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## **Given-New/New-Given? Children’s Sensitivity to the Ordering of Information in Complex Sentences**

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## **Abstract**

English and many other languages allow flexible ordering of main and subordinate clauses in complex sentences. Processing, discourse-pragmatics and semantics impact on the ordering of information. 3-year-olds, 5-year-olds and adults heard complex sentences containing main and subordinate clauses with differing informational status. Using an act-out method, we analysed participants' sensitivity to the ordering of new/given information and its interaction with clause order. All age groups changed the order of information to given-new, when exposed to a new-given structure, whereas only adults changed the clause order to SUBORDINATE-MAIN when exposed to the reverse. We suggest that children are sensitive to information-structure but not clause-order in complex sentences. The results are discussed in the context of possible limited processing capacities or understanding of clause order function in complex sentences.

## Introduction

English and many other languages allow some flexibility in the way main and subordinate clauses can be ordered in a complex sentence unit. However, there are a number of factors such as processing, discourse-pragmatics and semantics that have an impact on the ordering of clauses in any given sentence. Following Diessel (2001; 2005; 2008), we assume that the ordering and processing of complex sentences can be explained as a result of competing motivations between processing factors and discourse-pragmatics (i.e. givenness or newness). Studies by Diessel (2001; 2005; 2008) have suggested how speakers might resolve the competition between these factors but it is less clear when and how children acquire these different strategies and how they affect their comprehension and production of complex sentences during different stages of their language development. To our knowledge, there is no experimental study that has investigated this phenomenon from the perspective of first language acquisition. The present study aims to fill this gap by examining how these factors affect complex sentence comprehension.

### *Ordering effects in complex sentence units*

Complex sentences contain a main and subordinate clause. Languages such as English and German (and many more) permit main and subordinate clauses to occur in more than one position. For example, a native speaker of English can form a complex sentence either with the subordinate clause in initial position as in (1) or with the subordinate clause in final position as in (2):

1. When Peter came home<sub>[SUB]</sub> Mary was cooking a meal<sub>[MAIN]</sub>.
2. Mary was cooking a meal<sub>[MAIN]</sub> when Peter came home<sub>[SUB]</sub>.

However, studies report that speakers tend to have a preference for one order over the other (Diessel, 2001; 2005; 2008), depending on various factors.

In his corpus study of English adverbial clauses, Diessel (2005) found that speakers have a preference for placing adverbial clauses after the main clause whereas adverbial clauses in initial position are less frequent. He reports that 38% of the 2034 adverbial clauses in his corpus sample occur in initial position whereas 62% occur in final position, and suggests that this relates this to processing factors in utterance planning and comprehension. He argues that the processing load for the speaker is much higher, if subordinate clauses occur before main clauses in a complex sentence unit, since the speaker has to keep the subordinate clause in working memory while planning the main clause (see also Arnold, Wasow, Losongco & Ginstrom, 2000; Ferreira & Dell, 2000; Wasow, 1997a; 1997b). However, different kinds of adverbials show differing patterns of use, with conditional adverbials occurring more often in preposed position than temporal adverbials which, in turn, are more frequently preposed than causal adverbials (Diessel, 2005). Thus, the precise semantics of the particular clause plays a role. On the other hand, if the main clause precedes the subordinate clause, each clause can be planned successively which reduces the processing load for utterance planning (cf. Diessel, 2005:458-459). The same holds true from the hearer perspective. Processing load is higher if the hearer has to keep the whole adverbial clause unit in working memory until the link to the main clause is established (Hawkins, 1994; 2004). However, processing factors do not explain why speakers of English also make use of adverbial clauses in initial position. In line with Chafe (1984), Ford (1993), and Givón (1990) and Thompson (1987), Diessel (2005:459) argues that the use of utterance-initial adverbial clauses is due to discourse-pragmatic factors: initial adverbial clauses are *“commonly used to organize the information flow in the ongoing discourse; they function to provide a thematic ground or orientation for subsequent clauses.”* Taking these two factors into account, Diessel (2005) argues that the ordering of main and subordinate clauses is motivated by competing forces from discourse-pragmatics and processing. Processing factors are

overridden by discourse-pragmatic factors in those cases in which adverbial clauses precede their main clauses (cf. Diessel, 2005:451).

#### *Discourse-pragmatic factors*

The present study makes use of the widely-used distinction between given and new information which focuses on the degree of accessibility of referents in discourse (Allen, 2000; Allen, Skarabela & Hughes, 2008; Arnold et al., 2000; Guerriero, Oshima-Takane & Kuriyama, 2006; Haviland & Clark, 1974; Hughes & Allen, 2006; Mishina-Mori, 2007; Skarabela, 2006;). Whereas Chafe (1976) and Du Bois (1987) suggest three categories of givenness and newness (i.e. non-new, accessible and new), other researchers (e.g. Allen, 2000; 2006 Allen et al., 2008; Arnold et al., 2000; Guerriero et al., 2006; Hughes & Allen, 2006; Mishina-Mori, 2007 and Skarabela) make a binary distinction between givenness and newness whereby a referent is considered to be *given* if it occurs in the previous utterances, and *new* otherwise. Chafe (1970) and Halliday (1967) also define givenness as information that has a recoverable antecedent in memory (see also Bock & Irwin, 1980). In this study we follow Arnold et al. (2000) in using a binary given/new distinction which focuses on the degree of accessibility of referents in discourse (i.e. on whether a referent has been mentioned in the previous discourse or not).

*Information flow and word order.* The impact of *given* and *new information* on language use has been extensively investigated by researchers from the perspective of word order (e.g. Arnold et al., 2000; Birner & Ward, 1998; Bock & Irwin, 1980; Bresnan, Cueni, Nikitina, & Baayen, 2007; Brown, Savova & Gibson, 2012; Clifton & Frazier, 2004; Ferreira & Yoshita, 2003; Kaiser & Trueswell, 2004; Siewierska, 1993) and referent encoding (e.g. Ariel, 1988; Du Bois, 1987; Gundel, Hedberg & Zacharski, 1993;). The bulk of studies conducted on the ordering of given and new information in sentences is concerned with processing

advantages for one order over the other. There is relative agreement for the existence of the so-called *given-new strategy* proposed by Haviland & Clark (1974). They argue that there is a processing advantage for given information occurring before new information for the hearer: the hearer has to (1) identify what is given and what is new, (2) link the given information to an antecedent in memory (i.e. information already existing in memory), and (3) link the new information to the given information in memory (see also Clark & Clark, 1978; Levelt, 1989). They found evidence for this, reporting that reaction times for sentence comprehension were much faster, if the information in their test sentence was linked to some information in the previous (i.e. context) sentence. When there was no direct link to the previous sentence, the reaction times were much slower (see also Clark & Sengul, 1979; Garrod & Sanford, 1977).

