Impaired Semantic Guidance in Visual Search Differentiates Prodromal Dementia with Lewy Bodies from Alzheimer's Disease

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Abstract

Dementia with Lewy bodies (DLB) and Alzheimer's disease (AD) show substantial symptom overlap at the prodromal stage, complicating early differential diagnosis. To identify markers of cognitive dysfunction, we investigated visual search performance in prodromal DLB (LB-MCI), prodromal AD (AD-MCI), and healthy controls across four levels of target visual richness: Gabor patches, abstract shapes, mid-level forms, and real-world objects. While increased stimulus richness improved search performance across all groups, LB-MCI participants exhibited a selective impairment in target-present searches involving real-world objects, despite perceptual sensitivity comparable to that of AD-MCI participants. Moreover, unlike healthy older adults, both clinical groups failed to adaptively shift decision thresholds as stimulus complexity increased. These findings suggest that prodromal DLB is associated with difficulty leveraging semantic information to guide visual search, reflecting impaired deployment of semantic target templates rather than early perceptual discrimination deficits.

Keywords: visual search; Dementia with Lewy bodies; Alzheimer's disease; semantic guidance; visual richness

Introduction

Dementia with Lewy bodies (DLB) is the second most common neurodegenerative dementia and is often misdiagnosed as Alzheimer's disease (AD), particularly in its early stages (Prasad et al., 2023; Walker et al., 2015). Consequently, DLB at the prodromal stage of mild cognitive impairment (LB-MCI) remains under-investigated and frequently misdiagnosed (D'Antonio et al., 2021; see Russo et al., 2022 for evidence of a 26% prevalence in an Italian cohort), representing a major challenge for clinical management. While AD patients typically present with memory concerns, DLB is characterised by more pronounced deficits in visuoperceptual, visuospatial, and executive attentional functions (Collerton et al., 2003; Jellinger, 2023; Wyman-Chick et al., 2024). In fully developed DLB, visual hallucinations affect approximately 72% of patients (McKeith et al., 2020). This clinical marker suggests the visual system plays a pivotal role in characterising DLB pathology, potentially before hallmark symptoms become clinically manifest.

The behavioural output of the visual system, particularly eye movements, is highly sensitive to neurodegeneration due to its close coupling with attentional control (Anderson & MacAskill, 2013). Abnormalities are frequent in anti-saccade tasks, in which individuals with MCI and AD show difficulties suppressing exogenous cues and reorienting attention endogenously (Heuer et al., 2013; Wilcockson et al., 2019). Such impairments extend to fixation-based measures, including shorter scan-paths during free viewing (Care et al., 2023), reduced novelty preference in visual memory tasks (e.g., Crutcher et al., 2009), and increased fixation counts in simple visual search, such as letter detection in visually noisy backgrounds (Xue et al., 2022; see Verón et al., 2026 for a recent review).

Despite this evidence, systematic investigations employing visual search in people with dementia remain scarce, particularly in DLB populations vulnerable to visuospatial and attentional deficits. Visual search requires locating a target among distractors by balancing stimulus-driven (bottom-up) salience with goal-directed (top-down) guidance (Van Zoest & Donk, 2004; Wolfe, 2021). Thus, search performance provides a valuable window into the interaction between sensory information and cognitive control, potentially pinpointing distinct processing breakdowns across neuropathologies. Previous work reported reduced search efficiency in DLB compared to AD using geometric shapes (Cormack et al., 2004), and impaired conjunction search in both groups (Landy et al., 2015). Within the AD spectrum, eye-tracking studies using real-world objects revealed decreased accuracy and increased distractor fixations (Eraslan Boz et al., 2024; Pereira et al., 2020), even though high-level semantic access may remain preserved (Cimminella et al., 2022; but see Yamada et al., 2024 for contrasting evidence in naturalistic scenes).

In sum, the literature lacks a systematic investigation of how target selection and distractor suppression unfold as a function of stimulus complexity. A critical question is whether target selection efficiency changes as stimuli vary in informational richness, from simple low-level features to complex, semantically rich objects. This study aims to determine whether visual search performance depends on the type of information available and to identify the point along this complexity continuum at which search behaviour differentiates between early-stage neurodegenerative diseases.

