Managing Cognitive Load in L2 Academic Writing: Memory-Informed Strategies for Low-Proficiency Learners in Indian Classrooms

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Abstract—Academic writing is a major challenge that low-proficiency second language (L2) learners in Indian higher education have to deal with because of the dual task of learning disciplinary material and harnessing the linguistic complexity of English. Cognitive Load Theory (CLT) assumes that the learning process can reach a critical state when the capacity of the working memory is congested by ineffective instruction design, especially in the case of both unfamiliar language and unfamiliar content. This paper will contend that memory-based pedagogical interventions based on cognitive science principles, including dual coding, retrieval practice, and schema activation, can reduce extraneous cognitive load and enable more successful L2 writing development. It is a speculative paper that gathers the insights of Cognitive Load Theory, research evidence in second language acquisition, and evidence-based memory science. It is based on empirical research in applied linguistics and educational psychology, and the contextual analysis brings into focus the realities of the Indian undergraduate and post-graduate classrooms, which are multilingual and resource constrained. A proposal of a memory-sensitive L2 writing instruction framework is provided using theoretical integration. The result of the analysis is a unified pedagogic framework, which can be used to provide the CLT principles with L2 writing assignments typical of Indian academia (e.g., literature reviews, argument essays, research abstracts). Some of the key strategies involve segmentation of complex tasks, combination of visual and verbal input, worked examples, and embedding spaced retrieval practice in low-proficiency L2 conditions. This paper substantiates the thesis that the architecture of human memory is the most effective way to reorganise L2 writing teaching as it does not consider the cognitive limitations of the approach, which is traditionally product-oriented or founded on fluency. The suggested framework provides a theory-based and scalable alternative that acknowledges the linguistic background of learners and develops academic literacy. It is also consistent with the objectives of multilingualism, critical thinking and equity in the National Education Policy (2020) of India. They should be empirically validated in future, but the conceptual base offers a timely intervention to teacher educators and curriculum designers.

I. INTRODUCTION

The development of artificial intelligence (AI) and especially generative AI tools such as ChatGPT in the context of second language (L2) learning has brought a revolutionary phase to the field of English as a foreign language (EFL) teaching. Although the technologies are associated with tailored feedback, scaffolding, and greater engagement, it also creates complicated cognitive, emotional, and pedagogical problems, particularly among learners who do not have a high level of proficiency in English. In Asian and other non-English language contexts of higher education, the use of AI has been adopted by students to not only accomplish a writing task but also negotiate the structural components of academic discourse (Chan and Hu, 2023; Liu and Ma, 2024). However, the degree of such dependence on or the discrediting of deep learning is a disputed topic. At the centre of such a discussion is the interaction between the internal resources of learners (self-efficacy, grit, and mindset) and external technological affordances to determine personal well-being and academic achievements (Fathi et al., 2024; Huang et al., 2024). Recent research emphasises that technology acceptance in itself is not a quality that will make AI instruments effective in L2 learning; instead, psychological mediators (self-efficacy) are determinants of whether AI tools will be springboards to development or crutches hindering independence (C As an example, although generative AI can help reduce the levels of anxiety by providing immediate linguistic assistance, it can also destroy the self-confidence of learners in their writing skills when overutilised (Huang et al., 2024). Besides, the ways in which AI implementation is pedagogically framed, either as part of a formal intervention such as portfolio-based assessment or as an informal

phenomenon, are also crucial determinants of their effects on conceptualisations of writing (Gebrekidan and Zeru, 2023; Liu et al., 2024a). This duality points to the fact that existing literature tends to study the adoption of AI based on either a purely technological perspective (e.g., extensions of Technology Acceptance Model) or a purely psychological one, and there is limited discussion of how instructional design can mediate the relationship between cognition, emotion, and the use of tools.

