WHEN TO STOP LEARNING: SEARCH AND SATISFICING DURING SELF-REGULATED LEARNING ACROSS THE LIFESPAN

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INTRODUCTION

Using an Information Foraging framework (Pirolli & Card, 1999), we examined how learners studying a domain in a multi-text environment regulate their effort among multiple sources. Specifically, the goal was to understand what cues learners use in decisions to discontinue reading about one topic to explore another in that domain. We examined whether people continue study as long as they perceive themselves to be learning and contrasted two hypotheses about cues to perceived learning:

• Mnemonic cues: Encoding fluency / processing ease (Dunlosky et al., 2006), which is a misleading cue (e.g., showing low correlations with learning outcomes).

• Extrinsic: Potential for information gain (profitability), such that learners leave a patch/webpage when the rate of available information decreases (Charnov, 1976, Fu & Pirolli, 2007; Metcalfe & Kornell, 2005).

We tested this by creating three types of reading ecologies that varied in the **amount of new information (I)** and **conceptual overlap (CO)** across texts within a patch:

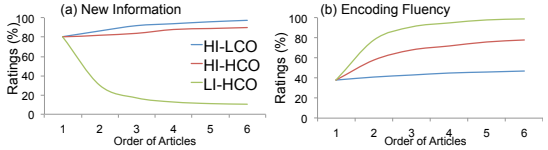
-HI-LCO: introduced more new ideas using new concepts (maximizing profitability)

-HI-HCO: introduced more new ideas using repeated concepts

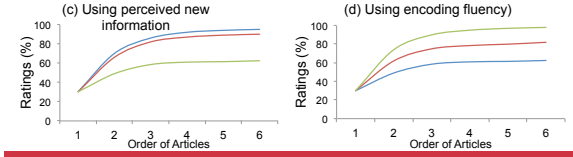
-LI-HCO: introduced few new ideas using repeated concepts (maximizing fluency)

	Foraging	Learning
Goal	Resources uptake	Knowledge building
Determinants of uptake rates	Profitability of patch	Both texts and learners ability
Resources	can be depleted.	cannot be depleted.
Satiety mechanism/ stopping rules	Rate of gain, #prey, give up time	unclear

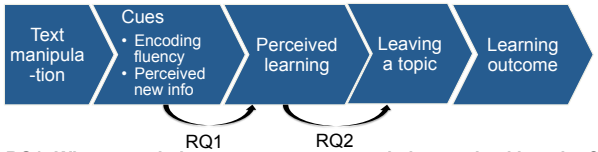
I. Expected functions of perceived new info and encoding fluency in 3 conditions



II. Expected functions of perceived learning in 3 conditions



Research Questions



RQ1: What cues do learners use to access their perceived learning?

RQ2: How do learners discontinue learning?

METHOD

Participants

	Study 1	Study 2	Study 3	Study 4	Study 5	
	N=52	N=37	N=38	N=17	Young N=17	Old N=19
Age	38.9 (10.9)	38.1 (11.2)	37.5 (12.6)	40 (11.1)	21.5 (2.6)	71.6 (4.5)
Range	23-69	21-63	21-69	19-64	18-27	64-80
Female	46.3%	59.5%	57.9%	70.6%	76.5%	73.7%
Edu (yrs)	15.3 (1.9)	15.6 (1.9)	15.4 (2.5)	15.3 (2.1)	15.0 (1.4)	16.2 (2.4)
Verbal	8.0 (3.7)	9.3 (3.2)	9.9 (2.9)	10.2 (2.3)	8.9 (1.7)	10.6 (2.0)
Speed	10.4 (10.3)	41.6 (10.7)	39.5 (10.2)	38.6 (10.2)	34.7 (7.2)	48.4 (10.0)

• Recruitment: Study 1 to 4: Amazon Mechanical Turk; Study 5: Lab.

