

ABSTRACT

Previous studies found that letter-counting performance for low-vision observers is better with “smooth” (anti-aliased) letters than with “jagged” (pixilated) letters on a CRT display (Bailey et al., 1987).

On the other hand, Geiger and Lettvin (1998) found that recognition is more accurate with jagged letters than with smooth letters when the letters were presented in the periphery of normal sighted subjects using a tachistoscope.

We sought to determine if Geiger and Lettvin’s effect generalized to letter recognition on a high-resolution CRT monitor.

If jagged letters increase letter recognition in the periphery, low-vision

patients with central field loss might benefit from a pixilated display.

In the first experiment, we presented one letter in the center and one letter in the periphery at various eccentricities and compared recognition for smooth and jagged letters. No difference was found.

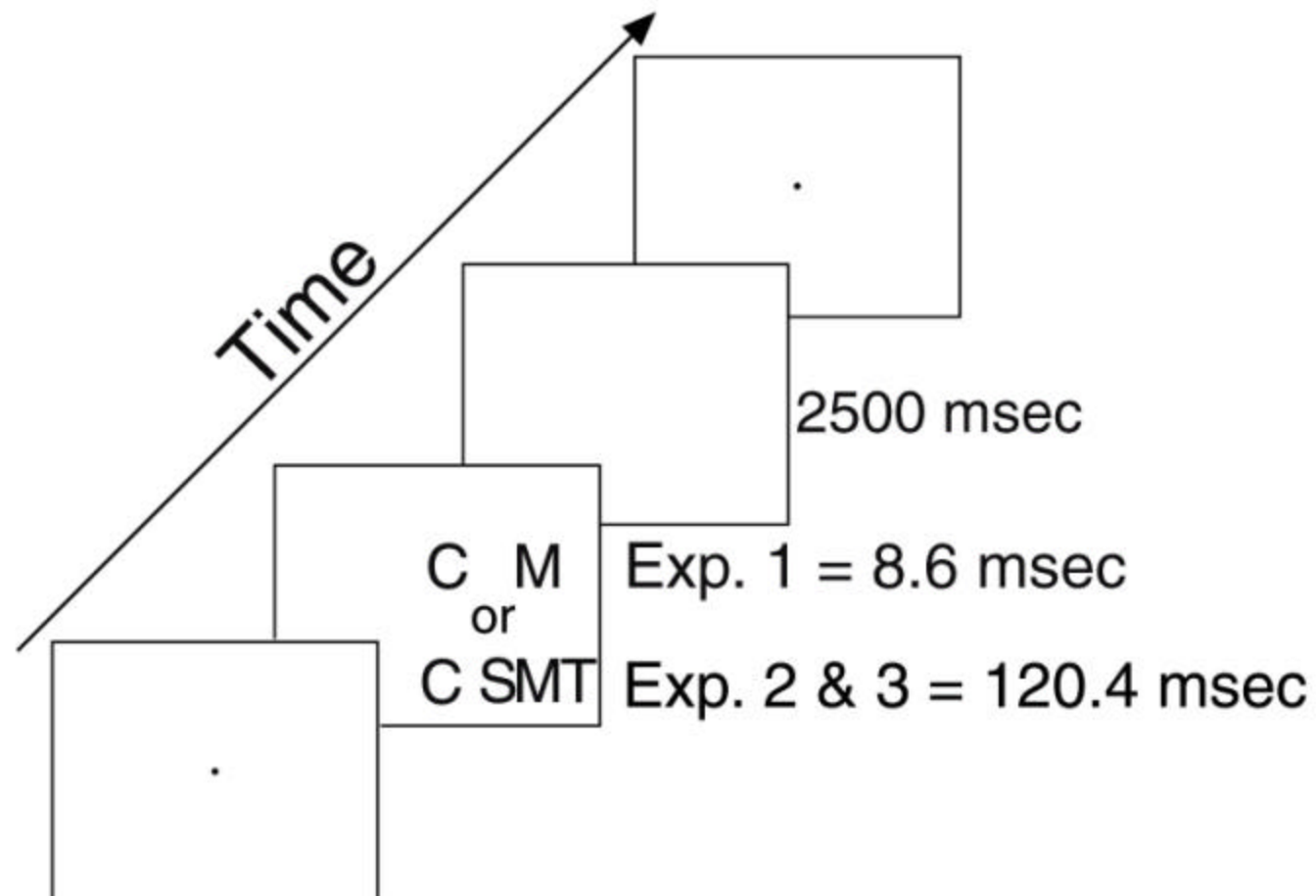
In the second and third experiments, we used the same procedure, except that a three-letter string was presented in the periphery instead of a single letter.

Recognition of jagged letters in the periphery was not different from smooth letters. This suggests that there would be no added advantage in presenting jagged letters for reading patients with central field loss.

MOTIVATION

- Replicate Geiger and Lettvin using a high-resolution CRT monitor.

STIMULUS PRESENTATION



METHODS

- Smooth (anti-aliased) Helvetica letters
- Letters were 0.6 deg from 57.5 cm
- Jagged letters generated from smooth letters by thresholding gray pixels
- Peripheral letters presented randomly on left or right
- Subjects reported both central and peripheral letters
- Correct identification of center letter for trial to be counted (ensured proper fixation)
- Dark letters on white background (white luminance = 75 cd/m²)

