

Article

Subjective Cognitive Decline and Antisaccade Latency: Exploring Early Markers of Dementia Risk

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Abstract: Background/Objectives: Subjective cognitive decline (SCD) is a common symptom experienced by individuals in the preclinical stage of dementia. However, traditional neuropsychological tests often fail to detect subtle cognitive changes associated with SCD. People with SCD may appear to have intact cognitive function (as measured by traditional tests), but they themselves subjectively feel that their cognition is becoming impaired. **Methods:** This preliminary study investigated the relationship between SCD and antisaccade performance as a potential early marker of dementia risk in a community-based sample of older adults (N = 17, mean age = 77.71 years). SCD was also explored by calculating the dissociation between objective and subjective memory performance, with SCD implied if there was a large dissociation between perceived memory performance but intact objective performance. **Results:** Participants with evidence of SCD exhibited significantly increased antisaccade latency compared to healthy controls, even when standard cognitive tests were normal. Antisaccade latency showed a significant correlation with self-reported cognitive complaints ($r = 0.57$, $p = 0.018$), while traditional cognitive measures did not. **Conclusions:** These compelling but preliminary findings suggest that antisaccade performance may be a more sensitive indicator of early cognitive decline than traditional cognitive measures, even in the preclinical stage of dementia. The results have implications for early dementia diagnosis, as antisaccade tasks could be incorporated into routine assessments to identify individuals at risk for dementia, potentially enabling earlier therapeutic intervention.



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1. Introduction

The preclinical stage of dementia is a critical window of opportunity for early intervention. During this phase, individuals may experience a subtle decline in cognitive function that often manifests as subjective cognitive decline (SCD: [1]). SCD refers to the feeling of having memory or thinking difficulties despite performing normally on standard cognitive tests (e.g., [2]). SCD is distinct from mild cognitive impairment (MCI), where neuropsychological tests show objective cognitive impairment, but daily functioning is not affected [3]. Even though many older adults (aged 70 and older) perform well on cognitive tests, it is estimated that between 50% and 80% of them believe their cognitive abilities are declining [4,5]. Therefore, as 14% of people with SCD develop dementia and 27% develop MCI within four years [6], SCD may represent an early stage of cognitive decline, which an alarming number of older adults are at risk of. Yet, not all people with SCD will eventually get dementia, and not all people with dementia go through a phase

of SCD [7]. SCD is a broad condition with various underlying causes, leading to different outcomes [8]. In some cases, SCD may appear and then resolve completely, with no lasting impact on objective cognitive function. This type of SCD can be linked to temporary factors like depression, medication side effects, or sleep disturbances. In other instances, SCD may persist without remission, but individuals may continue to function cognitively at a stable level. Normal ageing can be a contributing factor in such cases. However, in a more serious progression, SCD can lead to a decline in cognitive function, ultimately resulting in dementia. Therefore, although not all people with SCD develop dementia, people with SCD are at an increased risk, and, in some cases, SCD may represent an early stage of the disease [9]. It is therefore vital to identify those with SCD at increased risk of objective cognitive decline and dementia, as early diagnosis of dementia-related SCD may then mean that interventions could be utilised sooner.

Diagnosing SCD in practice provides a challenge for clinicians and researchers. Often, the symptoms of SCD are too subtle for traditional measures, such as standardised memory tests (e.g., word list recall) and global cognitive screening tools (e.g., Mini-Mental State Examination), so subjective impairments are not always easy to measure with an objective test [10]. This discrepancy between subjective experience and objective performance makes early diagnosis challenging. This may be because traditional neuropsychological tests often focus on memory impairments; however, memory decline is not necessarily one of the earliest impairments that patients with cognitive impairment would experience [11]. Attention-based measures have been shown to potentially be an early biomarker (e.g., [12]). This may be because the dementia disease pathway may affect sensory and attentional systems before memory is affected (e.g., [13]). Therefore, if SCD is related to early cognitive decline, it may be that attention-based measures could objectively measure this decline where memory-based measures are insensitive.

Mounting evidence suggests that attention and visual processing may be affected by dementia progression up to 12 years earlier than traditional measures [14]. Further research is needed to fully understand the mechanisms underlying these early cognitive changes, but the results underline the potential to explore attentional and visual processing deficits as early biomarkers for dementia risk. This is where eye movement tasks, particularly antisaccade tasks, emerge as promising tools for earlier detection. Such tasks have been previously used to identify participants with Alzheimer's disease [15] and MCI [12], which therefore demonstrates that these tasks are measuring a core component of cognitive decline. Antisaccade tasks require participants to make a saccade (eye movement) in the opposite direction of a visual cue. This seemingly simple task, however, involves the integration of several complex systems: cognitive functions, including visual attention, saccadic programming (planning eye movements), and inhibitory control (suppressing the reflex to look at the cue). Therefore, as people with cognitive decline gradually lose the efficient control of attention and develop impairments of both inhibitory control and eye movement error-correction [12], the task is very sensitive to cognitive decline.

