

## Why a “Word Order Difference” Is Not Always a “Word Order” Difference: A Reply to Weyerts, Penke, Münte, Heinze, and Clahsen

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*We present evidence that the supposed processing advantage for an SV<sub>fin</sub>O word order over an SOV<sub>fin</sub> word order in German argued for by Weyerts, Penke, Münte, Heinze, and Clahsen (2002) is supported by neither experimental nor theoretical evidence. Specifically, we show (a) that the frontocentral negativity for an SOV<sub>fin</sub> in comparison to an SV<sub>fin</sub>O word order in Weyerts et al.’s Experiments 2 and 3 is reducible to more general differences in the electrophysiological responses elicited by nouns versus verbs in a sentence context, and (b) that the P600 difference between the two word orders in Experiment 2, as well as the reading time differences in Experiment 1, result from the fact that the two supposedly ungrammatical conditions actually differ in their degree of ill-formedness. We conclude that there is no evidence for a processing disadvantage for SOV<sub>fin</sub>, thus reconciling Weyerts et al.’s results on German sentence processing with the grammatical regularities of German.*

**KEY WORDS:** verb placement; ERPs; syntactic processing cost; P600; anterior negativity.

In a recent article, Weyerts, Penke, Münte, Heinze, and Clahsen (2002) argue that the human language comprehension system exhibits a general preference for an SV<sub>fin</sub>O word order, even in constructions and languages in which this ordering is ungrammatical. The authors claim that this relative positioning of a finite verb to its arguments is favorable from a processing

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perspective, because it minimizes the distance between subject and verb. Thus the prediction of a verb that is initiated when the subject is processed may be fulfilled at the earliest possible point. To show that the processing of an  $SV_{fin}O$  order is indeed advantageous, Weyerts *et al.* (2002) present a reading time study and three ERP studies, which, as they argue, show a consistent disadvantage for the processing of  $SOV_{fin}$  in comparison to  $SV_{fin}O$ . A set of example stimuli from Weyerts *et al.*'s Experiment 2 are shown in Table I.

For the behavioral study (Experiment 1), the authors report higher reading times for ungrammatical  $SOV_{fin}$ <sup>5</sup> in comparison to the three other conditions examined ( $SOV_{fin}$ ,  $SV_{fin}O$ ,  $*SV_{fin}O$ ), whereas ERP measures show an anterior negativity for  $SOV_{fin}$  in comparison to  $SV_{fin}O$  independently of grammaticality. Finally, the data show a P600 effect for ungrammatical  $SOV_{fin}$  in Experiment 2. Thus, on the basis of the findings (a) that  $SOV_{fin}$  elicits an anterior negativity in comparison to  $SV_{fin}O$ , and (b) that there is apparently no additional processing of ungrammatical  $SV_{fin}O$ , Weyerts *et al.* (2002) argue that an  $SOV_{fin}$  order is generally associated with higher processing costs than an  $SV_{fin}O$  order.

Certainly, the role of word order regularities in on-line language comprehension is an area of central psycholinguistic concern. Unfortunately, however, the studies presented by Weyerts *et al.* (2002) are subject to a number of experimental and theoretical concerns, which render their conclusions questionable. In the following, we will focus primarily on problems

<sup>5</sup> Here and in the following, underlined positions indicate the sentential constituents at which the comparison under discussion was undertaken.

**Table I.** Example Stimuli from Weyerts *et al.*'s (2002) Experiment 2<sup>a,b</sup>

Condition	Example
$SV_{fin}O$	<i>Es ist Ostern, und die trauernde Witwe opfert Kerzen.</i> it is Easter and the grieving widow offers candles "It is Easter and the grieving widow is offering candles."
$*SOV_{fin}$	<i>*Es ist Ostern, und die trauernde Witwe Kerzen opfert.</i> it is Easter and the grieving widow candles offers
$SOV_{fin}$	<i>Der Priester sieht, daß der fromme Novize Kerzen opfert.</i> the priest sees that the pious novice candles offers "The priest sees that the pious novice is offering candles."
$*SV_{fin}O$	<i>*Der Priester sieht, daß der fromme Novize opfert Kerzen.</i> the priest sees that the pious novice offers candles

<sup>a</sup> S, subject; O, object;  $V_{fin}$ , finite verb.

