

Transitives with inchoative semantics

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Abstract The paper investigates the semantics and event structure of change-of-state verbs that undergo the causative alternation – specifically, lexical causative verbs and their anticausative counterparts. Following some of the previous literature, we challenge the traditional decomposition of lexical causatives into a cause event plus a become event. Instead, we argue on the basis of new arguments that both transitive and intransitive verbs of change-of-state involve a single event yielding a result state. Through various tests, we demonstrate that this event-state relation is interpreted as become not only in intransitive anticausatives, but also in lexical causatives with a causer subject and in transitive anticausatives. Only when a lexical causative verb has an agent subject is this event-state relation interpreted as cause. We face, then, a syntax/semantics mismatch: except when an agent subject is present, change-of-state verbs in transitive sentences exhibit ‘intransitive’ (inchoative) semantics: they describe mere changes (become events), just as they do when they are used in intransitive, anticausative sentences. We argue that the distinction between agent and causer subjects is not based on animacy, but rather on the semantic type of the subject participant. Agent subjects (whether animate or inanimate) denote individuals participating in the vP-event (which is a cause event), whereas causer subjects denote eventualities or facts that bring about the vP-event (which is a become event). Our analysis is developed within the framework of Distributed Morphology, in which external arguments are introduced by a Voice projection that combines with the eventive vP, either Agent Voice or Causer Voice (or Expletive Voice present in transitive anticausatives, for which we provide an updated semantics). We treat these Voice heads as syncategorematic expressions, as opposed to categorematic expressions, as the choice of Voice head determines how the event-state relation in the vP is interpreted.

Keywords: change-of-state verbs, causative alternation, event structure, cause vs. become, agent vs. causer subjects, inanimate agents, Voice

1 Introduction

The English verb *change* is an example of a verb undergoing the causative alternation, illustrated in (1).

- (1) a. The shape of mankind will change. (intransitive anticausative sentence)
b. Geneticists will change the shape of mankind. (transitive causative sentence)

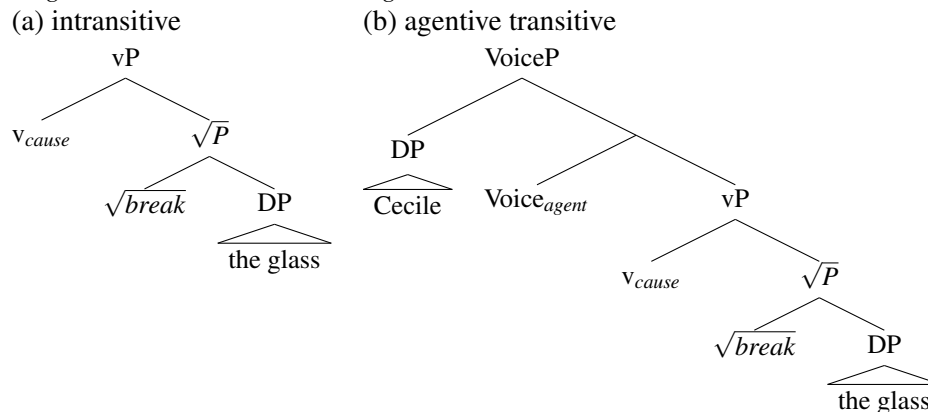
A standard view on the causative alternation is that the transitive, causative verb has a more complex event structure than the intransitive, anticausative verb. According to this view, the lexical-causative variant of the alternation is roughly analyzed as ‘cause to V-intransitive’ (Dowty 1979, Levin & Rappaport Hovav 1995), projecting two event variables, one for a cause event, and the other for a become (inchoative) event leading to some state that satisfies the stative property lexicalized by the

verb. For instance, [Parsons \(1990: chap.6\)](#) can be attributed the following analyses of *break* in its anticausative and its (agentive) causative variant.¹

- (2) a. $x \text{ break}_{\text{anticaus}} \rightsquigarrow \exists e[\text{theme}(e, x) \wedge \exists s[\text{be-broken}(s) \wedge \text{theme}(s, x) \wedge \text{become}(e, s)]]$
 b. $x \text{ break}_{\text{caus}} y \rightsquigarrow \exists e[\text{agent}(e, x) \wedge \exists e'[\text{cause}(e, e') \wedge \text{theme}(e', y) \wedge \exists s[\text{be-broken}(s) \wedge \text{theme}(s, x) \wedge \text{become}(e, s)]]]$

Other authors such as [Rapp & von Stechow \(1999\)](#), [Kratzer \(2005\)](#) or [Alexiadou et al. \(2015\)](#) argue that change-of-state verbs have the same event semantics in their transitive and intransitive uses: both denote a set of events that yield some state satisfying the predicate of state lexicalized by the verb.² For example, [Alexiadou et al. \(2015\)](#) propose that causatives and anticausatives involve the same verbalizing v-head taking a RootP introducing the internal argument DP as its complement; see (3). In both structures in (3), this v-head introduces a causative event leading to the state property expressed by the root and predicated over the internal argument. Lexical causatives and anticausatives therefore do not differ in their event structure. Rather, the causative alternation is, for these authors, a Voice alternation: Voice, the syntactic head responsible for introducing external arguments ([Kratzer 1996](#)), is projected in causative (transitive) construals, and absent from anticausative (intransitive/unaccusative) construals. The Voice-head does not, itself, introduce any event, but relates a DP in its specifier to the event denoted by the vP in its complement position, in (3b) as the agent of this vP-event.

- (3) *The glass broke/Cecile broke the glass*



In this paper, we provide a fresh look at the event structure of verbs of change-of-state undergoing the causative alternation by addressing two related questions:

- (4) In sentences built with alternating change-of-state verbs,
- what kind of events are described in vP and VoiceP in sentences built with a change-of-state verb: causing (cause) events, inchoative (become) events, or both, i.e., full causation events?
 - Does this vary with the presence of VoiceP and the nature of the external argument introduced by Voice?

¹ We follow in (2) the reconstruction of Parsons' analysis of the two variants of change-of-state verbs proposed in [Piñón \(2001: 361\)](#). As noted in [Piñón \(1999: 430\)](#), while [Parsons \(1990: 119–120\)](#) (hesitantly) represents result states via the become relation between events and states, he never actually says that verbs denoting events with a result state should be analyzed as having a result state argument, even if it is possible to understand him as endorsing this view. But he clearly endorses the view that the event structure is more complex for the causative than the anticausative variant, which is the main point of interest here.

² We leave aside alternating verbs which do not encode a result state but rather a result event, like *bounce*, *rock*, *fly*, *roll*, *spin*, etc (see [Levin & Rappaport Hovav 1995](#) among others).

Whereas we adopt [Alexiadou et al.'s \(2015\)](#) view that alternating change-of-state verbs have one event argument only in both their intransitive and their transitive use,³ we will answer to the second question in the affirmative.

Our proposal will be that in sentences built with a change-of-state verb, the verb and the vP leave the relation between the verbal event and the ensuing state underspecified. It is the syntactic context that determines the nature of this relation.⁴ The hypothesis we argue for is that in all syntactic contexts except when an *agentive* external argument is present, this relation is interpreted as become, which we define as a relation between a change that an entity *x* undergoes and some new state of *x* this internal change leads to. In the presence of an agentive external argument, it is interpreted as cause. A key difference between become and cause events is that while the former only have the theme *x* of the ensuing state as a participant, the latter necessarily involve a second participant (an agent or a causer).

We will refer to this hypothesis as the ‘inchoative hypothesis’, as the idea is that in their default meaning, change-of-state verbs have inchoative semantics, i.e., express *just* a change. As the distinction between agentive and non-agentive external arguments is therefore crucial to determine the type of relation between the verbal event and the state, we need a clear difference between the two types of external arguments. An operative distinction cannot rely on the criterion of animacy only, since agents can also be inanimate ([Cruse 1973](#), [Piñón 2001](#), [Fauconnier 2012](#), [Folli & Harley 2008 a.m.o.](#)).

The paper is structured as follows. Section 2 critically discusses different views on the event structure of change-of-state verbs. Section 3 provides a brief background on the Voice framework adopted here. It focuses on the semantic differences between agent vs. causer subjects (that is, between agentive and non-agentive external arguments), and brings together tests that make it possible to distinguish between agents and causers without resorting to the animacy feature. One of our conclusions is that while inanimate DPs can be associated with the agent role, animate DPs can only be causers in restricted contexts (such as the subject position of causative psych-verbs). Section 3.1 focuses on inanimate subjects, and Section 3.2 on animate subjects. Section 4 summarizes data supporting the view that causative predicates express inchoative events when

³ A reviewer reminds us that [Bruening \(2019\)](#) challenges the idea that change-of-state verbs have only one event argument in their transitive use, based on the following Voice-mismatch in *do-so* anaphora. For some speakers, and to various degrees, a lexical causative can antecede *do so* with an anticausative interpretation (ia), but this is not possible vice versa (ib):

- (i) a. The metal the damp weather rusted did so in spite of an extra heavy coating of grease.
- b. The metal rusted in spite of a heavy coat of grease because the damp weather did so. (*rusted the metal).

Bruening argues that (ib), under the intended causative interpretation, must involve a causative v-head on top of an inchoative vP realized by *do so*. Since, as he suggests, the causative head c-selects for a vP with a syntactic object, but *do so* does not provide such an object, the derivation fails. While this analysis captures the contrast in (ia, b), it offers no positive *semantic* evidence for a second event in lexical causatives but only indirect evidence based on a c-selectional stipulation. If lexical causatives lack *semantic* evidence for a second event, as argued here, positing such a second v-head just serves as a technical device to differentiate causatives from anticausatives. Further, Bruening’s proposal predicts (ia) to be fully acceptable which, as Bruening himself notes, is not the case. An alternative analysis of (ia) vs. (ib) which assumes a single event in both causatives and anticausatives, could develop the idea that *do so* can, at best, denote an event of lower arity than its antecedent (cf. (ia)), but not an event of higher arity (cf. (ib)). We must leave a detailed evaluation of this idea for the future.

⁴ Our approach shares thereby some similarities with the one adopted by [Marantz \(2013\)](#) and [Wood & Marantz \(2017\)](#), for which lexical causatives and anticausatives involve the same single eventive v-head which is, however, interpreted as cause in the context of Voice introducing an external argument and as become in the absence of such Voice. Our hypothesis is different in that we argue that even with non-agentive (causer) external arguments, the relation between the verbal event and the state is become. Also, our analysis does not resort to ‘contextual allosemy’ (that [Wood & Marantz 2017](#) define as the semantic analogue of contextual allomorphy). That said, there is a kinship between the two approaches in that in the approach in terms of contextual allosemy, the rules that determine the choice of one of the meanings of an expression in a particular context are, in a sense, syncategorematic rules.

they are combined with a causer subject, and full causation events when combined with an agent subject. Section 5 presents an approach which accounts for this generalization in the semantics in a compositional way. This approach treats Voice heads as syncategorematic expressions, as opposed to categorematic expressions. Section 6 turns to transitive anticausatives (as in *The room changed its temperature*), as a further instance of cases where change-of-state verbs are used in transitive contexts but nevertheless describe inchoative events.