STIMULI

Exp 1 & 2: C, M, N, O, S, V, E, H, I, T

Exp 3: C, M, N, O, S, V, A, Q, U, X

- Contrast of letters

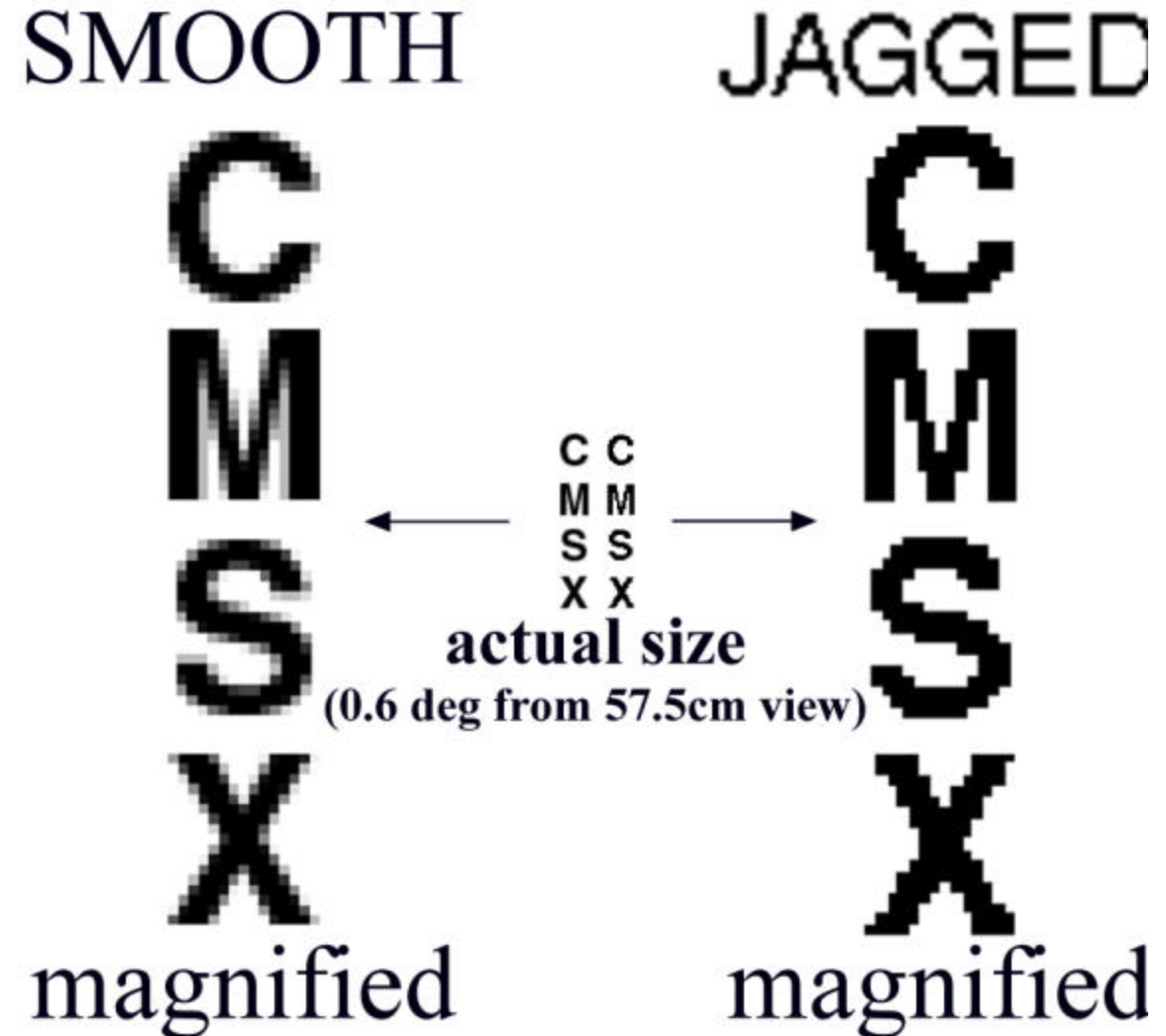
- 50%, 60%, 70%, 80%, or 100% $\left(\frac{L_{\max} - L_{\min}}{L_{\max} + L_{\min}} \right)$

SUBJECTS

- 18 to 35 year old male and female naïve observers with normal or corrected-to-normal vision

APPARATUS

- Nanao™ Eizo® monitor 1024 x 600, 122 Hz non-interlaced; driven by VisionWorks™ (Durham, NH)



EXPERIMENT 1

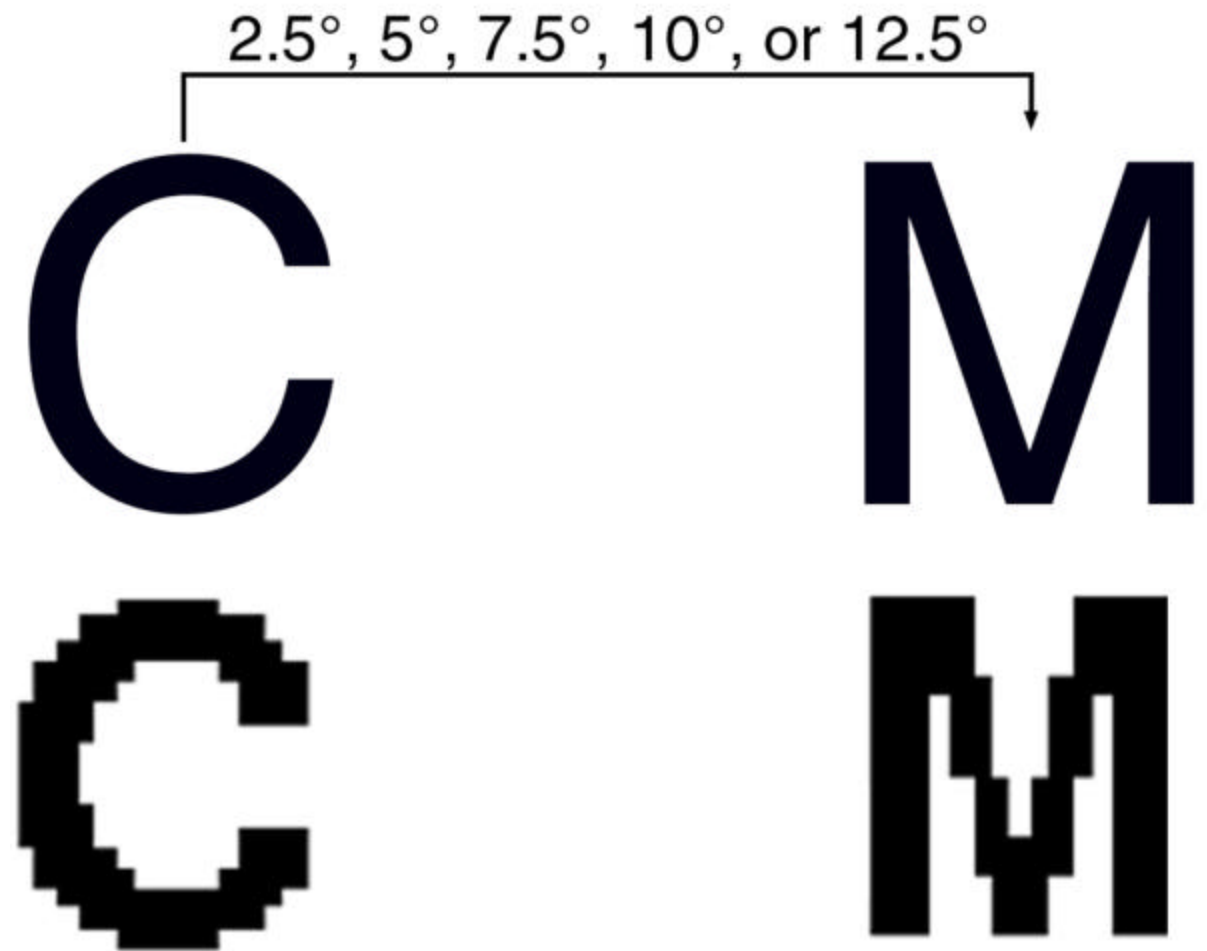
PURPOSE: Replicate Geiger and Lettvin
on CRT