The current study

A visual search paradigm is employed to systematically examine how bottom-up salience and top-down guidance are modulated by stimulus complexity in early-stage neurodegeneration. We manipulated the informational richness of visual stimuli across four levels: low-level

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Gabor patches, Abstract geometric Forms, Mid-level structural Forms, and high-level semantic Real-world Objects. The core objective was to characterise performance profiles of individuals with LB-MCI and AD-MCI relative to healthy older (HO) adults across this continuum, identifying where target detection accuracy diverges. Using Signal Detection Theory, we further assessed whether performance changes reflect impaired target–distractor discrimination (sensitivity, d′) or shifts in decision strategy (criterion, C).

We anticipated that LB-MCI participants would exhibit more pronounced deficits than the AD-MCI group in geometric and structural integration (abstract Shape and Midform conditions), as reported by Cormack et al. (2004). Conversely, following Cimminella et al. (2022), we expected HO and AD-MCI participants to benefit from increased stimulus richness by leveraging semantic and structural cues. We hypothesised this benefit would be attenuated or absent in LB-MCI, reflecting difficulty in the verbal-to-visual mapping required to convert word cues into stable visual representations of the target. Finally, as complexity increased, we expected both clinical groups to show reduced discriminability (d′) relative to HO adults, potentially with a more conservative response criterion (C), reflecting a strategic shift toward uncertainty avoidance as visual information becomes richer.

Methods

Participants

The clinical sample was recruited at the Department of Human Neurosciences, Sapienza University Hospital of Rome, comprising individuals with prodromal Dementia with Lewy Bodies (LB-MCI; N=20) and prodromal Alzheimer's disease (AD-MCI; N=12), alongside 24 healthy older (HO) controls (Total N=56; demographics in Table 1). LB-MCI diagnoses followed McKeith et al. (2020), and AD-MCI followed NIA-AA criteria (Albert et al., 2011). Participants (ages 54–85) had >3 years of education and normal/corrected vision. Exclusion criteria included substance abuse, major psychiatric or neurological disorders, severe medical conditions and the inability to complete at least two visual search tasks. Groups differed significantly in age, education, and MMSE (Table 1); patient groups were generally older, less educated, and scored lower on the MMSE than controls. The study was approved by the local ethics committee (Comitato Etico Territoriale Lazio Area 1) and conducted per the Declaration of Helsinki.

Apparatus

Eye movements were recorded using an SR Research EyeLink 1000 desktop-mounted system sampling at 1000 Hz. Visual stimuli were presented on a 1920 × 1080-pixel Dell monitor at a viewing distance of 60 cm, with head position stabilised using a chin-and-forehead rest. Viewing was binocular, but only the dominant eye was tracked.

Table 1. Demographic and clinical characteristics of the study sample. Values are reported as mean ± standard deviation unless otherwise indicated. Group differences in continuous variables (Age, Education, MMSE) were assessed using Kruskal–Wallis tests ([a]), followed by Dunn post-hoc comparisons with Benjamini–Hochberg FDR correction where appropriate. Group differences in sex distribution were assessed using chi-square tests ([b]). HO = Healthy older controls; LB-MCI = Lewy body mild cognitive impairment; AD-MCI = Alzheimer's disease mild cognitive impairment; MMSE = Mini-Mental State Examination.

Variable	HO (n = 24)	LB-MCI (n = 20)	AD-MCI (n = 12)	*p*
Age	67.9 ± 6.5	73.4 ± 6.4	70.5 ± 7.1	.015[a]
Education	15.7 ± 3.2	11.6 ± 4.5	15.4 ± 2.4	.006[a]
MMSE	28.8 ± 0.9	27.0 ± 2.0	26.7 ± 3.2	.002[a]
Female, n (%)	18 (75%)	11 (55%)	4 (33%)	.058[b]

[a] Kruskal–Wallis test.

[b] Fisher's exact test.

Simultaneously, EEG data were acquired using a 32-channel BrainAmp™ system sampled at 1000 Hz. Electrodes were positioned according to the international 10–10 system and referenced online to FCz, with the right mastoid serving as ground. Horizontal and vertical electrooculograms (EOGs) monitored ocular activity. Electrode impedances were kept below 5 kΩ. Signals were amplified with a band-pass filter of 0.01–70 Hz and a 50 Hz notch filter. Eye-tracking and EEG data streams were synchronised with stimulus onset using TTL timestamps in MATLAB and Psychophysics Toolbox Version 3 (PTB). Although co-registered to examine time-locked neural dynamics, the present paper focuses exclusively on behavioural data; electrophysiological and oculomotor analyses will be reported in future work.

