

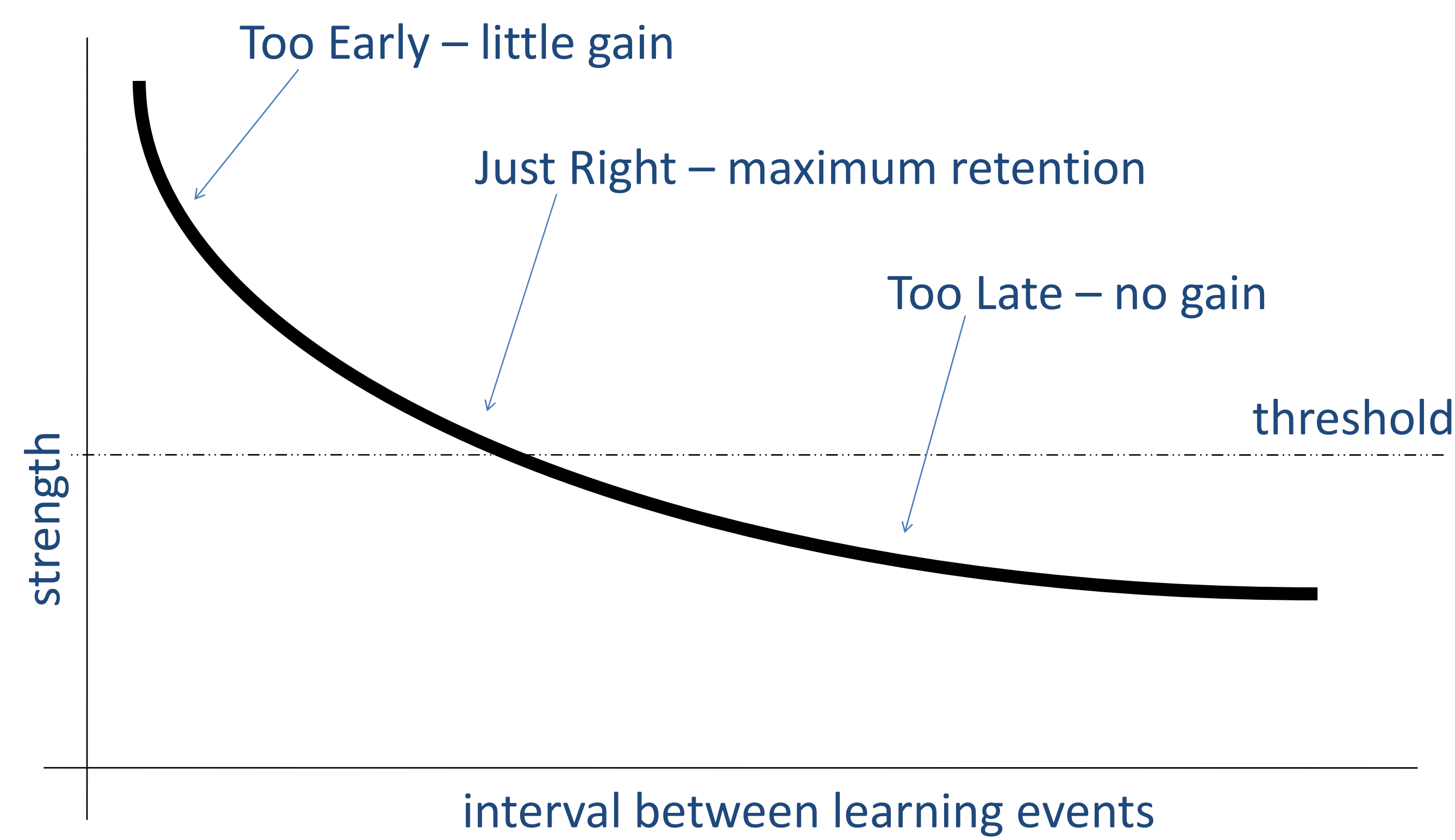
Expanding-Interval Retrieval Practice and The Goldilocks Principle

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1 Goldilocks and the Three Intervals

Long-term retention is superior when information is retrieved versus when it is re-presented...but **how can one schedule retrievals to optimize long-term retention?**
 Given #1. Spacing → learning
 Given #2. Retrievals must be successful



2 Arguments, Hypothesis, and Materials

Expanding-interval retrieval practice is designed to maximize the number of “just right” retrievals by requiring retrieval after a short delay (maximizing the probability of success) and then requiring additional retrievals after progressively longer delays (maximizing the benefit from spacing).

