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RESEARCH ARTICLE

Differential Effects of Online Task Planning on Formulaic Language Use and Working Memory over Time

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ABSTRACT

Despite sustained pedagogical emphasis on communicative competence, oral fluency remains a persistent challenge for EFL learners, particularly in task-based speaking contexts involving time pressure. While previous research has examined the effects of task planning on linguistic performance, less attention has been paid to learners' psychological experiences during task execution and how these experiences interact with cognitive and linguistic resources over time.

This study investigates how three online task planning conditions—pressured online planning (POP), unpressured online planning (UOP), and hybrid online planning (HOP)—shape learners' use of formulaic sequences (FSs), with a focus on both frequency and variation, as well as their relationship with working memory (WM). Ninety Chinese EFL undergraduates participated in an eight-week longitudinal intervention and completed dialogic narrative tasks at pre-test, post-test, and delayed post-test. Quantitative analyses examined changes in FS deployment and exploratory associations with WM capacity. To complement these analyses, stimulated recall interviews were conducted to capture learners' perceived pressure, emotional responses, and strategic decision-making under different planning conditions.

The results reveal condition-sensitive and time-dependent patterns in FS use, with distinct profiles emerging across planning conditions. Interview data suggest that these patterns are closely associated with learners' psychological regulation under task constraints, particularly their tendency toward risk avoidance, reliance on familiar expressions, and prioritization of fluency under pressure. Together, the findings highlight the importance of integrating psychological perspectives into the interpretation of task-based language performance and offer implications for the design of planning conditions in L2 speaking instruction.

Keywords: online task planning; formulaic sequences; working memory; psychological experience; L2 speaking

1. Introduction

Speaking fluently in a second language requires not only access to linguistic knowledge but also the ability to manage cognitive and psychological demands during real-time communication. During spoken task performance, learners must simultaneously conceptualize meaning, formulate linguistic structures, and articulate speech, a process that places substantial demands on limited attentional resources [21,36,16]. Under conditions of time pressure, these cognitive demands are often accompanied by psychological responses such

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as heightened tension, increased self-monitoring, and reduced willingness to take linguistic risks, all of which may shape observable speaking behavior [37,34,18,20].

Within the framework of task-based language teaching (TBLT), task planning has been widely recognized as a critical design variable influencing learners' oral performance. Empirical studies comparing pressured and unpressured online planning conditions have reported differential effects on fluency, accuracy, and complexity, frequently interpreted through theories of attentional resource allocation and cognitive load [12,53,40,9]. Among the linguistic resources supporting fluent speech, formulaic sequences (FSs) have received increasing attention due to their role in facilitating rapid lexical retrieval and reducing online processing demands [30,46-49]. Recent research further suggests that both the frequency and variation of FS use are sensitive to task conditions and may reflect learners' strategic adaptation to processing constraints during speech production [43,2,44].

In addition to linguistic resources, individual cognitive differences—particularly working memory (WM) capacity—have been shown to mediate learners' ability to retrieve and deploy formulaic language under task demands. Grounded in psycholinguistic models of speech production, WM supports the temporary storage and manipulation of phonological and lexical information during formulation and articulation [1,21,47]. Empirical studies have linked WM capacity to vocabulary learning, collocation development, and aspects of oral performance, though findings remain inconsistent and appear to vary across task types and planning conditions [19,13,25,45]. These mixed results suggest that WM does not operate in isolation but interacts dynamically with task constraints and learners' strategic responses during performance.

Despite growing interest in the cognitive underpinnings of task-based performance, comparatively limited attention has been paid to learners' psychological experiences during task execution. In particular, how learners perceive time pressure, regulate emotional responses, and strategically prioritize fluency or lexical experimentation under different planning conditions remains underexplored, especially in longitudinal task-based research [17,6,23,39]. From a psychological perspective, such regulatory processes may involve learners' attempts to balance performance goals with perceived risk, leading to adaptive behaviors such as reliance on familiar expressions, avoidance of complex forms, or prioritization of communicative flow over accuracy [9,38,35].

Building on this line of research, the present study examines how three online task planning conditions—pressured online planning, unpressured online planning, and hybrid online planning—shape learners' use of formulaic sequences in dialogic speaking tasks, with particular attention to their association with working memory capacity over time. The study adopts a primarily quantitative design, while also drawing on stimulated recall interviews to interpret observed performance patterns from a psychological perspective. These interviews focus on learners' perceived pressure, emotional experiences, and self-regulatory strategies during task performance [15,24,17]. By integrating behavioral measures with learners' reported psychological experiences, the study aims to offer a more nuanced understanding of how online task planning conditions influence L2 speaking performance.