2 The event structure of change-of-state verbs

One of the main arguments for not assuming that there is an additional event argument for the agentive transitive variant compared to the intransitive anticausative variant of alternating verbs is that this assumption predicts that separate modification is possible for the agentive subevent (the action) and the inchoative subevent (the change) (Fodor 1970, Rapp & von Stechow 1999, Higginbotham et al. 2000, Pykkänen 2008, Alexiadou et al. 2015 a.o). But separate modification is not possible, as illustrated by the contrast in (5) (see Higginbotham et al. 2000, Pykkänen 2008, Martin & Schäfer 2014 for related examples with manner modifiers that point to the same conclusion). The sentence in (5b) is not felicitous in the relevant context established in (5a) where Charlotte did nothing more to Jean-Paul other than pushing him out of the window on Sunday. In this scenario, the agentive *kill*-subevent (the pushing) takes place on Sunday, and the inchoative *kill*-subevent (the dying) takes place on Tuesday night. If the two subevents are modified separately, this scenario cannot be lexicalized with the verb *kill*. Sentence (5c) illustrates the same problem. For us, this is because the verb in its agentive use describes the mereological sum of the action performed by the agent and the resulting change-of-state of the theme.⁵

- (5) a. Charlotte pushed Jean-Paul out of the window **on Sunday**, and he eventually died **on Tuesday night**.
 b. #Charlotte pushed Jean-Paul out of the window **on Sunday** and he fell from the third floor. She ended up killing him **on Tuesday night**.
 c. #John killed Bill **on Sunday** by stabbing him **on Saturday**. (Fodor 1970: 433)

The problem of (5b/c) results from trying to modify two subevents separately. This requires the verb *kill* to have two different event arguments, which it does not have according to the authors mentioned above. Contrary to what is often assumed (including by Fodor 1970),⁶ the problem of (5b/c) is *not* due to the inability of lexical causatives to lexicalize a scenario as above, or more generally to express indirect causation, that is, causation between two spatiotemporally disjoint events. As noted for instance by Danlos (2000), as long as there is no attempt to modify the action and change subparts of the vP-event separately, a lexical causative like *kill* is perfectly fine as a description of a causation event such that the agentive component and the inchoative component are spatiotemporally disjoint. This is shown in example (6), which is inspired by a similar example in Danlos (2000) (see also Neeleman & Van de Koot 2012, Martin 2018 for arguments in favour of the idea that lexical causative verbs can convey causation between temporally disjoint events).

⁵ See the rule for the combination of Agent Voice with change-of-state verbs in (56) below. Whether the action and the change can be modified separately is distinct from the question of whether the verb denotes a predicate of states (resulting from the denoted change). Several tests indicate that a result state is made accessible for modification by change-of-state verbs; see Piñón (1999) on *for*-adverbials and Spathas & Michelioudakis (2021) on additive operators such as *too*. In analyses assuming that the vP is obtained by combining the *v* head and a predicate of states, this is accounted for by the fact that state argument can be modified before being bound existentially through the composition of the predicate of states with *v* (see (55) in Section 5).

⁶ “The point is, roughly, that one can cause an event by doing something at a time which is distinct from the time of the event. But if you melt something, then you melt it when it melts.” (Fodor 1970: 433)

- (6) Charlotte killed Jean-Paul. She pushed him out of the window **on Sunday** and he died **on Tuesday night**.

Research that shares the assumption that change-of-state verbs have a single event argument in both intransitive and transitive uses typically assumes that the nature of the relation between the event and the state is specified at the level of the verb or vP (but see [Wood & Marantz 2017](#) for a different view; cf. fn. 5). In this perspective, change-of-state verbs encode the same relation between the event and the state across transitive and intransitive uses. A first view is that events described by a change-of-state verb are become events. So for instance, for [Rapp & von Stechow \(1999\)](#), change-of-state verbs are decomposed into v-BECOME and a state predicate across transitive and intransitive uses, and the agentive transitive use involves, on top, Voice introducing the agent of this become-event, as illustrated in (7)-(8).

- (7) a. The door opened.
 b. [v_{BECOME} [the door OPEN]]
- (8) a. Ali opened the door.
 b. [Ali [VOICE [v_{BECOME} [the door OPEN]]]]

A problem for this view is that, in agentive transitive uses, the verbal event sometimes starts when the action of the subject's referent starts, not when the change begins. This is unexpected if the verbal event is only a become-event (at least under the common view that a become-event is the coming about of some state *s*, and only has the theme of this state as a participant). In English, this is especially obvious in progressive sentences. Take for instance (9):

- (9) Ali Baba is opening the cave door (right now).

Let us imagine that Ali Baba knows a long magic formula which, once recited, causes the opening of the cave door. In this context, (9) is true as soon as Ali Baba starts to recite this formula. In the context of an agentive subject, the opening event can therefore start before the door has started to open. The same observation holds for languages like French that do not have a futurate reading for the progressive ([Martin 2015](#)), and therefore cannot be explained away by the futurate use of the progressive in English (on such readings of the English progressive, see [Dowty 1977](#), [Copley 2014](#) among others).⁷

A second view is that change-of-state verbs always denote a set of cause events. For instance, [Alexiadou et al. \(2015\)](#) decompose change-of-state verbs into v-CAUSE and a state predicate across intransitive and transitive readings (see also [Wood & Marantz 2017](#)). Adding Voice to the structure of the anticausative yields the transitive use, as shown in (10) and (11).

- (10) a. The door opened.
 b. [v_{CAUSE} [the door OPEN]]

⁷ So for instance, as an anonymous reviewer observes, in a situation where two people *A* and *B* are walking up to the starting line of a race, *A* can ask *B*: *Are you running?*, and *B* can answer in the affirmative, even though *B* is walking at the time. On the other hand, a French-speaking person *B* would not be able to reply felicitously *Oui* to the progressive question *Est-ce que tu es en train de courir?* 'Are you running' in the same context. For us, this cross-linguistic contrast is due to the fact that the progressive has a futurate reading in English but not in French (cf. [Bertinetto 2000](#): 588, [Bonomi 1997](#): 204, fn. 9). But French *Ali Baba est en train d'ouvrir la porte* 'Ali Baba is opening the door' is perfectly acceptable in a context where Ali Baba has just started to recite a long magic formula and the door has not yet started to open. Since the French progressive needs an event that satisfies the vP to be ongoing in all its uses, this confirms our point that events in the denotation of causative vPs can begin before the change proper starts when these events involve an in-control agent. This is unexpected on the view that change-of-state verbs denote become-events across uses, as in [Rapp & von Stechow's \(1999\)](#) analysis.

- (11) a. Ali opened the door.
 b. [Ali [VOICE [_{VCAUSE} [the door OPEN]]]]

This solves the previous problem since the causing event can plausibly have the agent's action as a part. More specifically, [Alexiadou et al. \(2015\)](#) can say that in (9), the causing event is already in progress when Ali Baba recites the magic formula.⁸ But it is the analysis of the variants without an agent (anticausatives or non-agentive causatives) that turn out to be problematic. For [Alexiadou et al. \(2015\)](#), anticausatives and non-agentive causatives are all descriptions of causing events (cf. [Kratzer 2005](#)). The way in which they analyse causer subjects or causer-PPs such as the English *from*-PPs like in (12b) makes this particularly clear. Building on [Solstad \(2009\)](#), they assume that the *from*-PP introduces an event that gets identified with the verbal event of the anticausative. They assume the same for causer subjects in non-agentive causatives, such as (12a) (following [Pylkkänen 2008](#)). Thus for them, the event introduced by the causer DP or PP gets identified with the verbal event in (12a, b).

- (12) a. The wind opened the door.
 b. The door opened from the wind.

A problem with this view is that separate modification shows that the event introduced by the causer is different from the verbal event. This is observed in [Martin \(2018; 2020\)](#) for causer subjects, see e.g. (13). Note that in (13a/c), the adjectives *constant* or *continued* ensure that the subject DP denotes an event and is not coerced so as to get a result or a referential reading (see [Iordăchioaia 2020](#) and references therein on the distributional restrictions of these adjectives).⁹

- (13) a. **Today's** constant consumption of fossil fuels will change the shape of mankind **tomorrow**.
 b. Jean-Paul fell **on Sunday** from the third floor. After much agony and medical attempts to save him, the fall ended up killing him **on Tuesday night**.
 c. The continued snow melt **on Sunday** eventually flooded the valley **on Thursday**.
 (based on an example of M. Rappaport Hovav, p.c.)

The same observation extends to anticausatives modified by PPs introducing causers:

- (14) a. **Tomorrow**, the shape of mankind will change from today's constant **consumption** of fossil fuels.
 b. **On Tuesday night**, Jean-Paul died from **Sunday's** fall.
 c. **On Thursday**, the valley flooded from the continued snow melt **on Sunday**.

[Martin \(2020\)](#) concludes from examples like in (13) that the event denoted by an external argument causer DP *causes* the verbal event rather than being identified with it (i.e., in (12a), the wind *causes* the door-opening event). Data as in (14) point to the same conclusion for anticausatives combining with causer PPs.

⁸ Additionally, they can assume that a cause event optionally contains a become event as one of its parts. When they do, cause events are what we called causation events (sums of a causing event and a resulting change).

⁹ One of [Martin's \(2018\)](#) examples is as follows:

- (i) Ana stabbed Fido **on Saturday**. After much agony, the stabbing eventually killed Fido **on Sunday**.

However, as an anonymous reviewer also observes, the NP *the stabbing* makes this example problematic. We believe it is because such nominals, derived from manner verbs, describe an event necessarily involving an agent. But we are unsure at this point why separate modification is less easy with nominals derived from manner verbs than with nominals derived from result verbs as in our examples in (13a-c), and leave this point for further research.

Martin further argues that in non-agentive causative statements (as in (12)-(13)), the verbal event is simply the change, as in anticausative statements. An argument for this view is that in such statements, the verbal event necessarily starts when the change starts, and not before as in agentive causative statements, as we just observed in the Ali Baba example above. For instance, for (15) to be true, the door must start to open, just as it is the case in the anticausative (16). In (15), the cause of this change is not part of the (ongoing) verbal event; rather, this cause is referred to by the subject *the wind* (we return to this point in Section 4).

(15) The wind is (now) opening the door.

(16) The door is (now) opening.

Martin's (2020) idea that in a non-agentive causative statement like (15), the verbal event is a become-event is, in fact, exactly the proposal of Rapp & von Stechow (1999) discussed above. Rapp & von Stechow (1999), however, assume that this applies to causative predicates in general, whether they are agentivized or not. We are then back to the problem raised by progressive agentivized causative predicates like in the Ali Baba example (9): events in the denotation of such predicates cannot be just become-events.

Obviously, the verbal event is not identified in the same way in agentive and non-agentive statements. What the data reviewed so far shows us, and what we will argue for further below is summarized as follows:

(17) *Inchoative hypothesis*

In a sentence built with a change-of-state verb, the relation between the verbal event and the ensuing state is interpreted as become, except in the presence of an agentive subject. In the latter syntactic context, the relation is interpreted as cause.

Apart from the separate modification facts discussed above, we will present further evidence for the hypothesis in (17) based on two kinds of contrasts: (a) whether the occurrence of a change-of-state is entailed by the transitive progressive sentence, and (b) whether the occurrence of a change is entailed by a transitive change-of-state verb in the complement of *begin/start*. These empirical arguments will be developed in Section 4.

To investigate the semantics of change-of-state verbs, we break with the habit in much literature of only contrasting an alternating verb's anticausative use (cf. (18e)) with its causative use involving an in-control animate agent subject (cf. (18a)). Rather, we take into account a wider range of uses of alternating verbs. We will also discuss inanimate agents (for example *the meteorite* in (cf. (18b)) and non-agentive causatives involving causer subjects (cf. (18c)). Finally, we will discuss transitive anticausative statements (cf. (18d)), which express the same meaning as canonical anticausatives such as (18e), and, thus, must be distinguished from examples like (18a-c).