Visual stimuli

Four stimulus sets represented a continuum of increasing visual and semantic complexity (Figure 1C). The lowest level consisted of Gabor patches (oriented sinusoidal gratings modulated by a Gaussian envelope). The second level comprised abstract geometric shapes generated using Cassini ovals (Bertamini et al., 2016). For these tasks, cue, competitor, and distractor stimuli were created by manipulating shape regularity and angular structure. Midform stimuli were selected from a dataset by Long et al. (2018) and included equal exemplars of Big/Small Animals and Objects. Finally, real-world object stimuli were selected from Cimminella et al. (2022) that matched the midform categories. To align with the original study (Cimminella et al., 2022), the cue was presented as a written word while the search array consisted of visual objects, requiring a cross-modal verbal-to-visual mapping.

Experimental design and task conditions

Participants first completed an antisaccade task (Wilcockson et al., 2019) to assess endogenous attentional control (Figure 1A), comprising 36 prosaccade and 36 antisaccade trials. As this study focuses on visual search, analyses of the saccadic task will be reported separately.

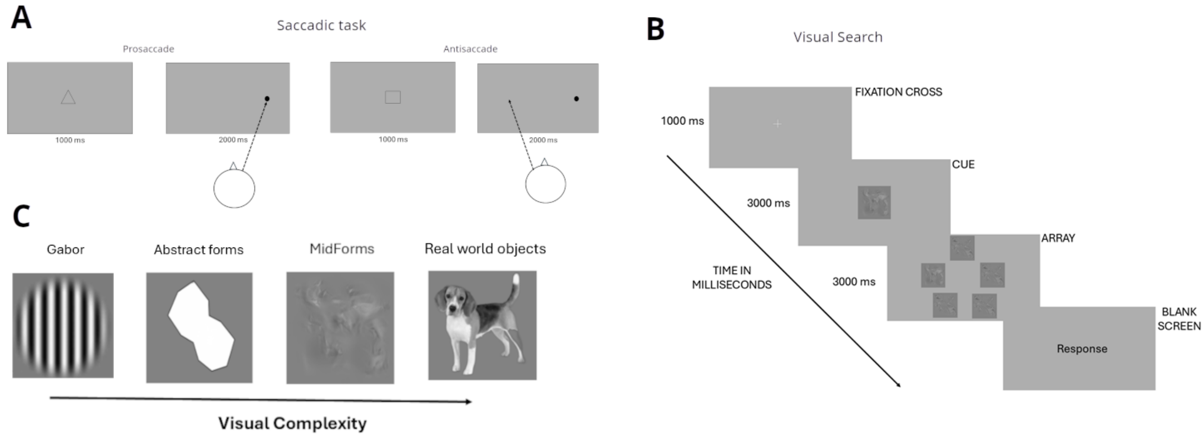

Figure 1. (A) Saccadic task: A cue symbol is presented centrally for 2 seconds, instructing the participant to saccade either towards the dot (pro-saccade, triangle) or in the opposite direction (anti-saccade, square). (B) Search task: After a fixation cross (1 sec), the search target is cued for 3 seconds, then a visual array is presented, and participants indicate vocally whether the cued target was present (or not). (C) Visual complexity: Examples of visual stimuli increasing in perceptual and semantic complexity are used in the visual search tasks.

Participants then completed four visual search tasks (80 trials each), divided equally between target-present and target-absent conditions (Figure 1B). Distractor homogeneity was manipulated to create pop-up and no-pop-up scenarios. In pop-up conditions, the array contained the target (or competitor) and four homogeneous distractors that differed markedly from the target (e.g., target Gabor target distance ±20° vs distractor ±30° or more). In no-pop-up conditions, distractors varied in features, increasing difficulty. For Midform and real-world tasks, distractors were additionally manipulated according to semantic relatedness (related vs unrelated categories). Effects of pop-up salience and semantic relatedness are not examined here, as the primary objective is to compare overall search efficacy across complexity levels.

Procedure

Each task began with a nine-point eye-tracker calibration. The central cue was followed by an eccentric stimulus array. Each stimulus (150 × 150 pixels; 3.98° visual angle) was positioned 4.72° from the centre with a 5.41° angular separation, ensuring parafoveal placement. Trials started with a 1000 ms fixation cross, followed by a central cue for 3000 ms (reduced to 1200 ms for word cues in the real-object task). The stimulus array was displayed for 3000 ms, followed by a blank screen until a vocal response was produced. The experimenter recorded whether the participant indicated the target was present ("C" key) or absent ("N" key). The session lasted approximately 2 hours (392 total trials), with breaks every 8 trials to minimise fatigue.