2. Literature review

2.1. Task-Based language teaching and online task planning

Task-Based Language Teaching (TBLT) has long emphasized the use of meaning-oriented tasks as a central means of promoting second language development [8,22]. Within this framework, task planning has attracted sustained attention, largely because it directly shapes what learners are able to do under real-time communicative pressure. Rather than treating planning as a uniform construct, researchers have

distinguished between pre-task planning and online task planning, the latter referring to the planning activity that unfolds while learners are already engaged in task performance [9,30].

Much of the early work on online task planning examined how time pressure constrains learners' attentional resources during speech production. Studies comparing pressured and unpressured conditions consistently show that learners under time pressure tend to prioritize speech continuity, often at the expense of monitoring and reformulation [12,40,53]. From this perspective, performance differences are commonly explained in terms of limited attentional capacity, with learners reallocating resources toward meaning expression when temporal constraints are salient [37].

More recent studies have begun to explore intermediate planning conditions that attempt to balance these competing demands. Hybrid online planning, for instance, allows learners some degree of preparatory support while still requiring real-time formulation, and has been shown to yield performance profiles distinct from those observed under purely pressured or unpressured conditions [43,46]. However, even in this line of work, explanations have largely remained cognitive in nature. How learners experience these task conditions psychologically—particularly in terms of perceived pressure or readiness—has received comparatively little attention [17,39].

2.2. Formulaic sequences and oral performance

In this study, formulaic sequences (FSs) are treated as multiword units that are retrieved as wholes rather than assembled word by word during speech production, following Wray's [51,52] usage-based account. From this viewpoint, FSs offer speakers an efficient means of managing processing demands, especially in time-constrained communicative contexts. A growing body of empirical work has linked FS use to various dimensions of oral fluency, including speech rate and breakdown fluency [43,48,49].

Importantly, FS use is not a unitary phenomenon. While frequent reliance on a limited set of familiar sequences may support fluent delivery, variation in FS use reflects learners' ability to flexibly adapt formulaic knowledge to different communicative contexts. Studies adopting this distinction suggest that task demands can differentially affect FS frequency and variation, with time pressure often encouraging reliance on well-rehearsed expressions while discouraging experimentation [2,13,44].

From a task-based perspective, such patterns are unlikely to reflect linguistic competence alone. Learners' choices regarding which expressions to deploy may also be shaped by their evaluation of communicative risk during task performance. Under pressure, speakers may favor expressions they perceive as safe and reliable, even when alternative formulations are available [9,38]. This suggests that FS deployment can be understood as a strategic response to both cognitive and psychological demands imposed by tasks.

2.3. Working memory and task performance

Working memory (WM) plays a central role in models of speech production, supporting the temporary storage and manipulation of information during formulation and articulation [1,21]. In SLA research, WM has been linked to a range of learning and performance outcomes, including vocabulary development, grammatical processing, and aspects of oral fluency [19,47].

With respect to formulaic language, WM has been proposed to facilitate the retrieval and integration of multiword units during speech production, particularly when tasks place heavy demands on processing resources [44,45]. At the same time, empirical findings concerning WM–performance relationships remain inconsistent. Some studies report clear associations, whereas others find only weak or task-specific effects [13,25].

One possible explanation for these mixed findings is that WM does not operate independently of learners' responses to task demands. As Kormos [17] argues, cognitive capacity interacts with affective and motivational factors during speech production, shaping how learners regulate performance under pressure. From this perspective, learners with similar WM capacity may nevertheless adopt different performance strategies depending on how they perceive and manage task constraints.

2.4. Psychological regulation under task constraints

Although cognitive explanations have dominated task-based research, learners' psychological experiences during task performance are increasingly recognized as relevant to understanding performance variation. Psychological constructs such as perceived pressure, anxiety, and self-regulation have been shown to influence language use in demanding communicative contexts [6,23]. In task settings, these factors may shape how learners balance competing performance goals, such as maintaining fluency versus attempting more complex or varied language use.