- (18) a. Geneticists will change the shape of mankind. (agentive causative sentence)
 b. A meteorite will change the shape of mankind. (agentive causative sentence)
 c. Today's consumption of fossil fuels will change the shape of mankind tomorrow. (non-agentive causative sentence)
 d. Mankind will change its shape tomorrow. (transitive anticausative sentence)
 e. The shape of mankind will change tomorrow. (intransitive anticausative sentence)

Our proposal will be that sentences like (18c/d) exhibit a syntax/semantics mismatch: they are syntactically transitive, but the verbal predicate receives the same interpretation as in intransitive anticausative construals such as in (18e). That is, they form *transitive predicates with inchoative semantics*.

To develop this proposal, we turn next to the semantic and pragmatic differences between change-of-state sentences built with an agent and a causer subject.

3 Agent vs. causer subjects

We couch our analysis in the Voice framework originating in Kratzer (1996). Following Alexiadou et al. (2006), Schäfer (2008), Alexiadou et al. (2015), and Schäfer (2024), we differentiate between three different Voice heads: Agent Voice, Causer Voice and Expletive Voice (we focus on active versions of these Voice heads; passivized or non-active versions of these heads are possible, too; cf. Bruening 2013, Alexiadou et al. 2015, Schäfer 2017). We give a semantics for the composition of the vP with these different voice heads in Section 5, after the presentation of the facts supporting this analysis in Section 4. Expletive Voice is addressed in more detail in Section 6, devoted to transitive anticausatives.

Agent Voice (henceforth Voice_{ag}) associates the thematic role ‘agent’ with the DP merged in its specifier. All kinds of agents (exerting agent control on their behaviour or not, acting intentionally or not, animate or inanimate) are introduced by the same Voice_{ag} . We furthermore assume that in order for a DP to be associated with the role of agent, it must denote an individual (as opposed to an eventuality), and therefore be of type e .

Causer subjects are introduced by *Causer Voice* (henceforth Voice_c). We take Causer Voice to introduce an eventuality or a fact and to state that this eventuality/fact causes the verbal event. That is, Voice_c introduces cause-semantics (Martin 2020), and in the specifier of Voice_c , we find either eventuality-denoting DPs, as in (18c), or fact-denoting DPs, as in (19).

(19) The fact that we are over-consuming fossil fuels will change the shape of mankind tomorrow.

Fact-denoting DPs are virtually never addressed in the Voice framework, but are regularly found in the subject position of some change-of-state verbs such as *cause* (Vendler 1967; see also Rose et al. 2021 on subject DPs denoting omissions such as in *The lack of sunscream caused Jane’s skin to burn*), *kill*, or *change* (Martin et al. 2024, see Section 3.1.1). However, treating facts as causer subjects requires some revision of the semantics of Causer Voice (i.e., Voice_c). For Pylkkänen (2008) and Alexiadou et al. (2015), Voice_c has an event-denoting DP in its specifier. This event e is identified for them with the vP-event e' , see (20) (Voice is combined with a vP via Event Identification, as in Kratzer 1996). So for instance for these authors, in *The tornado destroyed the city*, the tornado e ends up being identified with a causing event e' in the denotation of the vP.

(20) $\text{Voice}_c \rightsquigarrow \lambda e \lambda e'. e = e'$ (Alexiadou et al. 2015)

Our first modification then concerns the ontological type of causer subjects. We take eventualities and facts to be of type s , and use the variable i as ranging in the domain of situations, which is the union of the set of eventualities, facts and other states of affairs. As our second modification, and following Martin (2020), we depart from the view proposed in Pylkkänen (2008) and Alexiadou et al. (2015) according to which the eventuality e (or, we add, the fact) introduced in the specifier of Voice_c is identified with the vP-event.

A first problem with the latter view is that if the causer subject is a verbal gerund with a genitive (a POSS-*ing* gerund) and thereby denotes a fact (Vendler 1967, Asher 1993) or another sort of abstract object (Huang 2024), this fact or abstract entity cannot be identified with the verbal event.¹⁰

¹⁰ As Vendler (1967) observed, verbal POSS-*ing* gerunds are not compatible with event-selecting expressions such as *occur*, as shown below:

(21) a. #My neighbor’s not watering my plants started yesterday.

For instance in (22a), the killing *event* cannot be the *fact* denoted by the subject. A fact cannot be identified with an event; e.g., the fact that my neighbor did not water my plants is distinct from the killing-my-plants event (Martin et al. 2024).

- (22) a. My neighbor's not watering my plants killed them.
 b. Josh's plugging the socket in the wrong voltage destroyed the computer.
 (Martin et al. 2024)

A second problem with such a view is that as already mentioned in the introduction, it predicts separate temporal modification for the event denoted by the causer subject and the vP-event not to be possible, which is not the case, as shown in (13a-c) repeated below:¹¹

- (13) a. **Today's** constant consumption of fossil fuels will change the shape of mankind **tomorrow**.
 b. Jean-Paul fell **on Sunday** from the third floor. After much agony and medical attempts to save him, the fall ended up killing him **on Tuesday night**.
 c. The continued snow melt **on Sunday** eventually flooded the valley **on Thursday**.

Instead, we take Voice_c head to introduce an eventuality or fact *i* and state that this eventuality/fact *i* causes the verbal event. When the causally responsible entity is an event, this event can temporally precede the vP-event, which explains why separate modification as in (13) is possible.¹² On this view, Voice_c does not carry *thematic* information, because it does not associate a thematic role to a participant of the vP-event. Rather, it introduces the eventuality or fact that is causally responsible for the vP-event (or what Neeleman & Van de Koot 2012 call the crucial contributing factor).

In line with much of the literature (e.g. Levin & Rappaport Hovav 1995, Reinhart 2000, Davis & Demirdache 2000, Doron 2003, Levin & Rappaport Hovav 2005, Alexiadou et al. 2006, Kallulli 2006b, Folli & Harley 2008, Schäfer 2008, Alexiadou et al. 2015), we assume that external arguments of transitive causative predicates are necessarily either agents or causers.¹³ External arguments cannot be associated with the role Theme (see Kratzer 1996 on Holder Voice with stative transitives). Some nominative instrumental subjects can be subsumed under agents, others under causers (Schlesinger 1989, Alexiadou & Schäfer 2006).¹⁴

In (23a/b), we recapitulate the assumptions made in this section about the external argument of lexical causative change-of-state verbs.

- (23) a. External arguments of lexical causative verbs are either agents or causers.
 b. Agent subjects denote individuals; they participate in the vP-event.
 c. Causer subjects denote eventualities, facts or state-of-affairs; they cause the vP-event.

b. #Josh's plugging the socket in the wrong voltage occurred at noon.

¹¹ We do not look at the possibility to have temporal modification with fact-denoting causers. See Huang (2024) and reference therein about the temporal properties of facts and other abstract entities as they are expressed in verbal gerunds.

¹² However, we do not assume causation to *require* temporal precedence. Therefore, the event denoted by the causer subject and the vP-event can in principle be simultaneous.

¹³ van Valin & LaPolla (1997), Borer (2005) or Ramchand (2008) assume a more abstract role *effector* that includes agents and causers in our typology, and in that respect subscribe to the even more restricted view according to which there is only one type of external argument.

¹⁴ Similarly, DPs denoting natural forces can be agents or causers (just like instruments), depending on whether they denote an individual or an event. DPs such as *the rain* are flexible and can be used as individual- or event-denoting expressions, while others such as *the sun* or *the sea* systematically behave as individual-denoting DPs, as will be shown in the next section.

It follows from (23b/c) that for us, in the context of change-of-state verbs, the distinction between agents and causers maps onto the distinction between individual-denoting DPs (of type *e*), and situation-denoting DPs (of type *s*): in the subject position of a transitive (and eventive) change-of-state verb, an individual-denoting DP is necessarily an agent (whether animate or not), and a fact- or eventuality-denoting DP is necessarily a causer.¹⁵

The distinction between agents and causers is not just a terminological issue; it is key, for instance, to understanding the difference between manner (or *hit-*) verbs and result (or *destroy-*) verbs (Levin & Rappaport Hovav 2005, Alexiadou et al. 2015). Whereas result verbs are compatible with event-denoting (causer) subjects, manner verbs are not. Thus for instance, the manner verb *hit* cannot host an event description in subject position, cf. (24a) vs. (24b): its subject must be of the semantic type *e*.

- (24) a. The stone hit the window.
 b. #The falling of the stone hit the window.

So for us, *the stone* is an agent in (24a), not a causer. We address agentive inanimate subjects in more detail in the next section.

3.1 Inanimate subjects

Previous research has not always been very clear about the exact differences between agent vs. causer subjects. While a number of authors have proposed before us that agentivity does not require animacy and that agents in the grammar can be inanimate (see, e.g., Cruse 1973, Delancey 1985; 1990, Alexiadou & Schäfer 2006, Schäfer 2008, Folli & Harley 2008, Fauconnier 2012, Lowder & Gordon 2015, Alexiadou et al. 2015), inanimate subjects are often classified as causer subjects, unless they are clearly instruments. This, in turn, suggests that in practice the distinction between agents and causers maps onto the distinction between animate and inanimate subjects.

As just mentioned in the previous section, for us, a key difference between agent and causer subjects is in the *semantic type*. Inanimate external argument DPs are either agent or causer subjects depending on whether they denote an individual or an eventuality/fact. In contrast, animate external argument DPs are associated with the role of agent in the context of a concrete verb: there is no clear evidence that animate external arguments can be reinterpreted as event- or fact-descriptions in the context of *concrete* causative verbs (Section 3.2).

In (25)-(27), we give examples of subjects of eventive predicates that are classified as causer subjects in Kallulli (2007), Folli & Harley (2008) and Alexiadou et al. (2015) respectively.

- (25) Folli & Harley (2008)
- a. The branch (broke the window).
 - b. The gust of wind (broke the window).
 - c. The sea (ate the beach away).
 - d. The storm (broke the window).

- (26) Kallulli (2007)
- a. The earthquake (broke the window).
 - b. The pressure (cracked the window).

¹⁵ An anonymous reviewer asks why we do not dispense with the notions of agents and causers altogether given our assumptions (23b/c). The reason why we do not do so is that we need a different semantics for the two Voice heads (in particular, only Causer Voice encodes cause). Furthermore, we need the role of agent to distinguish agentive from non-agentive individual-denoting DPs.

(27) Alexiadou et al. (2015)

- a. The lightning (*cut the clothesline).
- b. The rocks/the storm (broke the window).
- c. The wind/the hurricane (broke the vase).
- d. A stone (broke the window).
- e. The smoking of cigarettes (worsened the air quality in the room).
- f. The sea air (rusted the fence).
- g. The fire (destroyed the package).
- h. The storm (destroyed the painting).
- i. The sun (dried my hair).

Many subject DPs in these examples are, or at least can be, event-denoting. Event-denoting DPs are compatible with Vendler's (1967) event-selecting expressions such as *occur*, *take place*, *begin*, *end*, *take up (time)*, etc., see (28).

(28) The earthquake/fire/storm took place/began/ended at twelve o'clock.

Some subject nouns in the above examples, such as *pressure*, are not very compatible with these expressions (see (29)), but are perfectly acceptable with Vendler's (1967) proposition/fact-selecting expressions such as predicates like *be informed of* or *deny*, see (30). For Zucchi (1998: 176, 202, 204 a.o), these predicates select for propositional entities.

(29) ?The high pressure took place/occurred at 12 o'clock.

(30) I am informed of the high pressure.