ARGUMENTS

- Because of the shorter initial interval, the average successfully retrieved item in the **expanding-interval retrieval practice (XRP)** condition is **weaker** than in the **uniform-interval retrieval practice condition (UNI)**.
- For the hypothesis to be properly tested, there must be **more** successfully retrieved items during learning in the **expanding** condition than in the **uniform** condition.

HYPOTHESIS

When Argument 2 is satisfied, meaning that the short initial interval in the expanding condition “saves” items from being forgotten – compared with the longer initial interval in the uniform condition – the items practiced on an expanding schedule will enjoy superior long-term retention.

To test this compound hypothesis, we asked UCLA undergraduates to retrieve answers to **nonfictional** and **fictional** trivia questions.

Question Type	Example	Prior Experience	Forgetting Rate
Fictional	What is the famous prehistoric structure situated on Devil's Coast, Australia?	None	Faster
Nonfictional	Which Peanuts character constantly refers to Peppermint Pattie as "Sir"?	Some (on average)	Slower

Acknowledgements

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 Thank you to **Dan Fink**, without whose software these experiments would have been impossible to conduct.

3

Method

INDEPENDENT VARIABLES

Schedule (within-subjects): **expanding** with an **immediate** first retrieval attempt, **expanding**, and **uniform**.

Question Type (within-subjects): fictional and nonfictional

Delay (between-subjects): 10 minutes or 48 hours

PROCEDURE

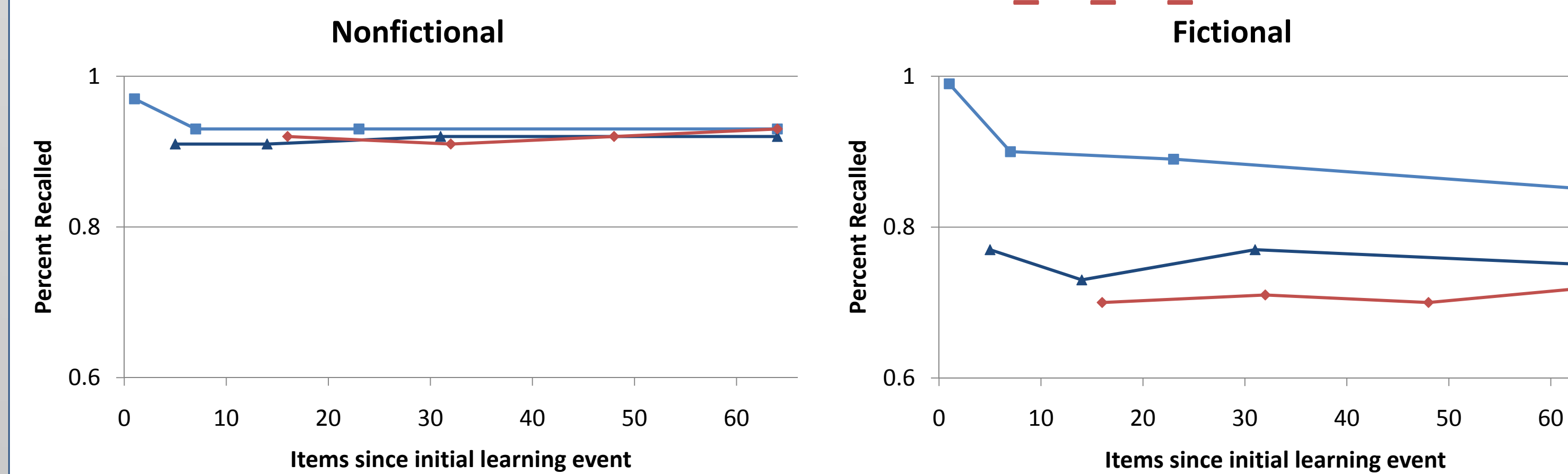
- LEARNING PHASE: Participants were provided the correct answer after attempting to answer each question, and were asked the questions (without feedback) several more times on one of the three schedules.
- TEST PHASE: Participants were asked all of the questions after a distractor task or after they returned 48 hours later. Again, feedback was not provided.

4

Experiment 1 (n = 60)

