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# An Overview of the Forward Testing Effect and Its Interactions with Release from Proactive Interference

## Abstract

The forward testing effect is a well known aspect of learning and memory. For a long time it was believed that FTE provided a release from proactive interference as one of the ways that it enabled future learning. Recent testing has called this into doubt. It seems that FTE and release from PI are correlated but FTE is not causal for release from PI. So what is actually going on and why did these effects remain tied together for so long? There are a number of other effects that could explain release from PI such as strategy change, context change and forgetting cues. Many of these studies are hampered by small sample sizes so it is not possible to reach a definitive conclusion yet. There is much room for further study.

## Introduction

Testing of one sort or another has been part of learning as long as learning has been a thing. Testing helps to cement previously learned information in memory. This is termed the Backward-Testing Effect (BTE). Interestingly, testing also helps to clear the way for new information to be learned. This is termed the Forward-Testing Effect (FTE). A major confounding factor in learning is Proactive Interference (PI). This is the tendency of learned information to get confused with or block learning new information (Pastötter & Bäuml, 2014; Yang et al., 2018). PI is a significant component of learning and memory. Working around PI is highly relevant and valuable for academic performance and learning. One widely researched method for mitigating PI is interpolated testing (i.e. testing on earlier material before learning new material), i.e. induction of the FTE. A reduction in PI has been shown at least since Tulving

& Watkins (1974) through Nunes & Weinstein (2012). This paper by Ahn & Chan (2022) says that the reduction in PI from interpolated testing is a correlation of FTE and is not a cause.

## Forward-testing Effect and Release from Proactive Interference

Many FTE papers (O'Neill et al., 1976; Brewer et al., 2010; Dang et al., 2021; Yang et al., 2021) point to release-from-PI effects of FTE using list inclusions as an indicator.

In A-B A-D experiments, an FTE-mitigated PI effect was demonstrated (Walheim, 2015). However, when the testing was delayed, or the test word pairs were unrelated (A-B C-D), restudy showed a slight advantage over testing in generating correct results. However, when the original and new learning lag was significant (Chan et al., 2017), testing once again was superior to restudy. The latter test suffered from significant list intrusions when the interval was relatively large (25 minutes).

Dang et al. (2020) argue that release-from-PI plays a more significant role in adult FTE than semantic processing strategy change and that release-from-PI is wholly responsible for children's FTE. The critical data point was the number of prior list intrusions in the final list test. In the adult case, the testing group had almost no intrusions, while the child testing group still had some. It should be noted that the restudy groups in both cases had considerably more intrusions, so the FTE is still in full effect.

The multi-list learning and interpolated testing tasks used to examine FTE are very flexible, which helps design experiments, but the design of the lists, the tests, and the non-testing interpolated tasks can have a considerable effect on the outcomes, so care must be taken to achieve the desired result. Nunes & Weinstein's use of Deese-Roediger-McDermott (DRM)

words (Deese, 1959; Roediger & McDermott, 1995) and the arrangement of words in their lists and their lack of counterbalancing (words appearing in the target list never appear in any other list) made it problematic to cross-compare their experiments.

As an interesting corollary to the FTE, in Finn & Roediger, 2013, showed that the act of retrieval undermines the acquisition of new associations rather than facilitating them. This seems to be due to the particular design of their experiment, where the new information was partly visual. They used face-name associations and added a profession as the new information. Using different types of information may be why the FTE, as demonstrated in word lists, was not the same. Davis & Chan, 2015 showed a bias between relearning tested information and learning new information, called time borrowing. So it was not that it was different types of information but that the test included previously learned information in addition to the new information.

Ahn & Chan ran their tests carefully calibrated to manipulate PI and recreated Nunes & Weinstein's experiments. They used a traditional Brown-Peterson paradigm (Brown, 1958; Peterson & Peterson, 1959) to manipulate and control PI in their tests. They found that FTE consistently promoted new learning even in low PI instances. They conclude that FTE is independent of PI, and the release-from-PI account of FTE is not valid. If FTE does not cause the release from PI, what is happening here?

## Other Reasons for Release from Proactive Interference

Yang et al. 2021 offer several explanations for FTE. The first is the "traditional" release-from-PI effect, the theory that interpolated testing protects subsequent new information from PI. It is effectively a context change method similar to moving to a new learning environment or interpolating a time interval (i.e. taking breaks). The second potential explanation is the strategy-

change theory. This posits that learners learn how to study and develop more effective study and retrieval strategies as they go along. This is tested via list recall tests precisely aligned to different, randomly delivered semantic categories (Chan et al., 2018). The third explanation is the reset-of-encoding theory, where prior interim tests influence the subsequent encoding of new information. That is, the test makes it easier to encode new information in a similar vein to previous learning. This shows up in either a primacy effect (early list words are recalled first) in the study-test groups or a recency effect (later list words are recalled first) in study-restudy groups (Yang et al., 2020).

Kliegl & Bäuml (2021) also attempts to find reasons for release from PI other than interpolated testing. In addition to interpolated testing and context changes, they examined directed forgetting, where cues are given to forget non-critical information. This proves to be a beneficial and powerful means of PI mitigation but is hard to design into real-world learning materials, so it is not as easy to use as some of the other means of PI mitigation.

## The Problem of Small Sample Sizes

A significant problem with all of these studies is that their sample sizes are generally small. Before computer-based testing was common, these tests were labour-intensive to set up and monitor. Now, it should be possible to test far more subjects, draw them from a deeper pool than just “university psychology undergrads,” and arrive at answers to what is occurring here. Yang et al., 2021 for example, used 1000 subjects for their test. This is a good start.

## Conclusion

We have demonstrated that FTE is a real, powerful, and useful effect. PI occurs in situations where FTE is useful. However, as some of these papers have shown, FTE does not directly affect PI, and whether or not PI is even in effect, FTE will occur. Other systems and effects take place in the push and pull of learning and memorizing that affect FTE and PI. Further study is necessary to identify and control these to maximize FTE and minimize PI.

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