# Interdependence and Past Experience in Menu Choice Assessment

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## Introduction

Consider the task of searching a newly encountered web page for information that is relevant to some goal (figure 1).
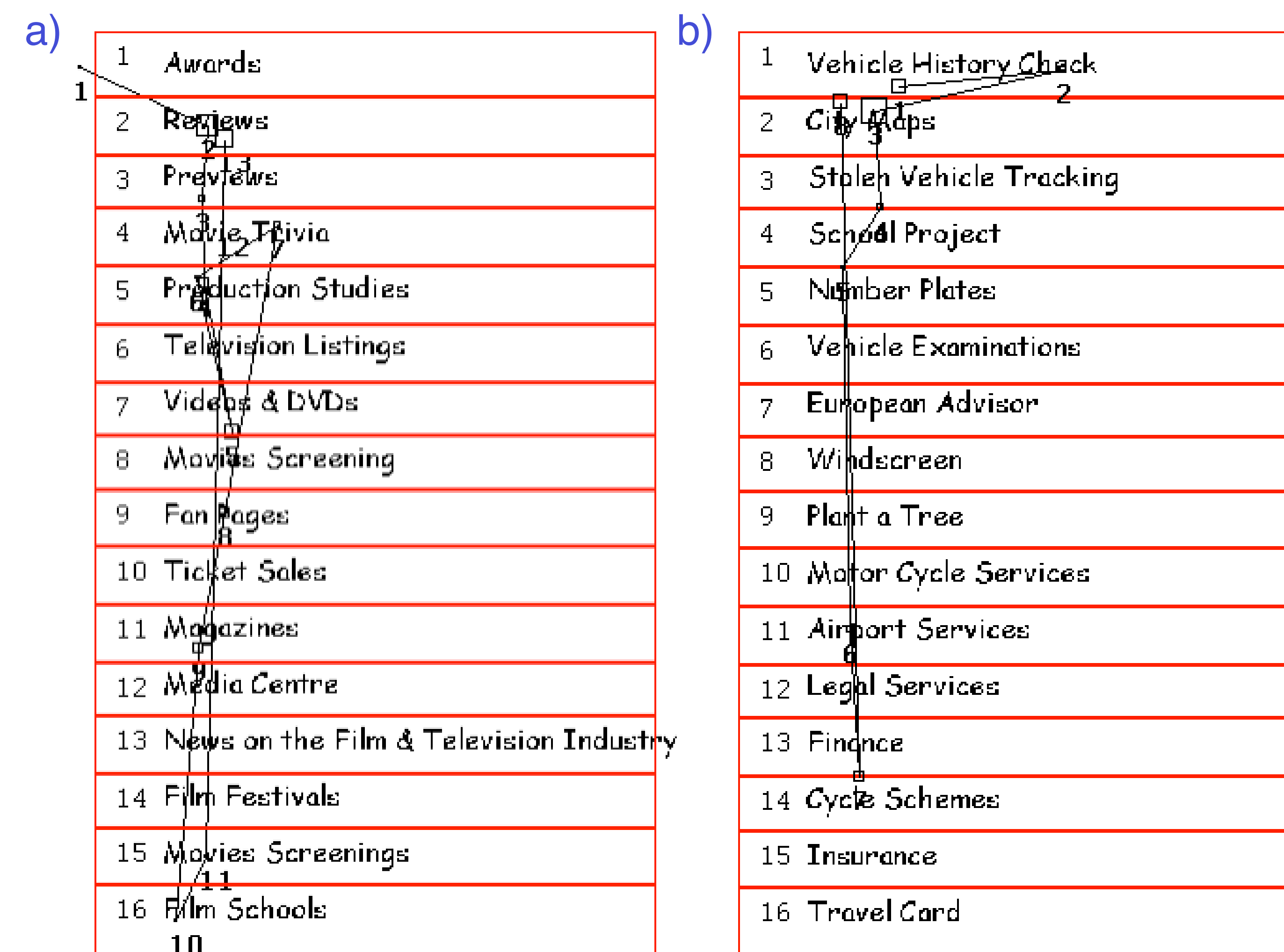


Figure 1. Typical traces of eye movement fixations whilst searching a menu. Participants task was to a) Find a Review of the Latest Movie Releases and b) Find a Road Map of Cardiff.

