

Enough, too, and causal dependence¹

Linmin Zhang — *Concordia University, New York University Shanghai*

Abstract. *Enough-/too-*constructions (E/T constructions) have an **implicative** reading: e.g., *Mary was clever enough to leave early* entails *Mary left early*. I argue that this implicative reading is not due to the lexical semantics proper of *enough/too*, but due to its **bi-clausal structure** (e.g., the above-mentioned example is analyzed as *Mary left early because she was clever enough*). I analyze *enough* and *too* simply as degree modifiers that involve a comparison: *enough* means reaching the lower bound of an interval, while *too* means exceeding the upper bound of an interval. Then inspired by [Baglini and Francez \(2015\)](#) and [Nadathur \(2016\)](#), I relate the semantics of E/T constructions to **causal dependence**: due to some sufficiency/excess, the infinitival complement clause in E/T constructions is episodically or generically (depending on its aspect being perfective or imperfective) true/false. I also argue that this infinitive has its tense and aspect marked on the main predicate of sentences, resulting in the seeming correlation between aspect and implication in languages that overtly make a distinction between perfective and imperfective aspects.

Keywords: *enough, too*, causal dependence, necessary/sufficient causes, infinitives, implicatives

1. Introduction

This paper analyzes the semantics of *enough, too* and **enough/too-constructions** (E/T constructions). E/T constructions contain an infinitival complement,² and it has been noticed that they have **implicative** inferences and license so-called **actuality entailment** (or **realis reading**) for their infinitival complement ([Karttunen 1971](#)). For example, sentence (1a) entails that *Mary left early* is true, while sentence (1b) entails that *Bill stayed awake* is **false** (i.e., its **negation** is true).

- (1) E/T constructions and their actuality entailment:
- a. Mary was clever **enough** to leave early. ↷ Mary left early.
 - b. Bill was too **tired** to stay awake. ↷ Bill didn't stay awake.

The implicative reading of these sentences is reminiscent of real implicatives (e.g., *manage*, see [Karttunen 1971](#)), but the contrast between (2a) and (2b) seems to suggest defeasibility and calls for a pragmatic account for the cases involving *enough/too*. However, a further complication has been noted by [Hacquard \(2005, 2006\)](#): in French, this defeasibility correlates with the use of **perfective/imperfective** aspect, as shown in (3). When French *assez(enough)-/trop(too)-*sentences are in perfective aspect (i.e., **passé composé**), their actuality entailment is not cancelable.

¹I thank my informants, Alan Bale, Aron Hirsch, the Semantics Reading Group at McGill University, as well as the reviewers of *Sinn und Bedeutung 22* for discussions and feedback. Special thanks to Prerna Nadathur!

²However, I will show that **not all** *enough-/too-*sentences containing an infinitive are genuine E/T constructions.

- (2) a. Sue **managed** to finish homework, # but eventually, she failed to finish homework.
 b. (i) John was tough **enough** to win tennis matches, but yesterday, he lost.
 (ii) John was **too** proud to apologize, but Tom made him apologize anyway.
- (3) French *assez*-sentences in **perfective** vs. **imperfective** aspect:
- a. Jean a été **assez** rapide pour s'enfuir, # mais il ne s'est pas enfui.
 John was-PFV enough quick to escape but he didn't-PFV escape
 'John was quick enough to escape, # but he didn't escape.' perfective
- b. Jean était **assez** rapide pour s'enfuir, mais il ne s'est pas enfui.
 John was-IPFV enough quick to escape but he didn't-PFV escape
 'John was quick enough to escape, but he didn't escape.' imperfective

Nevertheless, as noted by [Hacquard \(2006\)](#) and [Nadathur \(2017\)](#), even in French, *assez* and *trop* are questionable as real implicatives, since the implication of real implicatives (e.g., *réussir*) can never be cancelled, no matter whether they are in perfective or imperfective aspect (see (4)).

- (4) a. Juno a réussi à gagner la course, # mais elle n'a pas gagné.
 Juno succeed-PFV to win the race, but she didn't-PFV win
 'Juno managed to win the race, # but she didn't win.' perfective
- b. Juno réussissait à gagner la course, # mais elle n'a jamais gagné.
 Juno succeed-IPFV to win the race, but she didn't-PFV never win
 'Juno managed to win the race, # but she never won.' imperfective

Thus we need to explain (i) why sentences in (1) have an implicative reading and (ii) why there seems a correlation between aspect and implication in French. Previously, [Hacquard \(2005, 2006\)](#) has proposed that *enough* and *too* are real implicatives and their semantics contains hidden two-way entailment, and it is the use of a genericity operator (which is overtly reflected by the use of imperfective aspect in French) that is responsible for the non-implicative readings (see [Bhatt 1999](#)). However, according to [Nadathur \(2017\)](#), *enough* and *too* are not real implicatives themselves: they contain hidden modals to express some capacity, which makes them a necessary condition, and actuality entailment arises due to (i) the use of a sufficiency operator that creates a sufficient condition and (ii) 'actualistic' aspectual coercion under perfective aspect (see [Homer 2011](#)).

In Section 2, I use a set of data to show that **not all** *enough*-/*too*-sentences contain an infinitival complement, and thus, the lexical semantics of *enough*/*too* should be much simpler, involving neither hidden two-way entailment nor hidden modals. In Section 3, with an interval-based framework for gradable adjectives (see [Zhang and Ling 2015, 2017a,b](#)), I analyze *enough* and *too* as degree modifiers: *enough* means reaching the lower bound of an interval (i.e., *not less (than)*), while *too* means exceeding the upper bound of an interval (i.e., *more (than)*).

Section 4 shows that not all *enough-/too-*sentences containing an infinitive are **genuine E/T constructions**. Genuine E/T constructions are actually **bi-clausal**, and **causal dependence** is involved in their interpretation (see (5)): the meaning of **sufficiency** brought by *enough* provides a **necessary but insufficient** cause for its complement clause to be **true**, while the meaning of **excess** brought by *too* provides a **sufficient but unnecessary** cause for its complement clause to be **false**. Based on Wurmbrand (2014), Section 5 shows that due to the restructuring-like syntax of genuine E/T constructions, the semantic tense and aspect of their infinitival complement are marked on the main predicate, resulting in the seeming correlation between aspect (or rather episodicity) and implication in languages like French. Section 6 concludes the paper.

- (5) The interpretation of genuine bi-clausal E/T constructions involves causal dependence:
- a. $\llbracket(1a)\rrbracket =$ Mary left early **because** she was clever enough. \rightsquigarrow Mary left early.
 - b. $\llbracket(1b)\rrbracket =$ Bill didn't stay awake **because** he was too tired. \rightsquigarrow Bill didn't stay awake.

2. Challenges to previous accounts

Focusing on the actuality entailment of the infinitive in E/T constructions, previous studies (including Meier 2003, Hacquard 2005, 2006, Nadathur 2017) have proposed that the lexical semantics of *enough/too* contains hidden two-way entailment (Hacquard 2005, 2006) or modals (Meier 2003, Nadathur 2017). Here I use naturally occurring examples to show that infinitives are not always necessary in *enough/too-*sentences, and thus those previous accounts all under-generate.