TASK: Single letter recognition in
periphery

RESULTS SUMMARY

Did not replicate Geiger and Lettvin
(their presentation was shorter – 4 msec)

- No significant difference in recognition
between jagged and smooth letters



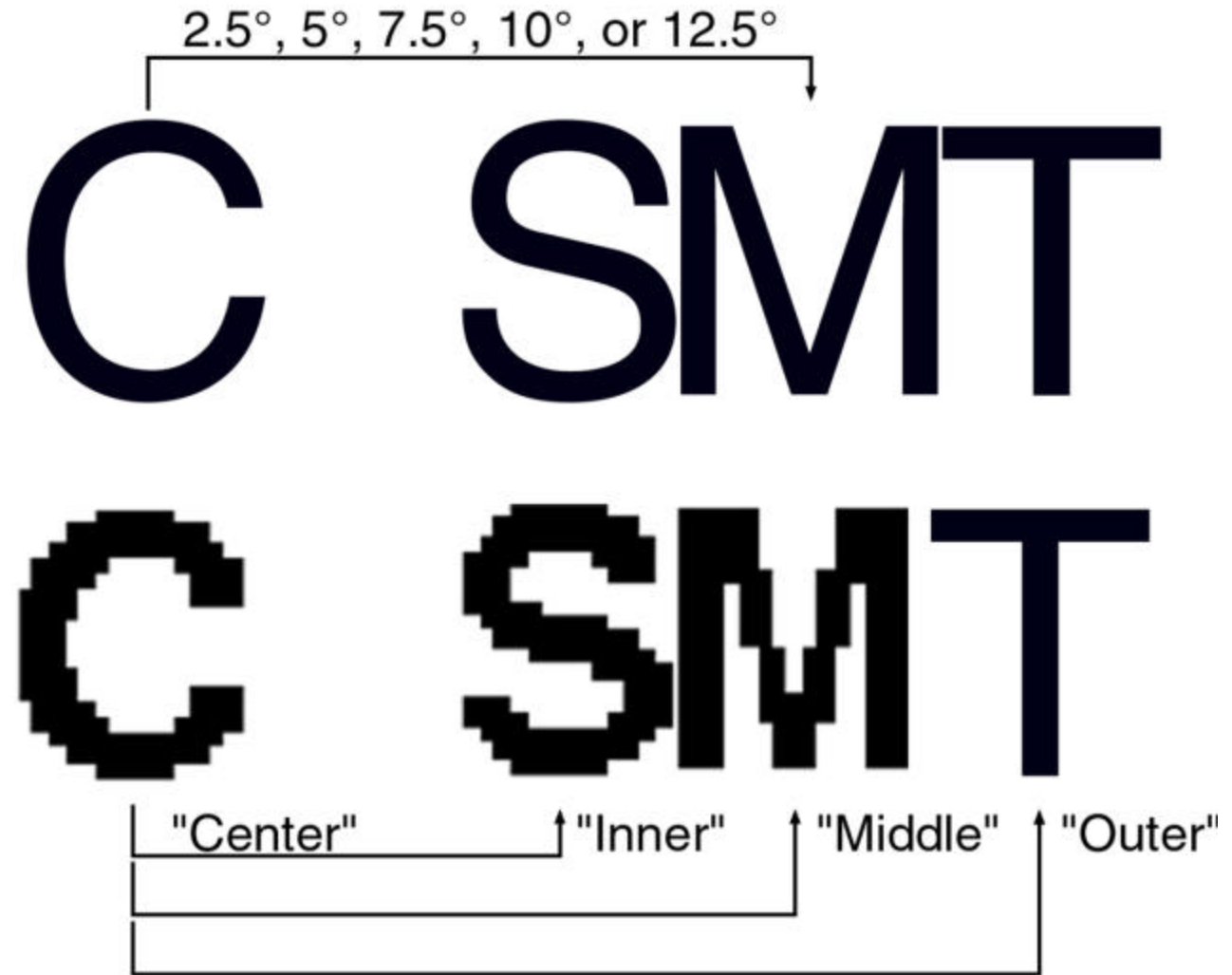
EXPERIMENT 2A

PURPOSE: Increase level of difficulty; make stimuli closer to reading task

TASK: 3-letter string recognition

RESULTS SUMMARY

- No significant difference between jagged and smooth letters
- Better performance on right side than left
- Outermost letter detected with greatest accuracy



EXPERIMENT 2B

PURPOSE: Increase statistical power of Exp. 2A;
tested 5° & 10° eccentricity only

TASK: 3-letter string recognition

RESULTS SUMMARY

- Same pattern of results as in Exp. 2A
- No significant difference between jagged and smooth letters
- Maybe due to non-jagged letters in jagged letter condition (e.g. I,T,E vs. S,M,X)