<sup>b</sup> Asterisks indicate ungrammatical constructions.

associated with the claim that the object in an SOV structure consistently elicits an anterior negativity in comparison to the verb in an SVO structure, thus reflecting extra parsing effort, for example, in the form of a higher memory load.

The crucial finding presented by Weyerts *et al.* (2002) in favor of the claim that  $SV_{fin}O$  is preferred over  $SOV_{fin}$  is that the latter elicited a frontal negativity in comparison to the former in two ERP experiments (Experiments 2 and 3). The authors interpret this component, which was observable independently of the grammaticality of the  $SOV_{fin}$  word order, as reflecting the failure of a syntactic prediction and the additional memory load thus arising. However, contrasting the two word orders in question requires a direct comparison between a nominal constituent (the object in an SOV order) and a verb (in the SVO order). As the authors acknowledge, such a comparison is problematic in terms of ERP measures. In an attempt to address this potential concern, a third ERP study (Experiment 4) is presented, in which the nouns and verbs used in Experiment 2 were compared directly in a word list presentation format and which yielded no effects resembling the critical anterior negativity. Despite this control experiment, however, we believe that the comparisons drawn upon by Weyerts *et al.* (2002) are critically flawed, for reasons we will elucidate in the following.

In particular, previous experimental findings indicate that it is not a trivial matter to generalize the comparisons between verbs and nouns in a word list presentation format to the sentence level. For example, using sentence-level presentation, Federmeier, Segal, Lombrozo, and Kutas (2000) report ERP differences in the form of (a) a left-lateralized early positivity (P200) for unambiguous verbs in comparison to unambiguous nouns, and (b) a negativity between 250 and 450 ms for nouns in comparison to verbs at fronto-central electrode sites. Two example sentences from this study are shown in (1).

- (1) a. Jim learned the *solution* but went blank when it was time for the test.
- b. The girl learned to *carve* but found it was more tedious than she had thought.

Thus, because it is apparent that the differences between nouns such as *solution* in (1a) and verbs such as *carve* in (1b) cannot be attributed to differences in word order, Federmeier *et al.*'s (2000) findings demonstrate that a direct electrophysiological comparison between nouns and verbs at the sentence level is inherently subject to the confounding influence of the categorical distinction. Further reports of similar differences between nouns and verbs in a sentence context (Corey, 1999) attest to the robustness of this finding.

Interestingly, Federmeier *et al.*'s (2000) results directly account for

the negativities for  $\text{SOV}_{\text{fin}}$  in comparison to  $\text{SV}_{\text{fin}}\text{O}$  sentences reported by Weyerts *et al.* (2002) without requiring any reference to word order regularities in parsing. In the following, we will show that this is the case for both of Weyerts *et al.*'s crucial experiments, namely Experiments 2 and 3.

The results of Experiment 2 are most straightforwardly accounted for. Here, Weyerts *et al.* (2002) report that, “[between] 300 and 500 ms post-stimulus, the SOV word order was associated with a larger negativity compared to  $\text{SV}_{\text{fin}}\text{O}$  word order, which was most pronounced over fronto-central electrode sites” (Weyerts *et al.*, 2002, p. 234). As discussed above, this crucial comparison between the two word orders in question contrasted a bare plural object noun in the  $\text{SOV}_{\text{fin}}$  condition with a verb in the  $\text{SV}_{\text{fin}}\text{O}$  condition (cf. Table I). Thus, Weyerts *et al.* (2002) observed a fronto-central negativity between 300 and 500 ms for *nouns* in comparison to *verbs*, which closely corresponds to the negativity reported by Federmeier *et al.* (2000) in terms of both topography and latency. In this way, the existence of the negativity in Experiment 2 may be derived without appealing to word order differences between the conditions.<sup>6</sup>

Recall, however, that, in addition to the negativity for  $\text{SOV}_{\text{fin}}$  structures in Experiment 2, ungrammatical  $\text{SOV}_{\text{fin}}$  structures also elicited a much more pronounced P600 component than ungrammatical  $\text{SV}_{\text{fin}}\text{O}$  structures in this experiment. Thus, at a first glance, this difference between the two ungrammatical conditions might seem to provide independent evidence for assuming that an  $\text{SOV}_{\text{fin}}$  word order is more difficult to process. Yet there are several major problems with this line of argumentation. Most importantly perhaps, although an  $\text{SOV}_{\text{fin}}$  ordering in a matrix clause (e.g., 2a) is clearly ungrammatical, the supposed ungrammaticality of an  $\text{SV}_{\text{fin}}\text{O}$  ordering in a subordinate clause (e.g., 2b) is much more problematic.

