq .01$.

Table 4. *Correlations between WMC, EI, and measures of linguistic complexity and accuracy*

	Attention to emotions	Emotional clarity	Emotional repair	Corsi	Stroop	MST
T1 Subordination index	-.055	-.063	-.229*	-.104	.131	.281*
T1 Mean length t-unit	.015	.050	.125	.086	.221	.133
T1 Mean length clause	.046	.089	.243*	.131	.149	-.006
T1 Lexical variation	.001	.014	-.020	-.026	-.211	-.144
T1 Linguistic accuracy	-193	-.014	-.164	.043	.135	.044
T2 Subordination index	-.141	.178	.102	.055	-.046	.229
T2 Mean length t-unit	-.119	-.036	-.043	-.174	-.005	-.114
T2 Mean length clause	-.075	-.071	-.070	-.195	-.014	-.169
T2 Lexical variation	.151	-.088	-.157	-.039	.065	.229
T2 Linguistic accuracy	.286*	-.048	-.138	-.034	.012	.086

*$p \leq .05$. **$p \leq .01$.

In order to delve into the correlational patterns described previously, we carried out a series of partial correlations between WMC, EI, and measures of linguistic complexity and accuracy. Results regarding the relation between subordination density in T1, on the one hand, and emotional repair and MST, on the other, were replicated and resulted in higher correlation coefficients (pr = –.318, p = .020, and pr = .352, p = .010, respectively). The same held for the positive correlation between linguistic accuracy in T2 and attention to emotions (pr = .299, p = .030). However, two additional statistically significant correlations emerged: a positive correlation between linguistic accuracy in T1 and attention to emotions, and a negative correlation between linguistic accuracy in T1 and emotional repair (pr = .310, p = .024, and pr = –.305, p = .026, respectively).

In addition, a series of stepwise regression models were conducted with proficiency level (when deemed relevant), linguistic distance, attention to emotions, emotional clarity, emotional repair and scores on MST as predictor variables, and measures of linguistic complexity and accuracy as the outcome variables. Scores on the Stroop and Corsi tasks were not included, as correlation coefficients with writing measures did not reach statistical significance. In what follows, we only summarise the findings that were statistically significant and report adjusted R^2 values. Emotional repair and WMC explained 16.4% of the variability in the subordination density in T1 (F(2,53) = 6.384, p = .003; β = –.345, t = –2.755, p = .008, for emotional repair; β = .340, t = –2.715, p = .009, for WMC). Attention to emotions contributed to linguistic accuracy in both T1 (F(1,54) = 5.441, p = .023; β = .303, t = –2.755, Adj. R^2 = .075) and T2 (F(1,54) = 4.571, p = .037; β = .279, t = 2.138, Adj. R^2 = .061). However, when MST scores were removed and only linguistic distance and the three EI branches were considered resulting in a greater sample size (n = 77), linguistic distance turned out to be the sole predictor variable of linguistic accuracy in T1 (F(1,75) = 5.147, p = .026; β = –.253, t = –2.269, Adj. R^2 = .052), while for linguistic accuracy in T2 the results remained almost identical.

Lastly, we also investigated whether the topic of writing influenced linguistic complexity and accuracy. Since the non-emotional task was different for students at A2 and B1 levels, comparison of means tests were conducted for each proficiency level separately (Table 5). We found that students at both proficiency levels produced more syntactically dense texts but with shorter clauses in T1. Moreover, students at the A2 level achieved a slightly higher linguistic accuracy in T2, as compared to the T1.