According to Hacquard (2005, 2006), sentence (6) **presupposes** that there is a unique degree of quickness which is a necessary and sufficient condition for John's escape and **asserts** that John meets this condition. Thus, Hacquard (2006) proposes (7a) and (7b) as the lexical entries of *enough* and *too*. Their presuppositional requirement is underlined: there is a unique degree d such that in all possible worlds w' accessible from the actual world w , sentence Q is true (for *enough*) or false (for *too*) iff x reaches the degree d on the scale P in world w' . The assertion is that x reaches this unique degree d on the scale P in the actual world w .

- (6) Jean a été **assez** rapide pour s'enfuir.
 John was-**PFV** enough quick to escape
 'John was quick enough to escape.' (French *enough-*construction in **perfective** aspect)
- a. Presupposition: there is a degree of quickness sufficient & necessary for him to escape.
 - b. Assertion: John had the degree of quickness sufficient & necessary for him to escape.
- (7) a. $\llbracket\text{enough}\rrbracket^w \stackrel{\text{def}}{=} \lambda P_{\langle d, \langle e, st \rangle \rangle} . \lambda Q_{\langle st \rangle} . \lambda x_e . P(\text{id} : \forall w' \in \text{Acc}(w) . Q(w') \leftrightarrow P(d)(x)(w'))(x)(w)$
 b. $\llbracket\text{too}\rrbracket^w \stackrel{\text{def}}{=} \lambda P_{\langle d, \langle e, st \rangle \rangle} . \lambda Q_{\langle st \rangle} . \lambda x_e . P(\text{id} : \forall w' \in \text{Acc}(w) . \neg Q(w') \leftrightarrow P(d)(x)(w'))(x)(w)$
 (P : gradable adjective; Q : the infinitival complement clause; x : subject.)

Under this account, as far as the actual world w is accessible to itself, the two-way entailment in the lexical entries of *enough* and *too* makes them **real implicatives**. Then to account for the non-implicative reading of sentences in imperfective, [Hacquard \(2006\)](#) adopts [Bhatt \(1999\)](#)'s **genericity operator** (see (8)), which was originally developed to explain the correlation between aspect and implication for French ability modal *pouvoir*.³ The use of this genericity operator is overtly reflected by the use of imperfective aspect in languages like French. As shown in (9), with the use of GEN, the set of accessible worlds is further restricted (by an overt or contextually-provided p), and the consequence is that the actual world is no longer necessarily one of those highly idealized ones where reaching a unique degree of quickness guarantees John's escape.

(8) $[[\text{GEN}]]^w \stackrel{\text{def}}{=} \lambda p_{\langle st \rangle} . \lambda q_{\langle st \rangle} . \forall w' [w' \in \text{Acc}(w) \wedge p(w') \rightarrow q(w')]$ (p restricts the set of w' .)

(9) Jean était **assez** rapide pour s'enfuir
 John was-**IPFV** enough quick to escape
 'John was quick enough to escape.' (French *enough*-construction in **imperfective** aspect)
 $\text{GEN}(w)[\lambda w . w \text{ was relevant}][\lambda w . \text{John had the sufficient/necessary quickness to escape in } w]$
 In all **relevant** worlds, John had the quickness to escape.

However, (4) shows that real implicatives like *réussir* seem immune to the actuality-entailment-cancelling effects of the genericity operator. This is not accounted for by [Hacquard \(2005, 2006\)](#).

Alternatively, [Bierwisch \(1987\)](#), [Meier \(2003\)](#), [von Stechow et al. \(2004\)](#), [Schwarzschild \(2008\)](#), [Marques \(2012\)](#), and [Nadathur \(2017\)](#) take the view that *enough* and *too* are **intrinsically non-implicative**. Essentially, they are analyzed in terms of a comparison involving a hidden modal. As shown in (10) and (11) (see [von Stechow et al. 2004](#) and [Nadathur 2017](#)), *enough/too* relates a predicate Q (typically provided by the infinitival complement), a gradable adjective P , and an individual x . E.g., *Jo was fast enough to escape* means that in **any world** w' where Jo escaped, her speed was not higher than her actual speed in world w ; *Jo was too slow to escape* means that in **at least one world** w' where Jo escaped, her speed was higher than her actual speed in w .

³[Bhatt \(1999\)](#) has pointed out that there is also a correlation between aspect and implication for French ability modal *pouvoir*, as illustrated by the contrast in (i). [Bhatt \(1999\)](#) proposes to analyze *pouvoir* as a real implicative like English *manage*: French *pouvoir* **asserts** the realization of its complement clause and **conveys the conventional implicature** that some effort contributes to the realization of the complement clause. Then [Bhatt \(1999\)](#) uses a genericity operator to derive the non-implicative reading of *pouvoir*-sentences in imperfective.

- (i) a. Jean a **pu** soulever cette table, # mais il ne l'a pas soulevée.
 John could-**PFV** lift this table but he didn't-**PFV** lift
 'John was able to lift this table, # but he didn't lift it.' ability modal + **PFV** \rightsquigarrow actuality entailment
- b. Jean pouvait soulever cette table, mais il ne l'a pas soulevée.
 John could-**IPFV** lift this table but he didn't-**PFV** lift
 'John was able to lift this table, but he didn't lift it.' ability modal + **IPFV** $\not\rightsquigarrow$ actuality entailment

- (10) a. $[[\text{enough}]]^w \stackrel{\text{def}}{=} \lambda Q_{\langle e, \langle st \rangle \rangle} . \lambda P_{\langle d, \langle e, st \rangle \rangle} . \lambda x_e . \{d : \forall w' \in \text{Acc}(w)[Q(x)(w') \rightarrow P(d)(x)(w')]\} \subseteq \{d : P(d)(x)(w)\}$
b. $[[\text{too}]]^w \stackrel{\text{def}}{=} \lambda Q_{\langle e, \langle st \rangle \rangle} . \lambda P_{\langle d, \langle e, st \rangle \rangle} . \lambda x_e . \{d : \exists w' \in \text{Acc}(w)[Q(x)(w') \wedge P(d)(x)(w')]\} \subset \{d : P(d)(x)(w)\}$
- (11) a. $[[\text{fast}]]^w \stackrel{\text{def}}{=} \lambda d_d . \lambda x_e . \text{SPEED}(x)(w) \geq d \quad \{d : \text{fast}(d)(x)(w)\} = [0, x\text{'s max. speed}]$
b. $[[\text{slow}]]^w \stackrel{\text{def}}{=} \lambda d_d . \lambda x_e . \text{SPEED}(x)(w) < d \quad \{d : \text{slow}(d)(x)(w)\} = (x\text{'s max. speed}, +\infty)$

Based on these lexical entries, [Nadathur \(2017\)](#) proposes an account within [Nadathur \(2016\)](#)'s framework of **causal dependence** (see also [Schulz 2011](#), [Baglini and Francez 2015](#)). According to this framework, as shown in (12), actuality entailment X holds if (i) there is a necessary and sufficient causing factor A and (ii) A holds.

- (12) Given an **implicative** I and a complement proposition X , then $I(X)$
- a. **presupposes** the existence of a **causing factor/event** A so that:
(i) A is **causally necessary** for X ,
(ii) A is **causally sufficient** for X ;
- b. **asserts** that A holds in the world of evaluation. (i.e., the actualization of A .)

