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The Orthographic Bottleneck in Revising: An Eye-Tracking and Cued Retrospective Recall Study Comparing Skilled Adult Dyslexic and Non-Dyslexic Writers

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Abstract

While developmental dyslexia is traditionally conceptualized as a reading disorder, its persistence into adulthood manifests prominently as a profound and disruptive impairment in written expression. Research on writing products has extensively documented that skilled adult dyslexic writers continue to produce texts characterized by an elevated frequency of spelling errors and compromised mechanical execution. However, the online real-time cognitive mechanisms underlying how these individuals revise their texts remain largely unexplored. This review article proposes and synthesizes a novel paradigm—the Orthographic Bottleneck in Revising. We argue that for skilled adult dyslexic writers, continuous orthographic uncertainty creates a persistent, sub-lexical, low-level cognitive bottleneck during the revision process. By draining limited working memory resources, this bottleneck paradoxically forces adult dyslexic writers to hyper-focus on and fix a larger proportion of surface-level errors, while simultaneously causing them to miss higher-level, macro-structural, and cohesive problems compared to age- and IQ-matched non-dyslexic controls. To bridge existing gaps in the literature—namely, the historical focus of dyslexia research on reading or offline writing products, and the writing community's emphasis on generic expert-novice dichotomies—this paper introduces an integrated methodology combining remote eye-tracking with Cued Retrospective Recall (CRR). By cross-referencing objective fixation metrics (e.g., total fixation duration, regression counts) across distinct Areas of Interest (AOIs) containing either sub-lexical orthographic errors or global text-cohesion failures, alongside subjective retrospective verbalizations, researchers can map the immediate interaction between focal attention and executive metacognitive goals. This review meticulously details the theoretical foundations, operational methodologies, and clinical and pedagogical implications of the Orthographic Bottleneck model, providing a definitive framework for future empirical investigations in Scopus- and Web of Science-indexed publications.

Keywords: Developmental Dyslexia; Cognitive Writing Process; Orthographic Bottleneck; Eye-Tracking; Cued Retrospective Recall; Working Memory Resources; Cognitive Load.

1. Introduction

Developmental dyslexia is a neurobiological learning disability characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities (Lyon et al., 2003). While substantial empirical and clinical attention has been dedicated to mapping the developmental trajectory of reading difficulties from childhood into early adolescence (Snowling, 2000; Vellutino et al., 2004), a significant and growing body of research recognizes that dyslexia is a lifelong condition that persists into adulthood (Becka et al., 2014; Connelly et al., 2006). In higher education and highly literate professional environments, individuals labeled as 'skilled adult dyslexic writers' often achieve high levels of academic and intellectual success, exhibiting intact verbal reasoning, high IQ scores, and sophisticated vocabularies (Topczewski et al., 2020; Wimmer, 1993). However, underneath these macro-level compensations lies a persistent, highly disruptive vulnerability in the mechanical execution of text generation, particularly within orthographic processing and retrieval (Tops et al., 2012; Wengelin, 2007).

When examining the writing product of these individuals, researchers routinely observe elevated rates of spelling misselections, morphology breakdowns, and punctuation errors (Connelly et al., 2006; Lefly & Pennington, 1991). Yet, writing is fundamentally an active, multi-componential cognitive workflow, rather than a passive or instantaneous translation of thought into script (Hayes & Flower, 1980; Kellogg, 1996). According to classic cognitive models of writing, text generation comprises three primary interacting components: planning, translating, and revising (Flower & Hayes, 1981; Hayes, 1996). Among these components, the revision phase holds a distinct status. It is an intensely metacognitive activity requiring writers to read their own drafted text critically, evaluate semantic coherence, diagnose rhetorical structural failures, and execute appropriate changes ranging from sub-lexical orthographic corrections to sweeping macro-structural transformations (Fitzgerald, 1987; McCutchen, 1996).

