



Age Differences in Efficiency of Information Uptake while Foraging in Multi-Text Environments

Xiaomei Liu¹, Jessie Chin², Wai-Tat Fu¹, Daniel G. Morrow¹ & Elizabeth A. L. Stine-Morrow¹

¹University of Illinois Urbana-Champaign, ²University of Waterloo

RATIONALE

Little is known about how readers regulate learning in multi-text environments, especially among older adults who have been found to benefit from self-pacing in text memory (Johnson, 2003). Older readers are able to adapt to different reading ecologies just as younger adults do (Liu et al., 2016), but it is unclear whether their strategies are optimal. We used the Information Foraging framework (Pirolli & Card, 1999) to examine age differences in learning from text in an ecology with multiple sources (i.e., information patches), which requires search, selection, and time allocation decisions.

Questions: 1. Are learners more efficient in foraging compared to controlled presentation? 2. Does the use of optimal strategies in learning vary with age in the foraging condition?

METHOD

- Characteristics of participants are presented in **Table 1**.
- Materials: Biographical information about six historical individuals (Curie, Newton, Dickinson, Shakespeare, Mother Teresa, Gandhi); 12 texts per person (**Table 2**).

Table 1. Sample characteristics.

	Young	Old	t	p
N	20	22		
Age	M (SE) 28.8 (1.6)	73.5 (1.3)		
	Range 20 - 40	61 - 81		
ED	M (SE) 14.8 (0.3)	13.7 (0.4)	2.29	.03
	Range 12 - 16	12 - 16		
WM*	M (SE) 0.6 (0.2)	-0.5 (0.1)	4.7	<.001

*WM = a composite score of reading span and listening span scores (Cronbach's $\alpha = .75$). ED = Years of Education.

Table 2. Sample Texts.

	Topic Cue	Text
Marie Curie	Danger	Her work-related papers are still radioactive, and those who wish to consult them must wear protective clothing.
	Wedding	Instead of wearing a bridal gown, she wore a dark blue dress, which served her for many years as a laboratory outfit.
	Religion	Raised by a Catholic mother and an atheist father, she became agnostic after her mother's death.
Williams Shakespeare	Marriage	At the age of 18, he married Anne Hathaway, who was 8 years his senior and the daughter of a local farmer.
	Missing	There is no record of his activities between 1585 and 1592, but some think he was fleeing prosecution for deer poaching.
	Death	At the age of 52, he died after signing his will, which he began by describing himself as being in "perfect health."

○ Procedure

- Participants' goal was to learn as much information as possible to prepare for a later quiz (**Figure 1**).
- Foraging condition: Given topic cues, readers selected texts for reading at their pace; overall time was matched with the Control condition.
- Control condition: Texts were presented in a random order, with presentation time systematically controlled ($RT = 500 + x (\# \text{ propositions})$), where x increased or decreased across trials).