To articulate the theoretical mechanism linking psychological regulation to WM and FS use, this study draws on Levelt's blueprint model of speech production [21] and its subsequent extensions in SLA research [16]. According to this framework, speech production involves interacting processes of conceptualization, formulation, and articulation, all of which draw on finite attentional and working memory resources. Under time pressure, the increased demands on the formulator may lead speakers to bypass certain monitoring processes and rely more heavily on pre-assembled units—namely, formulaic sequences—that require less online computation. Critically, the relationship between WM capacity and FS deployment is expected to vary as a function of learners' psychological appraisal of task demands. When learners perceive high time pressure, they may strategically conserve WM resources by restricting their lexical search to familiar, highly automated sequences, even when they possess relatively higher WM capacity [38]. In this scenario, high-WM learners may underutilize their cognitive resources in favor of communicative safety, which may attenuate the predictive power of WM on FS variation. Conversely, under less pressured conditions, learners may feel psychologically secure enough to engage in broader lexical retrieval, allowing WM capacity to exert a more direct influence on both the frequency and diversity of FS use. This theoretical account, grounded in established psycholinguistic models, provides a principled basis for understanding why the WM–FS relationship is expected to vary across planning conditions—a hypothesis that interview data in the present study are used to triangulate and interpret.

Within TBLT, psychological regulation can be understood as learners' strategic management of both internal resources and external task demands. Under time pressure, learners may deliberately simplify their language, rely on familiar expressions, or avoid potentially risky forms in order to sustain communicative flow [9,38]. Such behavior does not necessarily indicate limited competence; rather, it reflects adaptive decision-making in response to perceived task difficulty.

Stimulated recall interviews provide a means of accessing learners' subjective perspectives on these processes. By inviting learners to reflect on their performance shortly after task completion, this method offers insights into how learners perceive task demands and regulate their behavior during speech production [15,24]. When used alongside quantitative analyses, interview data can illuminate the psychological mechanisms underlying observed performance patterns, an approach adopted in the present study.

3. Method

3.1. Participants and research design

Ninety first-year undergraduate students majoring in English Education at a university in mainland China participated in the study. All participants were native speakers of Mandarin Chinese and had received at least six years of formal English instruction prior to the study. None had lived or studied in an English-speaking country for more than three months. Participants' ages ranged from 18 to 21 years.

Participants were assigned to one of three online task planning conditions—pressured online planning (POP), unpressured online planning (UOP), and hybrid online planning (HOP)—with 30 students in each group. Group assignment was conducted at the class level to minimize disruption to regular instruction. All participating classes were taught by the same instructor using identical teaching materials, task procedures, and instructional schedules. Efforts were made to ensure consistency in instructional delivery across groups throughout the intervention period. Prior to the intervention, no significant differences were found among the three groups in general English proficiency or baseline task performance.

The study adopted a quasi-experimental, longitudinal design with three planning conditions and three testing times (pre-test, post-test, delayed post-test). The intervention lasted eight weeks and was embedded within regular online speaking instruction. All participants completed the same dialogic narrative speaking tasks at each testing time, allowing for both within-group and between-group comparisons across conditions and over time. This design follows established approaches in task-based longitudinal research [9,31].

3.2. Tasks and planning conditions

The speaking tasks were dialogic narrative tasks based on short video clips, a task type widely used in task-based research to elicit spontaneous spoken interaction under time constraints [34,43]. Participants worked in pairs to co-construct a narrative by describing and interpreting the events depicted in the video. This task type was selected because it places simultaneous demands on conceptualization, formulation, and articulation during real-time speech production.

Three online task planning conditions were operationalized in line with established distinctions in the task-planning literature [12,53]. In the pressured online planning (POP) condition, participants viewed the video at normal speed and began speaking immediately after viewing, with no additional planning time provided. This condition was designed to induce time pressure and limit opportunities for monitoring and reformulation. In the unpressured online planning (UOP) condition, participants viewed the video at reduced speed and were given additional time before speaking to organize their ideas, thereby reducing temporal pressure and allowing greater opportunity for planning during task execution. In the hybrid online planning (HOP) condition, participants received brief pre-task exposure to the video followed by online task performance under moderate time constraints, combining elements of preparatory support and real-time planning.

Together, the three conditions systematically varied the degree of time pressure and planning support available during task performance.

3.3. Measures and interview data

Participants' spoken output was transcribed verbatim and analyzed for formulaic sequence (FS) use. FSs were identified following established criteria in the literature, focusing on multiword units that are retrieved and produced as prefabricated chunks rather than assembled word by word during speech production [51,52]. Two dimensions of FS use were examined: frequency, referring to the total number of FS tokens produced, and variation, referring to the range of distinct FS types used across tasks.