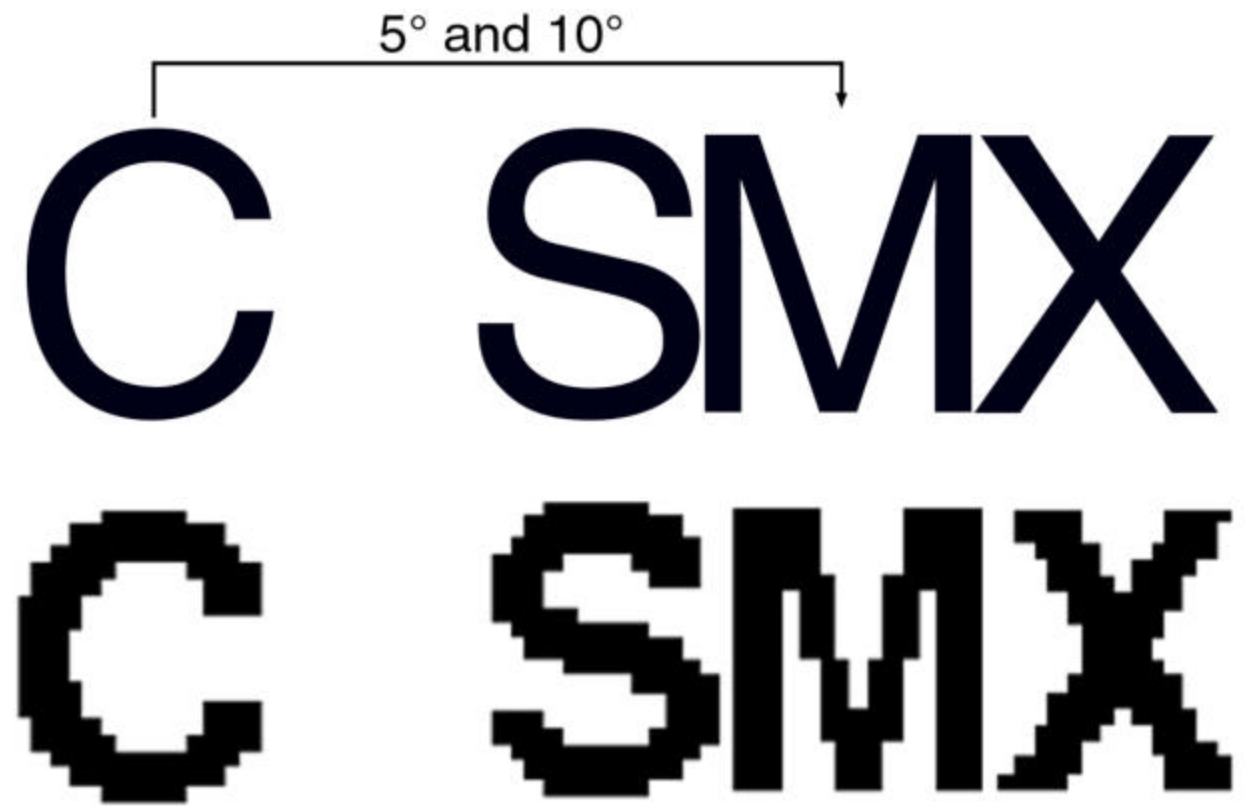
EXPERIMENT 3

PURPOSE: To test with different stimuli - all peripheral letters have jagged component