Following Martin et al. (2024), we take subject DPs of causative verbs containing a noun of the latter type to function in some cases as concealed fact descriptions; for instance, we take (31a) to have the same meaning as (31b) in one of its readings.¹⁶ We take such subjects in their fact-denoting use to be introduced by Causer Voice, just as subjects DPs which are overtly fact-denoting, such as *The fact that ...* in (19) above.

- (31) a. The high pressure changed the material.
 b. That the pressure was high changed the material.

A third type of DPs listed in (25)-(27), namely, those formed with *branch*, *sea*, *sun*, *rock*, *sea*, *air* and *stone* are incompatible with both event-selecting expressions (and this even with modifiers such as *moving* or *flying*), see (32), and fact-selecting expressions, see (33).¹⁷

- (32) a. #The (flying) stone took place at 12 o'clock.
 b. #The (falling) branch started at 12 o'clock.
 c. #The branch/sea/sun/rock/sea air/stone ended at 12 o'clock.

¹⁶ While we believe that these subject DPs can work as concealed fact descriptions in the context of change-of-state verbs, we do not think that such DPs are fact-denoting in all contexts; for instance, *I felt the high pressure* certainly is not paraphrasable by *I felt the fact that the pressure was high* (we thank an anonymous reviewer for pushing us to make this point clearer).

¹⁷ There seems to be a difference between *inform of* and *inform about*: both select for propositional entities, but while *inform of* is not able to coerce an individual-denoting DP (like *the branch*) into a fact-denoting one, *inform about* seems to be able to do so. For instance, *I'm informed about the branch* can easily convey the idea that I'm informed about a fact involving the branch.

- (33) a. ?#We informed him of the branch.
b. ?#We informed them of the sun.

Since these inanimate DPs cannot be causer subjects (they are neither event- nor fact-denoting), they must be agent subjects, on the assumption that the subject of causative verbs is either a causer or an agent.¹⁸

3.2 Animate subjects

We now turn to animate subjects of causative verbs. We show that in the context of causative verbs taken in their concrete sense, animate subjects tend to stick with their literal individual-denoting interpretation (of type *e*), which for us means that they are interpreted as agents.

Van Valin & Wilkins (1996: 301) defend the ‘metonymic clipping hypothesis’ according to which in a causative statement, an agentive animate DP “stands in for the whole causing-event sequence”.¹⁹ According to this idea, in a statement such as *Nina broke the vase*, the human subject DP is underlyingly a description of the causing event. In the same vein, Kallulli (2006a; b) argues that agent DPs are similar to event-denoting causer subjects such as *the wind*, although for her, this is only the case when the referent acts inadvertently.

However, at least in the context of concrete causative verbs, we do not see any positive evidence for the hypothesis that animate DPs can be eventuality- or fact-denoting. Rather, we see only evidence against it. First, animate DPs are not felicitous with Vendler’s event-selecting expressions, even when they serve as the subject of a change-of-state verb:

- (34) a. #The woman who broke the vase happened in the kitchen.
b. #The cat who ruined the painting occurred at midnight.

Second, animate DPs are not very felicitous either as complements of Vendler’s (1967) fact/proposition-selecting expressions (see (35)):

- (35) a. ??We informed Jean-Paul of the woman who broke the vase.
b. ??We denied the cat who ruined the painting.

Third, it has been argued that a *from*-PP requires an event description in its complement (Kallulli 2006a; b, Alexiadou & Schäfer 2006, Copley & Harley 2015), see (36a). We observe that *from*-PP can also host fact-denoting expressions, see (36b). Animate DPs are not acceptable in causal *from*-adjuncts (36c), suggesting that they cannot be easily reinterpreted as event descriptions in the context of concrete change-of-state verbs.

- (36) a. The window broke from the explosion.
b. The world changed from the fact that the nuclear option arose.
c. #The window broke from Johannes.

We therefore conclude that animate DPs neither form causer DPs nor causer PPs in the context of change-of-state verbs, at least when taken in their concrete sense.

It is not the case, however, that animate DPs can never be reinterpreted as concealed event descriptions. But it seems that very specific contexts are needed to trigger the reinterpretation

¹⁸ Obviously inanimates never do things with agent control, but they can be ‘doers’, that is, ‘do’ something in the broad sense of the term (Cruse 1973). This is enough to qualify as agents (see the discussion in Cruse 1973, DeLancey 1991, and see Joo et al. 2024 and Martin 2022 for a formal definition of the agent role which covers both inanimate and animate agents).

¹⁹ We thank Malka Rappaport-Hovav (p.c.) for this reference.

process. For instance, in so-called pancake sentences like (37) (Wechsler 2013), the agreement mismatch between the subject DP and the vP triggers a reinterpretation process: a subject, which in its literal reading denotes an individual, is reinterpreted as a description of an event or event type involving this individual (Greenberg 2008, Martin et al. 2020; see also Sant 2024 for a critical discussion in a cross-linguistic perspective):

- (37) a. Pancakes is good.
 ≈ Baking, buying, eating, ... pancakes is good.
 b. Angelika and Hamida is the way.
 ≈ Inviting, calling, ...Angelika and Hamida is the way.

Furthermore, previous work has argued that the human subject of a subset of causative verbs, namely causative *psych*-verbs (such as *surprise*, *worry*) can also stand for a covert event or fact description. For instance, Bott & Solstad (2014: section 3.2.1) provide arguments in favour of the view that in the non-agentive reading of examples such as (38), the proper name is "merely a placeholder, as it were, for something which is semantically more complex".²⁰

- (38) Peter annoyed Charlotte.

As an additional argument for the view that when used as the subject of psych-verbs, animate DPs are often reinterpreted as fact or event descriptions, we note that for many causative psych-verbs, the literal referent of an animate DP does not need to exist at the time of the vP-event; i.e., these verbs are not existence-entailing with respect to their subject, just as some subject-experiencer psych-verbs (e.g., *admire*) do not entail the existence of their object (see d'Ambrosio & Stoljar 2023). For instance, example (39) below can be truthfully asserted, while the literal referent of the subject cannot plausibly exist at the reference time. This indicates that the human DP stands for something more abstract (e.g., the description of something my great great great grand-mother did or a fact involving her). In our typology, the animate DP in (39) is therefore a causer, not an agent. (If my ancestor was an agent, her action should be part of the verbal event, which would then have to occur within the reference time – recall facts about temporal modification in Section 2.)

- (39) My great great great grand-mother surprised me again this morning.

In contrast, concrete (non-psychological) causative verbs are existence-entailing with regard to their animate subject:

- (40) #My great great great grand-mother broke a window again this morning.

Concluding this section, we have seen that while inanimate subjects of causative predicates can be agents or causers, animate subjects tend to always be associated with the agent role, except in restricted contexts such as the subject position of causative psych-verbs.

4 How subjects affect the meaning of the verbal predicate

The next subsections gather data in favor of the view that the causative predicate is interpreted as denoting causing events when it is agentivized, and as denoting inchoative (become)-events otherwise. In the latter case, the inchoative event described by the verb is understood as caused by the event or fact denoted by the causer subject. Examples (41) illustrate the two cases; in the

²⁰ See also Bouchard (1995) on the idea that "the subject of [experiencer object] verbs [...] is typically not interpreted as a Substantive, but as a Concept." (p. 359)

paraphrase, the description of the event contributed by the verbal predicate is put in italics, and the contribution of the Voice head is underlined.²¹

- (41) a. John killed my plants.
 ≈ John is the agent of an *event causing the death of my plants*.
 b. The hurricane/the lack of water killed my plants.
 ≈ The hurricane/the lack of water caused *the dying of my plants*.

The causal relation in the paraphrases of (41a) and (41b) is not exactly the same: while in (41a), it is a relation between an event and a state, in (41b), it relates a situation (an event or a fact) and an event. We use the operator *cause* for the latter, and we introduce *cause*⁺ for the former. In the next subsection, we present data in favor of the idea that the “causing⁺ event” denoted by an agentivized causative predicate consist of the full causation event (a sum of a causing event and some ensuing change), rather than the causing event only (the action), or the ensuing change only.

4.1 Interpretation of lexical causative verbs with an agentive subject

A first piece of evidence in favor of the view that when they are agentivized, causative predicates denote causing⁺ events is that separate modification is not possible for the action and for the ensuing change, see (5b) repeated below under (42).

- (42) #Charlotte pushed Jean-Paul out of the window **on Sunday** and he fell from the third floor.
 She ended up killing him **on Tuesday night**.

If, as in the metonymic clipping hypothesis of van Valin & Wilkins (1996), the agent subject of a causative predicate stood for the causing event (the action), it should be possible for the modifier that has the *verbal predicate* in its scope to temporally anchor the change only. Example (42) should turn out as felicitous as (43) below, given that lexical causative statements can convey causations with temporal gaps between the action and the change (as shown in (6)).

- (43) By pushing Jean-Paul out of the window **on Sunday**, Charlotte caused him to die **on Tuesday**.

A second piece of evidence in favor of the view that events in the extension of agentivized causative predicates are causing⁺ events concerns progressive sentences. As already mentioned in Section 1, events described by agentivized causative predicates in the progressive can start before the targeted change has started. Truswell (2011: 101) has already observed that (44b) is judged to be true in the context of (44a), even though the food has not yet been affected at all.

- (44) a. It had been a disastrous picnic, one which was really best forgotten. Tom clearly agreed, as he had picked up a nearby can of petrol and a box of matches, and was now approaching the leftovers with a look of steely intent on this face. Dick frowned. ‘What’s wrong?’, asked Harry.
 b. ‘Tom’s destroying what’s left of the food’, said Dick. (Truswell 2011: 101)

Example (45) below illustrates the same point: in the context of an agent subject, the verbal event is a causing⁺ event that can, in principle, occur before the targeted change begins.²²

²¹ We only address the case of in-control agents and leave the subcases of inanimate agents and inadvertent agents for future research.

²² An anonymous reviewer finds examples (44) and (45) infelicitous, and claims that the verb *try* has to be added for such examples to be felicitous in the relevant context. While we have to leave an experimental assessment of this inter-speaker

- (45) I'm waking up Ana – I've shaken her twice! but she's dead to the world – she hasn't even begun to flutter her eyes yet. (Harley & Folli 2023, adapted from Martin 2015)

An additional piece of evidence comes from aspectual verbs like *start* and *begin* embedding an agentivized causative verb (Martin 2015; 2020). Such structures may felicitously describe a situation where the action has begun while the intended change has not yet begun. For instance, the *start*-statements in (46) entail that an agentive breaking by the workers has started, because the onset of the action is also the onset of the causing⁺ event. But in an appropriate context, this action, which is performed with the aim of triggering a specific change in the theme, may begin even though the change itself has not yet been initiated, which explains why (46a/b) are not contradictory.

- (46) a. The workers started to break down the wall (but the wall only started to break down after some time, because it was very hard).
 b. Nina started to open the bottle of wine, but the cork broke inside the bottleneck before it started moving out, and the bottle sadly had to remain closed.

We thus conclude that in the context of an agent, the verbal event is a causing⁺ event, and this causing⁺ event can start before the intended change begins.

We still need to clarify whether the causing⁺ event described by an agentivized causative verb consists solely of an action, or the sum of an action and the change undergone by the theme. If it consisted solely of an action, it should be possible to temporally locate the change-of-state at a different time than the verbal event, as in example (47b). (Note that (47b) crucially differs from our previous example repeated in (47a), through which the speaker attempts to anchor the action and the verbal event at different times.)

- (47) a. #Charlotte pushed Jean-Paul out of the window **on Sunday** and he fell from the third floor. She ended up killing him **on Tuesday night**.
 b. #Charlotte killed Jean-Paul **on Sunday** by pushing him out of the window. He eventually died **on Tuesday night**.

