Feedback Specificity Requirements for Learning in Younger and Older Adults: The Role of Cognitive Resources and Task Demand

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The amount of feedback needed to learn a new task has long been debated (cf. Schmidt & Bjork, 1992; Van Merrienboer & Sweller, 2005). One potential answer to the amount of feedback required is that feedback should be contingent upon the learner’s cognitive resources and demands imposed by the task (McLaughlin, Rogers, & Fisk, 2006). To test this model, a study is proposed that accounts for the learner’s cognitive resources by comparing samples of populations with known differences, older and younger adults (Horn & Cattell, 1967; Salthouse & Babcock, 1991). To account for task demands, a simple rule-based cue learning task has been created. Participants will be provided with varying levels of feedback specificity while learning the task. We predict younger adults will benefit from less feedback support while older adults benefit from more feedback support. Theoretical and applied contributions are also discussed.

INTRODUCTION

Despite 100 years of research, results are mixed as to the optimal amount of feedback needed for learning. It is generally acknowledged some amount of feedback is required for learning; however, the specificity of the feedback is still disputed (see Schmidt & Bjork, 1992; Van Merrienboer & Sweller, 2005). Results from the feedback literature may be divided into two general categories. One view argues more specific feedback should be provided to the learner; this was the prevailing view for most of the 20th century. Recent research contends that, although more specific feedback increases performance while the feedback is being provided, less specific feedback actually results in more learning (as measured through retention or transfer tests.) There are competing theories as to why more or less specific feedback is beneficial.

Studies have traditionally looked at feedback in terms of “more” or “less” information; however, these terms have been used ambiguously and inconsistently. For the purpose of this paper, more or less feedback will be defined as providing more or less specific information to the learner (McLaughlin, 2007).

Cognitive load theory argues that providing more specific feedback to the learner frees up cognitive resources needed for learning by reducing the cognitive load of the task to be learned (Sweller, 1988). In this view, the cognitive resources of the learner are limited and providing more specific feedback reduces cognitive load during learning, leading to increased retention. Research supporting cognitive load theory has generally found that as feedback specificity increases in acquisition, performance increases in retention (McLaughlin, 2007; Tuovinen & Sweller, 1999; Vollmeyer & Rheinberg, 2005).

Conversely, others have argued less specific feedback should be provided during acquisition to prevent learners from becoming dependant on the feedback (Salmoni, Schmidt, & Walter, 1984; Schmidt & Bjork, 1992). Termed the “guidance hypothesis,” this hypothesis suggests feedback specificity be used as a tool to guide the learner’s performance in acquisition; providing too much feedback results in the learner becoming reliant on the feedback (Salmoni et al., 1984) and will reduce performance on tests of learning. Another term describing reduced feedback is “desirable difficulties;” providing less specific feedback forces the learner to engage in transfer-appropriate processing (such as self-evaluation of performance) that will be needed in retention tests (Bjork, 1994). Research supporting this view has generally found that although reducing feedback specificity decreases acquisition performance, retention or transfer performance increases relative to when more feedback was provided (Butki & Hoffman, 2003; Schmidt, Young, Swinnen, & Shapiro, 1989; Weinstein & Schmidt, 1990).

Cognitive Resources

McLaughlin et al. (2006) proposed a model that views feedback requirements as contingent upon cognitive resources and task complexity. In this way, the model accounts for situations where more feedback specificity is desirable as well as situations where reduced feedback specificity is desirable. Higher amounts of feedback should benefit learners with low cognitive resources (particularly fluid resources, such as working memory or reasoning ability) or those learning complex tasks.

Older Adults. Adults over sixty-five commonly have fewer fluid cognitive resources. Age-related differences in fluid abilities, working memory, and processing-speed are well documented in the cognitive aging literature (Craik & Salthouse, 2000; Horn & Cattell, 1967; Salthouse, 1990, 1996; Salthouse & Babcock, 1991). Fluid abilities are the abilities associated with the learning process (Horn & Cattell, 1967). Working memory is one of the fluid abilities affected by the decline in processing speed proposed by Salthouse (1996). Working memory capacity is the ability to simultaneously process and store information (Feldman-Barrett, Tugade, & Engle, 2004). As the working memory capacity of older adults declines, it is subject to overload at lower task load levels than younger adults. In this situation, providing more specific feedback reduces the cognitive load of learning to perform the task.

Younger Adults. Conversely, lower amounts of feedback specificity would benefit learners with more cognitive resources or those learning simple tasks. An example of a
population that generally exhibits high cognitive resources is college students. Those with large amounts of available cognitive resources may benefit from the challenge of less specific feedback, thus increasing their need to self-generate feedback. This is similar to the idea of germane task load (van Merrienboer, Schuurman, de Croock, & Paas, 2002).

