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The contest of the *causer* contender and the *agent* defender

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Abstract

Skilled and impaired language users can fail to understand sentences with noncanonical thematic role ordering. To advance understanding of the cause of the difficulty, we compared noncanonically ordered, object-experiencer-verb (OE) sentences to canonical agentive sentences in otherwise comparable syntactic structures. However, the field has neglected to consider that OE thematic roles may be altered by the comprehender's interpretation; the aim of the investigation reported here was to address this research gap. We collected participants' thematic role interpretations for sentences while measuring incremental processing speed as they read the sentences in a self-paced reading paradigm. Fluent English speakers rated the intent of the subjects of OE and agentive active sentences and of the objects of OE and agentive passive sentences. Consistently high ratings of intent identified a cluster containing agentives and an OE eventive subtype with an *agent*. In contrast, a spread of ratings in a second cluster suggested labile interpretation for a second OE subtype. Splitting the labile group at its active and passive mean, we compared reading time of OE and agentive sentences with a higher-intent, *agent* interpretation with OE sentences with a low-intent *causer/theme* interpretation. Whether active or passive, canonicity as determined by the relative prominence ordering of the rated role compared to the necessary OE *experiencer* or agentive *theme*, accounted for reading speed at the verb, second noun, and prepositional phrase. We propose that the results support an *agent* > *experiencer* > (*causer*)/*theme* thematic role hierarchy, suggesting refinements to event structure theory and little *v*/CAUS morphology.

Keywords: agent; canonicity; causer; experiencer verbs; event structure aspect; little *v*; processing speed; thematic role hierarchy

1. Introduction

Skilled language users can be slower and more error-prone when producing and comprehending written (Brennan & Pytkänen, 2010; Cupples, 2002; Grodzinsky, 1995; Jacobs & Thompson, 2000; Szterman & Friedmann, 2014) or auditory sentences (Jacobs & Thompson, 2000; Lee, 2017; Meltzer-Asscher *et al.*, 2015; Schipke *et al.*, 2012; van der Lely, 1996) with a nontypical ordering of thematic roles across languages (Beretta & Campbell, 2001; Grimshaw, 1990). This difficulty may be insurmountable for young children (in German: Schipke *et al.*, 2012), second language learners (of Spanish: Lee, 2017) and for those with language impairments, such as from stroke (Jacobs & Thompson, 2000), hearing impairment (Szterman & Friedmann, 2014), specific language impairment (van der Lely, 1996) and short-term memory impairment (in Korean: Sung, 2015). A deeper understanding of the source of these difficulties is important not only for theory but also for optimisation of communicative environments and for remediation for these individuals.

The aim of this investigation is to determine which features of sentence syntax and event structure make them more difficult to process. We analyse thematic role identity and ordering and sentence event structure, comparing common ordering with misordered sentences both with and without morphological marking to indicate their ordering divergence. We first examine the proposals for hierarchies of thematic role prominence. We then describe how thematic role prominence manifests in more typical agentive actives and passives. We describe the alterations in thematic role prominence predicted for experiencer-verb sentences and test these predictions. Then, we test whether thematic role identity is influenced by the comprehender's interpretation. Finally, we test which of these features make sentences more difficult to process.

1.1. Canonicity

A sentence is thematically canonical if it follows a first-to-last prominence ordering of thematic roles along a hierarchy (Bates *et al.*, 1982; Slobin & Bever, 1982).¹ Thematic role hierarchies propose explanations for language behaviour, such as our tendency to order the thematic roles of the arguments of sentences from first to last according to hierarchical thematic-role prominence (like the dominant proposals listed in Table 1), the increased difficulty processing sentences that are atypically ordered, our intrinsic ability to judge the grammatical acceptability of sentences, and

¹Note that there are additional factors which can influence canonicity: Sentences can also be canonical if they follow a subject-verb-object (SVO) word order (Birner & Ward, 2009; Biber *et al.*, 1999; Quirk *et al.* 1985). It is also canonical for an animate noun to precede an inanimate noun (Croft, 2003), or for the first sentence participant to coincide with earlier timing in the sentence's event sequence (Rappaport-Hovav & Levin, 2007). First or second person tends to occur before third person (Bates *et al.*, 1982). External thematic roles tend to occur before internal roles (Reinhart, 2002). Finally, more highly imageable thematic roles tend to precede less imageable roles (Bock & Warren, 1985) However, the current investigation is concerned with thematic role canonicity with these other factors influencing prominence controlled for in the experimental design.

Table 1. Theoretical proposals of thematic role hierarchies

Hierarchy	Theorist	Date
<i>Agent > Instrument > Theme</i>	Fillmore	1968
<i>Agent > Goal/Source/Location > Theme</i>	Jackendoff	1972
<i>Agent > Benefactor > Patient > Location > Instrument</i>	Givón	1984
<i>Agent > Experiencer > Theme</i>	Belletti & Rizzi	1988
<i>Agent > Instrument > Patient/Theme > Goal/Location</i>	Baker	1989
<i>Actor > Patient/Benefactor > Theme > Goal/Source/Location</i>	Jackendoff	1990
<i>Agent > Effector > Experiencer > Location > Theme > Patient</i>	Van Valin	1990
<i>Agent > Experiencer > Goal/Source/Location > Theme</i>	Grimshaw	1990
<i>Agent?/Causer > Experiencer > Target/Subject Matter</i>	Pesetsky	1995

commonalities in syntax across languages, such as the tendency to obligatorily require subjects (Chomsky, 1993).

Some of the roles and ordering differ across proposals. However, the *agent* is invariably regarded as the most prominent thematic role. The *theme* (often considered to be the same role as the *patient*) is lower in prominence. Hence, an English active-voice sentence, with *agent-verb-theme* ordering – ‘*Mary washed the clothes*’ – is canonical as well as being a common sentence we encounter. Noncanonical sentences violate this first-to-last prominence ordering. For example, they may have their *theme* before their *agent*, such as in the passive sentence, ‘*Peter was instructed by Mary*’.² (Abbot-Smith et al., 2001; Bock & Levelt, 1994; Chomsky, 1995; Cinque, 2013; Grimshaw, 1990; Levin & Rappaport-Hovav, 1995; Love et al., 2003; Manouilidou et al., 2009; Meltzer-Asscher et al., 2015; Pinker, 1989, 2016; Shapiro et al., 1991; Van Valin, 1991).

Due to the more common canonical ordering, comprehenders can often correctly deduce sentence meaning without attention to sentence syntax by assuming the first noun is the *agent* (Bates et al., 1982; Slobin & Bever, 1982). They can also arrive at a correct understanding through a logical combination of content words. For example, for ‘*The ball was kicked by Mary*’, it would not be consistent with our world knowledge for the ball to be the *agent*. Similarly, the discourse context can aid comprehension (Ward & Birner, 2019).³ However, when sentences are both non-canonical and semantically reversible – meaning that either noun could potentially act in either thematic role – and are not facilitated by discourse context – correct interpretation relies on word order and morphosyntactic information (Ferreira, 2003; Richardson et al., 2010; Grodzinsky, 1995). For example, for the passive sentence with two human, animate nouns, ‘*Peter was instructed by Mary*’, the *agent* cannot be identified through logical deduction, and application of an *agent*-first heuristic would yield an incorrect interpretation (Stella & Engelhardt, 2022; Richardson et al., 2010; Grodzinsky, 1995).

²English relies heavily on word order to mark thematic roles, however, other languages (e.g., German; ergative Australian Aboriginal languages) can show greater variation in word order even in active voice because they can mark thematic roles using morphological affixes. However, we still see an *agent*-first tendency (e.g., Scheepers et al., 2000; Nordlinger et al., 2022).

³Although added context may not counteract the effects of noncanonical sentence ordering (Brennan & Pyllkkänen, 2010; Szterman & Friedmann, 2014).

Despite numerous studies pointing to the processing benefit of canonical ordering, experiments aiming to discover the mechanism underpinning this benefit contain confounds (Agnew *et al.*, 2014; Chomsky, 1993; Friedmann *et al.*, 2008). For example, a comparison of actives with passives conflates voice and sentence length with canonicity because passives differ from actives not only in canonicity but also in voice, and number of words and morphemes (Beretta & Campbell, 2001; Ferreira, 2003). Other studies have included alterations of case (Gattei *et al.*, 2015) or animacy (Cupples, 2002; Nordlinger *et al.*, 2022). While the above studies do provide valuable insights into syntactic comprehension, a purer investigation of canonicity is also warranted. Therefore, the current investigation aimed to investigate the canonical ordering of thematic roles, controlling for sentence length, voice, case, and animacy, when comparing processing of English transitive sentences containing object experiencer (OE) verbs with agentive sentences.

1.2. Object-experiencer verbs

OE verbs, such as *'frightened'* and *'bored'*, feature *theme-verb-experiencer* ordering in active voice (e.g., *'Peter depressed Mary'*: Ryan *et al.*, 2025a; Ryan, 2024; Beretta & Campbell, 2001; Brennan & Pylkkänen, 2010). Since the thematic role hierarchy proposals place an *experiencer* thematic role as intermediate in prominence between an *agent* and a *theme*, this active-voice ordering is noncanonical. Syntactic theorists and experimental researchers tend to class these OE actives as 'stative', describing ongoing states rather than dynamic events (Belletti & Rizzi, 1988; Grimshaw, 1990; Pesetsky, 1995). However, syntactic theorists propose a second, eventive/agentive subtype of OE verb that forms sentences with canonical *agent-verb-experiencer* ordering (Belletti & Rizzi, 1988; Grimshaw, 1990; Landau, 2010; Pesetsky, 1995; Verhoeven, 2010, 2017), for example, *'Mary encouraged Peter'*. For these sentences, their first noun is seen as deliberately or intentionally causing an emotion, resembling an agentive (Belletti & Rizzi, 1988; DeLancey, 1985; Landau, 2010; Verhoeven, 2010). Psycholinguistic investigations of experiencer-verbs have tended to overlook the possibility that they may be generalising across OE subtypes that differ significantly in thematic identity and canonicity. Since the manipulation of concern is thematic role ordering, it is imperative that these differences are controlled empirically (Beretta & Campbell, 2001; Brennan & Pylkkänen, 2010). Ryan *et al.*'s (2025a) results identified a subtype with a role rated as an *agent*, and they therefore suggested that prior empirical results are likely to have been influenced by generalisation across differing subtypes.

1.3. The causer

Despite characterising active OE subjects as varying between an *agent* or *theme* role, several syntactic theorists have also proposed that this thematic role is a *causer*, with *causer-verb-experiencer* ordering (Arad, 1998; Croft, 1993; Grimshaw, 1990; Landau, 2010; Pesetsky, 1995). For example, in *'Mary annoyed Peter'*, it is plausible that *'Mary'* has caused *Peter's* fright whether or not she was an *agent* who deliberately intended to do so. Pesetsky suggests that in active sentences, the *causer* is the subject of both stative and eventive OE subtypes. He regards the *causer* as an external thematic role,

projected by a non-pronounced (in English) CAUS morpheme, high in prominence on his thematic hierarchy:

...causer > experiencer > target/subject matter⁴...

In support of Pesetsky's *causer* role, Croft (1993) describes a causal morpheme like Pesetsky's (1995) CAUS for languages such as Lakhota and Classical Nahuatl, where OE verbs are marked with a causative affix. Consistent with the *causer* role, Ryan et al. (2025a) found evidence for a general causal attribution to active OE subjects. However, a *causer* and an *agent* differ in that while the *agent* is intentional, a *causer* may 'cause' the event without intent (Landau, 2010; Verhoeven, 2017). Indeed, Pesetsky's high prominence *causer* conflicts with his description of OE statives which he suggests feature low-prominence active subjects. Pesetsky's proposals conflict: If the active OE subject is a high-prominence *causer*, both subtypes would be canonical, whereas if the stative subtype features a *theme*, this subtype would be noncanonical.