In the present study, formulaic sequences were operationally defined as recurrent multiword units consisting of two or more words that were retrieved and produced as prefabricated chunks. Identification followed a multi-criteria approach informed by previous studies [50,51]. Specifically, candidate sequences were evaluated against three operational criteria: (1) semantic unity—the sequence functions as a single meaning unit in context; (2) structural fixedness—the sequence exhibits limited internal variability and resists syntactic modification; and (3) frequency of co-occurrence—the sequence demonstrates conventionalized usage patterns. To operationalize "conventionalized usage," candidate sequences were cross-checked against established multiword unit inventories, primarily the PHRASE List [26], with the Academic Formulas List [42] used as a supplementary reference where relevant. Additionally, sequences were verified against frequency data from the Corpus of Contemporary American English [5] and the British National Corpus, with a heuristic threshold of 10 instances per million words adopted as indicative of conventionalized co-occurrence, consistent with prior corpus-informed FS identification practices. Where possible, frequency checks prioritized spoken and conversation-related registers to better align with the dialogic narrative task context. Sequences not appearing in these resources were retained if they met all three operational criteria and were judged by both raters to reflect holistic retrieval based on delivery features in the recordings (e.g., production with minimal internal pausing and perceived chunking). Final inclusion was determined by the operational criteria and rater agreement.

Working memory capacity was assessed using a non-word repetition task, which has been widely adopted as an index of phonological working memory in psycholinguistic and SLA research [1,14]. Participants listened to and immediately repeated unfamiliar phonological sequences of increasing length, with performance scored based on repetition accuracy. This measure has been shown to be sensitive to individual differences in phonological working memory relevant to L2 speech processing [47].

To complement the quantitative analyses, semi-structured stimulated recall interviews were conducted with a subset of participants following task completion. The interview subsample consisted of 6 participants selected purposively to represent a range of performance levels across the three planning conditions (POP: n = 2; UOP: n = 2; HOP: n = 2). This sampling strategy was adopted to capture diverse subjective experiences associated with different task planning environments. This method was employed to elicit learners' reflections on their task performance while minimizing retrospective distortion [15,24]. During the interviews, participants were prompted to comment on specific moments in their recorded performances and to explain their choices regarding pacing, expression selection, and task management. The interviews focused on learners' perceived time pressure, emotional responses, and self-regulatory strategies during task performance. Importantly, interview data were not treated as an independent qualitative dataset but were used to contextualize and interpret quantitative findings, particularly patterns observed in formulaic sequence use across planning conditions.

3.4. Data analysis

Quantitative data were analyzed using inferential statistical procedures to examine differences across planning conditions and testing times. Repeated-measures analyses were conducted to assess within-group development and between-group differences. Where appropriate, post hoc comparisons were applied with adjustments for multiple comparisons [11]. Preliminary normality tests indicated that several dependent variables deviated from normal distributions; therefore, non-parametric statistical procedures were adopted where appropriate to ensure robust analysis.

Interview data were analyzed descriptively and selectively. Rather than conducting full thematic coding, interview responses were examined to identify recurring psychological experiences related to time pressure,

confidence, and strategic decision-making. These observations were used to support and interpret the quantitative patterns observed in the data.

4. Results and discussion

This section examines changes in learners' formulaic sequence use and working memory performance across the three task planning conditions. Figure 1 provides an overview of how formulaic sequence frequency and variation evolved over time under different planning conditions, offering a general picture before the results are discussed in detail in the following subsections.

