IS A-MOVEMENT A MOVEMENT?

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AN EYE-TRACKING AND SPR INVESTIGATION

BY

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A THESIS
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Abstract

In this thesis, I investigate the link between A-movement and online processing in eye-tracking and self-paced reading (SPR). A-movement refers to movement of an element to an argument position, where an element may be base-generated and hold a semantic role of the main predicate of the clause. I analyze six constructions in English, divided into three experimental pairings. Unaccusative constructions argued to involve movement are contrasted with unergatives as control, in a purely intransitive pairing. Transitive verb expectations are controlled by contrasting optional transitive constructions and purported movement in inchoative constructions. Argument alternation is taken into consideration in comparing instrumental constructions and possible movement in middle constructions.

The results from the SPR experiment did not show significant differences in reading times or fixation durations between pairings in any regions. In the eye-tracking results, no significant effects were found at the verb region, where the syntactic complexity of movement could lead to greater processing effort. In the subject noun region of the optional transitive and inchoative constructions and instrumental and middle constructions, significant differences in gaze duration, total fixation duration, and go-past time were found. These results are compatible with theories of frequency effects. Differences at the adverb could support lexical or derivational approaches, as controls and experimental conditions had equal length fixations in our first pairing, controls had longer fixations in our second pairing, and experimental items had longer fixations in our third pairing. Ultimately, the results do not offer strong support for the derivational approach, and are not accounted for through a lexical approach.

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CONTENTS

CHAPTER 1: INTRODUCTION

In this thesis, I look for experimental evidence of A-movement in the processing of several constructions. A-movement involves movement of an element to an argument position, a position in which an argument can be base-generated and take a semantic role with respect to the main predicate of the clause (Baltin, 2001). However, there is debate as to whether the theoretical construct of A-movement has a psychological underpinning (Perlmutter, 1978; Burzio, 1986; Baltin, 2001) or does not (e.g., Bresnan, 1978, 1982; Pollard & Sag, 1987, 1994; Van Valin, 1984, 1993). Three pairs of constructions are compared to investigate A-movement. By adding constructions that are not purely intransitive, we also had to control for argument alternation and transitive verb expectations. I conducted a self-paced reading experiment (*Experiment 1: Self-paced reading*) and an eye-tracking experiment (*Experiment 2: Eye-tracking*) to examine the online processing of these six constructions.

Examples of the six construction types used in *Experiments 1* and *2* are depicted in (1)-(3), with (a) as baseline condition and (b) as experimental condition. Unergative and unaccusative constructions are contrasted in (1). This purely intransitive pairing contrasts A-movement in the unaccusative construction with non-movement in the unergative construction. In (2), optional transitive and inchoative constructions are contrasted. Inchoative constructions are argue to involve movement, while optional transitive constructions do not involve movement. Optional transitive and inchoative constructions also control for transitive verb expectations, as the active verb form may prime the parser to expect an argument following the verb. Finally, in (3), instrumental and middle constructions are contrasted. Middle constructions may involve A-

movement, while instrumental constructions do not, and both involve argument alternation. Each stimulus consisted of 10 regions: *subject* | *preposition phrase* | *verb* | *adverb* | *preposition phrase*.

(1) [− movement, − object] vs. [± movement, − object]

a. The dog in the doorway howled repeatedly before the walk. *unergative (baseline)*

b. The clouds in the sky disappeared rapidly after the storm. *unaccusative (experimental)*

(2) [− movement, + object] vs. [± movement, − object]

a. The tourist with the gear hiked briskly during the trip. *optional transitive (baseline)*

b. The pants in the suitcase creased awkwardly during the flight. *inchoative (experimental)*

(3) [− movement, + object] vs. [± movement, − object]

a. The saw in the backyard cut effortlessly before the renovation. *instrumental (baseline)*

b. The bread in the basket cut easily before the banquet. *middle (experimental)*

Current theories of grammar suggest that A-movement is more syntactically complex than non-movement (Baltin, 2001). Linking theories between grammar and processing offer a starting point, but are not well-specified enough to determine how that complexity will impact sentence processing. Work on listening and speech production has suggested reactivation of the A-moved element in the gap position of unaccusative and inchoative constructions (Friedmann, Taranto, Shapiro, & Swinney, 2008; Momma, Slevc, & Phillips, 2018). However, eye-tracking analysis of middle and unaccusative constructions has suggested that unaccusative constructions involve movement and middle constructions do not (Moed, Kuperman, Kučerová, 2013). I discuss these three constructions argued to involve A-movement and contrast them with control constructions that do not involve A-movement.

One plausible linking hypothesis between syntax and sentence processing is that the syntactic complexity of A-movement will lead to greater processing effort in sentence processing. This processing effort may manifest itself in slower reading times and longer fixation durations for conditions involving A-movement compared to conditions that do not involve movement. Previous work on another type of syntactic movement, Ā-movement, has shown processing costs at the gap left by the moved element (e.g., Stowe, 1986; Osterhout & Swinney, 1993; Traxler & Pickering, 1996; Hofmeister, 2011; Omaki, Lau, Davidson White, Dakan, Apple, & Phillips, 2015). While Ā- and A-movement differ, the Ā-movement literature offers insight into the processing effort required for movement.

I aim to address the following questions. Will we see longer reading times and fixation durations in A-movement conditions? If so, this could be evidence of A-movement and the associated processing cost. Or, will we see no differences in reading time and fixation duration between our experimental pairings? This could suggest no difference in processing complexity, and would not offer evidence that A-movement exists. I will discuss these predictions further in the following sections, considering specific regions in the stimuli used, as well as the different measures that self-paced reading and eye-tracking offer. My goal is to offer insight into the link between online processing of the six syntactic constructions and their theoretical analyses in the interest of understanding A-movement.

CHAPTER 2: RESEARCH BACKGROUND

2.1 A-movement

2.1.1 Theoretical overview

Unlike Ā movement, for which we have a variety of tests, A-movement is difficult to diagnose. The properties of an argument that has undergone A-movement and the properties of an argument that was base generated in that position are often indistinguishable. Conversely, Ā-movement has properties that highlight the difference between an Ā-moved element and a base-generated element. Safir (2019) contrasts the properties of A-movement and Ā-movement in **Table 1** (p. 287).

Table 1: *The A/Ā movement contrasts*

	Ā	A
Case can be assigned to landing site	− / % −	+
Can agree with T in landing site	−	+
Bypasses intervening subjects	+	−
Allows pied-piping	+	−
Landing site can bind anaphors	−	+
Licenses parasitic gaps	+	−
Can induce weak crossover	+	−
Must reconstruct	mostly yes	no

While performing syntactic tests of movement on Ā-movement is informative, such tests are ineffective for A-movement. In **Table 1**, three contrasts present issues for distinguishing an A-

moved argument from an argument base-generated in the same position: Case can be assigned to the argument in its landing site, the argument can agree with T in its landing site, and the argument can bind anaphors in its landing site. Ā-movement does not allow case to be assigned in the landing site, does not allow the moved element to agree with T, and its landing site cannot bind anaphors. For example in (4a), *how many boys* undergoes Ā-movement and therefore does not agree with T in its landing site. However, in (4b) *the boys* undergoes A-movement and must agree with T. The A-movement of *the boys* to Spec-TP results in the same pattern of agreement as an element base-generated in Spec-TP would, and therefore does not show evidence of movement. Unlike A-movement, the Ā-moved element in (4a) does not act as a base-generated element would.

(4) a. How many boys is/*are it clear that Mary likes?

b. The boys happen(*s) to be guilty.

(Safir, 2019, p. 287)

Further, A-movement does not allow pied-piping, nor does it license parasitic gaps. Pied-piping and licensing of parasitic gaps demonstrate movement has occurred, and are both possible with Ā-movement. Pied-piping presents clear evidence of movement in (5a), in the Ā-movement of the entire phrase *about whom*. Conversely, A-movement cannot undergo pied-piping. In (5b), *about Mary* undergoes A-movement, which produces an ungrammatical result.

(5) a. About whom did John speak?

b. *About Mary was spoken? (*cf*. Mary was spoken about)

(Safir, 2019, p. 287)

Passives, unaccusatives, and raising constructions are the most widely-held examples of constructions derived by A-movements (Baltin, 2001). For example, subject-to-subject raising involves movement of the subject from the infinitival complement to Spec-TP of the matrix clause for Case. One of the major arguments for A-movement is the absence of requirements imposed by raising predicates on their subject (Bhatt, 2001). Rather, the constraints on the raising predicate are imposed by the embedded clause (Bhatt, 2001). Raising predicates only allow for expletive subjects if their clausal complement allows for expletive subjects, as in the contrast in (6). Further, predicate specifiers in infinitival complements of passivized verbs offer support for A-movement, as in (7). The example in (7) is more complex because it involves quantifier float. The acceptability of the pre-verb *to* indicates that a nominal occurred after the matrix passivized verb, before undergoing A-movement (Baltin, 2001).

(6) a. There seems to be a vampire in the city.

b. *There seems to laugh a man/*There seems a man to laugh.

(Bhatt, 2001, p. 1)

(7) They were believed all to be quite diligent.

(Baltin, 2001, p. 237)

The common viewpoint among those who argue that A-movement does not exist is that passives and unaccusatives are related through a lexical redundancy rule (e.g., Bresnan 1978, 1982; Foley & Van Valin, 1984; Pollard & Sag, 1987, 1994; Van Valin, 1993, as cited in Baltin, 2001). The invisibility of A-movement in its landing site is taken as support of the argument that A-movement does not exist.

For Chomskyan generativists, Baker's (1988) Uniformity of Theta Assignment Hypothesis (UTAH) is key to this debate. Under UTAH, there is a one-to-one mapping between position in the syntactic structure and theta role assignment. Consequently, an argument with a theta role that does not map to its uniform position in the syntactic structure must have undergone a movement. In the case of unaccusative, inchoative, and middle constructions, the logical object is the grammatical subject. Under UTAH, the logical object of these constructions must have undergone movement to arrive in subject position. In contrast, the mapping between syntax and semantics is not uniform in Lexical Functional Grammar (LFG). Rather, syntax and semantics are mediated by functions that allow flexibility between structure and interpretation. In this case, the logical object does not require movement to hold the subject position.

2.1.2 Experimental overview

In keeping with the theoretical difficulties in analyzing A-movement as compared to Ā-movement, the experimental literature on Ā-movement is more comprehensive than that of A-movement. Ā-movement has been investigated experimentally in multiple domains, including eye-tracking, self-paced reading, and neural measures (e.g., Traxler & Pickering, 1996, 1998; Staub, 2007; Dickey & Thompson, 2009; Sekerina, Laurinavichyute, & Dragoy, 2015). As such, Ā-movement is the best example available of linking syntactic movement to processing.

Here, I will briefly consider the experimental evidence of Ā-movement, and how this evidence might relate to A-movement. Stowe (1986) observed a filled-gap effect at *us* during *wh*-fronting in (8a). She found slower reading times in direct object position in the *wh*-fronting condition (8a) than in the control condition (8b). She interpreted this as evidence of active prediction of gap

locations, later named the active filler strategy by Frazier and Flores d'Arcais (1989). Although the filled gap effect is not compatible with our intransitive stimuli, it is possible that the parser engages in something similar upon encountering the inanimate subject noun in our experimental conditions. The inanimate subject of an A-movement construction may be kept in memory for later processing, or the parser may predict an upcoming verb compatible with movement upon encountering the inanimate subject (e.g., unaccusative).

(8) a. My brother wanted to know who Ruth will bring us home to ___ at Christmas.

b. My brother wanted to know if Ruth will bring us home to Mom at Christmas.

(Stowe, 1986, p. 234)

2.2 Pair 1: Unergative and unaccusative constructions

2.2.1 Theoretical overview

2.2.1.1 Unergative constructions

The Unaccusative Hypothesis argues that intransitive verbs come in two flavours (Perlmutter, 1978). Unergative constructions actively initiate the action of the verb and are actively responsible for the action (Perlmutter, 1978). Unaccusatives differ semantically from unergatives in that they do not initiate the action of the verb, nor are they responsible for the action (Perlmutter, 1978). Both unaccusative and unergative constructions lack a transitive counterpart (Hale & Keyser, 1999), and superficially they share a word order, as in (9). The syntactic structure of the unergative construction is depicted in (10). Unergative constructions contain a single argument, the agent, that is merged as external argument. While there is no disagreement

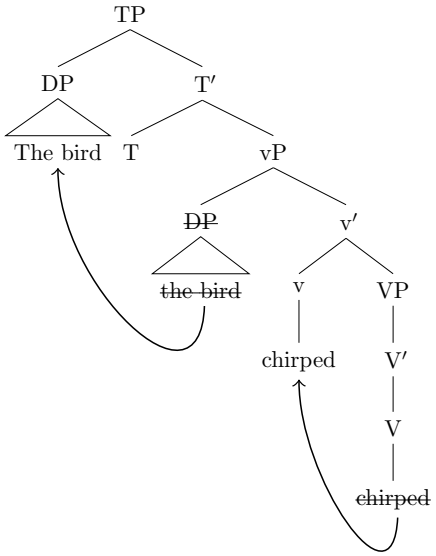
about the derivation of unergative constructions, the derivation of unaccusative constructions is widely debated.

(9) a. The leaf fell.

b. The bird chirped.