It may be that antisaccade performance may be a more sensitive indicator of subtle cognitive decline compared to traditional neuropsychological tests in the preclinical stage of dementia (e.g., [12]). Studies have shown that individuals experiencing prodromal dementia, such as MCI, exhibit increased antisaccade latency—the time it takes to make the corrective eye movement—and decreased accuracy compared to healthy controls (e.g., [12]). Wilcockson and colleagues [12] even demonstrated that the antisaccade task could be utilised to differentiate patients with MCI into those more likely to transition from MCI to dementia and those with MCI who were more likely not to get dementia. This demonstrates that the antisaccade task is measuring a component of cognitive decline that is specific to the disease rather than a measure of cognitive decline as a result of transient factors.

These findings suggest that even when objective cognitive tests are normal, changes in antisaccade performance may reveal underlying dysfunction in the brain networks crucial for cognition. Indeed, recent research on the topic of SCD demonstrates the potential for using eye movements for measuring SCD; however, a previous study [16] may have overestimated the prevalence of SCD by solely relying on self-reported cognitive decline on the nine-item SCD questionnaire scale (SCD9: [17]), potentially including individuals with genuine concerns but no actual cognitive impairment, while potentially excluding those with subtle cognitive decline who may not be fully aware of their deficits. However, the growing research on the topic does demonstrate the potential utility of antisaccades for monitoring SCD, but more objective data-driven approaches to classifying SCD patients are important for the area.

Therefore, if evidence suggests that the antisaccade task can be used as an early indicator of dementia likelihood in patients with MCI, it is possible that the antisaccade may also be sensitive enough to objectively measure cognitive decline in even earlier stages of the condition, including SCD. The primary aim of this preliminary study is to investigate the relationship between SCD and antisaccade performance as a potential early marker of dementia risk (see Figure 1). Specifically, we hypothesise that individuals with SCD will exhibit increased antisaccade latency compared to healthy controls, even when traditional neuropsychological tests are within normal limits. To identify individuals with SCD, we employed a novel approach to capture the discrepancy between subjective and objective cognitive decline. This approach involved ranking participants based on their subjective cognitive decline and their objective cognitive performance. This allowed us to compare an individual's self-perceived cognitive status relative to their peers within the study cohort. Measures relying on self-report may be influenced by individual factors such as insight; however, the use of this measure in this manner enables us to identify participants who feel as if their cognition is becoming impaired, even if this impairment is too subtle for objective measures to identify. By identifying participants with a discrepancy between their subjective complaints and their objective cognitive performance, we aimed to isolate individuals who may be experiencing subtle cognitive decline currently unmeasurable with traditional cognitive tasks and therefore explore whether eye movements could be a more effective early screening tool. This study seeks to contribute to a growing body of evidence suggesting that attention-based measures, such as the antisaccade task, may be more sensitive than traditional cognitive assessments in detecting subtle cognitive decline associated with the preclinical stage of dementia, potentially leading to the development of more effective early screening tools.

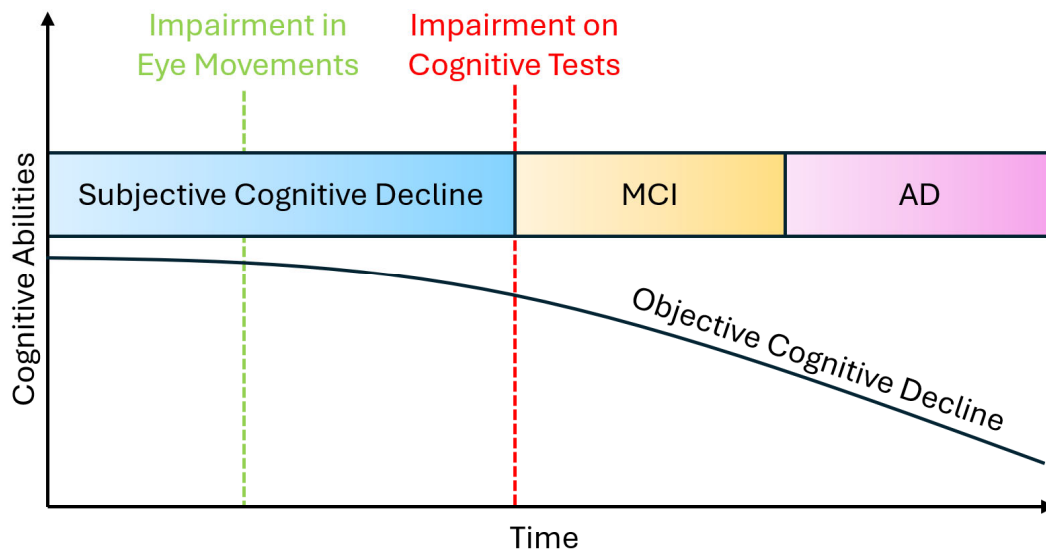


Figure 1. Impairment on standardised cognitive tests is required to confirm objective cognitive decline. However, eye movement impairments are hypothesised to indicate cognitive decline earlier than subtle cognitive decline can be observed by traditional measures.