1.4. OE verbs are labile

Verhoeven (2010, 2017; see also Belletti & Rizzi, 1988; Landau, 2010; Langacker, 1990) raises another possibility, that OE verbs are neither stative nor eventive/agentive but are labile, able to be interpreted EITHER statively or agentively. Like subtypes, this possibility appears plausible, yet remains untested to our knowledge. If OE sentences are indeed labile, this is an important potential further experimental confound that requires control in experiencer-verb investigations.

Amid the contention surrounding OE actives, further debate surrounds OE passives, such as, '*Peter was humiliated by Mary*'. While the first noun in the passive is an *experiencer*, syntactic theorists do not present clear predictions as to the identity of the second noun. Pesetsky (1995) and Landau (2010) suggest that the thematic role of the 'by'-phrase noun is a low-prominence *target* or *subject matter* and also that the presence of the 'by'-phrase forces a verbal passive with a high-prominence *agent*. Ryan et al.'s (2025a) psycholinguistic investigation demonstrated that the thematic role of the passive 'by'-phrase object mirrored the role of its active subject – either *agent* or *theme* depending on subtype. Hence, a subtype was noncanonically ordered, *experiencer*–was verbed by–*agent*, and a second subtype canonically ordered, *experiencer*–was verbed by–*theme*. Syntactic theorists have asserted that OE passives have lost their causal feature (Grimshaw, 1990; Landau, 2010; Pesetsky, 1995). However, Ryan et al.'s participants consistently attributed these passive objects causality. As with active voice, the varied impact on canonicity and hence, processing, of passive subtypes cannot be overlooked and needs to be attended to in investigations of experiencer verbs.

1.5. The lexicon

It is important to consider the possibility that individual sentence canonicity does not adhere to a general prominence hierarchy, but rather, each individual verb's

⁴The *target* and *subject matter* roles Pesetsky (1995) describes are low prominence and so are similar in prominence to *themes*.

lexical entry should specify its own idiosyncratic preferential canonical order of thematic roles, such that a low-prominence *theme* role might be expected as subject for stative OE actives. However, if we interpreted sentences via each verb's individual lexical specification, we could not begin to process them until the sentence verb was encountered. For English sentences, one or many words can precede the verb, and evidence indicates that we begin to interpret sentences as soon as they start (Hartshorne *et al.*, 2015; Slobin & Bever, 1982). Most sentences have a canonical version, including the eventive interpretation of these stative OE subtypes, so if the prominence hierarchy were idiosyncratic, we would potentially need to store both of these verb homophones to accommodate varying interpretations. It appears more likely that we apply a general, hierarchically organised sentence parse that can be updated once we encounter lexical or morphological cues to alter our predictions.

Chomsky (1993) proposes that a verb's lexical entry specifies the arguments/thematic roles that the verb requires, and that they are ordered according to a general hierarchy. To form a sentence, an argument lower in prominence is projected to the complement position internal to the verb phrase, straight after the verb. The most prominent argument is generated above the verb, moving to a position external to the verb phrase (Koopman & Sportiche, 1991), such as the external *agent* subject in an agentive *agent-verb-theme* sentence (Chomsky, 1993; Grimshaw, 1990; Landau, 2010). When the eventive OE subtype has an *agent-verb-experiencer* ordering, this more prominent *agent* role is also described as external (Arad, 1998; Croft, 1993; Landau, 2010; Pesetsky, 1987). Chomsky describes that the external role is absorbed by the passive morpheme in formation of a passive, and is added optionally in the 'by'-phrase. He describes that the internal thematic role is projected to subject, since according to his Extended Projection Principle (EPP: Chomsky, 1982) sentences require a subject.

In comprehension, we begin processing from the first word in a sentence, and make an initial interpretation that the sentence is a common canonical active agentive. If, on encountering the passive morpheme or verb, we realise this interpretation is incorrect, we will necessarily reanalyse. This reanalysis may involve mentally moving the internal argument from the sentence subject back to its base position, so it is aligned with the thematic role hierarchy in the sentence verb's lexical entry. (Brennan & Pyllkänen, 2010; McKoon & Macfarland, 2002; Meltzer-Asscher *et al.*, 2015). However, moving the internal role to its base position would slow processing down at this point in the sentence progression.

Belletti and Rizzi (1988) argue that for stative OE actives, the more prominent *experiencer* is generated after the verb as a sister to the internal thematic role, anchored there due to inherent lexical case. They describe that the internal *theme*, also projected as a verb complement, is moved to the subject to satisfy the Extended Projection Principle, comparable to a passive (Agnew *et al.*, 2014; Friedmann *et al.*, 2008; Grimshaw, 1990; Pesetsky, 1995). If stative OE actives have internal *theme* subjects, they cannot undergo regular passivisation since we cannot further derive a derived subject (Belletti & Rizzi, 1988; Grimshaw, 1990; Pesetsky, 1995). Instead, stative OE passives form adjectival passives, such as '*Peter was surprised by Mary*'. Here, the verb is '*was*', and '*surprised*' is an adjective (Belletti & Rizzi, 1988; Grimshaw, 1990; Kratzer, 2000; Pesetsky, 1995; van der Lely, 1996).

Disagreement surrounds whether the *experiencer* subject of adjectival passives is an external argument. Grimshaw (1990) and Landau (2010) describe the adjectival

passive *experiencer* as an added external argument to the structure. Kratzer (2000) and McIntyre (2013), on the other hand, argue that it is not external and that adjectival passives can sometimes have an implicit *agent* or *causer* in the 'by'-phrase. McIntyre's description suits eventive OE passives with an *agent* in the 'by'-phrase which renders them noncanonical. Grimshaw's characterisation describes stative adjectival passives that are canonical, the *experiencer* subject more prominent than the low-prominence *theme* role in the 'by'-phrase.

1.6. Little *v*

While the focus above has been on thematic roles, the Distributed Morphology branch of theoretical linguistics has more recently recommended we replace psycholinguistic investigation of thematic roles with investigations of 'little *v*' (Marantz, 2013). Little *v*, similar to Pesetsky's (1995) CAUS morpheme, is a light verb or functional morpheme that is often phonetically null and denotes the sentence's event structure. According to little *v* proponents, event structures are eventive/causative or stative (Marantz, 2013). Little *v* is positioned immediately above the verb/verb phrase (Larson, 1988; Marantz, 2013), the base position of the external thematic role. Accordingly, theorists propose it assigns the external thematic role – an *agent* or *causer* – and active sentence voice. Some researchers have split little *v* into Voice (Kratzer, 1996; Schäfer, 2009) and Applicative (AppI; Marantz, 2013; Pylkkänen, 2002) sitting above little *v*. 'AppI' is tasked with assigning the external *agent* or *causer* argument for an eventive or causative little *v* (Alexiadou & Schäfer, 2006; Kallulli, 2007; Pesetsky, 1995). Little *v* (or 'Voice' for proponents of a split) also has a passive variety that is stative, that absorbs the external thematic role, instead projecting an internal *theme* to the sentence subject.

Experiencer-verb sentences allow unique insight into sentence event structure and offer the possibility of testing and potentially refining little *v* theory. Psycholinguistic experiments with experiencer verbs provide results that dispute the little *v* account. While an eventive little *v* should project an external *agent* or *causer*, Ryan et al. (2025a) found causal attribution to both stative and eventive active subjects, and Pesetsky (1995) describes a *causer* for all OE actives, a subtype of which he describes as stative. Additionally, though a passive little *v* is regarded as stative, Ryan et al.'s (2025a) participants attributed causality to both eventive and stative passive 'by'-phrase objects. Furthermore, a passive little *v* that is stative cannot account for OE actives with an internal *theme* subject, which are generally regarded as stative. Finally, Belletti and Rizzi (1988) describe a stative adjectival passive subtype with an external *experiencer* subject.

1.7. Event structure aspect

There is considerable theoretical consensus that the active OE subject has a *causer* thematic role (e.g., Alexiadou & Schäfer, 2006; Arad, 1998; Croft, 1993; Kallulli, 2007; Landau, 2010; Marantz, 2013; Pesetsky, 1995; Pylkkänen, 2000; Verhoeven, 2017). However, theoretical evidence for the *causer*'s prominence on the thematic role hierarchy, and its involvement in delineating event types according to the little *v* account, are equivocal. Other theorists advance that a *causer* is not a thematic role but a sentence event structure aspect (Grimshaw, 1990; Van Gelderen, 2014). van

Gelderen suggests little *v* projects event structure aspect. Grimshaw argues that the increased difficulty comprehending OE actives is due to their increased argument structure (Argument Structure Complexity Hypothesis). She proposes that for the majority of sentences like the agentive, '*Mary pushed Peter*', the most prominent aspectual argument (the cause) and the most prominent thematic role (the *agent*) both fall on the sentence subject. However, she proposes that for OE actives like '*Mary fascinated Peter*', the most prominent aspectual argument (the cause), on the sentence subject, does not coincide with the most prominent thematic role (the *experiencer*) which falls on the sentence object. Grimshaw's account suggests that the low-prominence *theme* role of stative OE actives is projected to the subject rather than the more prominent *experiencer* role to maintain a more common cause-effect event structure aspect. An active OE low-prominence *theme* subject with a causal aspect is noncanonical.

1.8. Research questions

Given the debates in the literature, we aimed to provide evidence for whether or not the thematic role of the active OE subject and passive OE object was an *agent*. The identity of this thematic role, compared to the *experiencer* thematic role, should determine the sentence's canonicity. We also sought to investigate whether OE verbs are labile: Can the same verbs produce sentences containing *agents* as well as sentences without *agents*, again, theoretically varying canonicity? We then aimed to measure processing patterns to corroborate the predicted canonicity resulting from OE thematic role variations. Psycholinguistic evidence for noncanonical sentence structures comprising internal thematic role subjects that have moved from verb complement position, is a slowdown in processing speed after the verb, in comparison with sentences with external subjects. The slowdown would be required to reactivate the internal subject in the verb complement position, in order to realign the sentence arguments with the ordering in the lexical entry for the verb, for comprehension. Therefore, we predicted that noncanonical sentences – whose thematic roles are not ordered hierarchically in prominence – would show relative slowing in processing speed after the verb. Finally, we aimed to discover which syntactic theories received support from online processing patterns in skilled adult readers. A theoretical CAUS or little *v* morpheme is phonologically null in English. Therefore, we aimed to determine whether there was psycholinguistic evidence that this functional morpheme was psychologically real in English despite not being pronounced. That is, we looked for evidence that the morpheme generates a *causer* thematic role subject when a sentence is eventive. We looked for evidence for the theoretical predictions that an external thematic role *causer* is generated by an eventive/active little *v* and the theoretical predictions that an internal thematic role is generated by a stative/passive little *v*, by identifying whether reading speed slowed after the verb. We investigated whether an OE active subtype was noncanonical, with an internal thematic role subject. We also investigated whether their passives were correspondingly adjectival and whether they had an external or internal subject. The results of the experiments reported here will enable development of syntactic theory in relation thematic role identity, functional morphology and causal aspect/event structure, to elucidate the template used to comprehend sentences with speed and accuracy.

1.9. Experiment

We asked participants to read OE and agentive active and passive sentences phrase-by-phrase in a self-paced reading paradigm. Then, to establish the presence of an *agent*, we asked participants to rate the intent of either the subject or object sentence noun on a Likert scale (Ryan et al., 2025a; Schlesinger, 1992).

Evidence for thematic role subtypes and lability was obtained through natural clustering algorithms as well as absolute rating of intent and through our concurrent experimental design, where we recorded the reading speed of each phrase in the sentences that participants rated. All sentence arguments were animate nouns and were presented without context to best isolate and control for the impact of the thematic-role ordering of the verbs' arguments.

The following are the research hypotheses:

Hypothesis 1

- OE-verb actives and passives will partition into eventive and stative subtypes proposed by theory (Landau, 2010; Pesetsky, 1995; Verhoeven, 2010):
 - Active subjects and passive objects of OE eventives will be rated high in intent (as *agents*; 1):
 1. *'The executive intimidated the comedian in the grey hoodie'*
 - Active subjects and passive objects of OE statives will be rated low in intent (2):
 2. *'The announcer agitated the runner in the thin jacket'*
 - Silhouette plotting and cluster analysis will identify two natural clusters of the ratings of intent measure, whose distributions will significantly differ.

