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Semantic roles and the causative-anticausative alternation: evidence from French change-of-state verbs

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Abstract: Change-of-state verbs are heterogeneous with respect to their occurrence in the causative-anticausative alternation. While some of them are never used as anticausatives (e.g., *destroy*), others seem to largely favor the anticausative form (e.g., *wither*). On the basis of corpus data and statistical analysis for French change-of-state verbs, we show that there is a relationship between the anticausative use of a verb and the semantic role of its transitive subject: The more frequently the transitive subject of a verb is a cause (as opposed to agent or instrument), the more frequently the verb is used as anticausative (as opposed to transitive causative). In addition to presenting this novel empirical finding, we propose an account for the observed correlation: Depending on their semantic role, causers have different likelihoods to end up in the subject position of a transitive causative sentence, and the likelihood is lower for causes than for agents. Different factors are considered responsible for the observed correlation, including the asymmetry between agents and causes concerning salience as event participants, topic-worthiness, and the possibility of being expressed as anticausative adjuncts.

Keywords: causative-anticausative alternation; causative-anticausative scale; change-of-state verbs; French; semantic roles

1 Introduction

Verbs across languages are known to often alternate between two or more valency frames (Dixon and Aikhenvald 2000; Haspelmath and Müller-Bardey 2004;

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Malchukov 2015; among others). One of these valency alternations is the causative-anticausative alternation (CAA), illustrated in (1).

(1) a. *John broke the window.* Causative
b. *The window broke.* Anticausative

Based on their syntactic and semantic properties, the two parts of the causative-anticausative alternation (the causative alternant and the anticausative alternant) can be characterized as follows (see also Schäfer 2009): The causative alternant describes a change of state, and both the causer (agent, cause, instrument)[1] that brings about the change of state and the undergoer (patient, theme) that undergoes the change of state are expressed as arguments. The causer is expressed as a subject and the undergoer as a direct object. The anticausative alternant also describes a change of state, but neither expresses as an argument nor semantically implies the causer that brings about the event; the sole argument, namely the undergoer, is expressed in subject position.[2]

The set of alternating verbs is heterogeneous and shows considerable variation with respect to the proportion between causative and anticausative uses. Some alternating verbs are used typically as transitive causatives (e.g., French *fermer* 'close'), while other verbs are used typically as anticausatives (e.g., French *grandir* 'make/become big') (see the percentages in (2)); and of course we find verbs between these two poles.

(2) a. *fermer* 'close': 90% causative vs. 10% anticausative (N = 122)
b. *grandir* 'make/become big': 4% causative vs. 96% anticausative (N = 294)
(Proportions found in a random sample of corpus occurrences from *Frantext*, see Heidinger [2019: 59])

We can thus locate alternating verbs on a *causative-anticausative scale* that represents the proportion between the causative and the anticausative use of a verb. *Grandir* is located towards the anticausative end and *fermer* towards the causative end of the scale, as represented in (3).

1 See Section 2.3 for a detailed description of these semantic roles.

2 As is shown in (1), we do not restrict the terms *causative* and *anticausative* to the formally marked alternants (unlike Zúñiga and Kittilä [2019: 12] or Haspelmath [1993: 91] who limit the term *anticausative* to cases where the non-causative alternant is formally marked compared to the causative alternant); whenever necessary we use the labels *marked* and *unmarked* to specify the morpho-syntactic properties of the verb that appears in the causative or the anticausative alternant (see Section 2.1 for details).

(3) Causative-anticausative scale

only anticausative •-----|----------|----------• only causative

grandir *fermer*

In the abundance of literature on the CAA, the causative-anticausative scale or any other concept covering the proportion between transitive causative and anticausative (e.g., *noncausal verb percentage* [Haspelmath et al. 2014], *causalness* [Heidinger 2015]) has received relatively little attention (although a few studies relate this property of alternating verbs to the encoding, i.e., the morphosyntactic form, of alternating verbs [see Section 2.2 for details]). In this paper, we consider the proportion between transitive causative and anticausative but go beyond the existing literature and investigate a novel aspect of the alternation. More specifically, we investigate whether there is a relationship between the anticausative use of a verb and the semantic role of its transitive subject.