TASK: 3-letter string recognition

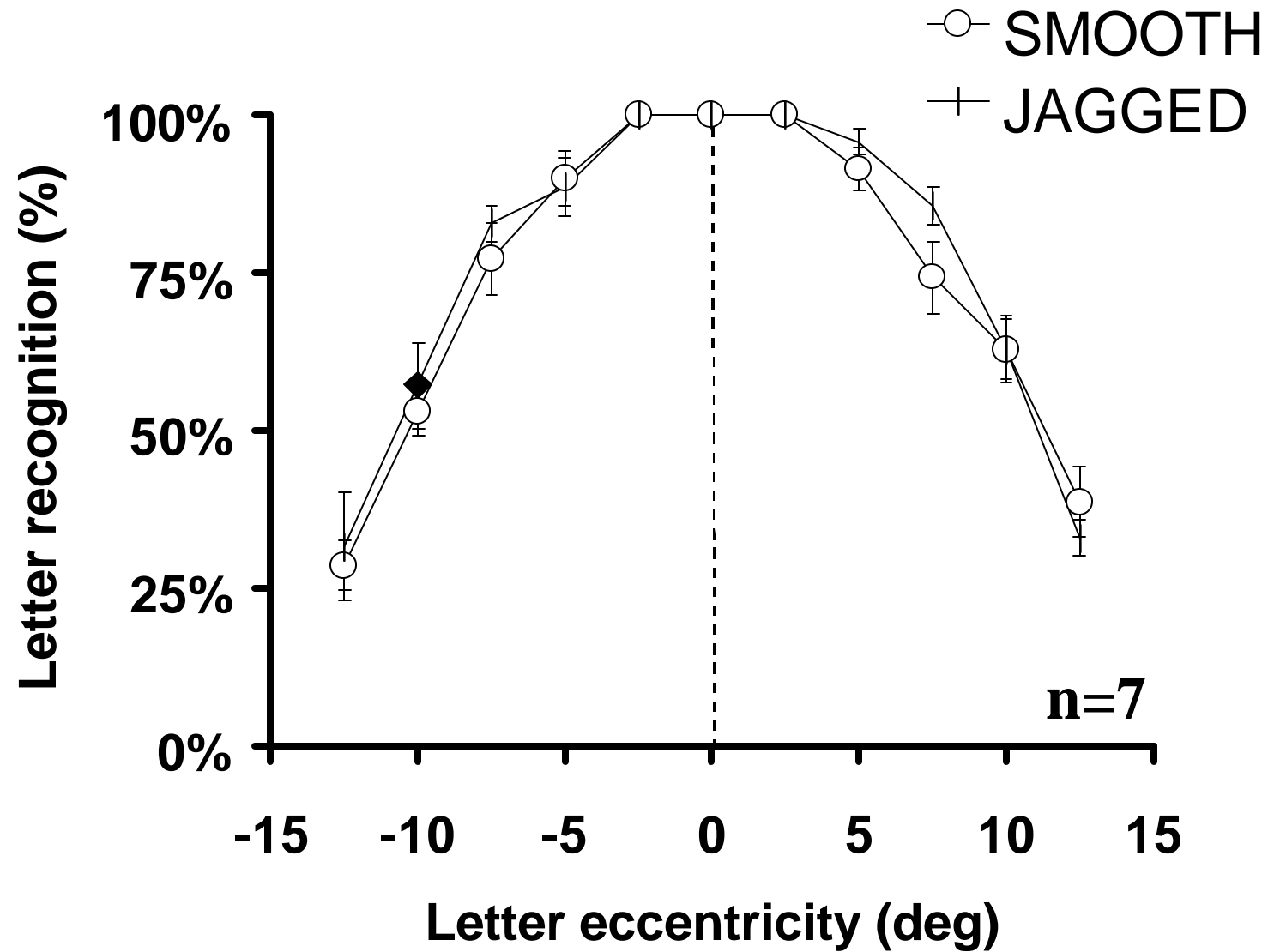
RESULTS SUMMARY

- Introduction of jagged components in