The given-before new principle was also found to have an impact on the speaker from the perspective of utterance planning. Note that these studies define 'new information' either in terms of 'hearer-new' (Clark & Haviland, 1974; Haviland & Clark, 1974) or as 'less recent/accessible' for the speaker (Arnold et al., 2000; Prince, 1981; Gundel, 1988) as new information cannot be considered truly 'new' from the perspective of the speaker. The rationale for the given-before-new principle from the perspective of utterance planning is that if given information precedes new information, the given information can be prepared earlier for production and gives the speaker more time to plan and produce the less available (i.e. less recent/newer) information. For example, Bock & Irwin (1980) found a processing advantage for *given-new* over *new-given* sentences in the faster availability of given information compared to new information for the speaker. Arnold et al. (2000) investigated the notion of given and new information in association with syntactic heaviness (i.e. the longer the linguistic referent, the heavier it is). Their corpus data of English revealed that speakers tend to postpone newer and heavier elements and that new elements tended to be postponed even when the referents were relatively equal in length.

Ferreira & Yoshita (2003) found that speakers of Japanese tended to shift the order of information from new-given to given-new, if the referents in the target sentence were presented in a scrambled word order (i.e. new before given). This is particularly interesting, as Japanese is a left-branching language whose speakers make use of different parsing strategies than speakers of right-branching languages such as English (see also Diessel, 2001; 2005; 2008; Hawkins, 1994; 2004). This supports the assumption that a preference for given before new information can be considered a cross-linguistic tendency (Clark & Clark, 1978).

The given-before-new principle has also been observed on the complex-sentence-level. Diessel (2005) argues that initial adverbial clauses tend to establish a link between the previous discourse and the following main clause, suggesting that adverbial clauses have particular discourse-pragmatic functions with respect to their position (see also Chafe, 1984; Ramsay, 1987; Verstraete, 2004). Thus, placing adverbial clauses before their main clauses may have a similar advantage in sentence processing and utterance planning as the ordering of given-before new information seen in NPs in simple sentences. That is, in comprehension, initial adverbial clauses referring back to the previous discourse help the hearer to access given information very quickly, and give them more time to establish a link in memory for the newer information encoded in the main clause. From the perspective of utterance planning, delaying the less accessible (i.e. newer) information encoded in the main clause gives the speaker more time to plan the utterance.

*Given and new information in children's language.* There is a large number of studies focusing on how children build up a repertoire of strategies in order to express different levels of informativeness. In what follows, we give a brief summary of what has been found on the level of one-word utterances, two-word utterances and referent encoding. However, none of these studies has investigated this phenomenon in the domain of complex sentences.

First, in order to discriminate between given and new information, children need to notice a difference between them. Research suggests that infants have the ability to discriminate between new and old elements long before they start to talk (Baker & Greenfield, 1988; Greenfield, 1973; 1979; Muir & Field, 1979). This sensitivity is also apparent once children start to talk. Baker & Greenfield (1988) found that at the one-word stage, children's single word-utterances primarily encoded new or uncertain elements (cf. Baker & Greenfield, 1988:25) and that children only started to verbalise given elements (in combination with new elements) at the two-word stage. Moreover, children who were capable of producing two-word utterances continued to show a tendency to verbalise new information in their one-word utterances (see also Leonard & Schwartz, 1977 and Narasimhan & Dimroth, 2008) and to omit given elements. Baker & Greenfield (1988) argue that children might show a preference to verbalise new elements in their one-word utterances because they are lacking alternative strategies such as the use of stress or referring expressions to express different degrees of informativeness. However, children may also prefer to verbalise new elements when labelling objects because new elements are commonly associated with moving objects whereas given elements commonly refer to static objects (cf. Baker & Greenfield, 1988: 5; see also Chan, 1986; Lempert & Kinsbourne, 1985; Nelson, 1973). This points to the possibility that children may prefer to verbalise names of new (dynamic) objects because they catch their attention more easily than given (static) objects. It is therefore not entirely clear to what extent children are sensitive to the new-given distinction and its relation to how one talks about referents, at the one-word stage.

As children grow older they become more experienced language users and can apply other strategies such as using stress or pronouns to label the information status of referents. For example, studies by MacWhinney & Bates (1978) and Wieman (1976) reported that children tend to use stress to highlight new elements. However, a recent study by Gruenloh, Lieven, Tomasello (under review) suggests that the use of stress to signal new information is



not fully adult-like for German-speaking children who have just entered the multi-word stage.

Another strategy for distinguishing the information status of referents that children seem to have some grasp of early on is the use of nominal referring expressions. In adult language, there is a cross-linguistic tendency for new referents to be encoded by lexical forms whereas given referents tend to be encoded by pronominal forms or omitted altogether (cf. Ariel, 1994; Du Bois, 1985; 1987; Givón, 1983; Gundel et al., 1993). There is a large body of studies using naturalistic data that seem to suggest a sensitivity to the use of nominal vs. pronominal, and definite vs. indefinite referring expressions in children crosslinguistically (e.g. Allen, 2000 for Inuktitut; Allen, Skarabela, & Hughes, 2008; Bittner, 2007 for German; Guerriero, et al. (2006) for English & Japanese; Gundel, Sera, & Page, 1999; Gundel, Sera, Kowalsky, & Page, 2001 for English & Spanish; Narasimhan, Budwig, & Murty, 2005 for Hindi; Rozendaal & Baker, 2008 for Dutch, English & French), with some studies showing relations between language-specific patterns of usage in child-directed-speech and patterns of acquisition. Experimental studies by Matthews, Lieven, Theakston & Tomasello (2006) and Salomo, Lieven & Tomasello (2010) found that three to four-year old English- and German-speaking children were sensitive to how to encode given and new referents when exposed to questions of the type “*What happened?*” or “*What is X doing?*”. Children tended to reply with a lexical noun when the referent had not been mentioned in the previous context whereas pronouns or null reference were more commonly used to encode given referents (see also Graf, 2010 for German; Serratrice, 2005; 2006 for Italian).