Measure

Measuring Cognition: verbal (advanced vocabulary); speed (letter comparison)

Measuring Cues and Perceived Learning:

-Encoding fluency: *How easy was this article to read?* (0: very difficult; 100: very easy)

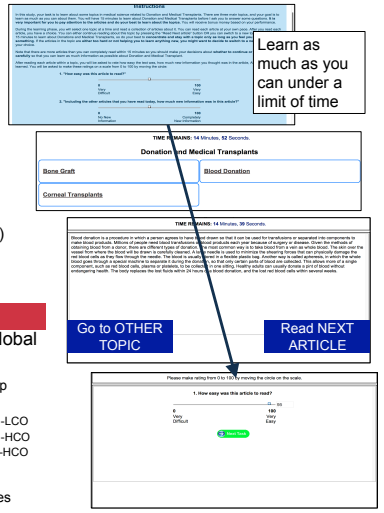
-The perceived amount of new information: *Including the other articles that you have read today, how much new information was in this article?*(0: no new information; 100: completely new information)

-Perceived learning: *How much did you learn from this particular article?*(0: didn't learn anything at all; 100: learned a lot)

Measuring Performance: cued recall

Experimental Design Within-subject design

Procedure



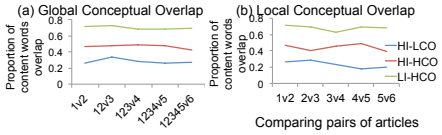
Materials

• 3 topics about medical transplants and donation (54 articles).

• Articles in 3 conditions did not differ in following properties.

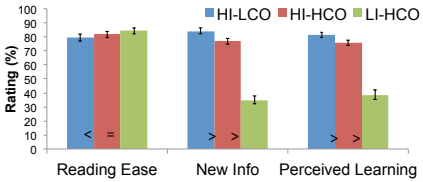
	HI-LCO	HI-HCO	LI-HCO
Number of words	220 (3.1)	220 (3.1)	220 (3.1)
Number of sentences	13.2 (0.4)	13.4 (0.4)	12.6 (0.4)
Sentence length	16.9 (0.5)	16.7 (0.5)	17.8 (0.5)
Log word frequency (WF)	2.9 (0.0)	2.9 (0.0)	2.9 (0.0)
Flesch-Kincaid grade level	10.1 (0.2)	10.2 (0.2)	9.5 (0.2)
#unique concepts in one patch	172-190	100-106	56-80

• Only differ in #new concepts in one article ((a) global and (b) local conceptual overlap).



RESULTS

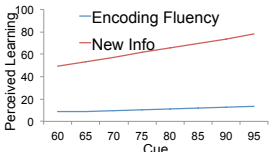
Study 1: Validation of the Manipulation



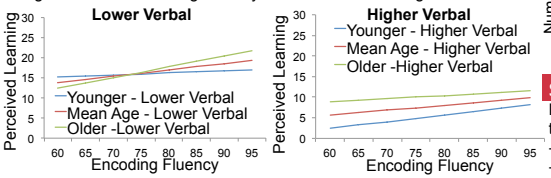
RQ1: Cues used to Gauge Perceived Learning

• Perceived new information is the dominant cue

	Est (SE)	t
Encoding Fluency	0.14 (0.02)	7.31*
New Info	0.82 (0.01)	69.31*

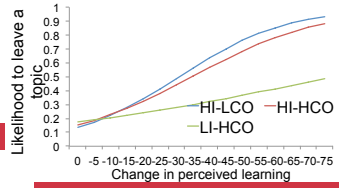


• Age x Verbal x Encoding Fluency on Perceived Learning

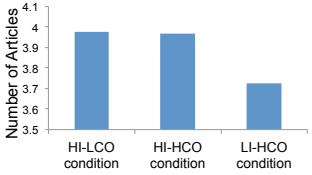


RQ2: Leaving a Topic

Leave a topic when perceived learning decreased for the two recent articles (no age difference).



Resource Allocation



Study 5: Actual Learning Outcome

Perceived learning was associated with the actual learning outcome of a topic.

-Did not vary with condition and age

-Relative accuracy not absolute accuracy

DISCUSSION

Main findings:

Learners are likely to discontinue study as perceived learning decreases.

The dominant cue used to gauge perceived learning was the perceived amount of new information. However, encoding fluency was a relatively more important cue among older adults with lower levels of verbal ability.

The study established a novel paradigm to better investigate adult learning in the wild, and suggests extensions of theories of foraging and metacognition to account for adult age differences in learning.

• Consistent with the foraging metaphor, learners discontinue study when they reach "satiety" (cf. Murayama et al., 2015)

• Monitoring and patch-leaving rules based on perceived learning appear to be preserved with age.

• However, cues to perceived learning are weighted differently depending on the age and abilities of the learner.

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