INTRODUCTION TO THE SPECIAL ISSUE

Eye-Movement Recordings in Second Language Research

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An important part of understanding how languages are learned is understanding the cognitive processes that underlie acquisition. Many methodologies have been used over the years to understand these processes, but one method of recent prominence is eye-movement recording, colloquially referred to as eye-tracking. Because more and more attention is being paid to this methodology by SLA researchers, we believe the time is ripe for this special issue focusing on eye-movement recording and SLA.

Eye-movement recording is a versatile research technique with implications that reach into diverse areas. Thus, within the field, eye-movement registration has already been used to investigate lexical access and representation in bilinguals (e.g., Blumenfeld & Marian, 2011; Duyck, Van Assche, Drieghe, & Hartsuiker, 2007; Felser, Sato, & Bertenshaw, 2009; Flecken, 2011; Van Assche, Drieghe, Duyck, Welvaert, & Hartsuiker, 2011; Van Assche, Duyck, Hartsuiker, & Diependaele, 2009), syntactic ambiguity resolution (e.g., Dussias & Saggarra, 2007; Frenck-Mestre & Pynte, 1997; Roberts, Gullberg, & Indefrey, 2008; see also reviews by Dussias, 2010, and Frenck-Mestre, 2005), attention (Godfroid, Boers, & Housen, in press), and cognitive processes during specific tasks, such as second language (L2) testing (Bax & Weir, 2012) and video-based L2 listening (Winke, Gass, & Sydorenko, 2013). This special issue presents the reader with an up-to-date understanding of some of the current research questions being investigated through eye-movement registration. In so doing, this special issue affords an opportunity to pause and evaluate how some applied linguists are utilizing this novel data-collection method in our field.
THE PRINCIPLES OF EYE-MOVEMENT CONTROL

By way of introduction to the eye-movement research in this volume, we provide the reader with some basic terminology. Many of the processes and terms introduced here are explained in more detail by Roberts and Siyanova-Chanturia, who forefront this issue with an overview of how SLA researchers use eye-movement data to investigate topics in L2 processing.

Eye-movement behavior falls into two distinct categories: eye fixations and saccades. During eye fixations, readers process visual input, which is typically—but not always—the word or object at which they are currently looking (e.g., Rayner, 1998, 2009a). Saccades occur when the person moves his or her eyes from one location to the next, providing the cognitive system with new visual information (e.g., Brysbaert & Nazir, 2005). The default eye movement in reading is forward, but about 10–15% of all saccades are regressions (Rayner, 1998): backward eye movements that allow the reader to reinspect an earlier part of the text. The time in between two saccades is the fixation duration, which is an important class of dependent variables (more detailed explanation to follow). Fixation durations are influenced by a number of low-level (visual) and high-level (cognitive) factors. The “big three” low-level predictors in reading are the length, frequency, and predictability of the currently fixated word (see Kliegl, Nuthmann, & Engbert, 2006, p. 13). High-level factors relate to the integration of the word into the sentence and discourse representation—that is, whether or not the reader can make sense of the word in the wider context of what he or she is reading (see Reichle, Warren, & McConnell, 2009).

As regards fixation durations, reading researchers typically distinguish between early and late measures (e.g., Clifton, Staub, & Rayner, 2007; Rayner, 1998, 2009b; Rayner, Sereno, Morris, Schmauder, & Clifton, 1989). Early measures (i.e., first fixation duration and gaze duration) gauge aspects of first pass reading: the initial fixation and possible refixations a reader makes when he or she encounters a target region for the first time during forward reading (e.g., in English: left to right). Early measures may index “processes that occur in the initial stages of sentence processing” (Clifton et al., 2007, p. 349), such as word recognition or lexical access. Sometimes, the reader’s line of vision will exit a target region and move to a location further ahead in the text but regress (i.e., return) to the initial target region later on. The measures associated with such revisits (i.e., second pass time, rereading, and total time) indicate comparatively late stages of processing and may signal an interruption to the normal reading process.

Eye-movement registration has also been employed in conjunction with pictures to study auditory language processing. This approach,
exemplified by Dussias, Valdés Kroff, Guzzardo Tamargo, and Gerfen’s study, is known as the visual-world paradigm (see Dussias, 2010, and Huettig, Rommers, & Meyer, 2011, for reviews). Visual-world researchers tend to work with a different set of dependent variables than reading researchers do. They present participants with an auditory stimulus (e.g., “Click on the panda”) and are interested in how the proportion of participants’ fixations at the target object (e.g., panda) in relation to its competitors (e.g., pencil) changes over time. This indexes the level of activation of the different lexical candidates, their competition, and the ultimate selection of a single lexical representation as the target. Lexical access is considered complete when the proportion of target looks approaches 100%.