However, there are also studies showing that children’s use of referent encoding is not fully adult-like. De Cat (2011) found that 2;6 to 3;3 year-old French-speaking children were generally able to make adult-like use of definite and indefinite forms of reference when reporting picture book stories. However, errors were observed in the use of indefinite forms to refer to given information when previous reference to the entity occurred on an

earlier page in the book. She attributes this to difficulties in determining what counts as 'new' as a function of the visual context, rather than a lack of knowledge of how to encode different informational forms. However, a large body of studies reveals developmental changes crosslinguistically in children's abilities to maintain discourse cohesion in narrative that signal both language-general and language-specific influences on the pattern of acquisition (see e.g. Hickman & Hendriks, 1999 for a detailed overview & study). In addition, in a video description task, Theakston (2012) found that 5-year old English-speaking children are more likely to erroneously use pronominal forms for new referents in subject position than in object position, whereas adults reliably use lexical forms for new referents in both sentence positions. Together, these findings suggest that children only gradually learn an adult-like use of referent encoding.

Narasimhan & Dimroth (2008) investigated whether 3 and 5-year old German-speaking children have a preference for the ordering of given and new information. In an object naming task they presented children with two objects, one of which was new and one which they had seen before. The children were then asked to label the objects. The children preferred to label the new object before the given one, in contrast with the ordering normally associated with adult speech. In order to see whether the children's labelling might be a reflection of the input, Narasimhan & Dimroth (2008) also tested their caretakers on the same task. In contrast to the children, the caretakers preferred to mention given objects before new objects, thus suggesting that the children's ordering preference is not directly related to their input but rather can be considered a cognitive bias.

What these studies show is that children gradually acquire some sensitivity to different levels of informativeness but that even for simple utterances this may not be fully adult-like until relatively late in language development (e.g. beyond five years of age). Of interest in the current study is whether similar sensitivity to new and given information might be

observed for complex sentences, since children are learning to comprehend and produce these during the same period.

#### *Developmental studies of complex sentence ordering*

Diessel (2004) provides the most comprehensive (observational) study that examines the ordering of main and adverbial clauses from a developmental perspective. Although Diessel (2004) considers a larger number of adverbial clauses, there is particularly detailed data for the acquisition of *when*-clauses. Investigating corpus data from 5 English-speaking children between the ages of 1;3 and 5;1, he found that children younger than 3;0 prefer to put *when*-clauses into final position whereas sentence-initial *when*-clauses occur only later - before the age of 3;0 only 6.5% of *when*-clauses occurred in initial position. Between 3;0 and 4;0, the number increased to 31.3% on average and between 4;0 and 5;0 to 42.1% (cf. Diessel, 2004:168-169). Following Havilland & Clark (1974), Diessel (2004) relates this preference for final *when*-clauses to the two factors of *processing load* and *discourse-pragmatics* which, he argues, have a significantly greater effect in language learning children, though they are still important in adult language. With respect to processing load he argues that children's early subordinate clauses primarily occur in final position because of greater limits on their working memory in comparison to adults. Diessel's argument (2004; 2005) is based on Hawkins' (1994; 2004) parsing theory in which the relative distance or 'recognition domain' between constituents in a sentence affects ease of parsing. That is, in comprehension if the *when*-clause occurs after the main clause, the main clause can be processed as an independent clause unit and the *when*-clause can be processed afterwards, with only a short recognition domain between the main clause and the adverbial *when* in which the relation between the two clauses is established. In contrast, the human parser needs more time to recognise the relationship between the *when*-clause and the main clause in *when*-main orderings because the adverbial *when* must be kept in working memory

until its relation to the main clause can be resolved, requiring greater processing resources. Diessel (2005) also applied Hawkins' theory to utterance planning. That is, if the *when*-clause is produced in initial position, the speaker has to keep it in working memory while planning the main clause because the *when*-clause cannot be uttered as a separate intonation unit, if it is embedded in a complex sentence. However, if the *when*-clause is placed in final position, the speaker can plan the two clauses successively. The main clause can be uttered as a separate intonation unit which can function as a simple sentence (cf. Diessel, 2005), thus giving the speaker more time to plan the *when*-clause. Thus, Diessel (2004) argues that children do not produce initial *when*-clauses before the age of 3 because their processing and working memory capacities are too limited.

Diessel's results (2004) can also be related to those of Clark (1973) who reports that children start to produce coordinate clauses before they use subordination strategies. She found that young 3-year olds tended to produce adverbial clauses in which the adverbial clause occurred after the main clause whereas initial adverbial clauses were only produced by the older 3-year olds. She suggests that children start to produce coordinate clauses and main-before-adverbial clauses earlier than sentences with an adverbial-main clause order because coordinate clauses and main-adverbial orders tend to encode events in the order of their mention whereas adverbial-main structures tend to encode events in which the order of mention and clause order do not correspond with each other. According to Clark (1973), these latter structures make greater demands in terms of children's working memory capacities and thus emerge only later.

From the point of view of discourse-pragmatics, Diessel (2004) further argues that children might not produce initial *when*-clauses before the age of 3;0 because they serve a discourse-pragmatic function that is not needed in early child discourse. Their function is to establish a link to the previous discourse by enhancing discourse coherence (see also Chafe, 1984; Ford, 1993; Givón, 1990; Thompson, 1987). However, Diessel (2004) suggests that, in

early child discourse, children are much more likely to talk about referents that are physically present than about referents that have only been mentioned in the previous discourse. Similarly, Silva (1991) found that children prefer to place adverbial clauses such as *when* and *while* in initial position with increasing age (between 4;10 and 11;11) because they become more aware of their discourse-pragmatic function.

Although Diessel (2004; 2005) attributes the low occurrence of initial adverbial clauses in children's early speech to factors from discourse-pragmatics and clause-processing, he did not conduct a systematic analysis of the information status of *when*-clauses with respect to the previous discourse. Thus, it is impossible to determine from these corpus data the extent to which the early scarcity of *when*-clauses in initial position reflects processing vs. discourse-pragmatic factors. Furthermore, it is not clear exactly how these factors might be expected to interact.