Hypothesis 2

- Stative OE actives will be processed slower than agentive and eventive OE actives after the verb because theory predicts they are noncanonical, featuring internal thematic role subjects that require reactivation at verb complement position for comprehension (e.g., Belletti & Rizzi, 1988; see Examples 1 and 2 above).

Hypothesis 3

- OE-verbs are labile according to syntactic theory (e.g., Verhoeven, 2010):
 - different participants will differentially rate instances of the same verbs.

Hypothesis 4

- We will see corroborative evidence for agentive OE subtypes identified via ratings of intent. This evidence will constitute a processing slowdown for agentive and eventive subtypes of OE passives after the verb, compared to agentive and eventive subtypes of OE actives. This processing slowdown will result from the noncanonical ordering that is predicted for this subtype due to the presence of the theorised *agent* thematic role:
 - The agentive passive:
 3. *'The sheriff was rewarded by the adventurer in the bright colours'*

Is predicted to be processed slower than the agentive active (4):

4. *The lieutenant dismissed the protester on the black hill*

- Stative passive OE subtypes will be processed faster than agentive and eventive OE passives after the verb because they are canonical and adjectival, interpreted with an external subject (5):

5. *The vampire was agitated by the runner in the thin jacket*

Is predicted to be processed faster than (6):

6. *The narrator was grabbed by the mugger in the picket line*

2. Method

2.1. Participants

Sixty-seven fluent-English-speaking undergraduate psychology students elected to participate for course credit as part of their studies. They were accepted for inclusion regardless of gender, age or other language background (45 F: 18 M; 52 aged 18–25; 11 aged 26–59). All participants had begun to acquire English by the time they had started primary school. Thirty-seven self-identified as monolingual Australian-English speaking. Although 26 self-identified as bilingual, 19 reported their knowledge of a language other than English was either basic or they were no longer able to speak it.⁵ Four participants were omitted due to repetitive selection of a single value on the Likert scale across sentences and nouns (they rated 96%, 99% or 100% of sentences at the maximum value or 99% at the minimum value). Their ratings indicated systematic responding that was not in accordance with task instructions. The study was approved by Macquarie University Human Research Ethics committee, Medical Sciences, necessitating participant consent and ability to withdraw without penalty.

2.2. Materials

In order to develop the 240 experimental sentences (see the project's OSF page for full list'), we first identified 180 agentive verbs and 180 OE verbs in the SUBTLEX Frequency Database of the English Lexicon Project (<http://elexicon.wustl.edu>, Balota *et al.*, 2007). The agentive verbs were selected if they were judged by the authors not to describe an emotion and that they could form semantically reversible transitive sentences in which their required active subject or passive object (which we term an '*antipodean subject*' for conciseness) was a clear, intentional, animate *agent* who performed an action. Likewise, the OE verbs could form semantically reversible transitive sentences in which their active object or passive subject (which we term an '*antipodean object*') was an animate *experiencer*. For semantic reversibility it was also necessary that the non-*agent* and the non-*experiencer* roles could also be animate. We assumed that the large sample selected from the database would include both stative and eventive OE subtypes.

⁵The analysis was rerun with the seven fluent bilinguals/nonstandard English speakers removed, however, processing patterns were maintained, although the passive difference at the prepositional phrase no longer reached significance, most likely due to the reduction in power.

A ‘*The/the*’ determiner and animate, common nouns as subjects and objects were added to each verb to form a sentence. We ensured that each noun was not semantically or associatively related to the verb or predictive of the subsequent sentence elements to further ensure that logical combination of sentence elements could not facilitate a correct interpretation without attention to sentence syntax or word order. Sentence initial nouns were relatively high frequency – greater than 5 words per million (SUBTLEX, Balota et al., 2007). Active agentives and OE sentences were grouped into pairs, whose verbs (VP/V) and nouns were matched on SUBTLEX frequency and letter and syllable length, resulting in a matched set of 120 agentive and 120 OE verbs. Each sentence was semantically reversible. A passive version was created of each agentive and OE sentence. Experiencer-verb actives were in their simple past-tense forms and passives in their past participle form (with an ‘-ed’ ending) so that each active and passive version was identical apart from the addition of the ‘was’ and the ‘by’ to create the passives. We added a prepositional phrase to each sentence (in addition to the ‘by’-phrase for passives) with the criteria that they did not induce an instrumental reading, add another sentence participant, or coerce an *agent* reading of either grammatical subject or object. Instead, these prepositional phrases tended to describe a location, an item of clothing or physical characteristic.

The active and passive version of each sentence had an identical second noun (NP2/N2) and prepositional phrase (PP), and had a matched first noun (NP1/N1) on SUBTLEX frequency, concreteness, letter length, and number of syllables. The addition of the passives created a total set of 480 English sentences. The actives were of the form, NP1 VP NP2 PP (e.g., agentive: ‘*The lieutenant dismissed the protester on the black hill*’; OE: ‘*The executive intimidated the comedian in the grey hoodie*’); the passives were, NP1 ‘was’ VP ‘by’ NP2 PP (e.g., agentive: ‘*The narrator was grabbed by the mugger in the picket line*’; OE: ‘*The sheriff was rewarded by the adventurer in the bright colours*’). We presented active and passive versions of sentences to different participants to avoid repetition. Likewise, we presented subjects and objects of each sentence for rating to different participants. These controls resulted in four lists of 240 sentences. Each list comprised equal numbers of agentive and OE actives and passives and listed an equal number of first and second nouns to be rated.

We added the same ungrammatical 48 fillers to each list. Fillers comprised OE verbs that were not used for the test items. Fillers were in identical sentence forms to the test items but were ungrammatical due to the reversal of two adjacent sentence words (e.g., ‘*The foreigner was infatuated by the from manicurist the glossy flyers*’). Reversals could appear anywhere in the sentence after the first noun phrase, and appeared in all sentence positions in equal numbers. Half of the fillers were active and half passive. The fillers were added to ensure participants read the sentences carefully and was confirmed by testing that they were able to correctly judge the grammaticality of the test and filler sentences (see Procedure).

2.3. Procedure

The lists were uploaded to the Gorilla online survey hosting and timing platform (www.gorilla.sc). Participants were randomly allocated to each of the four lists. Filters ensured participants used a laptop or desktop computer, keyboard and mouse, and used Google Chrome internet browser.

To start each trial, each participant saw a fixation cross centred on their monitor. They pressed the spacebar to begin reading each sentence at their own pace, with further spacebar presses to add each subsequent sentence phrase to the end of the ongoing sentence on the monitor (NP1, then VP or ‘was’ VP ‘by’, then NP2, then PP) until they had read the whole sentence, the end of each marked with a full stop. We included the ‘was’ auxiliary and ‘by’-phrase with the verb phrase to keep the second noun phrases the same length across conditions, since the NP2 sentence position was our main region of interest. A final spacebar press introduced a Grammaticality Judgement Task, which was a frame with only two buttons, ‘Grammatical’ and ‘Ungrammatical’, from which participants chose using their computer mouse. The sentence was not on the screen for this judgement. If participants pressed ‘Grammatical’ and the sentence was indeed grammatical, a final screen of the trial appeared upon which the sentence was displayed in full along with the subject or object noun phrase of the sentence, plus a 5-point Likert scale. Participants were instructed to rate the intent of the noun displayed on that screen in that sentence by selecting one of the five Likert options with their computer mouse: ‘No intention’, ‘Not sure either way’, ‘Weak intention’, ‘Moderate intention’ or ‘Strong intention’. These scale-points were allocated weighted values of -3 , 0 , 1 , 2 and 3 , respectively, for analysis. Sentence nouns for rating appear alongside the sentences on the OSF page, as well as Task instructions and examples. Each participant was presented with a unique, randomised order of trials.

The Gorilla task was programmed so that any spacebar press faster than 80 ms from display of the sentence fragment or screen would not register and the participants would need to respond again, to ensure participants were reading the phrases. Participants were timed-out at 5000 ms for the sentence reading and the grammaticality judgement, at which point the next phrase or display would appear. For the ratings judgement, participant reactions before 500 ms had passed would not register, to ensure they made a considered decision. This last decision was timed-out at 10,000 ms.

2.4. Design and analysis

Initially, the dependent variable of interest was the rating of intent for the antipodean subjects (i.e., active subjects and passive objects) of verbs in agentive and OE actives and passives. To determine whether this noun was an intentional *agent* or a non-intentional *theme* or *causer*, we calculated a mean rating of intent for each active and passive verb separately: For each verb, we multiplied the number of ratings at each point in the rating scale by its weighted value, summed these together, then divided the total we obtained by the number of ratings for that verb.

To determine whether there were natural clusters or subtypes in the mean ratings data (Rousseeuw, 1987), and how many best fit the data, we conducted silhouette plots (*MATLAB and Statistics Toolbox Release 2022b, The MathWorks, Inc., Natick, Massachusetts, United States*). Silhouette plots were used to calculate the mean distance of each verb from the verbs in the other cluster(s), compared to the mean distance of each verb from the other verbs in its own cluster. We conducted silhouette plots for differing numbers of clusters, with the highest value indicating the number of clusters that best fit the data. We then performed a kmeans cluster analysis

(*MATLAB*) specifying the optimum number of clusters identified in the silhouette plotting stage.

We first analysed the impact of active and passive subtype (Cluster) on reaction times to correct judgements (since these paired with a Likert rating). We fitted a generalised linear mixed effects model for our research design: a 2 (active or passive voice) \times 2 (stative or eventive cluster) \times 4 (timepoint in the sentence – NP1, VP, NP2, or PP), and all possible interactions, including an intercept as a fixed effect and for each random effect (*MATLAB*). As all the independent variables were categorical – nominal (Voice, Cluster, Participant and Verb (Item)) or ordinal (Timepoint), we chose reference contrast coding. The random factors were Participant and Verb (Item). The natural log linking function was chosen because it produced the most normal distribution of residuals. The shape of the data was inverse Gaussian, which is typical for reaction time data (Lo & Andrews, 2015). We then conducted a priori independent samples t-tests (*MATLAB*; *SPSS*, 27: *IBM Corp*, 2020) for our hypotheses; t-tests suitable because the number of data points in each group was very large ($N > 300$; Norman, 2010; Fagerland, 2012). We corrected a significance level of $\alpha = 0.05$ via the Bonferroni familywise error method at each point in time since the hypothesis differed at each sentence position (Rubin, 2017). Equality of variance was tested for the contrasts (Levene's; *SPSS* 27: *IBM Corp*, 2020), and if variance was not equal, the t-statistic reported was corrected. Points of interest were the VP and at NP2 compared to the control timepoint, at NP1. NP1 was matched rather than identical within the matched pairs, so we checked that reading speeds did not differ at this point.

The labile verbs were partitioned by grouping, separately for actives and passives, all verbs whose mean rating of intent was below the mean (the 'Low' group), and all verbs whose mean rating was above the mean (the 'High' group). Analysis of Variance (ANOVA) of the effect on reading time for each 'Rating Group' (four experimental groups: Low labile OE, High labile OE, Eventive OE and Agentive), and Voice (active or passive), were conducted with Type III Sums of Squares separately at NP1, at the VP, and at NP2, since again, the hypotheses differed at these sentence points (*MATLAB*). Post-hoc comparisons were conducted at PP upon observation of results (*Stata* 19.0, *StataCorp LLC*, *College Station, TX*), with Bonferroni familywise error rate correction of the significance value of $\alpha = 0.05$. Deidentified raw data and analysis scripts are publicly available (https://osf.io/h3gqa/?view_only=39d62b560dde43f7b4246ad75cdae6cc).

3. Results

We omitted reaction times above the timeouts because these indicated timing inaccuracies of the Gorilla platform, internet or browser or personal computer equipment failure. Gorilla reports that the timing error of its platform is 80 ms plus $2 \times$ the standard deviation of the timing error (2×8.25 ms: <https://app.gorilla.sc/support/blog/timing-performance>), so we further omitted reaction times outside these bounds. This resulted in the removal of 135 of the 19,800 data points (<1%).