But example (47b) is not felicitous, which already indicates that the change is understood as a part of the verbal event expressed by an agentivized causative verb.

Another way to probe whether the change is necessarily part of the verbal, causing⁺ event concerns *in*-adverbials. Time span *in*-adverbials measure the time span between the onset and the telos of events in the extension of the predicate they apply to. If the verbal event consists solely of the action, the telos of the verbal event is the endpoint of the action. If the verbal event is a full causation event, its telos corresponds with the onset of the result state.

Suppose now that in order to open the door to the cave, Ali Baba has to recite a magic formula for one minute, and that at the end of this minute, the door needs another minute to open. The question is whether (48a) or (48b) is true in this situation.

variation for future research, we would like to note that the fact that some speakers do not fully accept examples like (44) and (45) does not contradict our main point that such 'zero-change' readings are much worse when the subject is not an in-control agent (on the latter, see the next subsection). These speakers are simply more restrictive in that they conceive the action and the change as temporally overlapping because it is the most typical situation. Secondly, we note that the *try*-variant of examples such as (45) (*I'm trying to wake up Ana*) does not fulfill the same communicative intention as the statements without *try*, since the use of *try to P* by default triggers the inference that the attempt is not successful (Karttunen 1971). The speaker who aims to convey their optimism about the ultimate outcome of their attempt might therefore have good reasons to avoid the use of *try*, while still using the sort of discursive continuations we have in (45) to admit with honesty that the attempt has not been successful *yet*.

- (48) a. Ali Baba opened the door in one minute.
 b. Ali Baba opened the door in two minutes.

While the intuition is perhaps a bit shaky, the right answer seems to be (48b) rather than (48a), further confirming that the verbal event is the sum of the action and the ensuing change.

From this discussion, we conclude that the causing⁺ event described by the agentivized causative predicate contains both the action and the change of state as parts.

4.2 Interpretation of lexical causative verbs with a causer subject

We now turn to cases where causative verbs are combined with causer subjects. We argue that with a causer subject, the verbal event is an inchoative (become) event.

A first piece of evidence concerns the possibility to temporally locate the event denoted by the causer subject and the verbal event at non-overlapping intervals, see (13b), repeated below in (49).

- (49) Jean-Paul fell **on Sunday** from the third floor. After much agony and medical attempts to save him, the fall ended up killing him **on Tuesday night**.

(49) is felicitous because *kill Jean-Paul* describes just the change-of-state endured by Jean-Paul. If, by contrast, we assumed that the verbal predicate described the full causation event (the fall and the ensuing death), we would expect the sentence to be contradictory.

The second piece of evidence concerns progressive sentences. Example (50) illustrates the point: the discursive continuation denying the occurrence of a change is contradictory. This is because in the context of causer subjects, the events in the denotation of the verbal predicate are mere changes-of-state, and PROG returns some part of one of these events.²³ As we saw in (44) and (45), causative predicates combined with an agent subject behave differently in this respect.

- (50) The noise of the dishwasher is waking up Ana, #but she's dead to the world– she hasn't even begun to flutter her eyes yet. (Harley & Folli 2023, adapted from Martin 2015)

Start-statements in (51)-(52) illustrate the same contrast between agents and causers:

- (51) a. A. The workmen have started to crack the wall.
 B. Why do you say that? The infrared and inspection cameras show that the wall is completely intact!
 A. Because they're hammering on it, with the intention of cracking it.
 b. A. The heat has started to crack the wall.
 B. Why do you say that? The infrared and inspection cameras show that the wall is

²³ An anonymous reviewer argues on the basis of examples in (i) below that the verbal event can be conceived as starting before the change has begun even with anticausative statements. Their argument concerns the following progressive anticausative examples in the context given in parenthesis:

- (i) a. Be patient, the door is opening. (said where no visible change is happening, but the speaker knows some hidden mechanism has been set in motion)
 b. Be patient, it's growing. (no growth is visible yet, even microscopically)
 c. Be patient, it's heating up. (no perceptible change in temperature has happened yet)
 d. Be patient, the cells are dividing. (no actual division yet)

According to our intuition, these examples are also acceptable in progressive sentences in French (standard German has no progressive). While these examples deserve careful investigation, our immediate reaction to them is that these sentences *do* require the change to be initiated, although this change is not observable. In favor of this idea, we note that a continuation denying the occurrence of any change (e.g., with *but nothing at all has happened yet*) is not felicitous.

completely intact!
 A: #Because the heat is increasing. [not a sufficient warrant for the assertion]

- (52) a. A: Jean-Paul has started to open the door.
 B: Why do you say that?
 A: Because he's pulling on the door, with the intention of opening it.
- b. A: The wind has started to open the door.
 B: Why do you say that?
 A: #Because it's pulling on the door, with the intention of opening it.
 [plainly incoherent]
- A: #Because it's applying pressure on the door.
 [not a sufficient warrant for the assertion]

We therefore conclude that the event described by the verbal predicate is a mere change in the context of causer subjects.

In this section, we have gathered data supporting the view that the event described by a causative verb is identified as a become-event in the presence of a causer subject, just like in the anticausative construal of change-of-state verbs, while in the presence of an agentive subject, it is identified as a full causation event.

In the next section, we present an analysis that accounts for this data in the semantics.

5 A new semantics for Voice

The proposal developed below takes at face value the fact that at the level of the verb and the vP, the relation between the event and the state awaits further specification. Neither the verb nor the vP tells us whether the events in their denotation are causing⁺ or inchoative events, and this needs to be specified in order to obtain a full event description. To account for this 'incompleteness' of change-of-state verbs/vPs, we introduce a relation *R* as their argument (and thereby also of the change-of-state vP). As we adopt a Distributed Morphology approach (Halle & Marantz 1993), we take this argument to be inherited from the verbalizing head *v* responsible for forming change-of-state verbs and vPs. Since this argument will only be introduced for change-of-state verbs/vPs, and since we will need Voice heads to 'see' whether the vP is of this type, we introduce a way of syntactically marking change-of-state vPs. The easiest way to do this is to introduce a syntactic feature [\pm COS], where change-of-state verbs and vPs are [+COS], and non-change-of-state verbs and vPs are [−COS], so that we would have (e.g.) the following for *open the door*:

- (53) [_{vP}[+COS] open the door]

More generally, a verb or vP would be marked as [+COS] if it results from the combination of the verbal head *v* with a stative predicate (provided by a root or an adjective as in *hammer flat*), and it is marked as [−COS] otherwise.²⁴

²⁴ One might reply that the syntactic feature [\pm COS] is unnecessary or redundant because we already treat change-of-state verbs semantically as denoting relations between events and states, and we treat non-change-of-state verbs as *not* denoting relations between events and states, in which case why not simply make an appeal to this semantic difference?

There are two considerations here. The main one is that at the level of vP, we simply have an event predicate and no longer have a relation between events and states, as seen in (53) for *open the door*, and many non-change-of-state verbs are also represented as event predicates at the level of vP. This means that at the level of vP, we cannot easily distinguish change-of-state vPs from non-change-of-state vPs in terms of semantic type (i.e., in terms of relations between events and states versus event predicates). The second (lesser) consideration is that strictly speaking, the syntactic component does not see semantic types as such: semantic types are not part of the vocabulary of the syntactic component, and so if we want to refer to semantic types in the syntax, we need to do this in a way that is syntactically valid.

Taking *open the door* as an example, we implement this suggestion that the corresponding vP bears the feature [+COS], and we attribute to it the following semantic representation with an additional relational argument R :

$$(54) \quad [\text{vP}_{[+\text{COS}]} \text{ open the door}] \rightsquigarrow \lambda R \lambda e. \exists s (R(e, s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))$$

More generally, this proposal assumes that change-of-state verbs and vPs come with a relational argument R between events and states that needs to be applied to a particular relation between events and states.

The semantics given in (54) is the result of composing the verbalizing head v to the state predicate *open* in (55a). We assume that next to its verbalizing role, v also comes with an additional argument R , as shown in (55c). A vP composed with the verbalizing head v gets the feature [+COS].

$$(55) \quad \begin{array}{l} \text{a. } [\checkmark \text{ open}] \rightsquigarrow \lambda x \lambda s. \text{open}(s) \wedge \text{theme}(s, x) \\ \text{b. } [\checkmark_{\text{VP}} \text{ open the door}] \rightsquigarrow \lambda s. \text{open}(s) \wedge \text{theme}(s, \text{the-door}) \\ \text{c. } v \rightsquigarrow \lambda P \lambda R \lambda e. \exists s (R(e, s) \wedge P(s)) \end{array}$$

Our second suggestion is that we have a rule that translates the combination of the head Agent Voice with a vP that is [+COS] as follows:

$$(56) \quad [\text{Voice}' \text{ Voice}_{\text{ag}} [\text{vP}_{[+\text{COS}]} \alpha]] \rightsquigarrow \lambda x \lambda e. \text{agent}(e, x) \wedge \alpha'(e, \lambda s' \lambda e'. \text{cause}^+(e', s'))$$

(Where α' , a relation between relations between events and states, on the one hand, and events, on the other, is the semantic representation of α , the vP)

The rule in (56) says that the combination of the head Agent Voice with a vP that is [+COS] is translated as a relation between events e and individuals x such that x is the agent of e and the relation α' is a relation between e and the relation cause^+ , where α' is the semantic representation of α , the vP, and cause^+ is a relation between events and states.

In the case where the vP is *open the door* (see (54)), the result of applying the rule in (56) is shown in (57).

$$(57) \quad \begin{array}{l} \text{If } \alpha' = [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))] \text{ (see (54)), we obtain the following as an application of the rule in (56):} \\ \lambda x \lambda e. \text{agent}(e, x) \wedge \\ [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))](e, \lambda s' \lambda e'. \text{cause}^+(e', s')) \\ = \text{(by two applications)} \\ \lambda x \lambda e. \text{agent}(e, x) \wedge \exists s (\text{cause}^+(e, s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door})) \end{array}$$

Next, we adopt a rule that translates the combination of the head Causer Voice with a vP that is [+COS] as follows:

$$(58) \quad [\text{Voice}' \text{ Voice}_{\text{c}} [\text{vP}_{[+\text{COS}]} \alpha]] \rightsquigarrow \lambda i \lambda e. \text{cause}(i, e) \wedge \alpha'(e, \lambda s' \lambda e'. \text{become}(e', s'))$$

(Where α' , a relation between relations between events and states, on the one hand, and events, on the other, is the semantic representation of α , the vP)

The rule in (58) says that the combination of the head Causer Voice with a vP that is [+COS] is translated as a relation between events e and situations i such that i causes e and the relation α' is a relation between e and the relation *become*, where α' is the semantic representation of α , the vP, and *become* is a relation between events and states.

In the case where the vP is *open the door* (see (54)), the result of applying the rule in (58) is shown in (59).