Despite the cognitive complexity of revision, contemporary dyslexia research exhibits an asymmetric distribution of focus. Studies have traditionally quantified offline writing products—counting spelling errors per hundred words or evaluating overall essay quality metrics—while neglecting the real-time, online cognitive orchestration of the writing process itself (Wengelin et al., 2014). Conversely, mainstream psychological research on writing and revision processes has historically emphasized general expert-novice dichotomies (Bereiter & Scardamalia, 1987; Hayes et al., 1987), tracking how skilled, professional writers adjust macro-text structure while novices focus on surface mechanics. This expert-novice literature entirely overlooks a highly specialized population: adults who are cognitively 'expert' in terms of vocabulary, content knowledge, and academic standing, but remain linguistically and orthographically 'novice' due to a hard-wired neurobiological bottleneck.

> *The Central Theoretical Proposition: The Orthographic Bottleneck in Revising represents an executive crisis where low-level linguistic uncertainty subverts high-level cognitive intentions. Even when an adult dyslexic writer intends to revise for global coherence, the sudden visual encounter with an orthographically ambiguous token triggers an involuntary reallocation of working memory resources, blinding the executive system to concurrent macro-structural failures.*

This review article addresses this theoretical intersection by proposing a new conceptual framework: The Orthographic Bottleneck in Revising. This framework posits that for skilled adult dyslexic writers, continuous orthographic uncertainty (arising from a weak, unstable mental lexicon and fragile orthographic representations) establishes a persistent, low-level cognitive drain during text revision. As these individuals review their text, the sudden encounter with potentially misspelled words or ambiguous word forms consumes significant portions of their central executive and working memory capacity (Baddeley, 2003; Sweller, 1988). Because human working memory is strictly limited in total processing capacity, this sub-lexical burden creates a dramatic cognitive bottleneck. The immediate consequence is a paradoxical, counter-intuitive behavioral split: skilled adult dyslexic writers allocate a disproportionate amount of their online attentional resources to evaluating, worrying about, and correcting surface mechanics, which inadvertently blinds them to higher-level paragraph coherence, argumentation structure, and text-level logical inconsistencies.

To rigorously operationalize and evaluate this bottleneck model, empirical research must move past traditional offline methodology. We present a multi-method experimental paradigm that couples remote eye-tracking with Cued Retrospective Recall (CRR). Eye-tracking offers an objective, millisecond-by-millisecond measure of visual attention and cognitive processing load, capturing exact gaze patterns, regression loops, and total fixation durations across pre-defined Areas of Interest (AOIs) (Rayner, 1998, 2009). However, because long eye fixations can reflect multiple underlying cognitive states (e.g., processing difficulty vs. deep semantic integration), eye-tracking data alone can be ambiguous. By overlaying CRR—where writers review a dynamic replay of their own gaze path immediately after the task and verbalize their conscious thoughts—researchers can directly map objective physiological gaze distributions to subjective metacognitive goals (Guan et al., 2006; van Gog et al., 2005). This review systematically dissects the components of this proposed paradigm, positioning it as a fundamental methodology for future high-impact psycholinguistic and cognitive research.

2. Theoretical Framework and Literature Review

2.1 Cognitive Models of Writing and the Mechanics of Revision

The cognitive architecture of writing has long been framed as a complex, non-linear system of competing mental processes. In the foundational model of Hayes and Flower (1980), writing consists of three major elements: the writer's long-term memory (containing knowledge of topic, audience, and text plans), the external task environment (the writing assignment and the text produced so far), and the central cognitive processes of planning, translating, and reviewing. Reviewing is further subdivided into reading and editing. This model was subsequently expanded by Hayes (1996) to place a greater emphasis on the central role of working memory, executive functions, and the specific cognitive processes involved in text revision.

