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ORIGINAL RESEARCH

Müller-Lyer Illusion in Adults Increases with Age but Is Not Affected by Mild Visual Acuity Loss

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Purpose: To investigate the impact of mild visual acuity loss on the Müller-Lyer illusion in adults and evaluate its potential as a clinical indicator for visual-cognitive integration mechanisms.
Methods: Three experiments were conducted. Experiment 1 measured illusion intensity in 49 young adults (25.08 ± 3.38 years) before and after inducing transient visual acuity loss (0.40 logMAR) via Bangerter occlusion foils. Experiment 2 compared 26 cataract patients (65.19 ± 3.87 years) with 59 age-matched controls (63.98 ± 5.57 years). Experiment 3 tracked 14 cataract patients (69.50 ± 6.14 years) pre- and post-surgery. Illusion intensity was quantified using a two-alternative forced-choice task.
Results: Illusion intensity remained stable across conditions: no differences were observed before /after wearing occlusion glasses (4.33% vs 3.75%, $p = 0.141$), between cataract patients and controls (8.79% vs 8.20%, $p = 0.301$), or pre-/post-surgery (9.46% vs 9.87%, $p = 0.357$). However, normally-sighted elderly participants exhibited stronger illusions than young adults (8.20% vs 4.33%, $p < 0.001$). Multivariate regression confirmed age as the sole predictor of illusion intensity ($\beta = 0.088$, $p = 0.001$), independent of visual acuity.
Conclusion: The intensity of Müller-Lyer illusion in adults is modulated by age but resistant to mild visual acuity loss, implicating its utility in studying visual-cognitive integration.

Keywords: Müller-Lyer illusion, illusion intensity, visual acuity, aging, visual cognition

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Introduction

The Müller-Lyer illusion, first described by Müller-Lyer,[1] remains a cornerstone for investigating the intricate interplay between sensory input and cognitive processing in visual perception. In this illusion, two physically identical lines appear mismatched in length when flanked by inward- (> <) or outward-pointing (< >) arrowheads. Remarkably, the illusion persists robustly in the vast majority of observers even when they are consciously aware of its illusory nature,[2] highlighting its automaticity and potency as a probe of fundamental perceptual processing and cortical mechanisms.[3–5] Nevertheless, recent evidence demonstrates that susceptibility can be significantly modulated, with specific visual expertise even conferring near-immunity to certain geometric illusions,[6] underscoring the role of cognitive factors and experience-dependent plasticity.

Central to understanding the Müller-Lyer illusion is how spatial context distorts local feature processing. The probabilistic strategy[7] posits that the visual system resolves ambiguous retinal input by generating percepts based on statistical regularities of real-world stimuli. Here, the arrowheads act as contextual cues that bias the probabilistic distributions of line length. This mechanism accounts for developmental trajectories in children:[8] accumulating visual experience refines internal statistical models, progressively reducing the biasing effect of the misleading cues.

Crucially, while childhood-to-adulthood decline in Müller-Lyer illusion susceptibility is well-established,[8–10] the trajectory across later life stages remains controversial.[11,12] Further complexity arises from visually impaired populations: Gandhi et al[5] demonstrated that children with severe bilateral congenital cataracts (8–16 years old) exhibited intact susceptibility to the Müller-Lyer illusion immediately after sight restoration, suggesting innate origins independent of

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extensive learned visual experiences. Conversely, Lin et al[13] reported heightened illusion intensity in congenital visually impaired children (4–17 years) compared to age-matched normally-sighted peers. They proposed that abnormal visual experience during early childhood alters the typical development of illusion mechanisms through interactions with cognitive maturation. These divergent findings raise a pivotal question: does visual development and sensory experience differentially modulate Müller-Lyer illusion processing mechanisms across distinct life stages, particularly during adulthood where longitudinal data are sparse?