Table 5. *Influence of the writing topic on linguistic complexity and accuracy*

		T1 M	T2 M	t	p
Subordination index	A2	1.24	1.06	4.938	< .001
	B1	1.27	1.15	4.558	< .001
Mean length t-unit	A2	8.08	10.66	-2.884	.009
	B1	8.11	8.48	-1.057	.298
Mean length clause	A2	6.53	10.11	-3.968	.001
	B1	6.46	7.38	-2.848	.007
Lexical variation	A2	0.66	0.68	-0.167	.869
	B1	0.68	0.71	-1.655	.107
Linguistic accuracy	A2	73.65	78.43	-2.167	.041
	B1	77.64	78.79	-1.075	.290

7. Discussion

This study explored the relationship between WMC, EI, and linguistic complexity and accuracy in two writing tasks that differed in their degree of emotionality. With regard to the relation between WMC and EI, we only found a statistically significant and positive correlation between scores on the Corsi task and emotional repair; in other words, those participants with a greater visuospatial memory capacity reported a greater ability to regulate their emotions. This result is consistent with Rutherford et al.'s (2015) findings, who also found a positive correlation between performance on the Corsi task and self-assessed emotional regulation in a group of 41 women with children. The researchers argued that "enhanced visuospatial working memory may facilitate the internal representation of emotional events and experiences, making room for employing ER [emotional regulation] strategies" (p. 6). This seems to indicate that visuospatial memory is related to what precedes emotional meta-regulation, which is the emotional meta-evaluation. Emotional meta-evaluation is conceptualised as the attention directed towards managing emotions in ourselves and others and, therefore, being aware of how clear, appropriate, or influential our moods are (Mayer & Salovey, 1997, p. 14). Closely related to meta-evaluation is emotional clarity. Consistent with previous studies, our results confirm the higher correlations between emotional clarity and emotional repair than between these dimensions and attention to emotions, suggesting that people who are better able to perceive their feelings and repair their moods tend to achieve better well-being (Delhom et al., 2017; Salovey et al., 2002).

Additionally, attention to emotions positively contributed to linguistic accuracy in both tasks. To our knowledge, only two studies examined the link between EI and linguistic accuracy and found different results — a positive link in Korpi and Farvardin's (2016) study and no link in Mavrou's (2020) study. Among other factors, these discrepancies could be attributed to the self-assessment scales used to measure EI (i.e. Bar-On's Emotional Quotient Inventory and Petrides' Trait Emotional Intelligence Questionnaire-Short Form, respectively). A plausible explanation for the results obtained in our study is that when L2 students write about

emotional topics that induce certain emotions and moods, the more attention they pay to their emotions, the greater their need to express these emotions and feelings accurately.

It is also worth noting that linguistic distance seemed to play a role in linguistic accuracy but only in the task about the emotional topic. Descriptive information corroborated this finding since those participants whose L1 had a lower linguistic distance from Spanish (n = 42) achieved an average linguistic accuracy of 78.5%, while participants with an L1 that had a greater linguistic distance from Spanish (n = 34) obtained an average linguistic accuracy of 73.6%. This result fits well with evidence on the positive influence between languages, known as positive transfer (Odlin, 2003). Positive transfers from L1 enhance linguistic accuracy in a L2, and this type of transfer usually happens when the L1 and the L2 belong to the same language family or share similar features, either real or perceived (Woll, 2019). Furthermore, this linguistic proximity might play a greater role in texts that require a more explicit expression of emotions and the use of more abstract (emotion) words rather than in texts mainly based on concrete — and probably more familiar and common — vocabulary. A question that arises is whether linguistic distance could eventually be a proxy for emotional distance or discourse emotionality (an issue addressed in Mavrou et al., 2023). Future studies should try to further elucidate this issue.

Another finding of the current study is that emotional repair correlated negatively with subordination density in the task about the emotional topic. It is possible that participants who reported greater emotional repair employed more cognitive resources and time to block unpleasant thoughts and emotional disturbances (either because of the cognitive and linguistic challenges that writing in an L2 entails or because of the emotional content of their stories) and to replace them with more pleasant ones. By doing so, they probably had fewer cognitive resources to devote to the generation of more intertwined or connected ideas (i.e. subordinate clauses), leading them to produce a larger number of simple (one-clause) sentences.