Data analysis

Analyses were conducted on behavioural data only. Binomial tests indicated that participants' performance exceeded the chance level (50%); one participant performed below it and was excluded, leaving 55 participants for analysis. Mean probability of correct responses indicated adequate overall task comprehension: 0.881 ± 0.035 in HO, 0.800 ± 0.102 in LB-MCI, and 0.839 ± 0.081 in AD-MCI. Each participant had to complete 80 trials per task (17,600 expected trials total). Of these, 1,849 trials (10.5%) timed out without a response, leaving 15,751 trials for analysis. Behavioural performance was indexed by trial-level detection accuracy and signal-detection measures of sensitivity (d') and response bias (criterion C). Sensitivity (d') was computed based on the target-present/target-absent structure of the task, defining hit rates as "present" responses on target-present trials and false alarm rates as "present" responses on target-absent trials. These frequencies were provided as input to the `dprime()` function from the `psycho` package in `R`. Trial-level accuracy was analysed using generalised linear mixed-effects models (GLMMs) with a binomial link function, including Task (Gabor, Abstract shape, Midform, Real object), Group (HO, LB-MCI, AD-MCI), and their interaction as fixed effects, with participant as a random intercept. Signal detection measures were analysed using linear mixed-effects models (LMMs) with the same fixed-effects structure. All statistical analyses were performed in R (version 4.5.2) using the `lme4` package. P-values for LMMs were obtained using Satterthwaite's approximation, while GLMM significance was assessed via asymptotic Wald tests. Post hoc pairwise comparisons were conducted on estimated marginal means and corrected using Tukey's method.

Results

Target Detection Accuracy

As expected, participants were more accurate in target-present than target-absent trials ($\beta = 2.24$, $z = 17.32$, $p < .001$). Detection accuracy increased with stimulus richness across groups, progressively improving from Gabor patches to real-world objects, indicating that structural and semantic information facilitated search.

Table 2. GLMM outputs for trial-level accuracy. Predictors included Target (Absent vs. Present; reference = Absent), Task (Gabor Patch, Abstract Shape, Midform Object, Real Object; reference = Gabor Patch), and Group (HO, LB-MCI, AD-MCI; reference = HO), including all interaction terms. Models included a random intercept for participant. β coefficients are reported on the log-odds scale. Significance was assessed using Wald z-tests.

Predictor	β	SE	CI (2.5%; 97.5%)	z-value
Target: Present	2.24	0.13	[1.99, 2.49]	17.32***
Task: Abstract Shape	2.72	0.16	[2.42, 3.03]	17.41***
Task: Midform object	3.27	0.19	[2.89, 3.64]	17.00***
Task: Real Object	4.16	0.28	[3.62, 4.70]	15.12***
Group: LB-MCI	−0.070	0.19	[−0.44, 0.30]	−0.37
Group: AD-MCI	−0.063	0.23	[−0.51, 0.38]	−0.28
Present × Abstract Shape	−2.82	0.22	[−3.25, −2.39]	−12.77***
Present × Midform object	−3.14	0.25	[−3.64, −2.65]	−12.46***
Present × Real Object	−3.24	0.34	[−3.91, −2.58]	−9.55***
Present × LB-MCI	−0.94	0.18	[−1.30, −0.59]	−5.20***
Present × AD-MCI	−0.58	0.22	[−1.02, −0.15]	−2.62**
Abstract Shape × LB-MCI	−0.99	0.21	[−1.40, −0.58]	−4.73***
Midform object × LB-MCI	−1.07	0.25	[−1.56, −0.57]	−4.24***
Real Object × LB-MCI	−1.85	0.32	[−2.47, −1.23]	−5.86***
Abstract Shape × AD-MCI	−0.57	0.26	[−1.06, −0.066]	−2.22*
Midform object × AD-MCI	−1.44	0.27	[−1.97, −0.90]	−5.28***
Real Object × AD-MCI	−1.70	0.34	[−2.37, −1.02]	−4.93***
Present × Abstract Shape × LB-MCI	0.91	0.29	[0.34, 1.48]	3.12**
Present × Midform object × LB-MCI	1.08	0.33	[0.43, 1.73]	3.27**
Present × Real Object × LB-MCI	1.70	0.40	[0.91, 2.48]	4.23***
Present × Abstract Shape × AD-MCI	0.78	0.36	[0.081, 1.48]	2.19*
Present × Midform object × AD-MCI	1.59	0.38	[0.84, 2.34]	4.15***
Present × Real Object × AD-MCI	2.03	0.47	[1.12, 2.94]	4.36***