Thus, as illustrated in (13), under [Nadathur \(2017\)](#)'s account, the actualization of Jo's escape depends on (i) her speed in the actual world w (here written as 'Jo's maximum speed') being a **sufficient and necessary** factor for Jo's escape and (ii) Jo's actually being that fast.

Essentially, the lexical semantics of *enough* makes Jo's speed in the actual world a **necessary** factor, while the use of a **causal sufficiency operator** $\triangleright_{\text{CAUS}}$ further makes it a **sufficient** factor. Notice that the use of $\triangleright_{\text{CAUS}}$ requires that (i) the **flavor** of the modal involved in the lexical semantics of *enough* be **circumstantial** and that (ii) the gradable adjective represent **an exercisable capacity**. Finally, the use of **perfective** aspect (which is overtly marked in French) guarantees Jo's actually being that fast (see [Homer 2011](#)). Therefore, we get the actuality entailment that *Jo escaped*.

- (13) Jo was fast enough to escape.
- a. Jo's maximum speed is a **necessary** condition for her escape:
(i) Presupposition: $\exists d_{\text{nec}} : \forall w' \in \text{Acc}(w)[\text{Jo's speed in } w' < d_{\text{nec}} \rightarrow \neg \text{escape}(\text{Jo})(w')]$
(ii) Assertion: Jo's max. speed $\geq d_{\text{nec}}$
- b. Jo's maximum speed is a **sufficient** condition for her escape:
With (i) a **circumstantial modal** and (ii) a gradable adjective representing **an exercisable capacity**, the sentence backgrounds:
 $\forall w' \in \text{Acc}(w)[\text{fast}(d_{\text{nec}})(\text{Jo})(w') \triangleright_{\text{CAUS}} \text{escape}(\text{Jo})(w')]$

Nadathur (2017)'s account has some conceptual problems. First, according to the framework (12), it has to be the same factor/event (here A) that serves both a necessary and a sufficient condition for X . However, for sentence (13), Jo's being d_{ned} -fast is by itself a necessary condition for Jo's escape, while it is the use of a sufficiency operator that turns this into a sufficient condition. Thus, it is questionable whether the necessary and the sufficient conditions are exactly the same here.⁴

Moreover, in the framework (12), implicative I is distinct from causing factor A . However, under Nadathur (2017)'s account, it remains unclear which element in E/T constructions contributes to the expression of implicative I . If it is the semantics of *enough/too*, then how can *enough/too* be involved in the expression of both the implicative and the causing factor? What would be the consequences in terms of compositionality? Further explanation is needed here.⁵

Another issue is that actuality entailment does not necessarily result from causal dependence. For example, sentence (14) means that *John made a boat with oak* and entails that *John made a boat*, but no causal dependence is involved here. Thus, any account for the actuality entailment of E/T constructions needs to explain the exact source of their actuality entailment. If it turns out that the source is not a causally necessary and sufficient factor, the framework (12) would be irrelevant.

(14) John used oak to make a boat. \rightsquigarrow John made a boat.

Empirically, by including hidden two-way entailment or hidden modals in the lexical semantics of *enough/too*, the accounts of both Hacquard (2005, 2006) and Nadathur (2017) suffer from under-generation. Naturally occurring examples from *the Corpus of Contemporary American English* (COCA, Davies 2008) show that *enough* and *too* do not always have an infinitival complement:

- (15)
- a. The double-bedded room seemed luxury **enough** compared to the farm house. (*Fantasy & Science Fiction*, 1995)
 - b. The rest of us do count for something, but not **enough** compared with him, since Walter's absence makes us all invisible in our parents' eyes and in our own. (*The Hudson Review*, 2009)
 - c. He was young **enough** and strong **enough** compared to H. (*CBS: 48 Hours*, 2011)
 - d. Erdogan and his party won a mere 258 seats, not **enough** even for a parliamentary majority. (*National Review*, 2015)
 - e. She uses a 2013 Dell laptop: new by government standards, but clunky **enough** compared with the cutting-edge devices of her former life. (*New York Times*, 2015)

⁴Notice also that the use of this sufficiency operator also brings additional stipulations (i.e., its requirements for modal flavor and adjective type), which makes this operator rather *ad hoc*. However, without these *ad hoc* stipulations, presumably, this operator would turn any necessary condition into a necessary and sufficient one.

⁵Notice that uncontroversially real implicatives like *manage* do not play this kind of dual role, i.e., they do not themselves contribute to the expression of causing factors. See the analysis of *manage* by Baglini and Francez (2015).

- (16) a. The costs of this technology were at that time **too** high compared to diskettes for such applications. (*IBM Journal of Research and Development*, 1998)
- b. (...) The U.S. petroleum industry found itself shutting in an extraordinary portion of its domestic production capacity, which was **too** high-priced compared to foreign-sourced oil. (*Journal of International Affairs*, 1999)
- c. Perhaps it was **too** expensive compared to similar items. (*Reference & User Services Quarterly*, 2012/2013)
- d. They appeared much **too** small compared with the actual Sun (...). (*space.com*, 2015)
- e. Property taxes (...) are way **too** high compared with neighboring states. (*Omaha World-Herald*, 2017)

Obviously, to have a unified account for E/T constructions as well the data in (15) and (16), we need much simpler lexical entries for *enough* and *too*. The mechanisms underlying the implicative reading of E/T constructions should not be part of the lexical semantics proper of *enough/too*.

3. Proposal: the semantics of *enough* and *too*

Here I propose that *enough* and *too* are simply **degree modifiers** that involve a **comparison** with a certain **interval** on a scale. Essentially, *enough* means **reaching the lower bound** of an interval, while *too* means **exceeding the upper bound** of an interval (see Figure 1).

To formally implement this proposal, I adopt Zhang and Ling (2015, 2017a,b)'s interval-arithmetic-based framework for the semantics of gradable adjectives and comparatives. This framework is motivated to allow for a **generalized comparison** on a scale and based on two assumptions. First, a comparative (e.g., *5:00 is 1 hour earlier than 6:00*) means a relation among three degree-related items: two positions on a scale – **comparative subject** and **comparative standard** (e.g., the positions marking 5:00 and 6:00 on the temporal scale) – and the distance between them – **differential** (e.g., here *1 hour*). Second, we adopt a generalized view for positions on a scale and represent them as intervals. An **interval** is a range of degrees so that it marks a position in a not-so-precise way. Thus it is a **convex** set of degrees: e.g., $\{x|a \leq x \leq b\}$, which means a position ranging from *a* to *b* and can also be written as $[a, b]$.⁶ Operations on two intervals result in **the largest possible range** (Moore 1979). As shown in (17), a generalized comparison can be characterized in terms of **interval subtraction**: subtracting the interval representing the **comparative standard** from the interval representing the **comparative subject** results in a third interval – the **differential**.

$$(17) \quad \text{Interval subtraction: } \overbrace{[y_1, y_2]}^{\text{comparative subject}} - \overbrace{[x_1, x_2]}^{\text{comparative standard}} = \overbrace{[y_1 - x_2, y_2 - x_1]}^{\text{differential}} \quad (\text{Moore 1979})$$

E.g., $[7, 8] - [2, 3] = [4, 6]$ 4 and 6 are the min. and max. **distances** between the **positions** [7, 8] and [2, 3] respectively.