entire 3-letter string did not influence results

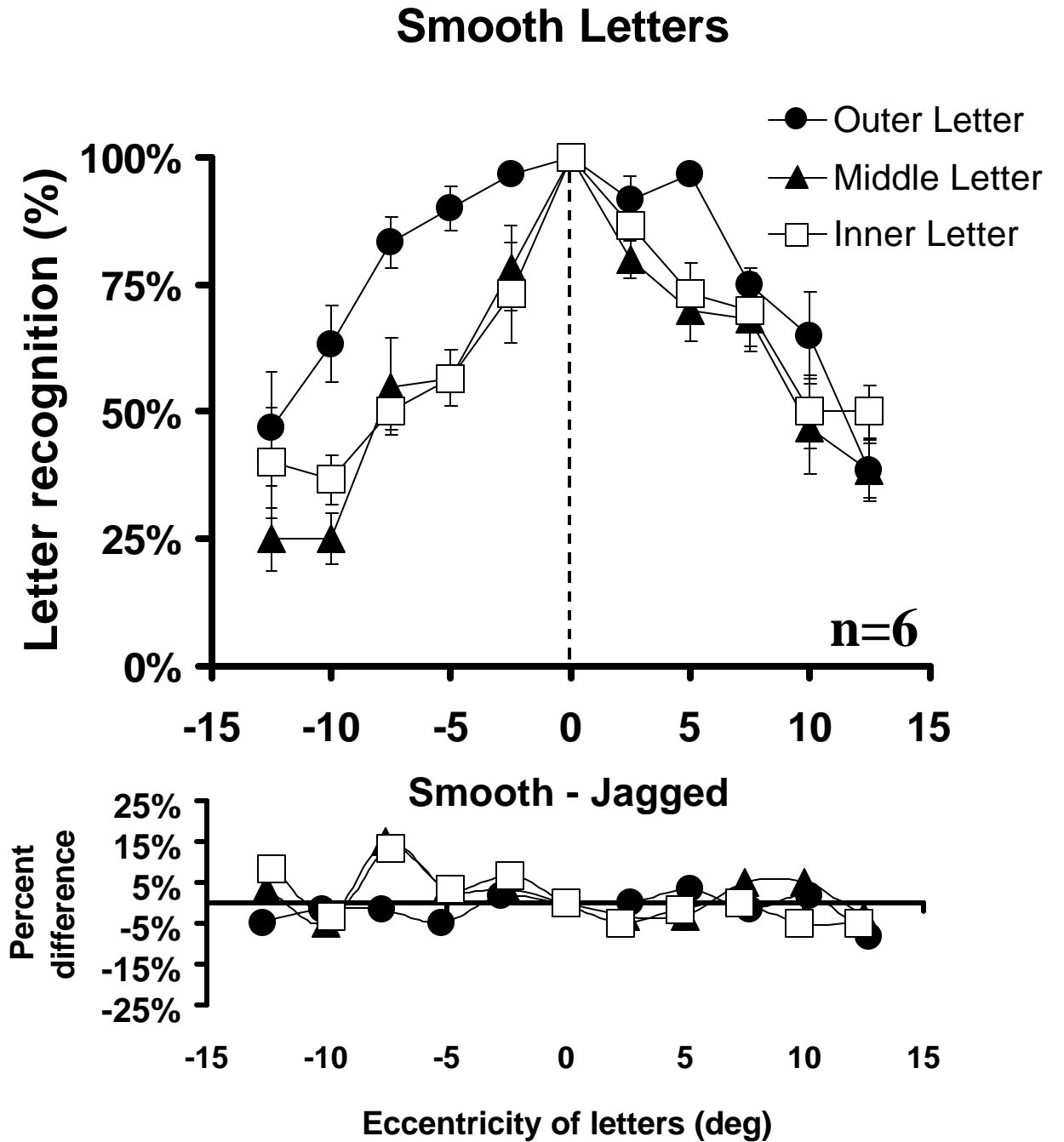
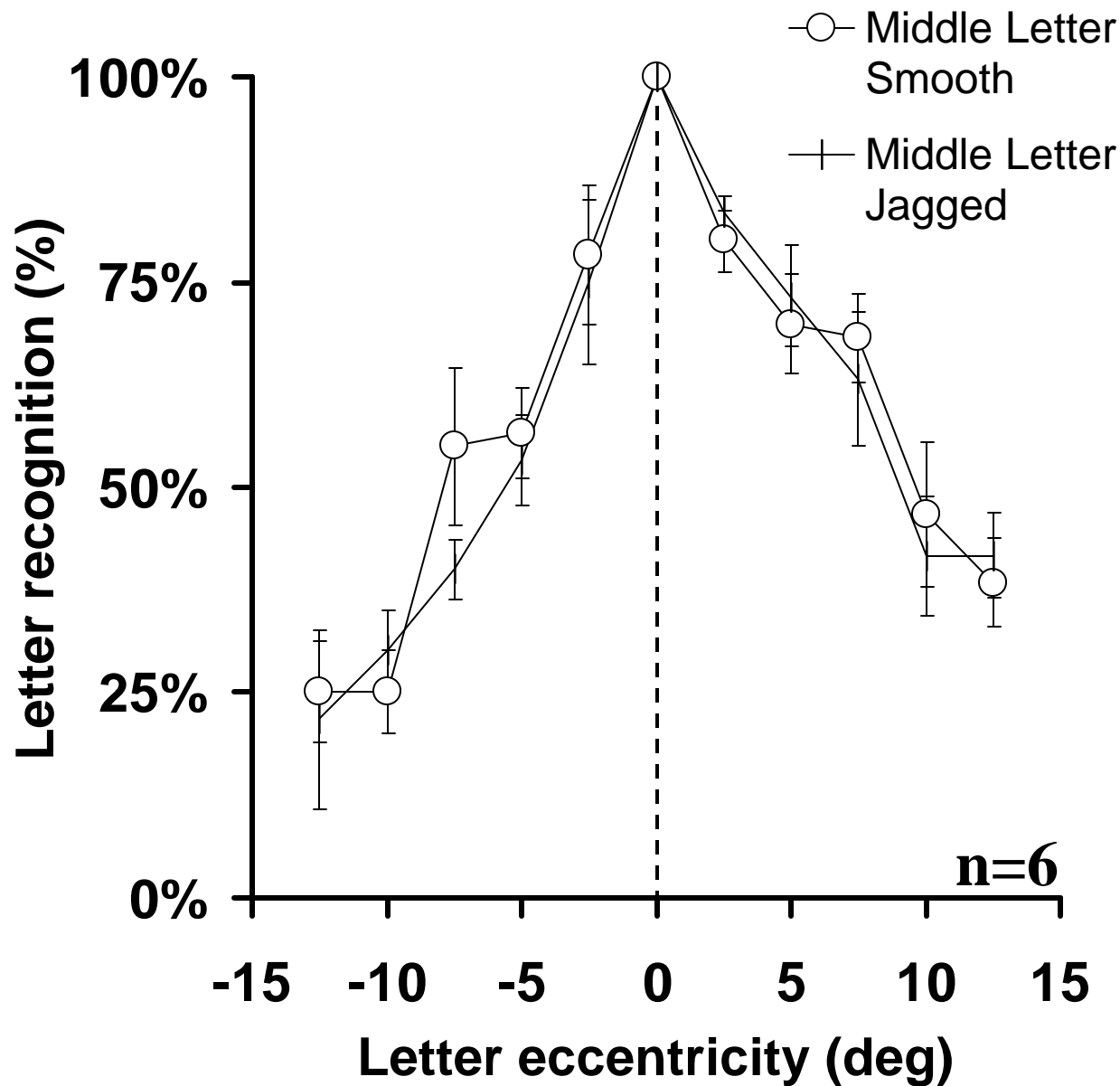