#### *The present study*

The studies outlined above suggest that, on the one hand, children younger than 3;0 are already sensitive to information-structural cues at the phrasal level and that they tend to focus on new information (e.g. Baker & Greenfield, 1988; Narasimhan & Dimroth, 2008). On the other hand, in complex sentences, children are much more likely to put adverbial clauses in final position until the age of about 4;0. This suggests that, in complex sentences, processing factors might be quite strong before the age of 4;0 whereas discourse-pragmatic factors such as givenness and newness become more important at a later age. However, interpreting these findings is problematic due to the lack of control over the contexts present in naturalistic corpora. The present study focuses on the ordering of *when*-clauses. This clause type was chosen for a number of reasons. First, the aim was to examine clause ordering preferences in the absence of any specific causal or ordering relation between events (as is often implied by alternative clause types such as *because*, *so*). Second, a

preliminary search of the Manchester corpus (Theakston, Lieven, Pine & Rowland, 2001) revealed that adverbial clauses such as *before*, *after* and *while* and '*at the same time (as)*' are very rare in the data of the children and the input whereas *when*-clauses occur relatively frequently and are thus likely to be familiar to young children. Third, *when*-clauses are the first to appear in children's speech positioned both before and after their accompanying main clause and thus children are likely to have some awareness of the potential for positional variation (Diessel, 2004). Fourth, although *when* can function as a subordinate clause with close integration with its main clause, the distinction between subordinate and co-ordinate clauses is often not clear cut (Lehmann, 1988; Diessel, 2004), thus it lends itself to use in a context in which two events are relatively independent of each other. Finally, children start to produce *when*-clauses around the age of 3 years (Diessel, 2004), thus children at this age are expected to be able to indicate their comprehension of these sentences via a behavioural response. In the present study we investigate the ordering of given and new information in complex sentences in an experimental, act-out task in which the variables of main and subordinate clause order and the informational status of the clauses were systematically varied. This allowed us to evaluate the relative influence of clause type and order, and information status on children's and adults' comprehension of complex clauses.

The following research questions were addressed:

1. Do 3- and 5-year old children and adults show a preference for given-new or new-given ordering in their comprehension (act-out) of a complex sentence? According to the bulk of previous research there seems to be a preference for given-before-new (e.g. Arnold et al., 2000; Haviland & Clark, 1974; Narasimhan & Dimroth, 2008)
2. Do children and adults show a preference for main-*when* or *when*-main orders in their act-out of complex sentences? Previous research (Diessel, 2004; 2005) suggests that children and adults prefer main-*when* orders.

3. Are there interactions between clause order and the ordering of given and new information? Are there any differences as a function of age? According to previous research (Diessel, 2005; Ramsey, 1987; Silva, 1991), adult speakers should show some sensitivity to the tendency for initial *when*-clauses to encode given information. With increasing age, children should show increasing sensitivity to the discourse-function of initial *when*-clauses (see Clark, 1973; Diessel, 2004; Silva, 1991).

## **Method**

### *Participants*

Twenty-one typically-developing 3-year-olds ( $M=3;01.19$ ; 10 males; 11 females) and 16 typically-developing 5-year-olds ( $M=5;01.14$ ; 10 males; 6 females) were included in the study. All children had some level of nursery (3-year olds) or school experience (5-year olds). In addition, 16 adult participants (primarily undergraduate students) from the same geographical area were tested as controls. A further 11 children participated but had to be excluded from the analysis because they did not complete the session ( $N=4$ ), could not remember the actions ( $N=3$ ), did not perform the act out ( $N=2$ ), did not give any verbal response ( $N=1$ ) or due to experimenter error ( $N=1$ ). All participants were monolingual speakers of British English and were tested in the Max Planck Child Study Centre in Manchester or in their homes (2 children). All participants were tested in one testing session.

### *Procedure*

We used an act-out method in which the child heard a pre-recorded story from a speaker and then was asked to act out what s/he had just heard. To act out our test sentences, the child was presented with animal hand puppets and additional objects which s/he could use.

First, experimenter 1 (E1) made sure that the child was familiar with the names of the animals by asking him/her to label the hand puppets that she was going to use for the act out. E1 then told the child that they were going to play a game in which they would hear a story, and would then have to act out what they had heard with the hand puppets. The child was told to listen carefully and was promised a prize at the end of the game, if s/he played it well. E1 then started a warm-up session in which she and the child listened to 3 different stories which they heard from a loudspeaker. The 3 sentences in the warm-up session consisted of simple unlinked sentences (e.g. *The frog is jumping. The cat is running.*) E1 then showed the child how to play the game by first acting out the action with the hand puppet encoded by the first clause and then the action with the other hand puppet encoded by the second clause (e.g. *The cat is jumping. The dog is running.*). To avoid any training effects on the order of act out, E1 showed the child that any order was possible with the same target sentence by playing the sentence again and acting out the actions in the reverse order. A second experimenter (E2) sat at the other end of the table and prepared the hand puppets and objects for each trial on a tray which was pushed towards the child at the end of each story. Each act out trial started with E1 asking the child: *Can you show me what the animals did?* After the warm-up session the child was exposed to the 24 test sentences (i.e. complex sentences containing either a *when*-clause and a main clause or two conjoined clauses). After each trial, the child received positive feedback from the experimenter(s). For the purpose of coding and reliability checks, the child was video recorded. Adults were tested with exactly the same procedure.

### *Materials*

The stimulus materials consisted of animal hand puppets whose names were used as protagonists in pre-recorded stories that the participants heard from a speaker. The hand puppets were then used to act out what the child had heard in the story for each trial. The



hand puppets' names were selected based on parental reports of frequently used labels for animals by English-speaking children. The test sentences in the story consisted of a *when*-clause and a main clause or two main clauses which were manipulated for their order (i.e. WHEN-MAIN, MAIN-WHEN, MAIN-MAIN) and for the information status of the action encoded by the sentences (i.e. whether the verb in the *when* or main clause had occurred in the story before). The selection of intransitive verbs used in the study was based on the most frequent verbs found in the Manchester corpus (Theakston, et al., 2001; available on the CHILDES website, MacWhinney, 2000).

The stories that each child heard consisted of 3 sentences: a sentence which introduced the characters, a sentence which included the given action, and the test sentence which included the new and given action in the *when*- and main clause or in the two main clauses. For example, in the NEW-GIVEN & MAIN-WHEN condition (condition e in Table 1), one story that the children heard was as follows:

*Look, there's a dog and a cat!!!*

*The dog is pushing, he's pushing, he's pushing.*

*The cat is washing when the dog is pushing.* [TEST SENTENCE]

As 24 test sentences were used, each child heard 24 different stories. All test sentences and the stories in which they were embedded were pre-recorded by a native speaker of (British) English. To avoid a sequential or causal interpretation, the test sentences were produced under a single intonation contour and had no pauses between the main and the subordinate, or between the two main clauses.