In deciding which item to select in pursuit of an information goal, menu items must be assessed to provide an estimate of their subjective relevance to the task.

What influences the decision to stop assessing and select an item?

The relevance of the goal item to the task description is obviously important (Miller & Remington, 2001; Pirolli & Fu, 2003). Young's (1998) rational model of exploratory search, however, continues to assess items so long as the expected information gain of making another assessment exceeds the cost of the assessment. Importantly, due to a normalization assumption there is an interdependency between assessments of items. A novel prediction that emerges from Young's model is that the relevance of the distracter items to the goal will also affect the decision to select an item.

Another potential influence on the decision to select an item or assess further items is the history of previous experience. In problem solving tasks an operator is more likely to be selected if it was previously successful (Lovett & Anderson, 1996). In menu selection the influence of previous history of success is an open question.

The aim of our study was to demonstrate that the decision to select an item is not simply determined by the relevance of the goal item to the search goal, but is also strongly influenced by the relevance of the remaining distracter items and also by past experience.

## Method

Menu search tasks were derived from a web usage survey. Menu items were sampled from WWW sites provided by respondents to the survey. The quality of the sampled items was rated to assess the degree to which an item was relevant to the achievement of the search goal.

Trials were split between filler trials and critical trials. Filler trials occurred in the initial half of the experiment and the discrimination of the goal item was either hard or easy (between-subjects). On critical trials the quality of the goal item was approximately equal and the distracter items were either or very bad or moderate in quality (within-subjects). Eye-tracking was performed using an ASL Pan/Tilt optic eye-tracking system. Participants ($n=36$) were native English speakers.