- (2) a. \* $\text{SOV}_{\text{fin}}$   
       \*Es ist Ostern und die trauernde Witwe Kerzen opfert.  
       *it is Easter and the grieving widow candles offers*  
 b. \* $\text{SV}_{\text{fin}}\text{O}$

<sup>6</sup> In fact, similar ERP differences between a bare plural object noun in an  $\text{SOV}_{\text{fin}}$  word order and a verb in an  $\text{SV}_{\text{fin}}\text{O}$  word order were already reported by Meyer and Friederici (1997). In this study, the contrast between these two constructions was even apparent when both were grammatical and, more importantly, when the word order of the sentence was fully predictable even before the critical position. Thus these data call into question a general disadvantage for  $\text{SOV}_{\text{fin}}$ , because an account assuming such a disadvantage should predict differences between the critical conditions as soon as the word order of the clause is unambiguously identifiable. Moreover, in minimally differing ungrammatical conditions in each of the two word orders, Meyer and Friederici (1997) observed clear electrophysiological markers of the processing of ill-formed structures (i.e., an N400 and a P600), thus raising the question of why such clear effects of ungrammaticality were not apparent in the experiments presented by Weyerts *et al.* (2002).

Der Priester sieht, dass der fromme Novize opfert (\*Kerzen).  
*the priest sees that the pious novice offers candles*

As the examples in (2) indicate, the point at which the ungrammaticality becomes apparent differs between the two critical sentence types: whereas the ungrammaticality in SOV<sub>fin</sub> sentences is encountered at the position of the object, the positioning of which violates the verb-second requirement for German main clauses, the SV<sub>fin</sub>O sentences do not become ungrammatical until the post-verbal object is encountered, because the clause could still be a canonically ordered (SV<sub>fin</sub>) intransitive sentence up to this point. Indeed, more than 50% of the verbs used in Weyerts *et al.*'s Experiments 1 and 2 clearly allow an intransitive reading (in terms of our judgments: 8 out of 12 in Experiment 1 and 40 out of 68 in Experiment 2), as the verb *opfern* ("to offer/sacrifice") in (2b) nicely illustrates. Furthermore, even under the assumption that the majority of the verbs used by Weyerts *et al.* are "truly" transitive and that this transitivity information is immediately accessed when the verb is encountered, the well-formedness of an embedded SV<sub>fin</sub>O clause is still not predictable at the position of the verb. Consider the example in (3).

- (3) Der Priester sieht, dass der fromme Novize opfert, was er entbehren kann.  
*the priest sees that the pious novice offers what he do-without can*  
*"The priest sees that the pious novice offers whatever he can do without."*

The sentence in (3) is fully acceptable despite the post-verbal positioning of the free relative clause *was er entbehren kann* ("whatever he can do without"), that is, despite an embedded SV<sub>fin</sub>O word order.<sup>7</sup> Hence, this example illustrates that, independently of the transitivity of the verb, the ungrammaticality of an embedded SV<sub>fin</sub>O order can never be recognized until the object is encountered.

In summary, the critical comparison between the verb in an SV<sub>fin</sub>O order and the object in an SOV<sub>fin</sub> order in Weyerts *et al.*'s Experiment 2 cannot provide an unbiased measure of possible differences in processing load arising from the two word orders, because—without the availability of a lookahead—only the SOV<sub>fin</sub> sentences are ungrammatical at this point. This difference may be seen as resulting in the more pronounced P600 component for \*SOV<sub>fin</sub> in comparison to \*SV<sub>fin</sub>O in Experiment 2. The fronto-central negativity for SOV<sub>fin</sub> in comparison to SV<sub>fin</sub>O sentences, by contrast, is a reflection of general differences in the electrophysiological response

<sup>7</sup> In fact, the canonically ordered (SOV<sub>fin</sub>) equivalent, of (3), . . . *dass der fromme Novize, was er entbehren kann, opfert*, is clearly the more marked of the two sentences.

elicited by nouns and verbs in a sentence context.