(Friedmann et al., 2008, p. 2)

(10)



2.3.1.3 Derivational approach to unaccusative constructions

Investigation of the structural properties of unaccusative constructions provides insight into the theoretical debate about A-movement. Lexical approaches to unaccusatives argue against A-movement, whereas derivational approaches argue A-movement is involved. Proponents of Lexical Function Grammar (LFG) assert that underspecified roles are freely mapped onto compatible grammatical functions (e.g., Bresnan, 1978; Levin, Rappaport, & Zaenen, 1983; Dalrymple, 1999; Bresnan, Asudeh, Toivonen, Wechsler, 2016). Under LFG, the *mapping principles* in (11) differentiate unergative and unaccusative constructions (Bresnan et al., 2016). The mapping principles state that the logical subject is mapped onto the subject function in the

initial argument structure, and if that is not possible then the logical object is mapped onto the subject function. Unergative constructions are subject to mapping principle (11ai), whereas unaccusative constructions are subject to principle (11aii). Thus, according to LFG the difference in classification of the sole argument of English intransitive verbs arises from semantics. The structure of unaccusative constructions under the lexical approach is depicted in (12). All of the trees in this thesis are Chomskyan to allow for direct comparison across constructions.

(11) **Mapping principles**:

a. Subject roles:

i. [the logical subject] is mapped onto SUBJ when initial in the argument structure

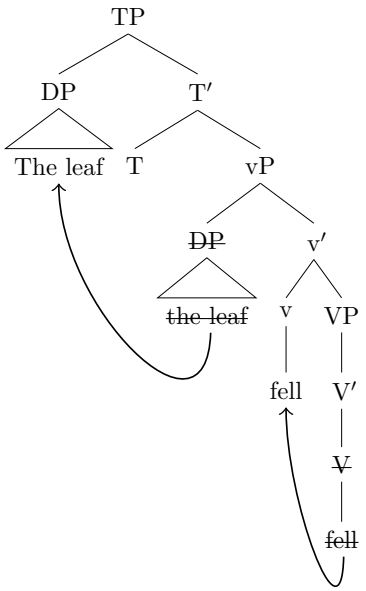
otherwise:

ii. [a patient or theme] is mapped onto SUBJ

b. Other roles are mapped onto the lowest compatible function

(Bresnan et al., 2016, p. 334)

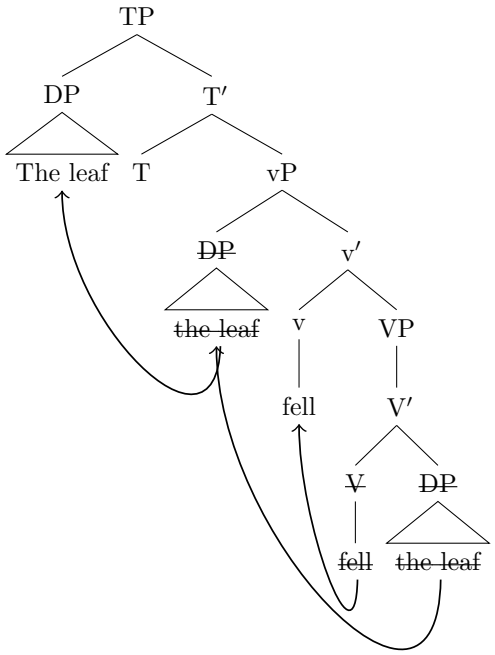
(12)



The Unaccusative Hypothesis posits that the single argument of unaccusatives is syntactically the internal argument, whereas the single syntactic argument of unergatives is the external argument (Perlmutter, 1978). Maintaining the Unaccusative Hypothesis, the word order in (9a) is derived through A-movement of *the leaf* to subject position. Thus, while (9a) and (9b) are superficially similar in their word order, under the Unaccusative Hypothesis their syntactic structure differs. The unaccusative in (9a) contains a base-generated object that moves to subject position, while the lone argument of the unergative in (9b) is merged directly into subject position.

In contrast to transitive verbs, unaccusative verbs do not assign accusative Case (Belletti, 1998). Thus, the derivational approach argues that the internal argument must move to Spec-TP to receive Case, as shown in (13). The ability of the A-moved element in (13) to receive Case and agree with T in its landing site gives it the same characteristics as an element base-generated in Spec-TP.

(13)



2.2.2 Experimental overview

The lexical and derivational analyses of unaccusative constructions differ in their relation to unergative constructions. The lexical approach to unaccusatives merges an external argument and does not involve syntactic movement, resulting in no structural difference between unaccusative and unergative constructions. The derivational approach to unaccusatives merges an internal argument that undergoes A-movement to subject position, yielding a syntactic difference between unaccusative and unergative constructions.

Friedmann and colleagues (2008) tested whether there was an observable difference between unaccusatives, unergatives, and alternating unaccusatives using cross-modal lexical priming (CLMP). CLMP involves presentation of the participant with a word shortly after a semantically related word (Swinney, Onifer, Prather, Hirshkowitz, 1979, as cited in Friedmann et al., 2008). In their paradigm, sentences are presented aurally. A letter sequence (word or non-word) is displayed briefly on the screen at some point during the sentence, referred to as a "Probe" (Friedmann et al., 2008). The participant is asked to make a lexical decision as to whether the letter sequence is a word or non-word using a button press. CLMP studies have demonstrated activation of a moved constituent at first encounter and at the syntactically linked gap.

Friedmann and colleagues predicted a reactivation effect after the verb for unaccusatives on the condition that unaccusatives are derived by A-movement. They did not predict any reactivation effect for unergative sentences. Three visual targets (words) appeared at three probe positions in each sentence: (1) offset of the head of the subject, (2) offset of the verb, and (3) 750

ms after offset of the verb. Their predictions were borne out, as they found a reactivation pattern following the verb for unaccusatives at Probe 3, but not for unergatives. Their findings support a derivational approach to unaccusative constructions. Under the lexical approach, the sole argument of an unaccusative verb is merged directly as external argument, providing no reason for reactivation following the verb.

Taken together with previous findings, there appears to be a difference in the time course of processing A-movement and Ā-movement (Friedmann et al., 2008; Osterhout & Swinney, 1993). Friedmann and colleagues note that both A- and Ā-movement involve reactivation of the moved constituent, but reactivation for A-movement shows up later in the sentence.

Further evidence of processing differences between unaccusative and unergative constructions has been found in sentence production. Momma and colleagues (2018) found verb interference before subject onset in production of unaccusative sentences. However, for unergative sentences verb interference was found during subject articulation (Momma et al., 2018). The differences in processing during production suggest a structural difference between unaccusatives and unergatives, consistent with a derivational approach to unaccusative verbs (Momma et al., 2018). Momma and colleagues (2018) suggest that the computation required to retrieve the lemma of an internal argument noun or to assign the syntactic/semantic status to moved object nouns after lemma retrieval could be a key factor in the processing of unaccusative verbs as compared to unergative verbs during production. While the findings of Momma and colleagues do not contribute to specific predictions in the SPR and eye-tracking study we conducted, they aid in the argument that unaccusative and unergative constructions are processed differently.

2.3 Pair 2: Optional transitive and inchoative constructions

2.3.1 Theoretical overview

2.3.1.1 Optional transitive constructions

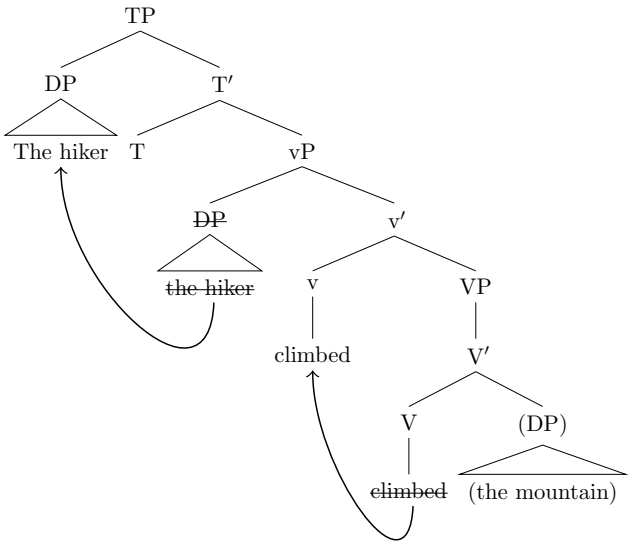
Optional transitive verbs have an intransitive and transitive variant, wherein the subject bears the same semantic relation to the verb in both variants (Levin, 1993). The intransitive variant in these alternations involves an unexpressed but understood object, as in (14). The tree structure is displayed in (15).

(14) a. Mike ate the cake.

b. Mike ate. (cf. Mike ate a meal or something one typically eats.)

(Levin, 1993, p. 33)

(15)



2.3.1.2 Lexical approach to inchoative constructions

Central to the causative-inchoative alternation is the shared semantic relation of the subject in the inchoative use and the object in the causative use. In (16a), *the window* is the subject of the inchoative, whereas in (16b) *the window* takes the role of object in the causative. How the

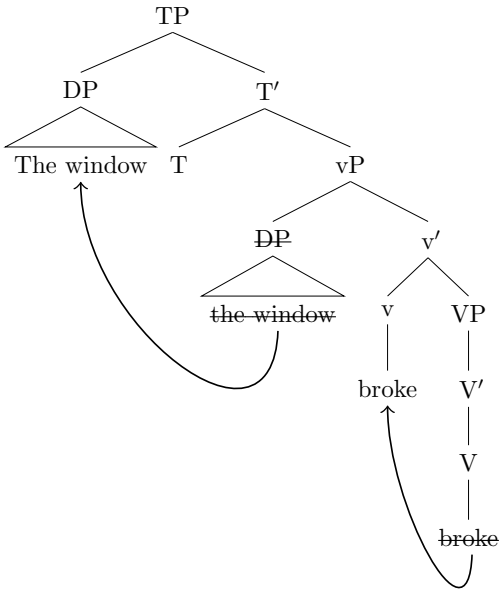
causative-inchoative alternation is organized in the mental lexicon is widely debated. Lexicalist accounts assume syntactic structure to be projected from the lexicon (Schäfer, 2009). Consequently, both idiosyncratic and structural information is included in the lexical entry of the verb, and transitive alternations occur within the lexicon (Schäfer, 2009). Linking rules place lexical arguments into different positions in the syntactic tree, rather than derivations that occur in the syntax.

(16) a. The window broke.

b. The boy broke the window.

(Schäfer, 2009, p. 641)

(17)



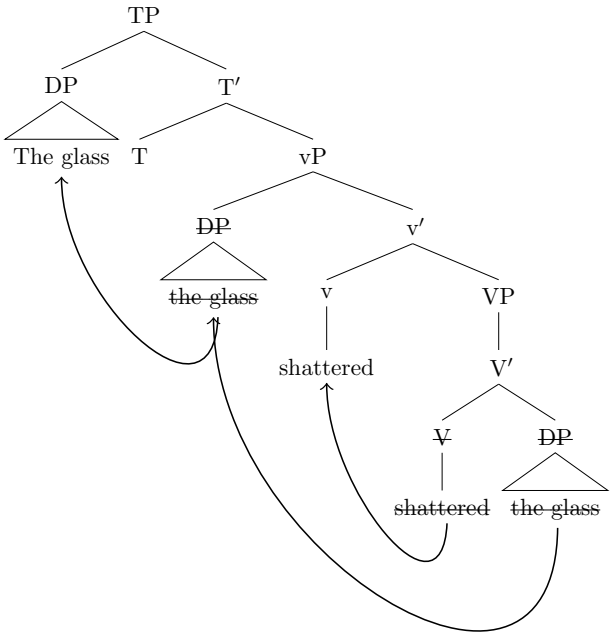
However, not all inchoative verbs have a causative counterpart, and conversely not all causative verbs have an inchoative counterpart. Lexicalist approaches argue that derivational approaches are misguided due to this imbalance (Piñón, 2001). Accounts that require causatives to be derived from inchoatives do not account for causatives with no inchoative counterpart, and

vice versa (Piñón, 2001). Piñón proposes a single verb stem from which both the causative and inchoative are derived pre-syntactically.

2.3.1.3 Derivational approach to inchoative constructions

Syntactic accounts posit that transitivity alternations are a result of syntactic structure interacting with the lexical base. The question that arises with a derivational approach is which version forms the lexical base: (i) causative alternant derived from inchoative via causativization, (ii) inchoative alternant derived from transitive via anticausativization or detransitivization, or (iii) both versions are derived from a common source (Alexiadou, 2006; Schäfer, 2009).

(18)



According to causativization approaches, inchoatives are monadic and lack an implicit external argument (Brousseau & Ritter, 1991; Pesetsky, 1995). Under this approach, the causative form is derived from the inchoative via causativization. According to the anticausativization view, alternating verbs are dyadic predicates. Inchoatives undergo

detransitivization, creating an intransitive entry from the transitive entry, resulting in the lack of external argument (Levin & Rappaport Hovav, 1995; Reinhart, 2002). Levin and Rappaport Hovav address the imbalance between inchoative and causative forms through a condition on detransitivization. They state that the nature of the causing event must be unexpressed for the causer argument to be unexpressed and an inchoative to be derived. Kratzer (1996) and Alexiadou, Anagnostopoulou, and Schäfer (2015) take a different approach, wherein inchoatives and causatives do not differ in event complexity, but instead in the presence or absence of the VoiceP, which introduces the external argument. An anticausativization analysis is depicted in (18), in which the external argument has been demoted and the internal argument moves to subject position.