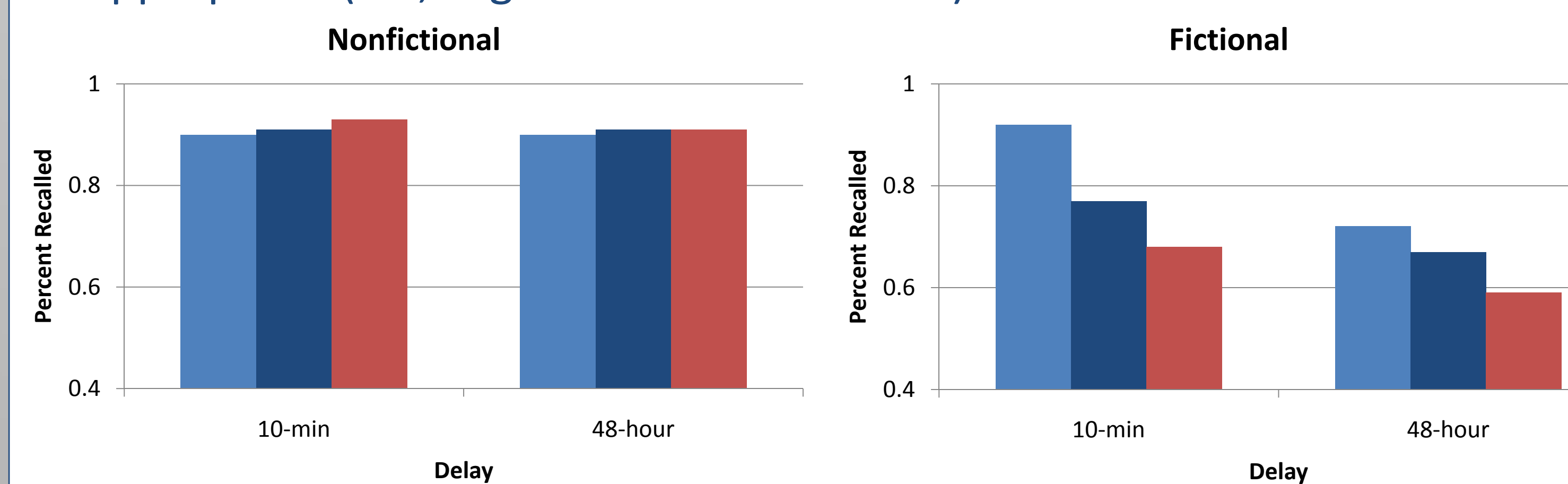
Shorthand explanation: If three retrieval attempts were scheduled after **one, five, and nine** intervening learning events (for *other* items, after the initial learning event), we would refer to that schedule as **01_05_09**.

Expanding_Immediate: 00_05_15_40
Expanding: 04_08_16_32
Uniform: 15_15_15_15



Nonfictional: Negligible variance between schedules (Argument 2 not satisfied; intervals not properly scheduled; hypothesis not testable)

Fictional: Different pattern – with the very same intervals. **Immediate** retrieval saved items, but comparing **expanding** and **uniform** is inappropriate (i.e., Argument 2 not satisfied)



FINAL RETENTION: 10-MINUTE DELAY

Nonfictional: Negligible difference between schedules

Fictional: Recall: **expanding_immediate** > **expanding** > **uniform**

FINAL RETENTION: 48-HOUR DELAY

Nonfictional: Well-learned items – although unretrievable at the beginning of the study phase – exhibited negligible forgetting even after 48 hours.

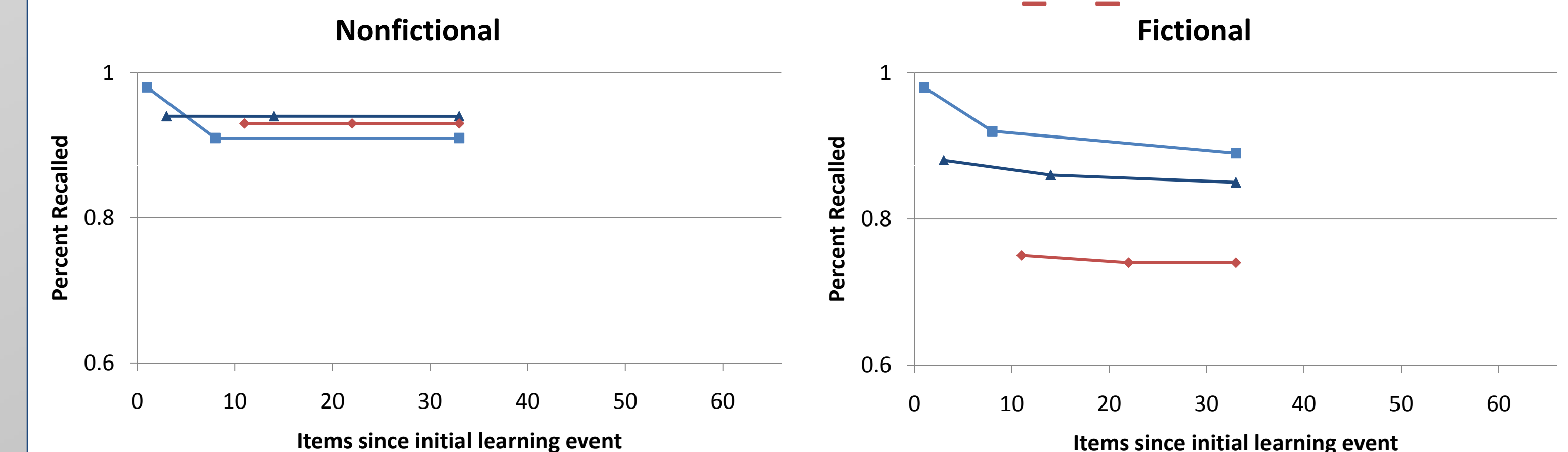
Fictional: The rate of forgetting was more rapid in **expanding_immediate** than in **expanding**, and in **expanding** than in **uniform** (i.e., Argument 1 was satisfied).