⁶A convex totally ordered set is a totally ordered set *P* such that for any elements *a* and *b* in the set, if $a \leq b$, then any element *x* such that $a \leq x \leq b$ is also in the set. Evidently, sets such as $\{x|x \leq 5 \vee x > 8\}$ are not convex.

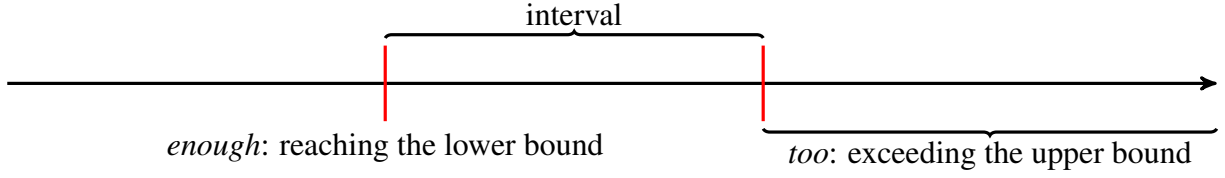


Figure 1: The lexical semantics of *enough* and *too*. *Enough* means reaching the lower bound of an interval, while *too* means exceeding the upper bound of an interval.

As shown in (18), the semantics of gradable adjectives is analyzed as relations between intervals (of type $\langle dt \rangle$) and entities (of type e). For the absolute use of gradable adjectives, the interval argument is a context-dependent interval I^C (see (18a)), which means ‘the context-dependent interval such that it is from the lower to the upper bound of being tall for a relevant comparison class’. Then in (18b), δ' can be interpreted either as a singleton set or an interval with δ' as its lower bound.

- (18) $\llbracket \text{tall} \rrbracket_{\langle dt, et \rangle} \stackrel{\text{def}}{=} \lambda I_{\langle dt \rangle} . \lambda x_e . \text{HEIGHT}(x) \subseteq I$
- a. $\llbracket \text{John is tall} \rrbracket \Leftrightarrow \text{HEIGHT}(\text{John}) \subseteq I^C$ absolute use of gradable adjectives
- b. (i) $\llbracket \text{John is } \delta' \text{ tall} \rrbracket \Leftrightarrow \text{HEIGHT}(\text{John}) \subseteq [\delta', \delta']$ ‘exactly’ reading
- (ii) $\llbracket \text{John is } \delta' \text{ tall} \rrbracket \Leftrightarrow \text{HEIGHT}(\text{John}) \subseteq [\delta', +\infty)$ ‘at least’ reading

More/-er is analyzed as the default differential in comparative sentences (see (19a)); *little* changes the polarity of an interval (see (19b)); based on the semantics of *more* and *little*, *less* means the default differential in *less-than* comparatives (see (19c)); and *(th)-an* encodes an interval subtraction (see (17) and (19d)). (20) illustrates how to derive the meaning of a comparative sentence.

- (19) a. $\llbracket \text{more/-er} \rrbracket_{\langle dt \rangle} \stackrel{\text{def}}{=} (0, +\infty)$ (i.e., the largest possible range of **positive** degrees)
- b. $\llbracket \text{little} \rrbracket_{\langle dt, dt \rangle} \stackrel{\text{def}}{=} \lambda I_{\langle dt \rangle} . [0, 0] - I$ (see Zhang and Ling 2017b)
- c. $\llbracket \text{less} \rrbracket_{\langle dt \rangle} \stackrel{\text{def}}{=} \llbracket \text{little} \rrbracket \llbracket \text{more/-er} \rrbracket = (-\infty, 0)$ (i.e., the largest possible range of **negative** degrees)
- d. $\llbracket \text{(th)-an} \rrbracket_{\langle dt, \langle dt, dt \rangle \rangle} \stackrel{\text{def}}{=} \lambda I_{\text{std}} . \lambda I_{\text{diff}} . \iota I [I - I_{\text{std}} = I_{\text{diff}}]$

- (20) $\llbracket \text{Lucinda is taller than every boy is} \rrbracket = \llbracket \text{tall} \llbracket \text{[-er] -an th-[every boy is (tall)]} \rrbracket \llbracket \text{Lucinda} \rrbracket \rrbracket$
- $\Leftrightarrow \text{HEIGHT}(\text{Lucinda}) \subseteq \iota I [I - \llbracket \text{the} \rrbracket \llbracket \text{every boy is (tall)} \rrbracket = (0, +\infty)]$ (see (18): $\llbracket \text{tall} \rrbracket$)
- $\Leftrightarrow \text{HEIGHT}(\text{Lu}) \subseteq \iota I [I - \llbracket \text{the} \rrbracket \llbracket \lambda I' . [\forall x [\text{boy}(x) \rightarrow \text{HEIGHT}(x) \subseteq I']] \rrbracket = (0, +\infty)]$
- $\Leftrightarrow \text{HEIGHT}(\text{Lucinda}) \subseteq (I_{\text{upper-bound}}^{\text{the-interval-including-every-boy's-height}}, +\infty)$ (see (17): interval subtraction)

Based on these, I analyze *enough* as ‘not less (than)’, and *too* as ‘more (than)’ (see (21) and (23)). Basically, *enough* means reaching the lower bound of an interval I , while *too* means exceeding the upper bound. Similar to numbers (see (18b-i)), *enough* also has an ‘exactly’ reading (see (22)).

(21) [[John was strong **enough** compared to his classmates]] (see (15c))
 = [[strong [**not less -an th-[his classmates (are strong)]**]] [John]]
 \Leftrightarrow STRENGTH(John) $\subseteq U \setminus \iota I [I - \llbracket \text{the} \rrbracket \llbracket \text{his classmates (are strong)} \rrbracket] = (-\infty, 0]$
 \Leftrightarrow STRENGTH(John) $\subseteq U \setminus (-\infty, I_{\text{lower-bound}}^{\text{the-interval-including-his-classmates'-strength}})$ $U = (-\infty, +\infty)$
 \Leftrightarrow STRENGTH(John) $\subseteq [I_{\text{lower-bound}}^{\text{the-interval-including-his-classmates'-strength}}, +\infty)$
 \therefore [[enough]] $_{\langle \langle dt, et \rangle, \langle dt, et \rangle \rangle} \stackrel{\text{def}}{=} \lambda G_{\langle dt, et \rangle} . \lambda I_{\langle dt \rangle} . \lambda x_e . G\text{-DIMENSION}_{\langle e, dt \rangle}(x) \subseteq [I_{\text{lower-bound}}, +\infty)$
 (i.e., *enough* means reaching the lower bound of an interval, the lower bound included.)