2.3.2 Experimental overview

The lexical approach and the anticausativization approach of inchoative constructions have different structural relations to optional transitive constructions. Under the lexical approach, inchoative constructions merge a single argument in subject position, just as an optional transitive verb does in its intransitive variant. The anticausativization approach of inchoatives differs from optional transitive constructions, in that it merges an internal argument that undergoes A-movement to subject position. As such, if the anticausativization approach of inchoatives is correct, the syntactic complexity of movement may lead to greater processing effort that takes the form of longer reading times and fixation durations.

However, optional transitives have another characteristic that differentiates them from inchoatives: their ability to take an object. While a causative-inchoative verb has the capacity to

take an object in its causative form, it is implausible in its inchoative form. Optional transitive verbs can be considered temporarily ambiguous in that they bear no overt morphology indicating whether they are the transitive or intransitive alternant and share a subject in both variants. Thus, the reader cannot disambiguate the argument structure until passing the verb.

Traxler and Pickering (1996) investigated processing of filler-gap dependencies with optional transitive verbs using eye-tracking. They were interested in whether the processor can form a relationship between the filler argument and verb, prior to encountering the gap. They used optionally transitive sentences and manipulated plausibility of the filler to determine whether the parser postulates a gap prior to encountering the verb. They found a plausibility mismatch effect at the critical verb in first fixation duration, italicized in (19). The first fixation duration at the verb increased when the filler was an implausible object of the verb (*city*), compared to when the filler was a plausible object of the verb (*book*). This finding suggests that a gap is postulated prior to encountering the verb, analyzing the filler as a plausible object of the verb, even when it is implausible (Traxler & Pickering, 1996). The capacity for the parser to postulate an object in a context where it is not plausible suggests a potential bias to fulfill the object role of the optional transitive. If there is expectation of an object, and subsequent violation of that expectation, we may see an effect on processing of optional transitive constructions in our experiments.

(19) We like the city/book that the author *wrote* unceasingly and with great dedication about ____ while waiting for a contract.

(Traxler & Pickering, 1996, p. 465)

Staub (2007) replicated Traxler and Pickering's findings, suggesting that the parser is aware of a verb's subcategorization restrictions. If the parser does not ignore a verb's subcategorization

restrictions, this would indicate an awareness on the part of the parser of optional transitive verbs' ambiguity.

In Friedmann and colleagues' (2008) cross-modal lexical priming study, discussed in *Section 2.2.2*, non-alternating unaccusatives were contrasted with alternating unaccusatives. These conditions translate to the unaccusative condition (non-alternating) and inchoative condition (alternating unaccusative) in our study. The alternation they refer to is the inchoative-causative alternation. Under a derivational approach, Friedmann and colleagues predicted that both inchoatives and unaccusatives would show reactivation effects following the verb. However, under a lexical approach, they predicted inchoatives would pattern with unergatives. They found that the inchoatives did not consistently show reactivation effects. While some of the inchoative verbs in this condition showed reactivation of the subject after the verb, others did not. They suggested that the alternating property of inchoatives resulted in this variable behaviour, as the verb is ambiguous in its ability to be intransitive and transitive (Friedmann et al., 2008). Friedmann and colleagues propose that reactivation may occur later in these instances due to ambiguity.

2.4 Pair 3: Instrumental and middle constructions

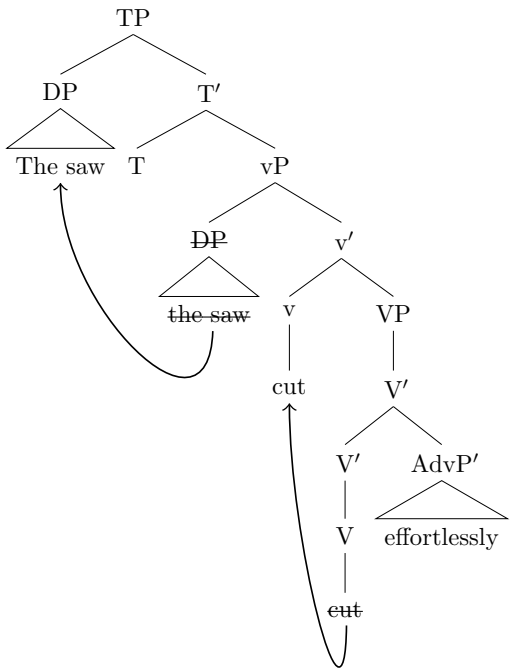
2.4.1 Theoretical overview

2.4.1.1 Instrumental constructions

Unlike the other verbs discussed, the literature focusing on instrumental verbs is sparse. Instrumental verbs involve an instrument as external and only argument. Levin (1993) considers instrumentals to be an intransitive variant used to indicate an instrument's capability for carrying

out the action expressed by the verb. I follow Levin in assuming instrumental verbs have a single argument. An instrumental construction is depicted in the tree in (20).

(20)



2.4.1.2 Lexical approach to middle constructions (non-movement)

Although there is ongoing theoretical disagreement about the syntactic structure of middles, most authors agree on three empirical generalizations:

(i) the external argument of the non-middle counterpart of the middle verb cannot be expressed as a regular DP-argument in the middle;

(ii) the logical subject argument, while not overtly expressed, is semantically present; and

(iii) if the non-middle counterpart of the middle verb has a direct internal argument role, it is the subject of the middle sentence that carries this role.

(Stroik, 2006)

The above observations are demonstrated in (21). In (21a) the external argument of the non-middle counterpart in (21b) cannot be expressed as a regular DP-argument. While the external argument is not expressed in (21a), it is semantically present. Finally, the direct internal argument of (21b), the non-middle counterpart, is expressed as the subject of the middle sentence in (21a).

(21) a. The branches on the tree clipped easily.

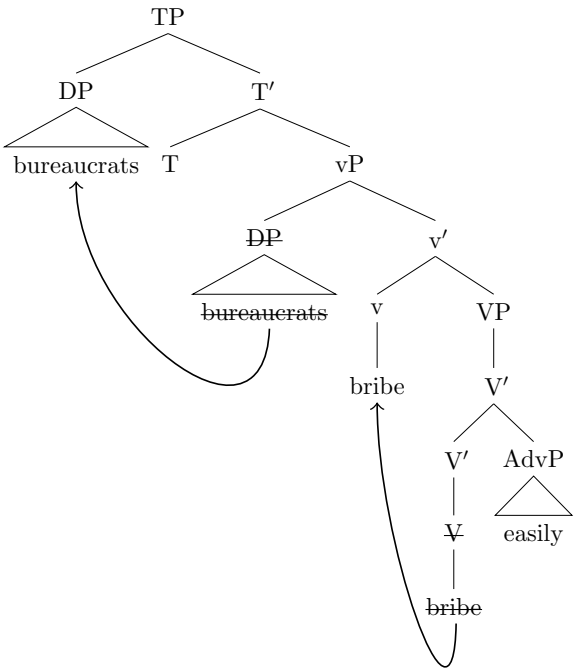
b. She clipped the branches on the tree easily.

Roberts (1987), Zribi-Hertz (1993), Ackema and Schoorlemmer (1994, 1995, 2017), and Fagan (1992, 1998), among others, have argued for a presyntactic/lexical analysis of middles. They propose that the middle and non-middle counterpart are differentiated in the lexicon. While the non-middle projects two arguments syntactically, the middle projects a single argument (i.e., the logical object). Under this account, the logical subject of middle appears only at Logical Form and receives a generic interpretation.

On the basis of Jackendoff (1990), Ackema and Schoorlemmer present two tiers of semantic representation: a thematic tier and an action tier (1994). The thematic tier corresponds to traditional theta-roles, while the action tier encodes the affectedness relations between arguments (Ackema & Schoorlemmer, 1994). They argue the agent is not present syntactically in the middle. The result is an unspecified action tier that takes an otherwise eventive verb and transforms it into a stative verb. Thus, the logical object is merged directly as the external argument, before undergoing movement to the specifier of TP to check case features (Roberts, 1986; Fagan, 1988; Ackema & Schoorlemmer, 2017). Ackema and Schoorlemmer provide the structure in (22a) for their analysis (2017, p. 2542), which I present as a tree in (22b).

(22) a. [$_{TP}$ bureaucrats$_i$ [$_{VP}$ t$_i$ [$_{V'}$ bribe easily]]]

b.



English generally requires an adverb like *easily* or *well* for a middle structure to be licit (Marelj, 2004; Lekakou, 2006). Non-movement analyses, such as Roberts (1986) and Marelj (2004), argue that agentive adverbs such as those in (23), as well as rationale clauses, are incompatible with the stativity of middles. Marelj identifies additional adverbs unable to be licensed in middles, including those in (24). Unlike agentive adverbs, these cannot be unacceptable due to the aspectual properties of middles (Marelj, 2004). Instead, Marelj considers Vendler's (1984) classification of adverbs, which posits a trait in the agent for *carefully* and experiencer for *passionately* (i.e., *care*, *passion*). Fellbaum (1986) argues that middles cannot "ascribe to this Agent role" due to their interpretation as generic (as cited in Marelj, 2004, p. 132). Fellbaum's argument is compatible with a lexical approach to middles. Marelj is not

convinced by Fellbaum's argument, as impersonals have a "quasi-universal interpretation" and still allow adverbs such as *passionately*.

(23) a. *This book reads deliberately/voluntarily/safely.

b. *This book reads passionately/completely.

(24) a. She read this book deliberately/voluntarily/safely.

b. She read this book passionately/completely.

(Stroik, 2006, p. 323)

Further, presyntactic analysis of middles do not take *for*-phrases as evidence of a syntactically present agent. In (25a), a compatible *for*-phrase could be argued to be the agent of the middle verb. However, in (25b) the middle is incompatible with the *for*-phrase. Further, (25c) illustrates the compatibility of other constructions that do not assign a theta-role with *for*-phrases.

(25) a. This book reads easily for Mary. (Stroik, 1992, p. 131)

b. This dress buttons (*for everyone). (Ackema & Schoorlemmer, 2017, p. 141)

c. That book is heavy/expensive for Mary. (Zribi-Hertz, 1993, p. 587)

2.4.1.3 Derivational approach to middle constructions (movement)

Keyser and Roeper (1984), Stroik (1992, 1995, 2006), Hoekstra, Roberts, and Abraham (1993), and others, argue for a derivational analysis of middles. Under the derivational analysis, middles are formed through the demotion of the external argument of the middle verb, the syntactic projection of the middle verb's internal argument into a VP-internal position, and finally A-movement of the internal argument to the subject position (Stroik, 2006).

Following Chomsky (1995), Stroik (2006) assumes that the *v*P projection is the projection in which a verb's external argument merges. From this Stroik concludes that a construction which lacks a *v*P will not have the capacity for an external argument. To test for the presence of a *v*P, he targets the *v*P projection using reduced *ing*-relative clauses:

(26) a. I'll talk to [anyone reading Chomsky's latest book].

b. I'll talk to [anyone arriving on time.]

c. I'll talk to [anyone resembling me].

d. *I'll talk to [anyone being tall].

(Stroik, 2006, p. 321)

(26) demonstrates that the reduced *ing*-relative can have unaccusative verbs (26b), stative verbs (26c), activity verbs (26a), and accomplishment verbs (26b), yet they cannot have verbs that lack a *v*P projection (26d). Stroik emphasizes that the ungrammaticality of (26d) cannot be explained by stativity, as the grammaticality of (26c) demonstrates. This suggests that reduced *ing*-relatives are sensitive to the presence or absence of a *v*P projection rather than verb type. Stroik applies this test of *v*P-hood to middles in (27).

(27) a. *I'll pay attention to [any Latin texts reading easily].

(cp. I'll pay attention to [any Latin texts that read easily].

b. *I'll buy [any silk dresses washing easily].

(cp. I'll buy [any silk dresses that wash easily].

(Stroik, 2006, p. 322)

Given the data in (27), Stroik concludes that middle verbs do not have *v*P projections. Consequently, neither the logical subject nor logical object can be merged as an external

argument. If Stroik is correct that middles lack a *v*P projection, the lexical analysis of middles cannot hold. The lexical analysis relies on the merging of the logical object directly as the external argument, which is not possible without a *v*P projection.

Stroik argues that the type of adverbs middles permit is further evidence of the absence of a *v*P projection. The lexical account argued that stativity and genericity prevented both *deliberately*- and *passionately*-type adverbs from appearing with middle verbs, as in (23) and (24). However, neither of these arguments hold, as such adverbs can appear with impersonals and statives.

(28) Mary loves John passionately/completely.

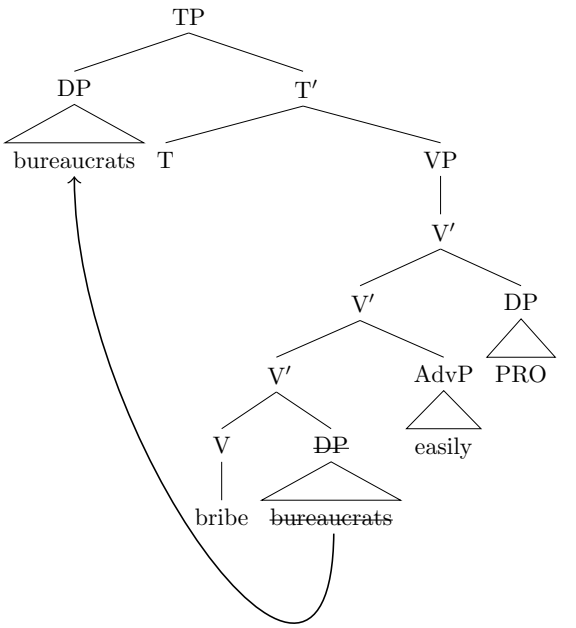
(Stroik, 2006, p. 323)

Stroik argues that middles may have an overt agent in the form of a *for*-phrase. For Stroik, middle constructions such as (29) read as "it is a generic property of events of Mary's reading this book that they are events easily performed by Mary" (1992, p. 131). While this interpretation allows the middle to have a generically interpreted event, the external argument is not generically interpreted. He follows Larson's (1988) Principle of Argument Demotion, which allows an argument to be projected syntactically as an adjunct. Stroik argues that the agent is not missing in instances where a middle is incompatible with a *for*-phrase, as in (25b). Instead, the agent takes the form of non-overt DP (PRO) that has been demoted to a VP adjunct. PRO functions as a variable bound by the GEN operator at LF, accounting for the generic interpretation of middle constructions that lack an overt agent. I depict Stroik's proposal using PRO in (30) and using a *for*-phrase in (31).

