

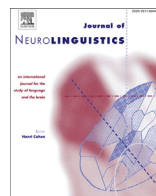


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Pronoun processing in anglophone late L2 learners of French: Behavioral and ERP evidence



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ABSTRACT

This study investigated offline, behavioral, and online cortical responses to French clitic and strong pronouns by two groups of anglophone learners (L2) and native French controls. English in situ object pronouns behave morphosyntactically like full lexical noun phrases (I saw **Bill**/I saw **him**), whereas in French they are cliticized to the verb (J'ai vu **Guillaume**/Je l'ai vu/*J'ai vu **le/lui**). We used ERPs, known to be sensitive to word order and morphological violations in natives, to investigate neural responses to word order violations of in situ pronouns. Results indicate native sensitivity to ungrammatical in situ pronoun placement in offline (grammaticality judgment (GJ)), as well as online end-of-sentence and ERP responses, notably a robust P600. L2 groups demonstrated distinct capacities according to level. Both high- and low-intermediates showed online cortical sensitivity to ungrammatical in situ pronouns, producing a P600 in response to such violations (though with distributions that sometimes differed from native controls). However, on behavioral measures the L2 groups differed, both from natives and from each other. Native controls correctly rejected more in situ clitic and strong pronouns than both the L2 groups, and the high-intermediate group correctly rejected more than the low-intermediate group. For natives, the similarity of online/offline responses confirmed a grammaticalized

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representation and processing of pronouns. Both groups of learners showed a stronger ERP response to in situ pronoun placement than behavioral data would suggest. This is especially true for low-intermediate learners who, despite high rates of acceptance of strong pronouns/clitics in situ, showed a cortical response in the P600 window though without the canonical topography of the native response. While both learner groups are apparently using (at least some) L1 English settings for pronoun placement, their cortical response clearly demonstrates unconscious increasing sensitivity to French parameters.

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1. Introduction

An important part of second language (L2) learning is the acquisition of grammatical constraints and rules and their integration into a well-established first language (L1) grammar processing system. This is especially the case with respect to the integration of categories of the L2 that are not part of the L1 grammar. As highlighted by [Herschensohn \(2004\)](#), under a minimalist account, morphological features of grammatical (functional, as opposed to lexical) categories are the driving force of syntax. Hence, the acquisition of L2 grammatical categories is paramount to both syntax and morphology and a topic in need of further investigation. With regard to L2 acquisition, one can ask whether L2 learners can fully acquire categories that are absent from their L1 system or not overtly realized (for opposing views see [Herschensohn, 2000](#); [Hopp, 2010](#); [Schwartz & Sprouse, 1996](#); versus [Hawkins & Chan, 1997](#); [Tsimpli & Dimitrakopoulou, 2007](#)) and, if so, how this is achieved. The present work examines these questions from a psycholinguistic viewpoint, using a combination of cortical activity recorded from the scalp (ERPs) and offline, behavioral responses to chart adult L2 acquisition and processing capacities.

Of interest for present purposes is the acquisition of L2 French by anglophone learners and, more specifically, the acquisition of functional (grammatical) categories such as pronouns, which have been the object of numerous studies in recent years ([Cuza, Pérez-Leroux, & Sánchez, 2013](#); [Granfeldt & Schlyter, 2004](#); [Grüter, 2006, 2008](#); [Grüter & Crago, 2012](#); [Herschensohn, 2004, 2007](#); [Rossi, 2013](#); [Rossi, Kroll, & Dussias, 2014](#); [Tsedryk & Punko, 2008](#)). The reason for this interest lies in the parametric variations between English and French concerning how pronouns are represented morpho-syntactically and their functional projections. In minimalist terms, these cross-linguistic differences, described briefly below and in detail by [Herschensohn \(2004\)](#), are variations on a universal syntactic template and can be characterized by the differences in the value of features in functional categories such as Determiners. An investigation of L2 pronouns provides the opportunity to gauge the learner's ability to acquire these features and master L2 functional categories. We will begin with an overview of the English and French pronominal system.

1.1. Parametric variations of English and French pronominal systems¹

Cross-linguistically, pronouns fall into strong, weak and clitic classes ([Cardinaletti & Starke, 1999](#)), each exhibiting distinct morphological and syntactic behaviors. Strong pronouns project the most complex syntactic structure, followed by weak pronouns and finally by clitics; we focus on the first and last, which are most representative of French and relevant to the current study. Strong pronouns, in this

¹ The syntactic structure and analysis proposed for Romance clitics has been the topic of decades of discussion and debate beginning with [Kayne \(1975\)](#) and recently summarized by [Roberts \(2010\)](#) and [Grüter \(2008\)](#). Briefly, one group argues that clitics must move from within the VP ([Cardinaletti & Starke, 1999](#); [DeCat, 2005](#); [Kayne, 1975](#); [Roberts, 2010](#)), while others treat clitics as agreement markers on the verb ([Culbertson, 2010](#); [Grüter, 2008](#); [Roberge, 1990](#)). The theoretical details are not relevant for the present study.

hierarchy, are essentially like lexical determiner phrases (DPs) in terms of their semantic and phonological properties: they are phonetically free-standing, fully referential to usually human antecedents, and syntactically case marked (usually by prepositions). In contrast, clitics are syntactic heads (minimal syntactic projection in the D node), morphosemantically minimal (e.g., in French, they bear person, gender and number features only; they are referential to \pm animate and may be non-referential as in pleonastic *il* 'it, there'), and their structural deficiency requires phonological attachment to a host (Roberts, 2010). English object pronouns are generally strong pronouns constituting a maximal nominal projection and behaving morphosyntactically like full lexical DPs (I saw **Bill**/I saw **him**), whereas French object pronouns are cliticized (attached) to the verb (J'ai vu **Guillaume**/Je **l'**ai vu/*J'ai vu **le**). The types of pronouns under discussion are displayed in Table 1.

In contrast to English pronouns, French pronouns show distinct morphosyntactic behavior of strong versus clitic pronouns. The following examples (cf. Kayne, 1975) demonstrate the differences between these types and the syntactic constraints on their distribution. Strong but not clitic pronouns can be coordinated (1), occur in isolation (2) and be modified by adjectives or within a prepositional phrase (PP) (3).

- (1) *Lui et l'autre, je les ai aidés.*
 **Le et l'autre, je les ai aidés.*
 'Him and the other one, I helped them.'
- (2) *Qui a-t-elle vu? 'Who did she see?'*
Lui/Moi/Eux. 'him/me/them'
 **Le/*Je/*Les. 'him/I/them'*
- (3) *Lui seul mange des oursins avec moi.*
 **Il seul mange des oursins avec me.*
 'He alone eats sea urchins with me'

Strong pronouns in French are stressed, morphologically unmarked for case (and can be used in any syntactic position including left and right dislocation), and generally restricted to animate nouns. They are obligatory in contexts that require stress, such as in a PP (*sans elle* 'without her', *avec moi* 'with me') and remain in their constituent location, only moving for information or stylistic reasons (e.g., topicalization). Clitic pronouns contrast in every respect in that they are unstressed, marked for case (nominative, accusative, dative), may not remain in situ (they must cliticize to the verb), and may refer to animate and inanimate referents. Roberts (2010, p. 41) analyzes French clitics as "simultaneously maximal and minimal elements", feature bundles in D (number, gender, person, case) whose defective nature requires that they cliticize to an inflected verb or infinitive.

The differences between English and French object pronouns include morphosyntactic and morphological variation between the two languages of four varieties: morphological features such as gender, number, person, case; placement, cliticization (Roberge, 1990); levels of deficiency (Cardinaletti & Starke, 1999); and morphological realization (Kayne, 1975). Anglophone learners of L2 French must revise all four characteristics, learning gender features, cliticizing object pronouns onto the inflected verb (as opposed to English in situ pronouns), gaining new stress patterns, and mastering new morphological forms.

Table 1
 Pronouns of English and French.

	1st s.	2nd s.	3rd s.	1st p.	2nd p.	3rd p.	
French							
Strong	<i>moi</i>	<i>toi</i>	<i>vous</i>	<i>lui, elle</i>	<i>nous</i>	<i>vous</i>	<i>eux, elles</i>
Cl nom.	<i>je</i>	<i>tu</i>	<i>vous</i>	<i>il, elle, on</i>	<i>nous</i>	<i>vous</i>	<i>ils, elles</i>
Cl acc.	<i>me</i>	<i>te</i>	<i>vous</i>	<i>le, la</i>	<i>nous</i>	<i>vous</i>	<i>les</i>
Cl dat.	<i>me</i>	<i>te</i>	<i>vous</i>	<i>lui</i>	<i>nous</i>	<i>vous</i>	<i>leur</i>
English							
Stg nom.	I	you	you	he, she, it	we	you	they
Stg obj.	me	you	you	him, her, it	us	you	them

1.2. L1 and L2 acquisition of French pronouns

L1 acquisition of clitic pronouns occurs substantially earlier with subject than with object clitics (Hamann, Rizzi, & Frauenfelder, 1996; Müller, Crismann, & Kaiser, 1996; Zesiger et al., 2010). Children begin using subject clitics with inflected verbs around age two (Pierce, 1992; Thordardottir, 2005). They go through a brief period of using no object pronouns (Grüter, 2008), but then begin productive use of them in the second half of the third year (Granfeldt, 2005; Hulk, 1997; Meisel, 2011). Note that during this period, omission is not systematic and hinges upon several factors (Pirvulescu & Hill, 2012).

The acquisition of L2 clitic pronouns in French has been the focus of many studies (e.g., Herschensohn, 2004; Granfeldt & Schlyter, 2004; Tsedryk & Punko, 2008; inter alia), the results of which have provided evidence supporting Towell and Hawkins' claim (1994) that learners use a variety of forms for French clitic pronouns in their production. The four variants attested include in situ, null, past participle clitic and target placement (Granfeldt & Schlyter, 2004; Herschensohn, 2004; Hulk, 1997; Towell & Hawkins, 1994). The available studies cover L1 English, Swedish and Dutch, yet find similar variants in L2 French clitics. Initially, some argue, the pronoun remains in situ (e.g., *Les pommes? Ils ont mangé *les*. 'The apples? They ate them.' *J'ai vu *elle*. 'I saw her') with preference for the use of a clitic pronoun for non-human direct objects and for a strong pronoun for human direct objects (e.g., Herschensohn, 2004; Selinker, Swain, & Dumas, 1975). The second category constitutes omission of the pronoun (e.g., *Les pommes? Ils *Ø ont mangées* 'The apples? They ate Ø.'). and the last, intermediate placement (e.g., *Les pommes? Ils ont *les mangées* 'They have them eaten.' Granfeldt & Schlyter, 2004; Towell & Hawkins, 1994). Eventually, target position is produced fairly consistently (e.g., *Les pommes? Ils les ont mangées*).