### *Conditions*

The test sentences consisted of a *when*-clause and a main clause for which the order was manipulated (i.e. WHEN-MAIN or MAIN-WHEN). In addition, sentences involving two main clauses (i.e. MAIN-MAIN) were included to determine whether information structure influenced the ordering of given and new information, independently of the clause type. The clauses in the complex sentences (i.e. *when*-and main clause) were manipulated for their information status (i.e. given or new) to create 6 variable-level combinations (a- f in Table 1).

TABLE 1 ABOUT HERE

Each condition formed a test block and included 4 test sentences, that is, block 1: 4xGIVEN-NEW & WHEN-MAIN, block 2: 4xGIVEN-NEW & MAIN-WHEN, block 3: 4xGIVEN-NEW & MAIN-MAIN, block 4: 4xNEW-GIVEN & WHEN-MAIN, block 5: 4xNEW-GIVEN & MAIN-WHEN, block 6: 4xNEW-GIVEN & MAIN-MAIN. Thus, there were 24 test sentences in total. After half of the test blocks, the child was presented with a distracter task in order to maintain their motivation. Half of the participants started with the first 3 test blocks (i.e. blocks 1,2,3) presented in a counterbalanced order, and then were presented with the last 3 blocks (i.e. blocks 4,5,6), also in counterbalanced order after the distracter task. The other participants were presented with the reverse order of test blocks (i.e. a counterbalanced order of 4, 5, 6 and then 1, 2, 3). In addition, the order of presentation of the test-sentences within each test block was randomised for each participant.

The test sentences were controlled for length to avoid ordering effects due to syntactic heaviness (cf. Arnold *et al.* 2000). To avoid children failing to remember the complex sentence units, all verbs in the test sentences were presented intransitively (e.g. *the dog is eating/ pushing/drawing*) rather than transitively (e.g. *the dog is eating an apple/pushing the cat/ drawing a picture*). However, the hand puppets were presented with additional objects so that the participants could use these objects for the act out (e.g. an apple for the

test sentence: *The dog is eating*). To control for ordering effects due to cause-consequence patterns (e.g. *The cat is screaming and the dog is running away*), the test sentences did not contain actions that can be related to each other. Due to the low number of possible intransitive test verbs that are available, children received each verb twice, once within each of two different story contexts, one which occurred within the first three test blocks, and the second within the last three test blocks, and the information status of the verb was changed (i.e. given verbs in the first three blocks were then used in a new condition in the last three blocks and vice versa). In order to avoid interference from the changing information status of these verbs, we introduced a distracter task (i.e. jigsaw) in between the first three story contexts and the last three. In addition, the verb-combinations were randomised so that the participants did not hear the same verb-pairings in the two clauses again during the second half of testing.

### *Coding*

We coded the order in which the child acted out the actions in the test sentences (new-given vs. given-new). We then coded whether this was different from what they had heard in the test sentences. For those cases in which the child picked up one hand puppet, put it back down and then decided to pick up the other puppet in order to complete an action, we coded only those instances in which the child performed an action with the hand puppet. Thus, picking up the toy only without performing the action was not coded as the child's preferred first action since the child might have been only interested in the toy. As some actions (e.g. washing and wiping) were very similar to act out and the child might not have remembered the actions correctly, the experimenter asked the child what the current animal was doing while the child was performing the act out with the hand puppet (note that the experimenter started to ask for a verbal response only when the child had already started the act out). Typically, children only responded with the action (e.g. "Washing").

## Results

Our main focus was on the order in which the participants acted out the information (i.e. Did they change the order of information from new-given to given-new or from given-new to new-given in their act out?). For purposes of reporting results, the term 'order of information' is used to refer to the ordering of given and new information. We computed the mean proportion of changes in the order of information in their act outs per condition as a function of what they had heard in the relevant test sentences. To investigate whether the children's and adults' ordering of information was a function of processing factors (i.e. clause order) or information status (i.e. given or new), we ran a 2x3x3 mixed effects ANOVA, with two repeated measures factors: *order of information* (i.e. given-new or new-given) and *clause order* (i.e. WHEN&MAIN, MAIN&WHEN or MAIN&MAIN). *Age* was a between-subjects factor (3-year-olds, 5-year-olds, and adults).

FIGURE 1 ABOUT HERE

Figure 1 gives the mean proportion of changes in the order in which given and new actions were enacted, according to the *clause order & order of information* the participants had heard in the six conditions. The statistical analysis shows that there are significant main effects for *order of information* ( $F(1,50)=102.126$ ,  $p<.001$ ) and *clause order* ( $F(2,100)=5.028$ ,  $p=.008$ ). A significant 2-way interaction was found between *clause order\*age* ( $F(4,100)=5.255$ ,  $p=.001$ ) whereas interactions between *order of information\*age* ( $F(2,50)=1.655$ ,  $p=.201$ ), *clause order\*order of information* ( $F(2,100)=2.746$ ,  $p=.069$ ) and *clause order\*order of information\*age* ( $F(4,100)=1.323$ ,  $p=.267$ ) were not significant. To investigate the nature of the significant interaction, individual ANOVAS for each age group were carried out. Bonferroni adjustments were applied to control for multiple testing. For

the 3-year olds and 5-year olds there was a main effect of *order of information* (3-year olds:  $F(1,20)=36.545$ ,  $p<.001$ ; 5-year olds:  $F(1,15)=25.042$ ,  $p<.001$ ), but no main effect of *clause order* (3-year olds:  $F(2,40)=.986$ ,  $p=.382$ ; 5-year olds:  $F(2,30)=1.496$ ,  $p=.240$ ) nor an interaction between *clause order\*order of information* (3-year olds:  $F(2,40)=.782$ ,  $p=.464$ ; 5-year olds:  $F(2,30)=1.320$ ,  $p=.282$ ).