2. Materials and Methods

2.1. Participants

Participants were men ($n = 8$) and women ($n = 9$) between the ages of 65 and 87 ($N = 17$; Mage: 77.71; $SD = 6.531$), with at least 12 years of education ($M: 16.24$; $SD: 2.587$; range 12–21 years) and fluent English-speakers. Study participants were recruited from community centres and dementia care homes in Loughborough, United Kingdom, between January and April 2024, and were therefore of similar socioecological background. Additionally, volunteers from the Join Dementia Research platform and self-referrals were considered. Cognitive status was evaluated using the Mini-Mental State Examination (MMSE) with a cutoff score of 24, the Lawton Instrumental Activities of Daily Living (IADL) scale with a cutoff score of 12, and the Hopkins Verbal Learning Test (HVLT) with a cutoff score of 14.5. All participants were required to score more than the cutoff scores to be eligible for the study. Individuals with neurological diseases, severe psychiatric conditions (including anxiety and depression, due to their association with SCD, e.g., [18]), significant vision or hearing impairments, or difficulty understanding the study were excluded. The study protocol was approved by the Loughborough University ethics committee (2023-11214-13950), and all participants provided informed consent prior to participation. Participants were reimbursed £10 for participating.

The study involved identifying older adults with SCD to establish whether they performed differently than people with intact cognition on eye movement scores. In order to do this, we first had to establish whether someone had evidence of SCD or not by looking for any dissociation between subjective and objective decline. Specifically, we ranked participants on their perceived subjective cognitive decline and also ranked participants on their objective cognitive decline. We ranked all Cognitive Failures Questionnaire (CFQ: see Measures section below) scores from 1 to 17, and we also ranked all Mini-Mental State Examination (MMSE: see Measures section below) scores from 1 to 17. From these rankings, we calculated the difference between them. A large “difference score” would indicate that participants were inaccurate at rating their own cognitive abilities. This enabled us to identify participants who had objectively intact cognitive function but underestimated their cognition, suggesting potential SCD. This mismatch between their subjective and objective cognitive assessments may potentially be indicative of early, pre-clinical cognitive decline

that is too subtle to measure on traditional cognitive tests. The participants with evidence of SCD are then grouped together so that we can compare their scores to those with a more accurate perception of their cognitive abilities. Ranking difference scores ranged from -17 to $+13$. Based on these distributions, participants with a ranking score of -3 or less were placed in the SCD group, whilst those with a score of 2 or more were placed in the Control Group. Demographic information about each group can be found in Table 1. Note, the participant groups did not differ in terms of demographics, including age, sex, or education. In fact, the groups only differed in terms of CFQ performance. Further, we note that we do not anticipate a difference in MMSE, HVLIT, or IADL due to ceiling effects.

Table 1. Average (SD) demographic and cognitive status of the subjective cognitive decline and control groups.

	Subjective Cognitive Decline ($n = 7$)	Control Group ($n = 10$)	p Value
Age	79.4 (7.6)	77.4 (7.2)	0.583
Sex (percent male)	57.1%	40%	0.517
Education	16.4 (2.2)	15.7 (3.0)	0.589
Cognitive Failures Questionnaire	51.6 (15.7)	28.9 (11.9)	0.002 *
Mini-Mental State Examination	27.6 (2.4)	27.0 (2.4)	0.317
Hopkins Verbal Learning Test	24.6 (7.0)	27.7 (7.5)	0.198
Instrumental Activities of Daily Living	15.2 (1.6)	16 (0)	0.100
Percent prosaccade trials analysed	82% (10.1)	84% (13.1)	0.412
Percent antisaccade trials analysed	99% (2.1)	98% (4.5)	0.864

Note, * indicates a significant difference at $p < 0.005$.

2.2. Measures

2.2.1. Mini-Mental State Examination (MMSE)

The MMSE is a 30-point measure of cognitive functions [19,20]. Scores ranging from 25 to 30 are considered normal; the National Institute for Health and Care Excellence (NICE) classifies scores of 21–24 as mild, 10–20 as moderate, and <10 as severe impairment [21]. The MMSE, while potentially influenced by factors like education and socioeconomic status, provided a representative measure of objective cognitive performance.

2.2.2. Cognitive Failures Questionnaire (CFQ)

Self-reported cognitive decline was measured using the 30-question Cognitive Failures Questionnaire (CFQ: [22]). Participants rated the frequency of various cognitive failures on a 5-point Likert scale ranging from “very often” (4) to “never” (0). The total CFQ score, calculated by summing the responses to all 30 items, ranged from 0 to 120, with higher scores indicating greater perceived cognitive decline. The CFQ is a widely used and validated instrument for assessing self-perceived cognitive decline (e.g., [16,17]).

2.2.3. Instrumental Activities of Daily Living

The Lawton Instrumental Activities of Daily Living (IADL) scale was used to assess participants’ ability to perform complex daily tasks [23]. This widely recognised scale evaluates independence in areas like meal preparation, financial management, transportation, shopping, housekeeping, laundry, telephone use, and medication management. Each domain is rated on a scale of 0 (complete dependence) to 16 (complete independence).

2.2.4. Hopkins Verbal Learning Test

The Hopkins Verbal Learning Test (HVLIT) assesses verbal learning and memory [24,25]. It consists of a 12-word list divided into three semantic categories. Participants listen to the list read aloud three times and are asked to recall as many words as possible after each

reading. The total number of words recalled after the third attempt is recorded. A cut-off of 14.5 on the total words remembered during the learning trial has optimal sensitivity and specificity for dementia [25].