The vast majority of research on Romance L2 clitic acquisition has relied on corpus studies mainly of production, not comprehension (Granfeldt & Schlyter, 2004; Herschensohn, 2000; Towell & Hawkins, 1994). More recently, studies have used elicited production, offline judgment tasks (e.g., Grammaticality Judgment (GJ), Truth Value Judgment (TVJ)), comprehension checks and translation (Cuza et al. 2013; Grüter, 2006; Grüter & Crago, 2012). These measures do not provide insight, however, into the learner's tacit, online knowledge of the grammar of pronouns. One particularly useful way to probe online knowledge is the recording of event related potentials (ERPs). ERPs have been shown to reflect online processing ability in the absence of clear offline knowledge (McLaughlin, Osterhout, & Kim, 2004) and to reveal different stages of grammatical competence (Foucart & Frenck-Mestre, 2012; McLaughlin et al., 2010; Tanner, McLaughlin, Herschensohn, & Osterhout, 2013). Per the present structures, learners who are able to correctly produce or interpret clitic placement in offline tasks may not exhibit native-like online processing. Conversely, learners may demonstrate online sensitivity to grammaticality through their cortical response, but not have sufficient capacities to correctly produce or evaluate the grammaticality of sentences offline (for a similar argument, see McLaughlin et al., 2004). Further, by testing participants of varying proficiency, we may be able to see evidence of different patterns of processing at different levels of proficiency, be it online or offline. To our knowledge, there have been few ERP studies of French pronouns in terms of their gender and number agreement or in terms of placement (cliticized versus in situ), either of native Francophones or of L2 learners.

1.3. Current study

As noted above, in the early stages, spontaneous productions by L2 French learners whose native language uses in situ pronouns (e.g., English, Swedish) include use of in situ French pronouns, pronoun omissions, and intermediate placements (Granfeldt & Schlyter, 2004; Herschensohn, 2004; Towell & Hawkins, 1994). However, the cause of the errors is unclear. For instance, the in situ location (*Les pommes? Ils ont mangé *les*. 'The apples? They ate them.' or *Le garçon? Ils ont vu *lui*. 'The boy? They saw him.') is both the L1 (English/Swedish) setting and also the lexical DP position in French, so it remains uncertain whether this phenomenon is an example of transfer from the L1, a mistake based on French DP object placement, or, in the case of in situ strong pronouns, related to the fact that strong pronouns can appear in other postverbal positions (e.g., after prepositions, in dislocations) and receive stress. Alternatively, the source of the errors could be related to processing overload. In a comparison of production data with comprehension (TVJ), Grüter (2006) demonstrated that L2 production errors are more a function of processing overload than of deficient grammatical knowledge because the learners'

responses on the TVJ were far more accurate than their clitic production. Indeed, some studies have shown that the most frequent error is not the use of in situ pronouns, but pronoun omission (Cuza et al., 2013; Grüter, 2006; Grüter & Crago, 2012; Herschensohn, 2004).

Most of the recent experimental studies of Romance clitics in native speakers have used elicited production and comprehension, focusing on either pronoun omission or gender-number agreement (e.g., Cuza et al., 2013; Grüter & Crago, 2012; Rossi, 2013),² although the latter topic was investigated by Rossi et al. (2014) using ERPs. However, aside from Rossi's (2013) work on Italian agrammatic aphasics, there have been no studies of clitic placement (i.e., word order), particularly in terms of native language influence in L2. Indeed, there has been an evident lack of online work on Romance clitics, especially as concerns online processing, and even more so, direct measures of cortical activity. To fill this gap, the present study used ERPs to investigate the online response to French clitic placement by anglophone learners of L2 French.

ERPs are online temporally fine-tuned recordings of electrophysiological activity measured through scalp electrodes that monitor cortical activity while participants engage in some task—in this case, comprehending language. Previous research has indicated that native speakers respond distinctly to two kinds of linguistic manipulation: lexico-semantic anomalies elicit an increased negative wave about 400 ms after the event (N400), while morpho-syntactic anomalies elicit a later positive wave (P600) and under some conditions an earlier negativity (for recent discussions, see Molinaro, Barber, & Carreiras, 2011; Molinaro, Barber, Caffarra & Carreiras, 2014; Tanner, 2014). Nonetheless, several recent monolingual studies have stressed the importance of not over-generalizing either ERP response (N400 and P600) to “lexical” versus “syntactic” processing and in decomposing each of the two (Gouvea, Phillips, Kazanna & Poeppel, 2010; Kuperberg, Caplan, Sitnikoa, Eddy, & Holcolomb, 2006; Lau, Phillips, & Poeppel, 2008; Steinhauer, Drury, Portner, Walenski, & Ullman, 2010). While we know of no studies of clitic word order violations for native speakers, extensive cross-linguistic evidence from earlier ERP studies of word order violations have shown P600 responses in native speakers (Friederici, Pfeifer, & Hahne, 1993; Hahne & Friederici, 1999; Lau, Stroud, Plesch, & Phillips, 2006; Neville, Nicol, Barss, Forster, & Garrett, 1991), which have been found in conjunction with earlier negativities in some studies (Friederici et al., 1993; Neville et al., 1991, but see Steinhauer & Drury, 2013).

Recent research with L2 learners has provided mixed results in terms of ERP responses to the same anomalies in that beginners tend to have non-native-like responses (i.e., to ignore lexical or grammatical anomalies), whereas more advanced learners often mimic native patterns of response (cf. Steinhauer, 2014, for a review). However, even advanced learners do not match native reactions on all types of anomalies, nor do they consistently show “nativelike” patterns in terms of the onset, amplitude or distribution of the electrophysiological response to anomalies.

To explore the electrophysiological responses of French language learners to French clitic placement in comparison to native controls, we used offline and online evaluation measures to test two levels of learners with respect to the documented cases of in situ L2 French pronouns. Our research questions relate to the three subject groups: native Francophones, low- and high-intermediate learners; to the different modalities (online/offline); and to L1/L2 differences in morpho-syntax and stress.

Research Questions.

1. Are subjects (native speakers, low- and high-intermediate learners) sensitive to ungrammatical in situ clitic pronouns (i.e., stranded unstressed pronoun, word order violation)?
2. Are subjects sensitive to ungrammatical in situ strong pronouns (i.e., ungrammatical morphological form, word order violation)?
3. Are responses to offline and online tasks comparable?
4. For L2 learners, is proficiency level a significant factor?

It is generally accepted that L2 acquisition by late learners is heterogenous. Not only is time spent in classroom language study often a poor predictor of proficiency in L2, but mastery of particular aspects

² ERP studies of Romance DP indicate that gender and number disagreement between the head noun and its modifiers elicit P600 responses in native speakers (Foucart & Frenck-Mestre, 2011, 2012; Frenck-Mestre, 2005; Gillon Dowens, Guo, Guo, Barber, & Carreiras, 2011; Gillon Dowens, Vergara, Barber, & Carreiras, 2010).

of the L2 often varies considerably within a single group of learners in the same classroom as shown by their ERP response to various manipulations (McLaughlin et al., 2004; Osterhout, McLaughlin, Pitkanen, Frenck-Mestre, & Molinaro, 2006; Tanner et al., 2013). Our cross-sectional comparison should allow us to determine whether a developmental difference is apparent for L2 anglophone learners of French as concerns their online, cortical, and offline, behavioral, sensitivity to clitic placement. If, at early stages, learners' developing L2 grammars allow in situ pronouns (either as a transfer phenomenon or by analogy with lexical DPs in French), then they should not show systematic sensitivity to such violations, either behaviorally or electrophysiologically. Regarding the ERP response across learner groups, it is possible, although not universally attested, that at early stages of L2 acquisition a different cortical response will be evoked by grammatical violations for these learners than for more advanced L2 and native speakers. Specifically, variation in the N400 as opposed to P600 amplitude has sometimes been attested (McLaughlin et al., 2010; Osterhout et al., 2006; Tanner et al., 2013). Note, however, that the same L2 learner can show either a more canonical P600 response or an N400 response to grammatical anomalies as a function of the L1/L2 overlap and or frequency of word orders (Foucart & Frenck-Mestre, 2012).

To examine the online processing of French pronouns, we compared the ERP response to clitic versus strong pronouns in situ, and one word downstream, following the critical pronoun region, as illustrated in examples (4) through (6), below:

(4) In situ clitic

Après le match elle a rencontré le/les *dans la rue.

"After the match she met him-cl/them-cl in the street"

(5) In situ strong

Après le match elle a rencontré *lui/*eux dans la rue.

"After the match she met him-sg/pl in the street"

(6) Correct

Après le match elle l'a/les a rencontré(s) dans la rue.

"After the match she met him-sg/pl in the street"

First, to test the claim that L2 learners initially accept a strong form in situ, as in (5) above, we compared the ERP response to the strong form of third person masculine (singular/plural) *lui/eux* to that elicited by the clitic pronoun form *le/les*, which in the post-participle position in (4) above, is ambiguous between an (ungrammatical) in situ clitic pronoun and a (grammatical) definite determiner. If L2 learners accept the strong form in situ, as a pattern in their intermediate L2 grammar (as has been attested in earlier production studies), no ERP anomaly response should be elicited when the participant encounters the strong form (*lui*) in comparison to the clitic form (*le*). If L2 learners reject the strong form, however, it should elicit an ERP grammatical anomaly response in comparison to the clitic form. Native participants were expected to show a violation response (P600 and possible earlier negativity) to the strong form in comparison to the ambiguous form *le*.

Second, the in situ clitic form (*le/les*) should not elicit an error response at this point in the sentence as the clitic is indeed potentially acceptable as a (grammatical) determiner (*elle a rencontré le [garçon]* 'she met *him/the [boy]'); its grammatically ambiguous role as a misplaced clitic is not yet evident. However, when the following word is not the anticipated noun, native speakers should recognize a grammatically anomalous misplaced clitic. To examine the online processing of in situ clitic forms, we compared the clitic and felicitous conditions one word downstream (i.e., examples (4) and (6) illustrated above). At this point in the sentence, the ungrammaticality of an in situ clitic becomes apparent. We would therefore expect *dans* in (4) to elicit a syntactic anomaly response (P600) for native speakers compared to the correct sentence (6). If learners whose L1 is Germanic accept this construction in their early L2 grammar, no indication of an online processing difficulty should be apparent in the ERP trace.