The impact of acquired visual impairment on Müller-Lyer illusion susceptibility in adults remains underexplored. Age-related cataract, the most common cause of reversible vision loss in older adults, primarily degrades vision through increased optical blur and light scattering. It provides a unique model to dissect this relationship. Studying how the illusion changes under degraded visual conditions, such as optical blur, allows us to probe the relative contributions of sensory input quality versus higher-level spatial integration mechanisms. This has significant implications for low-vision populations where high-level perception persists despite sensory impairment.

We thus conducted three experiments to: (1) Test if transient mild visual acuity loss (via Bangerter occlusion foils) affects illusion intensity in young adults; (2) Compare illusion intensity between cataract patients and age-matched controls to assess effects of long-term visual acuity loss; (3) Track longitudinal changes in illusion intensity pre- and post-cataract surgery to evaluate vision restoration effects. This approach directly investigates the influence of visual acuity while enabling exploration of age-related differences in illusion perception across adulthood.

Materials and Methods

Participants

This study was conducted at the Eye Hospital of Wenzhou Medical University, Zhejiang, China. In Experiment 1, forty-nine healthy young participants were recruited from Wenzhou Medical University (Wenzhou, China) (27 females; mean age: 25.08 ± 3.38 years). The inclusion criteria were as follows: (1) ≥18 years; (2) distant best-corrected visual acuity (BCVA) in both eyes ≤0.00 logarithm of the minimum angle of resolution (logMAR); (3) without other ocular diseases affecting visual function such as glaucoma, optic nerve disease, etc.; (4) able to comprehend the test content and communicate effectively. The exclusion criteria were as follows: (1) history of mental and nervous system diseases; (2) unable to complete the test; (3) had received specific training to counteract the illusion or possessed expert-level knowledge of its mechanisms. In Experiment 2, twenty-six patients diagnosed with age-related cataracts in both eyes were enrolled as the cataract group (mean age: 65.19 ± 3.87 years, 17 females). Inclusion criteria: (1) ≥50 years-old; (2) diagnosed with bilateral age-related cataract; (3) BCVA of both eyes between ≤1.00 logMAR and ≥0.30 logMAR. Additionally, fifty-nine normally-sighted participants with matched age and education levels comprised the control group (mean age: 63.98 ± 5.57 years, 39 females). Inclusion criteria: (1) aged ≥50 years; (2) no cataract, glaucoma, degenerative optic nerve diseases, or other eye diseases affecting visual function; (3) BCVA of both eyes was ≤0.10 logMAR. Exclusion criteria: same as Experiment 1. In Experiment 3, fourteen patients scheduled for binocular cataract surgery were enrolled (mean age: 69.50 ± 6.14 years, 10 females). The inclusion and exclusion criteria were the same as those of the cataract group in Experiment 2. All patients underwent microincision phacoemulsification and intraocular lens implantation performed by experienced cataract specialists. The surgery of the second eye was performed one day after the first operation.

The experimental protocol was approved by the institutional ethics committee of the Eye Hospital of Wenzhou Medical University (2020–075-K-67-01 and 2020–075-K-67-02). All procedures complied with the Declaration of Helsinki. Written informed consent was obtained from all participants after detailed explanation of the study procedures.

Müller-Lyer Illusion Measurements

Stimuli

The classic Müller-Lyer illusion was presented as black lines (luminance: 1 cd/m²) against a white screen (luminance: 140 cd/m²), with a contrast of 100% (Figure 1). The standard line (featuring an outward-pointing arrowheads) had a length of 250 pixels and a nominal width of 12.5 pixels. The arrow stimulus occupied 50 pixels on the screen, with