2.2.5. Eye Tracking Apparatus

Eye movements were recorded using an EyeLink Portable Duo eye-tracker (SR Research Ltd., Mississauga, ON, Canada) at a sampling rate of 500 Hz. Participants were seated 55 cm from a 60 Hz monitor, and their dominant eye was determined using the Miles test. The EyeLink Portable Duo was controlled by ExperimentBuilder version 2.3.38 (SR Research Ltd., Mississauga, ON, Canada) software to manage stimulus events during eye-tracking tasks. A 9-point calibration procedure was conducted before each eye-tracking task, ensuring accurate tracking of eye movements. The main experiment only began after participants successfully completed the calibration process to a predetermined threshold.

2.2.6. Antisaccade Task (AST)

Each antisaccade task (AST) trial started with a 1 s instruction screen prompting participants to focus on the target. A central fixation point was displayed for one second, followed by a brief blank interval, and then the appearance of a red distractor. The distractor appeared randomly to the left or right of the fixation point and remained visible for 2 s. Participants were instructed to maintain fixation at the centre and then make a saccade in the opposite direction as soon as the distractor appeared. The AST included 24 trials, with four additional practice trials. The primary variables measured were reaction time (RT) mean and standard deviation (SD), which reflect inhibition latency and variability. Antisaccade errors, or the number of incorrect saccades, were also calculated.

2.2.7. Prosaccade Task (PST)

The prosaccade task (PST) followed a similar procedure to the AST, except participants were instructed to look towards the target instead of away from the distractor. Each PST trial began with a 1 s instruction screen, followed by a central fixation point and a brief blank interval. A green target then appeared randomly to the left or right of the fixation point for 2 s. Participants were instructed to fixate at the centre and then make a saccade towards the target. The PST included a total of 14 trials, with four additional practice trials. The variables measured were reaction time (RT) mean and standard deviation (SD), which indicate prosaccade latency and variability.

2.3. Data Analysis

To prepare both antisaccade and prosaccade data, we performed some preprocessing of the data. The raw eye-tracking data exported from the EyeLink DataViewer version 4.4.1 (SR Research Ltd., Mississauga, ON, Canada) software were analysed offline in bespoke software [26] with the following features: noise and spikes were filtered by removing all the frames where the velocity signal was greater than 1500 deg/s or the acceleration signal was greater than 100,000 deg²/s. All the fixations and saccadic events were detected by the EyeLink parser. All the saccades extracted for each trial, as well as a range of spatial and temporal properties measured for each saccade, were then stored in a table. Microsaccades with an amplitude less than 0.7 deg were filtered from the data. The latency of the saccade was measured from the onset of the saccade to the target onset. Only the saccades made within the time window 80–700 ms after target onset were included to avoid 'anticipatory saccades', i.e., saccades which are initiated prior to the presentation of the distractor. Note, fewer prosaccades than antisaccades are included in the final analysis (see Table 1) due to fewer trials included following the data preprocessing. This may indicate a slightly increased number of anticipatory saccades or issues with increased noise on this task.

For the formal analysis, we first examined whether there was an association between raw CFQ scores and eye tracking using Pearson's correlation. This would inform whether eye tracking is sensitive to self-reported cognitive decline. Second, we examined whether eye tracking was associated with raw MMSE and raw HVLTL scores using Pearson's correlation. This would indicate whether eye tracking was related to objective global cognitive impairment within this sample. Finally, we compared participants using the rank difference variable. By categorising participants using this variable, we were able to do a comparison that would show us whether there is a difference in eye tracking between participants who showed evidence of SCD and controls using a *t*-test. All analyses were conducted in SPSS version 29.

3. Results

There was a significant correlation between CFQ and antisaccade latencies, $r(15) = 0.57$; $p = 0.018$. This indicated that people reporting more cognitive failures had longer antisaccade latencies (see Figure 2). However, MMSE performance was not significantly associated with antisaccade latencies ($r(15) = -0.041$; $p = 0.957$) nor was HVLTL associated with antisaccade latencies ($r(15) = -0.131$; $p = 0.617$). This indicated that within this sample, there was no association between objective general cognitive function and antisaccade latency. Note, there were also no significant associations between CFQ, MMSE, or HVLTL for the antisaccade uncorrected error-rate and prosaccade latencies.