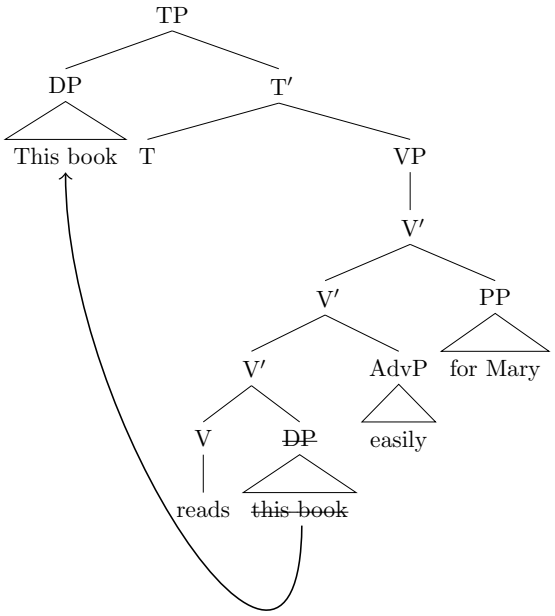
(29) This book reads easily for Mary.

(Stroik, 1992, p. 131)

(30)



(31)



2.4.2 Experimental overview

Moed (2013) employed eye-tracking to investigate A-movement in English. She contrasted middle, unaccusative, inchoative, unergative, and instrumental constructions. In the critical verb

and adverb region in the unaccusative condition, Moed identified the longest total fixation duration and highest rates of regressions. She interpreted this as evidence of A-movement in unaccusatives. In contrast, the middle and inchoative constructions had the shortest total fixation duration and lowest rate of regressions among all conditions in the critical verb and adverb region. This suggests no additional complexity in processing in these regions, which Moed interpreted as supporting the lexical analysis of middle constructions.

By including multiple constructions involving varying argument structure and argument structure alternations, Moed makes valuable comparisons in investigating A-movement. However, inconsistencies in stimuli (e.g., animacy, tense, structure) and classification of stimuli (e.g., middle stimulus classified as inchoative) present issues. Further, the raw fixation durations of all conditions were compared against the inchoative condition in statistical analysis. By contrasting all conditions against inchoatives, argument structure and argument structure alternations are not controlled for.

In this thesis, I aim to investigate constructions argued to involve A-movement to see if Moed's findings are replicable. The stimuli for both experiments in my thesis are drawn from Moed and were thoroughly redone by Cassandra Chapman. Ivona Kučerová, Jon Sprouse, and Cassandra Chapman created three conditional pairings to control for argument structure and transitive verb expectation.

CHAPTER 3: SUMMARY OF PREDICTIONS

This thesis discusses six verbal constructions. Under a lexical approach, all six constructions merge an external argument. Under a derivational approach, three constructions merge an internal argument and three constructions merge an external argument. The goal is to detect possible evidence of A-movement, while controlling for argument alternation and transitive verb expectations. The lexical and derivational approaches are contrasted in **Table 2**.

Table 2: Contrasting lexical and derivational approaches to six experimental conditions

	Lexical Approach		Derivational Approach	
	Merge External Argument	Merge Internal Argument	Merge External Argument	Merge Internal Argument
Pair 1	Unergative Unaccusative	-	Unergative	Unaccusative
Pair 2	Optional Transitive Inchoative	(Optional Transitive)	Optional Transitive	(Optional Transitive) Inchoative
Pair 3	Instrumental Middle	-	Instrumental	Middle

3.1 Processing the verb and adverb

3.1.1 Effects of movement

Movement is a syntactic operation, previously argued to induce a processing cost in studies on Ā-movement (Stowe, 1986; Osterhout & Swinney, 1993; Traxler & Pickering, 1996; Hofmeister, 2011; Omaki et al., 2015) and A-movement (Friedmann et al., 2008; Moed, 2013; Momma et al., 2018). The lexical approach predicts unaccusative, inchoative, and middle constructions should not result in greater processing effort compared to their (non-movement) control pairings. In

contrast, the derivational approach to unaccusative, inchoative, and middle constructions should lead to greater processing effort as compared to the respective control constructions. If A-movement is present in these constructions, it is still unknown if it will be evident in the SPR and eye-tracking record. I found limited previous experimental work on unaccusative, inchoative, and middle constructions in SPR and eye-tracking, with the exception of the origin of this work (Moed, 2013). Moed (2013) had inconsistent findings with respect to A-movement. She found potential evidence of A-movement in unaccusative constructions, but did not find evidence of A-movement in middle constructions.

Under the derivational approach, I hypothesize that we will see increased reading time at the verb or adverb region in the movement conditions compared to their non-movement pairings. Previous work has shown the verb to be the site at which argument structure becomes available, and as such is a likely site of processing cost of movement (e.g., Bader & Lasser, 1994; Omaki et al., 2015). The verb and adverb also border the base-generated location of the A-moved element. However, we do not know whether the effects of interest will be observed in the specified regions, or in spillover regions. As such, we added prepositional phrases following the critical regions to identify possible spillover effects.

3.1.2 Effects of transitive verb expectations

Under a lexical approach, all six experimental conditions merge a single argument as external argument. Under a derivational approach, each pairing has one condition that merges an external argument and one condition that merges an internal argument, which undergoes A-movement to

subject position. Shared between both approaches, the optional transitive is the only condition that can plausibly merge a second argument (i.e., an object).

While the causative alternant of an inchoative verb can take a subject and object, the inchoative takes a single argument as its grammatical subject. Optional transitives are temporarily ambiguous in that they can plausibly merge an object, as in (32b). This temporary ambiguity may be resolved upon encountering the adverb in our study, as in (32a). This resolution of ambiguity and potential violation of an expectation of an object could result in increased reading times for optional transitives compared to inchoatives. Experimental work on disambiguation of optional transitives has shown lengthened first fixation duration at the disambiguating region (Traxler & Pickering, 1996).

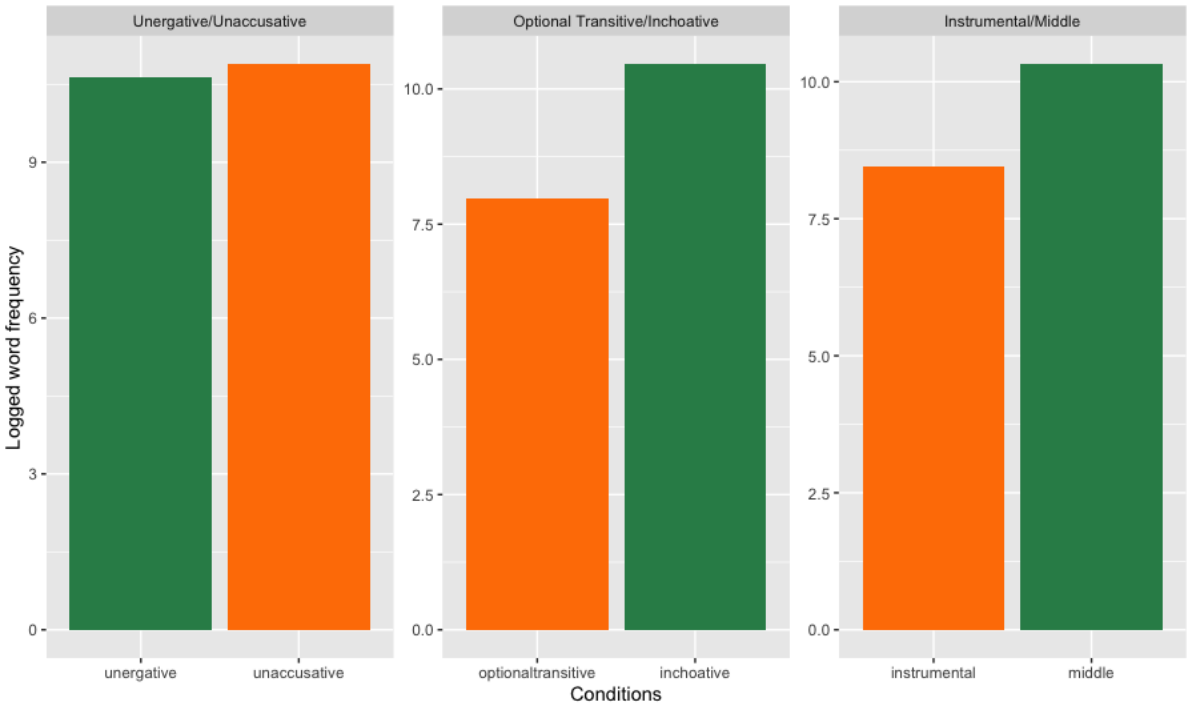
(32) a. The biker in the group raced cautiously after the injury.

b. The biker in the group raced *home* cautiously after the injury.

3.2 Processing the subject

The inanimate subject of an A-movement construction may provide a cue to hold the noun in memory or signal an upcoming gap, as inanimate subjects are unlikely agents of the event. In Ā movement, these signals are processed separately. However, we do not know where holding the noun in memory or prediction of a gap would be processed in A-movement. These processes could occur simultaneously at the subject, or later in spillover regions, the verb, or adverb. Although, if the lexical approach is correct and there is no A-movement, there would be no processing cost of movement at the subject noun.

Figure 1: Logged mean word frequency of subject noun by condition (Davies, 2008-, Corpus of Contemporary American English (COCA))



Additional factors that could impact processing of the subject noun include word frequency and animacy. Lexical access is assumed to be influenced by word frequency, such that low frequency words are fixated on longer than high frequency words (e.g., Just & Carpenter, 1980; Inhoff & Rayner, 1986; Raney & Rayner, 1995). If word frequency drives an effect at the subject noun we could see longer reading times and fixation durations for optional transitive compared to inchoative constructions, and instrumental compared to middle constructions. As discussed, animacy may signal movement under the derivational approach. The syntactic complexity of movement could lead to greater processing effort at the subject noun. This processing effort could appear as longer reading times and fixation durations in the inanimate subject noun of unaccusative, inchoative, and middle constructions, or spillover into the prepositional phrase. Importantly, unaccusatives and inchoatives differ in animacy from their control conditions, while

middles do not. As such, the distinguishing factor between the middle and instrumental conditions would not be animacy, but whether inanimate non-instruments signal movement while inanimate instruments do not. Another possibility is that the difference in animacy between unaccusative and unergative constructions and optional transitive and inchoative constructions may result in differences in processing that we do not see between middle and instrumental constructions.

CHAPTER 4: METHODOLOGY

4.1 Experiment 1: Self Paced Reading

4.1.1 Participants

Forty participants recruited through Prolific took part in the experiment (male: 21, female: 18, other: 1; mean age: 35). On Prolific, participants were restricted by location and language. All participants were from Canada or the United States, monolingual English speakers, and had normal or corrected to normal vision. They received $6.72 CAD in exchange for their participation.

4.1.2 Materials

We constructed sixty experimental stimuli divided into six conditions: unergative, unaccusative, inchoative, optional transitive, instrumental, and middle. The experimental stimuli were based on Moed (2013) and thoroughly redone by Cassandra Chapman. Verbs were repeated across the instrumental and middle condition, due to the limited number of verbs that can form the structures under investigation. Each stimulus shared a structure: *subject* | *preposition phrase* | *verb* | *adverb* | *preposition phrase*. The regions of interest included the subject noun, verb, and adverb. We consider that inanimate subject nouns may cue the parser to the presence of movement, resulting in a processing cost, and that in general animacy and frequency may affect reading times. To take potential spillover effects from the noun region into account, an intervening prepositional phrase was included following the noun region, preceding the verb

region. Additionally, a prepositional phrase was included following the adverb to avoid sentence final effects on the adverb.

Table 3: Experimental stimuli separated by region and condition

	Analysis regions									
	1	2	3	4	5	6	7	8	9	10
unergative	The	dog	in	the	doorway	howled	repeatedly	before	the	walk
unaccusative	The	clouds	in	the	sky	disappeared	rapidly	after	the	storm
optional transitive	The	hiker	on	the	trail	climbed	dangerously	during	the	landslide
inchoative	The	pants	in	the	suitcase	creased	awkwardly	during	the	flight
instrumental	The	saw	in	the	backyard	cut	effortlessly	before	the	renovation
middle	The	bread	in	the	basket	cut	easily	before	the	banquet
example comprehension question:		Was it an axe that cut effortlessly?								

Forty filler items were included to distract participants from the research question and to ensure our measures were garnering accurate results. We selected forty pairs of items from work on *Hyper-active gap filling* by Omaki and colleagues (2015). The forty pairs included ten items from four conditions: transitive plausible island constructions, transitive implausible island constructions, transitive plausible non-island constructions, and transitive implausible non-island constructions. The results of the filler items looked reasonable, and will not be discussed here in detail.