(22) The ‘exactly’ reading of *enough*: reaching the singleton set of the lower bound
 [[enough]] $_{\langle \langle dt, et \rangle, \langle dt, et \rangle \rangle} \stackrel{\text{def}}{=} \lambda G_{\langle dt, et \rangle} . \lambda I_{\langle dt \rangle} . \lambda x_e . G\text{-DIMENSION}_{\langle e, dt \rangle}(x) = [I_{\text{LOWER-BOUND}}, I_{\text{LOWER-BOUND}}]$
 E.g., The city hides 3,000 eggs in an annual Easter egg hunt (...), which is **more than enough** for the 200 children who usually show up. (from COCA, *The Detroit News*, 2017)

(23) [[This laptop was **too** expensive compared to similar items]] (see (16c))
 = [[expensive [**more -an th-[similar items (are expensive)]**]] [this laptop]]
 \Leftrightarrow PRICE(this laptop) $\subseteq \iota I [I - \llbracket \text{the} \rrbracket \llbracket \text{similar items (are expensive)} \rrbracket] = (0, +\infty)$
 \Leftrightarrow PRICE(this laptop) $\subseteq (I_{\text{upper-bound}}^{\text{the-interval-including-similar-items'-price}}, +\infty)$
 \therefore [[too]] $_{\langle \langle dt, et \rangle, \langle dt, et \rangle \rangle} \stackrel{\text{def}}{=} \lambda G_{\langle dt, et \rangle} . \lambda I_{\langle dt \rangle} . \lambda x_e . G\text{-DIMENSION}_{\langle e, dt \rangle}(x) \subseteq (I_{\text{upper-bound}}, +\infty)$
 (i.e., *too* means exceeding the upper bound of an interval, the upper bound excluded.)

As illustrated in (24), comparatives (in particular those containing modals in their *than*-clause) and *enough/too*-sentences are interchangeable in terms of truth conditions. The current account reflects exactly this interchangeability: *enough* and *too* are analyzed as variations of *more/less*. This interchangeability also shows that modals are not part of the meaning of *enough/too*. Instead, when involved, they are part of the overtly expressed or contextually suggested comparative standard.

(24) CONTEXT: Cal wants to be a fighter pilot. Air Force regulations require all pilots to be between 5’4” and 6’5” tall.
 a. Cal is **taller than** required = Cal is **too tall** (to be a pilot). (Cal is 6’6”.)
 b. Cal is **not less tall than** required = Cal is **tall enough** (to be a pilot). (Cal is 5’4”.)

In sum, empirical evidence shows that *enough/too* does not always take an infinitival complement. Thus, by reducing *enough/too* to degree modifiers, I have excluded hidden modals or two-way entailment from their lexical semantics. In the *enough/too*-sentences in (24), it is rather the phrase *to be a pilot* that involves a modal element and contributes to the expression of comparative standard. In the next section, I show that in terms of syntax and semantics, the infinitival complement of **genuine E/T constructions** (see (1)) is totally different from the phrase *to be a pilot* in (24). Then I further explain the source and the nature of the implicative reading of genuine E/T constructions.

4. Causal dependence in the interpretation of E/T constructions

Having shown that not all *enough-/too*-sentences contain an infinitive, now I show that not all *enough-/too*-sentences containing an infinitive are **genuine E/T constructions** that have an implicative reading. Essentially, I argue that genuine E/T constructions with an implicative reading have a **bi-clausal** structure, while non-genuine E/T constructions have a **mono-clausal** structure. Section 4.1 presents the diagnosis of these two types of sentences. Then Section 4.2 shows that causal dependence is involved in the interpretation of bi-clausal E/T constructions.

4.1. E/T constructions: bi-clausal vs. mono-clausal

At first sight, it seems that sentences (25a) and (25b) (hereafter called the *chess*-sentence and the *party*-sentence respectively) have the same syntactic structure, both containing an infinitive, but intuitively, we feel that only the *party*-sentence has an implicative reading. I will use four diagnoses to show that these two sentences actually have different syntactic structures.

- (25) a. CONTEXT: Jerry was a talented kid. He wanted to learn to play chess. This chess club admitted kids with an IQ of 120 from low-income families. (*chess*-sentence)
Jerry was clever **enough** to join this chess club. ↗ Jerry joined this chess club.
- b. CONTEXT: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. (*party*-sentence)
Mary was clever **enough** to leave the party early. ↘ Mary left the party early.

First, under the given context, the infinitive in the *chess*-sentence can be omitted (since we can accommodate the comparative standard) or replaced by similar expressions (e.g., *for joining this chess club*, etc.) that contribute to the expression of comparative standard (see (26a)), with no difference in meaning. In contrast, for the infinitive in the *party*-sentence, its omission or replacement by expressions like *for leaving the party early* would lead to differences in meaning (see (26b)).

- (26) **Diagnosis (I):** whether the infinitive is omissible or replaceable
- a. Jerry was a talented kid. He wanted to learn to play chess. This chess club admitted kids with an IQ of 120 from low-income families. Jerry was clever enough (to join this chess club / for joining this chess club / with regard to the threshold of IQ).
- b. (i) Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. # Mary was clever enough.
- (ii) Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. # Mary was clever enough for leaving the party early. (This sounds like there's a qualification for leaving early.)

Second, (27a) shows that the *chess*-sentence can be nominalized without meaning change: for both the original and the nominalized versions, it is Jerry's cleverness that pleased his mother. In contrast, (27b) shows that the *party*-sentence **cannot** be nominalized without meaning change: for the original *party*-sentence, it is Mary's early leaving from the party that pleased her mother, but for the nominalized one, it seems that it is rather Mary's cleverness that pleased her mother.⁷

- (27) **Diagnosis (II):** whether the sentence can be paraphrased with nominalization
- a. CONTEXT: Jerry was a talented kid. He wanted to learn to play chess. This chess club admitted kids with an IQ of 120 from low-income families.
 - (i) Jerry was clever enough to join the club, so his mother was happy. =
 - (ii) Jerry's sufficient cleverness to join the club makes his mother happy.
 - b. CONTEXT: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
 - (i) Mary was clever enough to leave the party early, so her mother was happy. ≠
 - (ii) Mary's sufficient cleverness to leave early makes her mother happy.

Third, (28a) shows that the *chess*-sentence **cannot** be turned into a 'be adj. enough so that' version without meaning change. The semantic difference between (28a-i) and (28a-ii) can be tested by adding *but his family was too rich*: due to its entailment that *Jerry joined this chess club*, sentence (28a-ii) sounds contradictory, but sentence (28a-i) does not have this entailment and does not sound contradictory. In contrast, (28b) shows that the *party*-sentence can be paraphrased with a 'be-adj.-enough-so-that' sentence: (28b-i) and (28b-ii) have the same meaning.

- (28) **Diagnosis (III):** whether the 'adj.-enough-to'-sentence can be paraphrased with a 'be-adj.-enough-so-that' sentence
- a. CONTEXT: Jerry was a talented kid. He wanted to learn to play chess. This chess club admitted kids with an IQ of 120 from low-income families.
 - (i) Jerry was clever enough to join this chess club, but his family was too rich. – **no contradiction**
 - (ii) Jerry was clever enough so that he joined this chess club, but his family was too rich. – **contradiction**
 - b. CONTEXT: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
 - (i) Mary was clever enough to leave the party early.
 - (ii) Mary was clever enough so that she left the party early.