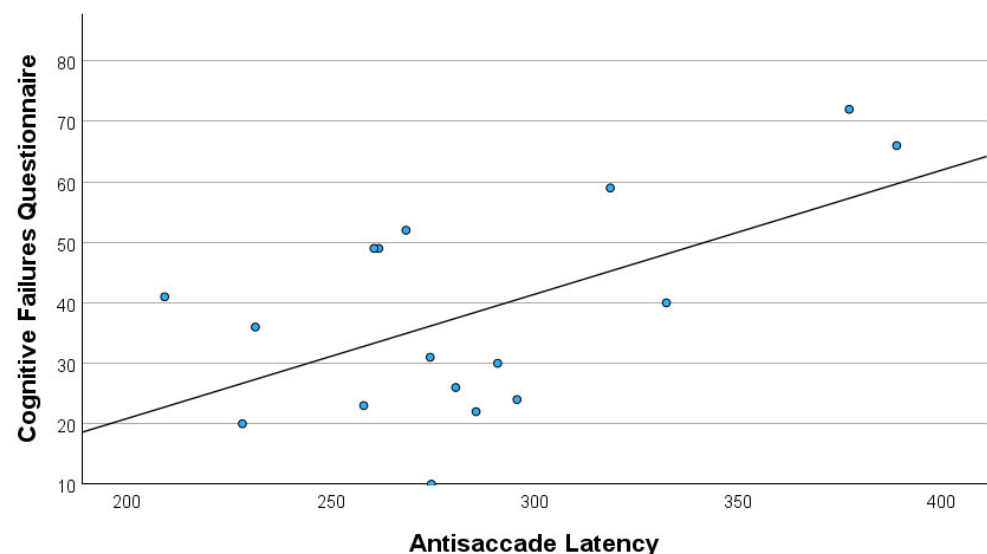


Figure 2. The association between the Cognitive Failures Questionnaire and antisaccade latency. The blue circles indicate each participant.

We further explored the significant correlation between antisaccade latencies and potential SCD by ranking participants based on the dissociation between their objective and subjective cognitive scores, as we were then able to conduct a *t*-test analysis to observe whether people with evidence of SCD ($n = 7$; $M = 317.22$; $SD = 52.61$) differed from people without evidence of SCD ($n = 10$; $M = 261.72$; $SD = 29.37$) for antisaccade latencies ($t(15) = 2.794$; $p = 0.007$; see Figure 3). These results indicated that antisaccade latency was sensitive to SCD. Note, however, that people with evidence of SCD ($n = 7$; $M = 6.60$; $SD = 3.13$) did not differ from people without evidence of SCD ($n = 10$; $M = 5.00$; $SD = 7.56$) in terms of antisaccade errors ($t(15) = -0.522$; $p = 0.609$), nor on any of the other eye movement variables ($p > 0.05$).

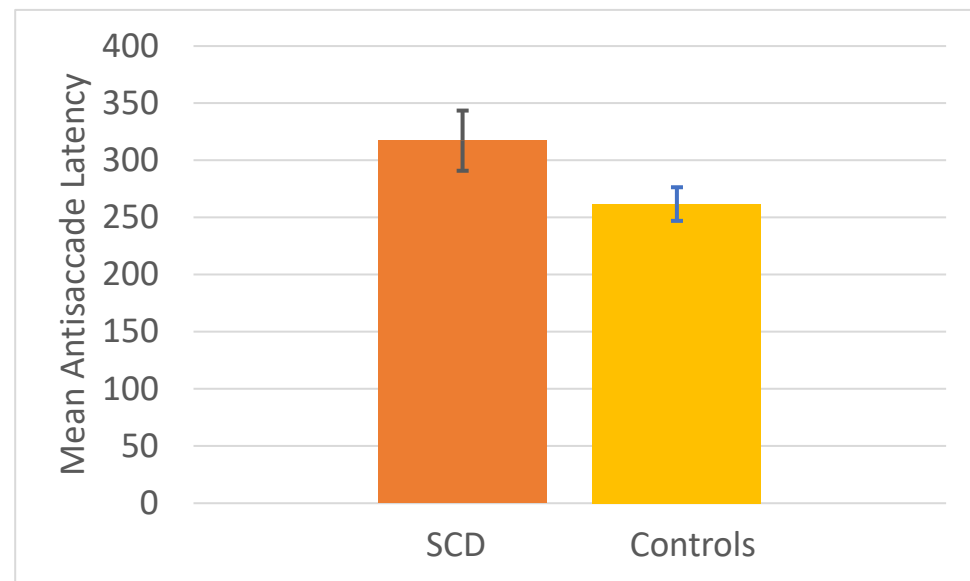


Figure 3. Mean antisaccade latency (SD error bars) for participants with evidence of SCD and participants without evidence of SCD.

4. Discussion

The present study explored the relationship between subjective cognitive decline (SCD) and antisaccade performance as a potential early marker of dementia risk. Previous research indicates that antisaccades may be an effective early marker of cognitive decline (e.g., [12]). Our findings, demonstrating both correlational evidence and group differences, provide further evidence supporting the notion that attention-based measures, such as the antisaccade task, may be more sensitive than traditional cognitive assessments in detecting subtle cognitive decline associated with the preclinical stage of dementia.

Consistent with our hypothesis, individuals with SCD exhibited significantly increased antisaccade latency compared to healthy controls, even when traditional neuropsychological tests were within normal limits. This suggests that antisaccade performance may be a more sensitive indicator of early cognitive decline than standard cognitive measures, particularly in the prodromal stage of dementia. However, the results may also indicate that antisaccade deficits may also exist in a preclinical phase, indicated by subjective decline (see [27]). These results align with previous research demonstrating that visual attentional functions are affected by dementia progression earlier than traditional cognitive measures [14].