4.1.3 Design

Each participant read 60 experiment sentences and 40 filler sentences. The 80 filler sentences were divided into two lists, such that each list contained one item from each filler pair. By

creating two lists, no pairing of plausible and implausible sentence was presented to a single participant. Presentation of the items was designed such that items within a single condition were not presented sequentially and filler items appeared between presentation of experimental items. Randomization measures were also used to ensure participants read the sentences in a variable order to prevent possible ordering effects between sentences.

4.1.4 Procedure

The self-paced reading task was implemented on Ibex Farm. We used word-by-word, non-cumulative moving window presentation (Just et al., 1982). In a non-cumulative design, each sentence appears as a series of dashes. The dashes are replaced by words as the participant presses the spacebar, with only a single word presented at a time.

Grammatical equivalency across experimental items is crucial in SPR, in order to draw comparisons across conditions (Jegerski, 2014). Grammatical equivalency entails that regions are consistent between stimuli (e.g., region two is always the subject noun). We maintain grammatical equivalency across all experimental items. This allows designation of consistent critical regions across all stimuli (i.e., region 6 as critical verb region). Filler items are grammatically equivalent, but between filler and experimental items we do not maintain equivalency.

SPR experiments typically involve a task, such as a comprehension question, following some or all of the stimuli. This task serves to gauge participant engagement throughout the experiment and prevent participants from reflecting on the task and altering their behaviour. We chose to use a yes-no comprehension question following each sentence. Feedback was provided to inform

participants if they answered correctly or incorrectly. Comprehension questions did not address the critical portion of the sentence (i.e., the verb).

Participants were instructed to read at a natural pace and answer the questions to the best of their ability. Two practice items were presented prior to the test items, followed by a reminder of the instructions and an opportunity to ask questions. The experiment took ~20 minutes. The experiment was approved by the McMaster Research Ethics Board (MREB #: 1765).

4.1.5 Data Analysis

For purposes of analyses, the experimental sentences were split into 10 regions, each consisting of a single word. The critical regions of interest include the subject noun, verb, and adverb (Regions 2, 6, 7). In these regions, we posit potential effects of movement under the derivation approach to unaccusative, inchoative, and middle constructions. Detailed predictions are provided in *Chapter 3: Summary of predictions*.

Prior to statistical analysis, experimental items with low comprehension score averages (< 70%) and trials with incorrect responses to comprehension questions were removed. Two experimental items coded with incorrect comprehension question responses were corrected prior to removal. No participants needed to be removed due to low comprehension scores. Two experimental items with average comprehension scores below 70% were removed. The removal of the aforementioned trials totalled a loss of 9.5% of the experimental data.

Statistical analyses were performed using log-transformed RTs to ensure residuals were distributed normally. Data was trimmed to within two standard deviations of the mean prior to log transformation (5.5% of remaining data removed). The BayesFactor package in the R

statistical computing environment was used to complete Bayesian *t* tests (Morey & Rouder, 2018).

4.1.6 Results

4.1.6.1 Comprehension accuracy

The mean comprehension question accuracy for experimental items was 90.9%. By condition: the mean comprehension question accuracy: unergative 93.75%, unaccusative 95.0%, optional transitive 86.0%, inchoative 94.0%, instrumental 91.25%, and middle 94.75%.

4.1.6.2 Reading time data

The region-by-region reading time data is presented in **Figure 2**, with a facet for each experimental pairing. In the non-critical regions (Regions 1, 3-5, 8-10), there were no significant differences in reading times. In the three critical regions, there was no significant difference in reading times within the three verb pairings. Additionally, the three movement conditions were collapsed (unaccusative, inchoative, middle) together and the three non-movement conditions were collapsed (unergative, optional transitive, instrumental) to perform a pairwise comparison. There was no effect of movement on reading times. The Bayes Factor, *t*, and *p* values for the the comparisons by experimental pairing are provided in **Table 4**. The *t* and *p* values for the movement comparison are in **Table 5**. **Figure 2**, **Table 4**, and **Table 5** appear on pages 38-39.

Figure 2: *Mean log reading times for the six experimental conditions, faceted into the experimental pairings*

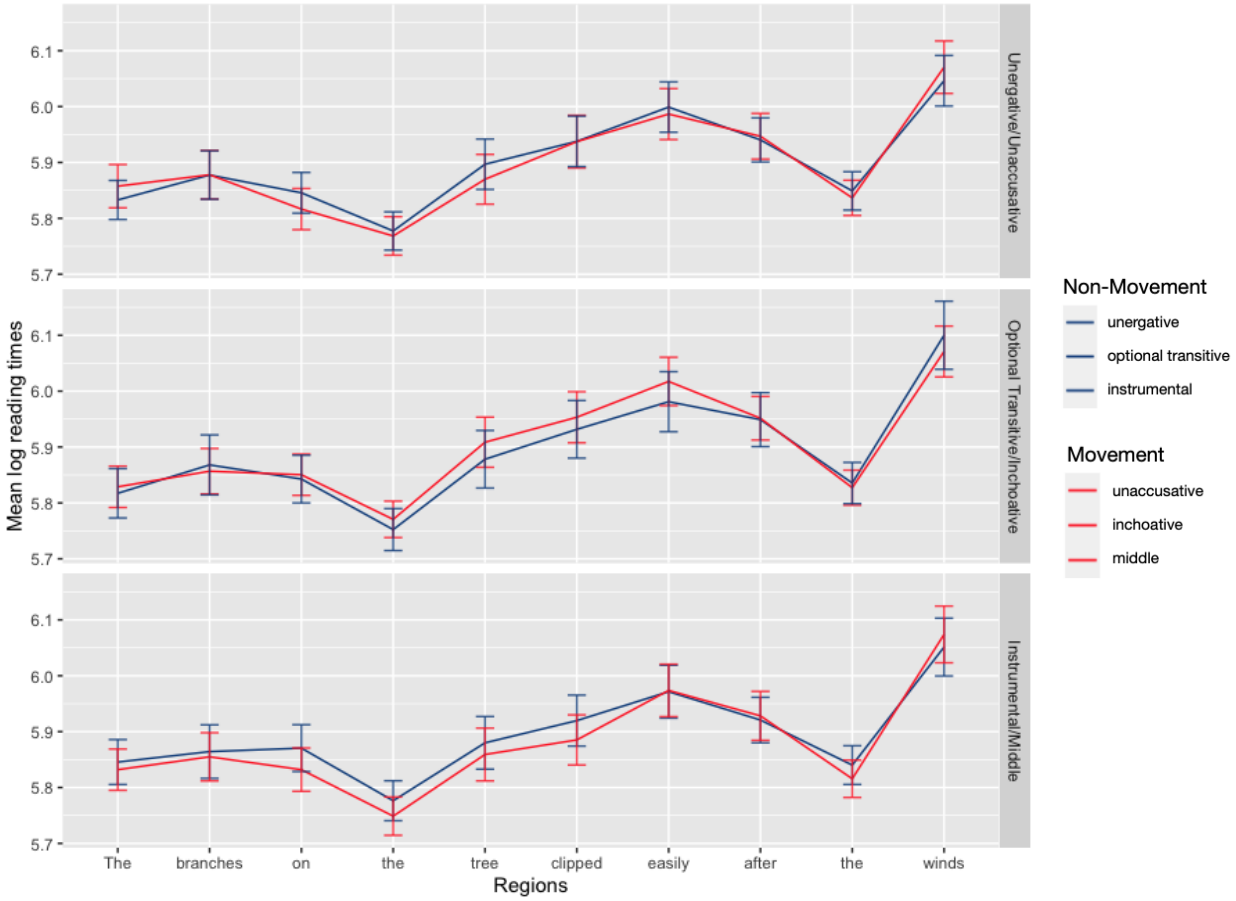


Table 4: *Bayesian t test results of the logged response time of each experimental pairing in the self-paced reading experiment*

	Subject noun (Region 2)			Verb (Region 6)			Adverb (Region 7)		
	Bayes	*t*	*p*	Bayes	*t*	*p*	Bayes	*t*	*p*
Response Time									
unergative v. unaccusative	0.083	0.950	0.062	0.084	0.199	0.084	0.199	-1.289	0.198
optional transitive v. inchoative	0.199	-1.289	0.198	0.097	0.460	0.645	0.091	0.305	0.760
middle v. instrumental	0.112	-0.761	0.447	0.122	-0.891	0.374	0.083	0.049	0.961

Table 5: *Bayesian t test results for the response time of movement vs. non-movement in self-paced reading experiment (unaccusative, inchoative, middle vs. unergative, optional transitive, instrumental)*

	Subject noun (Region 2)			Verb (Region 6)			Adverb (Region 7)		
	Bayes	*t*	*p*	Bayes	*t*	*p*	Bayes	*t*	*p*
Response Time									
movement v. non-movement	0.096	-1.162	0.246	0.049	-0.086	0.931	0.049	0.051	0.959

4.2 Experiment 2: Eye-Tracking

4.2.1 Participants

Forty-two participants recruited through McMaster University's Linguistics Research Participation System took part in the experiment. Participant age and gender are not available due to COVID-19 related closures. All participants were native speakers of English with normal or corrected to normal visual acuity. Participants received one experimental credit to be applied to their coursework in exchange for their participation.

4.2.2 Materials

The experimental and filler items for *Experiment 2* matched *Experiment 1*. There were six experimental conditions, each with ten stimuli: unaccusative, unergative, inchoative, optional transitive, instrumental, and middle. The 40 filler items were drawn from *Hyper-active gap filling* by Omaki and colleagues (2015).

4.1.3 Design

The design for Experiment 2 matched Experiment 1.

4.2.4 Procedure

The eye-tracking task was presented on a desktop computer attached to an EyeLink 1000 Plus (SR Research: Ottawa, ON, Canada). Participants first completed a consent form and read over the experimental instructions. Before beginning, the chin rest and forehead rest were adjusted to ensure the participant was comfortable for the duration of the experiment and the eyes were level with the top third of the monitor. The eye tracker monitored movement of the right eye for the duration of the experiment.

Nine-point calibration was performed at the beginning of the experiment. The experimenter continued to monitor calibration throughout the experiment, and recalibrated if necessary. At the beginning of each trial, a black circle appeared in the centre of the screen. The trial began after the participant successfully fixated on the black circle. After reading each sentence, the participant pressed the spacebar to continue. A yes-no comprehension question was then displayed, in which they could respond by pressing Y for yes or N for no on the keyboard. On the basis of their answer, they were provided with feedback (incorrect/correct). The comprehension question did not address the critical portion of the sentence (i.e., the verb). The experiment lasted approximately ~20-25 minutes. The experiment was approved by the McMaster Research Ethics Board (MREB #: 1765).

4.2.5 Data Analysis

Prior to data analysis, each trial was examined for eye-tracking calibration accuracy. Using Data Viewer, the overlay of each participants' fixations on the trial stimuli was analyzed. Trials where fixations were consistently above or below the interest areas were adjusted to account for

calibration issues. No leftwards or rightwards adjustments were made. Adjustments were made consistently up or down across all fixations within a trial.

Prior to statistical analysis, trials with incorrect responses to comprehension questions were removed. Two experimental items coded with incorrect comprehension question responses were corrected prior to removal. One participant was removed due to low comprehension scores. Altogether, 5.89% of the experimental data was removed prior to analysis.

Next, outlying fixation counts and artifacts such as blinks were removed from the data set. Fixation counts in the top 1% were removed (greater than 6 total fixations in a single region), along with fixation durations in the top 1% for all measures (e.g., first fixation duration, gaze duration, etc.). Fixations shorter than 50 ms were removed for first fixation duration. In total, 7.76% of the experimental data was removed in this stage.

The sentences were split into 10 regions, as shown in **Table 3**. I report eye-movement data for three regions of interest: subject noun, verb, and adverb (Regions 2, 6, 7). The most commonly used measures of processing difficulty in psycholinguistic research are *first fixation duration*, *gaze duration*, *total fixation duration*, *go-past time* (also known as *regression path duration*), and *regressions* (Rayner, 1998; Staub & Rayner, 2007, Sturt & Kwon, 2015). It is common in reading studies to contrast so-called early effects with later effects (Boland, 2004). Early measures tend to include first fixation duration and gaze duration, whereas late measures include total fixation duration and regressions (Boland, 2004; Staub & Rayner 2007). However, different researchers take this contrast to reflect different cognitive events, determined by their theoretical assumptions (Boland, 2004).

First fixation duration is the duration of the first fixation on a word. Gaze duration, also known as first-pass reading time, is the sum duration of all fixations on a word, prior to exiting the region to the left or right. Total fixation duration is the total time spent fixating on a word, including after the word has been left and re-reading occurs. Total fixation duration and gaze duration differ for a given region if refixation occurs after leaving the region, in which case total fixation duration is greater than gaze duration. The time from first fixating on a word to when the eyes shift to the right, including fixations on earlier parts of the sentence, is referred to as go-past time. Go-past time and gaze duration differ in that go-past time includes all fixations prior to the eye-gaze leaving the region to the right. Thus, if the region is first exited to the left prior to refixation and then exiting that region to the right, go-past time exceeds gaze duration in length. Go-past time differs from total fixation duration due to the inclusion of refixations after leaving to the region to the right in the calculation of total fixation duration.

Finally, the regressions out measure indicates whether a regression was made from the current region to an earlier region, with a value of 1 indicating a regression was made and a value of 0 indicating no regression was made. Regressions out are considered to be a "late" measure, and are more useful in looking at complex processing (Staub & Rayner, 2007). Difficulty integrating material may come in the form of regressions out of that region (Rayner & Sereno, 1994).