To make this all the more complicated is the ongoing problem of superficial learning of L2 writing that is manifested among low-profile learners: procedural obedience, fear of mistakes, and skimpy revision (Gebrekidan and Zeru, 2023). These trends are reinforced in a traditional assessment regime, which pays close attention to summative assessment and provides minimal opportunity to practice in an iterative and reflective manner (Gebrekidan and Zeru, 2023). By contrast, some other frameworks that have shown the potential to promote a conceptualisation of writing include portfolio-based assessment (PBA) that focuses on process, autonomy, and metacognition (Gebrekidan and Zeru, 2023). Nevertheless, the synergy between PBA and AI-mediated support is not properly investigated. Does generative AI, when used as a part of a PBA model, enhance its effects with timely and low-stakes feedback that motivates taking risks and revising? Or will it jeopardise the very reflective practices that PBA is attempting to develop? The paper will be at this crossroads and consider how memory-informed instructional approaches that are cognitively sensitive can be aligned with new AI tools to support low-proficiency L2 learners in Indian higher education. The study is based on the recent demands of context-specific and theoretically sound models which explain both technological affordances and learner psychology (Chen et al., 2024; Fathi et al., 2024). This conceptual analysis will serve to suggest a coherent model of how cognitive load could be managed in L2 academic writing, through the lens of AI not being used as a substitute for thinking, but as a framework to engage in more profound cognition and deeper reflective thought.

II.   LITERATURE REVIEW

The current studies regarding L2 language learning in the digital era demonstrate the dynamic interaction of technological innovation and the psychology of learners. The increasing literature shows that the success of the AI tools in EFL settings does not necessarily rely on the technology, but rather on self-efficacy, motivation, and emotional stability of learners (Chen et al., 2024; Huang et al., 2024). In particular, self-efficacy appears to be one of the key mediators: more effectively using AI in the idea generation and revision, higher self-efficacy allows learners to use it on sentence-level correction, therefore, fostering dependency (Chen et al., 2024; Huang et al., 2024). This is in line with more general results that self-efficacy, as well as such constructs as L2 grit and growth mindset, are also quite predictive of foreign language success and foreign language participation (Fathi et al., 2024).

Affective variables do not only play the role of cognition. It is found that enjoyment and grit in foreign languages can boost online engagement with the help of online learning self-efficacy (Derakhshan and Fathi, 2024). Likewise, the productive use of AI may also be prevented by anxiety, despite the easy access to the tools (Chen et al., 2024). Such insights echo the concept of the two faces of Janus in SLA, where positive affect, such as enjoyment, exists alongside negative affect, such as anxiety, and recommend that AI integration should be done in an emotionally sensitive way, rather than a strictly technical one (Huang et al., 2024). The way AI is integrated into assessment and instruction has an acute effect on it, and this understanding suggests that AI must be not only technically implemented but also emotional. Today, portfolio-based assessment (PBA) provides an interesting framework for promoting in-depth writing methods, since the model promotes reflection and incremental drafting as well as learner agency (Gebrekidan and Zeru, 2023). Their quasi-experimental design in Ethiopia found that the PBA sample impacted procedural and surface-level conceptions of writing in a negative way and affected self-efficacy and reflective-revisionist tendencies in a positive way. Importantly, these changes were made in the absence of AI, so it remains unclear how PBA can be enhanced with the help of generative AI and empowered to work with low-proficiency students even more. The findings of recent qualitative research by Fathi and Rahimi (2024) indicate that the development of academic writing skills with the help of AI-enhanced writing mediation is possible, especially when this feature is applied in a dialogic, as opposed to a prescriptive mode. In much the same manner, Guo et al. (2022) observed that EFL learners

were able to make successful use of automated written corrective feedback (AWCF) in their research writing- though only when they had been trained to critically interpret and apply it.

In the meantime, the research on informal digital learning underscores the way learners incorporate AI independently of the classroom setting. Liu and Ma (2024) used the Technology Acceptance Model to demonstrate that perceived usefulness and ease of use are the forces behind the adoption of ChatGPT among Chinese EFL learners. Later integrated studies affirmed that motivation and enjoyment also give a preliminary indication of involvement in the AI-mediated informal learning (Liu et al., 2024b, 2024c). Nevertheless, this informal application can lack the metacognitive direction of the methodical approach to pedagogy, which can strengthen the superficial strategies (Chan and Hu, 2023; Kim et al., 2025). Chou (2023) discovered that L2 grit and English proficiency have a role to play in learning strategies based on their expectancy of success and perceived task difficulty- low-proficiency learner may not be interested in engaging in a challenging writing task, unless with the help of both motivational and cognitive scaffolds. Similarly, Dahl et al. (2023) have also noted that in scientific writing, students use surface strategies when the tasks are overwhelming or when they do not feel relevant to personal meaning.