⁷The nominalized version in (27b), i.e., (27b-ii), might not even be grammatical. According to Pesetsky (1991) and Pesetsky and Torrego (2001, 2004, 2006) (see Wurmbrand 2014), English infinitives can combine with nominalized irrealis predicates, but not with nominalized propositional, implicative, or factive predicates. Though it is unclear whether most native speakers of English would judge sentence (27b-ii) grammatical or not, it is certain that even if it is grammatical, the semantic contrast shown in (27) holds.

	genuine E/T constructions	non-genuine E/T constructions
example	(25b): Mary was clever enough to leave the party early.	(25a): Jerry was clever enough to join this chess club.
analysis of sentence structure	bi-clausal: (i) comparative : expressing a cause (ii) infinitive : expressing a consequence Semantically main clause: the infinitive	mono-clausal: a comparative (Overt or covert <i>than</i> -clauses are not considered independent here.)
infinitive	not part of the comparative; not comparative-standard-related; not modal-related	part of the comparative; expressing comparative standard ; containing modal elements
implicative reading	available	unavailable

Table 1: *Enough-/too*-sentences containing an infinitive can be divided into two categories.

Fourth, modal elements can be inferred from context (29a), and both (29a-i) and (29a-ii) mean that Jerry’s cleverness reaches the required value. However, given the context (29b), interlocutors cannot accommodate any requirement, and thus different from the felicitous sentence (29b-i), sentence (29b-ii) is infelicitous. Thus, (29a-i) is interchangeable with a comparative, but sentence (29b-i) is not. Moreover, this contrast also suggests that the infinitive of the *chess*-sentence conveys a certain modal, but the infinitive of the *party*-sentence is actually irrelevant to the expression of modals.

- (29) **Diagnosis (IV)**: whether the sentence can be interchangeable with a comparative
- a. **CONTEXT**: Jerry was a talented kid. He wanted to learn to play chess. This chess club admitted kids with an IQ of 120 from low-income families.
 - (i) Jerry was clever enough to join this chess club.
 - (ii) Jerry was not less clever than he was **required** to be.
 - b. **CONTEXT**: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
 - (i) Mary was clever enough to leave the party early.
 - (ii) # Mary was not less clever than she was **required** to be.

In sum, these diagnoses suggest that the *party*-sentence (25b) is rather **bi-clausal**, including a **comparative** and an **infinitive**. Semantically, it is even this infinitive that seems the main clause (see Diagnosis (II)). Thus, it cannot be optional, and the whole sentence cannot be nominalized or reduced to a comparative. Crucially, this infinitive is not part of a comparative: it is not related to comparative standard or any modal elements. Therefore, as shown in Table 1, there are two categories for *enough-/too*-sentences containing an infinitive. Only the interpretation of bi-clausal E/T constructions is implicative and involves causal dependence (between its two clauses).

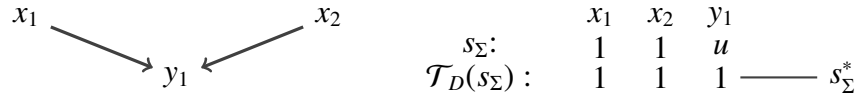


Figure 2: A dynamics D : $B = \{x_1, x_2\}$. $I = \{y_1\}$. $F(y_1) = \langle Z_{y_1} = \{x_1, x_2\}, f_{y_1} = (y_1 \Leftrightarrow x_1 \wedge x_2) \rangle$. E.g., let Σ be $\{x_1, x_2\}$, and s_Σ be the situation making all formulas in Σ true.

4.2. The semantics of E/T constructions: necessary vs. sufficient causes

Having shown that the implicative reading of genuine E/T constructions is due to its bi-clausal structure, here I further characterize the nature of this implicative reading. Inspired by [Schulz \(2011\)](#), [Baglini and Francez \(2015\)](#), and [Nadathur \(2016\)](#), I propose that **causal dependence** is involved in interpreting genuine E/T constructions. As illustrated in (30), bi-clausal E/T constructions can be paraphrased with the use of *because*: their infinitival complement represents a **consequence**, which **causally depends on** the factor expressed by the comparative part.⁸

- (30) a. [[M. was clever enough to leave early]] = [[M. left early **because** she was clever enough]]
 b. [[Bill was too tired to stay awake]] = [[Bill didn't stay awake **because** he was too tired]]

The intuition here is that under a given context (e.g., (25b)), (30a) means that among many other factors (e.g., her willingness to sacrifice fun for health), Mary's cleverness (in decision-making) in this situation was a **necessary** but **insufficient** one for her early leaving from the party, while (30b) means that among many other factors (e.g., his lack of effort to stay awake), Bill's excessive fatigue was a **sufficient** but **unnecessary** one for his not staying awake.

I adopt the framework of [Schulz \(2011\)](#) to formally describe the causal entailment between the two clauses of E/T constructions. A **dynamics** D is defined to represent causal relationships over a set of propositions \mathcal{P} . D includes **(I)** a set of **background variables** B which are causally independent, **(II)** a set of **inner variables** $I = \mathcal{P} - B$, and **(III)** the function F that associates every inner variable X with **(i)** a set of propositions Z_X that X directly causally depends on and **(ii)** a two-valued truth function f_X ($f_X : \{0, 1\}^n \rightarrow \{0, 1\}$) that describes how to calculate the truth value of X from the values of the members of Z_X . A **situation** s is an incomplete valuation of the propositions in \mathcal{P} , mapping \mathcal{P} to $\{0, 1, u\}$, where u means **undetermined**. **Operator** \mathcal{T}_D maps situations s to new situations $\mathcal{T}_D(s)$, calculating the direct causal effects of the settings in s . After a finite number of applications of \mathcal{T}_D , the **least fixed point** s_Σ^* is reached. (see Figure 2 for an example.)

⁸In fact, this kind of bi-clausal causal-dependence-related constructions are not limited to E/T constructions, as illustrated by (i). (i) means that grass is green, which is a factor contributing to the promotion of photosynthesis.

- (i) Grass is green to promote photosynthesis. ([Williams 1974](#))

Based on these definitions, [Baglini and Francez \(2015\)](#) defines the notions of **causal sufficiency** (see (31a)) and **causal necessity** (see (31b)). Evidently, when s_Σ is **causally sufficient** for ϕ , then s_Σ **causally entails** ϕ , i.e., $s_\Sigma \vDash_D \phi$. s_Σ is **causally necessary** for ϕ when there is no s' (where ϕ is still undetermined) different from s_Σ that causally entails ϕ , i.e., $s' \vDash_D \neg\phi$.

- (31) a. Let Σ be a set of literals and D a dynamics. Then $s_\Sigma \vDash_D \phi$ iff_{def} $\llbracket \phi \rrbracket^{D, s_\Sigma^*} = 1$
 (i.e., s_Σ **causally entails** ϕ given D iff ϕ is true on the least fixed point s_Σ^* .)
 b. $\phi \triangleleft_D s_\Sigma$ iff_{def} $\neg \exists s' :$ $\underbrace{s' \neq s_\Sigma}_{\text{in the values of determined variables relevant for } \phi} \wedge \underbrace{s'(\phi) \neq 1}_{\phi=u \text{ in } s'} \wedge \underbrace{s' \vDash_D \phi}_{s' \text{ causally entail } \phi}$

In the interpretation of E/T constructions, the causal dependence between the comparative (C) and the infinitive (X) is formally described in (32). Obviously, as noted by [Baglini and Francez \(2015\)](#), the choice of dynamics (in particular what background and inner variables are under consideration) plays a crucial role in analyzing causal dependence. Thus following [Baglini and Francez \(2015\)](#), I use minimal pairs of contexts to provide empirical evidence for the characterization in (32).