In support of our first hypothesis, the silhouette plots identified that two clusters grouped participant ratings of intent most naturally, providing the highest silhouette value (0.61 compared to the other tested number of clusters: 0.52 for 3 clusters, 0.58 for 4, 0.57 for 5, 0.55 for 6, 0.56 for 7 or 0.56 for 8 clusters). Accordingly, we conducted

a kmeans 2 cluster analysis. The first cluster had a mean intent rating (\bar{X} =1.09, on the weighted scale range – 3 to 3) representing a non-intentional (*'stative'*) *theme* or *causer* role (or causal aspect). This cluster comprised 124 OE actives and passives (e.g., *'The announcer agitated the runner in the thin jacket'*; *'The vampire was agitated by the runner in the thin jacket'*). The second cluster had a mean rating of intent (\bar{X} =2.38) indicating an intentional *agent* role and an eventive event structure subtype. This cluster comprised 116 OE actives and passives (e.g., *'The artist provoked the creator of the epic tragedy'*; *'The alien was provoked by the creator of the epic tragedy'*). Only three active agentive verbs and 22 passive agentive verbs were partitioned into the stative cluster based on low ratings of intent to their antipodean subjects. We omitted these reaction times from the analyses because they did not form a large enough group for means and standard deviations to be reliable, and this group was much smaller than the other groups. The reasons for the low intent rating for these verbs is worthy of investigation, but it was not the subject of the current inquiry. Our reason for the inclusion of agentive verbs was as a prototypical sentence with an *agent* to form a control group for comparison with the experiencer verbs, so inclusion of atypical instances would detract from this aim.

Next, we determined the impact of cluster and voice at different points of the sentence. The generalised linear mixed effects model found that compared to our NP1 control position, there was a significant effect of cluster and voice at NP2 (a 3-way interaction; *Estimate*, 0.151, $t[18283] = 2.31$, $p = 0.021$, *Confidence interval*–“*CI*” = 0.023–0.279). Additionally, there was an effect of voice at the verb compared to NP1, with actives faster than passives (2-way interaction; *Estimate*, 0.199, $t[18283] = 3.76$, $p < 0.001$, $CI = 0.095$ –0.303). Participant variability as a random effect, significantly accounted for reading time variability (*log ratio comparison statistic*[1] = 810.27, $p < 0.001$ compared to the model with no random effects, and *log ratio comparison statistic*[1] = 1423.9, $p < 0.001$ compared to the full model with both random effects added). Verb (Item) variability as a random effect, also independently accounted for reading time (*log ratio comparison statistic*[1] = 1241.5, $p < 0.001$ compared to the model with no random effects, and compared to the full model (*log ratio comparison statistic*[1] = 992.72, $p < 0.001$). The addition of these random effects accounting for additional variance above the independent variables/fixed effects, improved the fit of the model from $R^2 = 0.09$ (*Log likelihood* = –20702) to 0.24 (*Log likelihood* = –19584; *log ratio comparison statistic*[2] = 2234.2, $p < 0.001$). The data for this model is plotted in Figure 1.⁶

In support of our second hypothesis, our a priori pairwise contrasts revealed that the non-intentional cluster of OE actives were significantly slower than eventive OE actives and agentive actives combined, at NP2 ($t[405.543] = 2.581$, $p = 0.010$, $CI = 23.526$ –173.890). The variances also differed for this comparison (Levene's test for equality of variances: $p < 0.001$), with 'statives' more variable, so the p -value for the test for means above was corrected for the lack of equality of variances. The eventive OE actives and agentive actives did not differ from each other at NP2 ($t[2052] = 1.247$, $p = 0.213$, $CI = -16.634$ –74.706; equal variance $p = 0.283$). The same contrast was also not significant at the control position (NP1: $t[2249] = 1.125$, $p = 0.261$, $CI = -100.484$ –27.233; equal variance, $p = 0.221$). In the passive voice,

⁶A smaller R^2 effect size is expected for experiments testing human behaviour. Speed and priming effects are often small (Prasad & Linzen, 2021; a review of priming effect sizes: Lucas, 2000).

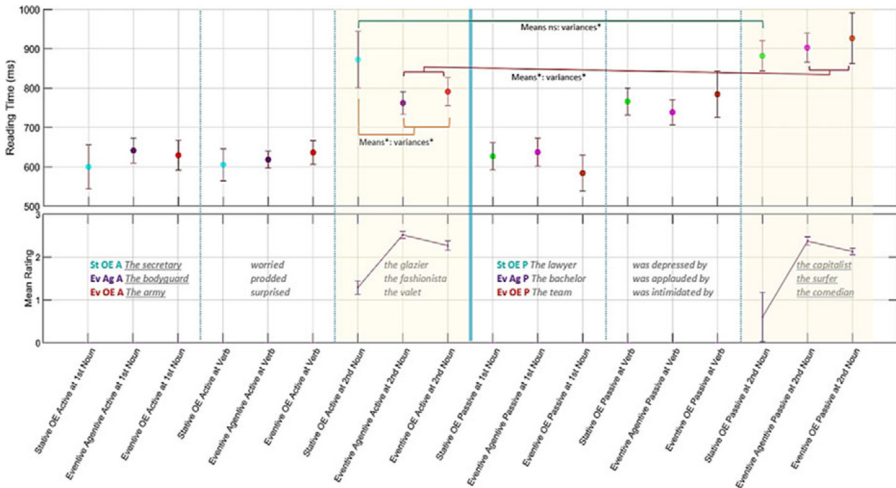


Figure 1. A graphic version of the generalised linear mixed effects model at NP1, V, and NP2, showing means and 95% standard error of the mean confidence intervals, plus mean and variance of rating of intent.

again the same contrast was not significant at NP1 ($t[2146] = 0.166, p = 0.868, CI = -41.600-49.309$; equal variance, $p = 0.990$).

At NP2 in the passive voice, our fourth hypothesis was not supported statistically: that is, while the low-intention cluster of OE passives was numerically faster than OE eventive passives and agentive passives at NP2, this was not significant ($t[2291] = 1.057, p = 0.291, CI = -77.628-23.241$; Levene’s test, $p = 0.055$). Agent-containing OE eventive and agentive passives were significantly slower than their actives at NP2 ($t[2609.485] = 6.746, p < 0.001, CI = -174.637-95.974$) and more variable (Levene’s test; $p < 0.001$), with passives more variable than actives. However, the same contrast for stative OE passives versus their actives at NP2, was not significant ($t[540.318] = 0.227, p = 0.820, CI = -90.682-71.874$). Their variances did differ though, with actives more variable ($p = 0.025$). At the control position (NP1), these same contrasts were not significant (agentive/eventive passives compared to their actives: $t[3208] = 0.706, p = 0.480, CI = -24.447-51.986$; stative OE passives compared to their actives: $t[1187] = 0.791, p = 0.429, CI = -92.967-39.545$; Levene’s test, $p = 0.204; p = 0.654$, respectively).

Antipodean subjects of agentive-verb sentences were almost exclusively rated as intentional, as expected, since they contain an agent by definition. The ratings of intent for these subjects clustered at the moderate to strong end of the Likert scale (shown in Figure 2c). In support of the third hypothesis, the eventive OE group also showed this pattern of ratings (Figure 2b). However, the low-intention OE cluster of verbs showed a more even spread of ratings across the Likert scale, suggesting labile rather than solely stative interpretation (Figure 2a. In Figure 2, more conservative Likert scale weights of 1, 2, 3, 4 and 5 were applied to ratings of intent to verify the spread was not an artifact of the -3-3 weighting). The mean split for active instances of these verbs was at $\bar{X}=1.30$ and for passives at $\bar{X}=0.594$. The actives and passives below their mean were termed the ‘Low’ group; those above the mean were termed the ‘High’ group; the ‘stative’ group was re-termed, the ‘labile’ group. Figures 3-6 depict the reading times for Low labile OE verbs whose antipodean subjects were rated

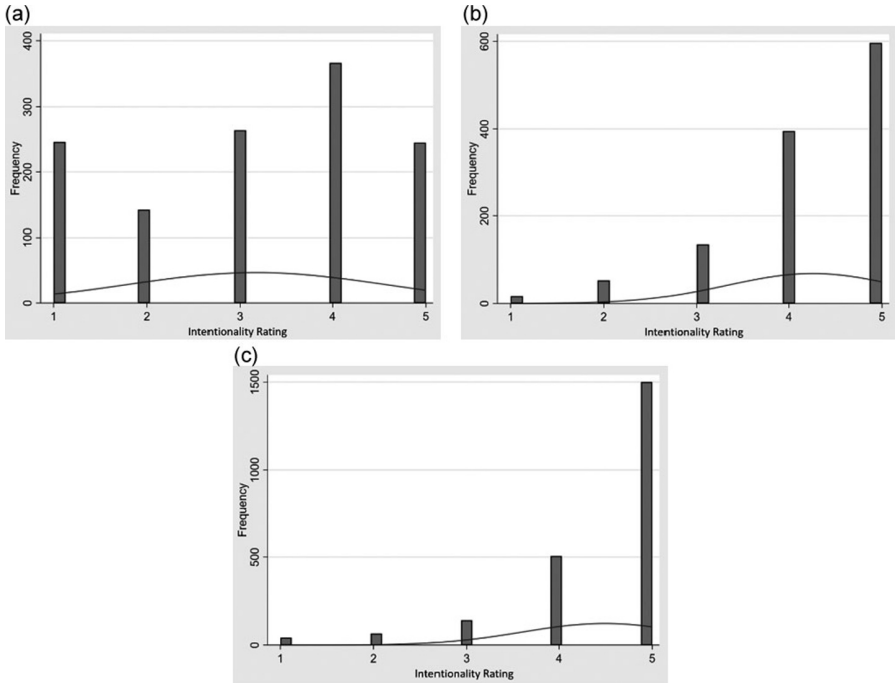


Figure 2. Intentionality ratings of sentences with conservative Likert scale weights, 1, 2, 3, 4 and 5; (a) OE stative/labile cluster; (b) OE eventive cluster; (c) agentive. *Note:* The frequency scales differ. The curve indicates a normal distribution.

below the mean for their cluster, as non-intentional *themes*, or *causers*, to these same verbs when their antipodean subjects were rated above the mean for their cluster, as intentional *agents* (i.e., the High labile group). The figures also compare this labile group with the reading speed of the eventive OE cluster of verbs and the agentive verbs, each rated to have *agents*.

Turning to reading speed of the ratings groups, at the point at which participants were reading NP1, the control position, reading speed did not significantly differ based on Voice, Rating Group or their combination (Voice: $F[1,1] = 0$, $p = 0.997$; Rating Group: $F[1,3] = 1.01$, $p = 0.386$; Voice \times Rating Group: $F[1,3] = 0.80$, $p = 0.494$). Speed of each voice and rating group at NP1 is shown in Figure 3.

At the VP, participant reading speed was significantly faster for actives than passives (Voice: $F[1,1] = 68.16$, $p = <0.001$). The other comparisons were non-significant (Rating Group: $F[1,3] = 1.09$, $p = 0.354$; Voice \times Rating Group: $F[1,3] = 0.99$, $p = 0.398$; Figure 4).