Statistical analyses was performed using log-transformed fixation durations to ensure residuals were distributed normally. The BayesFactor package in the R statistical computing environment was used to complete Bayesian *t* tests (Morey & Rouder, 2018). To address possible effects of frequency, the lme4 package and lmerTest package in the R statistical computing environment were used to complete linear mixed effects models (Bates, Maechler, Bolker, &

Walker, 2015; Kuznetsova, Brockhoff, Christensen, 2017; R Core Team, 2017). Condition was classified as a fixed effect in the linear model, while subject, item, and word frequency were classified as random effects.

4.2.6 Results

4.2.6.1 Comprehension accuracy

The mean comprehension question accuracy was 91.3% for experimental items. The mean comprehension question accuracy by experimental condition is as follows: unergative 96.9%, unaccusative 96.9%, optional transitive 84.28%, inchoative 96.67%, instrumental 93.8%, and middle 94.29%.

4.2.6.2 Eye-tracking measures

Table 6 presents the Bayesian *t* test results for five eye-tracking measures and three critical regions. The subject noun of the optional transitive was fixated on significantly longer than that of the inchoative in gaze duration (t = -2.475, p = 0.014), total fixation duration (t = -3.638, p = 0.0002), and go-past time (t = -2.727, p = 0.007). Similarly, the subject noun of the instrumental was fixated on significantly longer than the middle subject noun in gaze duration (t = -2.07 , p = 0.039) and total fixation duration (t = -2.563, p = 0.011). First fixation duration and gaze duration were significantly greater in the middle adverb region compared to the instrumental adverb (t = 2.511, p = 0.012; t = 2.493, p = 0.013). Total fixation duration and go-past time in the optional transitive condition exceeded that of the inchoative condition in the adverb region (t = -3.326, p = 0.001; t = -4.802, p = 1.933e-06). Additionally, the regressions out of the adverb region were significantly greater for the optional transitive condition compared to the inchoative condition (t

= -5.769, p = 1.207e-08). No significant differences in any fixation measure were found in the unergative and unaccusative experimental pairing.

Table 6: *Bayesian t test results of fixation durations and regressions for experimental pairings in eye-tracking experiment. Significant differences are highlighted, with longer fixations on control in yellow and shorter fixations on control in green.*

	Subject noun (Region 2)			Verb (Region 6)			Adverb (Region 7)		
	Bayes	*t* or *z*	*p*	Bayes	*t* or *z*	*p*	Bayes	*t* or *z*	*p*
First Fixation Duration									
unergative v. unaccusative	0.126	0.923	0.357	0.174	-1.234	0.218	0.099	0.633	0.527
optional transitive v. inchoative	0.095	0.395	0.693	0.111	0.731	0.465	0.468	1.863	0.063
middle v. instrumental	0.190	-1.27	0.204	0.117	0.797	0.426	1.821	2.511	0.012
Gaze Duration									
unergative v. unaccusative	0.096	0.537	0.591	0.106	-0.713	0.476	0.180	1.274	0.203
optional transitive v. inchoative	1.730	-2.475	0.014	0.104	0.643	0.520	0.144	1.031	0.303
middle v. instrumental	0.697	-2.07	0.039	0.155	1.099	0.272	1.744	2.493	0.013
Total Fixation Duration									
unergative v. unaccusative	0.101	0.621	0.534	0.219	1.41	0.158	0.216	1.412	0.158
optional transitive v. inchoative	53.678	-3.638	0.0002	0.0867	-0.172	0.863	18.573	-3.326	0.001
middle v. instrumental	2.116	-2.563	0.011	0.086	0.01	0.992	0.120	0.86	0.390
Go-Past Time									
unergative v. unaccusative	0.14	1.029	0.304	0.215	1.396	0.163	0.096	0.57	0.569

optional transitive v. inchoative	3.271	-2.727	0.007	0.139	0.995	0.32	5816.853	-4.802	1.933e-0
middle v. instrumental	0.519	-1.918	0.056	0.181	-1.232	0.218	0.091	0.403	0.687
Regressions Out									
unergative v. unaccusative	0.089	0.359	0.719	0.175	1.241	0.215	0.137	-1.026	0.304
optional transitive v. inchoative	0.270	1.519	0.130	0.094	-0.459	0.646	727948.5	-5.769	1.207e-0
middle v. instrumental	0.118	-0.801	0.423	0.114	-0.761	0.447	0.123	-0.881	0.379

Table 7 presents Bayesian *t* test results for the comparison of conditions with movement and conditions without movement. The baseline condition is movement. Gaze duration, total fixation duration, and go-past time showed a significant effect of movement at the subject noun. The non-movement control conditions were fixated on longer than the movement conditions. The movement conditions elicited longer first fixation durations and gaze durations than the non-movement controls at the adverb. However, go-past time and regressions out of the non-movement conditions significantly exceeded regressions out of the movement conditions.

Table 7: *Bayesian t test results of fixation durations and regressions for derivational contrast of movement/non-movement in eye-tracking experiment. Significant differences are highlighted, with longer fixations on control (non-movement) in yellow and shorter fixations on control in green.*

	Subject noun (Region 2)			Verb (Region 6)			Adverb (Region 7)		
	Bayes	*t* or *z*	*p*	Bayes	*t* or *z*	*p*	Bayes	*t* or *z*	*p*
First Fixation Duration									
movement v. non-movement	0.050	0.060	0.952	0.050	0.129	0.898	2.10	2.756	0.006
Gaze Duration									

movement v. non-movement	0.654	-2.279	0.023	0.059	0.597	0.551	1.516	2.634	0.009
Total Fixation Duration									
movement v. non-movement	6.702	-3.146	0.002	0.064	0.726	0.468	0.055	-0.499	0.618
Go-Past Time									
movement v. non-movement	0.466	-2.123	0.03386	0.060	0.619	0.536	0.648	-2.285	0.022
Regressions Out									
movement v. non-movement	0.592	0.591	0.555	0.049	0.074	0.941	3426.109	-4.7533	2.135e-0(

The region-by-region reading time data is presented in **Figures 3-7** (pp. 47-49). Each figure depicts results for a single eye-tracking measure and is divided into three facets for the three experimental pairings.