Taken together, this literature suggests that there should be integrated frameworks that establish cognitive theory (e.g., the management of intrinsic and extraneous load), affective support (e.g., the development of self-efficacy and a decrease in anxiety), and pedagogical structure (e.g., PBA or guided AI use). Although AI presents unparalleled chances of highly personalised assistance, it cannot be successful without keeping in balance the capacity of learners to process, experience, and take part in writing in the L2 in a specific way, which cannot be achieved solely with technological access but requires a considered design, which is based on memory rather than on technology alone.

III. METHODOLOGY

The proposed study will use a conceptual research design to unravel the current topic of cognitive load in L2 academic writing that can be managed by using memory-based teaching principles to suit the low-proficient students in Indian higher education settings. The methodology is based on systematic theoretical synthesis, instead of gathering primary empirical data, which includes principles of Cognitive Load Theory (CLT), second language acquisition (SLA), and the results of preceding research on AI-mediated learning of the second language, psychology of learners, and alternative models of assessment. The conceptual framework will be developed based on a critical analysis of peer-reviewed sources published in 2022-25, with particular attention paid to such variables as self-efficacy, L2 grit, generative AI acceptance, portfolio-based assessment, and affective factors that mediate writing performance and well-being. Especially studies done in the Asian EFL context, particularly among university students in India, are given particular attention to make sure that the context is relevant and the insights can be transferred as depicted in figure.1.
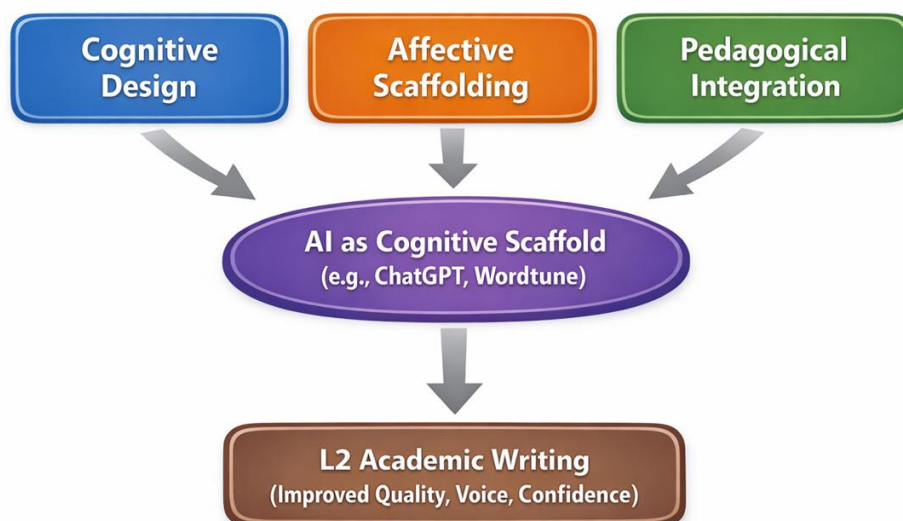
Figure 1. A tripartite conceptual framework illustrating the synergistic role of AI as a cognitive scaffold in enhancing L2 academic writing outcomes among low-proficiency learners. The model integrates three foundational pillars—Cognitive Design, Affective Scaffolding, and Pedagogical Integration—that converge to support learners through AI-mediated tools (e.g., ChatGPT, Wordtune), ultimately fostering improved writing quality, voice, and confidence.