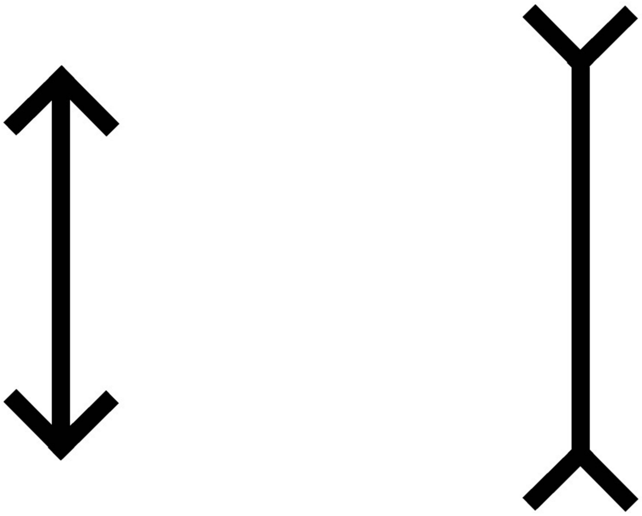

Figure 1 Müller-Lyer illusion stimulus pattern. This image is observed on a screen projecting a resolution of 1366 × 768 pixels, with the angle between the two arrows set at 90°.

a 90° angle between the two arrows. The vertical distance between the line segments was 333 pixels. The stimuli were presented on a 14-inch laptop screen (ThinkPad Edge E431, Lenovo Corporation, Beijing, China) with a screen resolution of 1366×768 pixels. A C# script (Visual Studio, version 25.0, Microsoft, USA) facilitated image display and response recording process.

Procedure

A program based on the adjustment method was used to measure the illusion threshold. The principle of this program have been described in a study published recently.[13] In this two-alternative forced choice task, participants selected the longer line segment by pressing the key (left/right) on a touch screen or mouse button while viewing binocularly at a distance of 40 cm. Head position was stabilized using an adjustable chinrest, with eye level aligned to the display center. The program iteratively altered the length of the comparison stimulus to converge with the standard stimulus, contingent on the participants' choices. The length of the comparison stimulus was symmetrically adjusted around its central point, ensuring that both ends expanded or contracted equally. An enhanced variable step size least mean square adaptive algorithm was implemented to regulate the length adjustments. The threshold data were computed as the average of the last five lengths of the comparison stimulus. The illusion intensity was calculated as the absolute difference between the illusion threshold and 100%, expressed as a percentage. A larger disparity between the illusion threshold and 100% indicated a robust Müller-Lyer illusion effect, thus yielding a higher illusion intensity in the task. All tests were performed by two trained postgraduates.

In Experiment 1, all participants wore a pair of glasses with Bangerter occlusion foils (BOF) to create a transient visual acuity decline. The BOFs are translucent, plastic filters that adhere to the front of a spectacle lens. They block light transmission and reduce visual acuity in a graded fashion (Ryser Optik AG, St. Gallen, Switzerland). The level of density was 0.4, which reduced visual acuity to approximately 0.40 logMAR. The Müller-Lyer illusion was measured before and 5 min (according to the study designs by Webster et al[14] and Ohlendorf et al[15]) after wearing the glasses. In Experiment 3, Müller-Lyer illusion tests were performed before surgery, day 1 and day 7 after surgery. All participants were provided near refractive correction during the test in Experiment 2 and 3.

Statistical Analysis

Continuous variables were presented as mean ± standard deviation or median (first quartile/Q_1, third quartile/Q_3) as appropriate. Paired *t*-test (conform to normal distribution) or Wilcoxon sign-rank test was used to compare the illusion intensity before and after wearing occlusion glasses. Independent *t*-test (conformed to normal distribution) or Mann–

Whitney *U*-test was used to compare the illusion intensity between the cataract patients and non-cataract controls. Repeated measures ANOVA (analysis of variance) was used to compare the illusion intensity before surgery, day 1 and day 7 after surgery. To quantify evidence for null hypothesis, Bayesian *t*-tests and ANOVA were conducted using JASP (version 0.19.3.0). A Bayes factor (BF_{10}) < 1/3 indicates substantial evidence for the null hypothesis, $1/3 \leq BF_{10} < 1$ suggests anecdotal evidence, and $BF_{10} \geq 1$ provides support for the alternative hypothesis. All analyses used SPSS (version 22.0; SPSS, Inc., Chicago, IL, USA), with statistical significance set at $p < 0.05$.