**Task Demands**

Germane task load is a relatively recent concept discussed in Cognitive Load Theory (Sweller, 1988) that emphasizes increasing germane load, or the cognitive demands essential to the task (van Merrienboer et al., 2002). However, an increase in task load of any kind may overload populations of learners with diminished cognitive resources, such as older adults. In addition, research has shown the importance of task demands in learning (e.g., Wulf, Shea, & Matschiner, 1998). If feedback requirements are resource dependent, then young adults in a simple task should benefit from less feedback than older adults. That is, younger adults will benefit from less specific feedback compared to younger adults given more specific feedback, and older adults more specific feedback compared to older adults given less specific feedback.

We will attempt to test the effects of available resources by controlling for cognitive resources, the load placed on the learner from the task itself, and how that load was altered during acquisition via different amounts of feedback on performance. The task all groups will learn is to differentiate real computer pop-ups from fake (often virus-related) pop-ups. While it may be suspected younger adults will be inherently better than older adults at this task of identifying fake computer pop-ups, there's no decisive evidence supporting this claim. A study conducted by Sharek, Swofford, and Wogalter (2008) suggests that younger adults have difficulty identifying fake pop-up messages. Results of the study revealed participants (young adults) responded incorrectly to fake pop-up messages 73% of the time. While we expect younger adults to outperform older adults, the important finding should be the difference in performance between feedback support groups for younger adults (see Figure 1).

**Overview of the Study**

The purpose of the current study is to systematically investigate the role of cognitive resources on optimal feedback levels on a simple, rule-based cue learning task. The proposed study will investigate the effect of cognitive resources on optimal feedback levels by recruiting from a population that, on average, exhibits decreased working memory capacity: adults over the age of sixty-five. Age 65 is considered an acceptable minimum age in which age-related research can be conducted (Salveny, 2006). This group of older adults will be compared to a younger adult sample. Task demand will be controlled for by using a relatively simple task that requires one decision from the learner.

If feedback requirements depend upon cognitive resources and task demand, younger adults learning a simple task should learn more with less feedback compared to younger adults receiving high levels of feedback. However, increasing feedback support for older adults should increase their learning. The anticipated pattern of results should show the connection between available cognitive resources of the learner and feedback support requirements in learning a simple task. Specifically, as shown in Figure 1, learners with higher cognitive resources available (younger adults) should require less feedback support; indeed they should show higher retention rates when challenged by lower feedback levels. Alternatively, learners with lower cognitive resources (older adults) should benefit from higher feedback support.

**Predicted Pattern of Results by Age Group and Feedback Level**

<table>
<thead>
<tr>
<th>Session</th>
<th>Younger - High Feedback</th>
<th>Younger - Low Feedback</th>
<th>Older - High Feedback</th>
<th>Older - Low Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition</td>
<td>■</td>
<td>■</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Retention</td>
<td>■</td>
<td>■</td>
<td>●</td>
<td>●</td>
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*Figure 1. Predicted pattern of results where younger adults outperform older adults, younger adults receiving less specific feedback outperform those receiving more specific feedback, and older adults receiving less specific feedback outperform those receiving more specific feedback.*

These results would support the view that feedback requirements are determined by available cognitive resources and task demands. A simple task should show learners with lower cognitive resources benefiting more from feedback support then learners with higher cognitive resources. Further, the numerous cognitive resources of younger adults should actually predict higher retention with low amounts of feedback compared to high amounts of feedback. This counterintuitive finding should arise from the transfer-appropriate processing required when less feedback is available to learners able to manage such processing.

**METHOD**

**Participants**

The study will include 48 participants, 24 from each age group. Younger adults will consist of men and women recruited from the undergraduate psychology pool at large southeastern university. They will range in age from 18 to 28
and will be offered a choice between course credit and $35.00 for their participation. Older adults will be recruited from the community. Their age will range in from 65 to 75. Older adults will be paid $40.00 for their participation.

The Task

The task consists of learning identify fake (virus) pop-ups via two cues. The cues will be limited to two identifiers in order to keep the task as simple as possible. There is never more than one cue present in a trial. Participants will be instructed to learn to identify real system pop-ups from fake ones. The task consists of a series of trials where a pop-up is displayed and the participant chooses “real” or “fake” (Figure 2).

The correct decision will be based on two different cues the participants will learn throughout the study. The first cue the participant will have to identify is the icon associated with the message. Two real icons, generated by Microsoft Windows, will be provided and two fake, designed for the experiment (Table 1). These fake icons would not appear on a legitimate pop-up window.

Table 1
Real and Fake Icons Used in Stimuli for Cue 1

<table>
<thead>
<tr>
<th>Icons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real</td>
</tr>
<tr>
<td>Icon 1</td>
</tr>
<tr>
<td>Icon 2</td>
</tr>
</tbody>
</table>

Note: Real icons are those provided by Microsoft Windows technical documentation. Fake icons were developed in-house and would never appear in connection with a real error message generated by Microsoft Windows.

The second cue participants will learn is language. Language refers to the grammar and/or tone associated with the message. One indication a pop-up is fake is an inappropriate tone (Figure 3), often too informal for technical writing or translated from a second language. Other cues that indicate a fake pop-up are the misspelling of words (Figure 4) or improper capitalization of words (Figure 5).