The initial motivation for this investigation comes from insights about the causative and the anticausative end of the causative-anticausative scale. The lack of agent-oriented meaning components, and thus the possibility of cause subjects, is often regarded as a necessary condition for anticausative formation (Alexiadou et al. 2015; Fellbaum and Zribi-Hertz 1989; Haspelmath 1993; Horvath and Siloni 2011; Levin and Rappaport Hovav 1995; Piñón 2001; Zúñiga and Kittilä 2019; but see Section 2.4 for details on how the relation between the possibility of anticausative formation and the types of causers is described by different authors); therefore, as shown in (4), verbs that only allow for agents and instruments should not license anticausatives (in Romance and Germanic languages).[3]

(4) a. **The lightning cut the clothesline*.
(Levin and Rappaport Hovav 1995: 103)
b. **The clothesline cut*.

Other authors seem to suggest that cause subjects are not only a necessary but also a sufficient condition for anticausative formation (Reinhart 2002: 234). This assumption links the agent role to the causative end of the scale (where verbs that only form causatives, but not anticausatives are located). As for the anticausative end of the scale, studies on "internally caused verbs" suggest that verbs that are predominantly used as anticausatives avoid humans/agents as subjects in their transitive uses (see (5), and further McKoon and Macfarland [2000]; Wright [2001]).

3 Note that crosslinguistic variation is not only found with respect to the set of verbs forming anticausatives. There are also languages such as Mandarin, Hindi or Salish which allow clearly agentive verbs (e.g., 'wash' or 'eat') to appear in intransitive syntactic frames with the theme in subject position (Martin et al. forthcoming: 11).

(5) a. *The cactus blossomed early*.
(Levin and Rappaport Hovav 1995: 97)
b. **The gardener blossomed the cactus early*.
(Levin and Rappaport Hovav 1995: 97)
c. *Early summer heat blossomed trees across the valley*.
(Wright 2001: 106)

Taken together, these two observations suggest a connection between semantic roles and the availability of transitive causative and anticausative uses at the extreme points of the causative-anticausative scale. In our study, we wish to verify the empirical validity of these claims and observations, but also go beyond them. We do not focus on the extreme points of the scale, but investigate the whole extent of the scale and consider the relationship between the anticausative use of a verb and the semantic role of its transitive subject in a frequentist approach. More precisely, we hypothesize a positive correlation between cause rate (i.e., the proportion of transitive uses of a verb with cause subjects) and anticausative rate (i.e., the proportion of anticausative uses of a verb): The more frequently the transitive subject of a verb is a cause (as opposed to agent or instrument), the more frequently the verb is used as an anticausative (as opposed to transitive causative).

(6) Cause-anticausative correlation:
The higher the cause rate, the higher the anticausative rate.

The main empirical goal of this paper is to show, on the basis of corpus data for French change-of-state verbs, that the correlation in (6) does exist. In addition, we propose an account for the observed correlation between anticausative rate and cause rate: Depending on their semantic role, causers have different likelihoods to end up in the subject position of a transitive causative sentence, and the likelihood is lower for causes than for agents. The reasons for this difference between causes and agents, which is responsible for the observed correlation, are manifold (we will draw on findings from experimental psychology, psycholinguistics, pragmatics and semantics). For example, causes are less topic-worthy than agents and therefore less drawn to the subject position. Hence, verbs that describe events as typically caused by agents are more likely to be used in transitive causative sentences than verbs that describe events as typically caused by causes.

We describe the methodological details of our corpus study in Section 3, followed by the results in Section 4 and the account of the data in Section 5. But first, in Section 2, we provide the necessary theoretical background for our study.

2 Theoretical background

In this section, we will successively introduce and elaborate on the concepts and observations alluded to in Section 1. We start with the causative-anticausative alternation, and the proportion between the transitive causative and the anticausative use (i.e., the causative-anticausative scale). We then turn to the semantic role of the subject in the transitive causative uses and review the literature that motivates our hypothesis (6) according to which cause rate and anticausative rate correlate.