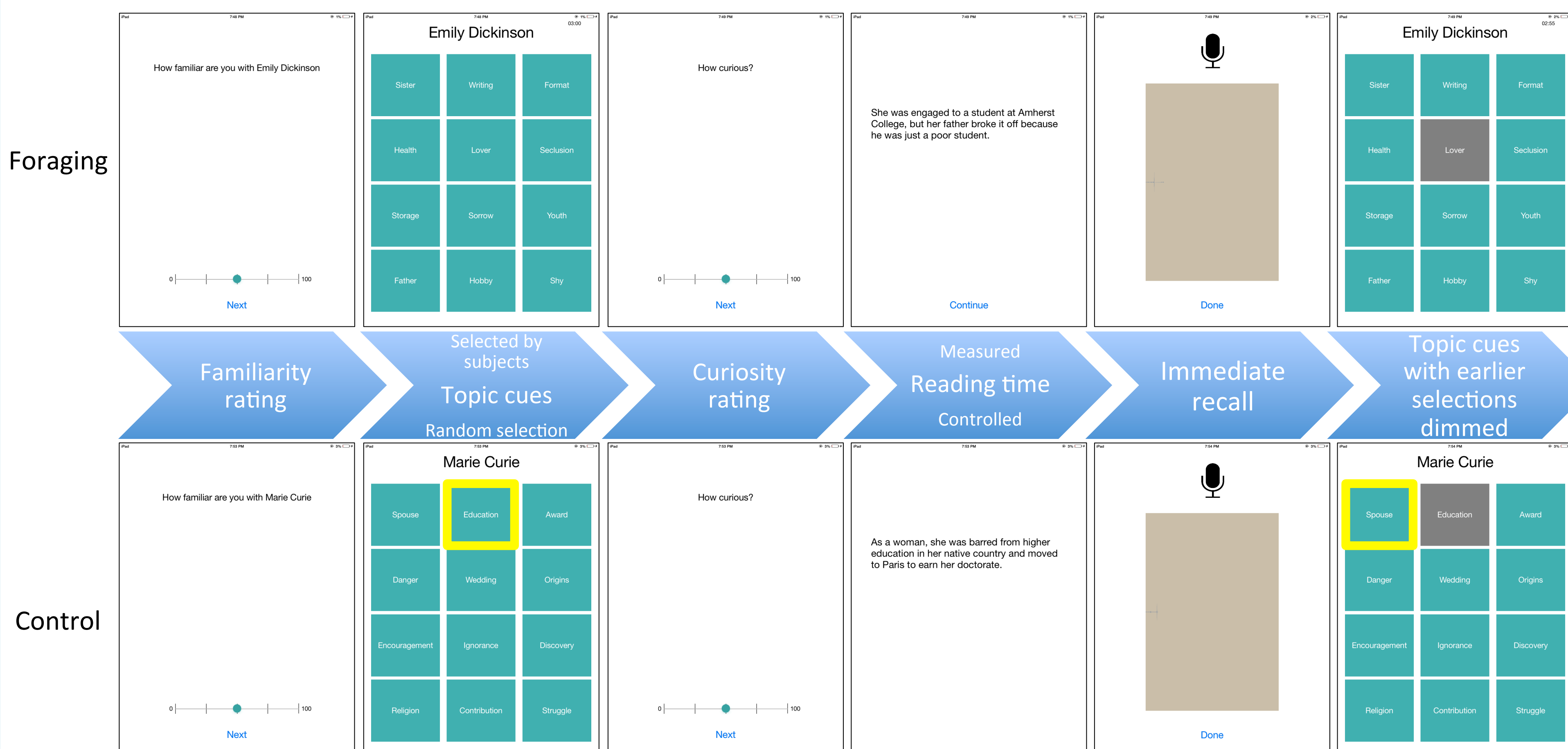


Figure 1. Reading Procedure on iPad.

○ Data Analysis Strategy

- Uptake rate and asymptote were estimated for each participant in the control condition, using the exponential function, $PR(t) = a - ae^{-rt}$, where $PR(t)$ = proportion propositions recalled at time spent per proposition t , a = asymptotic recall, and r = rate. To estimate the rate with controlled presentation, we used the point at which the recall performance approached asymptote. The point, t^* , is determined when $PR'(t) = 0.05$ (i.e., at t^* , the slope of the tangent to $PR(t)$ is 0.05). The estimated rate at t^* was the slope of the line from origin to the point of asymptotic recall (**Figure 2**).

- This rate was compared with the mean uptake rate in the Foraging condition, taken as the proportion propositions recalled per unit time allocated.