The dissociation between SCD and objective cognitive performance highlights the limitations of traditional neuropsychological assessments in detecting subtle cognitive changes in the preclinical stage of dementia (see [28]). While the MMSE did not correlate with antisaccade performance in our sample, the significant association between SCD and antisaccade latency underscores the potential of eye-tracking measures to identify individuals at risk of dementia. However, examining the dissociation between subjective and objective performance using our ranking method allowed us to identify a specific subgroup of participants who were experiencing SCD but were not yet objectively cognitively impaired. By comparing this group to those with more accurate self-perceptions of their cognitive abilities, we were able to demonstrate that antisaccade performance was specifically sensitive to this subtle form of cognitive decline. The results may therefore indicate that some people may be aware of a decline in cognitive function before objective memory tests can detect this, but antisaccade tasks are sensitive to this decline. However, it is important to acknowledge that the current study does not establish causation, and it

should therefore be clarified that any changes in eye movements do not necessarily predict dementia progression. Yet, this study does provide preliminary evidence that antisaccade performance may serve as an early marker of dementia risk in individuals with SCD.

Further, it may also be worth considering that the observed deficits in eye movement control may not entirely reflect a decline in cognitive function. The results may instead be associated with age-related changes in the extraocular muscles themselves. These muscles, responsible for precise eye movements, undergo gradual changes with age, including reduced muscle strength, slower reaction times, and decreased coordination. These age-related changes may directly impact the speed and accuracy of eye movements, independent of cognitive decline. For example, decreased muscle strength may lead to slower saccades, while reduced coordination may increase the variability of eye movements. These changes in eye movement control, while potentially influenced by cognitive factors, may also be a primary consequence of age-related physiological changes in the extraocular muscles. It is important to note that this study did not directly assess the physiological state of the extraocular muscles. Future research should investigate the relationship between age-related changes in these muscles, as measured through techniques such as electromyography (EMG) or neuroimaging, and eye movement performance in individuals with SCD. Such studies could help to disentangle the relative contributions of cognitive decline and age-related physiological changes in extraocular muscles to the observed deficits in eye movement control.

Overall, the results imply that people with SCD may be in an early phase of dementia, and eye movement tasks may be able to identify these people. These results do therefore indicate that subjective impairments could be considered as an early warning sign, and these people should be investigated further, regardless of whether objective tests support the subjective complaints or not. The results provide further evidence that SCD could be a preliminary phase of dementia. The implications of these findings for early dementia diagnosis and intervention could potentially be substantial. Given that early intervention is crucial for managing dementia progression, incorporating antisaccade tasks into routine assessments could enable memory clinics to identify individuals with SCD who are at increased risk for dementia. Early identification allows for the implementation of targeted interventions, such as lifestyle modifications (e.g., [29]), cognitive training (e.g., [30]), or potential disease-modifying therapies (e.g., [31]), which may delay or even prevent the progression of dementia. Although eye movement tasks can offer quick (10–15 min) and potentially sensitive screening for early cognitive decline, the required equipment and expertise make this approach more complex than traditional neuropsychological tests. However, the implementation of eye movement tasks in clinical settings holds promise, particularly as technology becomes more accessible and automated systems are developed. While initial setup costs are higher than traditional assessments, the potential for earlier detection of cognitive decline could provide long-term cost benefits through timely/targeted intervention.

However, this study has some limitations. The sample size was relatively small, and further research is needed to replicate these findings in a larger and more diverse population. The small sample size does limit the generalisability of the findings; however, previous research has demonstrated the utility of visual and eye movement tasks in cognitive decline, even with small sample sizes, e.g., [32–34]. Additionally, longitudinal studies are required to establish the predictive validity of antisaccade performance for dementia development. It is unknown whether the participants in our sample identified as having SCD would go on to develop dementia, remain stable, or eventually regain their subjective cognitive function. Future research should also investigate the specificity of these findings to different types of dementia and explore potential confounding factors such as education, anxiety, and

depression. Furthermore, there are potential limitations of the SCD identification method. The CFQ, while a widely used tool, relies on self-report and may be influenced by individual factors such as insight. Similarly, the MMSE, while a well-established screening tool, may be less sensitive to mild cognitive impairment and may be influenced by factors such as education and socioeconomic status. Our approach of ranking and comparing CFQ and MMSE scores aimed to capture the discrepancy between subjective and objective cognitive decline, but it is important to acknowledge that this approach may have limitations. Further research is needed to refine and validate this method for identifying SCD and explore alternative approaches, such as incorporating multiple objective cognitive assessments. However, the results provided here do demonstrate that the antisaccade shows promise and, with additional investigation, could eventually be used to identify people more at risk of dementia even at early stages of the disease.

5. Conclusions

In conclusion, this study provides compelling but preliminary evidence that antisaccade performance may serve as a valuable early marker of dementia risk in individuals with SCD. The combination of objective eye-tracking measures with subjective cognitive status could offer a promising approach for the early detection of cognitive decline. By incorporating attention-based measures into clinical practice, we may be able to improve early detection and intervention for dementia, ultimately reducing the burden of this devastating disease.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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References