Hence, because the results of Experiment 2 yield no convincing evidence for a processing advantage for  $SV_{fin}O$  sentences in comparison to  $SOV_{fin}$  sentences, the motivation for Weyerts *et al.*'s Experiment 3, which was designed to shed further light on this supposed processing disadvantage, also becomes questionable. Moreover, in view of these considerations, it appears unclear why Weyerts *et al.* (2002) should have observed that the "ERPs timelocked to the determiner of the object NP in [S-O-AUX] clauses were *more negative-going* than ERPs timelocked to the auxiliary in [S-AUX-O] clauses" (Weyerts *et al.*, 2002, p. 241, our italics). Recall, however, that both Federmeier *et al.* (2000) and Corey (1999) reported fronto-central *positivities* between 150 and 300 ms (enhanced P200 effects) for verbs in comparison to nouns. Thus the relative difference between the two conditions reported by Weyerts *et al.*, that is the more *positive* waveforms for the auxiliary in  $SV_{fin}O$  clauses in comparison to the determiner in  $SOV_{fin}$  clauses, could, in principle, again result from the confounding influence of the comparison between nominal and verbal constituents in a sentence context.

How, then, might one exclude an interpretation of Weyerts *et al.*'s Experiment 3 that subsumes the difference between the two word orders under a more general difference between verbs and nouns, that is, why should the crucial effect be interpreted as a (specific) negativity for object determiners rather than as a (more general) positivity for (auxiliary) verbs? In fact, an examination of the morphology (relation of the ERP curves to one another in the coordinate space) of the component in Weyerts *et al.*'s Fig. 6 (p. 240) indicates that the difference between the two conditions is more likely to result from a positivity in the S-AUX-O (verb) condition, rather than from a negativity in the S-O-AUX (noun) condition. However, in view of the fact that, in ERP measures, it is often difficult to determine which of two conditions should be considered the "control" on the basis of component morphology alone (and, indeed, there are no absolute criteria for doing so), an interpretation of the difference in question requires reference to an external criterion. Typically, such an external "decisive factor" may stem from either an independent (behavioral) experiment or a well-founded theoretical prediction.

With regard to independent experimental evidence, the discussion above has already shown that the P600 differences between ungrammatical  $SOV_{fin}$  and  $SV_{fin}O$  in Experiment 2 cannot be drawn upon as a potentially informative finding in this regard. Unfortunately, the same points of critique hold with regard to the reading time study (Experiment 1) presented by the authors, in which the only observable effect was due to higher reading times for ungrammatical  $SOV_{fin}$  in comparison to all other conditions, despite the

fact that the authors report joint reading times for the critical and the post-critical position in this experiment.<sup>8</sup> Therefore the difference in well-formedness between ungrammatical SOV<sub>fin</sub> and “ungrammatical” SV<sub>fin</sub>O accounts for both the reading times in Experiment 1 and the P600 pattern in Experiment 2, thereby showing that *neither* of these results may be drawn upon to motivate a general advantage for SV<sub>fin</sub>O over SOV<sub>fin</sub> and, hence, to provide evidence in favor of interpreting the effect in Experiment 3 as a negativity for SOV<sub>fin</sub>.

Having shown that there is no experimental evidence for assuming that the effect in Experiment 3 is a negativity for objects in an SOV<sub>fin</sub> word order, the only other possibility of independently motivating this assumption is to draw upon theoretical arguments. In this regard, the crucial claim made by Weyerts *et al.* (2002) is that an SV<sub>fin</sub>O structure is generally preferred over an SOV<sub>fin</sub> structure on account of the fact that the distance between subject and finite verb is minimized in the former in comparison to the latter.<sup>9</sup> However, in contrast to English, such a claim is problematic in German for several reasons. First, as exemplified in (4), there are unmarked German word orders in which the subject is not adjacent to the finite verb.

- (4) Vielleicht gefiel dem Jungen das Fahrrad.  
*perhaps pleased [the boy]<sub>DAT</sub> [the bicycle]<sub>NOM</sub>*  
 “Perhaps the bicycle pleased the boy.”