In either strand of research it is assumed that eye movements are related to cognition (see Rayner, 2009b; Rayner, Reichle, & Pollatsek, 2005; Reichle, Rayner, & Pollatsek, 2003). Therefore, processing difficulties can be captured in eye-movement records. In visual-world studies, interference from a competitor will show in the proportion of looks at the competitor object, whereas difficulties in written sentence processing are reflected in increased fixation durations and more frequent refixations or regressions relative to a control condition. The L2 context is rich for investigating these links between eye-movement control and language processing because processing difficulties are endemic in L2 learners and may be compounded by first language (L1)-L2 differences (Dussias et al.; Godfroid & Uggen; Sagarra & Ellis; but see Van Assche, Duyck, & Brysbaert for an illustration of how L1 knowledge may facilitate L2 processing; all of these articles can be found in this issue). As of yet, we are unaware of any theoretically oriented L2 eye-tracking research that has investigated the basic characteristics of L2 eye-movement control in a manner similar to the L1 research summarized in Rayner (1998, 2009a) or the large corpus studies by Kennedy, Kliegl, and their colleagues (e.g., Kennedy, Pynte, Murray, & Paul, 2013; Kliegl et al., 2006; Pynte, New, & Kennedy, 2009a, 2009b). Establishing these benchmarks for L2 readers will help to interpret the growing number of empirical studies in our field but will also prove to be challenging given the need to contextualize L2 eye-movement models in relation to the L2 learners’ proficiency, the L1-L2 pairings, the learners’ age, and the age when the L2 study began (i.e., age of onset).

This special issue is devoted to eye movements by L2 learners in the belief that, through these data, researchers will gain a better and more complete understanding of the processes of L2 development. Following an introductory chapter by Roberts and Siyanova-Chanturia, we have organized the empirical articles in this volume by two broad categories: (a) the processing of verbs and verbal morphology and (b) the processing of gender. Each article additionally goes beyond these central topics and incorporates other current topics of interest—for example, attention
Roberts and Siyanova-Chanturia overview commonly used eye-tracking measures in studies on written language processing. The authors review two lines of eye-movement research in SLA: (a) research that examines how bilinguals store and access words in their (language nonselective) mental lexicons, and (b) studies that investigate how L2 learners process ambiguous sentences or apply grammatical constraints during real-time sentence processing. Roberts and Siyanova-Chanturia’s initial explanations of the measures used by such eye-movement researchers are essential for all SLA researchers who need to understand the visual mechanics behind the reading process. Roberts and Siyanova-Chanturia demonstrate how eye-movement recording is a valuable tool for investigating the details of L2 learners’ knowledge base and how adults apply this knowledge during real-time, L2 reading.

The study by Van Assche et al. contributes to the first line of research reviewed by Roberts and Siyanova-Chanturia. Van Assche et al. test whether Dutch-English cognate verbs, which presumably have a privileged status in the bilingual lexicon, are processed faster than matched, noncognate verbs. This phenomenon is known as cognate facilitation and has been demonstrated many times with nouns. Van Assche et al. first extend these findings to verb processing in an English lexical decision task and show that cognate verbs like *win* (Dutch *winnen*) are accepted faster than matched, noncognates like *buy* (Dutch *kopen*). In a second experiment, which includes eye-tracking, a different group of L1 Dutch–L2 English participants read the same English verbs, but this time, the verbs were embedded in low-constraining sentence frames. The sentences had a language cue for lexical selection, which supposedly would help reduce or even eliminate any cognate facilitation effect. Nevertheless, Van Assche et al. found that cognate verbs were processed faster than noncognate verbs as measured by go-past time. Although Dutch-English past tense verb pairs arguably have a lower orthographic overlap than present tense verb pairs, the cognate facilitation effect was not modulated by verb tense.

Sagarra and Ellis explore aspects of the associative learning theory (e.g., Kruschke & Blair, 2000) that may explain why L2 learners have difficulty processing verb morphology (see also Godfroid & Uggen). They investigate the influence of saliency, word order, the L1, and L2 proficiency level on L2 learners’ sensitivity to grammatical features (as do Spinner et al., discussion to follow). Consistent with Dussias et al., Sagarra and Ellis consider the processing of a language with rich morphology (i.e., Spanish) by native speakers of a language with poor morphology (i.e., English) and native speakers of a language with rich morphology (i.e., Romanian). Sagarra and Ellis focus on verb-adverb
agreement in incongruent and congruent combinations in past tense sentences. Participants read a sentence and then selected a picture that corresponded in meaning to the sentence read. All learners had increased fixation durations on incongruous elements (i.e., a present-tense verb with a past tense adverb or vice versa), which attested to their sensitivity to these grammatical cues. The position of the incongruous word in the sentence, the participant’s proficiency level, and his or her L1 further affected fixation duration.