1. Si, T.; Xing, G.; Han, Y. Subjective cognitive decline and related cognitive deficits. *Front. Neurol.* **2020**, *11*, 247. [[CrossRef](#)] [[PubMed](#)]
2. Rabin, L.A.; Initiative, T.A.D.N.; Smart, C.M.; Crane, P.K.; Amariglio, R.E.; Berman, L.M.; Boada, M.; Buckley, R.F.; Chételat, G.; Dubois, B.; et al. Subjective cognitive decline in older adults: An overview of self-report measures used across 19 international research studies. *J. Alzheimer's Dis.* **2015**, *48* (Suppl. 1), S63–S86. [[CrossRef](#)]
3. Howard, R. Subjective cognitive decline: What is it good for? *Lancet Neurol.* **2020**, *19*, 203–204. [[CrossRef](#)]
4. Jessen, F.; Wiese, B.; Bachmann, C.; Eifflaender-Gorfer, S.; Haller, F.; Kölsch, H.; Luck, T.; Mösch, E.; van den Bussche, H.; Wagner, M.; et al. Prediction of dementia by subjective memory impairment: Effects of severity and temporal association with cognitive impairment. *Arch. Gen. Psychiatry* **2010**, *67*, 414–422. [[CrossRef](#)]
5. van Harten, A.C.; Mielke, M.M.; Swenson-Dravis, D.M.; Hagen, C.E.; Edwards, K.K.; Roberts, R.O.; Geda, Y.E.; Knopman, D.S.; Petersen, R.C. Subjective cognitive decline and risk of MCI: The Mayo Clinic Study of Aging. *Neurology* **2018**, *91*, e300–e312. [[CrossRef](#)]

6. Mitchell, A.J.; Beaumont, H.; Ferguson, D.; Yadegarfar, M.; Stubbs, B. Risk of dementia and mild cognitive impairment in older people with subjective memory complaints: Meta-analysis. *Acta Psychiatr. Scand.* **2014**, *130*, 439–451. [\[CrossRef\]](#)
7. Slot, R.E.; Sikkes, S.A.; Berkhof, J.; Brodaty, H.; Buckley, R.; Cavedo, E.; Dardiotis, E.; Guillo-Benarous, F.; Hampel, H.; Kochan, N.A.; et al. Subjective cognitive decline and rates of incident Alzheimer's disease and non-Alzheimer's disease dementia. *Alzheimer's Dement.* **2019**, *15*, 465–476. [\[CrossRef\]](#)
8. Jessen, F.; Amariglio, R.E.; Buckley, R.F.; van der Flier, W.M.; Han, Y.; Molinuevo, J.L.; Rabin, L.; Rentz, D.M.; Rodriguez-Gomez, O.; Saykin, A.J.; et al. The characterisation of subjective cognitive decline. *Lancet Neurol.* **2020**, *19*, 271–278. [\[CrossRef\]](#)
9. Pike, K.E.; Cavuoto, M.G.; Li, L.; Wright, B.J.; Kinsella, G.J. Subjective cognitive decline: Level of risk for future dementia and mild cognitive impairment, a meta-analysis of longitudinal studies. *Neuropsychol. Rev.* **2022**, *32*, 703–735. [\[CrossRef\]](#)
10. Molinuevo, J.L.; Rabin, L.A.; Amariglio, R.; Buckley, R.; Dubois, B.; Ellis, K.A.; Ewers, M.; Hampel, H.; Klöppel, S.; Rami, L.; et al. Implementation of subjective cognitive decline criteria in research studies. *Alzheimer's Dement.* **2017**, *13*, 296–311. [\[CrossRef\]](#)
11. Monsell, S.E.; Mock, C.; Hassenstab, J.; Roe, C.M.; Cairns, N.J.; Morris, J.C.; Kukull, W. Neuropsychological changes in asymptomatic persons with Alzheimer disease neuropathology. *Neurology* **2014**, *83*, 434–440. [\[CrossRef\]](#) [\[PubMed\]](#)
12. Wilcockson, T.D.; Mardanbegi, D.; Xia, B.; Taylor, S.; Sawyer, P.; Gellersen, H.W.; Leroi, I.; Killick, R.; Crawford, T.J. Abnormalities of saccadic eye movements in dementia due to Alzheimer's disease and mild cognitive impairment. *Aging* **2019**, *11*, 5389. [\[CrossRef\]](#) [\[PubMed\]](#)
13. Albers, M.W.; Gilmore, G.C.; Kaye, J.; Murphy, C.; Wingfield, A.; Bennett, D.A.; Boxer, A.L.; Buchman, A.S.; Cruickshanks, K.J.; Devanand, D.P.; et al. At the interface of sensory and motor dysfunctions and Alzheimer's disease. *Alzheimer's Dement.* **2015**, *11*, 70–98. [\[CrossRef\]](#) [\[PubMed\]](#)
14. Begde, A.; Wilcockson, T.; Brayne, C.; Hogervorst, E. Visual processing speed and its association with future dementia development in a population-based prospective cohort: EPIC-Norfolk. *Sci. Rep.* **2024**, *14*, 5016. [\[CrossRef\]](#)
15. Crawford, T.J.; Higham, S.; Mayes, J.; Dale, M.; Shaunak, S.; Lekwuwa, G. The role of working memory and attentional disengagement on inhibitory control: Effects of aging and Alzheimer's disease. *Age* **2013**, *35*, 1637–1650. [\[CrossRef\]](#)
16. Hao, C.; Zhang, X.; An, J.; Bao, W.; Yang, F.; Chen, J.; Hou, S.; Wang, Z.; Du, S.; Zhao, Y.; et al. An effective screening model for subjective cognitive decline in community-dwelling older adults based on gait analysis and eye tracking. *Front. Aging Neurosci.* **2024**, *16*, 1444375. [\[CrossRef\]](#)
17. Gifford, K.A.; Liu, D.; Romano, R.; Jones, R.N.; Jefferson, A.L. Development of a subjective cognitive decline questionnaire using item response theory: A pilot study. *Alzheimer's Dement* **2015**, *1*, 429–439. [\[CrossRef\]](#)
18. Sabatini, S.; Woods, R.T.; Ukoumunne, O.C.; Ballard, C.; Collins, R.; Clare, L. Associations of subjective cognitive and memory decline with depression, anxiety, and two-year change in objectively-assessed global cognition and memory. *Aging Neuropsychol. Cogn.* **2022**, *29*, 840–866. [\[CrossRef\]](#)
19. Folstein, M.F.; Folstein, S.E.; McHugh, P.R. "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. *J. Psychiatr. Res.* **1975**, *12*, 189–198. [\[CrossRef\]](#)
20. Kurlowicz, L.; Wallace, M. The mini-mental state examination (MMSE). *J. Gerontol. Nurs.* **1999**, *25*, 8–9. [\[CrossRef\]](#)
21. Woodward, S. NICE consults again on Alzheimer's drugs. *Br. J. Neurosci. Nurs.* **2006**, *2*, 5. [\[CrossRef\]](#)
22. Broadbent, D.E.; Cooper, P.F.; FitzGerald, P.; Parkes, K.R. The cognitive failures questionnaire (CFQ) and its correlates. *Br. J. Clin. Psychol.* **1982**, *21*, 1–16. [\[CrossRef\]](#)
23. Graf, C. The Lawton instrumental activities of daily living scale. *Am. J. Nurs.* **2008**, *108*, 52–62. [\[CrossRef\]](#)
24. Brandt, J. Hopkins verbal learning test. *Clin. Neuropsychol.* **2001**. [\[CrossRef\]](#)
25. Hogervorst, E.; Combrinck, M.; Lapuerta, P.; Rue, J.; Swales, K.; Budge, M. The Hopkins verbal learning test and screening for dementia. *Dement. Geriatr. Cogn. Disord.* **2001**, *13*, 13–20. [\[CrossRef\]](#)
26. Mardanbegi, D.; Wilcockson, T.; Sawyer, P.; Gellersen, H.; Crawford, T. SaccadeMachine: Software for analyzing saccade tests (anti-saccade and pro-saccade). In Proceedings of the 11th ACM Symposium on Eye Tracking Research & Applications, Denver, CO, USA, 25–28 June 2019; pp. 1–8.
27. van Harten, A.C.; Smits, L.L.; Teunissen, C.E.; Visser, P.J.; Koene, T.; Blankenstein, M.A.; Scheltens, P.; van der Flier, W.M. Preclinical AD predicts decline in memory and executive functions in subjective complaints. *Neurology* **2013**, *81*, 1409–1416. [\[CrossRef\]](#)
28. Zhou, C.; Fares, B.J.; Thériault, K.; Trinh, B.; Joseph, M.; Jauhal, T.; Sheppard, C.; Labelle, P.R.; Krishnan, A.; Rabin, L.; et al. Subjective cognitive decline and objective cognitive performance in older adults: A systematic review of longitudinal and cross-sectional studies. *J. Neuropsychol.* **2024**, *19*, 98–114. [\[CrossRef\]](#)
29. Begde, A.; Jain, M.; Hogervorst, E.; Wilcockson, T. Does physical exercise improve the capacity for independent living in people with dementia or mild cognitive impairment: An overview of systematic reviews and meta-analyses. *Aging Ment. Health* **2022**, *26*, 2317–2327. [\[CrossRef\]](#)