The main region of interest was NP2 since slowing as a result of reactivation would be expected to occur after the verb. When reading NP2, faster reading for actives over passives was maintained (Voice: $F[1,1] = 10.24$, $p = 0.001$). There was also significant main effect of Rating Group ($F[1,3] = 5.00$, $p = 0.002$) and a significant interaction between Voice and Rating Group ($F[1,3] = 4.75$, $p = 0.003$) on reading speed. This interaction indicated that the active advantage seen at VP, persisted for all ratings groups apart from Low OE actives, which were read much more slowly than all of the

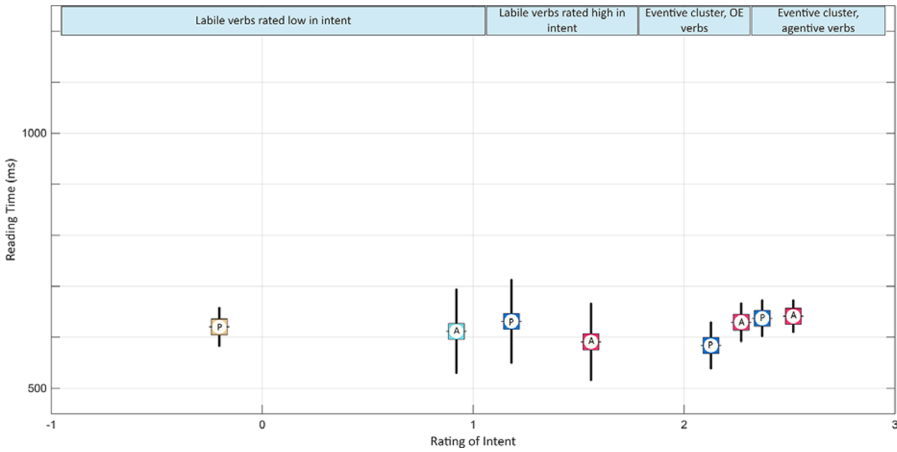


Figure 3. Mean reading speed and 95% standard error of the mean confidence interval (represented by the length of the bars) at the spacebar press for each sentence type and voice at the first noun (NP1/N1). A = active; P = passive.

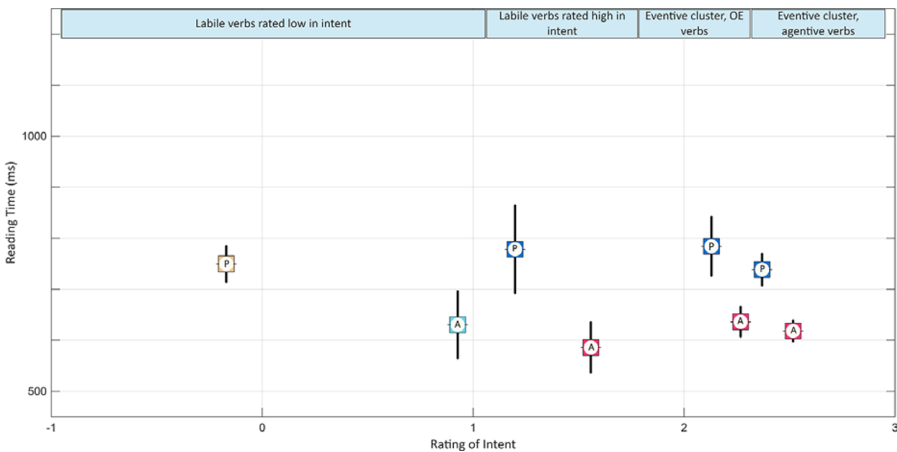


Figure 4. Mean reading speed and 95% standard error of the mean confidence interval at the verb (V/VP) for each sentence type and voice. A = active; P = passive.

other groups (the High OE group, the eventive group and the agentive group). This slower reading for Low OE actives was consistent with the third hypothesis. Figure 5 shows reading speed at NP2 for each rating group separated by voice.

The reading-speed benefit for adjectival (low labile OE) passives at NP2 did not significantly support the fourth hypothesis. However, at the prepositional phrase (PP; see Figure 6), a pairwise comparison showed that participants read Low OE passives significantly faster than the combined reading speeds of the other sentences: the Low labile actives group, the high labile OE actives and passives group, the eventive OE actives and passives group and the agentive actives and passives group ($t[462.844] = -2.389, p = 0.017, equal variances not assumed$).

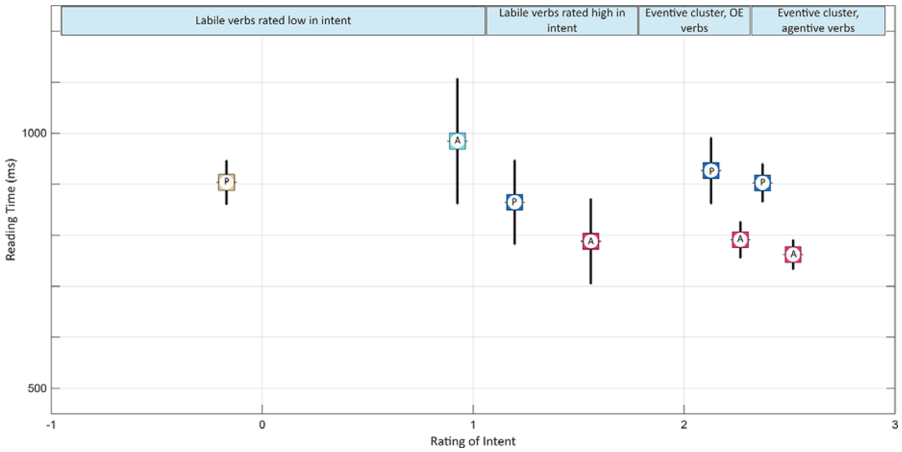


Figure 5. Mean reading speed and 95% standard error of the mean confidence interval at the second noun (NP2/N2) for each sentence type and voice. A = active; P = passive.

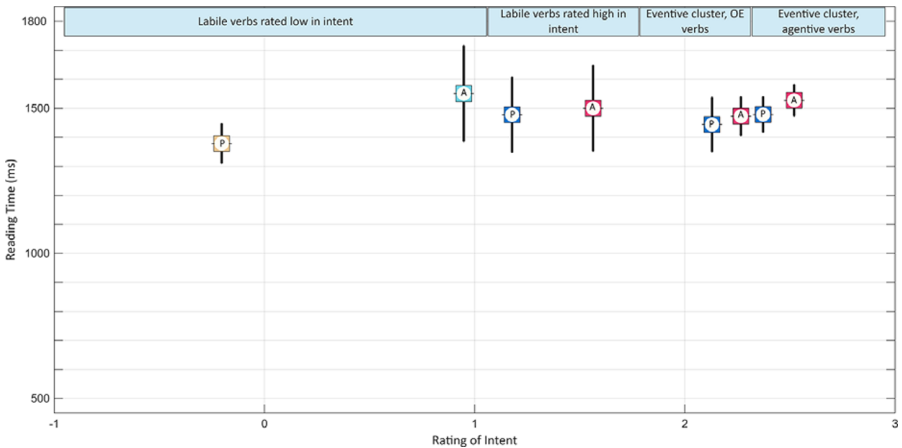


Figure 6. Mean reading speed and 95% standard error of the mean confidence interval at the prepositional phrase ('PP') for each sentence type and voice. A = active; P = passive.

4. Discussion

Though two differing subtypes of OE verbs have often been described in syntactic theory (Belletti & Rizzi, 1988; Grimshaw, 1990; Landau, 2010; Pesetsky, 1995; Verhoeven, 2010), psycholinguists have described and tested them as a single group, even while noting the existence of the other (untested) subtype. Our first hypothesis was that OE verb actives and passives would partition into these two subtypes, and inspection of ratings patterns (Figure 2), silhouette plotting and kmeans cluster analysis supported this hypothesis. The first was an *eventive* cluster, comprising verbs whose antipodean subjects were consistently interpreted as an *agent* with a high rating of intent. The second was a *stative* cluster, comprising verbs with a mean interpretation in the middle of our Likert scale, with a non-intentional antipodean

theme or *causer* subject (or causal aspect). These findings were also consistent with Ryan et al. (2025a) who had also found subtypes using Likert ratings of intent.

Importantly, the *agent* antipodean subject in agentive sentences and in the eventive OE cluster is the first noun in actives. These sentences are canonical due to the *agent*'s high thematic prominence over the second, *theme* (or *patient*), noun. The *agent* antipodean subject is the second noun in agentive and eventive OE passives, so its high prominence over the sentence's first noun results in noncanonical passives.

Our first round of reading time analyses for the subtypes formed in the cluster analysis provided further evidence to support the existence of subtypes. We hypothesised (Hypothesis 2) that canonical, *agent*-first actives would be faster to read than noncanonical stative agentless OE actives after the verb (at the second noun). The generalised linear mixed effects model partialled out the random effects of specific lexical items (Verb) and any of the participant's idiosyncratic reading speeds or levels of attention (Participant). The remaining variability could be accounted for by both passive morphology and by the effects of canonicity as participants read successive sentence phrases. At the first noun (the control position), there were no differences in reading speed between the sentence types. At the verb, participants were faster reading all the active verb phrases than the longer passive verb phrases (which added 'was' and 'by' to the form of the verb that was identical to the active). At the second noun, participants' reading times were slowed for passives and noncanonical stative OE actives, supporting our second hypothesis.

Research examining NP-movement suggests that realigning a noncanonical sentence to canonical ordering, involves reactivating a low-prominence internal first noun between 500 and 1000 ms after the offset of the verb (Friedmann et al., 2008; Osterhout & Swinney, 1993). This realignment to canonical ordering was expected to elicit slowed processing during the reading of the second noun rather than at the verb. Participants would likely have initially interpreted each sentence as a canonical active until encountering the verb, as the equivalent timing at NP1 attests. However, for stative OE actives, encountering the verb may have triggered a reanalysis to restore canonical ordering, slowing reading by the time the second noun was encountered. While our passive sentences showed slowed reading times at the verb, this may have resulted from the opportunity for earlier reanalysis due to a more salient cue to noncanonicity provided by the passive auxiliary and could also have resulted from the unavoidable confound of the extra words included as part of the passive verb phrase. At the second noun, we saw purer effects of canonicity. At the slower end of expectations, participants read the second noun of canonical actives for 775 ms on average ($sd = 524$). Noncanonical passives were read more slowly at this noun, for 897 ms ($sd = 595$). Finally, noncanonical (stative OE) actives were read even more slowly than the passives at this second noun, taking 985 ms ($sd = 753$).

As well as subtypes, in accordance with Verhoeven's (2010) predictions and reflected in Hypothesis 3, we found evidence that OE verbs are labile. The antipodean subjects of the eventive OE cluster were consistently rated with *moderate* or *strong intention*. By contrast, the stative/labile group, with its mean near the middle of the intentionality scale, received both non-intentional and intentional ratings for the same verbs from different participants. To provide a cleaner test of canonicity, we tested how the sentences were processed when, for different exemplars of the same verbs, they were interpreted as including an intentional *agent* role, and when instead, they were interpreted as including a non-intentional *theme* or *causer*.

Accordingly, the reading time analysis provided corroborating evidence that OE verbs are labile. There was no difference in reading speed between the intentionality rating groups at the first noun. At the verb, actives were always faster than passives. At the second noun, when the labile group was rated high in intent, implying an intentional *agent*, their active and passive reading speed paralleled the eventive OE group, and the agentive group – actives were consistently and significantly faster than passives. When the labile verbs were rated low in intent, they showed a significantly different pattern: their actives were slower than their passives. Therefore, the significant stative OE active reading slowing shown in the a priori t-tests (Figure 1) was entirely driven by the low labile actives, since the High group showed similar reading speeds to eventives and agentives. In sum, our third hypothesis that OE verbs are labile was supported by our results.

While, at the second noun, canonical adjectival passives were numerically faster in the hypothesised direction (Hypothesis 4) before the mean split, they were not significantly faster. Instead, significantly speeded reading for adjectival passives was not seen until the prepositional phrase and when we separated the stative OE group into Low and High exemplars. The prepositional phrase sentence position taps the effects of wrap-up at sentence end. In addition, it could reflect possible deliberate memorisation of the sentence required for the subsequent grammaticality judgement – since the sentence was not displayed on the screen for this judgement. However, we argue this memorisation cannot account for the results as we would not expect adjectival passives to be faster to memorise than the other sentence types. Adjectival passives are canonical because their first noun *experiencer* is more prominent than their second noun *theme* or *causer*. Still, canonical passives are less common and likely unexpected amongst this stimulus set. Consequently, a noncanonical initial interpretation would be expected due to their passive morphology, perhaps causing a delay to any reading advantage from their canonicity.