Results

Experiment 1: Effect of Transient Visual Acuity Loss in Young Adults

A total of 49 young participants (mean age: 25.08 ± 3.38 years, 27 females) were involved in Experiment 1. As shown in Table 1, BOFs induced significant binocular visual acuity loss at both distance (median [Q_1, Q_3]: −0.08 [−0.13, −0.08] to 0.40 [0.40, 0.40] logMAR; $p < 0.001$) and near (0.00 [0.00, 0.00] to 0.52 [0.40, 0.52] logMAR; $p < 0.001$). Critically, Müller-Lyer illusion intensity remained stable despite acute visual impairment (4.33 [2.00, 8.00] % vs 3.75 [2.17, 7.84] %; $Z = -1.471$, $p = 0.141$, $BF_{10} = 0.577$; Figure 2A).

Experiment 2: Effect of Long-Term Visual Acuity Loss in Cataract Patients

Twenty-six cataract patients (65.19 ± 3.87 years, 17 females) and 59 age-matched normally-sighted controls (63.98 ± 5.57 years, 39 females) showed no demographic differences ($p > 0.05$; Table 2). All patients reported experiencing blurred vision for years, with a median duration of 2 years (range: 1–8 years). Cataract patients exhibited clinically significant binocular acuity deficits versus controls at distance (0.40 [0.40, 0.57] vs 0.00 [0.00, 0.10] logMAR; $p < 0.001$) and near (0.52 [0.49, 0.70] vs 0.00 [0.00, 0.10] logMAR; $p < 0.001$). No significant difference was observed in the illusion intensity between cataract patients and controls (8.79 ± 2.08% vs 8.20 ± 3.01%, $t\ (83) = 1.042$, $p = 0.301$, *Cohen's* $d = 0.213$, $BF_{10} = 0.345$; Figure 2B).

Experiment 3: Effect of Visual Acuity Recovery After Cataract Surgery

Fourteen bilateral cataract patients (69.50 ± 6.14 years, 10 females) were evaluated before and after cataract surgery. All patients achieved significant postoperative improvement in binocular distance (0.52 [0.40, 0.73] to 0.02 [0.00, 0.10] logMAR, $p < 0.001$) and near visual acuity (0.65 [0.52, 0.73] to 0.26 [0.19, 0.30] logMAR, $p < 0.001$) (Table 3). Illusion intensity did not change significantly from preoperative to postoperative day 1 and day 7 (9.46 ± 2.06% vs 9.87 ± 2.18% vs 9.87 ± 2.05%, $F\ (2, 26) = 1.072$, $p = 0.357$, partial $\eta^2 = 0.076$, $BF_{10} = 0.345$; Figure 2C).

Comparison of Müller-Lyer Illusion Intensity Between Young and Elderly Adults

We further compared the illusion intensity of young participants from Experiment 1 (n=49) and normally-sighted elderly participants from Experiment 2 (n=59). The elderly group showed significantly higher illusion intensity than the young group (8.20 ± 3.01% vs 4.33 [2.00, 8.00] %, $U = 2266.0$, $p < 0.001$, $BF_{10} = 304$; Figure 3). Although the intergroup difference in BCVA was statistically significant ($p < 0.001$), it was clinically negligible (all BCVA better than 0.00 logMAR, and within one line difference). Multivariate regression analysis confirmed age as the sole significant predictor

Table 1 Participant Characteristics in Experiment 1 (n=49)

	Before Wearing Occlusion Glasses	After Wearing Occlusion Glasses	*p*
Age (years-old)	25.08 ± 3.38		-
Gender (Males: Females)	22:27		-
Binocular distant BCVA (logMAR)	−0.08 (−0.13, −0.08)	0.40 (0.40, 0.40)	<0.001[a]
Binocular near BCVA (logMAR)	0.00 (0.00, 0.00)	0.52 (0.40, 0.52)	<0.001[a]
Illusion intensity (%)	4.33 (2.00, 8.00)	3.75 (2.17, 7.84)	0.141[a]

Note: [a]Wilcoxon signed-rank test.