RESULTS

EXPERIMENT 1

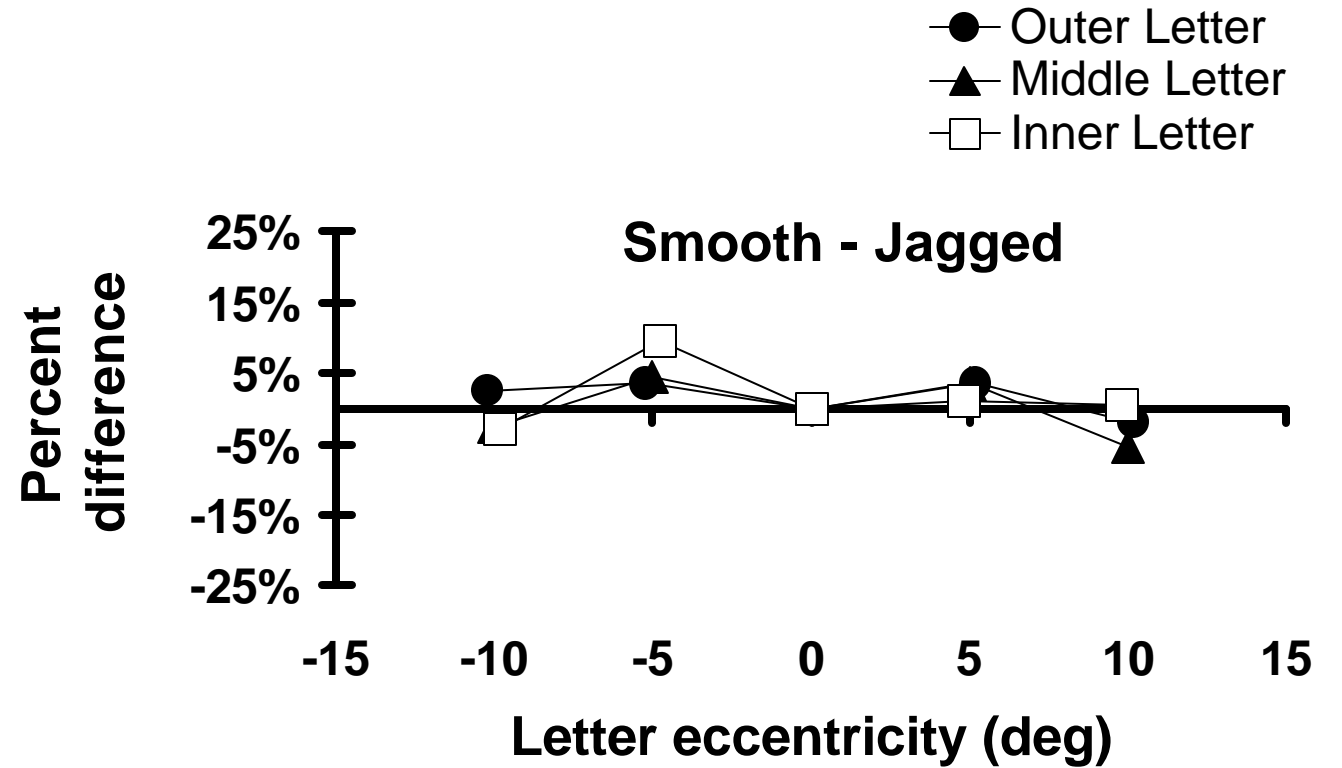
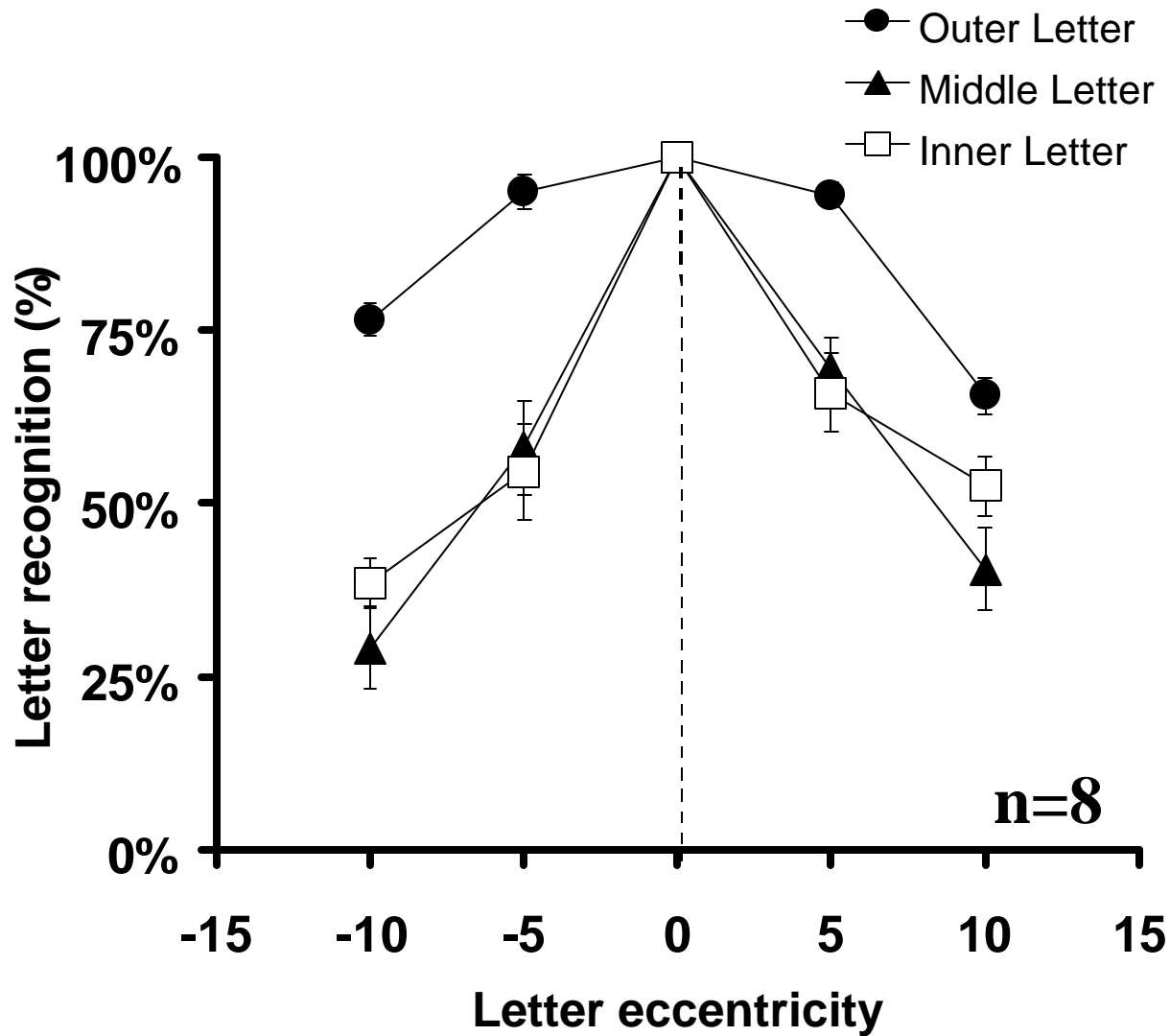