The theoretical framework represented by Figure 1 provides a theoretically stable, pedagogically viable framework to deal with the complex issues of low proficiency second language (L2) learners in academic writing situations. The underlying assumption of the model is that successful L2 writing education needs to target three interrelated areas of knowledge at the same time, namely, cognitive, affective, and pedagogical. These are not standalone entities but dynamic interactive systems that altogether influence the ability of learners to undertake complex academic tasks. The purple oval in the middle of the diagram, which is marked with AI as Cognitive Scaffold, is not a substitute of human teaching and critical thinking but a strategic mechanism that decreases the extraneous cognitive load, therefore, giving the mental resources a better chance to engage in higher-order linguistic and rhetoric (Chen et al., 2024; Huang et al., 2024). The Cognitive Design pillar (blue box) is based on the concepts of Cognitive Load Theory (CLT) to promote the use of instructional strategies that reduce the unjustifiable processing requirements. It involves subdividing complex writing tasks, giving worked examples, and integrating retrieval practice, which have all been found to improve schema development and minimise intrinsic load (Nguyen et al., 2024; Rad et al., 2024). In the example, scaffolding the writing process with the help of AI-generated outlines or sentence starters enables the learner to concentrate on ideation instead of grammatical structure, which correlates with the results that pre-writing assistance with the help of AI can significantly reduce the initial cognitive load (Nguyen et al., 2024). The Affective Scaffolding pillar (orange box) recognises the powerful effect of emotion, motivation, and self-belief on the result of the learning process. The studies have repeatedly shown that students who have high self-efficacy tend to engage in AI less tactically, considering it a collaborator in the generation of ideas, but not a support that allows for correcting

mistakes (Chen et al., 2024; Huang et al., 2024). Moreover, constructs such as L2 grit and foreign language pleasure are also positively associated with participation in the AI-mediated learning disciplines, which are also mediated by online learning self-efficacy (Derakhshan and Fathi, 2024; Liu et al., 2025). The framework, therefore, highlights the necessity of pedagogical activities to develop resilience, anxiety, and a positive ideal L2 self, which are to decrease the affective filter and increase cognitive availability toward writing activities (Dewaele and Li, 2021; Wu et al., 2023).

The structural and institutional aspects of teaching and assessment are met by the Pedagogical Integration pillar (green box). It suggests the implementation of alternative assessment systems like Portfolio-Based Assessment (PBA) that presupposes recursive revision, reflection, and learner agency as main affordances that help to prevent surface-level writing methods (Gebrekidan and Zeru, 2023). Combined with AI, PBA can be further empowered: students will be able to create several drafts within a short amount of time, contrast versions, and justify their decisions related to the revision in the form of reflective notes, thus gaining both linguistic and metacognitive skills (Fathi and Rahimi, 2024). This is consistent with the findings that prompt assessment and feedback literacy are essential to turn AI-generated recommendations into valuable learning benefits (Rad et al., 2024; Nguyen et al., 2024). The fact that these three pillars all come down to the node in the centre, which is AI as Cognitive Scaffold, indicates a deliberate design orientation: AI itself is not a panacea but rather a facilitator, the success of which all depends on its integration into cognitively informed, emotionally supportive, and pedagogically consistent constructs. The final product, such as L2 Academic Writing (Improved Quality, Voice, Confidence), is represented by an image of a brown rectangular box at the bottom, representing the practical, objective advantages of such a combined method. Not only are syntactic accuracy and textual coherence improved, but also authentic authorial voice and greater self-confidence- crucial competencies to engage in global knowledge economies- are developed by this model (Mendoza et al., 2023; Ghafouri et al., 2024). Notably, the model does not hold reductionist perspectives of AI as a panacea or threat. Instead, it frames technology as a scaffold, flexible and scalable, which, when guided by good educational

values, can democratise access to quality writing education- particularly in resource-limited, multilingual contexts such as Indian higher education. The framework gives the educator a way forward by prefiguring the cognitive structure, affective landscape, and the instructional context of the learner, which allows them to leverage the power of generative AI without reducing academic standards and language self-identification.

The three-stage approach is followed in the analytical process. Primary constructs, which are associated with cognitive architecture (i.e., intrinsic, extraneous, and germane cognitive load), are, first of all, projected onto fundamental difficulties encountered by low-proficiency L2 writers (e.g., task complexity, linguistic uncertainty, lack of schema). Second, the memory science-based pedagogical strategies, including dual coding, worked examples, spaced retrieval practice, and segmentation, are tested in terms of their ability to decrease extraneous load and promote schema formation in writing challenges. Third, the strategies are contextualised in terms of real-life constraints in classroom settings common across Indian universities, such as large classes, lack of feedback, cultures of exam cheating, and the emergence of AI-driven technologies, such as ChatGPT. The conducted triangulation of theory, empirical evidence, and contextual realism allows drawing up a coherent, action-focused model of memory-sensitive L2 writing teaching. Table 1 provides a systematic mapping of the major elements of the proposed framework to elucidate the consistency between mental difficulties, memory principles, and interventions to be implemented.