These data show that both 3-year olds and 5-year olds tended to change the order of information to *given-new* when they were exposed to a *new-given* structure in the test sentences (3-year olds: Mean proportion of changes = .63; 5-year olds:  $M=.66$ ), irrespective of the clause types used. For those test-sentences which already had a *given-new* order, the proportion of changes to *new-given* was much lower (3-year olds:  $M=.36$ ; 5-year olds:  $M=.29$ ). This suggests that a given-new bias might account for the order in which children enacted the test sentences whereas *clause order* does not have an impact on the children's choice.

For the adults there was a main effect of *clause order* ( $F(1.424,21.366)=7.536$ ,  $p=.007$ ) and of *order of information* ( $F(1,15)=40.474$ ,  $p<.001$ ), and a marginally significant interaction between the two variables ( $F(2,30)=3.219$ ,  $p=.054$ ). Mirroring the children's behaviour, the adults changed the order of information from new-given to given-new more often ( $M=.66$ ) than they changed the order for sentences presented in given-new order ( $M=.23$ ). However, unlike the children there was also an effect of *clause order*. Posthoc tests (Bonferroni) confirmed that the adults changed the order of information in their act-outs less often for test sentences containing a WHEN-MAIN order ( $M=.25$ ) than for those containing either a MAIN-WHEN order ( $M=.60$ ,  $p=.020$ ) or a MAIN-MAIN order ( $M=.47$ ,  $p=.005$ ). No differences were found between sentences containing a MAIN-WHEN and a MAIN-MAIN order ( $p=.601$ ). The marginal interaction reflected the adults' tendency to change the ordering of MAIN-MAIN structures from new-given to given-new at a rate similar to that seen for MAIN-WHEN structures. In contrast, they did not reverse the order of MAIN-

MAIN structures from given-new to new-given, but this was a trend observed for MAIN-WHEN structures. This reflects the overall preference for WHEN-MAIN clause order. Our results suggest that the adults prefer a WHEN-MAIN structure over a MAIN-WHEN structure, irrespective of the informational content.

## **Discussion**

This study investigated whether 3-year olds, 5-year olds, and adults are sensitive to informational (i.e. given vs. new) and structural (i.e. clause order) cues on the complex sentence level, both of which are thought to influence ease of processing, and how this is reflected in their comprehension of complex sentences, as measured by an act out task.

The results showed that 3-year olds, 5-year olds, and adults all preferred to put given elements before new elements in their act out of complex sentences when they were exposed to a new-given structure in the stimulus sentences. This suggests that information structure (i.e. given and new information) has a strong impact on how both children and adults comprehend complex sentences. Note that this is a particularly strong effect because the referents were referred to with full lexical NPs which could have worked to confuse the participants with respect to the information status of the referents. Clause order (i.e. the order of *when*- and main clause) was not found to have an effect on the children's act out of *when*- and main clauses. However, there was an effect of clause order for the adults tested in our study such that they changed the order of act out more often when they were exposed to a MAIN-WHEN structure than for WHEN-MAIN structures.

What accounts for the preference for given-new over new-given? As reported in the majority of studies reviewed above, the order of given before new information has some major processing advantages for the hearer. Thus, our results are in line with previous findings in the literature (e.g. Clark & Sengul, Garrod & Sanford, 1977; Haviland & Clark,

1974; 1979), but extend these findings to the comprehension of complex sentences in children.

However, our results differ from those of Narasimhan & Dimroth (2008) who found that children tend to mention new elements before given elements. There are a number of possible reasons for this. For one, the present study was based on a very different design. We embedded our test sentences in a language context (i.e. story context) whereas the stimuli in Narasimhan & Dimroth (2008) were presented non-verbally. Task complexity might be another factor: our task contained complex sentences whereas Narasimhan & Dimroth's study required participants to name two objects with a simple NP. There might be differences between the ordering of information in production and comprehension (note that Narasimhan & Dimroth's study was based on language production whereas this study was based on comprehension). Finally, Narasimhan & Dimroth (2008) tested information structure in isolation whereas we tested the information status of complex sentences in association with clause order. These findings are also compatible with a large body of evidence showing that children's use of referring expressions typically follows a given-new pattern. More specifically, children prefer to use subjects which typically encode given information and objects which typically encode new information (see Allen et al., 2008; Matthews et al., 2006; Salomo et al., 2010; Serratrice, 2005; 2006).

Our finding that clause order had an effect on the responses of the adults but not the children requires greater consideration. The adults showed a preference for WHEN-MAIN (i.e. SUBORDINATE-MAIN) over MAIN-WHEN (i.e. MAIN-SUBORDINATE) ordering, irrespective of information structure. Interestingly this does not support Diessel (2001; 2005) who found that adult speakers of English show a preference for MAIN-SUBORDINATE over SUBORDINATE-MAIN and a cross-linguistic tendency for MAIN-SUBORDINATE for right-branching languages. Although Diessel's studies are based on language production (i.e. spontaneous speech) he (2005; 2008) argues that there is also a processing advantage for

MAIN-SUBORDINATE in comprehension because the main clause can be fully processed before the subordinate clause. In contrast, if the subordinate clause precedes the main clause, the whole subordinate-unit has to be kept in working memory until the main clause is processed (see also Foss & Lynch, 1969; Hawkins, 1994; 2004; Tanenhaus & Carroll, 1975).

One possible line of explanation for our findings might be that the adults had certain semantic expectations about *when*- and main clauses. The *when*- and main clauses in our study were controlled for their semantics. To avoid ordering effects due to cause-consequence patterns (e.g. When the dog is barking the cat is running), we only used complex sentences that were truly simultaneous (e.g. When the cat is jumping, the dog is eating.). However, the adults might have interpreted the actions encoded by the *when*- and main clause as consecutive, especially given that they were asked to act out one action followed by the other (to allow unambiguous coding of their ordering of information according to clause type and information status). This might have influenced their choice of clause order. To investigate this possibility, we examined Diessel's (2008) corpus data from adult speakers. Diessel's analysis showed that although the majority of *when*-clauses were used to express simultaneity (86%), there were also instances of consecutive events (14%). Interestingly, 56% of the consecutive events had initial *when*-clauses in comparison with only 22% of simultaneous events. This suggests that although *when*-clauses are relatively infrequently used to mark consecutive events, when used in this way the *when*-clause is more likely to appear in initial position, in comparison to simultaneous events. Thus, if the adults in our study interpreted the events as consecutive rather than simultaneous, this might account for their preference for initial *when*-clauses. We should also bear in mind that many temporal adverbials including *when* can take a conditional meaning (Quirk, Greenbaum, Leech & Svartvik, 1985), and conditional adverbials appear in preposed position around 73% of the time (Diessel, 2005). Thus, specific interpretations of *when* clauses have different implications for their preferred positioning.