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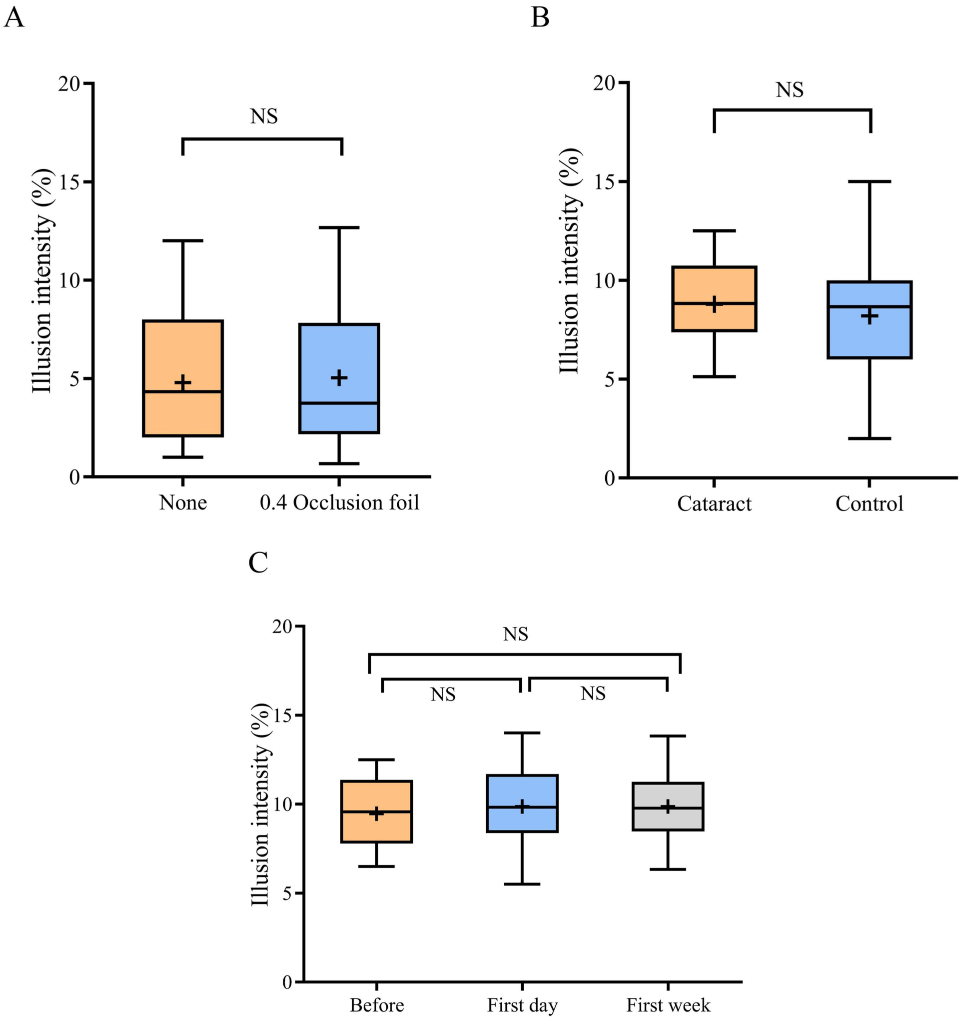

Figure 2 Illusion intensity across three experimental conditions. Effect of transient visual acuity decline (**A**), long-term visual acuity decline (**B**) and visual acuity recovery (**C**) on the intensity of Müller-Lyer illusion. Box encompasses upper and lower data quartiles; whiskers illustrate the upper and lower extremes of the data; "+" represents the means. No significant differences (NS) were observed in the illusion intensity (p = 0.141, 0.301, 0.357, BF_{10} = 0.577, 0.345, 0.345).

of illusion intensity ($\beta = 0.088$, 95% confidence interval: 0.038–0.138, $p = 0.001$), with no contributions from distance ($p = 0.780$) or near BCVA ($p = 0.421$).