5

Experiment 2 (expected)

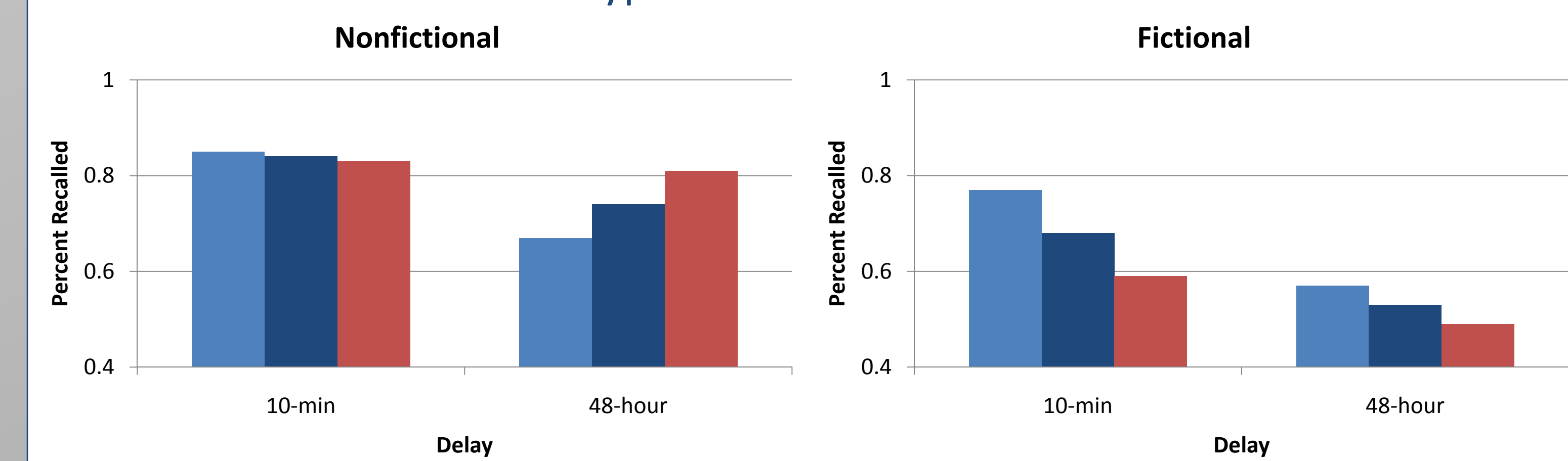
Expt 2 will use a shorter initial interval in the expanding condition in an attempt to satisfy Argument 2 and allow the hypothesis to be tested. Expt 2 uses fewer retrieval attempts and a smaller average interval.

Expanding_Immediate: 00_06_24
Expanding: 02_10_18
Uniform: 10_10_10



Nonfictional: Negligible variance between schedules (as in Expt 1, Argument 2 will not be satisfied)

Fictional: The shorter initial interval in 02_10_18 (compared to 04_08_16_32 in Expt 1) should save comparatively more items. Argument 2 will be satisfied and the hypothesis will be able to be tested.



FINAL RETENTION: 10-MINUTE DELAY

Nonfictional: Negligible difference between schedules

Fictional: Recall: **expanding_immediate** > **expanding** > **uniform**

FINAL RETENTION: 48-HOUR DELAY

Nonfictional: The reduced spacing should amplify the comparative weakness of the XRP items (Argument 1).

Fictional: As in Expt 1, **expanding_immediate** > **expanding** > **uniform**. However, the magnitude of the difference will have decreased because of the more rapid forgetting in the expanding conditions (Argument 1).

6

General Discussion

Experiment 1 demonstrates that, with exactly the same intervals, two very different patterns of results can be obtained – purely as a function of the forgetting rate of the to-be-remembered items. Experiment 2 should serve to demonstrate that, when they are to be compared with **uniform-interval** retrieval practice, expanding intervals must be scheduled such that the initial interval “saves” some items. Expanding-interval retrieval practice *can* produce superior long-term retention, but only if the intervals are scheduled just right.