Feedback Conditions

Two levels of feedback support, low and high, will provided via a computer screen. In the low feedback support condition, participants will be told whether or not their answer was correct or incorrect (knowledge of results). In the high feedback condition, participants will receive the same information given in the low feedback condition as well as information regarding the cue they are trying to learn. For example, if the participant answered “real” to a fake pop-up with an incorrect icon, the additional information in the high feedback condition will be similar to the following: “INCORRECT. A real pop-up does not use this icon.”

Acquisition. Acquisition will consist of four blocks of 20 trials over one hour. Participants will be randomly assigned to one of two feedback condition. They will be informed they are to identify whether a given pop-up is real or fake.
Retention. Participants will return three days later and complete an 80 trial retention test. No feedback will be given during retention or transfer tests.

Materials

Materials include a demographics survey, ability tests (vocabulary: Shipley, 1986; working memory: Unsworth, Heitz, Schrock, & Engle, 2005; and perceptual speed: Wechsler, 1997), a computer and technology experience questionnaire (Czaja, Sharit, Charness, Fisk, & Rogers, 2001) and an exit interview. Participants will be given written instructions about the task that will be available throughout the acquisition session.

The task will be performed on IBM-compatible computers (1.80 GHz Pentium Dual-Core, 1.96 GM RAM). Screen size is 20" with a resolution of 1280 x 1024 pixels and a refresh rate of 60 Hz.

Procedure

The study will take place in the laboratory over two sessions, an acquisition session and a retention (test) session.

Acquisition. Participants will be randomly assigned to one of two feedback condition. When participants arrive they will be given two informed consent forms. They will be instructed one copy is for them to keep. The experimenter will then go over the form orally after which participants will be asked to sign a copy and return it to the experimenter. Immediately after participants will complete ability tests and then begin the task. They will be informed they are to identify whether a given pop-up is real or fake, complete 5 practice trials intended to help familiarize them with the equipment and then complete 80 training trials.

Retention. Participants will return four days later and complete a 60 trial retention test. No feedback will be given during the retention test. When participants arrive they will be asked to complete a near vision test. After all participants have arrived the retention portion of the task will begin. Upon completion of the retention test participants will complete the exit interview, be debriefed and paid for their time.

Design

The study will be a 2 (Feedback: low and high) x 2 (Age: young or older) design. Feedback is a between-participant factor; half of each age group will receive knowledge of results + detailed feedback while half will receive only knowledge of results. Age group is also a between-participant factor. The primary dependent variables of interest are acquisition accuracy and retention test accuracy. In order to examine if there is a speed-accuracy tradeoff in performance, response time in acquisition and retention will also be measured. In addition, differences between participants’ computer and technology experience will be examined as well as responses to an exit interview.

Data Analyses

A repeated measures analysis of variance (ANOVA) will be used to examine age differences in performance, differences between acquisition and retention performance, as well as the difference in retention scores between feedback conditions.

A one-way analysis of variance (ANOVA) will be used to examine differences between participants’ computer and technology experience. If results reach significance, then a multivariate analysis of variance (MANOVA) will be used in the above analysis in lieu of the repeated measures ANOVA.

DISCUSSION

The proposed experiment will examine how feedback requirements are a function of the available cognitive resources of the learner and the demands of the task. Cognitive resources will be controlled for by recruiting younger and older adults to create general groups with higher and lower cognitive resources. Feedback will be manipulated by varying the amount of support provided, and the demands of the task controlled for by using a simple task.

Although it is predicted available cognitive resources will be a significant factor in feedback support requirements, it is possible both age groups will benefit from high feedback support. This would suggest abilities other than cognitive resources and task demands may contribute to feedback requirements. One possible explanation would be strategy use between the age groups. Previous research has shown older adults are less likely to develop a strategy for a task compared to younger adults (Touron, Hoyer, & Cerella, 2004). If this occurs, we would expect to find a difference between younger and older adults’ answers to various strategy questions on the exit interview.

Theoretical Contributions

Previous feedback research has been inconclusive regarding how much should be provided to a learner. The hypotheses from the current study were developed based on a review of the feedback and learning literature. These results will help add to the knowledge by identifying how available cognitive resources affect feedback use. By systematically categorizing cognitive resources (younger vs. older) and holding task complexity (simple) constant, it will help to support or refute if cognitive resources and task complexity explain feedback requirements.

Applied Contributions

Results of the study will be used to make recommendations about feedback requirements based on cognitive resources. This approach to feedback requirements for learning has implications for teachers, tutors, instructional designers, and others. With the advancement of technology and psychometric testing, it has become relatively easy to obtain a measure of cognitive resources in very short time. This coupled with recommendations of feedback requirements
based on cognitive resources could allow the creation of adaptive programs that provide feedback based on the learners’ cognitive resources.

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REFERENCES