Discussion

The result of this study showed that Müller-Lyer illusion intensity in adults remains resilient to both transient and long-term mild visual acuity loss but increases significantly with age. Three key observations support this conclusion: (1) no modulation of illusion intensity by Bangerter foil-induced acuity degradation in young adults, (2) comparable illusion

Table 2 Participant Characteristics in Experiment 2

	Cataract Patients (n=26)	Healthy Controls (n=59)	*p*
Age (years-old)	65.19 ± 3.87	63.98 ± 5.57	0.253[a]
Gender (Males: Females)	9:17	20:39	0.949[b]
Binocular distant BCVA (logMAR)	0.40 (0.40, 0.57)	0.00 (0.00, 0.10)	<0.001[c]
Binocular near BCVA (logMAR)	0.52 (0.49, 0.70)	0.00 (0.00, 0.10)	<0.001[c]
Illusion intensity (%)	8.79 ± 2.08	8.20 ± 3.01	0.301[a]

Note: [a]Independent *t*-test; [b]Chi-square test; [c]Mann–Whitney *U*-test.

Table 3 Participant Characteristics in Experiment 3 (n=14)

	Before Surgery	First day After Surgery	One Week After Surgery	*p*
Age (years-old)	69.50 ± 6.14			-
Gender (Males: Females)	4:10			-
Binocular distant BCVA (logMAR)	0.52 (0.40, 0.73)	0.02 (0.00, 0.10)	0.02 (0.00, 0.10)	<0.001[a]
Binocular near BCVA (logMAR)	0.65 (0.52, 0.73)	0.30 (0.22, 0.40)	0.26 (0.19, 0.30)	<0.001[a]
Illusion intensity (%)	9.46 ± 2.06	9.87 ± 2.18	9.87 ± 2.05	0.357[b]

Note: [a]Friedman test; [b]Analysis of variance of repeated measurement.

intensity between cataract patients and age-matched controls despite marked acuity differences, and (3) stability of illusion perception following surgical acuity restoration. Critically, normally-sighted elderly participants exhibited a higher intensity than younger adults ($p < 0.001$).

These findings indicted that the Müller-Lyer illusion in adults primarily engages high-level cognitive processes. Neuroimaging evidence localizes its mechanisms to the lateral occipital cortex (object recognition) and upper parietal cortex (spatial judgment) along the ventral and dorsal pathways,[16–22] as well as interactions within the visual and frontal-parietal cortices.[23,24] This network supports spatial context integration—the core process distorted by the illusion.

Perceptual integration is modulated by both top-down and bottom-up neural mechanisms.[25] For the Müller-Lyer illusion, bottom-up contributions encompass sensory encoding of visual features, whereas top-down regulation involves contextual interpretation based on prior experience. During childhood, when neural circuits exhibit strong plasticity due to critical period of development,[26] both mechanisms jointly shape illusion susceptibility. This accounts for the altered illusion intensity observed in children with congenital visual impairment compared to typically developing peers.[13] In adulthood, however, reduced neural plasticity and accumulated visual experience consolidate stable internal representations of contextual relationships, diminishing the influence of sensory inputs on illusion perception. Consequently, neither transient (BOF) nor long-term (cataracts) acuity decline significantly modulated the illusion intensity, as these primarily degrade sensory quality without disrupting contextual integration.