2.1 The causative-anticausative alternation

In crosslinguistic research on the causative-anticausative alternation, two issues have been at the center of attention. The first issue concerns whether or not a verb can participate in the alternation. The second issue relates to the morphosyntactic form of alternating verbs: What are the semantic and/or syntactic differences between formal types of causatives and anticausatives (e.g., reflexive vs. unmarked anticausatives) and what determines the morphosyntactic form of alternating verbs?

In the English examples in (1), the change between the causative and the anticausative alternant is not accompanied by a formal change in the verb. Crosslinguistically, however, the CAA is often encoded in ways that involve a formal change in the alternating verb. In his typological work, Haspelmath (1993) distinguishes five types of encoding of the CAA, which we present below in a slightly adapted terminology: (i) the marked causative type, where the causative alternant is formally marked compared to the anticausative alternant; (ii) the marked anticausative type, where the anticausative alternant is formally marked compared to the causative; (iii) the labile type, where no formal change in the verb occurs; (iv) the equipollent type, where both the causative and the anticausative alternant bear special morphology that is attached to a common stem; (v) the suppletive type, where the causative and the anticausative alternant are expressed by verbs which are formally not related. The five types are exemplified in Table 1.

Besides crosslinguistic variation, the CAA also often involves variation within a single language. In French, the causative and the anticausative alternant come in two variants: A formally marked and a formally unmarked variant (see Table 2).

In the literature, marked and unmarked causatives are also called, respectively, *analytic, periphrastic* or *syntactic causatives*, and *lexical causatives*. Note that marked causatives can also be formed morphologically, although not in French (Georgian *duɣ-s* 'cook (intransitive)' vs. *a-duɣ-ebs* 'cook (transitive)' from Haspelmath [1993]). In the remainder of this paper, we will not consider marked causatives,

Table 1: Encoding types of the causative-anticausative alternation (Haspelmath 1993, adapted).

Type		Example
(i)	Marked causative	Georgian: *duy-s* 'cook (intransitive)' *a-duy-ebs* 'cook (transitive)'
(ii)	Marked anticausative	Polish: *złamać-się* 'break (intransitive)' *złamać* 'break (transitive)'
(iii)	Labile	English: *break* 'break (intransitive)' *break* 'break (transitive)'
(iv)	Equipollent	Japanese: *atum-aru* 'gather (intransitive)' *atum-eru* 'gather (transitive)'
(v)	Suppletive	Russian: *goret'* 'burn (intransitive)' *žeč* 'burn (transitive)'

Table 2: Encoding of the causative-anticausative alternation in French.

	Unmarked	Marked
Causative	verb	*faire* 'make'+verb
Anticausative	verb	*se*+verb

but only unmarked causatives, i.e., plain transitive sentences. This choice is motivated by the fact that they are quantitatively marginal (less than 3 % of the causatives in Heidinger's (2015) French and Spanish data are marked causatives), and they are typically excluded from part of the general discussion of alternating verbs (Alexiadou et al. 2015) – often verbs that only have intransitive and periphrastic causative uses are not analyzed as alternating verbs.

As concerns unmarked and marked anticausatives, as in (7), (for the latter we use the term *reflexive anticausative*), several semantic differences have been proposed in French, and in Romance more generally. These differences relate to both aspectual and causal structure.

(7) a. Reflexive anticausative (RAC)
Le vase *s' est* *brisé.*
the vase SE be.PRS.IND.3SG break.PST.PTCP
'The vase broke'

b. Unmarked anticausative (UAC)
Les prix *ont* *augmenté.*
the prices have.PRS.IND.3PL increase.PST.PTCP
'The prices have increased'