(59) If $\alpha' = [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))]$ (see (54)), we obtain the following as an application of the rule in (58):

$$\begin{aligned} & \lambda i \lambda e. \text{cause}(i, e) \wedge \\ & [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))](e, \lambda s' \lambda e'. \text{become}(e', s')) \\ & = \text{(by two applications)} \\ & \lambda i \lambda e. \text{cause}(i, e) \wedge \exists s (\text{become}(e, s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door})) \end{aligned}$$

The rules in (56) and (58) need to be paired with a rule that says that in the absence of a Voice head introducing an external argument variable (an agent or a causer), the relational argument R is also applied to the relation *become*, as shown in (60).

$$(60) \left\{ \begin{array}{l} [\text{Voice}' \text{ Voice}_{\text{EXPL}} [\text{vP}^{+[\text{COS}]} \alpha]] \\ [\text{h}' \text{ h} \neq \text{Voice}/\text{v} [\text{vP}^{+[\text{COS}]} \alpha]] \end{array} \right\} \rightsquigarrow \lambda e. \alpha'(e, \lambda s' \lambda e'. \text{become}(e', s'))$$

(Where α' , a relation between relations between events and states, on the one hand, and events, on the other, is the semantic representation of α , the vP)

Syntactically, the application of this rule is triggered if a semantically empty (expletive) Voice head is merged on top of the vP (thereby ensuring that no further argument DP can be added to the vP). This is covered by the first line of (60). The same rule applies if a non-verbal head (i.e., a head like Aspect, Tense, an adjectivizer or a nominalizer) is merged with a vP lacking any Voice head. This, once again, ensures that no further argument DP could be added to the vP. This second case is covered by the second line of (60).²⁵ That is, this rule applies in all cases not covered by the rules treating the composition of vP with Agent Voice or Causer Voice. It applies (for instance) in the formation of anticausative predicates; these are sometimes analyzed as involving an Expletive Voice projection introducing non-active/anticausative morphology but no external argument variable, or as involving no Voice projection at all (see e.g. Schäfer 2008; Alexiadou et al. 2015, Wood & Marantz 2017; Expletive Voice will be taken up in Section 6).

In the case where the vP is *open the door* (see (54)), the result of applying the rule in (60) is given in (61).

(61) If $\alpha' = [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))]$ (see (54)), we obtain the following as an application of the rule in (60):

$$\begin{aligned} & \lambda e. [\lambda R \lambda e''. \exists s (R(e'', s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door}))](e, \lambda s' \lambda e'. \text{become}(e', s')) \\ & = \text{(by two applications)} \\ & \lambda e. \exists s (\text{become}(e, s) \wedge \text{open}(s) \wedge \text{theme}(s, \text{the-door})) \end{aligned}$$

These rules treating the combination of change-of-state verbs with Voice heads are paired with an additional rule that treats the combination of Agent Voice with a vP that is $[-\text{COS}]$ as *not* including the relation *cause*⁺, as seen in (62).

$$(62) [\text{Voice}' \text{ Voice}_{\text{ag}} [\text{vP}^{-[\text{COS}]} \alpha]] \rightsquigarrow \lambda x \lambda e. \text{agent}(e, x) \wedge \alpha'(e)$$

(Where α' , an event predicate, is the semantic representation of α , the vP)

In this much simpler case, α (= vP) is represented by a one-place event predicate (= α'), and so there is no relational argument R from the vP to deal with.

Additional rules for Causer Voice or Expletive Voice are not necessary, since Causer Voice and Expletive Voice combine with change-of-state vPs only (Schäfer 2008, Alexiadou et al. 2015, Schäfer 2024).

²⁵ The second line also ensures that the rule is not triggered if an applicative v-head is merged with the vP. The reason is that a Voice head could be added above the applicative head and trigger the rules in (56) or (58).

We do not have the space to clarify in detail how modification is implemented in this approach. A crucial point, though, is that our proposal has the characteristic that the relations cause^+ or become get specified only above vP. This means that inside of vP, we do not have a full event description yet (the relation between the verbal event e and the state s is still unspecified and therefore not assessable yet). As a result, we do not expect an ambiguity to arise depending on whether the modifier applies to the event argument within or above vP: the modifier needs to apply to the event argument above vP for the result to be interpretable.

The final point to settle concerns the behavior of the relation cause^+ . The principle in (63) says that for any event e , state s , property of state P and individual y such that e causes⁺ s , P holds of s , and y is the theme of s , there is an event e' and an event e'' such that e is the mereological sum of e' and e'' , become holds between e'' and s , and there is an individual x such that x is the agent of e' (see Piñón 2000 for an early application of mereological sums to the semantics of change-of-state verbs).

$$(63) \quad \forall e \forall s \forall P \forall y (\text{cause}^+(e, s) \wedge P(s) \wedge \text{theme}(s, y) \rightarrow \\ \exists e' \exists e'' \exists x (\text{agent}(e', x) \wedge \text{become}(e'', s) \wedge e = e' \oplus e''))$$

This ensures that the causing event denoted by agentivized predicate is the sum of an action performed by the agent and the ensuing change-of-state of the theme (see Section 4.1), and also that an agentivized causative predicate entails the corresponding anticausative predicate (Parsons 1990).

A further rule is not necessary to ensure that the non-agentive causative (with a causer subject) entails the anticausative, since the relation between e and s resolves as become in this case (recall (58)).

We now turn to a last type of transitive construal for change-of-state verbs with inchoative semantics, namely transitive anticausatives (*The gas changed its temperature*), and provide the first compositional semantic analysis for this type of statements, thereby updating Schäfer (2024). Whereas transitive *causative* statements report a whole causation event (denoted either entirely or only partially by the verbal predicate, depending on whether the external argument is an agent or a causer), transitive *anticausative* statements describe just a change, like intransitive anticausative statements.

6 Transitive anticausative vPs

6.1 Properties of transitive anticausatives

Recall the three-way contrast between the non-agentive uses of *change* illustrated again with the examples below:

- (64) a. The chemical process changed the gas's temperature. (non-agentive causative sentence)
 b. The gas's temperature changed. (intransitive anticausative sentence)
 c. The gas_i changed its_i temperature. (transitive anticausative sentence)

The pair in (64a) and (64b) exemplifies the canonical causative alternation between a transitive, lexical causative verb and the corresponding intransitive, anticausative verb. Example (64a) asymmetrically entails example (64b). As shown in detail in Schäfer (2024), the alternation between (64b) and (64c) is different from the causative alternation. Despite the fact that (64c) is syntactically a transitive structure, with a nominative external argument DP inducing verbal agreement and an internal accusative DP, it expresses a simple inchoative event undergone by the internal argument DP, i.e., it is understood as the description of a mere change. This must be concluded

from the fact that pairs like (64b) and (64c) are truth-conditionally equivalent (such pairs differ in their informational structuring only because their nominative DPs are different). Thus, transitive anticausatives illustrate a further type of a transitive use of a verb of change where the verbal event is just a become-event. Natural occurrences of transitive anticausatives taken from the internet are given below.

- (65) a. If *water changed its temperature* easily, we would constantly be too hot or too cold.
 b. Since *it generally increases its frequency* with age, glaucoma needs to be screened.
 c. Only in the past one month *the lake has expanded its surface area* by more than 200 square kilometers.
 d. During the observation period *the glacier reduced its mass* by 17.95 m water equivalents.

Transitive anticausatives also welcome event-denoting subjects, as illustrated by (66), also found on the internet (transitive anticausatives with human subjects are also possible in principle, although the agent bias makes this reading less accessible). The event-denoting subjects in (66) are *not* causer subjects; as detailed below, the subject of transitive anticausatives is neither an agent nor a causer.

- (66) a. The storm changed its direction.
 b. The game increased its speed.
 c. The explosion changed its shape.
 d. The earthquake increased its speed.

The central aspect of the alternation in (64b/c) is that it involves a possessive structure. The sole argument DP of the anticausative verb in (64b) is a possessee modified by a prenominal genitive possessor DP. In (64c), (as in (65a-d) and (66a-d)), this possessive relation is dissociated in that the possessor DP appears as the nominative subject and the possessee DP appears as the accusative object. Furthermore, the latter is modified by a possessive pronoun which is obligatorily bound by the nominative subject in order to obtain the transitive anticausative construal.

Across languages, only a small set of verbs undergoing the causative alternation allow the alternation illustrated in (64b/c). The majority of verbs undergoing the causative alternation do not enter the transitive anticausative construal even if the subject binds a possessive pronoun inside the object. This is exemplified below in (67)-(69). In each pair, the a-sentence provides a canonical anticausative structure where the verb's internal argument is modified with a prenominal genitive. If this prenominal genitive is turned into a subject binding the possessive pronoun of the verb's internal argument as in the b-examples, the result is conceptually deviant in a default context. Such sentences are fine only if the subject's referent is a (reduced) agent or effector of the event.²⁶

- (67) a. The roof of the house burnt. (intransitive anticausative sentence)
 b. #The house burnt its roof. (agentive causative sentence only)

²⁶ Claire Augusta Bergey, Bridget Copley and Julian Grove (p.c.) note that example (69b) is better than the other examples (67b/68b). What we understand from their feedback is that it is easier to assume that the cake can do something which affects the glaze (because the cake was very hot when the glaze was put on it, for instance) than to assume that a house does something which affects its roof. Claire Augusta Bergey furthermore notes that example (68b) would require to be acceptable that the gate can open itself automatically, which also aligns with our idea that such examples are acceptable as long as the inanimate has agentive properties.

An anonymous reviewer finds examples like (67b-69b) completely fine in a context where the inanimate has no (real or fictional) agentive properties. We cannot account for this intuition, and we do not understand the source of this inter-speaker variation. We ran a quick survey on social media to back up Schäfer's (2024) empirical claim reported here, and almost all participants (32 out of 33) found examples (67b)-(69b) bad in their native language. We leave this point for further research.

- (68) a. The left wing of the gate opened. (intransitive anticausative sentence)
 b. #The gate opened its left wing. (agentive causative sentence only)
- (69) a. The glaze of the cake burnt. (intransitive anticausative sentence)
 b. #The cake burnt its glaze. (agentive causative sentence only)

The above b-examples are deviant because their verbs, although undergoing the causative alternation, do not allow the construal as a transitive anticausative. Instead, the grammar enforces that their nominative subjects receive an external argument Theta-role (for us, the role of agent, as these DPs cannot be used as event or fact descriptions, and therefore cannot be causers). These sentences are canonical causative statements, entailing that the DP_{nom} did something that affected the object DP_{acc} along the property encoded by the verb. Since such a construal, in a default context, violates our world knowledge, these sentences are conceptually weird.

The list in (70) from Schäfer (2024) provides further verbs which, like the verb *change* in (64c), allow this construal (pending the right choice of theme DP):

- (70) accelerate, alter, change, decrease, diminish, double, drop, enlarge, expand, halve, increase, modify, multiply, narrow, r(a)ise, reduce, stabilize, slow down, widen

The verbs in this list are all change-of-state verbs undergoing the causative alternation. However, while these verbs denote measure-of-change functions, they (can) leave the property or scale along which they measure change underspecified (or unspecified; cf. Schäfer 2024 for details). Instead, their internal argument DP, a functional noun (Löbner 1981; 2020),²⁷ specifies the actual property or scale of change, and the possessor of the internal argument DP denotes the entity that changes along this scale. Consequently, the nature of the change expressed by these verbs varies with the particular functional noun they combine with. In the vP *increase the temperature of the soup*, change is measured along the *temperature*-scale, but many other scales are possible with this verb (thickness, price, flavor, etc). By contrast, like the majority of verbs undergoing the causative alternation, a verb like *warm* lexically specifies that temperature is the scale along which this verb measures change. We call verbs in (70) like *change* or *increase* ‘underspecified-scale verbs of change’.

Schäfer (2024) substantiates the view that in transitive anticausatives, the verb only takes the internal argument DP_{ACC} as its *semantic* argument. The external argument DP_{NOM} is not assigned any Theta-role by the verb. It is just interpreted as the possessor of the internal argument DP_{ACC}, as the former binds the possessive pronoun inside the latter. Thereby, the external argument is interpreted as the entity that undergoes a change along the scale denoted by the internal argument. Consequently, transitive anticausatives express the same truth-conditional meaning as the sentences headed by their corresponding canonical anticausative; transitive and intransitive anticausatives symmetrically entail each other.