Grimshaw (1990) argues that adjectival passives are converted from verbal passives by adding an external argument to the argument structure. The processing of the adjectival passives in the current investigation is consistent with Grimshaw's account. Initially, adjectival passives may be processed as verbal passives, since they contain the passive morphology that theory suggests triggers reanalysis. However, this reanalysis may have been abandoned once participants realised the sentence was canonical. In sum, speeded reading of adjectival passives (albeit somewhat delayed) supports our fourth hypothesis. Furthermore, Kratzer's (2000) claim that adjectival passives have an internal subject is not supported, since a processing catch-up was not seen for the other sentences with internal subjects.

A query of particular relevance to little *v* theory is whether non-prominent first nouns are *themes* or *causers*. Figure 7 shows the average reading speed from the verb to the prepositional phrase, of each rating group, separated by voice. Overall reading speed was determined by canonicity. Canonical agentive and eventive OE actives, with *agents* as first nouns, were read fastest. The next fastest sentences were adjectival passives, which are canonical with *experiencer* subjects and no *agent* but were temporarily slowed by passive morphology. The third fastest were all of the non-canonical sentences: agentive and eventive OE passives, which have the more prominent *agent* as second noun and passive morphology; and low labile/non-agentive OE actives, despite no passive morphology. Therefore, processing speed does not appear to be influenced by whether the non-prominent first noun's thematic role is termed a *causer*, *theme*, *patient* (as the role is sometimes labelled for agentive

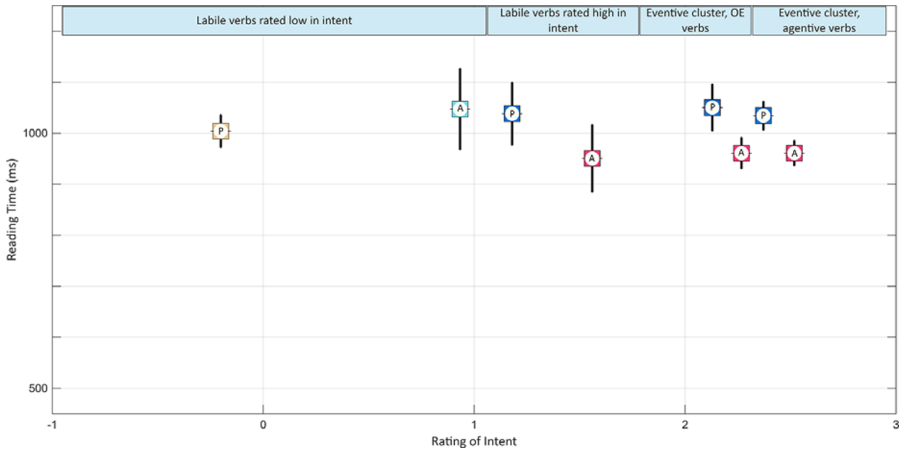


Figure 7. Mean reading speed and 95% standard error of the mean confidence interval of the sentence types, averaged across the verb, second noun and prepositional phrase. A = active; P = passive.

sentences), *target*, *subject matter* or *experiencer* (when an *agent* is present in the sentence). It appears to be the relative prominence of thematic roles that influence the syntactic parse. We propose that listeners apply a quick template utilising a broader distinction between fewer thematic roles to parse sentences for comprehension, with finer semantic distinctions (such as *path* detailed in Talmy, 2000 and Langacker, 1990 or *absolute* detailed in Langacker, or *causer* or *affected* detailed in Quirk et al., 1985) accommodated by the lexicon. This quick template is especially necessary in comprehension, since these finer distinctions proposed between thematic roles would not be apparent until we reach the verb phrase region across languages, often not until we reach the verb itself. Additionally, aspectual and logical-semantic spatial relationships reliant on whole sentence interpretation (Langacker, 1990; Talmy, 2000) are unlikely to be sufficiently apparent until its end, and may not alter thematic role identity.

In the current investigation, the active and passive sentences in the eventive OE cluster had antipodean subjects with an *agent* thematic role. The stative active and passive instances of the labile OE cluster had low-prominence antipodean subjects. The thematic roles of these antipodean subjects could either be *themes* or *causers*. Numerous theorists propose they are *causers* (Larson, 1988; Marantz, 2013; Pesetsky, 1995). Additionally, Ryan et al.'s (2025a) investigation found general causal attribution to these sentence positions. However, if OE active subjects hold a *causer* thematic role rather than a *theme*, the current investigation supports Landau's (2010) characterisation: That is, if a *causer* is an *agent*, it is high in prominence. Conversely, if the *causer* is not an *agent*, it is lower in prominence than the second noun *experiencer*. We reach this conclusion because only when the *causer* was interpreted as an *agent*, did we find speeded processing in actives indicative of agent-first, canonical ordering and slower processing indicative of *agent*-second, noncanonical passives. When not rated as an *agent*, a *causer* subject elicited slower processing, indicative of noncanonical actives. Therefore, rather than a consistently prominent *causer* on Pesetsky's (1995) hierarchy, when a *causer* is not an *agent*, it appears to be a low-prominence role on

our thematic hierarchy, *agent* > *experiencer* > *theme/(causer)*, similar to Grimshaw's (1990) *agent* > *experiencer* > ... > *theme* thematic hierarchy.

However, it is possible that a *causer* is not a thematic role. In fact, a thematic role is not expected to vary in prominence: Pesetsky's *causer* is unlikely to be a distinct thematic role because its presence does not affect thematic prominence or processing. Instead, differences in processing can be accommodated by OE subtypes and interpretation: one subtype/interpretation with an *agent* antipodean subject, the other subtype/interpretation with a *theme* antipodean subject.

Additionally, the current investigation casts doubt on the current characterisation of little *v* (Marantz, 2013) or CAUS (Pesetsky, 1995) as an account of syntactic structure. Little *v* proponents often task the same morpheme with assigning event structure (stative or eventive), sentence voice and the type of thematic role (active or passive, external or internal; Alexiadou & Schäfer, 2006; Kallulli, 2007; Pesetsky, 1995). Proponents argue that a stative variety assigns an internal *experiencer* or *theme*; the eventive assigning an external *agent* or *causer*. However, the current investigation found that a *causer* can be either eventive or stative. It will evince speeded processing consistent with a high-prominence external thematic role in an eventive active or in a stative adjectival passive. Alternatively, it can evince slow processing consistent with a low-prominence internal thematic role in an eventive passive or stative active. To allow for these variants, the further morphemes of Voice and Applicative are needed, possibly in a multi-tiered configuration, to assign thematic roles, voice and event structure independently.

Pylkkänen (2000) notes the possibility of tiered morphology but not for English. For English, she contrasts the active, '*John melted the ice*' with a non-external passive implied *causer*: '*The ice was melted*' (on purpose by *John*; p.135). However, Pylkkänen claims that, unlike English, Finnish and Japanese have overt causative morphemes ('*tta*' for Finnish and '*(s)ase*' for Japanese) that can separate the *causer* and external roles. The current investigation of English suggests that the English CAUSE morpheme is separable, as it is for Finnish and Japanese, whether or not it is overtly realised.

Grimshaw (1990) describes a *causer* as not a thematic role but a sentence aspect – captured by Ryan *et al.*'s (2025a) participants' causal attribution. Arad (1998) suggests that differences in types of experiencer verbs arise from differences in aspectual properties. Van Gelderen (2014) draws from Arad's ideas to argue that little *v* and V heads account for aspectual information. It is possible that events do not need to have an *agent* first noun or external thematic role but rather need an aspectual structure that proceeds in time from cause to effect. This preferred event structure also holds for another type of noncanonical active: unaccusative sentences. For example, the vast majority of Friedmann *et al.*'s (2008) and Agnew *et al.*'s (2014) unaccusative sentences are events. In the sentence, '*The leaf fell*' (Friedmann *et al.*, 2008), the falling of '*the leaf*' is clearly an event, though '*the leaf*' displayed reactivation consistent with an internal thematic role in this semantic priming study. Like unaccusatives, for OE sentences, a possible reason for the movement of the *theme* or *causer* noun from the post-verbal position, rather than the *experiencer* from a similar position, could be to place the causal aspect in the first-noun position (DeLancey, 1985; Dowty, 1991; Grimshaw, 1990) to maintain a cause-and-effect ordering of an event.

It is important that alternative explanations are considered for our results. One possibility is that syntactic priming played a part in ratings and processing patterns,

since Ryan et al. (2025a) found more OE stative than eventives when they were encountered alongside stative subject-experiencer-verb (SE) sentences (94:33; 74%:26%) than in the current investigation when they were encountered alongside eventive agentives (52%:48%). It is also possible that syntactic priming could account for our small number of stative agentive omissions, which was an unexpected result.

However, a subtype of OE verbs was classed as eventive despite being in the context of a high proportion of stative SE sentences in Ryan et al.'s (2025a) study, and, conversely, a subtype of OE verbs was attributed low intent/stativity even though they were encountered amongst a high proportion of eventive sentences in the current investigation. Additionally, in Ryan et al.'s study and the current investigation, the correlation between active ratings and passive OE ratings was high (actives: $R = 0.89$, $p < 0.001$; passives: $R = 0.59$, $p < 0.001$). Additionally, the correlation of OE intentionality ratings from the Ryan et al. study and the current study was also high ($R = 0.67$, $p < 0.001$), averaged across actives and passives. Despite differing environments, identification of both subtypes and such a high and significant correlation across the studies would discount syntactic priming as the primary driver of results.

In the present investigation, to control for animacy and to avoid a confound from contextual coercion, all argument nouns were animate. Animate nouns are likely to be rated as agents, increasing agentive interpretations. Agentive events are eventive rather than stative, hence the inclusion of only animate nouns possibly increased the tendency for labile verbs to be rated as eventive, while reducing their tendency to be rated as stative. Verhoeven (2017) argues that labile experiencer verbs are agentive or non-agentive depending on their context. While agentive sentences require an animate stimulus, Verhoeven argues a *causer* role is susceptible to being agentive if it is animate. However, despite the lack of inclusion of inanimate nouns in the current investigation, participant ratings demonstrated a non-agentive, eventive interpretation or a stative interpretation for OE verbs, meaning the animate nouns did not prevent a non-agentive interpretation. Verhoeven herself provides an example of an animate stimulus representing a situation rather than an agent: *'Leonie impressed the audience with her performance'*. (p.6), akin to *'Her performance impressed the audience'*.

A second potential alternative explanation is that the high or low attachment of the PP drove speeded reading of adjectival passives at this late timepoint. The prepositional phrases enabled padding of the sentences before the end without inducing an agent reading of either sentence noun that could influence ratings of intent. However, some of these sentence-final PPs modified the VP (high attachment), whereas others modified NP2 (low attachment). To address this possibility, we coded each sentence's PP as low attachment, high attachment, and ambiguous attachment (many sentences could be interpreted either way). We compared the Attachment height and Verb type of adjectival passives at this final timepoint compared to all other sentence groups (Group), controlling for Participant and including a fixed and random intercept. The generalised linear mixed effects regression model, specifying a gamma distribution and log link (*STATA*), accounted for a significant proportion of the variance in reading time with a high effect size ($\text{Log likelihood} = -35982.07$, $\text{Adjusted } R^2 = 0.25$, $p < 0.001$), and normalised distribution of residuals. With Participants as a random effect, and a significant speed advantage for adjectival passives compared to all other sentences ($z_{1,4525} = 2.71$, $p = 0.007$, $CI = 0.100-0.623$), low attachment was slower than ambiguous attachment, which was slower than high attachment

[$z_{1,4525} = -2.65, p = 0.008, CI = -0.241-0.036$]. This effect is the reverse of the effect that we found for adjectival passives. Also, agentives were read more slowly than OE verbs at the PP [$z_{1,4525} = -2.89, p = 0.004, CI = -0.318-0.061$]. There was an interaction between Group and Attachment height [$z_{1,4525} = 2.46, p = 0.014, CI = 0.0677-0.598$] as well as between Attachment height and Verb type [$z_{1,4525} = -2.81, p = 0.005, CI = -0.325-0.058$]. These effects indicated that ambiguous attachment for adjectival passives was slower than low attachment for adjectival passives; also, sentences containing agentive verbs with high or low attachment were slower than agentive verbs with ambiguous attachment. Adjectival passives demonstrated a clear advantage in reaction time compared to the other sentences, including OE actives and other OE passives; however, they also coincided with a tendency for low attachment. On the other hand, low attachment coincided with slower processing for the other sentences, with the reverse pattern seen for high attachment with eventives and agentives. Results suggested Group or Verb type may have driven attachment preferences and therefore, reading speed, rather than the PP. This pattern could be addressed in further investigations – particularly considering most sentences can be interpreted with either high or low attachment – providing insights into reading and comprehension difficulties.