Generally speaking, the reflexive clitic in Romance RAC signals telicity and a suppressed causer (Cennamo 2016: 971). As concerns aspectual structure, RAC shows a stronger affinity to a resultant state than UAC; such a difference has been defended for French by Zribi-Hertz (1987), Labelle (1992), Labelle and Doron (2010), Heidinger (2010), Legendre and Smolensky (2010), and Schøsler (2021). As concerns causal

structure, a causer is said to be semantically more present in RAC than UAC. Such a difference with respect to causal structure has been defended for French in Labelle (1992), Labelle and Doron (2010), Heidinger (2010, 2015, 2019), and Kailuweit (2011, 2012). It should be noted, however, that the semantic differences between the two formal types of anticausatives are undoubtedly subtle and still a matter of debate (see Dobrovie-Sorin [2017: 7–11] for a recent overview and Martin and Schäfer [2014] for a critical discussion of such semantic differences).

2.2 Encoding and the causative-anticausative scale

The fact that alternating verbs may differ with respect to the proportion between the causative and the anticausative use has not gone unnoticed in the literature. However, this property of alternating verbs received much less attention than the encoding of the alternation. Unsurprisingly, most existing studies that consider the proportion between causative and anticausative uses have tried to link it to the encoding of the alternation.

Haspelmath et al. (2014) test several predictions on the relation between causative rate and the tendency to formally mark the causative alternant and leave the anticausative alternant unmarked (*causative prominence* in their terms). The main result of their corpus study on 20 verb meanings in 7 languages suggests that there is a strong negative correlation between causative rate and marked causatives: Verb meanings with a high rate of marked causatives crosslinguistically tend to have a low causative rate, while verb meanings with a low rate of marked causatives tend to have a high causative rate. For example, in Haspelmath et al.'s (2014) sample of 20 verb meanings, 'sink' is the verb meaning with the highest rate of marked causatives and has a low causative rate (across all 7 languages), while 'close' has the lowest rate of marked causatives and a high causative rate.

The same method as in Haspelmath et al. (2014) has already been applied by Samardžić and Merlo (2012; see also 2018), but with the important difference that Samardžić and Merlo (2012) use all 31 verb meanings from Haspelmath (1993), but only apply them to English. Samardžić and Merlo (2012) show that a strong negative correlation exists between the causative rate of the English verbs and the formal marking of the causative (based on Haspelmath's 1993 data). English verbs with meanings that crosslinguistically tend to be encoded with a marked causative tend to have a lower causative rate than English verbs with meanings that crosslinguistically tend not to be encoded with an unmarked causative.

In Heidinger (2015), the frequency of the causative and the anticausative use of a verb is related to the frequency of formal encodings of individual verbs in individual languages – unlike as in Haspelmath et al. (2014) and Samardžić and Merlo (2012). On

the basis of a corpus study of 20 French and 20 Spanish verbs, it is shown that the frequency of the causative and the anticausative use and the formal encoding correlate: Verbs with a high causative rate tend to form marked anticausatives and unmarked causatives more often than verbs with a low causative rate; verbs with a low causative rate tend to form marked causatives and unmarked anticausatives more often than verbs with a high causative rate. Vietri (in press) applies the same method as in Heidinger (2015) to 22 alternating Italian psych verbs and also finds the same correlation between causative rate and formal encoding. In contrast to Heidinger (2015) and Vietri (in press), de Benito Moreno (2022: 136) reports for Spanish that causative rate and formal encoding do not correlate, although under a much wider definition of *anticausative* (including cases with agentive subjects) than Heidinger (2015).

2.3 Transitive subjects and their semantic roles

This paper investigates the potential link between the proportion of causative and anticausative use of change-of-state verbs on the one hand and the semantic role of their transitive subject on the other. Before reviewing the literature on this specific matter in Section 2.4, we first discuss in detail the three semantic roles *agent*, *cause* and *instrument*, and especially delimit the role *cause*, which figures prominently in the correlation in (6). As is well known, the literature on semantic roles is characterized by an abundance of terminological variation and approaches (Levin and Rappaport Hovav 2005), which we will occasionally allude to when describing the properties of *agent*, *cause*, and *instrument* in this section.

Given the topic of this study, we focus on the semantic roles relevant for transitive subjects of change-of-state verbs, exemplified by *John* and *the wind* in (8).

