

On the Effects of Immediate Feedback

Despite many years of research, previous studies of immediate feedback's effect on performance have led to quite mixed results. Whereas most field studies demonstrate the value of immediate feedback (see Kulik & Kulik, 1988), most direct laboratory studies document a positive effect of delayed feedback (see Schmidt & Bjork, 1992).

The current research attempts to clarify this debate with the assertion that immediate feedback triggers a class of obvious but important positive effects, as well as a class of cognitively interesting negative effects. The positive effects involve the association of (or understanding of the relationship between) outcomes and their causes. Immediate feedback reduces the risk of incorrect association (see Lewis and Anderson, 1985; Herrnstein, Loewenstein, Prelec & Vaughan, 1993), making more clear the relationship between events and their antecedents.

The cognitively interesting negative effects of immediate feedback are captured by the guidance hypothesis (see Schmidt et al., 1989), or the notion that immediate feedback can lead to reliance on information that is not available during transfer and thus on counter-productive strategies. According to the guidance hypothesis, subjects trained in delayed feedback conditions develop better error detection and correction skills (Lewis & Anderson, 1985; Schmidt, Young, Swinnen & Shapiro, 1989; Schooler & Anderson, 1990; Swinnen, Schmidt, Nicholson & Shapiro, 1990; Schmidt & Bjork, 1992). A related interpretation of these findings is that when immediate feedback renders error detection or correction processes unnecessary, these skills (quite obviously) fail to develop.

The present research attempts to clarify the net effects of immediate feedback by advancing two main ideas: First, as mentioned above, it is suggested that immediate feedback spurs two basic effects – association, and guidance. Second, it is suggested that past laboratory research may have over-controlled for the positive association effect of immediate feedback, leading to over-generalization of the negative guidance effect. As an initial address of this possibility, we focus on the sensitivity of the classic ‘guidance effect’ paradigm (which implies a negative effect of immediate feedback) to manipulations that enhance the role of the association effect. The first two experiments presented here demonstrate that a minimal modification of the classic guidance paradigm can elicit positive association effects for immediate feedback, reversing the traditional guidance pattern. Subsequent experiments further define boundaries for positive and negative effects of immediate feedback.

STUDY 1& 2: Replicating and Reversing the Guidance Effect

Study 1 replicates Schmidt et al. (1989) in a computerized reaction time task. Subjects were required to respond to a colored circle presented on a computer screen with two presses of the enter key, such that the interval between presses would be 750ms. Subjects were given feedback in the form of a performance graph. Immediate feedback subjects were shown the performance graph after every trial. Delayed feedback subjects were shown the graph after each 15 trials.

Results: Results show the expected “guidance” interaction: Immediate feedback facilitated practice performance, but harmed transfer/retention performance (measured 10-minutes and two-days later).

Study 2 proposes that a minimal modification of the classic guidance paradigm, an increase in the number of tasks, may be sufficient to reverse the guidance pattern. This modification increases the risk of incorrect association, and reduces the risk of the negative guidance effect (because it reduces the value of error correcting strategies that impair transfer). As a result, immediate feedback is expected to facilitate task performance. In order to test this hypothesis, Study 2 utilizes the same paradigm as that of Study 1, with one variation: subjects were trained to respond to four different stimuli (instead of one), each with its own corresponding target time.

Results: Results confirm a very different pattern than that of Schmidt et al. (1989) and Study 1. During practice with feedback, subjects in the immediate feedback condition performed significantly better than subjects in the delayed feedback condition. However, this time the immediate feedback condition retained its advantage over the delayed condition ten minutes as well as two days later when feedback was removed. In summary, guidance predictions did not manifest; immediate feedback facilitated practice, transfer, and retention.