(*) p < .10, *p < 0.05, **p < .01, ***p < .001

Table 3. LMM outputs for sensitivity (d′). Predictors included Task (Gabor Patch, Abstract Shape, Midform Object, Real Object; reference = Gabor Patch) and Group (HO, LB-MCI, AD-MCI; reference = HO), including their interaction. Models included a random intercept for the participant. β coefficients reflect changes in d′ relative to reference levels. Significance was assessed using t-tests with Satterthwaite approximation.

Predictor	β	SE	CI (2.5%; 97.5%)	t-value
Task: Abstract Shape	1.38	0.13	[1.13, 1.64]	10.48***
Task: Midform Object	1.64	0.13	[1.38, 1.90]	12.45***
Task: Real Object	2.01	0.13	[1.76, 2.27]	15.47***
Group: LB-MCI	−0.17	0.18	[−0.52, 0.19]	−0.91
Group: AD-MCI	−0.066	0.22	[−0.50, 0.36]	−0.30
Task Abstract × LB-MCI	−0.49	0.21	[−0.90, −0.087]	−2.38*
Task Midform × LB-MCI	−0.45	0.21	[−0.86, −0.039]	−2.15*
Task Real × LB-MCI	−0.61	0.20	[−1.01, −0.21]	−2.99**
Task Abstract × AD-MCI	−0.28	0.25	[−0.77, 0.20]	−1.14
Task Midform × AD-MCI	−0.63	0.25	[−1.11, −0.14]	−2.50*
Task Real × AD-MCI	−0.66	0.24	[−1.13, −0.18]	−2.72**

(*) p < .10, *p < 0.05, **p < .01, ***p < .001

However, significant three-way interactions (target presence × task × group) revealed that this benefit was not uniform across tasks and groups. The most pronounced divergence emerged in target-present trials with real-world objects (Table 2). Tukey-corrected post hoc comparisons of estimated marginal means showed AD-MCI performed comparably to HO, whereas LB-MCI exhibited significantly lower accuracy than both HO (OR = 3.21, SE = 0.82, p < .001) and AD-MCI (OR = 0.43, SE = 0.13, p = .014). This selective impairment aligns with the hypothesis that LB-MCI participants struggle to form an effective visual representation of verbally cued targets.

Table 4. LMM outputs for decision criterion (C). Predictors included Task (Gabor Patch, Abstract Shape, Midform Object, Real Object; reference = Gabor Patch) and Group (HO, LB-MCI, AD-MCI; reference = HO), including their interaction. Models included a random intercept for participant. β coefficients reflect changes in C relative to reference levels. Significance was assessed using t-tests with Satterthwaite approximation.

Predictor	β	SE	CI (2.5%; 97.5%)	t-value
Task: Abstract Shape	0.70	0.070	[0.56, 0.84]	10.00***
Task: Midform Object	0.81	0.070	[0.68, 0.95]	11.60***
Task: Real Object	0.95	0.069	[0.81, 1.08]	13.66***
Group: LB-MCI	0.064	0.086	[−0.10, 0.23]	0.75
Group: AD-MCI	0.052	0.10	[−0.15, 0.25]	0.50
Task Abstract × LB-MCI	−0.22	0.11	[−0.43, 0.0013]	−1.97
Task Midform × LB-MCI	−0.24	0.11	[−0.46, −0.023]	−2.17*
Task Real × LB-MCI	−0.36	0.11	[−0.57, −0.15]	−3.35**
Task Abstract × AD-MCI	−0.17	0.13	[−0.42, 0.092]	−1.26
Task Midform × AD-MCI	−0.33	0.13	[−0.59, −0.069]	−2.48*
Task Real × AD-MCI	−0.39	0.13	[−0.64, −0.14]	−3.06**

(*) p < .10, *p < 0.05, **p < .01, ***p < .001

Conversely, in target-absent trials—requiring exhaustive distractor rejection—both clinical groups showed marked accuracy decreases as complexity increased (Midform: p < .002; Real Object: p < .001), with LB-MCI showing a decline starting from Abstract shapes (OR = 2.88, SE = 0.68, p < .001) (Figure 2A). To determine whether these reductions reflected impaired discrimination or shifted decision strategy, sensitivity and response criterion were analysed.