(8) a. *John opened the door*.
b. *The wind opened the door*.

These subjects have in common that they bring about the change of state denoted by the verb *open* and undergone by the direct object *the door*. Hence, on an abstract level, they play the same role for which we use the cover term *causer* (see also Beavers and Lee 2020; Park 2022; Piñón 2001; Wolff et al. 2009; Wright 2001).[4] However, semantic roles are often defined not only by the role assigned by the verb but

4 Some other cover terms used in the literature (although not always intended as semantic roles) are *agent* (DeLancey 1991; Muentener and Lakusta 2011), *actor* (VerbNet), *external cause* (Levin and Rappaport Hovav 1995), *external argument* (Alexiadou et al. 2015; Martin 2020; Schäfer 2009). Note that some authors use the term *causer* for the non-agentive semantic role typically instantiated by natural forces such as the wind in (8b) (Alexiadou et al. 2015; Martin 2020; Schäfer 2008, 2009).

also by implicitly or explicitly including some ontological features. For example, agents are generally assumed to be animate entities, instruments to be tools or artifacts, whereas causes are prototypically identified as natural forces. The correlation between semantic roles and ontological features can influence the analysis of semantic roles, as in the case of instrument subjects. These are usually regarded as denoting instruments based on ontological categorization (Fillmore 1968; Grimm 2013; Kamp and Rossdeutscher 1994; Piñón 2001; Schlesinger 1989; among others), whereas they are arguably assigned by the verb the role of cause or agent rather than that of instrument (Alexiadou and Schäfer 2006; Ježek and Varvara 2015). In (8), differences between *John* and *the wind* include animacy and intention. *John* is human and, in the most salient reading, acts with the intention of opening the door. *The wind* is inanimate and does not act intentionally.[5] Still, transitive subjects can be considered *instruments* when controlled by an agent in the local linguistic context, as in (9).

(9) *John turned the key and it opened the door.*

Accordingly, we distinguish three semantic roles *agent*, *cause*, and *instrument* for subjects of transitive change-of-state verbs. These roles are defined by combining (i) animacy, (ii) the property of whether the entity acts with the intention of bringing about the event, and (iii) the property of being controlled by an agent that is present in the local linguistic context. The resulting definitions of the semantic roles *agent*, *cause* and *instrument* are given in (10).

(10) a. Agent
Animate causer that intentionally brings about the event denoted by the verb.
John opened the door.

b. Cause
Inanimate causer or unintentional animate causer that brings about the event denoted by the verb and that is not controlled by an agent present in the local linguistic context.
The wind opened the door.[6]
John tripped and he accidentally opened the door.

5 Additionally, there is a reading, where John unintentionally opens the door (e.g., by stumbling against it), but there is no second reading where the wind acts intentionally. While animates can act intentionally or unintentionally with respect to bringing about a certain event, inanimates never act intentionally.

6 A more ontologically driven label of such causers is *natural force* (Levin and Rappaport Hovav 1995; Piñón 2001; Wolff et al. 2009). We use the term *cause* to denote unintentional causers following the terminology used, e.g., in Lirics (Schiffrin et al. 2007) and VerbNet for semantic role labeling.

c. Instrument
Entity that is controlled by an agent present in the local linguistic context and that is used to bring about the event denoted by the verb.
John turned the key and it opened the door.

When analyzing the relation between semantic roles of transitive subjects and the frequency of anticausative formation, it might be unclear whether the constraints apply to semantic roles as assigned by the verb or to selectional restrictions about the ontological properties of the subject.[7] It remains true that intentionality as implied by the verb semantics or by contextual information is crucial in our analysis of semantic roles. For example, a hammer that falls from the roof and breaks a glass table is not an instrument, but a cause; it does not have the intention to break the table and it is not thrown by an agent with the intention to break the table (hence, the hammer is not an instrument).