30. Begde, A.; Alqurafi, A.; Pain, M.T.; Blenkinsop, G.; Wilcockson, T.D.; Hogervorst, E. The effectiveness of home-based Exergames training on cognition and balance in older adults: A comparative quasi-randomized study of two Exergame interventions. *Innov. Aging* **2023**, *7*, igad102. [[CrossRef](#)]
31. Smith, B.; Ownby, R.L.; Ownby, R. Disease-Modifying Treatments and Their Future in Alzheimer's Disease Management. *Cureus* **2024**, *16*, e56105. [[CrossRef](#)]
32. Plaza-Rosales, I.; Brunetti, E.; Montefusco-Siegmund, R.; Madariaga, S.; Hafelin, R.; Ponce, D.P.; Behrens, M.I.; Maldonado, P.E.; Paula-Lima, A. Visual-spatial processing impairment in the occipital-frontal connectivity network at early stages of Alzheimer's disease. *Front. Aging Neurosci.* **2023**, *15*, 1097577. [[CrossRef](#)] [[PubMed](#)]
33. Shakespeare, T.J.; Yong, K.X.; Frost, C.; Kim, L.G.; Warrington, E.K.; Crutch, S.J. Scene perception in posterior cortical atrophy: Categorization, description and fixation patterns. *Front. Hum. Neurosci.* **2013**, *7*, 621. [[CrossRef](#)] [[PubMed](#)]
34. Crawford, T.J.; Smith, E.S.; Berry, D.M. Eye Gaze and Aging: Selective and Combined Effects of Working Memory and Inhibitory Control. *Front. Hum. Neurosci.* **2017**, *11*, 563. [[CrossRef](#)]

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