- (32) The causal dependence between C and X in E/T constructions:
 a. *enough*-sentences: $\underbrace{\neg C \vDash_D \neg X}_{C \text{ is causally necessary for } X} \wedge \underbrace{C \not\vDash_D X}_{C \text{ is causally insufficient for } X}$
 b. *too*-sentences: $\underbrace{\neg C \not\vDash_D X}_{C \text{ is causally unnecessary for } \neg X} \wedge \underbrace{C \vDash_D \neg X}_{C \text{ is causally sufficient for } \neg X}$

In *enough*-sentences, C is causally necessary for X . The contrast in (33) shows that *enough*-sentences are **infelicitous** under contexts where $C = 0 \wedge X = 1$. Thus, C is necessary for X .

- (33) Mary was clever enough to leave the party early. CONTEXT (33a): ✓; CONTEXT (33b): #
 a. CONTEXT: Mary made a wise decision to leave early, and she left early. $C = 1 \wedge X = 1$
 b. CONTEXT: Mary was drunk, and Lucy took her back early. $C = 0 \wedge X = 1$

In *enough*-sentences, C is causally insufficient for X . For (34b), here $F(X) = \langle Z_X = \{C, K\}, f_X = (X \Leftrightarrow K \wedge C) \rangle$. Thus $X = 1$ does not follow from $C = 1$. Therefore, C alone is insufficient for X .

- (34) Mary was clever enough to leave the party early. CONTEXT (34a): ✓; CONTEXT (34b): #
 a. CONTEXT: Mary wisely decided to leave early, and she left early herself.
 b. CONT.: Mary wisely decided to leave early. Then she got drunk. Lucy took her home.
 ($X = \text{Mary left early}$, $C = \text{Mary was clever enough}$, $K = \text{Mary stayed sober}$.)

In *too*-sentences, *C* is causally sufficient for $\neg X$. (35) shows that *too*-sentences are **infelicitous** under contexts where (i) $C = 1 \wedge X = 1$ or (ii) $\neg X \Leftrightarrow C$. Thus *C* alone has to be sufficient for $\neg X$. Note that under (35c), if somebody asks *why didn't Bill come last night* and gets the answer *he was too busy*, we have very good reason to claim that this answer misses the crucial point.

- (35) Bill was too busy to come last night. CONTEXT (35a): ✓; CONTEXTS (35b) and (35c): #
- a. CONTEXT: Bill was overly busy. He didn't come last night. $C = 1 \wedge X = 0, \neg X \Leftrightarrow C$
- b. CONTEXT: Bill was overly busy, but he managed to come anyway. $C = 1 \wedge X = 1$
- c. CONTEXT: Bill was overly busy, but if he had been invited to this party, he would have come no matter whether he was busy or how busy he was. $\neg X \Leftrightarrow C$
(X = Bill came, C = Bill was overly busy, K = Bill wasn't invited to this party.)

In *too*-sentences, *C* is causally unnecessary for $\neg X$. Both contexts (36a) and (36b) are compatible with the sentence *Bill was too busy to come last night*, meaning that *C* is unnecessary for $\neg X$. Note that under (36b), if somebody asks *why didn't Bill come last night* and gets the answer *he was too busy*, we, who know the whole context, can still consider this a true and acceptable answer.

- (36) Bill was too busy to come last night. CONTEXT (36a): ✓; CONTEXT (36b): ✓
- a. CONTEXT: Bill was overly busy. This was the only reason for his not coming. $\neg X \Leftrightarrow C$
- b. CONTEXT: Bill would not come if he was overly busy or sick. Last night, he was both overly busy and sick, so he didn't come. $\neg X \Leftrightarrow C \vee K$
(X = Bill came, C = Bill was overly busy, K = Bill was sick.)

A further prediction of the current account is that since **positive *enough***-sentences contain a **necessary but insufficient** cause for their infinitival complement to be **true**, **negative *enough***-sentences should contain a **sufficient but unnecessary** cause for their infinitival complement to be **false**; while since **positive *too***-sentences contain a **sufficient but unnecessary** cause for their infinitival complement to be **false**, **negative *too***-sentences should contain a **necessary but insufficient** cause for their infinitival complement to be **true**. (37) and (38) show that this prediction is perfectly borne out. This kind of pattern for the implicative reading of positive and negative E/T constructions seems due to the lexical semantics of *enough/too* and their interaction with negation, but further details have to be left for future research.

- (37) a. Mary was clever enough to leave early. \leadsto Mary left early.
b. Mary was not clever enough to leave early. \leadsto Mary didn't leave early.
- (38) a. Bill was too busy to come last night. \leadsto Bill didn't come last night.
b. Bill was not too busy to come last night. \leadsto Bill came last night.

infinitive type	examples	syntax	episodic interpretation	temporal composition of infinitive
irrealis future	<i>decide, expect</i> <i>expect</i>	control ECM	possible	<i>woll</i>
propositional	<i>claim</i> <i>believe, expect</i>	control ECM	impossible	reference time is attitude holder's NOW
non-propositional; no attitude holder	<i>manage</i> <i>begin, seem</i>	control ECM	dependent on matrix tense	reference time is matrix reference time

Table 2: [Wurmbrand \(2014\)](#)'s framework on tense properties of English infinitives

5. The tense and aspect of the infinitival complement of E/T constructions

According to [Wurmbrand \(2014\)](#), infinitives are not semantically tenseless. Her framework on tense properties of English infinitives includes three classes: (i) future irrealis infinitives, (ii) those expressing propositional attitude reports, and (iii) those involving no attitude holder (see Table 2).

Here I argue that the infinitives of bi-clausal E/T constructions fall into the third class. There are at least two reasons. First, similar to *manage*-sentences, E/T constructions involve no attitude holders. Second, [Faraci \(1974\)](#) has shown that the infinitives in E/T constructions (even including *for*-phrases, e.g., *Mary runs too fast for me to keep up with her*) are reduced sentential objects (i.e., smaller than CP or even TP), which makes them similar to the infinitival complement of core **restructuring** predicates like *manage* (see [Wurmbrand 2001, 2004](#)). Thus, as a consequence, E/T constructions constitute a single temporal domain, and the tense and aspect (or rather **episodicity**) of their infinitival complement are reflected on the syntactically main predicate of the sentence.

Though the framework of [Wurmbrand \(2014\)](#) focuses on English infinitives, it seems generalizable to cross-linguistic data. For example, [Marques \(2012\)](#) notes that for Portuguese implicative E/T constructions, temporal overlap between the main predicate and the infinitive is required. This is a natural consequence if [Wurmbrand \(2014\)](#)'s analysis also works for Portuguese infinitives.

As mentioned earlier, for French E/T constructions, there seems a correlation between aspect and implication. An explanation is easily available if [Wurmbrand \(2014\)](#)'s analysis can be extended to French. In French, imperfective and perfective aspects are used to characterize generic and episodic events respectively. Thus, since the implicative reading of an E/T construction typically describes an episodic event (e.g., *nice enough to come last night*), its semantic aspect is perfective, leading to a perfective marker on the main predicate in French. In other words, it is the episodicity of the entailed event that dictates the requirement for the aspect of the main predicate, not the other way round. This explains why the aspect of the main predicate is not a perfect indicator for the implicative reading (see [Hacquard 2006, Nadathur 2017](#)): a non-genuine E/T construction is a comparative and thus usually in imperfective, but sometimes it can also be in perfective.