We thus predicted an anomaly response (P600, possibly preceded by an early negativity) in the group of native speakers for both the strong form, at the pronoun itself, and, for in situ clitic pronouns, at the subsequent word when the anomaly became apparent. Note, recent debates have revived the LAN/P600 debate as concerns cortical responses to syntactic anomalies (Molinaro et al., 2011, 2014;

Tanner, 2014). The pattern of results for L2 learners depends upon the degree to which they have grammaticalized clitic placement. We can predict, based on prior research, that different patterns will be observed as a function of L2 competence. This should be true, moreover, for both offline and online measures; previous work has in fact shown earlier cortical than behavioral sensitivity, at least at the lexical level (McLaughlin et al., 2004).

2. Methods

2.1. Participants

Thirty-two native speakers of American or British English (26 women) who were studying French in France and 16 native speakers of French (12 women) participated for monetary compensation and/or class credit. Six participants (4 L2 learners and 2 French controls) were excluded from ERP analyses due to excessive artifact during EEG recording and/or failure to follow instructions ($n = 14$ in each group). All participants were either university students or had recently graduated. Participants ranged in age from 18 to 24 years (mean = 20.7, SD = 1.1). All participants were right-handed as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971), had normal or corrected-to-normal vision, and had no history of neurological insult or language disability. The study was conducted at the Laboratoire Parole et Langage, an approved site for biomedical research, and received ethical approval.

2.2. Language assessment

To quantify L2 competence and to homogenize our L2 groups, we measured both self-reported competence and years of study of the second language as well as performance on two behavioral measures. On a language background questionnaire, participants gave their place of birth, number of months/years they had studied French and had lived in a French speaking country, and rated their abilities to speak, understand, read and write French on a seven-point Likert scale (1 = unable; 7 = native). All learners were born in an English speaking country and no learner had been exposed to French before the age of 5 years (mean age of exposure was 14 years). Performance measures consisted of an end-of-sentence acceptability judgment on the one hand and, on the other, an offline, post-test grammaticality judgment task to ascertain whether the metalinguistic (conscious) judgments of the learners matched and/or predicted their ERP results.

The self-reported measures did not reveal group differences (mean self reported scores of 3.5, 3.9, 4.2 and 3.7 for the high-intermediate group and 3.4, 3.8, 4.2 and 3.6 for the low-intermediate group for the four abilities). In contrast, performance on the two behavioral measures allowed the categorization of participants. The first of these was the number of correct end-of-sentence responses during ERP recording, calculated offline for each of the three pronoun conditions (in situ clitic and strong, and grammatically correct). The second measure consisted of the mean scores given by each participant for each of these conditions on the paper-and-pencil grammatical acceptability posttest. Based on these two measures, we separated learners into two groups (low- and high-intermediate). All participants in the high-intermediate group performed at 70% or better on end-of-sentence measures and clearly distinguished correct and incorrect clitic/strong pronoun placement on the offline grammaticality judgment task. In the low-intermediate group, no participant scored above 65% in either of the two pronoun conditions (strong or in situ clitic) on end-of-sentence measures and did not show a clear preference for grammatical versus ungrammatical clitic/strong pronoun placement in the offline grammaticality task. In general, individual performance on these two measures was closely aligned: participants who correctly accepted grammatical sentences and correctly rejected ungrammatical sentences during ERP recording also distinguished between correct and incorrect placement on the paper-and-pencil task. Results for these measures are reported in Section 3.1.

2.3. Stimulus materials

For the ERP experiment, test sentences consisted of 90 items presented across three experimental conditions. One version of each sentence (a) was grammatically correct and contained a clitic that was

cliticized to the finite verb (in all cases the auxiliary *avoir*) according to the target French grammar. The two ungrammatical versions involved leaving the pronoun in situ, either in its clitic form (b), or in its strong form (c).

- (7) a) Ce matin je l'ai/les ai oublié/oubliés alors je suis rentré.
 b) Ce matin j'ai oublié *le/*les alors je suis rentré.
 c) Ce matin j'ai oublié *lui/*eux alors je suis rentré.
 “This morning I forgot it/them so I returned home”

Both singular and plural clitics and strong pronouns were used across correct and incorrect sentences.³ A complete list of materials is available upon request.

Test sentences were created with the following constraints. All sentences were in the “passé composé” tense.⁴ In all cases, the pronominal referent was masculine and was singular or plural (50% in each case). To ensure that our participants were able to comprehend the materials, we selected lexical items from the vocabulary lists of the first four chapters of one of three first-year French textbooks. We limited the choice of verbs to regular first group verbs (-er) that could take a human direct object. The complete set of verbs is presented in [Appendix A](#).

The 90 pronoun sentences were divided into three different pseudo-randomized lists. Each list contained 30 sentences from each of the three pronoun conditions (correct, in situ clitic and in situ strong). A Latin square design was used such that each pronoun item appeared in a list only once and a given item never appeared in more than one condition in the same list. In addition to the pronoun sentences, there were 75 semantic control sentences in three different versions (divided across three semantic lists according to a Latin square design) and 15 filler items. The semantic manipulation is discussed elsewhere ([Frenck-Mestre & German, in preparation](#)). It is important to note, however, as illustrated in examples (8) and (9), that the control and filler sentences provided for a large number of cases where either present or “passé composé” forms were followed by a full DP⁵. As such, participants could not develop a strategy whereby they could predict an error based on the presence of the word “le” or “les.” Each participant thus read a total of 180 sentences (90 pronoun sentences, 75 semantic controls and 15 fillers).

Semantic control:

- (8) Le cigare a brûlé le tapis marron.
 “The cigar burned the brown carpet”

Filler:

- (9) Malheureusement j'ai cassé le verre que tu aimes.
 “Unfortunately, I broke the glass you like”

Following the ERP experiment, participants completed a paper-and-pencil post-test consisting of 40 sentences in French, adapted from a grammar questionnaire ([Herschensohn, 2004](#)). Twenty sentences were pronoun sentences, with four in each of five categories that reflected the four variants attested in the literature for anglophone learners of French: incorrect in situ (clitic, $n = 4$, and strong $n = 4$),

³ One of our reviewers suggested that although both strong and clitic pronouns can be viewed as closed class or function words, it was possible that any early differences between the two in the ERP record could be explained by lexical differences. [Steinhauer et al. \(2010\)](#) controlled for such differences by including contexts in which target words were presented in grammatical sentences, both preceded and followed by the same words. However, such a control is not possible in our case. There is no context in which clitic and strong pronouns contrast; they are in complementary distribution (due to syncretism, “lui” can also be an indirect object pronoun, in which case “le” and “lui” could be in the same position and preceded by the same context, but such is not possible for clitic and strong pronouns).

⁴ The passé composé is a “compound” past tense formed by an auxiliary and past participle. It is usually translated into English with the simple past tense; however, its use also has overlap with the present perfect in English.

⁵ Across the fillers and semantic sentences, there were 29 items of this form (i.e., grammatical sentences with post-verbal definite article) and two additional items that have a possessive post-verbal determiner.

incorrect omission, incorrect partial movement, and correct. The remaining 20 sentences served as fillers. Participants were asked to rate the acceptability of each sentence on a Likert scale of 1–7, where a score of 1 indicated that the sentence was infelicitous and 7 indicated that the sentence was perfectly acceptable. The main variable of interest, calculated for each of the five sentence types, was the mean acceptability score. The test was not timed, such that no reaction time measures for this test are available. A sample of post test items is available in [Appendix B](#).

2.4. Procedure

Participants were comfortably seated in a Faraday booth and read sentences silently concurrent with ERP recording. Sentences were displayed visually on a computer monitor situated 60 cm from the participant. Each trial sequence consisted of a fixation cross (450 ms) followed by the stimulus sentence, which was presented one word at a time, each word being displayed for 450 ms followed by a 150 ms blank-screen (600 ms inter-stimulus interval) followed by a yes/no prompt. Participants read for comprehension and made acceptability judgments at the prompt, indicating whether or not the sentence was acceptable both semantically and syntactically by means of a button box. Participants were instructed to reject sentences that failed on either measure. In order to minimize potential artifacts on target words, participants were instructed not to blink until they saw the yes/no prompt. At the prompt, participants were able to blink as needed to moisten their eyes. They were instructed to keep their acceptability judgment in mind until they were ready to go on to the next trial, which would start as soon as they made their judgment. The duration of the experiment itself was approximately 45–60 min, including three breaks. The precise duration was dependent on the subjects themselves as different participants took longer pauses at the yes/no prompt or during breaks.

EEG activity was recorded continuously from 64 scalp electrodes located at standard left and right hemisphere positions over frontal, central, parietal, occipital, and temporal areas by means of a 64-channel electrode cap mounted with silver-chloride active electrodes (BioSemi Active Two system AD-box). Individual electrodes were adjusted to a stable offset lower than 20 mV. Sampling rate was 512 Hz. In addition to the scalp electrodes, four additional electrodes were used: two electrodes (placed under the right eye and at the outer canthus of the left eye) monitored for eye movements and blinks, and one electrode was placed on each mastoid. Raw data contaminated by muscular or oculomotor artifacts or amplifier saturation were excluded from averaging. All electrodes were re-referenced to the average of both mastoids offline and low-pass filtered at 30 Hz. The EEG epochs were calculated for 1200 ms, starting at 100 ms before stimulus onset. Trials were averaged per condition and per participant. The percentage of trials retained for analyses for the four sentence conditions (in situ clitic, in situ strong, clitic plus one and correct clitic plus one) was 92.6, 92.4, 92.8 and 92.6, respectively, for the low-intermediate group; 94, 96.4, 97.6 and 92.1 respectively, for the high-intermediate group and 90.1, 89.5, 90 and 90.5 respectively, for the native controls. There was no significant effect of Condition ($F < 1$) or Group ($F < 1$), nor was there an interaction ($F < 1$).

Several time windows corresponding to known ERP components commonly found in linguistic studies were chosen for statistical analysis: 180–280, 300–500 and 500–800 ms post stimulus onset. Repeated-measures ANOVAs were performed on ERP data obtained at two critical locations: at the Pronoun (Strong vs. Clitic) and at the immediately following word (Correct+1 vs. Clitic+1). At midline sites the repeated factor Electrode involved six levels (from AFz to Pz). At lateral sites, repeated factors involved Hemisphere (Left vs. Right) and Region of Interest (ROI) (frontal/central/parieto-occipital, with six electrodes per ROI; see [Fig. 1](#)). Group was a between-participant factor. All reported p -values were adjusted using the Greenhouse-Geisser correction for nonsphericity, when appropriate. Post-hoc comparisons (Bonferroni) were conducted as necessary.