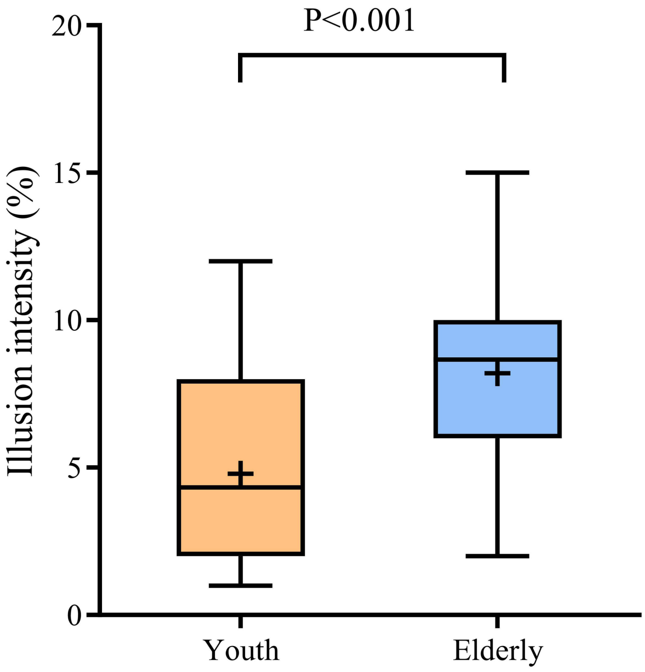

Figure 3 Müller-Lyer illusion in the youth and the elderly. Box encompasses upper and lower data quartiles; whiskers illustrate the upper and lower extremes of the data; "+" represents the means. Differences in the illusion intensity between the youth and the elderly were significant (p < 0.001).

The heightened Müller-Lyer illusion intensity in older adults suggests sustained top-down modulation by high-level cognitive regions. While extensive evidence—particularly from systematic reviews synthesizing developmental data—confirms a gradual decrease in illusion susceptibility throughout childhood,[8] our findings reveal a paradoxical reversal in late adulthood. Specifically, elderly participants exhibited stronger illusions than younger adults ($p < 0.001$), implicating age-related cognitive decline as a potential contributor. This phenomenon may arise through two complementary mechanisms: 1. Degraded top-down control: Cognitive functions undergo physiological decline after age 45,[27,28] potentially weakening top-down inhibitory regulation over contextual integration. 2. Attenuated bottom-up processing: As recently demonstrated by Wincza et al,[6] stronger local bias—a key bottom-up component involving fine-grained visual analysis—strengthens resistance to geometric illusions by suppressing contextual interference. Conversely, aging reduces local processing efficiency,[29,30] which may amplify reliance on top-down contextual modulation. In our elderly cohort, this dual impairment—compromised local analysis and heightened contextual weighting—likely synergistically increased susceptibility to the Müller-Lyer configuration. This account aligns with the inverse relationship between local bias strength and illusion intensity established in Wincza's framework.[6]

Our finding of heightened elderly susceptibility aligns with Barclay and Comalli's report of significantly stronger Müller-Lyer illusions in older adults compared to young university students.[11] However, this pattern contrasts with studies reporting lifespan decreases in susceptibility. This divergence likely reflects three factors: 1. Differential age sampling. Prior studies documenting age-related declines predominantly tested children/adolescents[8] or undersampled older adults. For instance, while Cretenoud et al[31] reported declining illusion intensity with age, their cohort predominantly comprised participants under 23 years. Similarly, Grzeczkowski et al[12] found no significant age correlation in adults, possibly due to sparse sampling beyond age 60. Our focused comparison (young: 25 ± 3 yrs vs elderly: 64 ± 5 yrs) targets ages where cognitive aging may amplify top-down modulation. 2. Cultural differences. Cross-cultural evidence confirms that susceptibility to geometric illusions varies with perceptual habits—eg, heightened Ebbinghaus effects in East Asian groups[32,33] and urban-rural developmental differences.[34] Our exclusively Chinese cohort may thus diverge from Western-dominant samples.[12,31] 3. Methodological influences. Recent systematic analyses highlight that task design critically modulates measured illusion intensity. Adjustment paradigms may engage distinct cognitive strategies and show higher variability compared to forced-choice tasks.[8,35] Here, our two-alternative forced-choice adaptive procedure with variable step sizes efficiently tracks perceptual thresholds while minimizing response bias—a design feature that may explain the robust capture of age-related susceptibility increases. Collectively, these factors reconcile apparent contradictions in the literature and underscore the importance of methodological and demographic considerations in illusion research.

