



Learning Better, Learning More: The Benefits of Expanding Retrieval Practice



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Optimizing Learning

DISTRIBUTED LEARNING

Spacing > Massing

(e.g., Dempster, 1988; Ebbinghaus, 1885/1964)

Why? Spaced repetitions engage more effective retrieval than do massed repetitions

- Retrieval is a memory-modifier (Bjork, 1975)
- The power of reminding (Benjamin & Tullis, 2010)

EXPANDING RETRIEVAL

As information is better learned, we should be able to afford to wait longer and longer before revisiting it—thus, an optimal schedule should involve expanding intervals.

Uniform:

S → S → S → S

Expanding:

S → S → S → S

But results have often been mixed:

- **Uniform < Expanding**
(Carpenter & DeLosh, 2005; Cull, Shaughnessy, & Zechmeister, 1996; Landauer & Bjork, 1978)
 - Especially when forgetting rate is fast
- **Uniform ≥ Expanding**
(Balota, Duchek, Sergeant-Marshall, & Roediger, 2006; Karpicke & Roediger, 2007; Logan & Balota, 2008)
 - Only spacing of the first interval is critical?

Prior studies equate (a) number of repetitions and (b) number of items, but these controls may miss some of the major benefits of expanding schedules...

Overlooked Benefits of Expanding Retrieval

Given a fixed amount of study time, can an **expanding retrieval** schedule...

- Be more efficient, and
- Allow for more information to be learned

General Method

Experiment 1

Uniform condition: 30 pairs repeated 6x (10-10-10-10-10)

Expanding condition: 30 pairs repeated 4x (5-10-15)

- + 20 “bonus” pairs repeated 3x (59-59)

Experiment 2

Uniform condition: 50 pairs repeated 4x (10-10-10)

Expanding condition: 30 pairs repeated 4x (5-10-15)

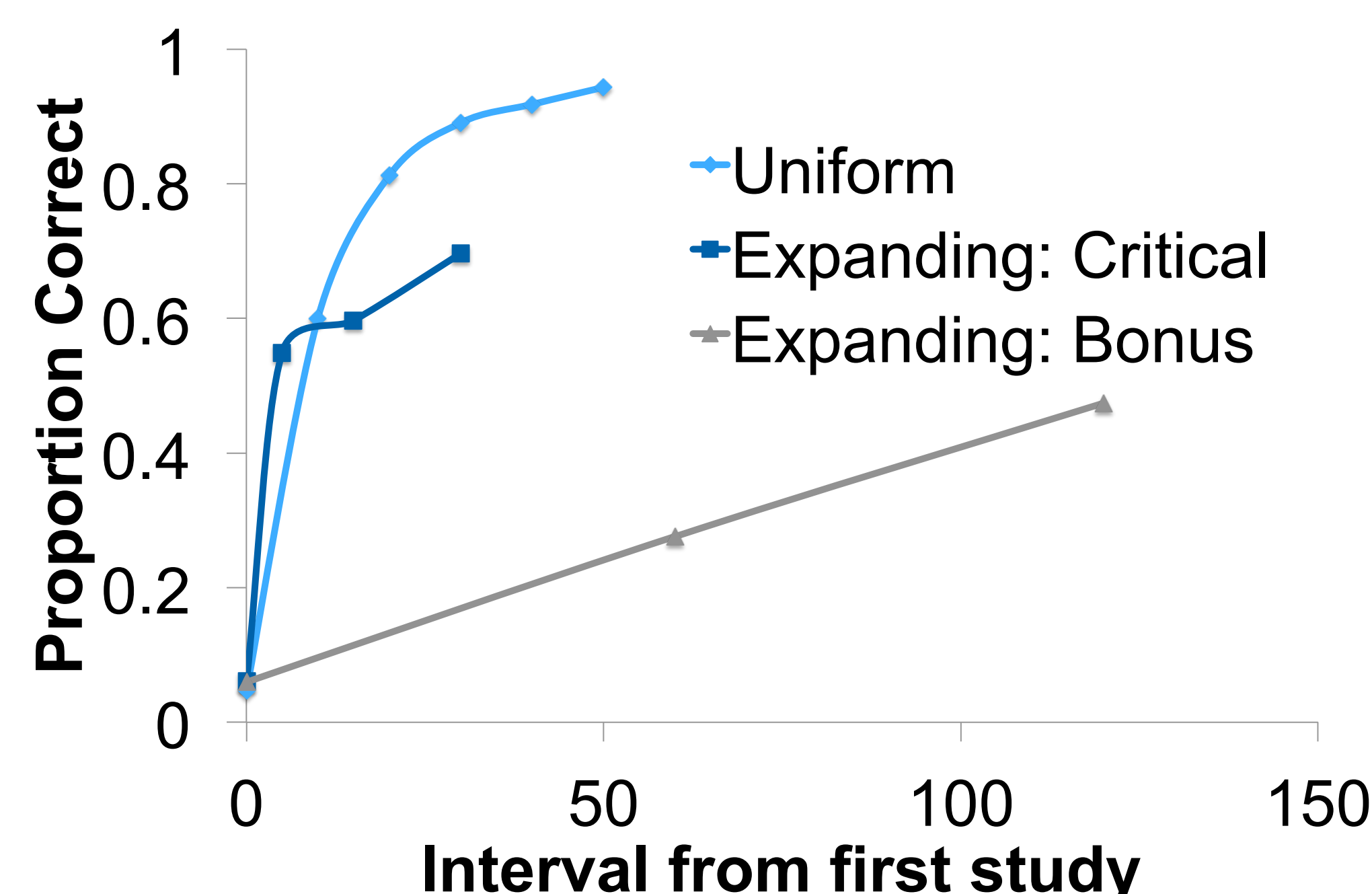
- + 20 “bonus” pairs repeated 4x (51-51-51)