3. Results

3.1. Behavioral data

The percentage of correct end-of-sentence responses, calculated per participant for each of the three sentence conditions were subjected to a 3 (Group: native, L2 low-intermediate, L2 high-intermediate) \times 3

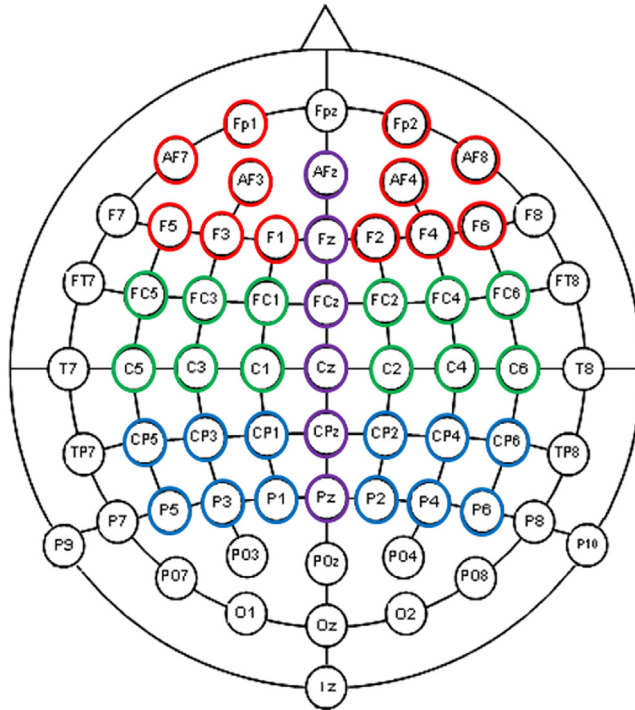


Fig. 1. Electrode groupings in analyses.

(Sentence Type: Correct, In situ clitic and In situ strong) repeated measures ANOVA. The main effect of Group was significant ($F(2,39) = 99.88, \text{Eta}^2 = .836660, p < .0001$) as was the effect of Sentence type ($F(2, 78) = 25.59, \text{Eta}^2 = .3962, p < .0001$) and their interaction ($F(4,78) = 16.25, p < .0001$). Independent ANOVAs performed on each of the three sentence types followed by post hoc (Scheffé) comparisons revealed the following pattern: for grammatically correct sentences, native controls performed better than L2 low-intermediate participants ($p < .01$) and tended to outperform the high-intermediate participants ($p < .08$) while the latter two did not differ from each other (94% (SD = 1.79), 84% (SD = 3.09) and 81% (SD = 0.79) for native controls, L2 high-intermediate and L2 low-intermediate groups, respectively; $F(2, 39) = 5.99, p < .005$). For the grammatically incorrect sentences (i.e., in situ strong and clitic pronouns), different patterns were obtained across groups. Native French controls correctly rejected more in situ clitic sentences than both the L2 high-intermediate learners ($p < .055$) and the L2 low-intermediate group ($p < .0001$), who also differed from each other ($p < .001$) (99% (SD = 0.350) 82% (SD = 4.96) and 49% (SD = 7.66), respectively; $F(2,39) = 27.31, p < .00001$). For in situ strong pronouns, the French controls correctly rejected more sentences (99%) than both L2 groups, and the high-intermediate learners, in turn, correctly rejected more sentences than the low-intermediate group (66% (SD = 6.77) and 23% (SD = 4.99), respectively; all comparisons at $p < .0001$; $F(2,39) = 61.77, p < .00001$). These effects are depicted in Fig. 2. RT data are not available for the end-of-sentence acceptability judgments due to the procedure followed (see above). Consequently RT is not a relevant measure in this study, however, the difference in accuracy across groups and sentence types for both measures shows clear effects.

The mean acceptability ratings provided on the grammaticality judgment post test were calculated per participant and per sentence condition. The 3 (Group: native, L2 high-intermediate, L2 low-intermediate) \times 3 (Sentence Type: Correct, In situ clitic and In situ strong) repeated measures ANOVA revealed significant effects of Group ($F(2,33) = 11.29, \text{Eta}^2 = .406165, p < .0001$) and Sentence Type ($F(2,66) = 126.03, \text{Eta}^2 = .792494, p < .0001$) and their interaction ($F(2,66) = 9.83, \text{Eta}^2 = .373342, p < .0001$). Post hoc comparisons (Scheffé) revealed that French controls rated grammatically correct sentences higher than both ungrammatical sentence types, which were not rated differently from each

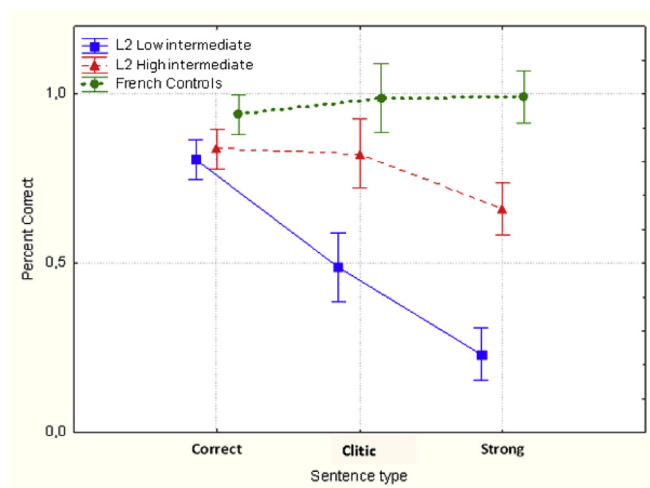


Fig. 2. Behavioral response to correct and in situ pronouns, end-of-sentence judgment.

other. L2 high-intermediate learners showed the same pattern as French controls. The L2 low-intermediate group rated both grammatically correct and in situ strong pronoun sentences as equally acceptable, while they rated in situ clitic sentences as less acceptable than grammatically correct sentences. These effects are visible in Fig. 3.

3.2. ERP data

The inspection of waveforms revealed clear differences across the native French, L2 high-intermediate and L2 low-intermediate groups at both the region of the in situ strong pronoun and the subsequent word, following the in situ clitic. For in situ strong pronouns, in comparison to in situ clitic forms (which, at presentation, are still potentially grammatical as a definite determiner), native French participants showed a clear positive deflection, starting at roughly 500 ms post onset of the pronoun. Both the timing and distribution of the effect correspond to a P600 effect. In the high-intermediate group, a P600 effect

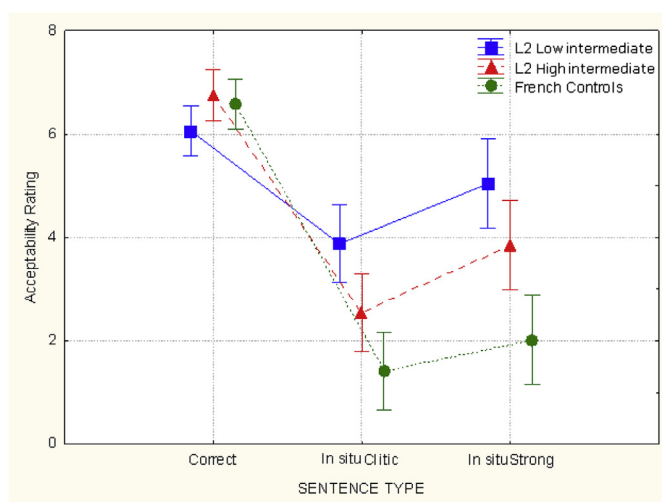


Fig. 3. Behavioral response to correct and in situ pronouns, post test.

was also visible, however; the effect was largely restricted to central and anterior sites. In the low-intermediate group, the ERP response to in situ strong pronouns showed a more anterior distribution.

To examine the response to the in situ clitic, we compared the ERP response at the subsequent word for in situ clitic sentences and correct sentences. There was a positive deflection for both the high-intermediate learners and for native controls to the in situ clitic. Both the timing and distribution was in line with a P600 effect although, again, the native group showed a more typical effect than the L2 group. In the low-intermediate group, the ERP trace for correct compared to clitic forms was more positive; however, the effect did not have the typical signature, with respect to onset or distribution, of a P600 effect. In this group, the positive deflection found at the word following the in situ clitic compared to correct sentences was both smaller and less widely distributed than in the native French or high-intermediate learner groups. These differences were borne out in the statistical analyses performed on the data for the three groups in the 500–800 ms post-stimulus onset window, for both the in situ clitic region (*lui* vs. *le*) and the subsequent region, generally an adverb or preposition (e.g., *dans*), following the clitic form and correctly formed sentences.

3.2.1. In situ pronoun region (*lui* vs. *le*)

3.2.1.1. 180–280 ms post stimulus onset. The analysis of midline sites revealed an effect of Pronoun ($F(1,39) = 7.5, p < .009; \text{Eta}^2 = .0906$), which was not modified by the interaction with Group ($F < 1$). Strong pronouns produced a more positive response than clitics. At lateral sites, there was also an effect of Pronoun ($F(1,39) = 5.92, p < .009; \text{Eta}^2 = .0906$), which interacted with Group and Hemisphere ($F(2,39) = 3.29, p < .048, \text{Eta}^2 = .0009$). Post hoc comparisons revealed that the effect of Pronoun was slightly left-lateralized for the native and high-intermediate group, but not the low-intermediate group.

3.2.1.2. 300–500 ms post-stimulus onset. The analysis of midline sites revealed an effect of Pronoun ($F(1,39) = 25.57, p < .0001; \text{Eta}^2 = .0195$), which was not modified by the interaction with Group ($F(2,39) = 1.41, p > .26$). At lateral sites, the effect of Pronoun ($F(1,39) = 20.13, p < .0001, \text{Eta}^2 = .0496$) interacted with Group and Hemisphere ($F(2,39) = 4.88, p < .02, \text{Eta}^2 = .0027$). In situ strong pronouns produced a positivity in this time window compared to in situ clitics, otherwise stated an early onset of a P600. The scalp distribution of the P600 differed according to Group, being slightly left lateralized for native French controls, slightly right lateralized for the high-intermediate group and not lateralized for the low-intermediate group.

3.2.1.3. 500–800 ms post-stimulus onset. At the in situ pronoun region (*lui* vs. *le*), as is visible in Figs. 4–6, the analysis of midline sites for all 3 groups revealed a significant effect of Pronoun ($F(1,39) = 72.06, p < .0001, \text{Eta}^2 = .2043$) of Group ($F(2,39) = 6.77, p < .001, \text{Eta}^2 = .1301$) and of Electrode ($F(5,195) = 17.57, p < .001, \text{Eta}^2 = .1302, \text{Partial Eta}^2 = .3106$) as well as the two-way interaction between these three factors ($F(10,195) = 2.8, p < .039, \text{Eta}^2 = .0065$). At lateral sites, there was an effect of Pronoun ($F(1,39) = 59.92, p < .0001, \text{Eta}^2 = .123$) of Group ($F(2,39) = 8.9, p < .001, \text{Eta}^2 = .1229$) and of ROI ($F(2,78) = 42.29, p < .0001, \text{Eta}^2 = .068$) as well as the two-way interaction between these three factors ($F(4,78) = 3.81, p < .02, \text{Eta}^2 = .0048$). Independent ANOVAs performed on the data for each of the three groups revealed the following effects at the first critical region.