An overview of the extensive literature on semantic roles is outside of the scope of this section. However, to further clarify our definitions, we compare them to some existing definitions (or uses) from the literature. Our definition of *agent* is more restricted than one where "[a]gent is the semantic role of a person or thing who is the doer of an event" (SIL glossary: s.v. *agent*). Less restricted definitions stem from the idea that roles like *agent* should be based on event structure. DeLancey (1991: 344), for example, argues for a "simpler and broader" conception of agent, which is based on causation, and he therefore classifies the inanimate subjects in (11) as agents.[8] Such broad definitions of *agent* obviously leave little or no room for causes.

(11) a. *His attitude infuriates me.*
b. *The beauty of this vista has inspired many artists.*
(DeLancey 1991: 344)

Our use of the notion *agent* is also more restricted than the one given by Schäfer (2008), who discusses the relation between humanness, intention and the distinction between agents and causes (he uses the term *causers* for the latter). Based on the observation that transitive subjects which are [+human, –intentional] behave like

7 Differences between agent- and cause-subjects have also been proposed with respect to phrase structural positions/syntactic configurations (Alexiadou et al. 2015), semantic types (Pylkkänen 2008), and semantic composition/event structure (Martin 2020). Although these theoretical issues are secondary for a definition of semantic roles that can be applied to a large number of tokens in the annotation of corpus data, we will make use of Martin's (2020) insights in our discussion of the empirical results in Section 5.

8 See also Muentener and Lakusta (2011: 342) for such a broad use of the term agent: "Children include objects and other nonhuman agents, such as the weather, as causal agents."

those which are [+human, +intentional] with respect to the licensing of instrument adjuncts, he argues that unintentional human causers are agents and not causes (Schäfer 2008: 101). To be more precise, Schäfer (2008) does not explicitly discuss semantic roles, but the voice (head) that introduces the external argument/transitive subject. He distinguishes between $\text{Voice}_{\text{AGENT}}$ and $\text{Voice}_{\text{CAUSE}}$ and argues that only $\text{Voice}_{\text{AGENT}}$ introduces external arguments, which can be combined with instrument adjuncts. He concludes that intention is not a "syntactically relevant property" (Schäfer 2008: 101). Besides that we are primarily interested in semantic roles and not phrase structure and that intentionality can be encoded in verbal semantics (e.g., *murder* vs. *kill*), there is another reason why we stick to intention as a criterion in our distinction between subtypes of causers: Psycholinguistic studies show that events with human causers are described differently, i.e., using different syntactic patterns, depending on whether the human acts with or without intention (Fausey and Boroditsky 2011; Fausey et al. 2010; Muentener and Lakusta 2011; Wolff 2003). In other words, transitive causative patterns are more frequent with intentional than with unintentional human causers. This makes *intention* a prime candidate for being relevant in the relation between semantic roles and the frequency of anticausative formation, and it should thus figure in the definition of semantic roles in the present study.

The terminological variation reported in this section might seem problematic for an overview of how the existing literature describes the relation between semantic roles and the possibility and frequency of anticausative formation. However, the literature we review in Section 2.4 is specifically interested in the relation between the semantic roles of transitive subjects and the frequency of anticausative formation. Hence, these authors use a more differentiated inventory of semantic roles for transitive subjects than, for example, DeLancey (1991). Further, since the statements from the literature typically refer to prototypical instantiations of these semantic roles (e.g., intentionally acting humans as agents, natural forces as causes) the statements are comparable, even if authors might differ with respect to the analysis of less prototypical cases.

2.4 Semantic roles and the causative-anticausative scale

Recall that our hypothesis (the cause-anticausative correlation in (6)) is motivated by observations about transitive subjects of verbs located at the causative and the anticausative end of the causative-anticausative scale. As concerns the causative end, we find two types of statements involving semantic roles (both try to answer the question of which transitive verbs can form anticausatives). Some authors have argued that verbs that only allow for agents (and instruments) as transitive subjects

cannot form anticausatives. Others have claimed that verbs that do not restrict the transitive subjects to agents (and instruments) can form anticausatives. The difference between the two statements is that in the first one the absence of agent-oriented meaning components is a necessary condition for anticausative formation, while in the second one the absence of agent-oriented meaning components is a sufficient condition for anticausative formation. Although it is sometimes difficult to unequivocally attribute the authors' statements to one of the two views, we will give some representative examples below (see also Martin [forthcoming: Section 5.2] for an overview of the restrictions on anticausative formation in Romance).