Experiment 1

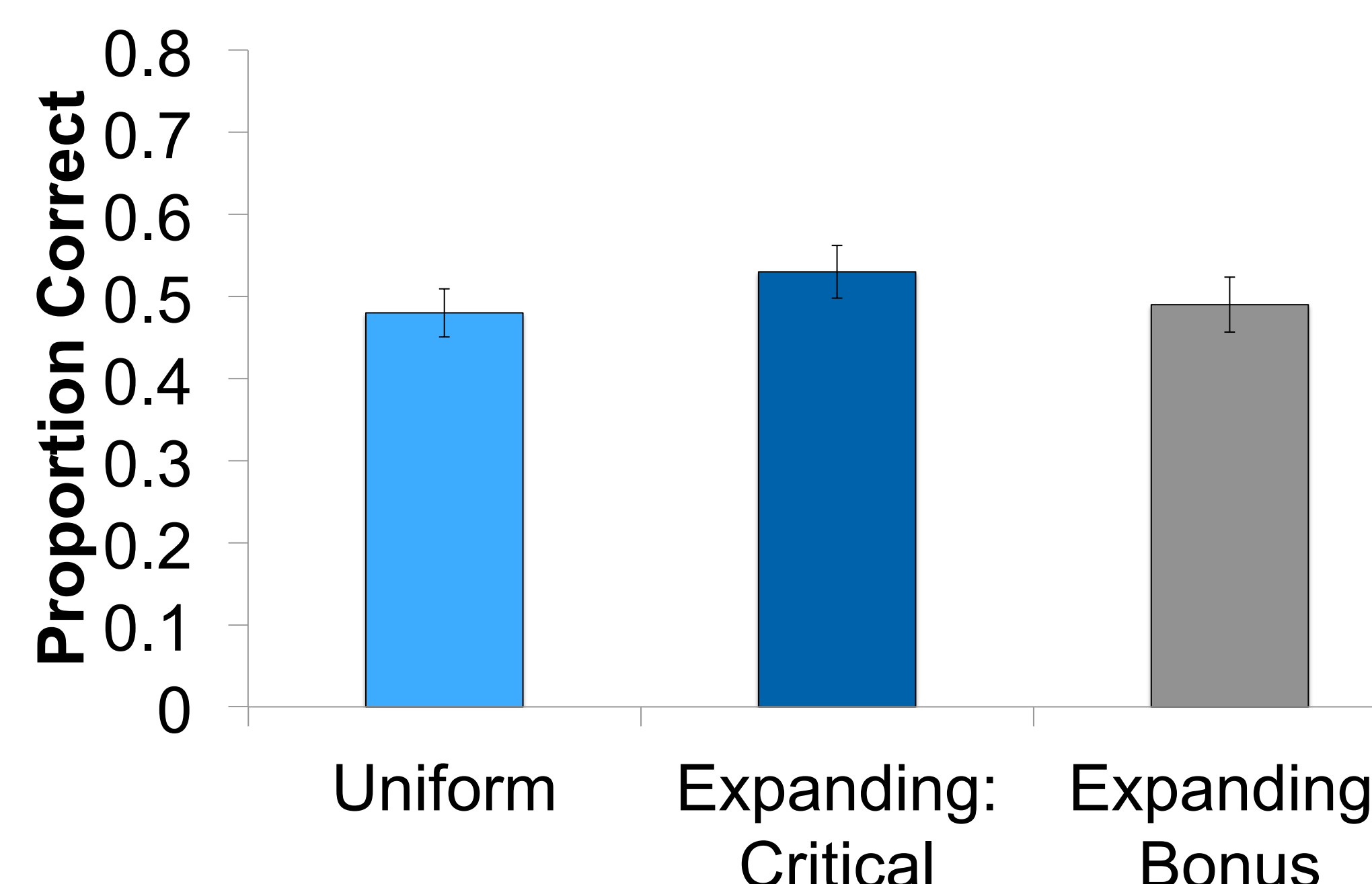
(N = 106)