Taking a developmental perspective into account, why does clause order have an impact on the adults' comprehension of complex sentences whereas it has no effect on the children? One line of explanation might be that children do not have sufficient exposure to *when*-clauses in different orders or to encode both simultaneous and consecutive events at the early stages of acquisition whereas adults are exposed to both structures and meanings much more frequently. Thus, the adults could be more sensitive to clause order in general, and its relation to meaning. To see whether there is a relation between the use of *when*- and main clauses in the input to children and the children's performance in the current study, we coded 100 randomly selected *when*-clauses from child-directed speech (CDS) using the input data from the Thomas corpus (age range 2;07.02-4;11,.20; Lieven, Salomo, Tomasello, 2009) for their semantics (simultaneous, consecutive) and position in the complex sentence-unit (initial or final). First, we found that 48% of these *when*-clauses were initial whereas 52% occurred in final position. Second, *when*-clauses were used equally often to express consecutive (51%) and simultaneous actions (49%). Finally, initial *when*-clauses accounted for 50% of consecutive events and 46% of simultaneous events. Thus, the child had roughly equal exposure to both clause orders, and both types of events. These data contrast with Diessel's adult data where there was a stronger preference for both MAIN-WHEN order and simultaneous events. There is also little if any relation between consecutive events and the use of initial *when*-clauses in the CDS, whereas this association was found in Diessel's adult data. Thus, it is possible that the difference in clause order preference between children and adults is due to a different pattern of use of *when*-clauses in early CDS compared to in adult language. In particular, based on this sample of CDS children have little reason to prefer one clause ordering over another, and are unlikely to associate initial *when*-clauses with consecutive events. However, as we have only examined data for one child, a detailed analysis of input data addressed to a wider range of children is needed to draw a strong conclusion. Another possibility is that the children essentially ignored the ordering of main

and *when*-clauses in the current study. None of the clause orders was designed to have a particular semantic or discourse-pragmatic function, although it was hypothesised that they may have differing processing requirements, and children may rely on prior knowledge of their typical discourse pragmatic function. However, if the children paid attention solely to the given-new distinction and treated the two clauses as if they were stand-alone main clauses, this would result in an apparent lack of sensitivity to clause order. Under different discourse pragmatic conditions, perhaps children would indeed show a preference for one clause order over another.

Another possible line of explanation might be that the adults prefer initial *when*-clauses because they serve a particular function in discourse. Diessel (2005:459) argues that initial adverbial clauses in adult language are "*commonly used to organize the information flow in the ongoing discourse; they function to provide a thematic ground or orientation for subsequent clauses*" (see also Chafe, 1984; Ford, 1993; Givón, 1990; Lambrecht, 1994; Thompson, 1987). In so doing, the adults might have a preference for initial *when*-clauses because they establish a link for the main clause by providing a context clause which helps to understand how the whole complex sentence unit has to be interpreted in terms of its informational content. The children might not be sensitive to this rather complex function in discourse yet and they develop this only later, or initially require the presence of more concrete discourse-pragmatic cues.

A final possible line of explanation might be a difference in the memory capacities of children and adults. Our task involved remembering both clauses in order to act them out. Adults have much better memory capacities than children. This could mean that they are better able to remember not only the information structural properties of the referents, but also the particular clause types used to convey this information, and integrate these two sources of information. Children may face problems in this process, outlined below.

The differences between the children and adults in the current study raise the question how children start to develop sensitivity to clause order and information structure on the complex sentence level. One possible path of development might be that children start out by using informational cues independently of processing cues. Our 3- and 5-year old children seem to have a bias for given-new as they tended to reverse the order of actions when they were exposed to a new-given structure. Even if they remembered the clause types used to convey new and given information, they may have failed to appreciate their discourse properties, and thus have discounted this source of information, showing no sensitivity to their function. Indeed, remembering the clause types might have been particularly difficult given that the referents of both clauses were referred to with full noun phrases rather than using pronouns to refer to the given referent. Processing sentences with multiple lexical noun phrases is known to affect children's interpretation of other sentence constructions, especially when the typical usage of these constructions in child directed speech includes pronouns or proper nouns (e.g. relative clauses, Kidd, Brandt, Lieven & Tomasello, 2007, dative constructions, Rowland & Noble, 2011). It might be only later (beyond the age of 5), when children have accumulated greater linguistic experience with different types of clause order, that they can establish a link between information structural-properties and clause order in order to maximise their comprehension of complex sentences. An alternative is that as complex sentence structures require heavier cognitive load, young children up until at least 5-years of age might remember the clause orders and have some understanding of their function, but be unable to fully integrate clause order with information-structural properties and/or transfer this information into their act-outs due to their limited processing capacities. However, the present study did not adopt any direct measure of working memory and processing capacities. Clearly further research is needed to distinguish these possibilities.

Diessel (2004) suggested that processing constraints (i.e. MAIN-WHEN vs. WHEN-MAIN) might have a larger impact on children's production of *when*-clauses around the age of 3- to 4-years whereas information-structural properties might become more important only later when children start to talk in more complex ways about referents that are not present in their physical environment. If this has a similar impact on children's comprehension of *when*-clauses, clause order should have had a strong effect on children's act out of the actions in our study (i.e. the children should show a preference for MAIN-WHEN over WHEN-MAIN clause order) whereas information structure should be less influential for 3-year old children. This is not what we found, although we have to bear in mind that we cannot draw a direct link between our comprehension results and previous production studies. On the other hand, the fact that the children in Diessel's (2004) study did not produce WHEN-MAIN sentences before the age of 4-years cannot be considered to demonstrate a preference for MAIN-WHEN clause order because it might be due to a lack of contexts in which WHEN-MAIN sentence types are appropriate, or a lack of appropriate input (although our preliminary corpus analysis suggests children do receive input of this type). Further research is needed to see whether there is a direct link between the complex sentence structures children hear and the order in which they are produced.