Revision is inherently a demanding task that requires the simultaneous management of multiple levels of representation (McCutchen, 2000, 2011). To successfully revise a text, a writer must execute a sequence of cognitive operations: (a) reading the generated text to comprehend its current state, (b) comparing the current state of the text against the internal idealized rhetorical goals, (c) detecting a mismatch or error, (d) diagnosing the precise nature of the breakdown (e.g., a spelling slip, a missing transition, or a contradiction in logic), and (e) selecting and executing an appropriate tactical repair strategy (Fitzgerald, 1987; Hayes et al., 1987). Each step relies heavily on the central executive, the visuospatial sketchpad, and the phonological loop (Baddeley, 1992, 2000).

According to the Cognitive Load Theory developed by Sweller (1988) and Chandler and Sweller (1991), human cognitive architecture is strictly constrained by working memory limits. When applied to writing, the Capacity Theory of Writing (Kellogg, 1996, 2001) argues that because planning, execution, and evaluation compete for the same limited pool of central executive resources, an increase in cognitive load in one domain inevitably causes a performance decrement in another. For instance, if the process of translating thoughts into words requires heavy conscious monitoring due to poor keyboarding skills or handwriting mechanics, the writer's ability to engage in high-level planning or structural evaluation is severely compromised (Alves & Limpo, 2015; Christensen, 2004). In the context of revision, if a writer must allocate significant conscious control to identifying or verifying word spelling, fewer cognitive resources remain to analyze whether paragraph configurations support the overarching argument (McCutchen, 1996, 2000).

2.2 The Manifestation of Dyslexia in Skilled Adult Writers

Developmental dyslexia is widely understood to stem from a core deficit in phonological processing—specifically, an impairment in the ability to access, manipulate, and represent the phonological structures of speech sounds (Ramus et al., 2003; Wagner & Torgesen, 1987). While intensive interventions and educational accommodations frequently enable dyslexic individuals to develop highly functional, compensated reading strategies in adulthood, the underlying orthographic core deficit rarely disappears completely (Becka et al., 2014; Bruck, 1992). Adults with dyslexia who achieve entry into higher education or professional careers are categorized as 'skilled adult dyslexics' because they demonstrate intact macro-linguistic comprehension and can comprehend complex texts, yet their sub-lexical processing remains highly effortful and prone to failure (Connelly et al., 2006; Lefly & Pennington, 1991).

Empirical studies looking at the writing products of compensated adult dyslexics show a highly specific profile. When producing essays or summaries under experimental conditions, these writers display a significantly higher density of spelling errors, morphological misuse, and mechanics issues relative to non-dyslexic control groups (Sterling et al., 1998; Tops et al., 2012). Their spelling errors are not merely phonologically inaccurate; they frequently include orthographically legal but contextually inappropriate homophone choices (e.g., 'their' vs. 'there'), omissions of silent letters, or severe disruptions in multi-syllabic word construction (Wengelin, 2007).

Crucially, keystroke logging investigations (e.g., using programs like Inputlog or ScriptLog) reveal that adult dyslexic writers display distinct temporal patterns during text generation.

They exhibit shorter bursts of continuous text creation, elongated pauses immediately before typing difficult orthographic tokens, and frequent, highly disruptive self-corrections at the single-character or single-word level (Wengelin, 2007; Wengelin et al., 2014). This indicates that the act of writing remains a highly conscious, stressful, and mechanically exhausting experience. The automatization of spelling—which allows non-dyslexic adults to generate text with minimal conscious attention to sub-lexical components—fails to mature fully in the dyslexic brain, leaving the individual in a state of chronic linguistic vulnerability during composition (McCutchen, 2011; Torrance & Galbraith, 2006).

2.3 Eye-Tracking and Cognitive Appraisals in Writing Process Research

To capture these online cognitive processes as they occur, researchers have increasingly turned to eye-tracking technology. Historically, eye-tracking has been used to study reading comprehension, establishing a robust vocabulary of metrics that track lexical access and syntactic processing (Rayner, 1998, 2009). For example, first fixation duration and gaze duration are reliable indicators of early lexical processing, whereas total fixation duration and regressions (backward eye movements) reflect late, macro-structural integration difficulties and re-parsing effort (Rayner et al., 2006).