Fellbaum and Zribi-Hertz (1989: 22) state that in order to form anticausatives, a verb must allow for cause subjects and thus not restrict the transitive subject to agents and instruments. Levin and Rappaport Hovav (1995) similarly argue that "an externally caused verb can leave its cause argument unexpressed only if the nature of the causing event is left completely unspecified" (Levin and Rappaport Hovav 1995: 107). Piñón (2001: 351, 357) claims (in a slightly different way) that anticausatives are ruled out when the change of state is always caused by an agent.[9] Horvath and Siloni (2011: 684) claim that anticausative formation is blocked whenever "participants (roles) whose mental state is relevant to the eventuality" are involved and that in the case of events triggered by a cause, speakers can conceptualize the event without the causing entity, while in the case of events that are caused by agents, speakers "are unable to disregard the causing entity; they perceive the causing entity as an inherent part of the eventuality" (Horvath and Siloni 2011: 648). Similarly, Zúñiga and Kittilä (2019: 51) argue that anticausative formation is blocked "whenever a given predicate denotes an event that requires some kind of volitionality and control", and that "only semantically bivalent predicates whose A [= subject of transitive] is not necessarily a prototypical agent […] can be anticausativized". Alexiadou et al. (2015) state under the label *Underspecified external argument condition* that the semantic role of the transitive subject is an adequate predictor of anticausative formation: "Those transitive verbs that cannot form anticausatives restrict their subjects to *agents* or *agents* and *instruments* and disallow *causers* [our causes]" (Alexiadou et al. 2015: 53; adapted).[10] In the above statements the underspecified causer or the lack of

9 See Piñón (2001: 362) on the subtle differences between his and Levin and Rappaport Hovav's (1995) view.

10 Given the topic of this paper, we will not talk about which intransitive verbs can also form transitive causatives; we refer the reader to Schäfer (2009) and Alexiadou et al. (2015: Chapter 2.3) for descriptions that also cover this aspect of the alternation. The perspective which has the intransitive use as a starting point is also taken by Rappaport Hovav (2014: 20) who assumes that alternating verbs always have a monadic lexical entry (≈ V(x)) and the external argument is added. Verbs with a dyadic lexical entry (≈ V(x,y)) cannot form anticausatives, since there is no process of external argument deletion (anticausativization/detransitivization).

agent-oriented meaning components are presented as a necessary condition for anticausative formation, i.e., agent-oriented meaning components are presented as blocking anticausative formation. Transitive-causative verbs, which restrict their subject position to agents and instruments, cannot form anticausatives.

However, we also find statements in the literature that can be interpreted as taking the lack of agent-oriented meaning components to be a sufficient condition for anticausative formation. The following statement by Haspelmath (1993: 94; also Haspelmath 1987) could be seen as representative of this view: "A verb meaning that refers to a change of state or a going-on may appear in an inchoative/causative alternation unless the verb contains agent-oriented meaning components or other highly specific meaning that makes the spontaneous occurrence of the event extremely unlikely". Another representative is Reinhart (2002: 234), who claims that verbs which do not restrict their transitive subject to agents or instruments can form anticausatives (*unaccusative alternate* in her terms), aside from "very few exceptions".

We will not discuss the empirical validity of the two claims (*necessary condition* and *sufficient condition*) now, but just point out that counterexamples for both views have been identified in the literature. Transitive-causative verbs that do not allow for cause subjects, but nevertheless form anticausatives seem to be rare but not inexistent (see Schäfer [2008: 148] on German *rollen* 'roll', which does not allow for causes but nevertheless forms anticausatives). The number of verbs that allow agents, instruments or causes as subjects but do not form anticausatives might vary from language to language. English examples are *kill* or *destroy*. For German, Härtl (2003) additionally mentions *erschlagen* 'strike dead' and *zerkleinern* 'reduce to small pieces' (see also Schäfer 2009: 15). Alexiadou et al. (2006, 2015) acknowledge the relevance of those latter non-alternating verbs and give them a specific label, namely "externally caused" (as opposed to "agentive", which is the second class of non-alternating verbs). Still, these verbs are typically presented as infrequent counterexamples (e.g., Reinhart 2002: 234).

