Predictive inferences take time to develop

Abstract In order to determine the time course of inferences about predictable events, predicting or control contexts were presented, followed by a target word (Exp. 1A, B, and C) or a continuation sentence (Exp. 2) that confirmed or disconfirmed the predicted event. Relative to the control condition, under the predicting condition there was facilitation in naming the confirming target words 1500 ms after the onset of the last word in the context (Exp. 1C), but not after 500 ms (Exp. 1A), and only a tendency after 1000 ms (Exp. 1B). In addition, there was facilitation in reading the post-target and final regions of the continuation sentence that confirmed the predicted event, as well as inhibition when the predicted event was disconfirmed, but no effect was observed on the target word itself (Exp. 2). It is concluded that, when the predicted event is highly constrained by the context, predictive inferences are likely to be drawn on-line, but they take time to construct.

Introduction

Predictive inferences have received considerable attention in reading research (e.g., Fincher-Kiefer, 1996; Keefe & McDaniel, 1993; Lea, 1995; McKoon & Ratcliff, 1986). They occur when we anticipate the consequences of an event, and they convey information about “what will happen next.” For example, “crashed” might be a predictive inference made when reading: “With hardly any visibility the plane quickly approached the dangerous mountain and the passengers began to shout in panic.” The aim of this study is to extend prior research on the time course of these inferences.

Extant models of inferences in reading (see a review in Graesser, Millis, & Zwaan, 1997) – i.e., the minimalist hypothesis (McKoon & Ratcliff, 1992, 1995) and the constructionist theory (Graesser, Singer, & Trabasso, 1994; Singer, Graesser, & Trabasso, 1994) – argue that predictive inferences are unlikely to be drawn on-line. The main reason is that these inferences are not necessary to satisfy the coherence and the explanation assumptions. That is, they are not required to make statements in the text locally coherent (e.g., referential assignment: McKoon & Ratcliff, 1992) or globally coherent in the situation model (e.g., superordinate goals: Graesser et al., 1994), nor to explain why actions, events, and states are mentioned in the text (e.g., causal antecedents: Graesser et al., 1994). Nevertheless, both models admit that these inferences can be drawn on-line if they are supported by well-known information readily available in memory (McKoon & Ratcliff, 1992) and if they are highly constrained by the context (Graesser et al. 1994). However, even in this case, both models assume that predictive inferences are not automatic; rather, they involve elaborative construction of meaning, i.e., post-lexical strategic processes. Therefore, they should take time to develop.

Some studies have found no evidence that predictive inferences are generated during reading (Duffy, 1986; Fincher-Kiefer, 1993; Magliano, Baggett, Johnson, & Graesser, 1993; Millis & Graesser, 1994; Potts, Keenan, & Golding, 1988; Whitney, Ritchie, & Crane, 1992). However, on-line predictive inferences have been detected in studies that have somehow followed the implications of the minimalist hypothesis and the constructionist theory (Fincher-Kiefer, 1993, 1994, 1995, 1996; Keefe & McDaniel, 1993; Murray, Klin, & Myers, 1993; Whitney et al., 1992). According to these implications, first, the activated inference concept must be kept foregrounded (Whitney et al., 1992) or in attentional focus (Murray et al., 1993) until the time of test in order to have the relevant information...
readily accessible in memory. This is especially important because predictive inferences are only temporarily held in working memory (Fincher-Kiefer, 1995, 1996; Keefe & McDaniel, 1993). Secondly, the predicting context must strongly imply one main consequence in order to meet the context constraints implication; otherwise, if there are multiple potential consequences, inferences would not be made because of inefficient resource expenditure.

Once it has been established that predictive inferences can be made under certain restricted conditions—i.e., when provided with sufficient supportive context—an important step is to analyze their precise time course (see Graesser et al., 1997), which is the main goal of the present study. Most prior experimental research on predictive inferences has not addressed this issue directly, as temporal parameters were not manipulated. In some studies, participants could read the predicting context in a self-paced mode; furthermore, this context was presented either as a whole text (Whitney et al., 1996), one sentence at a time (Fincher-Kiefer, 1993, 1994; Keefe & McDaniel, 1993; Lea, 1995), or one line at a time (Murray et al., 1993). In addition, there was an interval (generally, of 200–500 ms) between the end of the context and the probe or target word. Presumably, if inferences are detected after such a short interval, this implies that they occur on-line with a very short delay. The problem is that, as the participants could decide when to finish reading the context, they actually had all the time they needed to make the inference before the context-probe interval. Therefore, this interval becomes meaningless with regard to the time course of the inference. A procedure in which there is free reading time and in which long context segments are visible at a given time represents natural reading, but it does not allow precise assessment of the time course of inferences.

In order to overcome this problem, three methodological strategies have been used: (a) presentation of the last word in the inducing context for a limited time, (b) fixed-paced presentation of the context by means of Rapid Serial Visual Presentation (RSVP) procedures, and (c) manipulation of the interval between the onset of the last word in the context and the onset of the test word by means of the Stimulus Onset Asynchrony (SOA) technique. With the first approach, Millis and Graesser (1994, Exp. 2) used a word-by-word fixed-pace RSVP procedure to present the context, followed by a target word representing the inference (target word) in the “what happened next” protocols. In addition, they used either (a) a word-by-word fixed-pace RSVP procedure to present the context, followed by a target word representing the inference that the participants were to pronounce (Exp. 1), or (b) a word-by-word self-paced presentation of the context, followed by a continuation sentence that represented the inference (Exp. 2). The findings revealed (a) facilitation in naming target words after a 1250-ms SOA, but not after a 500-ms SOA (Exp. 1), and (b) facilitation in reading the target word plus a post-target region (spill-over effect) of the continuation sentence, but not in reading the target word itself (Exp. 2). The findings converged to suggest that predictive inferences occur on-line, but with delay.

However, some limitations in the experiments conducted by Calvo and Castillo (1996) can be overcome in order to obtain further knowledge on the process of predictive inferencing in the present study. First, the use of only two SOAs (500 and 1250 ms) provided a limited range to examine the time course of inferences; with two more SOAs (1000 and 1500 ms) in the present study, the

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1 However, in Magliano et al., with a comparable mean production likelihood score of .30, causal antecedent inferences, but not causal consequence (predictive) inferences, showed evidence of on-line encoding.

2 New features in the present study, in comparison with Calvo and Castillo’s study, include: (1) slower RSVP rate (100% vs 150%); (2) new SOAs (500–1000–1500 vs 500–1250 ms); (3) enhanced constraints in the predicting contexts (81–82% vs 67%); (4) control of word-based priming (subjective and objective—i.e., dictionary—word association vs subjective word association); (5) control contexts (explicit vs no context); and (6) post-target and final regions of the continuation sentences for the confirming and the disconfirming versions (identical vs different).