Further reinforcing this complexity, a recent comprehensive study by Mazuz et al[36] demonstrated differential age-related trajectories across distinct size illusions: susceptibility to the Ebbinghaus illusion decreased with age, while the Height-width illusion increased, and the Ponzo illusion remained stable. This illusion-specific pattern aligns with our observation of heightened Müller-Lyer susceptibility in aging, collectively indicating that visual perceptual changes in late adulthood are mediated by distinct mechanisms for different contextual illusions. Specifically, the age-related amplification observed in both our Müller-Lyer results and Mazuz's Height-width findings suggests a common vulnerability in illusions relying on contextual size scaling mechanisms, potentially reflecting shared neural substrates in global contextual processing that are disproportionately affected by aging.

Clinically, the preserved illusion intensity in cataract patients supports its utility as a biomarker of visual-cognitive integration. Notably, schizophrenia patients exhibit heightened sensitivity to the Müller-Lyer illusion compared to healthy individuals.[37–39] Pessoa et al[40] suggested that the Müller-Lyer illusion could serve as a screening tool for the prodromal phase of schizophrenia. Conversely, children with congenital visual impairment show reducible illusion intensity through low-vision aids.[13] Extending to neurodegenerative disorders, recent evidence reveals a distinct pattern in Parkinson's disease where patients exhibited comparable Müller-Lyer illusion susceptibility to age-matched controls,[41] despite documented dorsal-stream impairments. This highlights the illusion's specific dependence on intact ventral-stream processing. Collectively, these clinical observations position the Müller-Lyer illusion as a differential diagnostic marker: Its amplification may signal cognitive integration abnormalities (eg, schizophrenia prodrome), its plasticity reflects developmental visual-cognitive adaptation (eg, congenital visual impairment), while its stability may indicate preserved ventral-stream function in neurodegenerative motor disorders.

Nevertheless, several limitations warrant consideration in this study. First, the age comparison was restricted to young (25 ± 3 years) and older adults (64 ± 5 years), leaving potential non-linear developmental trajectories of illusion perception across intermediate ages unexplored. Second, while cataract patients were rigorously matched to controls, generalization to other forms of visual impairment (eg, glaucoma) requires verification. Third, no direct quantitative assessments of cognitive functions were performed. Although a recent study in Parkinson's disease patients found no correlation between cognitive ability and Müller-Lyer illusion susceptibility,[41] this does not preclude the potential contribution of specific cognitive domains (eg, local processing efficiency) to age-related illusion enhancement. Our interpretation that cognitive decline underlies increased illusion intensity in aging remains plausible but requires verification through domain-specific cognitive assessments. Fourth, as highlighted in systematic reviews,[8] methodological variations—particularly in task designs (forced-choice vs adjustment methods) and illusion stimuli parameters (eg, arrow angle, line length)—may influence absolute illusion intensity. While this does not challenge our core findings regarding age effects and acuity resistance, it necessitates caution when comparing quantitative values across studies. Future studies should incorporate longitudinal designs across continuous age spectra, diverse patient cohorts, and multimodal assessments integrating psychophysical (eg, contrast sensitivity) and cognitive metrics with standardized illusion protocols to facilitate cross-study validation.

Conclusions

The current study investigated the correlation between the Müller-Lyer illusion and visual impairment in adults. Our results demonstrate that neither transient mild visual impairment induced by Bangerter occlusion foils nor long-term mild visual impairment resulting from age-related cataracts significantly affected the illusion intensity. However, normally-sighted older adults exhibited stronger illusion susceptibility compared to younger participants, independent of visual acuity. These findings collectively indicate that the Müller-Lyer illusion in adults is resistant to mild visual acuity loss but shows significant amplification with advancing age. The dissociation highlights the illusion's potential as a robust probe for studying visual-cognitive integration mechanisms.

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Disclosure

The authors report no conflicts of interest in this work.

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