Figure 3: *Logged first fixation duration by condition for all regions*

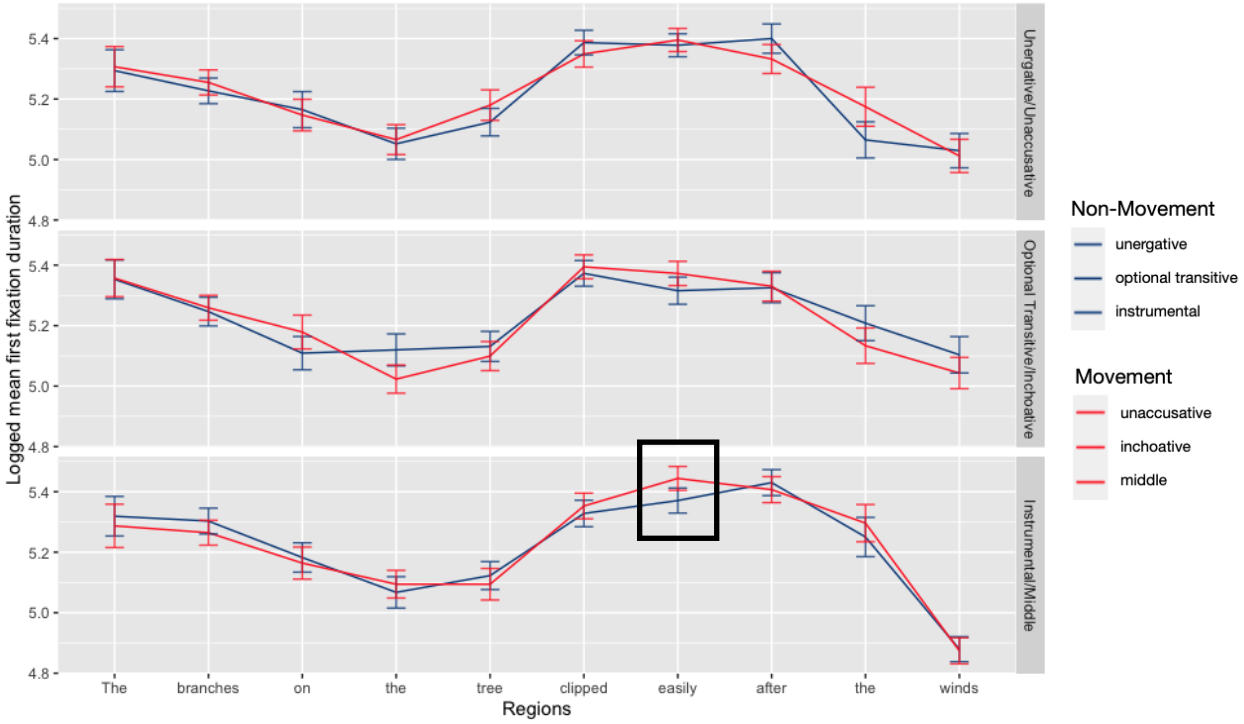


Figure 4: *Logged gaze duration by condition for all regions*

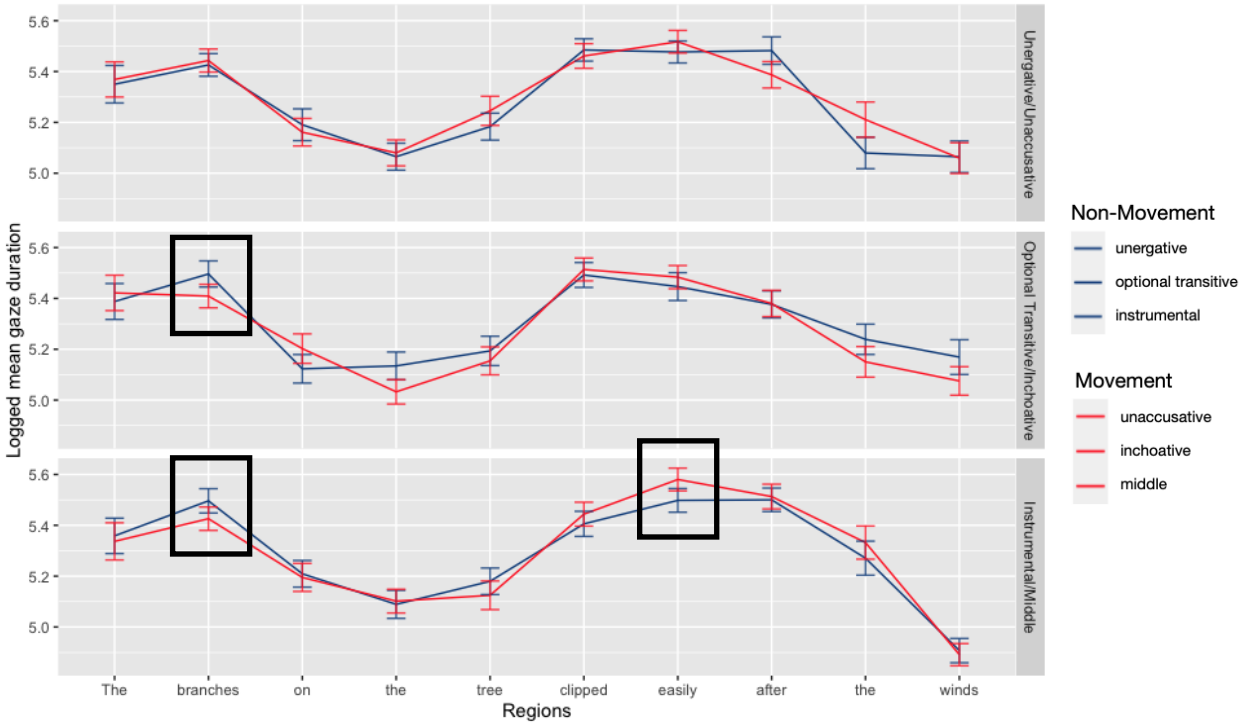


Figure 5: *Logged mean total fixation duration by condition for all regions*

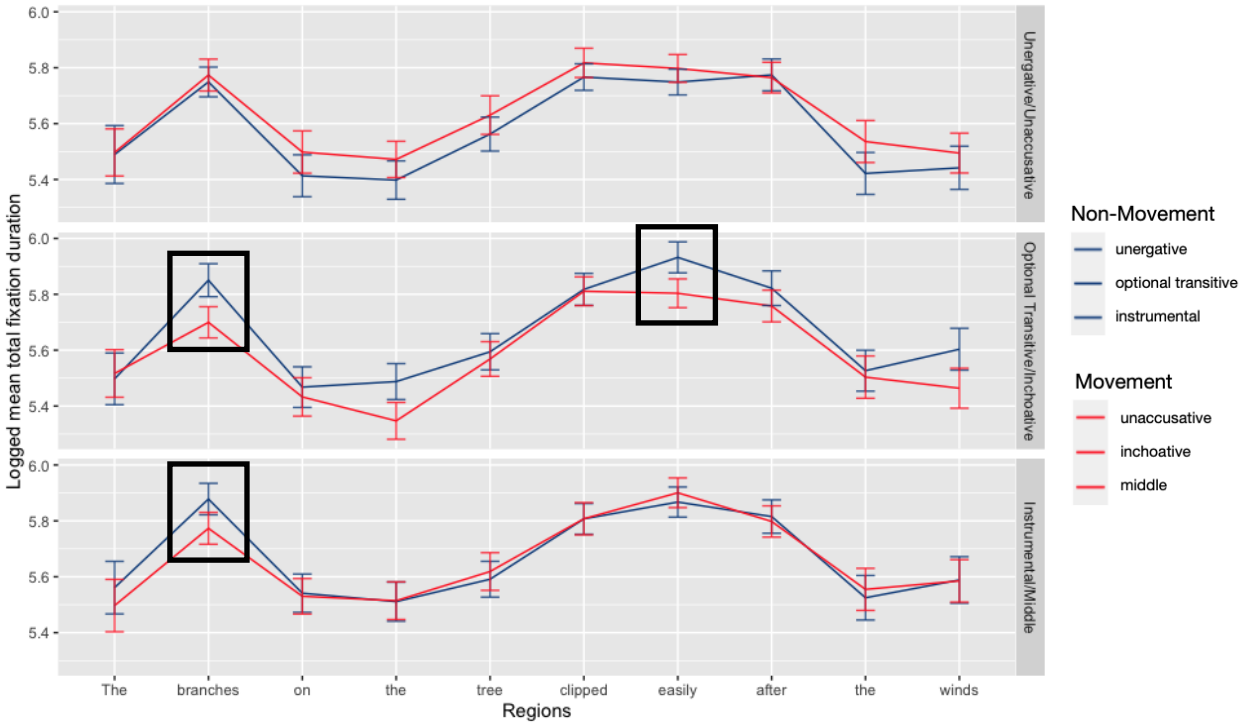


Figure 6: *Logged mean go-past time by condition for all regions*

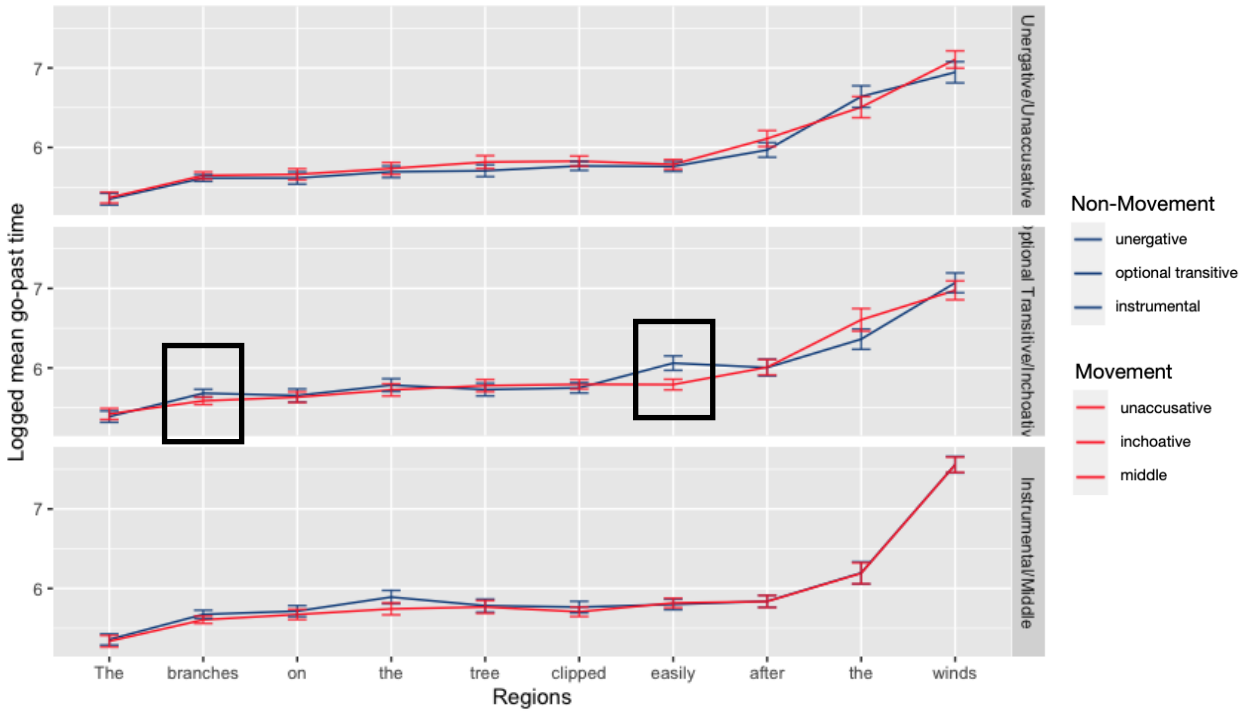
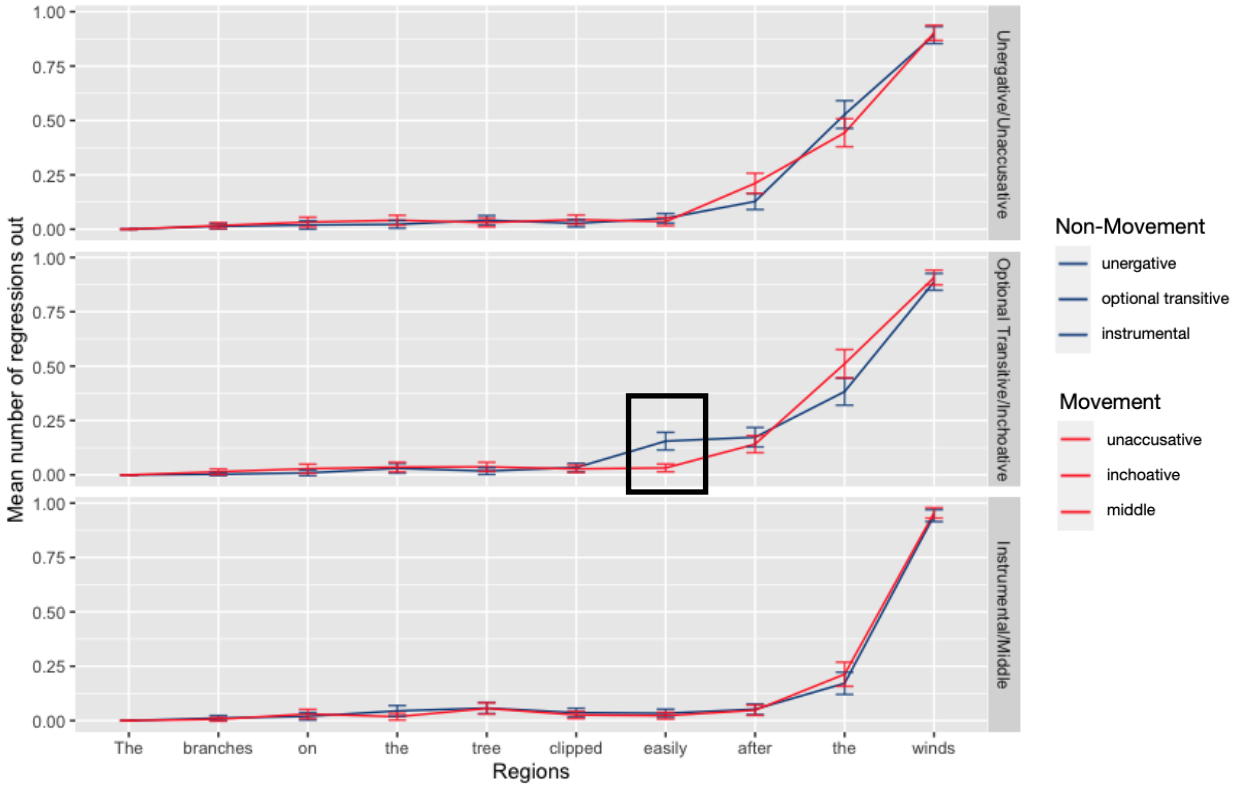


Figure 7: *Mean number of regressions out of a region*



CHAPTER 5: DISCUSSION

In this thesis, I examined the online processing of six syntactic constructions: unaccusative, unergative, optional transitive, inchoative, instrumental, and middle constructions. Under a lexical approach, all six experimental conditions merge a single argument as external argument. Under a derivational approach, each pairing has one condition that merges an external argument and one condition that merges an internal argument, which undergoes A-movement to subject position. In using three pairs of constructions, argument alternations and transitive verb expectations were controlled for. Transitive verb expectations were shared between both approaches, as the optional transitive is the only condition that can plausibly merge a second argument (i.e., an object). Argument alternations are only present under derivational approaches.

5.1 Interpretation of results

5.1.1 Lexical approach

Under a lexical approach, we do not expect significant differences in processing between experimental and control conditions. No significant differences in reading times were found in the verb or adverb region in the SPR experiment. In the eye-tracking experiment, there were no significant differences in fixation durations or regressions in the unergative and unaccusative pairing, compatible with the lexical approach. However, for the optional transitive and inchoative pairing and the instrumental and middle pairing, there were significant differences in across eye-tracking measures. These differences may be compatible with a lexical approach, but it is unclear. For example, the longer fixation durations for optional transitives at the adverb could

arise from transitive verb expectations, which are present in both a lexical and derivational approach. Further, the longer fixation duration at the middle adverb could have to do with complexity outside of movement, such as the requirement for adverbial modification in the middle that is not present in the instrumental construction.

There were no significant differences in reading time or fixation durations in the subject noun region for the unaccusative and unergative conditions. The absence of effects between the unergative and unaccusative conditions are consistent with the lexical analyses, wherein they differ in semantics but share a syntactic structure. This result does not replicate Moed's (2013) finding of longer total fixation duration and a greater number of regressions in unaccusative constructions. However, Moed contrasted all conditions against the inchoative condition as baseline. Due to the different syntactic properties among conditions, this may have contributed to Moed's result. In contrast, there were significant differences in fixation duration for both other experimental pairings.

The gaze duration, total fixation duration, and go-past time of the subject noun was significantly longer in the optional transitive condition compared to the inchoative condition. The inchoative subject nouns have a greater mean word frequency than the optional transitive subject nouns. There is evidence that words with low lexical frequency are fixated on longer than high frequency words (e.g., Just & Carpenter, 1980; Inhoff & Rayner, 1986; Raney & Rayner, 1995). To address this, the lme4 package and lmerTest package in the R statistical computing environment were used to complete linear mixed effects models (Bates, Maechler, Bolker, & Walker, 2015; Kuznetsova, Brockhoff, Christensen, 2017; R Core Team, 2017). Condition was classified as a fixed effect in the linear model, while subject, item, and word frequency were

classified as random effects. The linear mixed regression model results comparing optional transitive and inchoative subject nouns were significant in total fixation duration ($p = 0.007$; $t = -3.068$) and go-past time ($p = 0.027$; $t = -2.477$), and approached significance in gaze duration ($p = -1.931$; $t = 0.071$). Frequency does not appear to account for the difference in fixation durations at the subject noun for optional transitive and inchoative constructions.

The subject noun of the instrumental construction had significantly longer gaze duration and total fixation duration than the middle subject noun. This result is also compatible with effects of frequency, in that the middle subject nouns had a greater mean frequency than the instrumental subject noun. The linear mixed effects model revealed similar differences for gaze duration ($p = 0.05$; $t = -2.105$) and total fixation duration ($p = 0.09$; $t = -1.756$), suggesting frequency did not drive this difference.

In considering the derivational approach to A-movement, we theorized that the inanimate subject of our experimental constructions may lead to greater processing effort. We proposed that retaining the subject noun in memory for later interpretation may lead to a processing cost, or the inanimate subject noun may cue the parser to upcoming movement and incur a processing cost. However, we did not find evidence to support these theories of A-movement at the subject noun. In fact, collapsing the control condition and the experimental condition showed the opposite of the predicted effect. Experimental conditions had significantly shorter gaze duration, total fixation duration, and go-past time, compared to the control conditions.

At the adverb, the total fixation duration and go-past time of the optional transitive adverb significantly exceeded that of the inchoative adverb. This trend is contra our linking hypothesis of movement, in which we expect longer fixations in the movement condition. However, this

result may stem from transitive verb expectations. The optional transitive verb may take an intransitive or transitive form, and is presented in the intransitive form in our stimuli. The parser does not know the transitivity of the optional transitive verb until encountering the adverb. It is possible that expectations of an object led to a processing cost incurred at the adverb, following the site of the potential object. Further, regressions out of the adverb region in the optional transitive condition were significantly greater than regressions out in the inchoative condition.

5.1.2 Derivational approach

Under a derivational approach, we posited that the syntactic complexity of A-movement would result in greater processing effort, which in turn would be reflected in longer reading times and fixation durations. Specifically, this experiment is based on the psycholinguistic inquiry into A-movement using eye-tracking (Moed, 2013; Moed, Kuperman, & Kučerová, 2013). Moed did not find evidence of additional processing effort in middle or inchoative constructions at the verb or adverb region. However, Moed did find evidence of processing effort in total fixation duration and regressions out of the verb and adverb in unaccusative constructions. She interpreted longer total fixation duration in the unaccusative condition as evidence of A-movement. However, we did not replicate Moed's findings with respect to A-movement. We did not find evidence of processing differences between the unaccusative and unergative constructions in either experiment.

Our results are also at odds with previous work indicating reactivation of the subject following the verb in unaccusative constructions (Friedmann et al., 2008; Lee & Osterhout, 1993), as well as work on A-movement in passives showing activation at the trace (Bever & McElree, 1988;

McElree & Bever, 1989). Friedmann and colleagues note that the methodology they used can indicate activation, but is limited in detailing online behaviour (cross-modal lexical priming). While it is possible that the subject noun was reactivated in its purported base position, it is also possible that the subject noun simply remained active after first encounter in their study (Friedmann et al., 2008). If this were the case, their results are not evidence of A-movement.