For native French speakers, at midline there was an effect of Pronoun ($F(1,13) = 28.8, p < .0001, \text{Eta}^2 = .2933$), which interacted with Electrode ($F(5,65) = 4.37, p < .01, \text{Eta}^2 = .0121$). In situ strong pronouns elicited a large P600 effect compared to clitic forms, and the effect was larger at posterior than anterior midline sites ($p < .01$). At lateral sites, there was an effect of Pronoun ($F(1,13) = 26.09, p < .0002, \text{Eta}^2 = .1374$), of ROI ($F(2,26) = 13.58, p < .002, \text{Eta}^2 = .0635$) and a significant interaction between the two ($F(2,26) = 11.36, p < .003, \text{Eta}^2 = .0182$). No effects of Hemisphere were found. In situ strong pronouns produced a large P600 effect compared to clitic forms at lateral sites, and the effect was larger at posterior than at anterior ROIs ($p < .001$) and tended to increase from anterior to central ROIs ($p < .09$). These effects are shown in Fig. 4a and b.

High-intermediate learners showed a similar pattern of effects. At midline there was an effect of Pronoun ($F(1,13) = 24.0, p < .0003, \text{Eta}^2 = .1915$), which interacted with Electrode ($F(5,65) = 5.03, p < .03, \text{Eta}^2 = .0231$). In situ strong pronouns elicited a large P600 effect compared to clitic forms, and

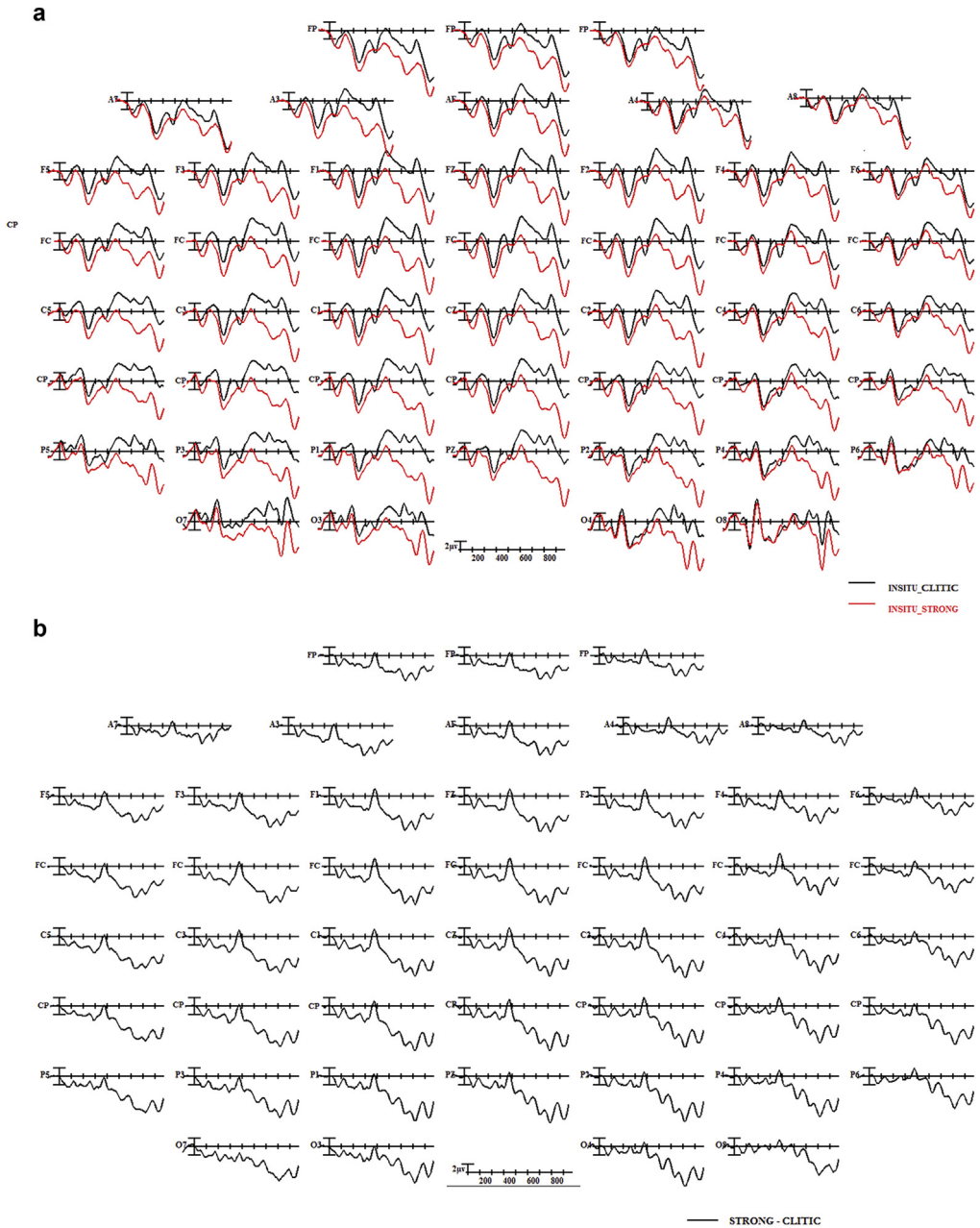


Fig. 4. a: In situ pronouns, wave forms for clitic vs. strong pronouns, natives. b: In situ pronouns, difference waves for clitic vs. strong pronouns, natives.

the effect was larger at posterior than anterior electrodes ($p < .01$). At lateral sites, there was an effect of Pronoun ($F(1,13) = 17.32, p < .001, \eta^2 = .1315$), and of ROI ($F(2,26) = 18.77, p < .0002, \eta^2 = .1281$) as well as a significant interaction between the two ($F(2,26) = 5.92, p < .03, \eta^2 = .0147$). No effects of Hemisphere were found. In situ strong pronouns produced a large P600 effect compared to clitic forms at lateral sites, and the effect was larger at posterior than anterior ROIs ($p < .005$) while the effect did

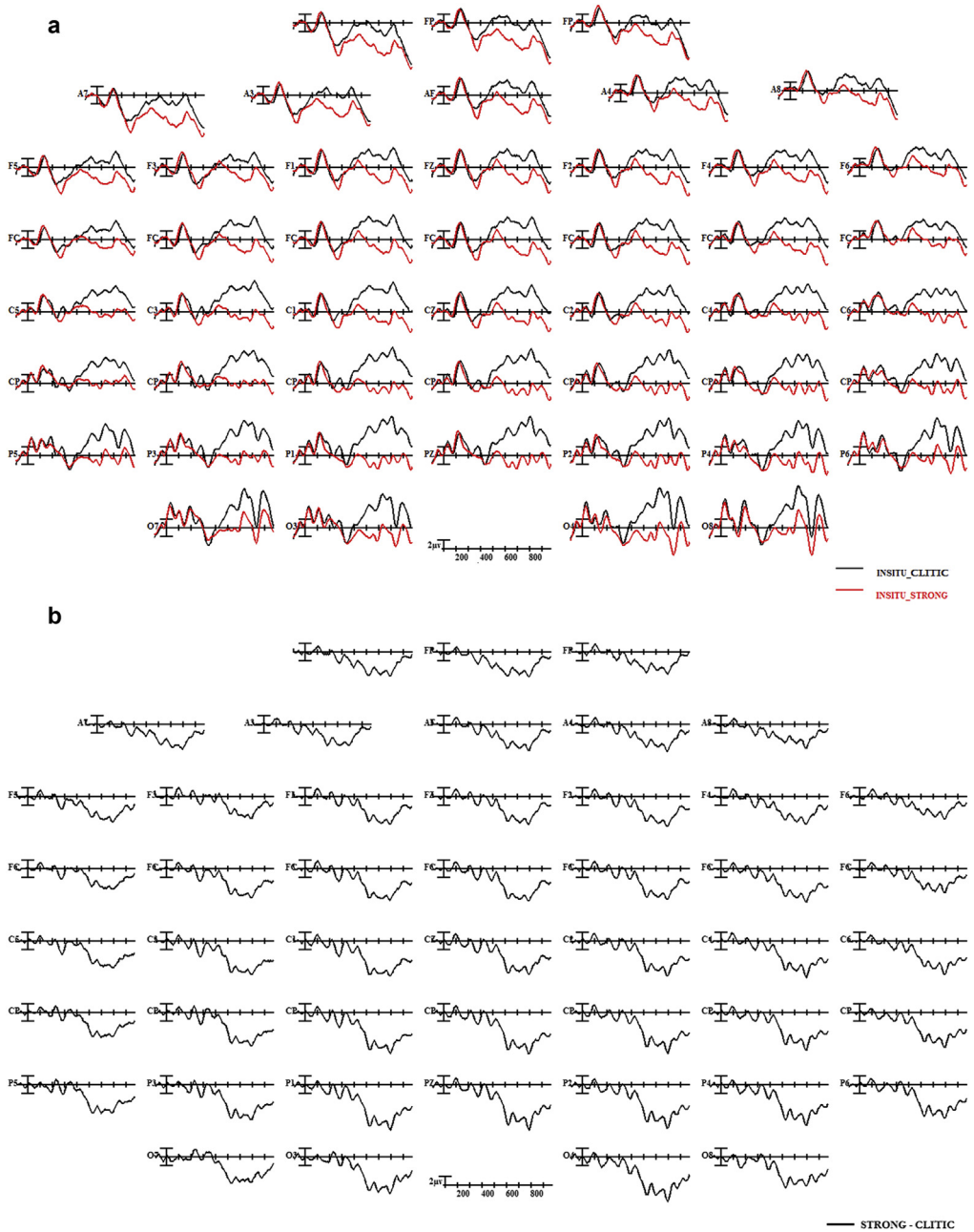


Fig. 5. a: In situ pronouns, wave forms for clitic vs. strong pronouns, L2 high-intermediate. b: In situ pronouns, difference waves for clitic vs. strong pronouns, L2 high-intermediate.