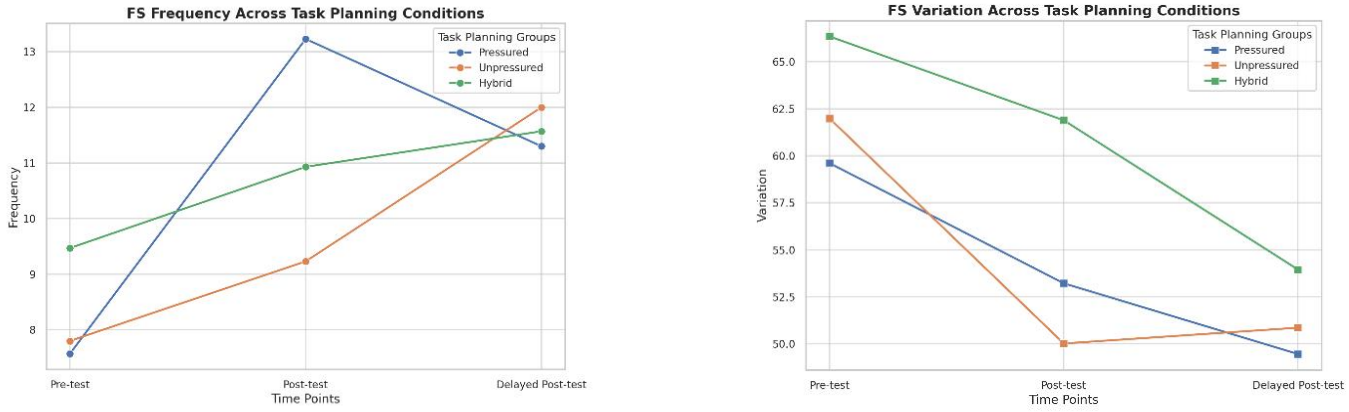

Figure 1. Changes in Formulaic Sequence Measures Across Task Planning Conditions

Note. *Left panel: Mean FS frequency scores across testing time points. Right panel: Mean FS variation scores across testing time points, with higher scores indicating greater variation. Results shown for Pressured, Unpressured, and Hybrid conditions. Y-axes represent raw scores for respective measures. N = 30 per group.*

4.1. Formulaic sequence frequency across planning conditions

As shown in Table 1 and Figure 1, formulaic sequence (FS) frequency increased from the pre-test to the post-test across all three planning conditions. This increase was most pronounced in the pressured online planning (POP) condition, where mean FS frequency rose from 7.57 at the pre-test to 13.23 at the post-test, before declining slightly at the delayed post-test (11.30). In contrast, learners in the unpressured (UOP) condition showed a more modest increase from 7.80 to 9.23, while the hybrid (HOP) condition displayed a steadier pattern of growth across testing phases.

Table 1. Descriptive Statistics for Formulaic Sequence Use and Working Memory Performance

Variables	Group	Pre-test	Post-test	Delayed Post-test
FS Background Test	Pressured	30.57 (5.32)	--	--
	Unpressured	30.60 (4.14)	--	--
	Hybrid	29.57 (4.26)	--	--
FS Frequency	Pressured	7.57 (4.87)	13.23 (5.05)	11.30 (3.54)
	Unpressured	7.80 (5.59)	9.23 (4.85)	12.00 (2.91)
	Hybrid	9.47 (6.39)	10.93 (2.61)	11.57 (3.00)
FS Variation	Pressured	59.61 (9.49)	53.22 (7.17)	49.46 (6.40)
	Unpressured	61.99 (6.20)	50.02 (6.82)	50.86 (5.81)
	Hybrid	66.35 (8.61)	61.89 (12.91)	53.95 (7.84)

Variables	Group	Pre-test	Post-test	Delayed Post-test
WM Test	Pressured	15.43 (3.84)	16.73 (2.91)	15.43 (3.55)
	Unpressured	14.37 (3.20)	16.80 (3.59)	16.13 (3.53)
	Hybrid	15.10 (3.08)	16.10 (2.95)	16.70 (3.13)

Table 1. (*Continued*)

Note. *Values are presented as Mean (Standard Deviation). FS = Formulaic Sequence; WM = Working Memory. FS Background Test was only administered at pre-test. N = 90 (Pressured = 30, Unpressured = 30, Hybrid = 30).*

This pattern suggests that time pressure accelerated learners' reliance on formulaic language, particularly in the short term. Similar effects of time pressure on formulaic language use have been reported in earlier task-based studies, which argue that prefabricated expressions support fluency when processing time is limited [12,38,50]. However, the present findings diverge from some previous research in one important respect: while earlier studies often reported sustained increases in formulaic language use, the POP group in this study showed a partial reduction at the delayed post-test. In addition to processing-efficiency accounts, Robinson ' s [34] Cognition Hypothesis would predict increased reliance on formulaic language under cognitively demanding conditions, as learners prioritize meaning and task completion over structural elaboration.

One possible explanation for this divergence lies in the longitudinal design of the study. Unlike one-shot task experiments, the present design captured learners' gradual adjustment to repeated task demands. Interview data illustrate this process. While several learners reported relying on familiar expressions at the post-test to avoid hesitation (e.g., *"I just used what I knew well because I didn't want to stop"*), others noted that repeated exposure reduced their sense of urgency over time (*"After a few times, it didn't feel that stressful anymore"*). These mixed accounts suggest that increased FS frequency under pressure reflects a dynamic strategy rather than a stable processing preference. By documenting this temporal shift, the present study extends previous work by showing that the effects of pressured planning on formulaic language use are shaped by learners' evolving psychological responses to task repetition.