Results of Studies 1 & 2, Combined: Notice that the results reported above imply an interaction between feedback timing and task (one-color/ four color) on retention. In order to clarify the importance of this interaction it is useful to analyze the main results over the two experiments. (Undoubtedly combined analyses across separates studies should to be exercised with caution. In the present study we allowed this comparison because all experimental components - procedure, apparatus, subject pool, experimenters, etc., - were identical between studies, only number of colored stimuli differed).

Results Combined

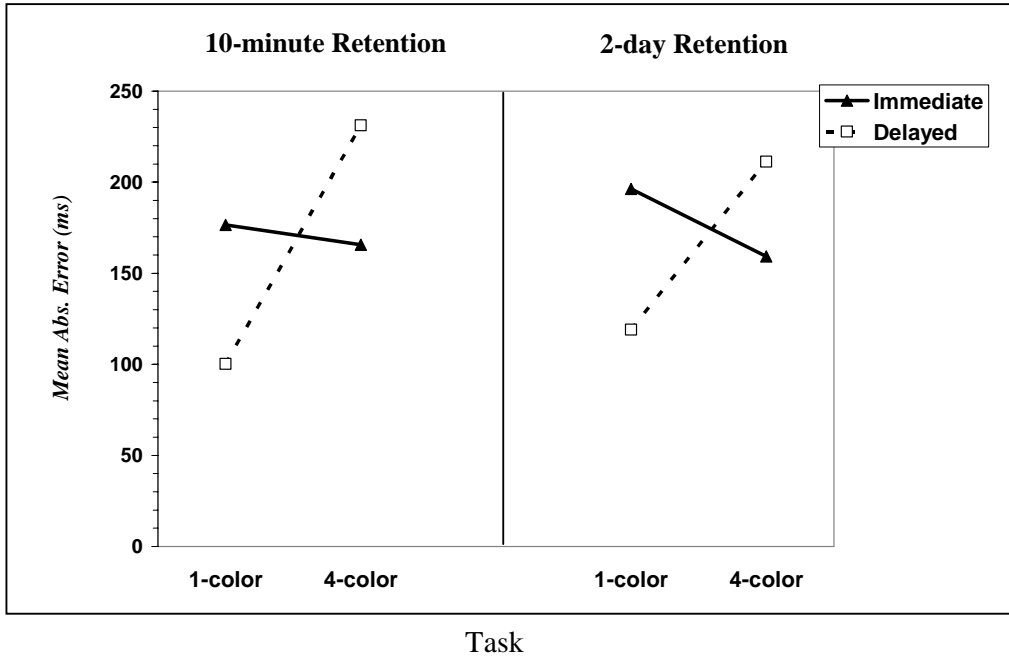


Figure 3: Results of 10-minute and 2-day retention, combined analysis

Figure 3 shows mean performance in two retention tests by task (1-color/4-color) and feedback (immediate/delayed). Results show a significant interaction between feedback timing and the number of tasks on both 10-minute and 2-day retention.

The results show better performance with delayed feedback in the one-interval condition, and the opposite pattern in the four-interval conditions. This interaction is significant in both retention tests, and supports the general pattern evident in Studies 1 and 2: that the relationship between performance and task (one-color/ four-color) interacts with feedback timing (immediate/delayed).

Under the interpretation offered here, immediate feedback has different effects on retention, depending on whether negative guidance effects (Study 1) are elicited, or whether positive association effects (Study 2) are imperative for optimal task performance.

Additional Studies in Dissertation: Additional studies proposed include further theoretical analysis of the boundary conditions which define the positive and

negative effects of immediate feedback. Two applied field studies are proposed which explore the value of association and guidance-reducing strategies in computerized tutorials. An additional theoretical study (laboratory + field) proposes to explore the trade-off between the *effect of practice* and the *likelihood to practice*. One set of situations explored is learning environments that offer delayed feedback (and thus develop optimal learning strategies/no guidance) but do not motivate practice, as compared to ones that offer immediate feedback (sub-optimal strategies) but increase the likelihood of practice (motivation).

Implications of association and guidance for organizational and managerial training, learning and feedback practices are explored.

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