EXPERIMENT 2A

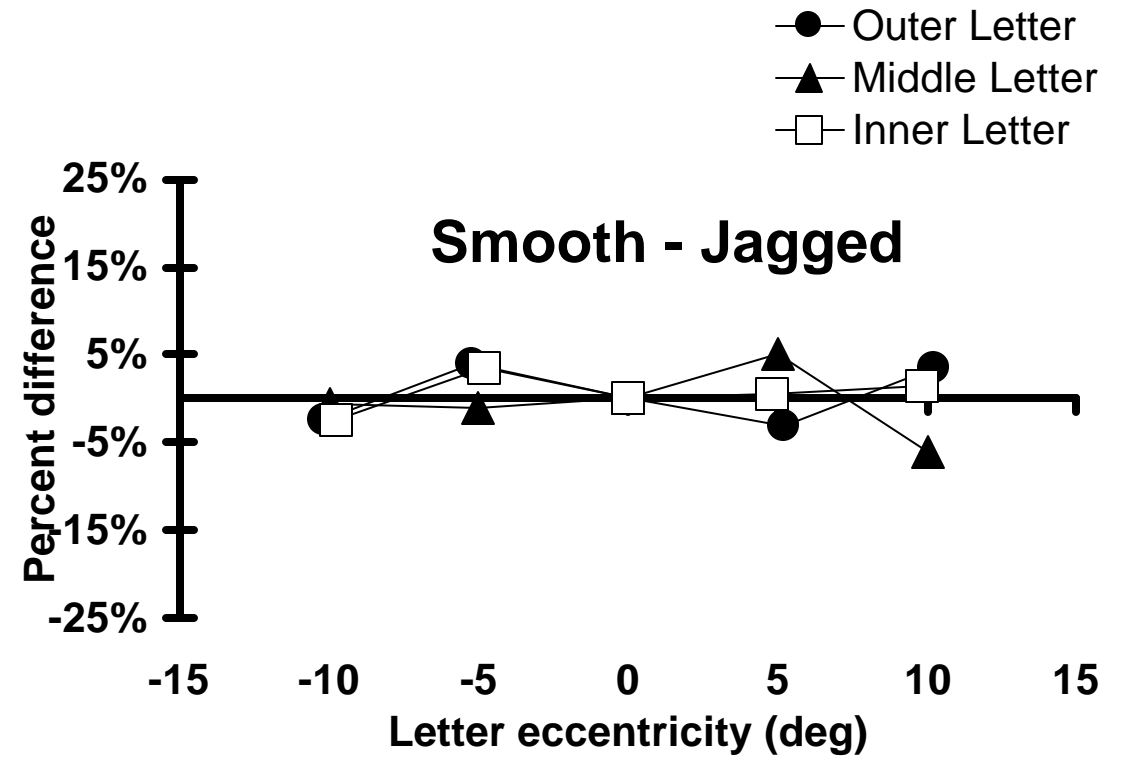
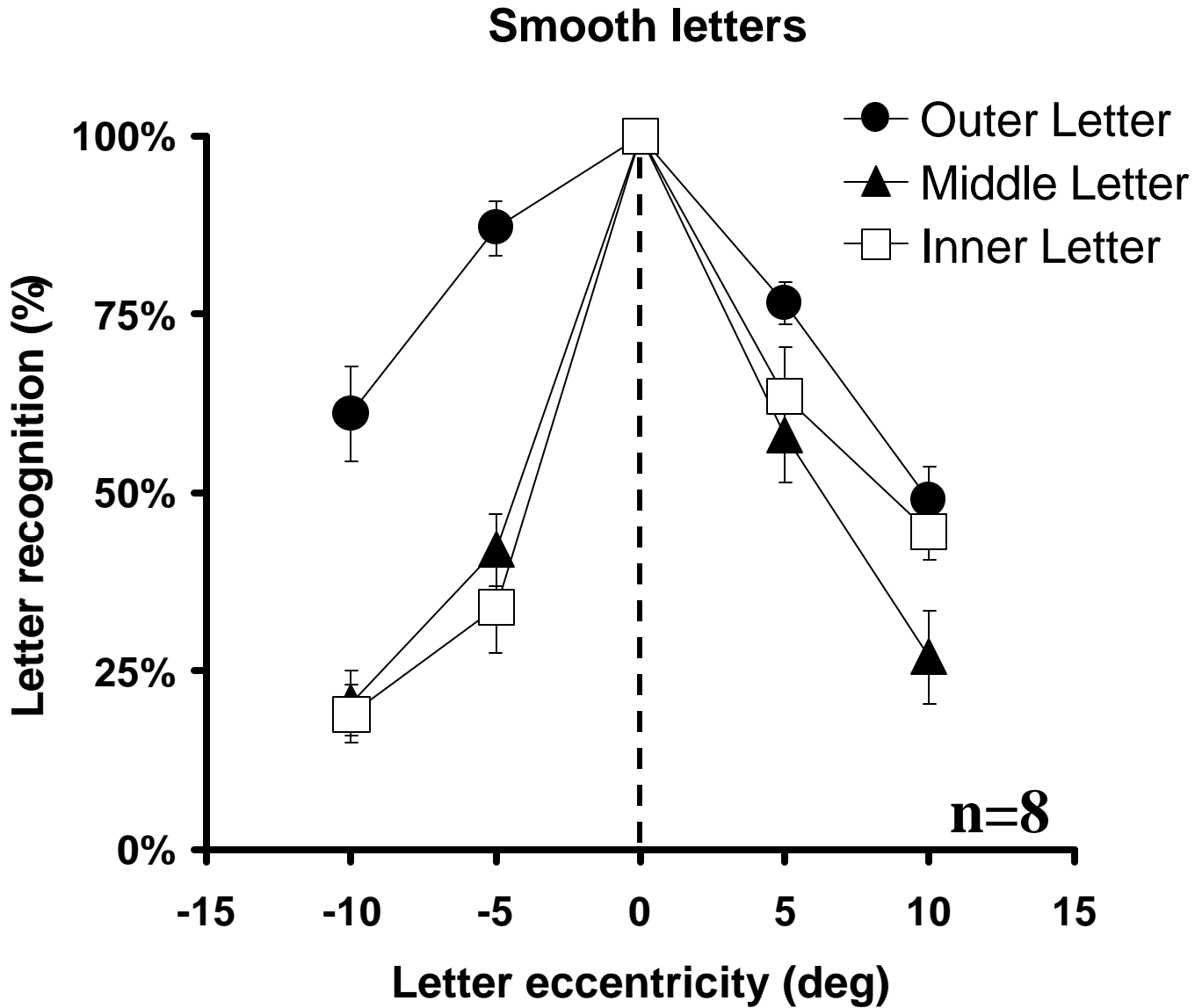


EXPERIMENT 2B

Smooth Letters



EXPERIMENT 3



CONCLUSIONS

- Recognition of jagged letters in the periphery is not different from that of smooth letters
- Data replicates Bouma's (1973) and Geiger and Lettvin's (1998) finding of better performance on right side than left (Exp. 2 & 3)
- The outermost letter was recognized with greatest accuracy followed by the innermost and middle
 - could be attributed to lateral masking
- Suggests no advantage in using jagged letters for low-vision reading

REFERENCES

Bailey, I., L. Boyd L.H., Boyd, W.L., & Clark, M. (1987). Readability of computer display print enlarged for low vision. *American Journal of Optometry and Physiological Optics*, **64**, 678-685.

Bouma, H. (1973). Visual interference in the parafoveal recognition of initial and final letters of words. *Vision Research*, **13**, 767-782.

Geiger, G. & Lettvin, J. Y. (1998). Jagged letters are more easily recognized than smooth ones in the peripheral visual field. *Perception*, **27** (suppl.): 15.

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COMMENTS