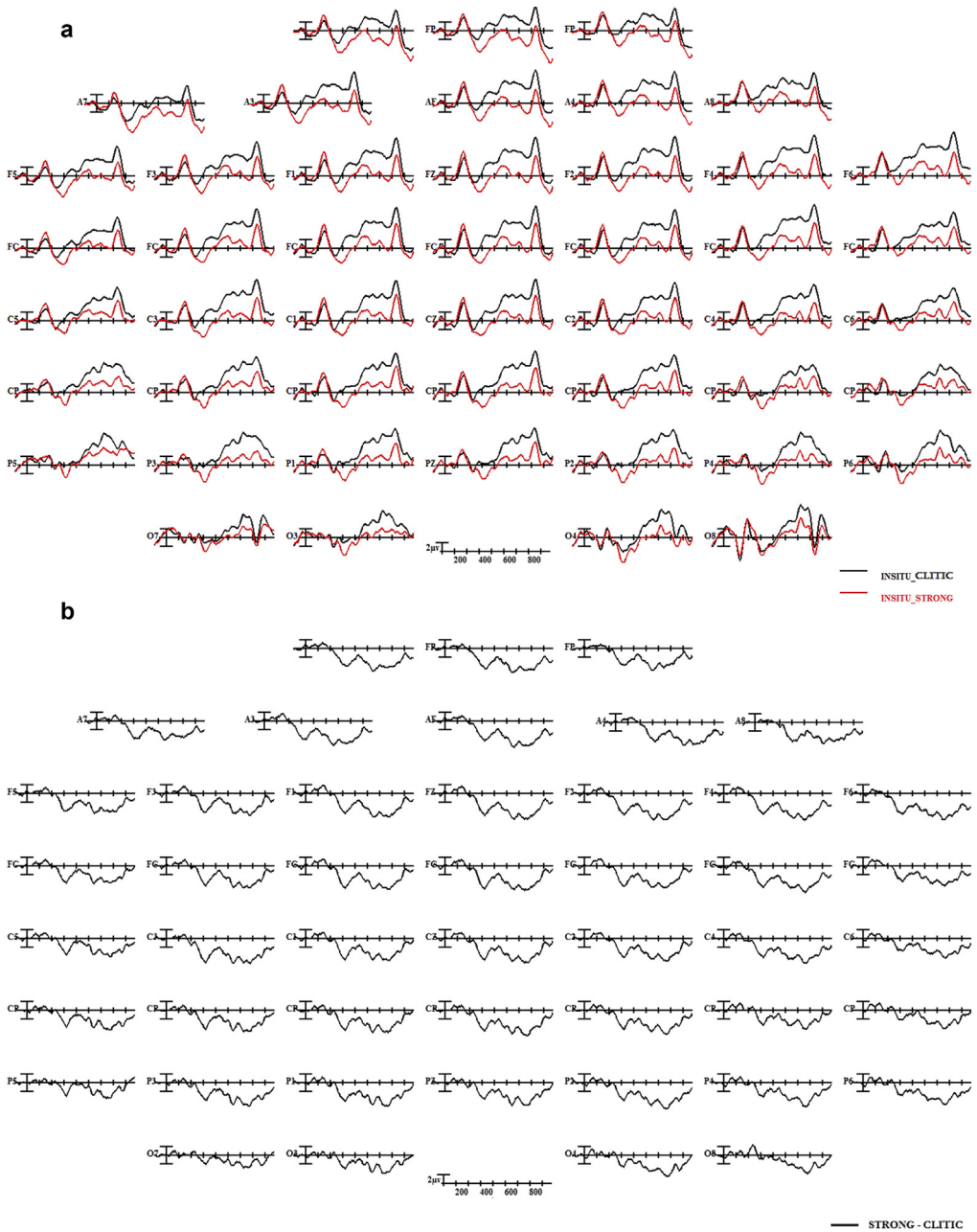


Fig. 6. a: In situ pronouns, wave forms for clitic vs. strong pronouns, L2 low-intermediate. b: In situ pronouns, difference waves for clitic vs. strong pronouns, L2 low-intermediate.

not differ between central and either anterior or posterior ROIs. These effects are depicted in Fig. 5a and b.

The low-intermediate French learners showed a different pattern than the native French and high-intermediate groups. At midline, there was an effect of Pronoun ($F(1,13) = 19.8, p < .001, \eta^2 = .2348$) but the effect was not modified by Electrode ($F < 1$). Similarly, at lateral sites, there was an effect of Pronoun ($F(1,13) = 18.79, p < .001, \eta^2 = .1555$) but no interaction with ROI ($F < 1$). At both midline and lateral sites, in situ strong pronouns elicited a more positive response than clitic forms, however, the effect did not differ according to scalp location ($p > .50$ for all comparisons). These effects are shown in Fig. 6a and b.

3.2.2. *In situ clitic pronoun + 1 versus correct condition +1*

3.2.2.1. *180–280 ms post stimulus onset.* No effects of any factor or interactions were found in this time window.

3.2.2.2. *300–500 ms post-stimulus onset.* At midline, there was an interaction between Pronoun and Electrode ($F(5,195) = 3.19, p < .05, \eta^2 = .0047$), which was not influenced by Group ($F < 1$). Post hoc comparisons revealed that no electrode showed a significant difference between Pronoun conditions however; at the most anterior electrode (AFz) the numerical difference between conditions was more negative than at Central (Cz) and parietal (Pz) electrodes. At lateral sites, there was an interaction between Pronoun and ROI ($F(2,78) = 5.53, p < .02, \eta^2 = .0042$), which was further modified by Hemisphere ($F(2,78) = 12.29, p < .05, \eta^2 = .0011$). This was due to a negativity in the situ clitic pronoun condition compared to correct sentences, at anterior sites, which was specific to the right hemisphere. Post hoc comparisons showed that on the left hemisphere, there was no effect of Pronoun at any ROI. On the right hemisphere, the effect of Pronoun was restricted to the anterior ROI, and was significant for all but 2 electrodes (F2 and F4).

3.2.2.3. *500–800 ms post-stimulus onset.* Comparison of the 3 groups at midline showed an effect of Pronoun ($F(1,39) = 39.20, p < .0001, \eta^2 = .1560$) and of Group ($F(2,39) = 3.61, p < .001, \eta^2 = .1128$), but their interaction was not robust ($F(2,39) = 2.35, p < .10, \eta^2 = .1552$). At lateral sites, there was an effect of Pronoun ($F(1,39) = 30.05, p < .0001, \eta^2 = .1022$) of Group ($F(2,39) = 3.78, p < .03, \eta^2 = .0592$) and of ROI ($F(2,78) = 40.44, p < .0001, \eta^2 = .0558$) as well as a trend for the interaction between Group and Pronoun ($F(2,39) = 2.59, p < .08, \eta^2 = .1327$). Posthoc comparisons revealed that the size of the P600 effect was larger for native French than the high-intermediate ($p < .06$) and low-intermediate group ($p < .11$). In addition, the P600 effect at posterior ROIs was larger than at frontal ($p < .01$) and central ($p < .05$) ROIs. These effects are visible in Figs. 7–9.

4. Discussion

Our study documents a clear baseline of both offline and online reactions to grammatical and ungrammatical uses of French pronouns by native Francophones. The results show clear sensitivity to violations of pronoun placement and morphological form, for both strong and clitic forms. Our results on both offline and online measures indicate that French speakers are sensitive to ungrammatical placement of both strong and clitic pronouns in post verbal in situ position rather than the correct placement in cliticized preverbal position. On an offline grammaticality judgment task, they attained near ceiling scores rejecting in situ placement of both strong and clitic pronouns, while their electrophysiological responses showed robust P600 profiles to these same placements. Recall that earlier ERP studies of word order and morphological violations have also shown P600 responses in native speakers (Friederici et al., 1993; Hahne & Friederici, 1999; Lau, Stroud, Plesch, & Phillips, 2006; Neville et al., 1991). Our study furnishes a baseline indicating that native French speakers reject in situ placement of both strong pronouns (*lui/eux*, morphologically incorrect forms for the direct object pronoun) and the clitic *le/les* that is ungrammatical as a bare form. The word order violation of the in situ clitic is both a syntactic and a morpho-phonological error. The present study confirms that French

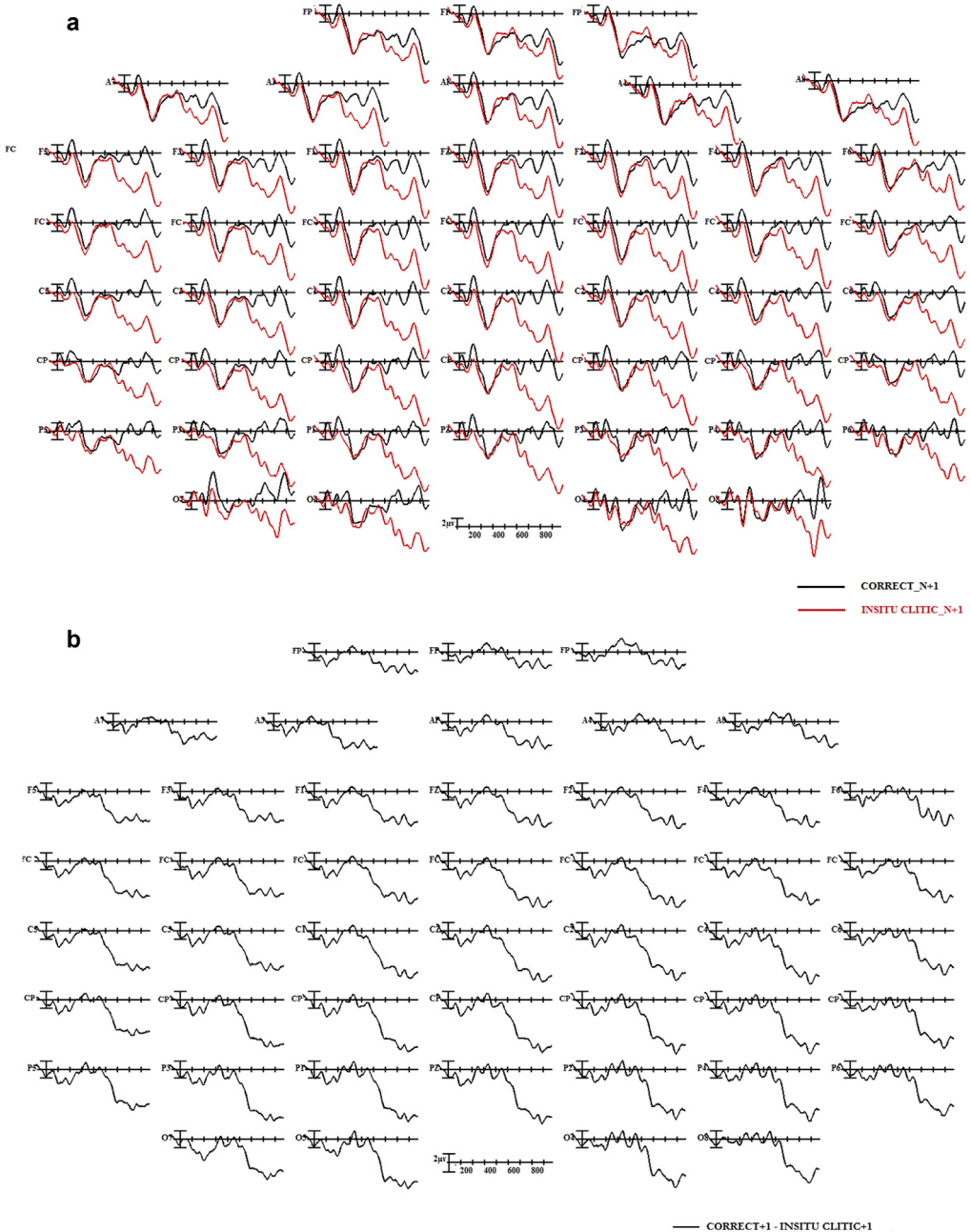


Fig. 7. a: In situ pronoun + 1, wave forms for correct vs. clitic pronouns, natives. b: In situ pronoun + 1, difference waves for correct vs. clitic pronouns, natives.

native speakers react to morphosyntactic anomalies involving pronoun placement and form with a P600, in a manner similar to other documented morphosyntactic anomalies.