We provide here two tests to show that transitive anticausatives, despite their syntactic transitivity, are not interpreted like lexical causative verbs but like anticausative verbs, using English examples (see Schäfer 2024 for additional tests and examples from further languages). The first test relies on paraphrases using a causative verb such as *cause* or a light agentive verb like *do*. Causative statements built with a lexical causative can be paraphrased with such a verb and the inchoative variant of the lexical causative without change of truth-conditional meaning; for instance, (71b) roughly expresses the same truth-conditional meaning as (71a), and (72b) roughly expresses the same truth-conditional meaning as (72a).

²⁷ Such nouns are called ‘property concept nouns’ in Dixon (1982), ‘individual concepts’ in Montague (1973) and ‘quality nouns’ in Francez & Koontz-Garboden (2017).

- (71) a. The temperature rise increased the volume of the gas.
 b. \approx The temperature rise caused the volume of the gas to increase.
- (72) a. Zsofia increased the volume of the gas.
 b. \approx Zsofia did something such that the volume of the gas increased.

By contrast, transitive anticausatives and the corresponding periphrastic causative paraphrases do not have the same meaning and, thus, are not paraphrases of each other. For instance, (73b/c) enforce a non-default interpretation under which the gas is the effector of its volume increase, while in its most natural, transitive anticausative reading, (73a) does not have this interpretation. For this paraphrase to work, one has to reinterpret (73a) as a (conceptually marked) transitive causative statement (where the gas is the effector of an event causing the change).²⁸

- (73) a. The gas increased its volume. (transitive anticausative sentence)
 b. $\not\approx$ The gas caused its volume to increase.
 c. $\not\approx$ The gas did something such that its volume increased.

A second test involves negation. It is possible to negate a causative statement and then assert without contradiction the truth of the corresponding anticausative, as in (74). This is because negation can associate with the subject in the first clause. The content of TP can be taken for granted, to the exclusion of the information that Zsofia is the agent of the verbal event, i.e., it is taken for granted that a change in Zsofia's appearance took place, either by itself, or caused by someone other than Zsofia (strictly speaking, negation still applies to the whole proposition). Since the occurrence of the change itself is therefore taken for granted in the first clause, the subsequent clause is not contradictory.

- (74) Zsofia did not change her appearance, but her appearance *did* change.

By contrast, in a default context, it is not possible to negate a transitive anticausative statement and then to assert the corresponding intransitive anticausative, as in (75b).

- (75) a. The room changed its appearance. (transitive anticausative sentence)
 b. The room did not change its appearance, #but its appearance *did* change.

This is precisely because transitive and intransitive anticausatives have exactly the same truth-conditional (inchoative) meaning. Therefore, (75b) necessarily amounts to denying that a change

²⁸ An anonymous reviewer reports that the first reading they get for example (73a) is the one where the gas is the effector of the change. They report not to like “transitive anticausatives” much, and prefer a construal with a PP, as *The gas increased in volume*. However, one easily finds natural examples of transitive anticausatives in corpora, for instance the examples in (65a-d) and many further attested examples in Schäfer 2024. Attested examples corresponding to (73a) are easy to find:

- (i) a. In detail, he found that *the gas increased its volume* from 1,000 units to 1,376 units, between 32 °F and 212 °F. (<https://doi.org/10.1093/acprof:oso/9780198716747.003.0010>)
 b. Isothermal means that the temperature during compression does not change, thus requiring heat dissipation; adiabatic means that *the gas changes its volume*, but without heat dissipation. (https://en.wikipedia.org/wiki/Theory_and_Construction_of_a_Rational_Heat_Motor)
 c. We argued earlier that when *a gas doubles its volume*, the number of ways in which the gas molecules can distribute themselves in space is enormously increased and the entropy increases by 5.76 J K⁻¹. (<https://sciencenotes.org/charless-law-definition-formula-examples/>)
 d. *A gas expands its volume* from 4.7 L to 8.9 L at constant temperature. (<https://www.jiskha.com/questions/1553808/a-gas-expands-its-volume-from-4-7-l-to-8-9-l-at-constant-temperature-answer-the>)

in the appearance of the room took place, and then asserting that it did take place. Rescuing this example is only possible at the cost of reinterpreting the first clause of (75b) as a (conceptually marked) causative statement.

Before proceeding to the semantic analysis of transitive anticausatives in the next section, we summarize the three necessary conditions for their formation:

- (76) a. A *functional noun* in object position (in (64c), the noun *temperature*)
 b. An *underspecified-scale verb of change*, which leaves the scale of change unspecified (in (64c), the verb *change*)
 c. A binding relation between the subject and a possessive pronoun in the object DP, such that the subject gets interpreted as the possessor of the internal argument (in (64c), *the gas* binds the possessive pronoun of *its temperature*)

Based on the third condition, it would be more accurate to display (64c) as follows:

- (77) [The gas]_i changed its_{i/*j} temperature. (transitive anticausative sentence)

(77) makes it clear that if this sentence is to be understood as a transitive anticausative, *the gas* and the possessive pronoun *its* must be co-indexed. If *the gas* and *its* are not co-indexed in (77), then the same string of words must be understood as a transitive causative (which would mean that the gas caused a change in the temperature of something else):

- (78) [The gas]_i changed its_j temperature. (agentive causative sentence)

Strictly speaking, co-indexation is also possible with the transitive causative reading in a pragmatically marked context as the one above (The DP *the gas* is then associated with the role of agent/effector, since this DP is of type *e*).

- (79) [The gas]_i changed its_i temperature. (agentive causative or transitive anticausative sentence)

On the agentive causative reading of (79), the gas caused its own temperature to change, which is not the preferred interpretation.

6.2 An analysis of transitive anticausatives

Our analysis of transitive anticausatives will be presented in three main steps, beginning with a discussion of functional nouns (e.g., *temperature*, *size*, *price*, *volume*, ..., see Löbner 2020 and literature cited therein on these nouns).

6.2.1 Functional nouns

Taking *temperature* as a canonical example of a functional noun, a straightforward idea is that *temperature* denotes a function that applies to an ordinary object *x* (its possessor) and then to a time *t*, yielding the temperature of *x* at *t*, as formalized in (80), where *ι* is the description operator and *d* is an individual variable for temperature degrees.²⁹

²⁹ For simplicity, we keep to an extensional semantics here.

(80) temperature $\rightsquigarrow \lambda x \lambda t. \iota d(\text{temperature}(t, x) = d)$ (the temperature d of x at t)

If (for simplicity) *the gas* is represented as the individual constant g , as in (81a), then the temperature d of g at an implicit time t' is represented in (81b).

(81) a. the gas $\rightsquigarrow g$
 b. the gas's temperature (at t') \rightsquigarrow
 $[[\lambda x \lambda t. \iota d(\text{temperature}(t, x) = d)](g)](t') =$ (by two applications)
 $\iota d(\text{temperature}(t', g) = d)$ (for a value of t')

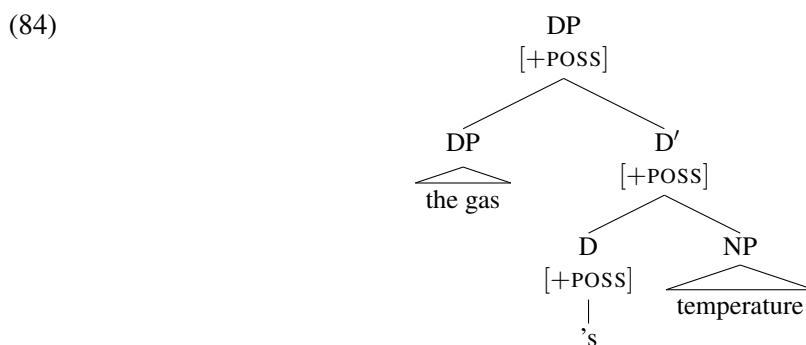
If the function represented in (80) is applied only to g , then the result is the following function on times:

(82) the gas's temperature $\rightsquigarrow \lambda t. \iota d(\text{temperature}(t, g)) = d$

By the way, note that *the temperature of the gas* would receive the same treatment as *the gas's temperature*:

(83) the temperature of the gas (at t') $\rightsquigarrow \iota d(\text{temperature}(t', g) = d)$ (for a value of t')

Returning to *the gas's temperature*, we adopt a DP approach and treat it syntactically as a DP with *the gas* as a DP in its specifier position and with a syntactic feature [+POSS(ESSIVE)] contributed by the possessive clitic 's, which is its head, as shown in (84).



For convenience, we treat the possessive clitic 's as semantically inert: normally, it would contribute a two-place possessive relation (e.g., in *Hongyuan's book*), but since the property concept noun *temperature* already denotes a relation (indeed, a function), we can (again, for convenience) treat 's as semantically inert here. Even so, 's does contribute the syntactic feature [+POSS].³⁰

This concludes our basic treatment of functional nouns, which was one of the three necessary conditions for transitive anticausatives (recall (76a)).

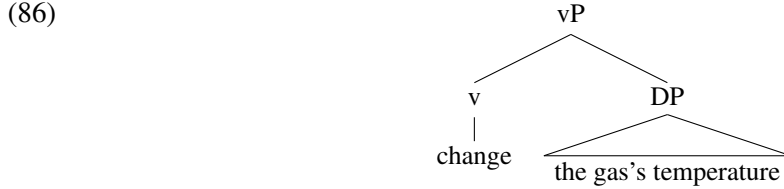
6.2.2 Underspecified-scale verbs of change

Taking *change* as a – if not *the* – canonical example of an underspecified-scale verb of change, another straightforward idea is that *change* denotes a change-of-state relation that applies to a function δ on times (of logical type $\langle e, e \rangle$), a relation R and an event e such that R holds between e and s and the value of δ at the beginning of e is not identical to the value of δ during s (which follows e), as shown in (85), where τ stands for a function that gives the time of an event or state.

³⁰ The possessive relation at hand here is an instance of inalienable possession between an attribute (temperature) and its holder (the gas).

$$(85) \quad [{}_{v[+cos]} \text{change}] \rightsquigarrow \lambda \delta \lambda R \lambda e. \exists s (R(e, s) \wedge \delta(\text{beg}(\tau(e))) \neq \delta(\tau(s)))$$

On the anticausative use, *change* is unaccusative, and the syntactic argument corresponding to δ in (85) is an internal DP-argument (which moves to SpecTP to check nominative case and/or the English EPP):



Bringing together the analysis of *the gas's temperature* as a function on times in (82) and the analysis of *change* in (85) is given in (87).

$$(87) \quad \begin{array}{ll} \text{a. } [{}_{DP} \text{the gas's temperature}] \rightsquigarrow \lambda t. \iota d(\text{temperature}(t, g) = d) & (\text{type } \langle e, e \rangle) \\ \text{b. } [{}_{vP[+cos]} [{}_{v[+cos]} \text{change}] [{}_{DP} \text{the gas's temperature}]] \rightsquigarrow & \\ \quad [\lambda \delta \lambda R \lambda e. \exists s (R(e, s) \wedge \delta(\text{beg}(\tau(e))) \neq \delta(\tau(s)))] & \\ \quad (\lambda t. \iota d(\text{temperature}(t, g) = d)) = & (\text{by application}) \\ \quad \lambda R \lambda e. \exists s (R(e, s) \wedge & \\ \quad \iota d(\text{temperature}(\text{beg}(\tau(e)), g) = d) \neq \iota d'(\text{temperature}(\tau(s), g) = d')) & \end{array}$$

The last step consists in applying the rule (60) through which the relation R receives its default interpretation in any syntactic context different from Agent or Causer Voice. The derivation of the event predicate corresponding to *The gas's temperature changed* (= (64b)), ignoring tense, is given in (88).

$$(88) \quad \begin{array}{l} [\emptyset [{}_{vP[+cos]} [{}_{v[+cos]} \text{change}] [{}_{DP} \text{the gas's temperature}]]] \rightsquigarrow \\ \quad [\lambda R \lambda e. \exists s (R(e, s) \wedge \\ \quad \iota d(\text{temperature}(\text{beg}(\tau(e)), g) = d) \neq \iota d'(\text{temperature}(\tau(s), g) = d'))] \\ \quad (\lambda s' \lambda e'. \text{become}(e', s')) = & (\text{by application}) \\ \quad \lambda e. \exists s (\text{become}(e, s) \wedge \\ \quad \iota d(\text{temperature}(\text{beg}(\tau(e)), g) = d) \neq \iota d'(\text{temperature}(\tau(s), g) = d')) \end{array}$$

This concludes our basic treatment of underspecified-scale verbs of change, which was another one of the three necessary conditions for transitive anticausatives (recall (76b)).