6. Summary and outlook

This paper addresses the semantics of *enough/too* and E/T constructions. It includes three components: (i) an interval-based account for the lexical semantics of *enough/too*; (ii) a causality-based account for the semantics of E/T constructions; and (iii) an analysis of the semantic tense and aspect of the infinitival complement in E/T constructions. The conclusion is that ***enough and too are essentially variations of comparatives*** (i.e., *enough* means *not less (than)* and *too* means *more (than)*), but **bi-clausal E/T constructions are real implicatives**. To some extent, I agree with Nadathur (2017) that *enough* and *too* are not implicatives, and I also agree with Hacquard (2005, 2006) that E/T constructions are real implicatives. However, this current work differs from these previous studies on two main issues. First, by showing that genuine E/T constructions are bi-clausal, I attribute the source of implicative readings to this bi-clausal structure, not to the lexical semantics proper of *enough/too*. Second, by showing that implicative readings do not necessarily rely on the existence of two-way entailment or a sufficient and necessary condition, the current analysis more precisely characterizes the interpretation pattern of E/T constructions. However, as mentioned in Section 4, the pattern of causal dependence in the interpretation of (positive and negative) E/T constructions seems based on the lexical semantics of *enough/too*, but the details of the underlying mechanism are still missing. Moreover, is there a unified mechanism for the interpretation pattern of the whole inventory of implicatives (see (39))? Syntactically, do implicatives all involve restructuring (cross-linguistically)? These are left for future research.

(39) Implicatives

- a. Involving a **necessary but insufficient** factor: **French ability modal *pouvoir*** (e.g., *Jean a pu venir* means *John came because he could*, see Bhatt 1999), **adj. *enough to, not too adj. to, manage to*** (see Baglini and Francez 2015), ...
- b. A **sufficient but unnecessary** factor: ***too adj. to, not adj. enough to, ...***

References

- Baglini, R. and I. Francez (2015). The implications of managing. *Journal of Semantics* 33(3), 541–560.
- Bhatt, R. (1999). Ability modals and their actuality entailments. In K. Shahin, S. Blake, and E.-S. Kim (Eds.), *Proceedings of the 17th West Coast Conference on Formal Linguistics*, pp. 17–34.
- Bierwisch, M. (1987). Semantik der Graduierung. In *Grammatische und konzeptuelle Aspekte von Dimensionsadjektiven*, Volume 26, pp. 91–286. Akademie Verlag Berlin.
- Davies, M. (2008). The Corpus of Contemporary American English (COCA): 560 Million Words, 1990–present. URL: <http://corpus.byu.edu/coca/>.
- Faraci, R. A. (1974). *Aspects of the grammar of infinitives and for-phases*. Ph. D. thesis, MIT.
- Hacquard, V. (2005). Aspect and actuality entailment: *Too* and *enough* constructions. In E. Maier, C. Bary, and J. Huitink (Eds.), *Proceedings of Sinn und Bedeutung*, Volume 9, pp. 116–130.
- Hacquard, V. (2006). Aspects of *too* and *enough* constructions. In *Semantics and Linguistic Theory*

- (SALT), Volume 15, pp. 80–96. Citeseer.
- Homer, V. (2011). French modals and perfective. In M. Washburn, K. McKinney-Bock, E. Varis, A. Sawyer, and B. Tomaszewicz (Eds.), *Proceedings of the 28th West Coast Conference on Formal Linguistics*, pp. 106 – 114.
- Karttunen, L. (1971). Implicative verbs. *Language* 47, 340–358.
- Marques, R. (2012). Covert modals and (non-)implicative readings of *too/enough* constructions. In W. Abraham and E. Leiss (Eds.), *Covert Patterns of Modality*, pp. 238 – 266. Cambridge Scholars Publishing.
- Meier, C. (2003). The meaning of *too*, *enough*, and *so... that*. *Natural Language Semantics* 11(1), 69–107.
- Moore, R. E. (1979). *Methods and Applications of Interval Analysis*. SIAM.
- Nadathur, P. (2016). Causal necessity and sufficiency in implicativity. In M. Moroney and J. Collard (Eds.), *Semantics and Linguistic Theory (SALT)*, Volume 26, pp. 1002–1021.
- Nadathur, P. (2017). Implicative inferences and causality in *enough* and *too* constructions. In A. Cremers, T. van Gessel, and F. Roelofsen (Eds.), *Proceedings of the 21th Amsterdam Colloquium*, pp. 355 – 364.
- Pesetsky, D. (1991). Zero syntax II: An essay on infinitives. Manuscript, MIT.
- Pesetsky, D. and E. Torrego (2001). T-to-C movement: Causes and consequences. In M. Kenstowicz (Ed.), *Ken Hale: A life in language*, pp. 355–426. MIT Press.
- Pesetsky, D. and E. Torrego (2004). Tense, case, and the nature of syntactic categories. In J. Guéron and J. Lecarme (Eds.), *The syntax of time*, pp. 495–537. MIT Press.
- Pesetsky, D. and E. Torrego (2006). Probes, goals and syntactic categories. In Y. Otsu (Ed.), *Proceedings of the 7th annual Tokyo Conference on Psycholinguistics*, pp. 25–60. Hituzi Syobo.
- Schulz, K. (2011). If youd wiggled A, then B wouldve changed. *Synthese* 179(2), 239–251.
- Schwarzschild, R. (2008). The semantics of comparatives and other degree constructions. *Language and Linguistics Compass* 2(2), 308–331.
- von Stechow, A., S. Krasikova, and D. Penka (2004). The meaning of German *um zu*: Necessary condition and *enough/too*. Handout for *the Tübingen Workshop on Modal Verbs and Modality*.
- Williams, E. (1974). *Rule ordering in syntax*. Ph. D. thesis, MIT.
- Wurmbrand, S. (2001). *Infinitives: Restructuring and clause structure*. Berlin: Mouton de Gruyter.
- Wurmbrand, S. (2004). Two types of restructuring – lexical vs. functional. *Lingua* 114(8), 991–1014.
- Wurmbrand, S. (2014). Tense and Aspect in English Infinitives. *Linguistic Inquiry* 45(3), 403–447.
- Zhang, L. and J. Ling (2015). Comparatives Revisited: Downward-Entailing Differentials Do Not Threaten Encapsulation Theories. In T. Brochhagen, F. Roelofsen, and N. Theiler (Eds.), *Proceedings of the 20th Amsterdam Colloquium*, pp. 478 – 487.
- Zhang, L. and J. Ling (2017a). Ambiguous *than*-clauses and the mention-some reading. In D. Burgdorf, J. Collard, S. Maspong, and B. Stefánsdóttir. (Eds.), *Semantics and Linguistic Theory (SALT)*, Volume 27, pp. 191 – 211.
- Zhang, L. and J. Ling (2017b). LITTLE: Not a dichotomy-based negation operator, but a trivalence-based polar opposition operator. In A. Kaplan, A. Kaplan, M. K. McCarvel, and E. J. Rubin (Eds.), *Proceedings of the 34th West Coast Conference on Formal Linguistics*. Cascadilla Press.