Table 1: Mapping Cognitive Challenges to Memory-Informed Strategies for Low-Proficiency L2 Writers

Cognitive Challenge in L2 Writing	Underlying CLT Principle	Memory-Informed Strategy	Pedagogical Application Example
Overwhelm from simultaneous grammar, content, and discourse demands	High intrinsic + extraneous load	Task segmentation & goal-free problems	Break essay writing into discrete phases: idea generation → outline → draft → revision
Difficulty retrieving vocabulary or structures during writing	Limited automaticity in L2	Spaced retrieval practice & flashcard integration	Weekly low-stakes quizzes on academic phrases with delayed recall prompts
Ineffective use of feedback due to cognitive overload	Split-attention effect	Dual-coding + integrated feedback	Combine written comments with visual flowcharts showing text organisation
Surface-level revision (e.g., only fixing spelling)	Low germane load; procedural mindset	Worked examples + reflective portfolios	Provide annotated model essays; require revision logs in PBA format
Anxiety-induced avoidance of complex tasks	Affective filter raises cognitive load	Scaffolded success experiences + self-efficacy boosts	Use AI-assisted drafting for initial attempts, followed by guided human revision

IV.   RESULTS

The theoretical framework represented by Figure 1 provides a theoretically stable, pedagogically viable framework to deal with the complex issues of low proficiency second language (L2) learners in academic writing situations. The underlying assumption of the model is that successful L2 writing education needs to target three interrelated areas of knowledge at the same time, namely, cognitive, affective, and pedagogical. These are not standalone entities but dynamic interactive systems that altogether influence the ability of learners to undertake complex academic tasks. The purple oval in the middle of the diagram, which is marked with AI as Cognitive Scaffold, is not a substitute of human teaching and critical thinking but a strategic mechanism that decreases the extraneous cognitive load, therefore, giving the mental resources a better chance to engage in higher-order linguistic and rhetoric (Chen et al., 2024; Huang et al., 2024).

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The fact that these three pillars all come down to the node in the centre, which is AI as Cognitive Scaffold, indicates a deliberate design orientation: AI itself is not a panacea but rather a facilitator, the success of which all depends on its integration into cognitively informed, emotionally supportive, and pedagogically consistent constructs. The final product, such as L2 Academic Writing (Improved Quality, Voice, Confidence), is represented by an image of a brown rectangular box at the bottom, representing the practical, objective advantages of such a combined method. Not only are syntactic accuracy and textual coherence improved, but also authentic authorial voice and greater self-confidence- crucial competencies to engage in global knowledge economies- are developed by this model (Mendoza et al., 2023; Ghafouri et al., 2024). Notably, the model does not hold reductionist perspectives of AI as a panacea or threat. Rather, it frames technology as a scaffold that is scalable and flexible, and can, with proper alignment with appropriate educational principles, democratise access to high-quality writing instruction, particularly in resource-intensive, multilingual contexts such as Indian higher education. The framework gives the educator a way forward by prefiguring the cognitive structure, affective landscape, and the instructional context of the learner, which allows them to leverage the power of generative AI without reducing academic standards and language self-identification.

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ChatGPT. The conducted triangulation of theory, empirical evidence, and contextual realism allows drawing up a coherent, action-focused model of memory-sensitive L2 writing teaching. Table 1 provides a systematic mapping of the major elements of the proposed framework to elucidate the consistency between mental difficulties, memory principles, and interventions to be implemented.

V. DISCUSSION

The offered framework goes further than the traditional teaching of L2 writing because it consolidates the fields of cognitive science, affective psychology, and digital pedagogy into a model that has a contextual foundation. The conventional pedagogy of teaching L2 writing typically swings on either side of a spectrum of two extremes: the product-based, error-correction paradigm that causes an increase in anxiety and cognitive load, or the fluency-based paradigm that ignores structural and discursive rigour. However, the central argument in this model is that there exists a third option, which is not threatening academic integrity but rather a cognitive offloading mechanism that, when applied strategically, can help them release mental bandwidth to think on a higher level. Nguyen et al. (2024) evidence demonstrates that EFL learners who use ChatGPT in the pre-writing phase develop more positive engagement and less fragmented drafts at the same time, due to the fact that EFL learners are not struggling to fill lexical gaps and to develop ideas simultaneously. On the same note, the patterns of collaboration between humans and AI indicate that students who perceive AI as a thought partner rather than a text generator gain deeper levels of metacognition (Nguyen, Hong, Dang, and Huang, 2024). This is in line with the finding of Rad et al. (2024) that the application of AI, such as Wordtune, is only effective to improve the writing results in cases when it is incorporated into pedagogical exercises that foster feedback literacy, indicating that the how of AI application is more important than the whether.