180 total trials during study

Learning Curve



Final Test



Total Number of Words Recalled:

Expanding > Uniform
(M = 25.66) (M = 14.44)

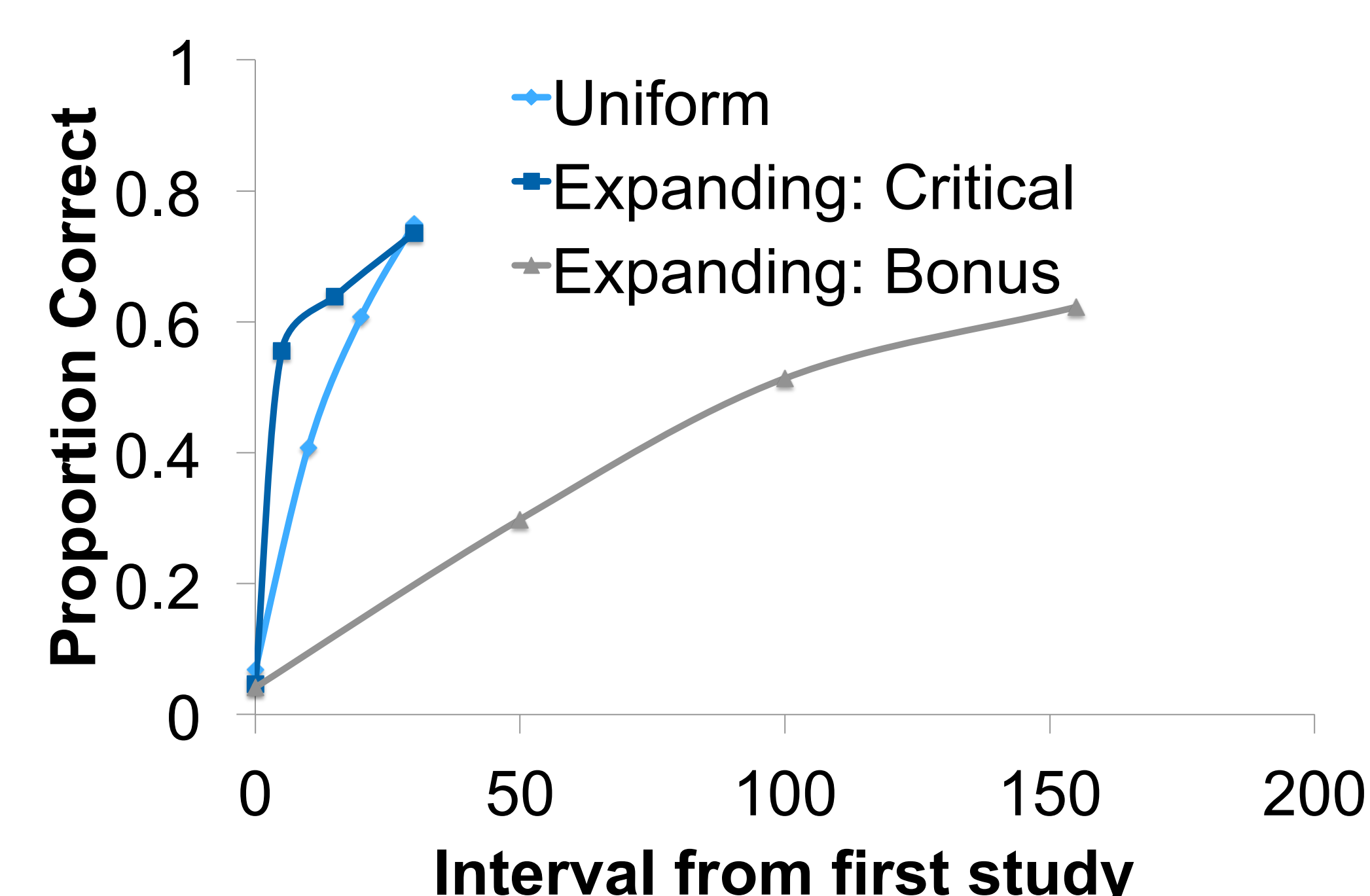
Experiment 2

(N = 104)