Over the past two decades, eye-tracking has been successfully extended into writing and revision research (Alamargot et al., 2006; Torrance et al., 2016). When a writer revises a text, their eyes do not simply move linearly from left to right; instead, they exhibit complex patterns of look-backs, jumps across paragraphs, and extended fixations on specific words or syntactical structures (Wengelin et al., 2009). Studies comparing expert and novice writers reveal that expert writers exhibit extensive global reading behaviors during revision, with their eyes frequently scanning across distant sentences to evaluate textual cohesion and narrative flow (Breetvelt et al., 1994; Chanquoy, 2001). Conversely, novice writers exhibit local, highly constrained eye movements, focusing almost exclusively on the immediate word or phrase currently under the cursor, which reflects a limited mental representation of the text (Bereiter & Scardamalia, 1987).

However, eye-tracking metrics are inherently limited by what is known as the 'mind-eye ambiguity' (Holmqvist et al., 2011). A prolonged total fixation duration on a specific word could indicate that the writer is struggling to spell it, or alternatively, that the writer is using that word as a conceptual anchor while planning a major structural reorganization of the surrounding paragraph. To resolve this ambiguity, writing researchers have adopted Cued Retrospective Recall (CRR) paradigms (Guan et al., 2006; van Gog et al., 2005). Derived from Ericsson and Simon’s (1993) protocol analysis methods, CRR involves presenting the participant with a visual cue—specifically, a video replay of their own eye movements across the screen—immediately following the completion of the task. This cue serves as a powerful retrieval prompt, allowing the participant to accurately reconstruct their working memory states and cognitive goals without the intrusive interference associated with concurrent ('think-aloud') verbalizations during the task (Russo et al., 1989). Combining eye-tracking with CRR provides a robust framework to match physiological data directly with psychological intent.

3. Identifying the Tripartite Literature Gap

Despite the maturity of these individual research domains, an examination of the literature reveals a significant tripartite gap at their intersection. This gap represents an important theoretical and methodological omission that limits our understanding of neurobiological learning differences and cognitive writing frameworks.

Table 1. Tripartite Literature Gap Matrix in Cognitive Writing and Dyslexia Research

Research Domain	Traditional Focus / Scope	Omission / Blind Spot	Proposed Solution / Target
Dyslexia Research	Reading fluency, child phonology, and offline writing products (e.g., counting spelling errors).	Neglects real-time, online cognitive processing during revision in adult populations.	Map online processing mechanisms of compensated adult dyslexics during active editing.
Revision Research	Expert-novice general differences, task environments, and strategic text interventions.	Fails to consider neurobiological learning differences (e.g., persistent orthographic deficits).	Integrate neurobiological constraints into cognitive architecture models of revision.
Methodological Paradigms	Isolated eye-tracking or keystroke logging; standalone think-aloud verbal protocols.	Fails to link objective eye fixations to subjective metacognitive revision intentions.	Combine remote eye-tracking with Cued Retrospective Recall (CRR) protocols.

3.1 The Dyslexia Research Gap: Isolation of Product Over Process

The first major gap lies in how dyslexia research has historically approached writing. For decades, clinical and educational diagnoses have relied on offline assessments—such as standardized spelling batteries or holistically scored essay tasks (Lefly & Pennington, 1991; Sterling et al., 1998). While these methods are useful for identifying performance deficits, they treat the writing process as a black box. They document that adult dyslexics make more mistakes, but fail to explain *how* those mistakes alter the writer's cognitive attention during the task. Keystroke logging has begun to address this by tracking pause locations (Wengelin, 2007), but it cannot track visual attention when a writer is reading back over a text without typing. Without tracking gaze patterns, it is impossible to determine whether a dyslexic writer misses an error because they failed to look at it, or because they looked at it but failed to process it correctly.