## Results

The focus of the study was on eye-tracking data on critical trials in which the participant accurately selected the goal item on the first selection (mean accuracy was 99% and 72% for very bad and moderate quality distracters). We analyzed the number of items that participants fixated (figure 2), finding an affect of quality of distracter items ($F_{(1, 34)} = 24.27$, $p<.001$) and difficulty of previous trials ($F_{(1, 34)} = 2.96$, $p<.1$).
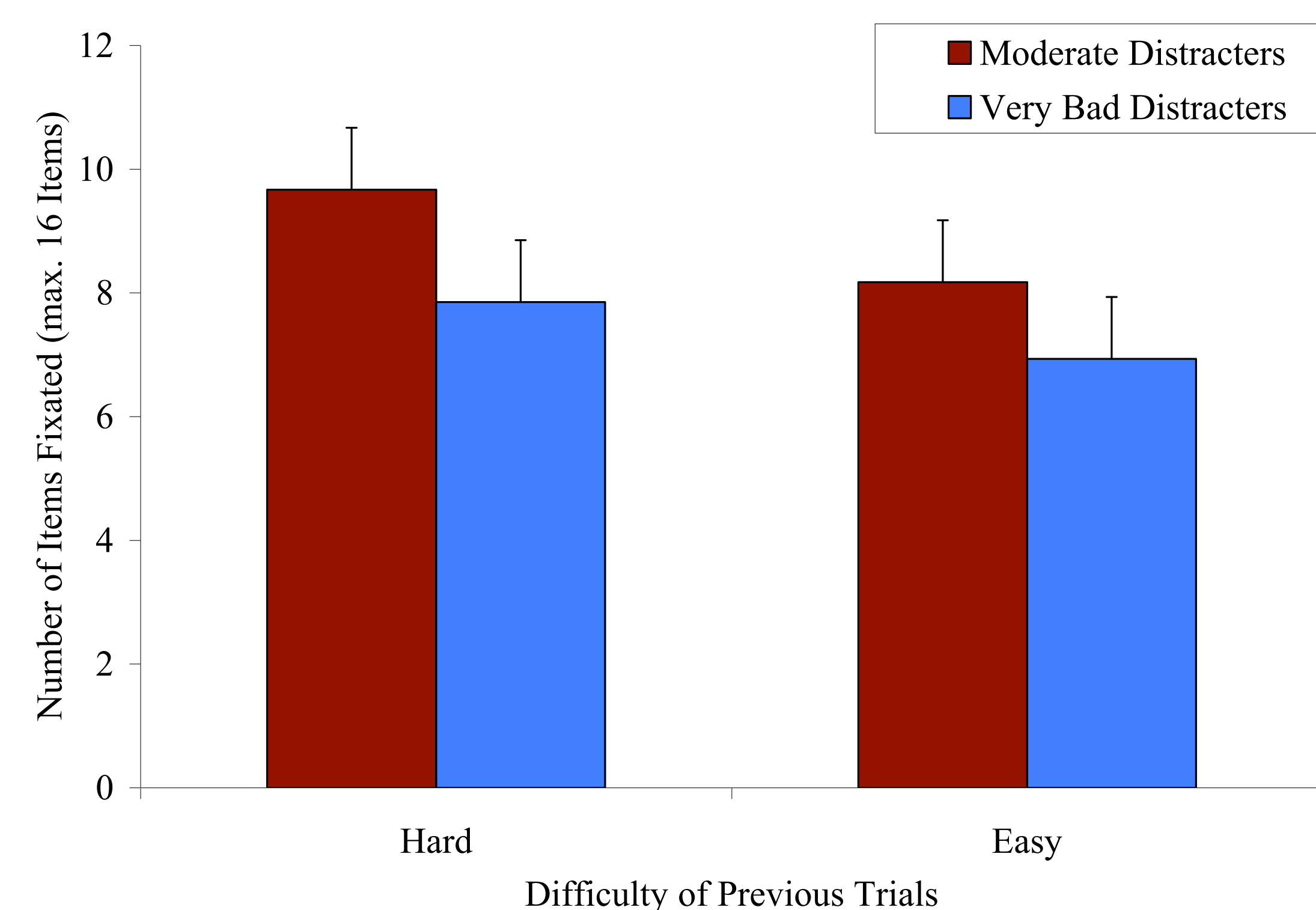


Figure 2. The effect of quality of distracter items and difficulty of previous trials on the number of items fixated prior to selection of goal item