The current investigation's unique design, pairing rating of intent with reading speed data, provided an immediate measure of both the identity of thematic roles as well as a measure of how they are processed. It also allowed for novel experimental evidence that OE verbs are labile. A further strength of the study is its ability to control for the active-passive confound of sentence length, animacy, case, subtype and interpretation, additionally controlling for the *experiencer* thematic role, which has been a disadvantage of previous studies on canonicity. The current investigation replicates Ryan *et al.*'s (2025a) investigation, providing further evidence of OE subtypes in a different population: Australian-English-speaking undergraduate psychology students rather than crowdsourced American-English-speaking adults.

A great strength of the current investigation is its unique, real-time test of prominent syntactic theory: examining external and internal thematic roles and their identity, little *v* and the causative morpheme or aspect, and event structure and its relation to both thematic roles and sentence voice. The data reported here informs the thematic hierarchy and the necessary distinction between possible thematic role candidates. This is a significant endeavour, as it is critical that we learn how the syntactic parser operates to isolate where difficulty may lie for individuals with language impairment and thereby target language remediation.

Syntactic theory is typically formed through cross-linguistic investigations and often grammaticality judgements. The current investigation provides a new measure. Different lexical elements – each noun, verb, adjective, preposition, etc. – add meaning to the hierarchical parse, but the parse appears not to be idiosyncratic in accordance with these elements. Consistent strategic scaffolds appear to be applied to each incoming sentence sequence, which may need adjustment as the sentence progresses. To generalise across the infinitely large possible number of utterances we can create and encounter, we need a strategy to apply. This strategy/scaffold is likely an ordering of prominence as the sentence moves along, with the causal aspect, often including an *agent*, first in an event. Sentences that do not adhere to the strategy need reworking for comprehension.

Suggestions for further research include a pairing of both causality ratings and intentionality ratings with reading time to further examine whether a *causer* is indicative of a low-prominence, internal thematic role. An additional test of interpretation could involve the inclusion of contextual coercion to examine reading speed when the variant of the labile reading is controlled for. It is also suggested that sentences constitute proper rather than common nouns where possible to reduce variability ('noise') that is less relevant to the aim. Finally, further study could investigate the generalisability of results to other linguistic groups.

5. Conclusion

Investigating the factors affecting reading speed and ease allows isolation of the cause of the comprehension difficulty seen in both skilled and language-impaired individuals on noncanonical structures. Noncanonically ordered, object-experiencer-verb (OE) sentences allow investigation of the reading speed effects of noncanonical ordering involving NP-movement without the confounds of an alteration in voice and number of words encountered in the more typical experimental comparisons of agentive actives and passives. OE verbs also allow testing of numerous syntactic theories. They allow:

- identification of stative and eventive subtypes;
- investigation of whether the comprehender's interpretation can influence thematic roles and processing speed;
- testing of a *causer* thematic role, or elucidation of whether it is a thematic role or aspect.
- testing of the Distributed Morphology branch of syntactic theory involving the causative morpheme (CAUS)/little *v*.
- testing of the distinctions between thematic roles for the neural syntactic parser and their relative prominence on a thematic role hierarchy.
- investigation of the thematic roles and causal aspect in passives compared to actives.

In the current investigation, we found that OE verbs did differentiate into stative and eventive subtypes, and differentiated further based on the listener or reader's interpretation of the intent of the antipodean subject. Whether sentence ordering was canonical was identified via ratings of intent. When sentences were not canonically ordered, processing slowed after the verb. However, the relative prominence of the thematic roles of *agent*, *experiencer* and *theme* was sufficient to account for results. Further distinctions between thematic roles to add *causer*, *patient*, *target* or *subject matter* to the set of thematic roles in the hierarchy are not supported by results since processing patterns were not altered for sentences in which they were predicted to appear. More specifically, since the identity of a verb argument as a *causer* did not affect the overall thematic prominence of the sentence or the processing behaviour, it is unlikely that it holds a place as a distinct thematic role in a hierarchy. Indeed, Pesetsky (1995) places the *causer* as more prominent than the *experiencer*, *target* and *subject matter* on his thematic hierarchy. However, our results suggested that an argument that is attributed causation was lower in prominence than the *experiencer* and not different in prominence than a *target* or *subject matter* (whose thematic

prominence on a hierarchy we suggest can be captured in the thematic role, *theme*), measured by ratings of intent and processing patterns. An argument attributed causation was only more prominent than these roles when it was rated as an *agent* via ratings of intent. Therefore, we can account for these prominence patterns without contending with a separate *causer* thematic role. Hence, a broader delineation of thematic roles into *agent*, *experiencer*, and *theme*, can account for thematic prominence and neural processing patterns of the agentive and OE transitive actives and passives in the current investigation. Theoretical proposals of little *v* bundle the event structure, voice, and thematic role projected to sentence subject together (Marantz, 2013). An eventive little *v* is proposed to project an external *agent* or *causer* to sentence subject in active voice. A stative little *v* is proposed to project an internal *theme* in passive voice. The current investigation suggests that a *causer* may not be an external thematic role even if in active voice. Moreover, ratings of intent support the division of stative and eventive subtypes, and labile interpretation inducing subtypes, in both active and passive voice (Belletti & Rizzi, 1988). Results support Grimshaw's (1990) account that OE actives are noncanonically-ordered thematically but canonically ordered aspectually. They suggest causation is an aspect that can fall on varying thematic roles. We may order the OE active noncanonically to preserve the more typical aspectual cause on the sentence subject.

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References

- Abbot-Smith, K., Lieven, E., & Tomasello, M. (2001). What preschool children do and do not do with ungrammatical word orders. *Cognitive Development*, 16, 679–692. [https://doi.org/10.1016/S0885-2014\(01\)00054-5](https://doi.org/10.1016/S0885-2014(01)00054-5).
- Agnew, Z. K., van de Koot, H., McGettigan, C., & Scott, S. K. (2014). Do sentences with unaccusative verbs involve syntactic movement? Evidence from neuroimaging. *Language, Cognition and Neuroscience*, 29(9), 1035–1045. <https://doi.org/10.1080/23273798.2014.887125>.

- Alexiadou, A., & Schäfer, F. (2006). Instrument subjects are agents or causers. In D. Baumer, D. Montero, & M. Scanlon (Eds.), *Proceedings of the 25th west coast conference on formal linguistics* (pp. 40–49). MA: Cascadilla Proceedings Project. lingref.com/cpp/wccfl/25/paper1431.pdf
- Arad, M. (1998). Psych-notes. *UCL Working Papers in Linguistics*, 10, 1–22. 10.1.1.375.8504.
- Baker, M. C. (1989). Object sharing and projection in serial verb constructions. *Linguistic Inquiry*, 20(4), 513–533. <https://www.jstor.stable/4178644>
- Balota, D. A., Yap, M. J., Cortese, M. J., Hutchinson, K. A., Bessler, B., Loftis, B., Neely, J. H., Nelson, D. L., Simpson, G. B. & Treiman, R. (2007). The English lexicon project. *Behavior Research Methods*, 39(3), 445–459. elexicon.wustl.edu
- Bates, E., McNew, S., MacWhinney, B., Devescovi, A., & Smith, S. (1982). Functional constraints on sentence processing: A cross-linguistic study. *Cognition*, 11(3), 245–299. [https://doi.org/10.1016/0010-0277\(82\)90017-8](https://doi.org/10.1016/0010-0277(82)90017-8).
- Belletti, A., & Rizzi, L. (1988). Psych-verbs and theta-theory. *Natural Language and Linguistic Theory*, 6(3), 291–352. <https://doi.org/10.1007/BF00133902>.
- Beretta, A., & Campbell, C. (2001). Psychological verbs and the double-dependency hypothesis. *Brain and Cognition*, 46(1–2), 42–46. [https://doi.org/10.1016/S0278-2626\(01\)80030-0](https://doi.org/10.1016/S0278-2626(01)80030-0).
- Biber, D., Johansson, S., Leech, G., Conrad, S., & Finegan, E. (1999). *The Longman grammar of spoken and written English*. London: Longman.
- Birner, B. J., & Ward, G. (2009). Information structure and syntactic structure. *Language and Linguistics Compass*, 3(4), 1167–1187. <https://doi.org/10.1111/j.1749-818X.2009.00146.x>.
- Bock, J. K., & Warren, R. K. (1985). Conceptual accessibility and syntactic structure in sentence formulation. *Cognition*, 21, 47–67. [https://doi.org/10.1016/0010-0277\(85\)90023-X](https://doi.org/10.1016/0010-0277(85)90023-X).
- Bock, K., & Levelt, W. (1994). Language production: Grammatical encoding. In M. A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 945–984). Cambridge, MA: Academic Press. <https://hdl.handle.net/2066/15534>.
- Brennan, J., & Pylkkänen, L. (2010). Processing psych verbs: Behavioural and MEG measures of two different types of semantic complexity. *Language and Cognitive Processes*, 25(6), 777–807. <https://doi.org/10.1080/01690961003616840>.
- Chomsky, N. A. (1982). *Some concepts and consequences of the theory of government and binding*. Cambridge, MA: MIT Press.
- Chomsky, N. A. (1993). Lectures on government and binding. In J. Koster & H. van Riemsdijk (Eds.), *The Pisa lectures* (7th ed.). Studies in Generative Grammar [SGG]. Berlin; New York: Mouton de Gruyter.
- Chomsky, N. A. (1995). *The minimalist program*. Cambridge, MA: MIT Press.
- Cinque, G. (2013). Cognition, universal grammar, and typological generalizations. *Lingua*, 130, 50–65. <https://doi.org/10.1016/j.lingua.2012.10.007>.
- Croft, W. (1993). Case marking and the semantics of mental verbs. In J. Pustejovsky (Ed.), *Semantics and the lexicon* (Vol. 59, pp. 55–72). Netherlands: Springer. https://doi.org/10.1007/978-94-011-1972-6_5.
- Croft, W. (2003). *Typology and universals* (2nd ed.). Cambridge University Press.
- Cupples, L. (2002). The structural characteristic and on-line comprehension of experiencer-verb sentences. *Language and Cognitive Processes*, 17(2), 125–162. <https://doi.org/10.1080/01690960143000001>.
- DeLancey, S. (1985). Agentivity and syntax. In W. H. Eilfort, P. D. Kroeber & K. L. Peterson (Eds.), *Causatives and Agentivity conference*, 2, 1–12. Chicago Linguistic Society.
- Dowty, D. (1991). Thematic proto-roles and argument selection. *Language*, 67(3), 547–619. <https://doi.org/10.2307/415037>.
- Fagerland, M. W. (2012). T-tests, non-parametric tests, and large studies- a paradox of statistical practice? *BMC Medical Research Methodology*, 12, 78.
- Ferreira, F. (2003). The misinterpretation of noncanonical sentences. *Cognitive Psychology*, 47, 164–203. [https://doi.org/10.1016/S0010-0285\(03\)00005-7](https://doi.org/10.1016/S0010-0285(03)00005-7).
- Fillmore, Charles J. (1968). Lexical entries for verbs. *Foundations of Language*, 4(4), 373–393. <https://www.jstor.stable/25000345>
- Friedmann, N., Taranto, G., Shapiro, L. P., & Swinney, D. (2008). The leaf fell (the leaf); the online processing of Unaccusatives. *Linguistic Inquiry*, 39(3), 355–377. <https://www.jstor.stable/40071442>
- Gattei, C. A., Dickey, M. W., Wainseboim, A. J., & Paris, L. A. (2015). The thematic hierarchy in sentence comprehension: A study on the interaction between verb class and word order in Spanish. *Quarterly Journal of Experimental Psychology*, 68(10), 1981–2007. <https://doi.org/10.1080/17470218.2014.1000345>.