Our results contradict those obtained by Korpi and Farvardin (2016), who found a positive correlation between EI and syntactic complexity. As mentioned previously, these discrepancies might be attributable to the different EI measures used, as well as the writing topic. Participants in Korpi and Farvardin's (2016) study were asked to provide their opinion about the appropriateness of exams as a way of measuring students' performance and their potential replacement by continuous assessment. Therefore, they probably interpreted the topic from a more radical or opinionated perspective, leaning towards one option rather than the other. Put differently, they might have felt the urge to express a single opinion on this issue, circumscribed to the academic sphere. In our view, emotional regulation was perhaps more straightforward, manageable, and less cognitively demanding. In contrast, the emotional topic used in our study was more open and could provoke more diverse or complex emotions in our participants, who required more cognitive resources to manage their emotions. This emotional investment perhaps entailed a more substantial trade-off between emotional repair and syntactic complexity.

However, participants with higher WMC seemed to handle the aforementioned trade-off better as they tended to produce more syntactically dense texts in the task about the emotional topic (see Bergsleithner, 2010, and Mavrou, 2020, for similar results). As Bergsleithner (2010) pointed out, participants with high WMC have probably more cognitive resources for processing the syntactic aspects of the target language, retrieving the grammatical structures that need to be produced from long-term memory while keeping them active and continuously updating them in their WM. Similarly, Lord (2002, in Bulté & Housen, 2012, p. 36) argued that subordination entails a greater cognitive effort compared to other types of syntactic elaboration, hence the greater involvement of WMC.

Regarding the topic of writing, Clachar (1999) claimed that when writing about an emotional topic, learners pay more attention to lexico-morphosyntactic aspects because they feel more involved and try to convey their ideas or memories with more precision. This is partially supported by the results of the current study, as the texts produced by the participants of both proficiency levels had a higher subordination density in the emotional task. However, this increase in subordination was apparently produced at the expense of the mean length of clause. In addition, the texts that participants at the A2 level produced on the non-emotional topic were slightly more linguistically correct. This might be attributed to the fact that the vocabulary required for the non-emotional topic had been more accessible or had already been acquired by the participants. It is also possible that the non-emotional topic mainly required concrete rather than abstract words (e.g. emotion words), and as Altarriba and Bauer (2004) stated, concrete vocabulary is easier to be retrieved and processed than abstract (emotion) concepts.

Nevertheless, the present study also has several limitations that need to be specified and acknowledged. First, the sample size was rather small. Second, each country has different socio-emotional behaviours, and "both cultural and individual processes shape emotion expression into congruence with cultural norms" (Mesquita et al., 2014, p. 297). Therefore, as Thompson et al. (2015) noted, the most important limitation of self-reports — such as the TMMS used in the current study— is related to the unawareness of the degree of introspection that individuals possess when evaluating their emotional clarity and their feelings or moods, in general. A possible solution would be to complement this kind of self-reports with the measurement of reaction times when participants rate their feelings during the task (Lischetzke et al., 2011; Thompson et al., 2015). Furthermore, a small number of WM tasks is never enough to assess the multiple functions of WM. Likewise, performance on specific WM tasks might reveal different correlation patterns with self-reports of EI. Although some work in psychology (Gutiérrez-Cobo et al., 2016, 2017a, 2017b) and applied linguistics (Mavrou, 2021) tackled this issue, more systematic work is needed. The writing tasks and writing measures used in this study also have certain limitations. For instance, the writing tasks differed in genre, and the emotionality of the topics was not assessed via objective emotional indexes (e.g. valence and arousal of the words in the writing

prompts), nor was the emotionality that the texts would produce to potential readers. One would probably claim that "describing your ideal house" is rather an emotional topic. On the other hand, as Ahmed (2014) points out, "What is posited as 'unemotional' also involves emotions, as ways of responding to objects and others" (p. 17). This statement clearly indicates that designing completely neutral tasks might be quite difficult and probably unrealistic. Moreover, only a small set of linguistic (general) measures was used to evaluate linguistic complexity and accuracy. In future work, these measures should be complemented by more specific ones, along with indicators that tap directly into the emotional components of the discourse (e.g. valence and arousal of the emotional vocabulary or sentiment analysis to assess the degree of emotionality at the discourse level).