Godfroid and Uggen also examine L2 learners’ attention to verb morphology, but, unlike Saggarra and Ellis, they focus on a grammatical feature with which their participants were unfamiliar. Beginning learners of German read stacked sentence pairs with an action verb that appeared in the first-person singular (in the top sentence) and in the second- or third-person singular (in the sentence underneath). In the two irregular-verb conditions, the latter verb form underwent a stem vowel change from e to i(ε) (e.g., ich sprache → du sprichst “I talk → you talk”) or from a to ä (e.g., ich fähre → du fährst “I drive → you drive”). In the control condition, the stem vowel was the same in both verb forms (e.g., ich lache → du lachst “I laugh → you laugh”). Learners looked longer at the second- or third-person singular of an irregular verb than that of a regular verb. Furthermore, longer total times on irregular verb forms had a favorable but small effect on the subsequent production of those forms. These findings inform theories of learned attention (Ellis, 2006a, 2006b) in that they suggest that L2 learners do attend to grammatical features that their L1 does not predispose them to notice but that the learning benefits may be small, particularly when the intervention is limited.

Winke also looks at learner attention, and, in particular, the claim that input enhancement is a relatively unobtrusive technique to promote learner attention to targeted linguistic forms (Sharwood Smith, 1993). Winke investigates how the enhancement of English passive constructions affects 55 English language learners’ understanding of the passive construction as well as their comprehension of the text itself. Using a between-subjects design, she found that learners who read the enhanced forms spent significantly more time fixating on the forms and rereading them than participants reading the unenhanced forms. Although this supports the notion that input enhancement induces visual attention, Winke found that enhancement did not significantly promote form learning—a finding that differed from previous studies—nor did enhancement significantly detract from comprehension. The results of Winke’s study thus appear to suggest that enhancement, mostly described as a relatively implicit method for increasing learner attention, may be best utilized in combination with explicit instruction, as most teachers probably already understand.

Two articles deal with grammatical gender: Dussias et al. and Spinner et al. In the first of these, Dussias et al. use a visual-world paradigm to
determine a gender facilitatory effect. The participants were 16 native speakers of Spanish and three groups of L2 Spanish learners: a high-proficiency group of native speakers of English \((n = 9)\), a low-proficiency group of native speakers of English \((n = 9)\), and a low-proficiency group of native speakers of Italian \((n = 15)\). Thus, represented in this study are speakers of a language with no gender marking (i.e., English) and speakers of a language with gender marking (i.e., Italian) learning a language with gender marking. The participants listened to sentences \((N = 28)\). While listening to each, they saw two pictures on screen, one of which depicted the target noun in the sentence. Either the two pictures both agreed in gender with the targeted noun, or only one of the pictures agreed. The participants had to click on the picture of the object named. The pictures were presented to investigate anticipatory effects monitored by eye fixations. Results were analyzed using the proportion of eye fixations on the two pictures. The native speakers of Spanish and the highly proficient learners of Spanish appeared to use gender information in the same manner during processing. The lower-proficiency Spanish groups with different L1s (i.e., one L1 with gender marking, the other without), however, provided interesting results. The lower-Spanish-proficient Italians did not anticipate gender when the target was either masculine or feminine and the pictures were both masculine, but they did when the target was feminine and one image was masculine and one feminine. The less-proficient L1-English learners of Spanish did not anticipate gender. These data show that both proficiency and language similarity influence how the processing of morphosyntactic features takes place.

In the second of these articles, Spinner et al. use eye-tracking to determine what cues 40 L2 learners of Italian (with English as the L1) use as they attempt to process Italian noun gender to subsequently mark gender on an agreeing adjective. Unlike the article by Dussias et al., they do not investigate online processing but are concerned with what information learners use to determine the gender of nouns. Analyses of second pass time and regressions suggest that L2 learners are sensitive to and utilize multiple sources of information regarding the gender of nouns, including morphosyntactic information (i.e., word endings and articles). This study differs from other processing studies in that the method used was not time sensitive; learners had the ability to reason through the process. Thus, the reported insensitivity to morphosyntactic cues in the previous literature may apply only to rapid, unconscious processing.

As with all (new) data-collection methodologies, there are numerous variations on how to apply and operationalize the method. Eye-tracking research is no exception. The article by Spinner et al., in addition to providing information about L2 gender, makes the argument that it is not sufficient to blindly follow commonly used data-collection procedures
when asking new questions. In particular, they argue that screen layout can significantly change study results and, hence, the interpretations and conclusions that researchers garner from their data.

As the variety of articles in this special issue demonstrates, L2 eye-tracking data are an invaluable resource to test aspects of SLA theories and models of the bilingual mind. Eye-movement recordings open new venues for empirical research, and they inform scientists’ understanding of the links between eye movement and cognition.

REFERENCES