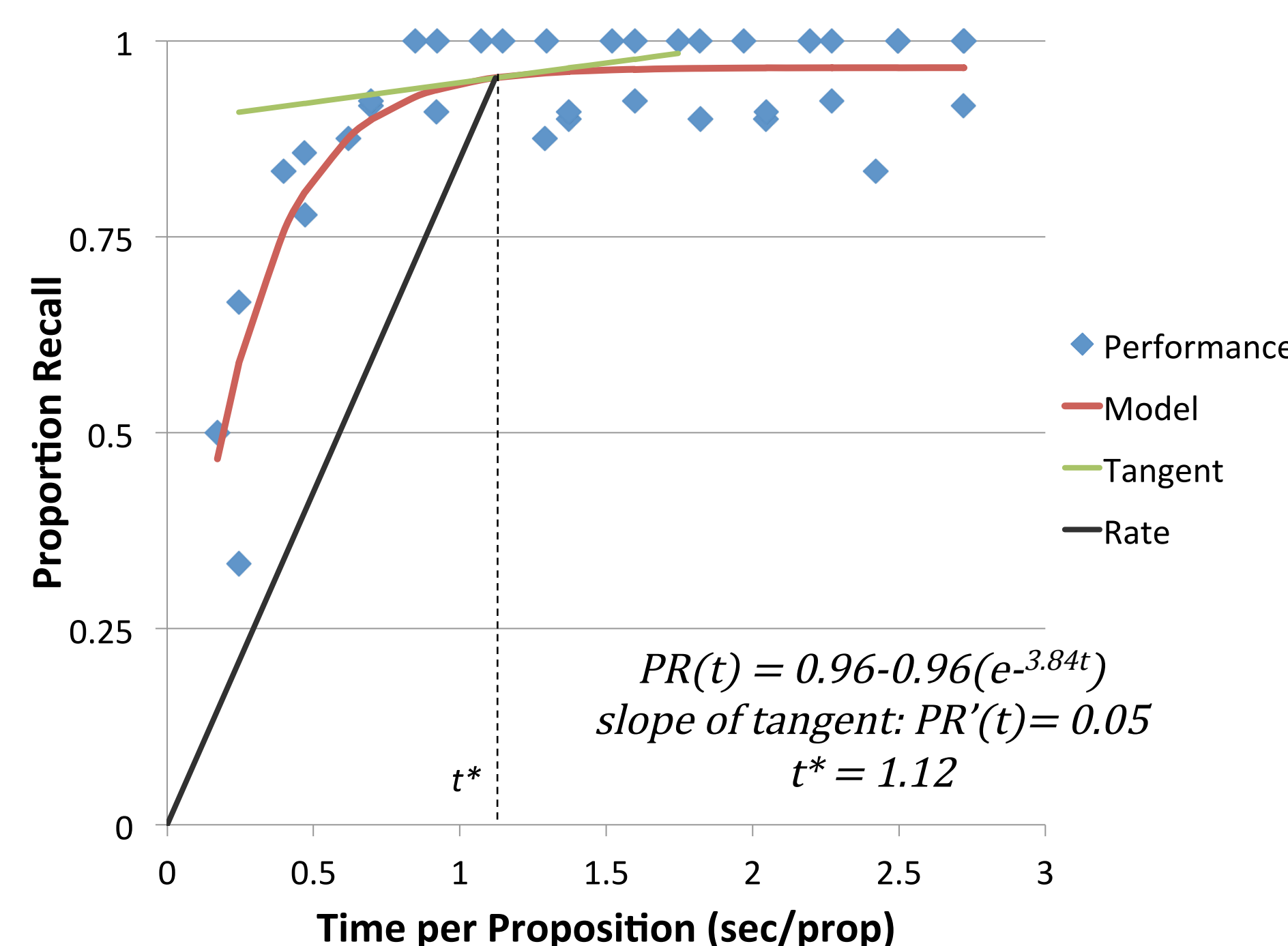


Figure 2. Illustration of modeling for an individual subject's recall performance in the control condition.

RESULTS

- There were no age differences in the information update rate in the Control condition; however, the asymptote was higher in the younger group relative to older group (**Figure 3**).

- The rate of information uptake was faster in the Foraging condition, relative to the Control, $F(1, 40) = 4.54$, $p = .04$ (**Figure 4, left**). The interaction of age and condition did not reach significance, $F < 1$. However, this result needs to be interpreted cautiously, because younger adults were significantly faster in Foraging relative to the Control, $t(19) = 2.12$, $p = .05$, whereas this difference was not significant in the older group, $t < 1$.

- Immediate recall performance was reduced in the Foraging condition compared to the asymptotic recall estimated in the Control condition $F(1, 40) = 8.13$, $p = .007$, and this did not vary with age, $F < 1$ (**Figure 4, right**).

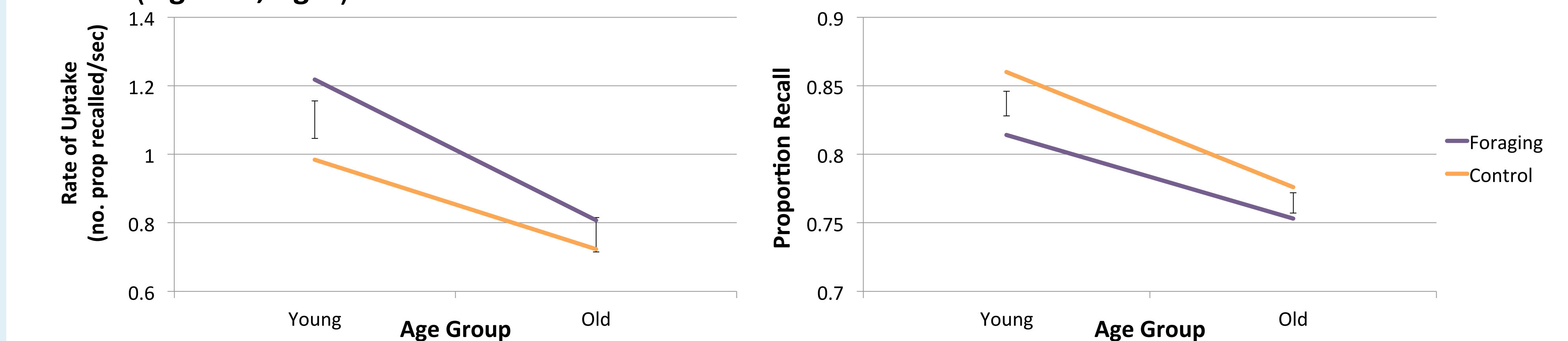


Figure 4. Mean immediate recall and rate of information uptake as a function of age and condition. Standard errors of differences are represented by vertical bars.