4.2. Development of formulaic sequence variation over time

As shown in Table 1 and Figure 1, formulaic sequence (FS) variation declined across time in all three planning conditions. At the pre-test, learners in the hybrid online planning (HOP) condition already demonstrated higher FS variation (M = 66.35) than those in the pressured (POP; M = 59.61) and unpressured (UOP; M = 61.99) conditions, and this relative advantage was maintained at both the post-test and delayed post-test. Group differences in FS variation were statistically significant at all three testing times (pre-test: $\chi^2 = 9.338$, $p = .009$; post-test: $\chi^2 = 15.467$, $p < .001$; delayed post-test: $\chi^2 = 6.894$, $p = .032$), indicating systematic effects of planning conditions on learners' use of varied formulaic expressions.

Across conditions, FS variation showed a strong downward trajectory over time ($\chi^2 = 73.756$, $p < .001$), suggesting increasing reliance on a narrower set of recurring expressions as learners repeatedly engaged with the same task type. This overall trend aligns with previous longitudinal research indicating that task repetition often leads to routinization and reduced linguistic diversity [3,44]. From this perspective, declining variation can be interpreted as a natural consequence of growing task familiarity and proceduralization.

However, attributing the decline in FS variation solely to routinization overlooks the dynamic interplay between task repetition and learners' evolving strategic choices. As previous research has argued [3,4], task repetition does not uniformly lead to reduced diversity; its effects depend on how learners allocate attention across successive task cycles. When cognitive demands are manageable, repetition may free up resources for

experimentation. In the present study, however, time pressure in the POP condition constrained this potential, channeling attention toward fluency maintenance. Furthermore, repeated task exposure may lead learners to develop stable routines if familiar strategies yield acceptable outcomes [6,20]. This interaction between task repetition, planning conditions, and strategic recalibration accounts for the steepest FS variation decline in POP, a more moderate decline in UOP, and the slowest decline in HOP.

Previous research has conceptualized formulaic sequence variation as an index of adaptive language use, reflecting learners' ability to flexibly recombine prefabricated elements in response to task demands [7,51]. From this perspective, sustained variation is often associated with greater linguistic control rather than mere fluency maintenance. Studies conducted in relatively low-pressure task environments have reported stable or even increasing levels of variation over time, suggesting that task repetition can facilitate exploratory language use when cognitive resources are not overly constrained [4,27].

The present findings complicate this picture by showing that under heightened time pressure, reduced variation may reflect a strategic narrowing of linguistic options rather than a lack of developmental potential. This interpretation aligns with recent work emphasizing learners' sensitivity to perceived task risk and communicative stakes, which can lead to conservative language choices even in repeated task contexts [33].

This pattern diverges from findings reported in less constrained task environments, where repeated task performance has sometimes been associated with increased experimentation and structural variation over time [4]. The present results suggest that time pressure may fundamentally alter how repetition shapes learners' language use.

Interview data shed light on this divergence. Learners in the POP condition frequently described their language choices in terms of minimizing risk and avoiding disruption. One learner noted that under time pressure, using familiar expressions felt "*safer*" than trying new formulations, even after multiple task cycles. In contrast, learners in the UOP and HOP conditions often framed their repeated use of familiar expressions as a matter of efficiency rather than anxiety, and several reported occasionally attempting alternative expressions when they felt confident. These accounts suggest that reduced FS variation under pressured planning reflects not only linguistic routinization but also learners' psychological regulation of risk and effort.

By capturing these condition-specific patterns, the present study extends previous work on task repetition by demonstrating that reduced variation is not a uniform developmental outcome. Instead, it emerges from an interaction between task repetition and learners' subjective experience of pressure, highlighting the importance of considering psychological factors when interpreting longitudinal changes in formulaic language use.

4.3. Working memory capacity and formulaic sequence use

With respect to working memory (WM), quantitative analyses indicated that WM capacity itself remained relatively stable across planning conditions over time. A repeated-measures ANCOVA revealed a significant main effect of Time on WM performance ($F(2, 172) = 5.487$, $p = .005$, partial $\eta^2 = .060$), while neither the main effect of Task Condition nor the Time × Task Condition interaction reached significance. As illustrated in Figure 2, although WM performance showed a modest overall change across testing phases, the developmental trajectories were largely parallel across the three planning conditions, indicating that WM capacity itself was not differentially affected by task planning. These results suggest that the planning conditions did not directly alter learners' underlying WM capacity during the intervention period.