3.2 The Revision Research Gap: The Blind Spot for Neurobiological Diversity

The second gap exists within mainstream cognitive writing research, which has largely operated under the assumption of a neurotypical cognitive architecture. Models such as those by Hayes (1996) and Kellogg (1996) assume that as a writer gains experience, low-level mechanics become fully automated, freeing up working memory for higher-level processes. Consequently, writing research has focused almost exclusively on the expert-novice continuum (Bereiter & Scardamalia, 1987). This focus creates a major blind spot for populations like skilled adult dyslexics, who possess advanced conceptual and academic skills but continue to experience low-level mechanical difficulties. Current cognitive writing models fail to account for how a lifelong neurobiological deficit disrupts this expected progression toward automated text production.

3.3 The Methodological Gap: The Disconnect Between Gaze and Metacognitive Intent

The third gap is methodological. While eye-tracking provides precise data regarding visual attention during writing (Alamargot et al., 2006; Torrance et al., 2016), it cannot independently identify the writer's internal motivations. For example, a long fixation on a word could indicate a spelling issue or a broader evaluation of paragraph flow. Conversely, while verbal protocols (such as think-aloud tasks) capture a writer's conscious goals, they are highly intrusive and can disrupt the natural flow of writing and revising (Ericsson & Simon, 1993). No study to date has integrated eye-tracking with Cued Retrospective Recall (CRR) to investigate text revision in adult dyslexic writers. By using the participant's own gaze path as a retrieval prompt, CRR allows researchers to connect objective eye-movement metrics with the writer's conscious metacognitive goals, bridging the gap between physiological behavior and cognitive intent.

4. The Orthographic Bottleneck in Revising: A New Conceptual Framework

To address these gaps, we propose a new conceptual framework: The Orthographic Bottleneck in Revising. This framework integrates Capacity Theory (Kellogg, 1996) with Cognitive Load Theory (Sweller, 1988), adapting them to account for the unique cognitive profile of skilled adult dyslexics. The core argument is that for adult dyslexics, orthographic processing never becomes fully automatic. Instead, it remains a conscious, resource-intensive task that creates a continuous drain on the central executive during revision.

4.1 The Mechanism of the Sub-Lexical Drain

In neurotypical adult writers, word recognition and orthographic verification are largely automated (Rayner, 1998). When reading their own text, these writers can quickly process surface features, leaving their working memory free to evaluate macro-structural elements like thematic coherence and logical flow (McCutchen, 2000). This efficient allocation of cognitive resources is illustrated in the equation below:

$$\text{WM\_Total} = \text{WM\_Orthographic} + \text{WM\_Structural} + \text{WM\_Residual}$$

For non-dyslexic adult writers, the cognitive resources required for orthographic processing are minimal, which can be expressed as:

Europe
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$$\text{WM\_Orthographic} \rightarrow 0 \Rightarrow \text{WM\_Structural} \approx \text{WM\_Total}$$

This allocation allows the writer to maximize the working memory resources dedicated to evaluating text structure and cohesion ($WM_{Structural}$).

In contrast, for skilled adult dyslexic writers, orthographic processing requires continuous, conscious effort due to unstable lexical representations in the mental lexicon. When a dyslexic writer encounters a word with an ambiguous spelling or morphology, the cognitive load spikes sharply, which can be modeled as:

$$\Delta \text{WM\_Orthographic} >> 0 \Rightarrow \text{WM\_Structural} = \text{WM\_Total} - \text{WM\_Orthographic}$$

As a result, the capacity remaining for higher-level structural processing ($WM_{Structural}$) is significantly reduced, creating an orthographic bottleneck that limits the writer's ability to address macro-structural text issues.

4.2 The Surface-Error Paradox

This bottleneck leads to a behavioral pattern we term the Surface-Error Paradox. Because orthographic issues demand immediate cognitive attention, adult dyslexic writers often fix a higher absolute number of surface-level errors (such as spelling and punctuation) than non-dyslexic controls. However, this focus comes at a high cognitive cost. The constant demands of orthographic verification consume the working memory resources needed to maintain a global representation of the text, leaving the writer with a fragmented view of their own writing.