8. Pedagogical Implications

The present study highlights the complex interaction between emotion, cognition, and L2 writing. As Brand (1987) pointed out, "writing, too, is an exercise in inclusion and exclusion, a lesson in decision making and choice. It is the basis on which we make those selections that determines cognitive style and writing style. And ... such choices link language to affect" (p. 437). This study showed that for some linguistic aspects (syntactic complexity), WMC and EI can have a cumulative but opposing effect. It also revealed that the ability to pay attention to our emotions may have a positive influence on the accuracy with which we express our ideas in L2 writing. However, these interactions seem to be dependent on the writing topic, that is, different writing topics might differently affect linguistic complexity and accuracy. Overall, the findings of this study carry implications about the importance of considering not only linguistic and cognitive aspects when researching L2 writing but also those that belong to the emotional sphere. We need EI abilities to be aware of our emotions, just as we need cognitive processes to manage these emotions and put them at the service of L2 written production.

Several pedagogical implications can be derived from the results of this study. In particular, our results showed that WMC contributed to subordination density. Therefore, L2 teachers can include in their lesson planning games that target the production of complex sentences to help students exercise their WMC. Games with cards have been proposed to aid memorisation of new items while students engage in cooperative activities that stimulate communication in the target language (Sheridan & Markslag, 2014, 2017). These games could be adapted to teach grammatical structures and thus enhance linguistic complexity. For example, L2 students can be presented with cards containing non-finite verbs and other grammatical and lexical items and asked to create meaningful subordinated sentences. This could be achieved in several rounds, for example, by starting with cards (and items) remaining in sight and progressively increasing the cognitive complexity and cognitive load by showing the cards only for a few seconds so that students must retain and mentally process the information in their memory while trying to produce a meaningful sentence.

We also found that attention to emotions was positively linked to L2 linguistic accuracy. To promote this EI ability, teachers could use EI dynamics on attention to emotions. As an illustration, teachers could ask their students to stay quiet for a few minutes while guiding them through introspection in the L2. The aim would be to make students reflect on their mood energy (e.g. how calm or agitated they feel, if they feel pleasant or unpleasant emotions) and then say aloud or write on a piece of paper how they feel using specific mood or emotion terms that they learnt in previous L2 lessons. Another activity employs art to encourage students to pay attention to emotions in paintings and music, as well as in themselves, when contemplating images or listening to songs. For instance, the teacher presents several paintings by famous artists from the L2 culture. Students are given some minutes to reflect on the emotions they think the artists wanted to portray and their own feelings. This is a great opportunity for L2 teachers to teach their students how to successfully manage emotional labelling and expression in an L2 — either in writing or in speaking. In addition, it is vital to reconsider how emotion words and emotional vocabulary are presented and taught in L2 classrooms and textbooks. Encouraging students to write about emotional topics can enhance and consolidate this vocabulary in memory and help them pay more attention to how they feel in different situations.

Furthermore, implementing journaling in L2 contexts can be particularly valuable. Journaling has been proven to be one of the most effective ways to deal with emotions since the writing process is believed to reduce information overload in memory, clarifies and improves the flow of thought, has de-stressing effects, and contributes to both emotional regulation and expression of emotions (Rimé et al., 1998). Students could further share their stories, experiences, and ideas with their teachers and classmates, building and strengthening teamwork and fostering deeper conversations in the target language.

Finally, we believe that L2 courses should include the expression of emotions within the L2 culture curriculum since the expression of emotions varies from country to country (Dewaele & Pavlenko, 2001–2003). Particularly, we noted that linguistic distance seemed to play a role in linguistic accuracy in the emotional task. Therefore, L2 teachers must take students' linguistic backgrounds into account because a greater linguistic distance between the L1 and the L2 might pose more difficulties when students have to express their emotions in the L2.

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