- Delayed recall, measured as the number of texts from which the information was recalled, showed an age by condition interaction, $F(1, 40) = 5.87$, $p = .02$ (**Figure 5**), such that Foraging enhanced performance among younger adults, but hurt performance among older adults.

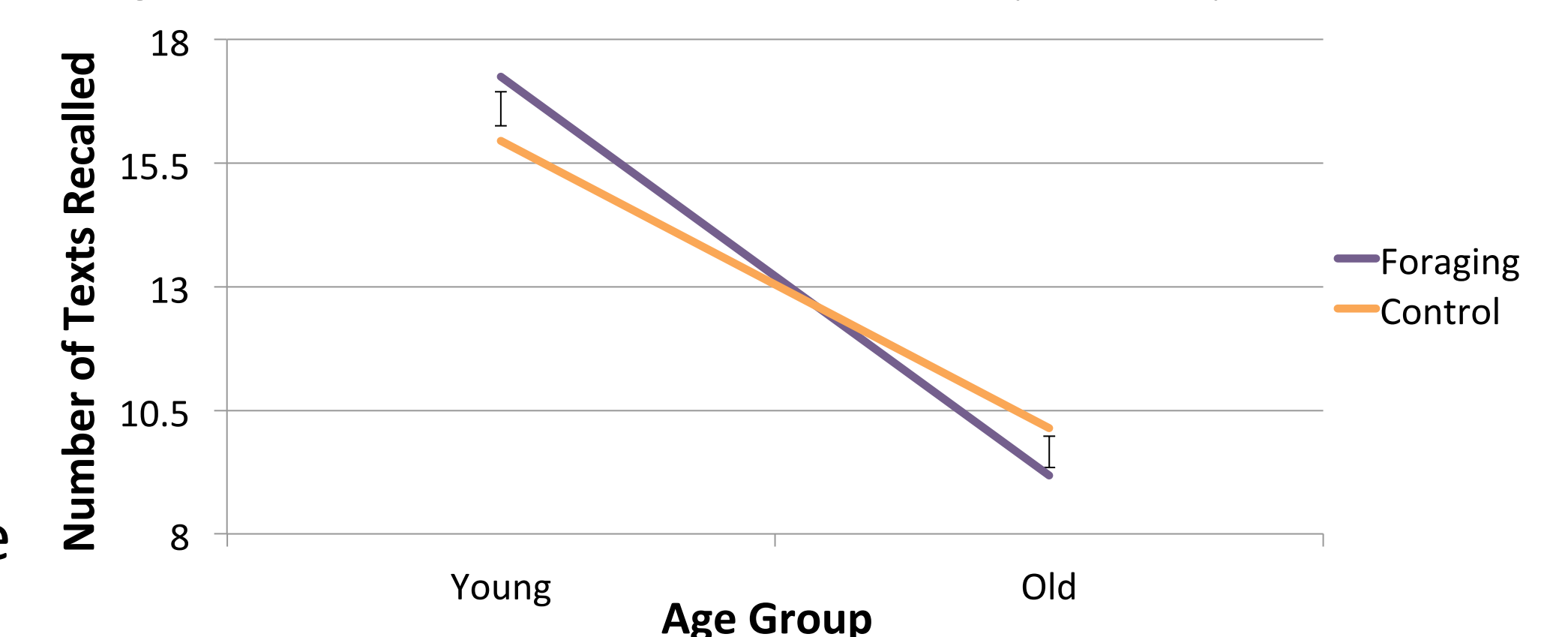


Figure 5. Mean number of texts recalled in delayed recall as a function of age and condition. Standard errors of differences are represented by vertical bars.

CONCLUSION

- Foraging increased the rate of information uptake among younger adults, but not among older adults.
- However, when readers had the opportunity to forage, memory for the material was reduced, relative to controlled presentation for both young and old.
- While younger adults learned more in a foraging ecology (under time constraints), older adults learned less relative to a controlled-presentation condition.
- These findings suggest that in foraging among multiple texts, both younger and older readers use a satisficing strategy. The regulatory demands of foraging may be especially costly for memory performance among older adults.

REFERENCES

- Johnson, R. (2003). Aging and the remembering of text. *Developmental Review*, 23, 261–346.
- Liu, X., Chin, J., Payne, B. R., Fu, W.-T., Morrow, D. G., & Stine-Morrow, E. A. L. (2016). Adult age differences in information foraging in an interactive reading environment. *Psychology and Aging*. Advance online publication. <http://dx.doi.org/10.1037/pag0000079>
- Pirolli, P., & Card, S. (1999). Information foraging. *Psychological Review*, 106(4), 643–675.

This research is supported by the National Science Foundation (Grant IBSS 1328545). Request for more info to xliu85@illinois.edu.