To summarise, our study suggests first that children (and adults) have a bias for given before new information in their comprehension of complex sentence units. This contrasts with a previous finding that young children prefer to verbalise new information before given information. However it supports the general assumption that given before new information is easier to process than new before given because the human parser needs more time to retrieve new information whereas given information can be accessed much faster (see Diessel, 2005; Haviland & Clark, 1974). It is also in line with the majority of findings from adult language studies within the domains of production and comprehension. While the

majority of studies have investigated this phenomenon on the phrase level, the present study has focused on the complex sentence level.

Second, our study suggests that it is not only information structure but also clause order that impacts on the comprehension of complex sentences for adults, whereas this was not found amongst the children. We suggest that this might be due to the adults having had more experience with the different clause orders and their associated semantics. More specifically, we suggest that the adults' preference for *when*-clauses in initial position might be due to the fact that WHEN-MAIN structures in adult language are favoured to mark consecutive events, and to create a link between the previous context and the main clause. Children may only establish this sensitivity later in development, and their ability to integrate clause-order and informational-structural properties may be limited by their processing capacity.

Our results therefore suggest that information structure is an early and important organising principle in children's comprehension of complex sentences but sensitivity to the more complex discourse effects of variations in clause order are not yet fully acquired by the age of 5;0. However, clearly the scope for extensive future research will be to examine these factors within other types of complex sentences. For example, it would be interesting to determine whether children's responses are similar for other kinds of clause types which carry similar meanings (e.g. *and*, *at the same time*), or to establish the effects of manipulating the extent to which the events are viewed as integrated or independent. In addition, cross-linguistic comparisons are needed to see determine how these factors operate in complex sentences cross-linguistically.

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**Appendix A:** Warm-up and test sentences

<b>WARM-UP</b>	<b>WARM-UP ITEMS</b>
<b>W.1</b>	Look, there's a bear and a bunny! The bear is dancing, he's dancing, he's dancing! The bear is dancing. The bunny is jumping.
<b>W.2</b>	Look, there's a monkey and a mouse! The mouse is sliding, he's sliding, he's sliding! The monkey is phoning. The mouse is sliding.
<b>W.3</b>	Look, there's a bunny and a mouse! The bunny is sticking, he's sticking, he's sticking! The mouse is folding. The bunny is sticking.

<b>Block 1: WHEN &amp; MAIN, GIVEN-NEW</b>	<b>TEST ITEMS</b>
<b>1.1</b>	Look, there's a cat and a dog! The cat is sitting, he's sitting, he's sitting! When the cat is sitting the dog is reading.
<b>1.2</b>	Look, there's a frog and a duck! The duck is drawing, he's drawing, he's drawing! When the duck is drawing the frog is climbing.
<b>1.3</b>	Look, there's a sheep and a pig! The sheep is wiping, he's wiping, he's wiping! When the sheep is wiping the pig is catching.
<b>1.4</b>	Look, there's a cow and a horse! The horse is drinking, he's drinking, he's drinking! When the horse is drinking the cow is crying.

<b>Block 2: MAIN &amp; WHEN, GIVEN-NEW</b>	<b>TEST ITEMS</b>
<b>2.1</b>	Look, there's a sheep and a duck! The sheep is riding, he's riding, he's riding! The sheep is riding when the duck is eating.
<b>2.2</b>	Look, there's a cat and a pig! The pig is cutting, he's cutting, he's cutting! The pig is cutting when the cat is throwing.
<b>2.3</b>	Look, there's a cow and a dog! The cow is swimming, he's swimming, he's swimming! The cow is swimming when the dog is building.
<b>2.4</b>	Look, there's a frog and a horse!

	The horse is pulling, he's pulling, he's pulling! The horse is pulling when the frog is washing.
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<b>Block 3: MAIN &amp; MAIN, GIVEN-NEW</b>	<b>TEST ITEMS</b>
3.1	Look, there's a sheep and a dog! The sheep is sleeping, he's sleeping, he's sleeping! The sheep is sleeping and the dog is driving.
3.2	Look, there's a cow and a duck! The duck is brushing, he's brushing, he's brushing! The duck is brushing and the cow is pushing.
3.3	Look, there's a frog and a pig! The frog is writing, he's writing, he's writing! The frog is writing and the pig is painting.
3.4	Look, there's a cat and a horse! The horse is singing, he's singing, he's singing! The horse is singing and the cat is playing.

<b>Block 4: WHEN &amp; MAIN, NEW-GIVEN</b>	<b>TEST ITEMS</b>
4.1	Look, there's a sheep and a cow! The sheep is wiping, he's wiping, he's wiping! When the cow is reading the sheep is wiping.
4.2	Look, there's a frog and a cat! The cat is sleeping, he's sleeping, he's sleeping! When the frog is catching the cat is sleeping.
4.3	Look, there's a duck and a horse! The duck is singing, he's singing, he's singing! When the horse is eating the duck is singing.
4.4	Look, there's a pig and a dog! The dog is drinking, he's drinking, he's drinking! When the pig is painting the dog is drinking.

<b>Block 5: MAIN &amp; WHEN, NEW-GIVEN</b>	<b>TEST ITEMS</b>
5.1	Look, there's a sheep and a cat! The sheep is swimming, he's swimming, he's swimming! The cat is driving when the sheep is swimming.
5.2	Look, there's a cow and a frog! The frog is drawing, he's drawing, he's drawing! The cow is crying when the frog is drawing.
5.3	Look, there's a horse and a pig! The horse is cutting, he's cutting, he's cutting! The pig is washing when the horse is cutting.



5.4	Look, there's a duck and a dog! The dog is brushing, he's brushing, he's brushing! The duck is throwing when the dog is brushing.
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Block 6: MAIN & MAIN, NEW-GIVEN	TEST ITEMS
6.1	Look, there's a frog and a sheep! The frog is writing, he's writing, he's writing! The sheep is building and the frog is writing.
6.2	Look, there's a cow and a cat! The cat is sitting, he's sitting, he's sitting! The cow is climbing and the cat is sitting.
6.3	Look, there's a duck and a pig! The duck is riding, he's riding, he's riding! The pig is pushing and the duck is riding.
6.4	Look, there's a horse and a dog! The dog is pulling, he's pulling, he's pulling! The horse is playing and the dog is pulling.

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Table 1. Variable-level combinations for order of information and order of *when*- and main clause

		order of information	
		GIVEN-NEW	NEW-GIVEN
order	WHEN-MAIN	a	d
WHEN &	MAIN-WHEN	b	e
MAIN	MAIN-MAIN	c	f

Figure 1. Mean proportion of changes in the order of act outs