Perceptual Sensitivity (d')

Perceptual sensitivity increased across groups as stimuli became visually and semantically distinct. A significant task-by-group interaction indicated both clinical groups showed reduced sensitivity relative to HO as complexity increased (Table 3). LB-MCI participants exhibited reduced d′ beginning in the Abstract shape condition (β = 0.66, SE = 0.18, p = .014), whereas AD-MCI showed significant reductions only in the Midform (β = 0.69, SE = 0.22, p = .0062) and Real object conditions (β = 0.72, SE = 0.21, p = .0022). Crucially, no significant differences in d′ were observed between the two clinical groups, suggesting perceptual discriminability is similarly affected in LB-MCI and AD-MCI (Figure 2B).

Decision Criterion (C)

Across groups, participants adopted increasingly conservative response strategies as search arrays became more semantically and structurally complex (p < .001). However, a significant task-by-group interaction revealed that this strategic adjustment was attenuated in both clinical groups for real-world objects (Table 4). While HO significantly increased their decision threshold in the Real object condition, both LB-MCI and AD-MCI participants maintained a more liberal response bias relative to controls (LB-MCI: β = 0.30, SE = 0.083, p = .0014; AD-MCI: β = 0.42, SE = 0.10, p = .0019) (Figure 2C). This pattern

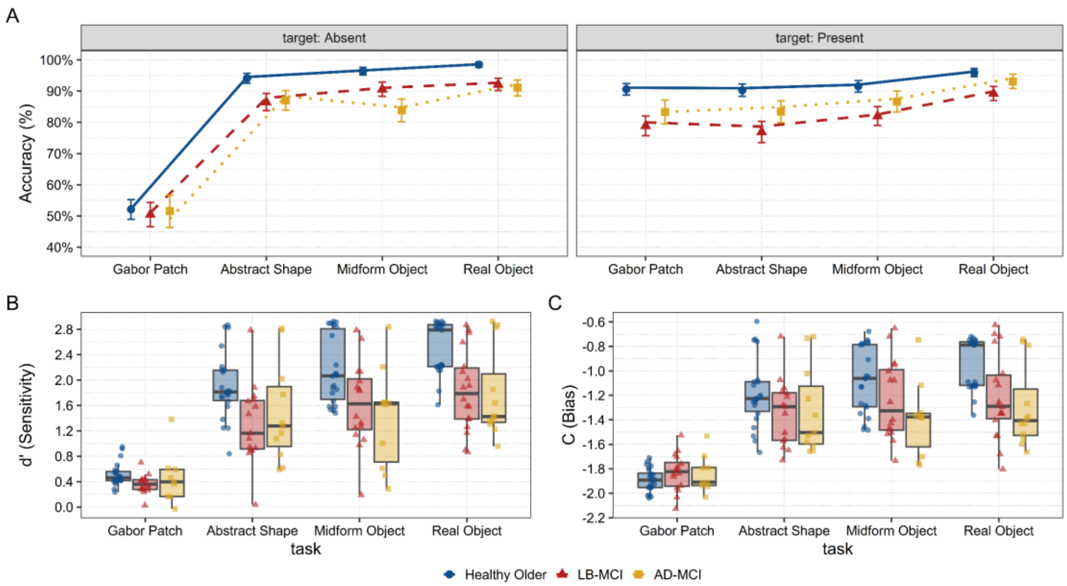

Figure 2. Accuracy (A), sensitivity (d′; B), and response criterion (C) across tasks of increasing visual richness in HO adults, LB-MCI, and AD-MCI. Panel A shows mean accuracy (%) for target-absent and target-present trials; panels B and C show distributions of d′ and criterion values by group and task.

indicates a greater propensity to signal target presence under uncertainty, consistent with the reduced accuracy observed in target-absent trials and suggesting impaired executive control over decision-making in complex search contexts.