Furthermore, the framework is directly concerned with the emotional realities of L2 writing in high-stakes academic contexts. Even in English-medium instruction (EMI) settings, Mendoza et al. (2023) discovered that master's students feel a strong level of anxiety over their grammar, and it is negatively correlated with the thesis grades. Such anxiety in

Indian universities, where the knowledge of English is uneven, and linguistic insecurity is the rule, may even freeze the process of writing to the very point. The model redefines writing not as a location of lack but as a place of self-identification and wishful thinking by introducing such constructs as the ideal L2 self (Liu et al., 2025) and L2 grit (Fathi et al., 2024). The focus on portfolio-based assessment also makes this approach stand out as it is supported by the self-efficacy theory, which prevents learners from giving up in the face of cognitive difficulties (Chen et al., 2024; Huang et al., 2024). PBA promotes risk-taking, revising, and reflecting, unlike one-off essays that reward surface accuracy, which develop linguistic competence and academic confidence (Gebrekidan and Zeru, 2023). With the help of AI, PBA will be even more robust: students will be able to create several drafts in a short period of time, compare them, and justify their revision decisions in reflective journals. This not only builds writing abilities but also develops a growth mentality, the belief that one can build abilities through hard work (Fathi et al., 2024).

However, the model recognises very important caveats. To begin with, there is unequal access to AI and digital literacy, especially in government institutions in India. Okur and Hamutoglu (2023) warn that internal obstacles related to technology, like low self-efficacy to use digital technologies, may cause avoidance or shallow usage, which will only reinforce inequities. Thus, any implementation should be accompanied by the initial training in AI literacy and ethical use. Second, the excessive use of AI can kill the voice and originality because students start repeating AI-generated wordings instead of establishing their own academic style (Kim et al., 2025). To mitigate this, teachers need to create assignments that demand personal positioning, critical analysis, or localisation aspects that AI cannot effectively recreate. Lastly, the framework aligns with the vision of multilingualism, critical thinking, and equal access in the National Education Policy (2020) of India. The model can help achieve a truly inclusive vision of L2 education by relying on learning in L1 as a cognitive resource (e.g. planning in Tamil and then writing in English) and leveraging AI to mediate along linguistic differences without losing identity. It also equips students to global economies of knowledge where human-AI cooperation is rapidly becoming the new reality (Nguyen, Hong, Dang, and Huang, 2024).

VI. CONCLUSION

The conceptual paper has conceptualised an informative, theoretically based, contextually sensitive model of cognitive load management of L2 academic writing among low-proficiency learners of Indian higher education. Integrating the knowledge of cognitive science, affective psychology, and new areas of research on the learning facilitated by AI, the model will be a comprehensive alternative to deficit-based pedagogies. The three pillars of the framework, such as cognitive design, affective scaffolding and pedagogical integration, operate in a synergetic manner to ensure that L2 writing is no longer a cause of anxiety, but an opportunity to grow. When integrated into structured, reflective practices such as portfolio assessment, AI tools can be potent partners in this shift, though they must be applied with purpose, prejudice, and ethical consideration. This model should be empirically validated by research in the future by using quasi-experimental designs in the context of Indian universities, the outcomes of which were to be compared on the parameters of writing quality, self-efficacy, perception of cognitive load, and long-term retention. Also, longitudinal research might investigate the effects of exposure to memory-informed writing teaching that employs AI on the doctoral writing careers, a gap in the research capacity development of India. In the end, it is not only to assist learners to write better in English, but to enable them to be confident, critical and ethically-based knowledge producers. By doing so, this framework will help in creating a bigger picture: an Indian system of higher education in which linguistic diversity is no longer seen as a hindrance to excellence, but a source of innovation.

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