Furthermore, we analysed the proportion of searches in which the goal item was selected immediately after it had been fixated (figure 3), finding an affect of quality of distracter items ($F_{(1, 34)} = 7.81$, $p<.001$) and difficulty of previous trials ($F_{(1, 34)} = 5.21$, $p<.05$).
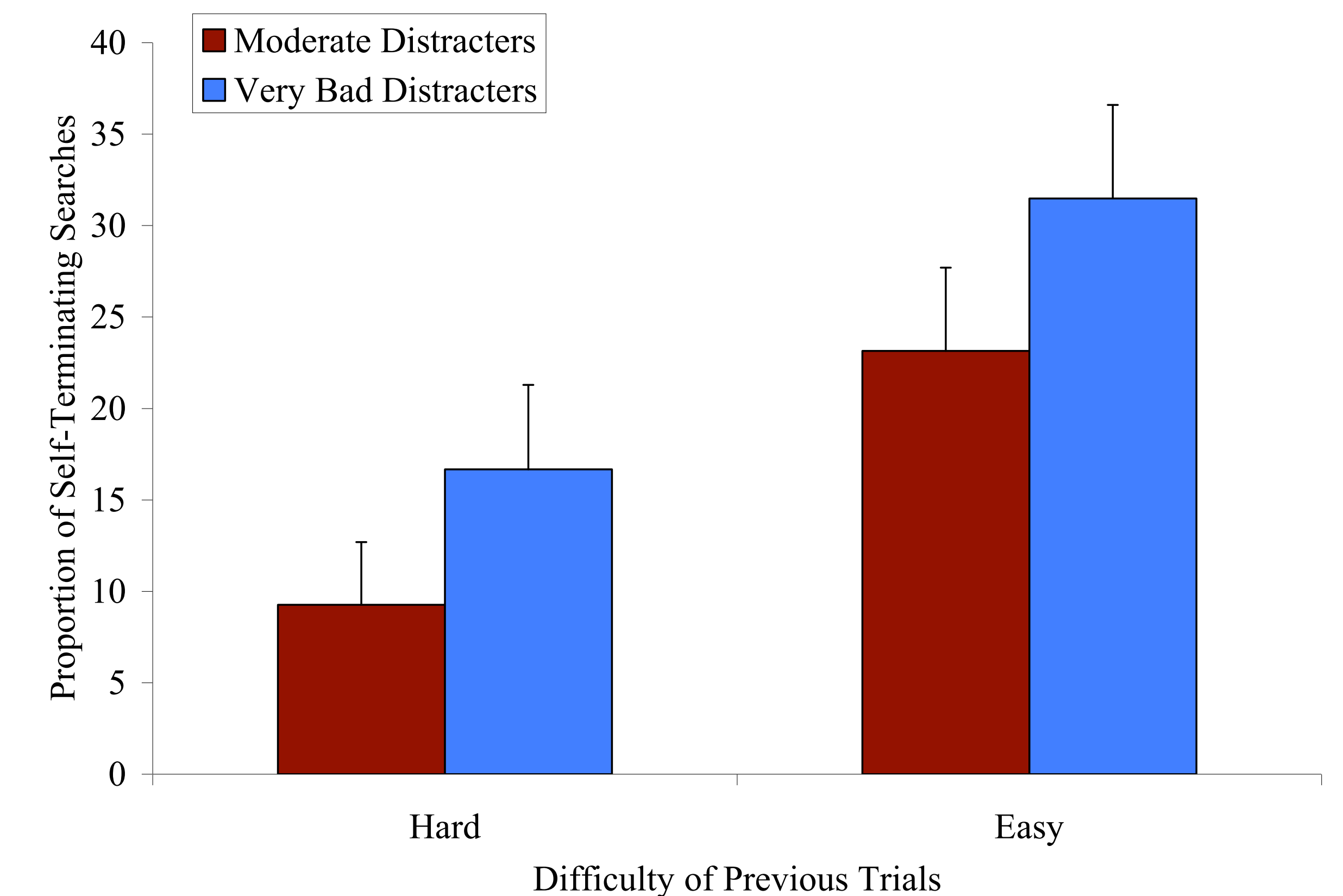


Figure 3. The effect of quality of distracter items and difficulty of previous trials on the proportion of self-terminating searches

We also analysed the number of fixations that occurred over contiguous blocks of items prior to selection, finding an affect of quality of distracter items ($F_{(1, 34)} = 19.95$, $p<.001$) and difficulty of previous trials ($F_{(1, 34)} = 3.72$, $p<.1$). This latter data was fitted to a Prolog implementation of Young's (1998) rational model. The model provides a reasonable fit to the data, accounting for the effect of lower quality distracter items on the number of assessments.

## Discussion

The findings of this study suggest that the choice between continued assessment and selection in menu search is not entirely determined by the relevance of the goal item to the information goal, but is also influenced by the relevance of the assessed distracter items. This finding provides empirical support for the idea that assessments of menu items are interdependent and can be accounted for within a rational model of menu search. It is not clear that previous cognitive models of menu search (e.g. Miller & Remington, 2001; Pirolli & Fu, 2003) would account for this finding.

The choice between evaluation and selection was also found to be affected by past experience. Future modeling work may be extended in the ACT-R framework (Anderson & Lebiere, 1998) to account for this finding, as the production rule learning mechanism is well suited to capturing the influence of past experience on operator selection.

Summary: Whether people choose to assess a label on a web page is dependent on the relevance of all other items so far assessed, not just the best so far.