General Discussion

Differentiating Dementia with Lewy bodies (DLB) from Alzheimer's disease (AD) at the prodromal stage remains challenging due to substantial overlap in cognitive symptoms during mild cognitive impairment (MCI; McKeith et al., 2020; Walker et al., 2015). Given the prominent visuospatial and attentional disturbances characterizing DLB (Collerton et al., 2003; Jellinger, 2023), the current study employed a series of visual search tasks in which the informational richness of the targets was manipulated along a graded continuum. This approach allowed us to probe disease-specific divergences between LB-MCI, AD-MCI, and HO adults in the interplay between stimulus-driven and goal-directed attentional processes (Van Zoest & Donk, 2004; Wolfe, 2021). Across groups, detection accuracy and perceptual sensitivity (d') increased as stimuli became more informative, consistent with previous evidence showing that structural and semantic richness facilitates target–distractor discrimination during visual search (Eraslan Boz et al., 2024; Pereira et al., 2020; Wolfe, 2021). HO adults additionally adapted to increasing stimulus richness by raising their decision thresholds, indicating flexible regulation of uncertainty at the decisional stage. In contrast, both clinical groups maintained a relatively liberal response bias as complexity increased, suggesting that impairments in search performance reflect disruptions in decision-level executive control mechanisms rather than solely degraded perceptual representations (Cromarty et al., 2018). Crucially, the benefits of stimulus richness were not uniformly expressed.

Although early involvement of ventral visual stream regions has been reported in Lewy body diseases (Braak et al., 2003), the behavioural data in this study suggest that deficits in semantic guidance and control, rather than early visual discrimination, are critical for differentiating LB-MCI from AD-MCI. Future work will further qualify this interpretation by examining the relationship between search performance and visuospatial neuropsychological measures (e.g., Visual Object and Space Perception battery), as well as by testing whether the observed effects are more pronounced in LB-MCI patients with visual hallucinations.

From a representational standpoint, the real-object condition required participants to transform a verbal cue into a visual target representation prior to search. LB-MCI participants may therefore have experienced specific difficulty in constructing or maintaining an effective semantic-to-visual mapping necessary to instantiate a stable target template. In line with previous findings (Cimminella et al., 2022), this capacity appeared relatively preserved in AD-MCI participants. This interpretation is supported by the substantially similar performance of AD-MCI and LB-MCI participants in the Midform condition, in which semantic access to broad categorical properties (e.g., animacy or size) is preserved through mid-level visual structure (Long et al., 2018). The convergence between groups in this condition indicates that the selective deficit observed in LB-MCI does not arise solely from difficulties in structural integration, but rather from a failure to exploit semantic constraints to stabilise the target template and resolve competition among distractors. These findings refine predictions derived from earlier visual search studies in DLB, which reported reduced efficiency for abstract and conjunction stimuli (Cormack et al., 2004; Landy et al., 2015). While LB-MCI participants did show reduced sensitivity relative to healthy controls at intermediate levels of complexity, structural processing deficits alone were insufficient to differentiate prodromal Lewy body disease from AD. Instead, disease-specific differences emerged at the interface between semantic representations and executive control, highlighting the importance of late-stage guidance and decision processes in visual search. From a neurocognitive perspective, this pattern aligns with evidence of early disruption to fronto-parietal attentional networks and associated thalamic and subcortical structures involved in goal-directed modulation of visual processing (Collerton et al., 2003; Jellinger, 2023), rather than impairments at the level of early sensory encoding (Carrarini et al., 2021). Although the groups were not perfectly matched for age and education, these demographic imbalances are unlikely to fully account for the present results, as group differences were selective to conditions requiring semantic guidance and absent when search was driven primarily by low-level features. Moreover, the lack of significant differences in overall cognitive functioning (MMSE) between patient groups supports the interpretation that the observed effects do not merely reflect generalised cognitive decline. Nevertheless, the relatively small and unequal sample size of the AD-MCI group, combined with demographic imbalances, may have reduced statistical power, potentially masking further differences and limiting the generalizability of null group effects. Further work with a larger, balanced sample will be essential to expand these findings and fully address this limitation.

In conclusion, by parametrically varying stimulus richness, this study demonstrates that visual search performance dissociates between LB-MCI and AD-MCI at the level of semantic guidance rather than early perceptual discrimination. These findings contribute to cognitive theories of visual search by identifying a specific locus of vulnerability—access to and deployment of semantic target templates—under conditions of disrupted attentional control. Ongoing analyses of co-registered eye-tracking and EEG data will allow us to further characterise the temporal dynamics of attentional guidance and decision-making, providing a more detailed account of how these mechanisms are altered in the prodromal phase of neurodegenerative disease.

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