6.2.3 Transitive anticausatives

In this section, we show how transitive anticausatives are semantically equivalent to intransitive anticausatives despite being syntactically transitive, which is the challenge set out in Section 6.1.

Recall (77), repeated in (89).

$$(89) \quad [\text{The gas}]_i \text{ changed its}_{i/*j} \text{ temperature.} \quad (\text{transitive anticausative sentence})$$

The LF representation of transitive anticausatives is given in Figure 1. Since transitive anticausatives are formally transitive (for example, they trigger *have*-selection, while their canonical anticausative counterparts select *be* in many languages; see Schäfer 2024 for data and additional arguments that these structures are formally transitive across languages), their structure must involve

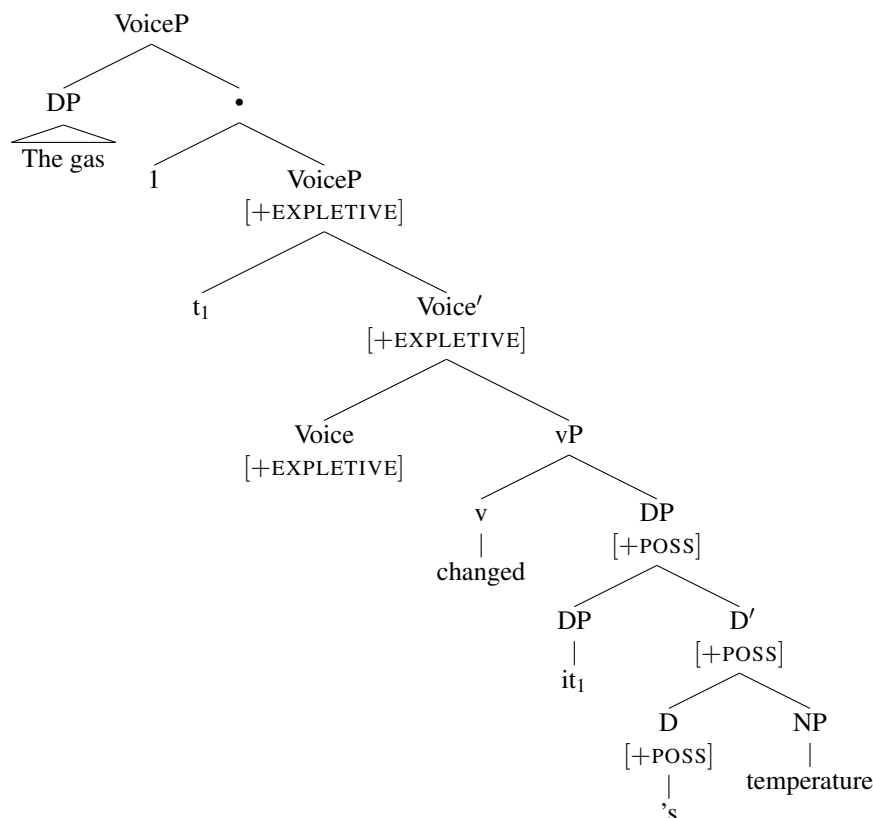


Figure 1: LF representation of transitive anticausatives

VoiceP hosting the external argument DP in its specifier. Furthermore, the internal argument DP involves a functional noun phrase with a possessive pronoun in its specifier.

We need to explain 1) why the DP located in the canonical external argument position Spec, VoiceP is not interpreted as an agent or causer of the verbal event (as it would be in canonical lexical causative uses), and 2) why the external argument DP obligatorily binds the possessive pronoun inside the internal argument DP.

Schäfer (2024) argues that these two aspects are related and depend on Voice in transitive anticausatives being neither Agent Voice nor Causer Voice, but rather *Expletive* Voice (as proposed for various other purposes in Schäfer 2008; Wood 2015; Alexiadou et al. 2015; Myler 2016; Wood & Marantz 2017 a.o.). An expletive Voice head provides a specifier position for an external argument DP to be merged, but does not enter any semantic relation with this DP. In particular, it does not assign any Theta-role to it. This answers 1). As further explained below, 2) follows, since, in the absence of an external argument Theta-role for the subject DP, this binding relation is the only way to semantically integrate the subject DP into the overall structure.

We now proceed step by step to the semantic derivation of transitive anticausative statements, starting with meaning the verb *change*. The semantic representation of *change* as a transitive anticausative is the same as the semantic representation of *change* in (85), repeated below.

$$(90) \quad [{}_{v[+cos]} \text{change}] \rightsquigarrow \lambda \delta \lambda R \lambda e. \exists s (R(e, s) \wedge \delta(\text{beg}(\tau(e))) \neq \delta(\tau(s)))$$

Turning to the internal argument DP, the functional noun *temperature* comes with a possessive pronoun *its*, which later must be co-indexed with the external argument DP *the gas* (i.e., bound by it) in order for the transitive anticausative to be available. The meaning of $its_1 \text{ temperature}$ is composed as follows (cf. (87a)):

- (91) a. $[\text{DP it}(s)_1] \rightsquigarrow x_1$
 b. $[\text{DP } [\text{DP it}(s)_1] [\text{NP temperature}]] \rightsquigarrow$
 $[\lambda x \lambda t. \text{id}(\text{temperature}(t, x) = d)](x_1) =$ (by application)
 $\lambda t. \text{id}(\text{temperature}(t, x_1) = d)$

Note that the index of the free variable representing the pronoun in (91a) is the same as the index of the pronoun (here: 1).

Applying the meaning of *change* to the meaning in (91b), we obtain the following meaning for the vP, ignoring tense (cf. (87b)):

- (92) $[\text{vP}_{[+\text{COS}]} [\text{v}_{[+\text{COS}]} \text{change}] [\text{DP its}_1 \text{temperature}]] \rightsquigarrow$
 $[\lambda \delta \lambda R \lambda e. \exists s (R(e, s) \wedge \delta(\text{beg}(\tau(e))) \neq \delta(\tau(s)))]$
 $(\lambda t. \text{id}(\text{temperature}(t, x_1) = d)) =$ (by application)
 $\lambda R \lambda e. \exists s (R(e, s) \wedge$
 $\text{id}(\text{temperature}(\text{beg}(\tau(e)), x_1) = d) \neq \text{id}'(\text{temperature}(\tau(s), x_1) = d'))$

Recall that since Expletive Voice is semantically inert, both Expletive Voice' and Expletive VoiceP have the interpretation of the vP (except that *R* receives its default interpretation become as a result of applying the rule (60)). But since Voice is expletive and does not assign a Theta-role to the subject DP, this raises the question of how the DP in the specifier of Voice can pass the Theta Criterion (Chomsky 1981). Schäfer's (2024) proposal is that this DP passes the Theta Criterion because it is interpreted as the possessor of the internal argument DP (recall that the transitive anticausative structure in (64c) and its canonical anticausative structures in (64b) entail each other). The only semantic effect at this Voice-level is then that the DP in the specifier of Voice binds the possessive pronoun inside the object DP, thereby acquiring the possessor role from the pronoun.

- (93) a. $\text{Voice}'_{[+\text{EXPLETIVE}]} \rightsquigarrow$
 $[\lambda R \lambda e. \exists s (R(e, s) \wedge$
 $\text{id}(\text{temperature}(\text{beg}(\tau(e)), x_1) = d) \neq \text{id}'(\text{temperature}(\tau(s), x_1) = d'))]$
 $(e, \lambda s' \lambda e'. \text{become}(e', s')) =$ (by application)
 $\lambda e. \exists s (\text{become}(e, s) \wedge$
 $\text{id}(\text{temperature}(\text{beg}(\tau(e)), x_1) = d) \neq \text{id}'(\text{temperature}(\tau(s), x_1) = d'))$
 b. $1 \rightsquigarrow \lambda x_1$
 c. $\bullet \rightsquigarrow$
 $\lambda x_1 \lambda e. \exists s (\text{become}(e, s) \wedge$
 $\text{id}(\text{temperature}(\text{beg}(\tau(e)), x_1) = d) \neq \text{id}'(\text{temperature}(\tau(s), x_1) = d'))$
 d. $\text{the gas} \rightsquigarrow g$
 e. $\text{VoiceP} \rightsquigarrow$
 $\lambda e. \exists s (\text{become}(e, s) \wedge$
 $\text{id}(\text{temperature}(\text{beg}(\tau(e)), g) = d) \neq \text{id}'(\text{temperature}(\tau(s), g) = d'))$

Despite the significant syntactic difference between transitive anticausatives and intransitive anticausatives, they are semantically equivalent, which is illustrated by the fact that the event predicate in (93e) and the event predicate in (88) (representing *The gas's temperature changed*) are identical.

If the subject DP does not bind the pronoun in the derivation in Figure 1, the string *The gas changed its temperature* turns out ungrammatical, as the subject DP falls victim to the Theta Criterion. The only way to rescue the string in the absence of binding is to resort to Agent or Causer Voice, via which the subject becomes an external argument. This leads to a (pragmatically dispreferred) causative interpretation of the sentence.

7 Conclusions

In this paper, we have addressed a specific and pervasive type of syntax/semantics mismatch: except in the presence of Agent Voice, change-of-state verbs used in *transitive* sentences have ‘intransitive’ (inchoative) semantics: they are used to describe mere changes (become events), just like when they are used in intransitive, anticausative sentences (what we called the inchoative hypothesis). In contrast, in the context of an agent, change-of-state verbs describe full causation events (sums of an action and the resulting change). In our proposal (like in the one developed by Wood & Marantz 2017), whether the relation between the verbal event and the state is interpreted as become or cause is determined by the syntactic context. While for Wood & Marantz (2017), the relation is causal in the context of any external argument, for us, it is so only if the external argument is an agent.

A interesting point concerns the link between the inchoative hypothesis explored in this paper and the Agent Control Hypothesis of Demirdache & Martin (2015). The latter states that across languages, zero-change readings of change-of-state verbs tend to require the subject’s referent to be associated with agentive properties (recall the agentive vs. non-agentive ‘wake up’ examples above in Section 4). The inchoative hypothesis captures the generalization that change-of-state verbs tend to describe only changes, *except* in the presence of an agent subject, in the context of which they describe full causation events (actions followed by their result). The agent control hypothesis derives directly from the inchoative hypothesis, since the latter says that when no agent is present, the verbal event is just a change. A ‘zero-change’ reading is impossible, since the change is then the only event whose existence can be asserted, in whole or in part.

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Competing interests

The authors declare that they have no competing interests.

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