These results for native Francophones provide affirmative answers to our research questions 1–4, repeated below:

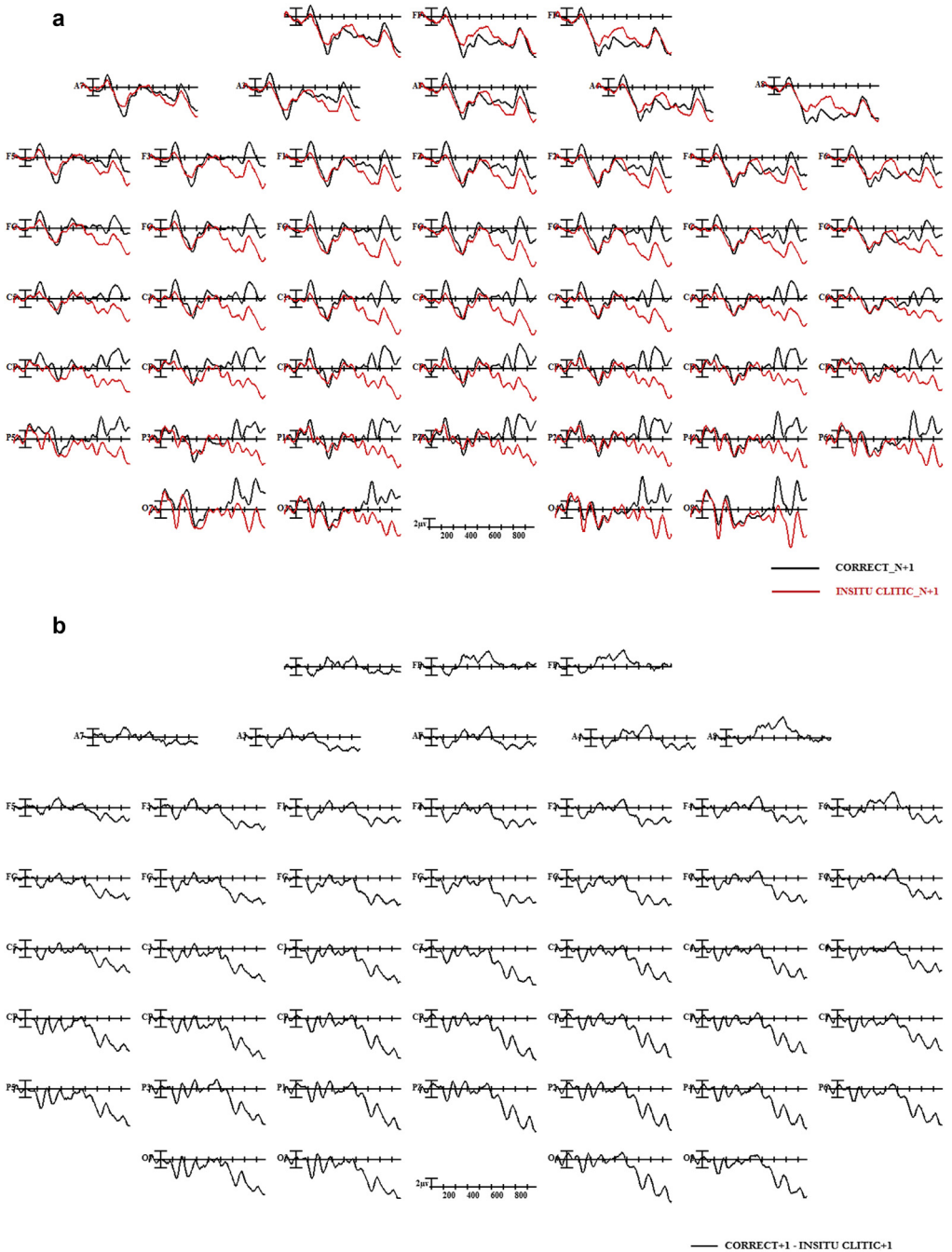


Fig. 8. a: In situ pronoun + 1, wave forms for correct vs. clitic pronouns, L2 high-intermediate. b: In situ pronoun + 1 difference waves for correct vs. clitic pronouns, L2 high-intermediate.

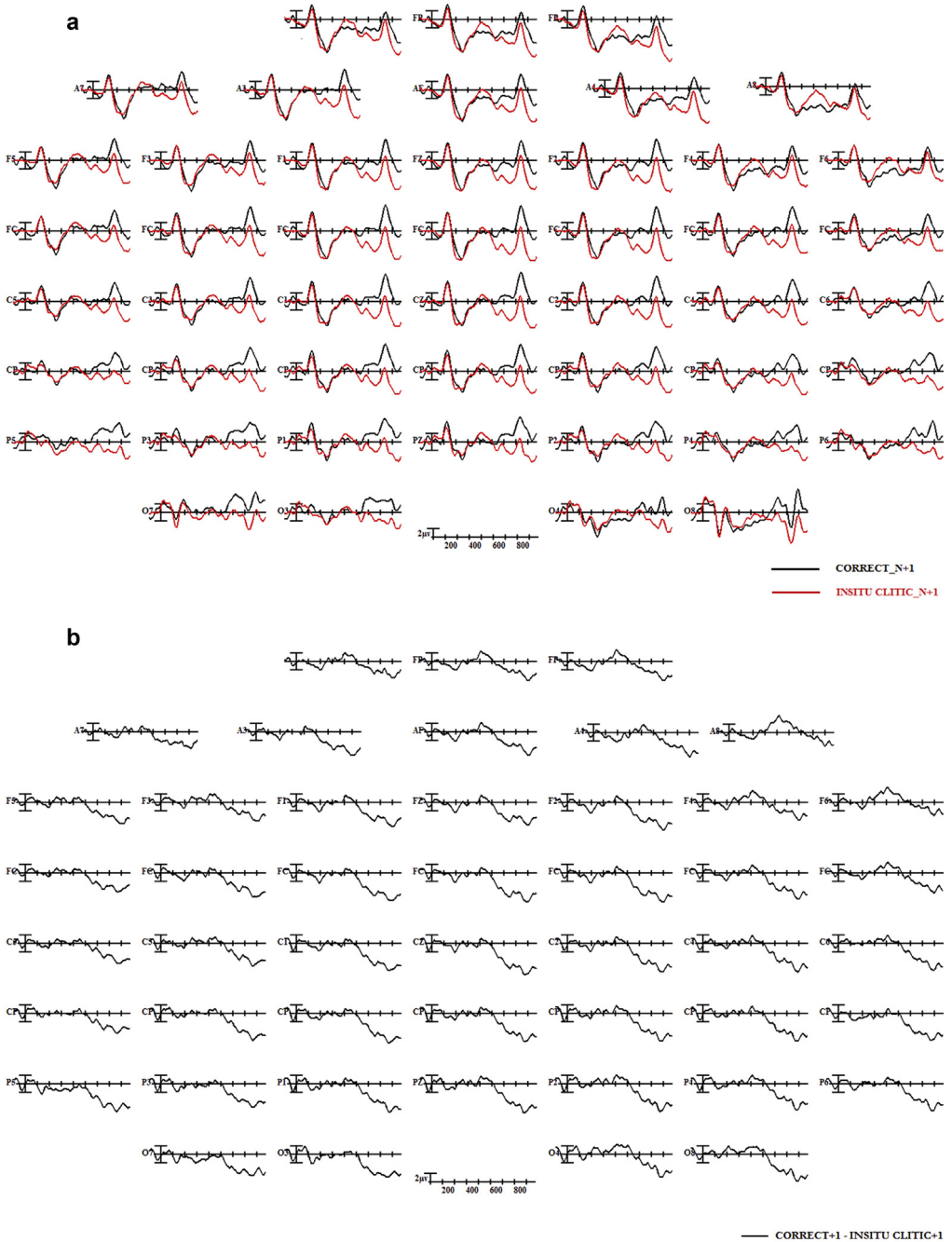


Fig. 9. a: In situ pronoun + 1, wave forms for correct vs. clitic pronouns, L2 low-intermediate. b: In situ pronoun + 1 difference waves for correct vs. clitic pronouns, L2 low-intermediate.

1. Are subjects (native speakers, low- and high-intermediate L2 learners) sensitive to ungrammatical in situ clitic pronouns (i.e., stranded unstressed pronoun, word order violation)?
2. Are subjects sensitive to ungrammatical in situ strong pronouns (i.e., ungrammatical morphological form, word order violation)?
3. Are responses to offline and online tasks comparable?
4. For L2 learners, is proficiency level a significant factor?