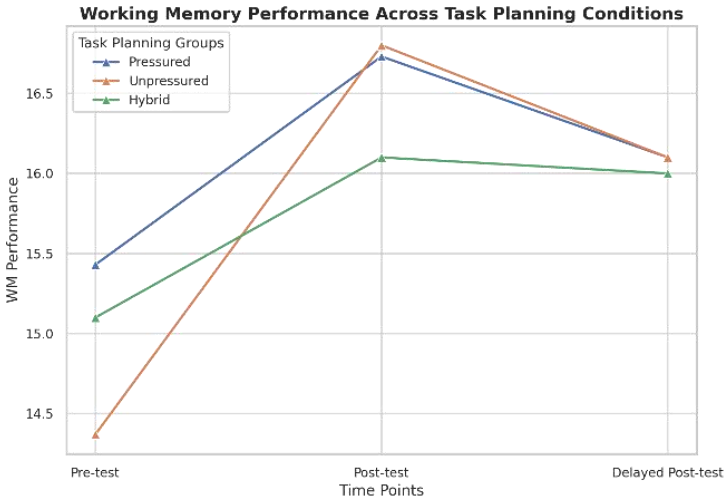

Figure 2. Working Memory Performance Development

Note. *Mean scores on Non-word Repetition Span Test across three testing time points for each planning condition (Pressured, Unpressured, Hybrid). Y-axis represents performance scores. N = 30 per group.*

Despite this overall stability, the relationship between WM and formulaic sequence use varied across task conditions. As shown in Figure 3, the strength and direction of the associations between WM and FS measures differed across planning conditions, with more consistent relationships observed under unpressured and hybrid planning than under pressured planning. In particular, WM showed clearer associations with both FS frequency and variation when learners were afforded greater planning flexibility, whereas these relationships appeared weaker and less stable under conditions of heightened time pressure.

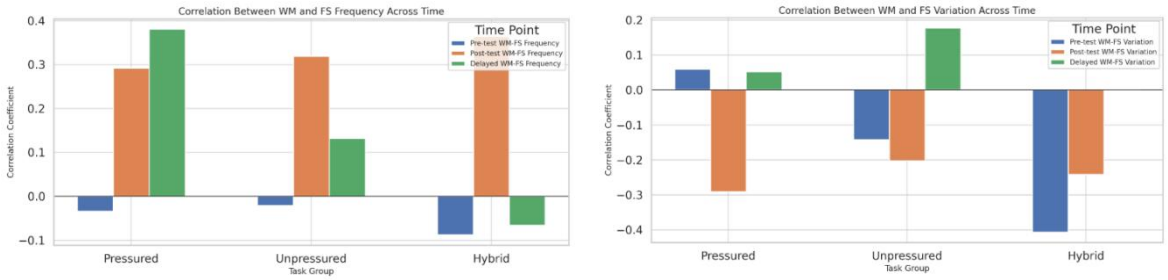

Figure 3. Changes in Correlation Patterns Between WM and FS Measures Across Time

Note. *Upper panel shows correlations between working memory (WM) and formulaic sequence (FS) frequency; lower panel shows correlations between WM and FS variation. Each group (Pressured, Unpressured, Hybrid) shows correlation coefficients at three time points: pre-test (blue), post-test (orange), and delayed post-test (green). Positive values indicate positive correlations; negative values indicate negative correlations. The y-axis represents correlation coefficients ranging from -0.4 to 0.4.*

Regression analyses at the post-test further clarified these patterns. As reported in Table 2, WM significantly predicted FS frequency in all three groups, with the strongest explanatory power observed in the unpressured condition (UOP: $R^2 = .22$, $p = .006$), followed by the hybrid condition (HOP: $R^2 = .19$, $p = .012$) and the pressured condition (POP: $R^2 = .15$, $p = .028$). For FS variation, WM emerged as a significant negative predictor only in the UOP group ($R^2 = .13$, $p = .042$). Although WM emerged as a significant predictor across conditions, the explanatory strength of the regression models differed, a pattern that aligns with the correlation differences illustrated in Figure 3. These results indicate that WM contributes more strongly to formulaic language use when task conditions allow sufficient processing space.