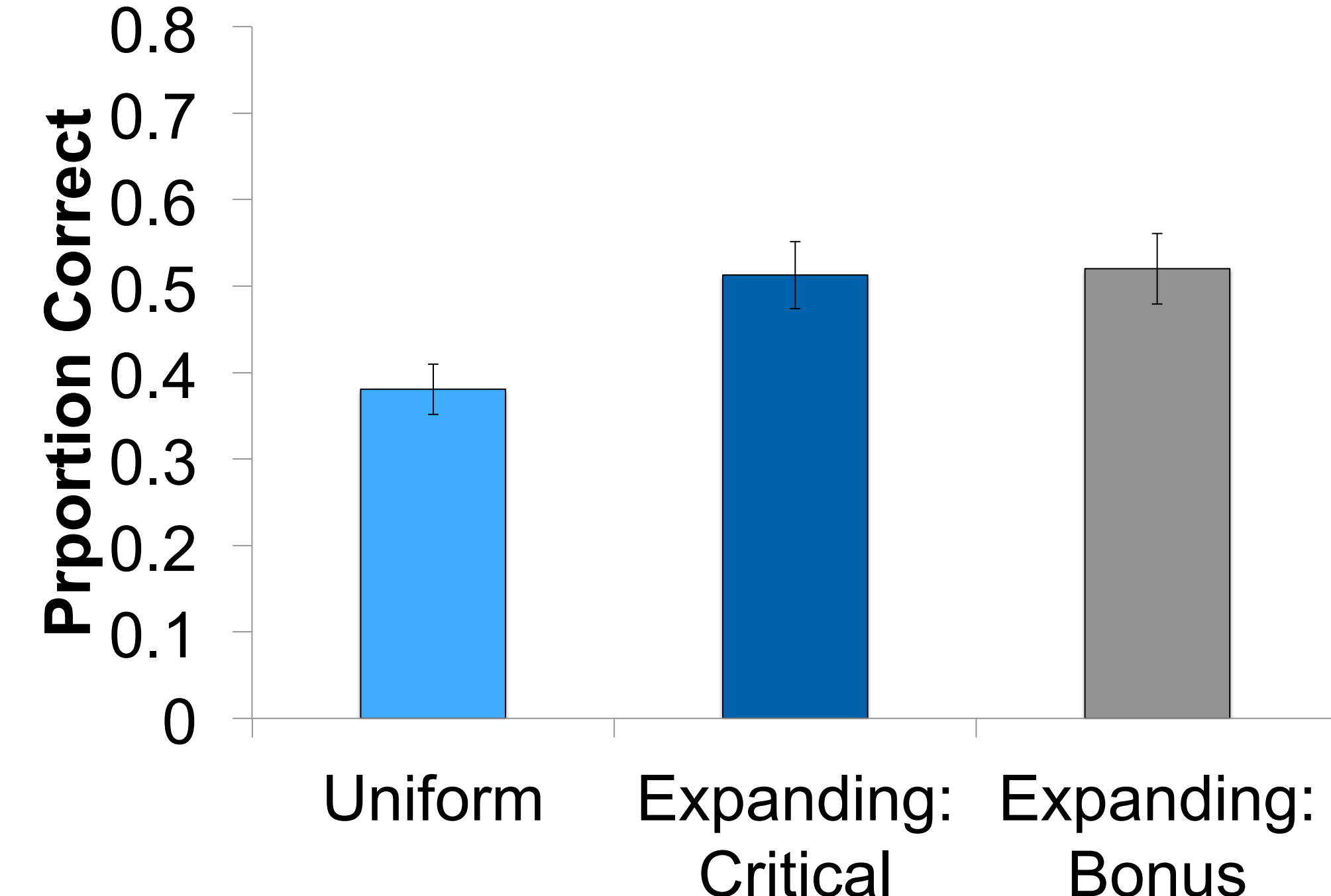
200 total trials during study

Schedules matched on # of to-be-learned pairs

Learning Curve



Final Test



Total Number of Words Recalled:

Expanding > Uniform
(M = 27.89) (M = 19.04)

Conclusion

- Expanding schedules (vs. uniform schedules) led to...
 - *Equal* (Exp 1) or *better* (Exp 2) retention of GRE-synonym word pairs
 - *More efficient learning*
 - In Exp 1, pairs on an expanding schedule were repeated 4 times; pairs on a uniform schedule were repeated 6 times
 - *Greater total number of words learned*
- Ongoing: Tests, without feedback

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