It is unclear if our experiment failed to highlight A-movement in unaccusative constructions, or if A-movement is simply not present in unaccusative constructions. For the optional transitive and inchoative pairing, transitive verb expectations may play a role. Optional transitive verbs may take a transitive or intransitive form, and are disambiguated following the verb. In our experiment, all optional transitive verbs took an intransitive form. However, the parser only becomes aware of this upon encountering the adverb. Thus, the longer fixations at the adverb for optional transitive constructions compared to inchoative constructions may be a result of transitive verb expectations. Further, it is possible that evidence of A-movement may be hidden by effects of disambiguating the optional transitive or the violation of an expectation of an object.

In the middle and instrumental pairing, the first fixation duration and gaze duration were significant longer at the middle adverb compared to the instrumental adverb. This result is compatible with a derivational approach, wherein middles are argued to involve A-movement. It is possible that the syntactic complexity of movement led to greater processing effort in middle constructions, resulting in longer fixations at the adverb. However, this argument is inconsistent across our experimental pairings. There is not a clear reason why we would see an effect of

movement in the middle and instrumental pairing, while seeing an opposite trend at the adverb in the other experimental pairings.

5.2 What does this mean for A-movement?

Our results are not clearly consistent with the lexical theories or derivational theories. There are differences in fixation durations in the eye-tracking record, but they are not consistent across our experimental pairings. It is unknown what resulted in these differences, as movement or an alternative characteristic of our stimuli may play a role. Further analysis of the subject nouns and adverbs used in our experimental stimuli could aid in our understanding of the effects we see.

Thus, we did not find consistent evidence of A-movement in the SPR experiment or eye-tracking experiment. Previous experimental analyses of A-movement in unaccusative and passive constructions has produced results that indicate reactivation of the A-moved element in trace position (e.g., Bever & McElree, 1988; McElree & Bever, 1989; Lee & Osterhout, 1993; Friedmann et al., 2008; Moed, 2013; Momma et al., 2018). However, I am not aware of work using eye-tracking or self-paced reading methodology that has consistently identified A-movement in online processing. Self-paced reading and eye-tracking have been shown to be sensitive to other syntactic processes, including movement. It is unclear as to whether A-movement is not present in the constructions analyzed, as posited by the lexicalist theories discussed, or if our measures did not detect movement in the stimuli we constructed. Alternatively, A-movement may be an overarching term for multiple syntactic processes, which are not consistent across unaccusative, inchoative, and middle constructions.

In the neural imaging literature, there is evidence of activation specific to processing of sentences with unaccusative verbs (Shetreet, Friedmann, Hadar, 2010; Shetreet & Friedman, 2012). Shetreet and colleagues (2010) observed a pattern of activation indicating that the brain distinguishes between unaccusative and unergative verbs, providing neurological support for the linguistic distinction. Another comparison of unaccusative, unergative, and reflexive verbs showed a different activation pattern for unaccusatives compared with unergatives, and a similar contrast between unaccusatives compared with reflexives (Shetreet & Friedmann, 2012). This elicits the question of whether this differential activation is due to A-movement or another contrast between unaccusative and unergative verbs.

Work on neural correlates of processing passive sentences has also investigated A-movement (Mack, Metlzer-Asscher, Barbieri, Thompson, 2013). Using functional Magnetic Resonance Imaging (fMRI), greater activation in bilateral inferior frontal gyrus (IFG) and left temporo-occipital regions was found in passive sentences relative to active sentences (Mack et al., 2013). The researchers proposed that activation in left temporo-occipital cortex reflects thematic reanalysis processes. They suggested activation in the left IFG supports processing of complex syntax, including A-movement, supporting previous work (Mack et al., 2013, Meltzer-Asscher, Mack, Barbieri, Thompson, 2015; Shetreet et al., 2010; Shetreet & Friedmann, 2012).

I believe employing the experimental design used in *Experiment 1: Self-paced reading* and *Experiment 2: Eye-tracking* with fMRI would yield informative results. We contrasted A-movement in three experimental pairings, controlling for transitive verb expectations and argument alternation. Using this design, neural processing differences of three different argument structure pairings could be analyzed. If A-movement is a unified process, we would expect

similar effects in all three experimental comparisons. On the other hand, this experimental design would help probe the issue of whether or not A-movement exists altogether. If there are not consistent differences in contrasting purported A-movement using fMRI, this would need to be considered. It is possible that the parsing operations of Ā-movement differ from A-movement, just as the syntactic tests do. Should this be the case, approaching A-movement through an Ā-movement lens would not yield evidence. For example, if Friedmann and colleagues (2008) are correct in their suggestion that A-movement is processed later than Ā-movement, the critical regions of interest would be different. That being said, we did not find consistent differences outside of our critical regions, either.

In conclusion, our results were not consistent with derivational or lexical approaches to unaccusative, inchoative, and middle constructions. Our aim in designing an experiment with three comparisons was to investigate A-movement in a controlled environment, with consideration for transitivity and argument alternation. However, we did not find consistent results between our baseline and experimental conditions, nor did we find significant differences when grouping our experimental and baseline conditions (unergative/optional transitive/ instrumental v. unaccusative/inchoative/middle). The significant difference in fixation durations at the subject and adverb regions of the inchoative and optional transitive pairing, as well as the middle and instrumental pairing, is interesting in its variability with respect to lexical and derivational approaches to A-movement. However, the lack of difference between unergative and unaccusative constructions in both sets of experimental results is incompatible with derivational approaches.

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APPENDIX A: Letter of Information and Consent Form

Date:

Processing of English verbs

Letter of Information and Declaration of Consent
Syntax Lab, ARiEAL Research Centre
LRW 4020

Researcher:	Tess Hudson Email: hudsontc@mcmaster.ca
Principal Investigators:	Dr. Cassandra Chapman and Dr. Ivona Kučerová Department of Linguistics and Languages and ARiEAL Research Centre McMaster University, Hamilton, Ontario, Canada
Research Sponsor:	Social Sciences and Humanities Research Council of Canada (SSHRC)

Invitation to participate: You are invited to participate in a study investigating syntactic processing and working memory conducted by Tess Hudson, Dr. Chapman, and Dr. Kučerová.

Purpose: This study aims to look more closely at how different types of verbs are processed in English. To explore this question, we will be using the eye-tracking while reading methodology. While there are several theories accounting for the properties of different types of verbs in English, we still have a lot to learn about how native speakers comprehend different verb types in real-time processing. This study examines this question by tracking participants' eye-movements as they read sentences presented to them on a computer screen.

Procedure: During this experiment, you will be presented with a series of sentences on a computer screen. You are asked to read each sentence as naturally as possible. After some or all of the questions, you will be asked a yes-no comprehension question. Please do your best to answer these questions as accurately as you can.

Prior to beginning the experiment, your eyes will be calibrated to ensure accuracy using the eye-tracker. If the eye-tracker happens to lose track of your eye position at any point during the experiment, we will re-calibrate.

Potential harms, risks or discomforts: There are no known risks to this study beyond those naturally occurring in everyday life. Your eyes may hurt a little throughout the experiment from looking at the screen. If you need to blink or take a break, please let the experimenter know.

Potential benefits: This research will have no direct benefit to you. However, your participation will help the researchers to learn more about how different types of verbs are processed in real-time by native speakers of English. This will be valuable information that the scientific community can use to better understand how language is processed in the mind and may lead to follow-up studies using more online methodologies, like eye-tracking while reading.

Payment or Reimbursement: If you are registered in the SONA system, you will be given a one-hour participation credit upon completion of the experiment. If you wish to withdraw from this study, you may do so at any time, without consequence. If you decide to withdraw, you will still receive your participation credit.

Confidentiality: The information gathered about you and from you in this study will be kept confidential and private. Your name and other identification will be available only to the principal investigators and the lab supervisor.

Every participant will be assigned an ID number and the only document linking your name with this ID number will be stored in a locked cabinet and/or in a password protected file on a computer in a locked laboratory. Hard copies of this data will be kept on file for seven (7) years, after which they will be destroyed. Electronic copies of the data, which will not include any identifying information, may be kept indefinitely.

What if I change my mind about participating in the study? Your participation in this study is entirely voluntary. You can choose to withdraw at any time for any reason. If you decide to withdraw, you will be thanked, debriefed and compensated as if you had completed the study. Any data collected to the point of withdrawal will only be used in the analysis with your consent. Should you choose to withdraw consent to include your data in the analysis any time after completing the experiment, this will be permitted if requested **within 30 days of your participation in this experiment.** After this date, the data collection for this experiment will be complete and data analysis will begin. Thus, it will not be possible to remove your data from the analysis after this date.

Study Results: More information about the study results will be posted on the principal investigators' websites once the experiment is complete.

Information about Participating as a Study Subject: If you have questions or require more information about the study itself, please contact the researcher, Tess Hudson at hudsontc@mcmaster.ca, or the principal investigators, Dr. Cassandra Chapman at chapmc3@mcmaster.ca or Dr. Ivona Kučerová at kucerov@mcmaster.ca. This study has been reviewed and cleared by the McMaster Research Ethics Board. If you have concerns or questions about your rights as a participant or about the way the study is conducted, you may contact:

McMaster Research Ethics Board Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Office of Research Services
E-mail: ethicsoffice@mcmaster.ca

CONSENT

I _____ have read the information presented in the information letter about a study being conducted by Tess Hudson, Cassandra Chapman, and Dr. Ivona Kučerová, Department of Languages and Linguistics and ARiEAL Research Centre, McMaster University. I have had the opportunity to ask questions about my involvement in this study, and to receive any additional details I wanted to know about the study. I understand that I may withdraw from the study at any time, if I choose to do so, and I agree to participate in this study. I have been given a copy of this form.

Signature: _____ Date: _____

Name of participant (printed): _____

Signature of researcher: _____ Date: _____

APPENDIX B: Experimental Stimuli

Experimental stimuli are based on Moed (2013) and have be redone by Cassandra Chapman.

Unaccusative:

The problem at the office arose quickly during the meeting.

The package with the supplies arrived safely before the deadline.

The clouds in the sky disappeared rapidly after the storm.

The volcano on the island erupted continuously after the earthquake.

The milk in the fridge expired instantly after the picnic.

The hail in the trees fell forcefully during the game.

The candle on the counter glowed eerily during the blackout.

The debate on the broadcast occurred immediately before the election.

The rash on the arm reappeared frequently after the trip.

The idea on the board vanished mysteriously before the interview.

Unergative:

The dog in the doorway howled repeatedly before the walk.

The singer on the stage coughed painfully after the song.

The comedian at the festival laughed nervously after the joke.

The musician in the competition sighed dramatically before the performance.

The princess in the castle slept peacefully after the ball.

The model on the cover smiled beautifully before the show.

The doctor at the hospital sneezed loudly during the examination.

The woman at the shop winked subtly during the conversation.

The infant in the stroller babbled cheerfully during the movie.

The student in the library yawned rudely before the exam.

Inchoative:

The glass on the table shattered violently during the argument.

The drain in the bathroom clogged repeatedly during the sleepover.

The food on the counter cooled rapidly before the party.

The dishes in the cupboard crashed forcefully after the tremor.

The pants in the suitcase creased awkwardly during the flight.

The paper on the desk crumpled easily during the exam.

The bomb in the trench detonated unexpectedly after the battle.

The vine in the garden grew impressively after the rain.

The curtains on the stage opened slowly before the concert.

The meat in the fridge thawed thoroughly before the barbecue.

Optional transitive:

The hiker on the trail climbed dangerously during the landslide.

The toddler on the floor crawled haphazardly after the tantrum.

The ballerina in the studio danced gracefully after the intermission.

The carpenter in the workshop hammered frantically before the inspection.

The tourist with the gear hiked briskly during the trip.

The athlete on the team jumped visibly before the whistle.

The mailman in the neighborhood knocked politely before the delivery.

The biker in the group raced cautiously after the injury.

The surfer in the water swam skillfully before the tournament.

The pedestrian on the sidewalk walked briskly during the signal.

Instrumental:

The saw in the backyard cut effortlessly before the renovation.

The chisel in the shed carved accurately during the restoration.

The cleaver in the kitchen chopped easily before the dinner.

The knife on the counter peeled quickly before the dinner.

The pen on the desk wrote smoothly after the class.

The razor in the tub shaved cleanly during the shower.

The sponge in the sink cleaned thoroughly after the meal.

The broom in the closet swept efficiently before the party.

The shears in the shed clipped well after the rain.

The spoon in the pot stirred thoroughly during the luncheon.

Middle:

The bread in the basket cut easily before the banquet.

The wood on the door carved effortlessly after the storm.

The carrot in the sink chopped cleanly before the meal.

The carrot in the sink chopped cleanly before the meal.

The apple from the orchard peeled evenly during the harvest.

The essay on the laptop wrote quickly during the class.

The hair on the patient shaved cleanly before the surgery.

The pan in the oven cleaned thoroughly after the breakfast.

The floor in the kitchen swept nicely after the feast.

The branches on the tree clipped easily after the windstorm.

The soup on the stove stirred effortlessly during the banquet.

Fillers:

Omaki, A., Lau, E. F., Davidson White, I., Dakan, M. L., Apple, A., & Phillips, C. (2015). Hyper-active gap filling. *Frontiers in Psychology, 6*, 384. doi: 10.3389/fpsyg.2015.00384