Consequently, while dyslexic writers may successfully correct individual words, they often fail to notice larger, structural issues, such as missing transitions between paragraphs or contradictions in their arguments. This is not due to a lack of high-level reasoning skills, but rather a direct consequence of a limited cognitive capacity caused by the demands of low-level linguistic processing.

5. Proposed Methodology: Testing the Bottleneck

To empirically evaluate the Orthographic Bottleneck framework, we propose an experimental design that combines remote eye-tracking with Cued Retrospective Recall (CRR). This dual-method approach allows researchers to gather objective data on visual attention alongside subjective insights into the writer's conscious cognitive goals.

5.1 Participant Selection and Matching Framework

To ensure a valid comparison, the study requires a sample of skilled adult dyslexic writers and carefully matched non-dyslexic controls. Participants in the experimental group must have a formal, documented clinical diagnosis of developmental dyslexia established in childhood or adolescence. To confirm the persistence of the condition into adulthood, researchers should administer a standardized battery of psycholinguistic tests, including word reading efficiency (e.g., TOWRE-2) and pseudoword decoding metrics.

The control group must be closely matched to the dyslexic group on age, gender balance, and general intellectual capability (IQ), as measured by standardized assessments like the Wechsler Adult Intelligence Scale (WAIS-IV). All participants must have normal or corrected-to-normal vision and demonstrate proficient keyboarding skills to minimize typing speed variations. Selecting a sample of university students or professionals ensures that both groups possess equivalent high-level conceptual and vocabulary skills, allowing researchers to isolate the effects of the orthographic deficit.

5.2 Experimental Task Design and Area of Interest (AOI) Configuration

The experimental procedure consists of two main phases: an initial composition phase and a subsequent revision phase. In the composition phase, participants are given a standardized prompt to write a short argumentative essay (300-400 words) directly into a text editor. The prompt should focus on a general academic topic that requires logical reasoning but no specialized prior knowledge. This text editor is integrated with a remote eye-tracker (sampling at a minimum of 250 Hz to 500 Hz) to record eye movements during the task.

In the revision phase, participants are instructed to review and improve their drafted essay, with full freedom to make edits. Crucially, the experimenters pre-define specific Areas of Interest (AOIs) within the text to evaluate how participants distribute their attention. These AOIs are categorized into two primary types:

1. Sub-Lexical/Surface AOIs: Individual words containing common spelling errors, morphosyntactic slips, or typographical mistakes made during the initial draft.
2. Macro-Structural/Cohesion AOIs: Complete sentences or paragraph boundaries that contain structural weaknesses, such as missing transition phrases, ambiguous pronoun references, or logical gaps.

5.3 Eye-Tracking Metric Selection

To quantify the cognitive load associated with different text elements, the eye-tracker records several key metrics within the pre-defined AOIs:

- Total Fixation Duration (TFD): The cumulative duration of all fixations falling within an AOI, serving as a primary indicator of overall cognitive processing load.
- Gaze Duration (GD): The sum of all fixation durations from the moment the eye enters the AOI until it leaves, reflecting early, text-based processing.
- Regression Count (RC): The number of times the eye moves backward into an AOI from a later point in the text, indicating re-parsing effort and text integration difficulties.
- Fixation Count (FC): The absolute number of discrete fixations within an AOI, providing a measure of structural complexity and inspection frequency.

5.4 Cued Retrospective Recall (CRR) Protocol Implementation

Immediately following the revision phase, participants complete the Cued Retrospective Recall (CRR) protocol. The researcher plays back a dynamic video recording of the participant's eye movements during the revision task. This recording shows the text on screen with a moving overlay representing the participant's gaze path and fixations. This visual feedback serves as a non-intrusive memory prompt (van Gog et al., 2005).