The L2 learners in our study split into low- and high-intermediate groups that demonstrated distinct processing and offline capacities according to level, indicating that proficiency level is significant in gaining mastery of L2 French pronouns. The high-intermediate group showed evidence of online sensitivity to grammatical constraints. Their response to in situ clitics was qualitatively similar to that of the native controls, while that to in situ strong pronouns was more idiosyncratic. For strong pronouns, the L2 high-intermediate learners responded to in situ placement with a P600 beginning 500 ms post onset, but the distribution of the P600 differed from that of native speakers in that it was less posterior. This difference was also borne out in the behavioral data on the GJ tests. The high-intermediate learners scored 84% for correct sentences, 82% for ungrammatical clitics in situ, and 66% for ungrammatical strong pronouns in situ. The lower score for in situ strong pronouns along with their ERP response indicates that these learners have not yet mastered the ungrammaticality of the strong forms as direct objects possibly due to the fact that they get conflicting cues about these pronouns; namely, that they do occur in postverbal positions, and are stressed. In contrast to the strictly morphological nature of the ungrammatical in situ strong pronoun, the ungrammaticality of the in situ clitic pronoun is both morphological and phonological, given the requirement that clitics attach to the verb. Indeed, both the offline GJ scores and online ERP response to these errors show that the high-intermediate group was more sensitive to in situ clitics than to in situ strong pronouns. This appears to be a case in which learners show online sensitivity in the cortical response to grammaticality (albeit different from that of native speakers), but do not have sufficient meta-linguistic knowledge to correctly evaluate grammaticality offline. While this has been reported in earlier studies for lexical processing (McLaughlin et al., 2004), to our knowledge ours is the first ERP study to report such a finding for syntactic processing. The high-intermediates' higher offline scores for the ungrammaticality of clitics over strong pronouns may indicate an unconscious sensitivity to French prosodic constraints and stress.⁶ For the in situ clitic forms, the high-intermediate group also showed a clear cortical response, which tended to be smaller than that observed in the native control group but did not differ in its distribution. The cortical sensitivity to in situ clitics in this group matched their capacity to correctly reject these sentences as ungrammatical both at the end of the sentence and on an offline grammaticality judgment task. For the high-intermediate learners, our results confirm a grammaticalized representation and processing of both the clitic and strong pronouns.

The low-intermediate group of learners, on the other hand, did not exhibit patterns similar to the high-intermediates or the natives as concerns their sensitivity to errors of pronoun placement, nor as concerns the relationship between their cortical response and their behavioral response to these errors. While their behavioral response to the end-of-sentence GJ task was at 81% for the correct sentences, they scored only 49% for the ungrammatical in situ clitic pronouns and 23% for the ungrammatical strong pronouns in situ. Moreover, the results from the offline task showed that this group largely accepted ungrammatical in situ strong pronouns. In stark contrast to their behavioral results, these learners showed a robust electrophysiological response to both types of pronoun errors. For the in situ strong pronouns, the low-intermediate learners showed a significant P600 response that differed from that observed for native speakers and the high-intermediate learners only in its distribution. For the word after the in situ clitics, the low-intermediate learners also showed a robust cortical response to anomalous word order and, rather surprisingly, this effect was not statistically different in terms of amplitude or distribution from that of

⁶ Mastery of prosody in L1 and L2 is foundational in that one has to have an innate sense of it to pronounce a word or to string words together. Instructed L2 rarely covers such topics and native speakers are usually incapable of describing the prosody of their native tongue with any accuracy in linguistic terms.

either native controls or the high-intermediate group. This is notable given the very low percentage of correct detection in offline tasks. As concerns their performance on metalinguistic tasks, it appears that these learners have still not mastered pronoun placement in French, be it due to using their L1 English settings for pronoun placement or due to their incorrect assumption that French pronouns may appear in the post verbal position, the same position for lexical DPs in both English and French. Despite this, these learners showed a P600 to erroneous word order for clitics. Thus while behavioral measures confirm the lack of clitic pronoun mastery of this level of learners, these learners showed online sensitivity in terms of their cortical response to clitic placement violations, and to a far greater degree than would have been expected based on their offline capacity to detect and correct such errors.

The difference between online and offline sensitivity to linguistic manipulations has been highlighted in previous ERP work, notably during the initial stages of learning (McLaughlin et al., 2004) although this has been reported for the discrimination of lexical forms. Our results provide the first evidence of late learners' cortical sensitivity to grammatical and prosodic properties of the L2 for processing levels in the absence of clear behavioral sensitivity. On this note, we should stress that such a result clearly demonstrates the non-determinate nature of behavioral responses as concerns electrophysiological responses to linguistic processing in the L2, as shown in previous studies at both the lexical (McLaughlin et al., 2004) and syntactic level (Tanner et al., 2013). Indeed, one concern is that ERP effects may be present but obscured in L2 groups due to averaging over all trials, especially when a large number of trials are not correctly identified in end-of-sentence judgments (cf. White, Genesee, & Steinhauer, 2012, for such an argument). Such clearly does not apply to the present data, where clear ERP responses were found despite L2 participants' low accuracy.

As concerns the cortical response we found for the low-intermediate group of learners, different patterns were found for *in situ* clitics and strong pronouns. The response we found in this group for strong pronouns did not show the typical posterior distribution found for this type of violation, but it was in the same time window as a P600. The nature of the difference in topography of the P600 and its underlying neural generators is an open question, but has been reported in several ERP studies of L2 acquisition (Foucart & Frenck-Mestre, 2011, 2012; Frenck-Mestre, McLaughlin, Osterhout, & Foucart, 2008; Sabourin, Stowe, & de Haan, 2006). For *in situ* clitic pronouns, quite surprisingly given their extremely low level of behavioral accuracy, the P600 effect in the low-intermediate group did not differ from that of the more advanced learners or native controls.

For *in situ* clitic sentences, we found a frontal negativity prior to the P600 response. This negativity was lateralized, being larger over the right than left hemisphere and did not depend upon participant group. This effect is of interest given the suggestion that “end state” grammaticalization should be accompanied by a biphasic ERP response, composed of an early negativity and subsequent P600 (cf. Hahne & Friederici, 1999; Steinhauer, White, & Drury, 2009). Our data show a hint of such a pattern but only for the *in situ* clitic condition, not for the strong pronouns. Moreover, the fact that such was independent of group, while the P600 effect differed across groups, being most typical for native controls and least typical for the low-proficiency group, is incompatible with any strong version of said hypothesis. The topography of the early negativity we found, being right lateralized, is also worthy of mention. This pattern contrasts with that reported in the vast majority of the literature, which, when early negativities are found, has shown them to be either left lateralized or bilateral (cf. seminal work by Hahne & Friederici, 1999; Hagoort, Wassenaar, & Brown, 2003; for a recent overview, cf. Steinhauer & Drury, 2012). The conditions that lead to the eliciting of early negativities are beyond the scope of the present paper; indeed, this debate still wages in the monolingual literature (Molinaro et al., 2011, 2014; Tanner, 2014).

In view of recent models of a purported sequence of ERP signatures associated with stages of L2 grammatical competence (McLaughlin et al., 2010; Osterhout et al., 2006; Steinhauer et al., 2009), it is of interest to note that the present results did not show evidence of any other clear ERP component specific to the less advanced L2 group; most notably, no N400 effect was reported for this group for placement violations. The lack of any clear N400 response in the low-intermediate group can be attributed to various factors, not the least of which being that our participant groups were divided on the basis of their behavioral responses as opposed to either the size of the different ERP components (McLaughlin et al., 2010) or demographic and motivational factors (Tanner, Inoue, & Osterhout, 2014). Indeed, the same L2 participant can

be seen to produce either a clear N400 or a distinct P600 effect at the same time in their L2 acquisition, depending upon the type of grammatical structure under question (Foucart & Frenck-Mestre, 2012).

In summary, our results indicate that anglophone learners of L2 French show implicit sensitivity to both pronoun placement and morphological realization of clitic and strong pronouns. For subjects in the lowest L2 group, who were unable to provide accurate offline judgments (especially for in situ strong pronouns), the cortical response to in situ clitics was both prominent and similar to that found for native speakers, while the ERP response to in situ strong pronouns did not have the typical distribution of a P600. It is notable that these learners showed a P600 to in situ clitic pronouns, despite their very low accuracy on the offline measures, whether end-of-sentence judgment or grammaticality judgment of an independent set of sentences. For the more advanced learners, their responses were qualitatively more similar to those of native Francophones, indicating their grammaticalized response to uncliticized object pronouns, as opposed to English in situ pronouns. Their behavioral and cortical responses indicate a command of morphological features that do not exist in English and a sensitivity to word order of pronouns, indicating mastery of the distinction related to both morpho-syntax and phonological deficiency of French clitics, morphological forms that differ from their L1. These results provide evidence that anglophone L2 learners of French can indeed master these factors relating to syntactic, morphological and phonological features of French pronouns and hence support L2 models of acquisition that propose learner access to L2 grammatical categories as well as neurolinguistic models that support such (Herschensohn, 2000; Schwartz & Sprouse, 1996; Steinhauer, 2014). Importantly, our ERP data demonstrates that this grammaticalisation process begins prior to learners' conscious ability to use their newly acquired system.

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Appendix A. Verb list

French (infinitive)	English
accepter	to accept
aider	to help
aimer	to like
amener	to bring/take
appeler	to call
cacher	to hide
chercher	to look for
contacter	to contact
détester	to hate
écouter	to listen
laisser	to leave
montrer	to show
oublier	to forget
payer	to pay
pousser	to push
préférer	to prefer
présenter	to present/show/introduce
quitter	to leave
regarder	to look at
rencontrer	to meet/run into
trouver	to find

Appendix B. Sample post-test items

Thank you for your help in doing this study of the acquisition of French. The results are anonymous and will only be used for research purposes.

Grammaticality judgment task

You will be presented with sentences which you will rate on a scale from 1 to 7, for their acceptability in French. Use the rating **1** if you are sure the sentence is infelicitous and use the rating **7** if the sentence is perfectly fine. Use the ratings in the middle of the scale if you are not sure, but are leaning one way or another. A rating of **4** means you are completely unsure.

The sentence is definitely infelicitous	1
The sentence seems kind of wrong	2–3
I am completely unsure	4
The sentence seems ok	5–6
The sentence is definitely perfectly fine	7

Please complete the task as quickly as possible. Do not think about your response, but just follow your intuition.

Sentence	The sentence is...						
	Infelicitous			Perfectly fine			
A. J'ai jeté le mouchoir dans la poubelle.	1	2	3	4	5	6	7
B. Ton pull, tu l'as mangé ?	1	2	3	4	5	6	7
C. Je l'ai salué cordialement.	1	2	3	4	5	6	7
D. Elle la pomme mange.	1	2	3	4	5	6	7
1. Ils n'ont pas relu leurs notes.	1	2	3	4	5	6	7
2. Antoinette a le traversé rapidement.	1	2	3	4	5	6	7
3. La télévision? Elle la regarde tous les jours.	1	2	3	4	5	6	7
4. J'ai acheter une Toyota l'année prochaine si j'ai assez d'argent.	1	2	3	4	5	6	7
5. Hugo n'a pas trouvé lui dans l'armoire.	1	2	3	4	5	6	7
6. Julie ne prend pas de vacances.	1	2	3	4	5	6	7
7. La glace ? Jeanne mange souvent.	1	2	3	4	5	6	7

Thank you for completing the test. If you can, please now go back and underline the part of the sentence that you think makes it infelicitous. Then, below, provide a correct version of the sentence on

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