The sentence in (4) is unmarked in German (e.g., Fanselow, 2000; Primus, 1999; Wunderlich, 1997) despite the fact that a dative-marked argument intervenes between the finite verb and the nominative-marked argument (the “subject,” in traditional terms). Thus, to motivate their locality requirement, Weyerts *et al.* (2002) would have to assume a fundamental discrepancy between the regularities of the German grammar and the manner in which German sentences are processed. Such a distinction is not supported by recent findings in the experimental literature (e.g., Bornkessel,

<sup>8</sup> Additionally, the results of Experiment 1 are difficult to interpret, because over 80% of the critical sentences in this experiment consisted of two conjoined clauses such as *Der Schäfer trinkt Tee und der Hund hütet die Schafe* (“The shepherd is drinking tea and the dog is watching the sheep”). In the majority of cases, this choice of sentence structure allows for a (local) interpretation of the ungrammatical (embedded) SOV<sub>fin</sub> condition as a fully grammatical—but often implausible—ellipsis such as *Der Schäfer trinkt Tee und der Hund die Schafe* (“The shepherd is drinking tea and the dog (is drinking) the sheep”). Thus the comparison between SV<sub>fin</sub>O and SOV<sub>fin</sub> is further confounded by the influence of implausible readings in the latter in comparison to the former. This problem is reduced in Experiment 2 by way of the lower percentage of conjoined clauses (cf. the sentence materials in Weyerts *et al.*'s (2002) Appendix).

<sup>9</sup> Incidentally, this adjacency-based account of the preferred structural relationship between the subject and the finite verb also predicts an OSV<sub>fin</sub> ordering, which is also possible in German.

Schlesewsky, & Friederici, 2002a; Schlesewsky, Bornkessel, & Frisch, *in press*), which also show that possible frequency differences between word order variants do not determine how these word orders are processed.

This brings us to the final point in our line of our argumentation, namely to Weyerts *et al.*'s (2002) attempt to derive potential experimental differences between objects in SOV<sub>fin</sub> sentences and verbs in SV<sub>fin</sub>O sentences in terms of enhanced prediction cost in the sense of Gibson (1998), that is, as expressing the higher degree of memory load that results when a predicted constituent (the verb) must be maintained in memory until the prediction is fulfilled (Weyerts *et al.*, 2002, p. 235). Specifically, the authors argue that, “in the grammar of German, there is a close syntactic relationship between the subject and the finite verb, [ . . . ] a subject may serve as an obligatory predictor for a finite verb” (Weyerts *et al.*, 2002, p. 246). There are two arguments against this view. First, in contrast to English, German allows finite sentences without an overt subject (5).

- (5) Der Croupier vermutete, dass schon seit Stunden geschummelt wurde.  
*the croupier suspected that already since hours cheated was*  
 “The croupier suspected that cheating had already been going on for hours.”

As the embedded clause in example (5) shows, a subject is *not* always obligatory in a well-formed German sentence, whereas a finite verb is. Therefore the prediction of a finite verb does not crucially depend on the subject, but must rather be initiated with the processing of a sentence-initial element. This type of account, which assumes a more general prediction of obligatory constituents when the processing of a sentence is initiated, is fully compatible with Gibson's (1998) proposal. Second, having shown that the prediction of a finite verb is not necessarily tied to the processing of a subject, the existing literature on the processing of German suggests that the establishment of a relation between the arguments themselves is at least as important—if not more so—than the establishment of a relation between the arguments and the verb (Bornkessel, 2002; Bornkessel, Schlesewsky, & Friederici, 2002b; Frisch, 2000; Frisch & Schlesewsky, 2001).

When considered together, the arguments presented above show that there is no theoretical motivation for assuming additional processing cost for SOV<sub>fin</sub> in comparison to SV<sub>fin</sub>O. We must therefore conclude that there is no independent evidence whatsoever for interpreting the difference between SOV<sub>fin</sub> and SV<sub>fin</sub>O in Experiment 3 as a negativity for the former in comparison to the latter, rather than as a positivity (enhanced P200) for verbal constituents in comparison to nominal constituents as reported by Federmeier *et al.* (2000) and Corey (1999).

In summary, we hope to have shown convincingly that there is neither

experimental nor theoretical evidence for a processing disadvantage for SOV<sub>fin</sub> in comparison to SV<sub>fin</sub>O in German. Rather, the crucial ERP differences reported by Weyerts *et al.* (2002) are attributable to inherent categorical differences between nominal and verbal constituents when processed in a sentence context. These differences therefore cannot be viewed as a more general measure of processing complexity in the sense of Gibson (1998), nor can they be considered evidence for certain word order preferences. Furthermore, we have argued that there are a number of theoretical considerations that render the assumption of a processing disadvantage for SOV<sub>fin</sub> unacceptably unattractive.

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