The researcher pauses the video at key points—specifically when the gaze enters a pre-defined Surface or Structural AOI—and asks a standardized question: 'What were you thinking when you looked here?' The participant's verbal responses are audio-recorded, transcribed, and coded using a systematic framework. Statements are classified into categories such as 'Low-Level Mechanical Worry' (e.g., checking spelling), 'High-Level Structural Planning' (e.g., evaluating paragraph transitions), or 'No Conscious Meta-Goal'. This qualitative data is then paired with the eye-tracking metrics to provide a detailed view of the participant's cognitive processing.

6. Expected Hypotheses and Empirical Predictions

Based on the Orthographic Bottleneck framework, we present several specific empirical predictions regarding eye-movement patterns and verbal reports during the revision task.

6.1 Gaze Parameter Hypotheses (Quantitative)

Hypothesis 1a (Surface AOIs): Skilled adult dyslexic writers are expected to exhibit significantly higher Total Fixation Durations (TFD) and Regression Counts (RC) within Surface AOIs compared to non-dyslexic controls. This prediction reflects the extra cognitive effort required for orthographic verification, as dyslexic writers repeatedly check ambiguous word forms to confirm spelling accuracy.

Hypothesis 1b (Structural AOIs): Conversely, within Macro-Structural AOIs, adult dyslexic writers are predicted to display significantly lower Total Fixation Durations and fewer Regressions than control participants. Because working memory capacity is consumed by low-level orthographic processing, dyslexic writers are expected to spend less time evaluating macro-structural text elements, often missing structural weaknesses entirely.

6.2 Verbalization Profile Hypotheses (Qualitative)

Hypothesis 2a: Analysis of the CRR transcripts is expected to show that adult dyslexic writers produce a significantly higher proportion of statements coded as 'Low-Level Mechanical Worry' when fixating on Surface AOIs compared to controls. Their verbal reports are predicted to focus on spelling anxiety, character-by-character verification, and uncertainty regarding word morphology.

Hypothesis 2b: Within Macro-Structural AOIs, non-dyslexic controls are expected to produce detailed verbalizations regarding 'High-Level Structural Planning' and text cohesion. In contrast, adult dyslexic writers are predicted to show a high rate of structural omissions, either reporting no conscious awareness of cohesive issues or misinterpreting structural prompts as opportunities for surface-level corrections. This divergence would support the hypothesis that low-level processing demands disrupt high-level metacognitive monitoring.

7. Synthesis and Discussion: Theoretical and Practical Implications

The Orthographic Bottleneck framework has significant theoretical implications for our understanding of learning differences and writing research. By demonstrating that a low-level orthographic deficit can disrupt high-level text revision, this model challenges traditional expert-novice paradigms. It shows that adult dyslexic writers can possess advanced conceptual and vocabulary skills while exhibiting local, resource-constrained processing behaviors typically seen in novice writers. This highlights the importance of incorporating neurobiological diversity into cognitive models of writing, recognizing that persistent mechanics issues can fundamentally alter how individuals manage limited working memory resources.

Practically, these findings suggest a need to re-evaluate writing instruction and support for dyslexic individuals in higher education and professional settings. Traditional interventions often focus on teaching general composition strategies or essay structure. However, if a writer's primary challenge is an orthographic bottleneck that drains working memory, strategy instruction alone may be insufficient. Instead, interventions should focus on reducing low-level cognitive load. Providing access to advanced spell-checking software, text-to-speech tools, or dedicated copy-editing support can assist with mechanical verification, allowing dyslexic writers to better allocate their cognitive resources toward high-level organization and structural refinement.

Future research should explore how different types of writing tasks and environmental factors influence the severity of the orthographic bottleneck. For instance, investigating whether writing under timed conditions amplifies the bottleneck, or whether the use of speech-to-text technology helps mitigate it, would provide valuable insights. Additionally, extending this multi-method approach to other learning differences, such as dysgraphia or specific language impairments, could help identify unique cognitive profiles across diverse writing populations, contributing to more targeted and effective support strategies.

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