Table 2. Regression Analysis Results for Working Memory Predicting Formulaic Sequence Use at Post-test

Group	Dependent Variable	R^2	F	β	p
Pressured	FS Frequency	.15	5.29	.39	.028*
	FS Variation	.08	2.61	-.28	.116
Unpressured	FS Frequency	.22	8.45	.47	.006**
	FS Variation	.13	4.49	-.36	.042*
Hybrid	FS Frequency	.19	7.03	.44	.012*
	FS Variation	.11	3.71	-.33	.063

Note. *FS = Formulaic Sequence. *p < .05, **p < .01. N = 90 (30 per group).*

These findings partially align with previous research suggesting that working memory capacity does not necessarily change as a result of task manipulation but may exert differential influence depending on task conditions [19,38]. In particular, studies adopting cognitively less constrained tasks have reported stronger associations between working memory and various dimensions of oral performance, highlighting the role of available processing space in enabling learners to deploy cognitive resources more flexibly [47].

At the same time, the relatively attenuated effects of working memory under pressured planning diverge from findings reported in some earlier studies, where working memory remained a strong predictor of fluency-related measures even under time constraints [29]. One plausible explanation for this discrepancy lies in differences in task design and analytical focus. Whereas prior studies often examined general fluency indices or short-term performance in single-task contexts, the present study traced formulaic language use across repeated task cycles, thereby capturing learners' evolving strategic responses to time pressure. From this perspective, reduced visibility of working memory effects under pressured planning may reflect learners' psychological regulation of risk and effort rather than limitations of cognitive capacity per se. Similar condition-dependent patterns have also been observed in studies adopting interaction-based tasks, where individual cognitive advantages were found to be more strongly expressed when learners perceived greater control over task execution [41].

Interview data provide further insight into this contingency. Several learners with relatively high WM capacity reported consciously simplifying their language use when they perceived strong time pressure, despite being aware of alternative expressions. One learner explained that trying more complex formulations felt "*too risky*" when time was limited. This pattern suggests that under pressured planning, learners may strategically underutilize available cognitive resources in favor of communicative safety.

Taken together, these findings indicate that WM does not exert a uniform effect on formulaic language use across task conditions. Instead, its contribution is mediated by learners' perceptions of task demands and their willingness to engage in cognitively demanding language use. By integrating cognitive and psychological perspectives, the present study clarifies why WM effects are more visible under unpressured and hybrid planning than under conditions of high time pressure.

5. Conclusion

This study examined how different online task planning conditions shape the development of formulaic language use and its relationship with working memory across repeated task performance. By adopting a longitudinal design and integrating quantitative measures with learners' interview accounts, the study offers a more nuanced understanding of how planning conditions influence not only observable performance outcomes but also learners' strategic regulation of task demands.

Across the three planning conditions, the findings demonstrate that the effects of task planning on formulaic sequence use are neither uniform nor static. Pressured planning was associated with short-term increases in formulaic sequence frequency but also with reduced variation and a diminished role of working memory in shaping language use. Importantly, these effects were not fully sustained over time, suggesting that learners' responses to time pressure evolve as they become familiar with task demands. This temporal dimension helps explain why some of the present findings diverge from earlier studies based on single-shot task performance.

Under unpressured and hybrid planning conditions, formulaic language development followed a different trajectory. Reduced time pressure allowed working memory capacity to play a more visible role, particularly in supporting flexible and selective use of formulaic expressions. These patterns indicate that the influence of cognitive resources on task performance is contingent on learners' psychological experiences of task demands rather than determined by cognitive capacity alone.

By highlighting condition-specific and time-sensitive patterns, the study contributes to task-based research in two important ways. First, it shows that longitudinal changes in formulaic language use cannot be fully accounted for by linguistic routinization or processing efficiency alone. Second, it demonstrates that learners actively regulate their language use in response to perceived pressure, risk, and effort, resulting in developmental trajectories that differ across planning conditions.

In conclusion, the findings underscore the importance of viewing task planning effects as the outcome of an interaction between cognitive resources and psychological regulation. From a pedagogical perspective, the results suggest that planning conditions can be strategically manipulated to balance fluency support and opportunities for flexible language use in online speaking tasks. Future research may further explore how learners' subjective task experiences interact with instructional design to shape long-term language development. In addition, working memory was assessed using a nonword repetition task, which primarily indexes phonological working memory. Future research could incorporate multi-component measures to capture a broader range of working memory functions.

Conflict of interest

The authors declare no conflict of interest.

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