- Givón, T. (1984). *Syntax. A functional-typological introduction* (1st ed.). J. Benjamins Pub. Co.
- Grimshaw, J. (1990). *Argument structure*. Cambridge, MA; London: MIT Press.
- Grodzinsky, Y. (1995). Trace deletion, theta roles and cognitive strategies. *Brain and Language*, 51(3), 469–497. <https://doi.org/10.1006/brln.1995.1072>.
- Hartshorne, J. K., Pogue, A., & Snedeker, J. (2015). Love is hard to understand: The relationship between transitivity and caused events in the acquisition of emotion verbs. *Journal of Child Language*, 42(3), 467–504. <https://doi.org/10.1017/S0305000914000178>.
- Jackendoff, R. (1972). *Semantic interpretation in generative grammar*. MIT Press.
- Jackendoff, R. (1990). *Semantic structures. Current studies in linguistics*. Cambridge, MA; London: MIT Press.
- Jacobs, B. J., & Thompson, C. K. (2000). Cross-modal generalization effects of training noncanonical sentence comprehension and production in Agrammatic aphasia. *Journal of Speech, Language, and Hearing Research*, 43, 5–20.
- Kallulli, D. (2007). Rethinking the passive/anticausative distinction. *Linguistic Inquiry*, 38(4), 770–780. <https://doi.org/10.1162/ling.2007.38.4.770>.
- Koopman, H., & Sportiche, D. (1991). The position of subjects. *Lingua*, 85, 211–258.
- Kratzer, A. (1996). Severing the external argument from its verb. In J. Rooryck & L. Zaring (Eds.), *Phrase structure and the lexicon. Studies in natural language and linguistic theory* (Vol. 33). Dordrecht: Springer. https://doi.org/10.1007/978-94-015-8617-7_5
- Kratzer, A. (2000). *Proceedings of the twenty-sixth annual meeting of the Berkeley linguistics society: General session and parasession on aspect*. Ed. L. J. Jonathan *et al.* (pp. 385–399). Berkeley Linguistics Society
- Landau, I. (2010). *The locative syntax of experiencers*. Cambridge, MA; London: MIT Press. <https://doi.org/10.7551/mitpress/8387.001.0001>.
- Langacker, R. W. (1990). *Concept, image, and symbol: The cognitive basis of grammar*. Berlin: Mouton de Gruyter.
- Larson, R. K. (1988). On the double-object construction. *Linguistic Inquiry*, 19(3), 335–391.
- Lee, J. F. (2017). Word order and linguistic factors in the second language processing of Spanish passive sentences. *Hispania*, 100(4), 580–595.
- Levin, B., & Rappaport-Hovav, M. (1995). Unaccusativity: At the syntax-lexical semantics interface. *Linguistic Inquiry Monograph*, 26. <https://hdl.handle.net/2027/heb08443.0001.001>.
- Lo, S., & Andrews, S. (2015). To transform or not to transform: Using generalized linear mixed models to analyse reaction time data. *Frontiers in Psychology*, 6, 1–16. <https://doi.org/10.3389/fpsyg.2015.01171>.
- Love, T., Maas, E., & Swinney, D. (2003). The influence of language exposure on lexical and syntactic language processing. *Experimental Psychology*, 50(3), 204–216. <https://doi.org/10.1026/1617-3169.50.3.204>.
- Lucas, M. (2000). Semantic priming without association: A meta-analytic review. *Psychonomic Bulletin & Review*, 7(4), 618–630.
- Manouilidou, C., de Almeida, R. G., Schwartz, G., & Nair, N. P. V. (2009). Thematic roles in Alzheimer's disease: Hierarchy violations in psychological predicates. *Journal of Neurolinguistics*, 22, 167–186. <https://doi.org/10.1016/j.jneuroling.2008.10.002>.
- Marantz, A. (2013). Verbal argument structure: Events and participants. *Lingua*, 130, 152–168. <https://doi.org/10.1016/j.lingua.2012.10.012>.
- Mcintyre, A. (2013). Adjectival passives and adjectival participles in English. In A. Alexiadou & F. Schäfer (Eds.), *Non-canonical passives*, 205, 21–42. John Benjamins Publishing Company. <https://doi.org/10.1075/la.205>
- McKoon, G., & Macfarland, T. (2002). Event templates in the lexical representations of verbs. *Cognitive Psychology*, 45, 1–44. [https://doi.org/10.1016/S0010-0285\(02\)00004-X](https://doi.org/10.1016/S0010-0285(02)00004-X).
- Meltzer-Asscher, A., Mack, J. E., Barbieri, E., & Thompson, C. K. (2015). How the brain processes different dimensions of argument structure complexity: Evidence from fMRI. *Brain & Language*, 142, 65–75. <https://doi.org/10.1016/j.bandl.2014.12.005>.
- Nordlinger, R., Rodriguez, G. G., & Kidd, E. (2022). Sentence planning and production in Murrinhpatha, an Australian free word order language. *Language*, 98(2), 187–220.
- Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advanced Health Science Education, Theory and Practice*, 15(5), 625–632. <https://doi.org/10.1007/s10459-010-9222-y>.
- Osterhout, L., & Swinney, D. A. (1993). On the temporal course of gap-filling during comprehension of verbal passives. *Journal of Psycholinguistic Research*, 22(2), 273–286. <https://doi.org/10.1007/BF01067834>.
- Pesetsky, D. (1987). Binding problems with experiencer verbs. *Linguistic Inquiry*, 18(1), 126–140.

- Pesetsky, D. (1995). *Zero syntax: Experiencers and cascades*. Cambridge, MA: MIT Press.
- Pinker, S. (1989). *Learnability and cognition: The acquisition of argument structure*. Cambridge, MA: MIT Press.
- Pinker, S. (2016). *Learnability and cognition: The acquisition of argument structure*. The MIT Press. <https://doi.org/10.7551/mitpress/9700.001.0001>
- Prasad, G., & Linzen, T. (2021). Rapid syntactic adaptation in self-paced reading: Detectable, but only with many participants. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 47(7), 1156–1172. <https://doi.org/10.1037/xlm0001046>.
- Pylkkänen, L. (2000). Representing causatives. *Semantics and Linguistic Theory*, 10, 132–148.
- Pylkkänen, L. (2002). *Introducing arguments*. MIT Press. <https://doi.org/10.7551/mitpress/9780262162548.001.0001>
- Quirk, R., Greenbaum, S., Leech, G., & Svartvik, J. (1985). A comprehensive grammar of the English language. *Journal of English Linguistics*, 20(1), 122–136. <https://doi.org/10.1177/007542428702000108>.
- Rappaport-Hovav, M., & Levin, B. (2007). Deconstructing thematic hierarchies. In A. Zaenen & J. Simpson & T.H. King & J. Grimshaw & J. Maling & C. Manning (Eds.), *Architectures, rules, and preferences: Variations on themes by Joan W. Bresnan* (pp. 1–16). Stanford, CA: CSLI Publications.
- Reinhart, T. (2002). The theta system – An overview. *Theoretical Linguistics*, 28, 229–290. <https://doi.org/10.1515/thli.28.3.229>.
- Richardson, F. M., Thomas, M., S. C., & Price, C. J. (2010). Neuronal activation of semantically reversible sentences. *Journal of Cognitive Neuroscience*, 22(6), 1283–1298. <https://doi.org/10.1162/jocn.2009.21277>.
- Rousseuw, P. J. (1987). Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. *Journal of Computational and Applied Mathematics*, 20, 53–65. [https://doi.org/10.1016/0377-0427\(87\)90125-7](https://doi.org/10.1016/0377-0427(87)90125-7).
- Rubin, M. (2017). Do *p* values lose their meaning in exploratory analyses? It depends how you define the familywise error rate. *Review of General Psychology*, 21(3), 269–275. <https://doi.org/10.1037/gpr0000123>.
- Ryan, M. (2024). Doctoral dissertation. Department of Medicine, Health and Human Sciences, Macquarie University. <https://doi.org/10.25949/26020579.v1>
- Ryan, M., Cupples, L., Giblin, I., Lyndsey, N., & Sowman, P. F. (2025a). The causer's intent. [Manuscript in review]. <https://doi.org/10.25949/26020579.v1>.
- Scheepers, Christoph & Konieczny, Lars & Hemforth, Barbara. 2000. Linking syntactic functions with thematic roles: psych-verbs and the resolution of subject-object ambiguity. In B. Hemforth & L. Konieczny (eds.), *German Sentence Processing*, 279–310. Dordrecht: Springer. DOI: 10.1007/978-94-015-9618-3_4
- Schäfer, F. (2009). The causative alternation language and linguistics compass, 3(2), 517–718.
- Schipke, C. S., Knoll, L. J., Friederici, A. D., & Oberecker, R. (2012). Preschool children's neural correlates of their behavioral performance. *Developmental Science*, 15(6), 762–774. <https://doi.org/10.1111/j.1467-7687.2012.01167.x>.
- Schlesinger, I. M. (1992). The experiencer as an agent. *Journal of Memory and Language*, 31, 315–332. [https://doi.org/10.1016/0749-596X\(92\)90016-Q](https://doi.org/10.1016/0749-596X(92)90016-Q).
- Shapiro, L. P., Brookings, B., Gordon, B., & Nagel, N. (1991). Verb effects during sentence processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17(5), 983–996. <https://doi.org/10.1037/0278-7393.17.5.983>.
- Slobin, D. I., & Bever, T. G. (1982). Children use canonical schemas: A crosslinguistic study of word order and inflections. *Cognition*, 12, 229–265. [https://doi.org/10.1016/0010-0277\(82\)90033-6](https://doi.org/10.1016/0010-0277(82)90033-6).
- Stella, M., & Engelhardt, P. (2022). Use of parsing heuristics in the comprehension of passive sentences: Evidence from dyslexia and individual differences. *Brain Sciences*, 12(209), 1–19. <https://doi.org/10.3390/brainsci12020209>.
- Sung, J. E. (2015). Age-related changes in sentence production abilities and their relation to working-memory capacity: Evidence from a verb-final language. *PLoS One*, 10(4), 1–12. <https://doi.org/10.1371/journal.pone.0119424>.
- Szterman, R., & Friedmann, N. (2014). Relative clause reading in hearing impairment: Different profiles of syntactic impairment. *Frontiers in Psychology*, 5, 1–16. <https://doi.org/10.3389/fpsyg.2014.01229>.
- Talmy, L. (2000). *Toward a cognitive semantics* (2 Vols). Cambridge: MIT Press.
- van der Lely, H. (1996). Specifically language impaired and normally developing children: Verbal passive vs. adjectival passive sentence interpretation. *Lingua*, 98, 243–272.

- Van Gelderen, E. (2014). Changes in psych-verbs: An analysis of little *v.* *Catalan Journal of Linguistics*, 13, 99–122.
- Van Valin, R. D. Jr. (1990). Semantic parameters of Split intransitivity. *Language*, 66(2), 221–260. <https://www.jstor.stable/414886>
- Van Valin, R. D. (1991). Functionalist linguistic theory and language acquisition. *First Language*, 11, 7–40. <https://doi.org/10.1177/014272379101103102>.
- Verhoeven, E. (2010). Agentivity and stativity in experiencer verbs: Implication for a typology of verb classes. *Linguistic Typology*, 14(2–3), 213–251. <https://doi.org/10.1515/lity.2010.009>.
- Verhoeven, E. (2017). Scales or features in verb meaning? Verb classes as predictors of syntactic behavior. *Belgian Journal of Linguistics*, 31, 164–193.
- Ward, G., & Birner, B. (2019). 12. Discourse effects of word order variation. In P. Portner, C. Maienborn, & K. Heusinger (Eds.), *Semantics - sentence and information structure* (pp. 413–449). Berlin, Boston: De Gruyter Mouton. <https://doi.org/10.1515/9783110589863-012>.

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