This brief review suggests, despite counterexamples, a link between the agent role and the causative end of the causative-anticausative scale. We expect verbs that only form causatives to have only or mainly agents or instruments (but not causes) as subjects. It is less clear whether this also holds for those verbs that do alternate but are predominantly used as causatives (as opposed to anticausatives). Do these verbs also favor agents as subjects? The existing literature is not conclusive, but in our view, it provides sufficient hints that make an empirical investigation a reasonable endeavor.

Let us now consider the other end of the scale, where we find verbs that predominantly form anticausatives.[11] The most relevant set of empirical data comes from McKoon and Macfarland (2000) and Wright (2001), who compare the transitive subjects of internally and externally caused verbs. The details about the distinction between internally and externally caused verbs is not our concern here. However, the fact that many verbs labeled as *internally caused* only rarely form transitive causatives makes them interesting for the matter at hand: They are indicative of the anticausative end of the scale.[12]

McKoon and Macfarland (2000) present for a total of 28 English change-of-state verbs the frequency of the transitive use and the intransitive use, as well as the ontological class of the transitive subject (McKoon and Macfarland 2000: 838, 843–844). Since one of these classes is *animate*, we can calculate the frequency of inanimate transitive subjects, which in turn may serve as an approximation to the frequency of non-agentive subjects. Their set of internally caused verbs shows (on average) a high frequency of anticausative use: 76.8 %. For these verbs, the corpus data shows a high frequency of inanimate (average = 82.7 %) and thus typically non-agentive subjects in the transitive use. This suggests high anticausative and low agent rates.

Wright (2001) also investigated a total of 28 English change-of-state verbs for the frequency of the transitive and the intransitive use, and the ontological class of the transitive subject. For the anticausative end of the scale again the internally caused verbs are most interesting. Wright (2001: 116) summarizes the behavior of these verbs as follows: "While transitive concrete uses can be found, most do not involve a human subject; instead, many of the subjects are nature-related." For the 14 internally caused verbs the anticausative use clearly dominates over the transitive use (80.5 % anticausative vs. 19.5 % transitive causative; Wright 2001: 121). As concerns the transitive subject, internally caused verbs (in the non-metaphorical uses) show 29 % human and 71 % non-human subjects (Wright 2001: 141). The difference with the 14 externally caused verbs is striking: The causative use dominates (76.1 % transitive causative vs. 23.9 % anticausative; Wright 2001: 123), and the transitive subject is predominantly human (91.5 %; Wright 2001: 143).

Taken together the empirical results from McKoon and Macfarland (2000) and Wright (2001) suggest a connection between the frequency of transitive and anticausative use on the one hand and the ontological class of the transitive subjects on

11 The extreme case of verbs that only form anticausatives is not relevant to us because the absence of a transitive causative use leaves no room to investigate the semantic role of transitive subjects.

12 Bentley (2023) investigates the transitive subjects of internally caused verbs in Italian, French and Spanish. She finds both agentive and non-agentive subjects in these transitive uses and relates the availability of different subject types to different subtypes of internally caused verbs. Since she does not quantify the semantic roles or ontological properties of the transitive subjects, we concentrate on the data reported in McKoon and Macfarland (2000) and Wright (2001).

the other. Verbs that are dominantly used as anticausatives (as opposed to transitive causatives) tend to have non-human subjects, while verbs that are used dominantly as transitive causatives tend to have human subjects. Although ontological classes do not directly translate to semantic roles, a high frequency of non-human subjects implies a high frequency of non-agentive subjects. Hence their empirical data clearly suggests a high frequency of non-agentive subjects at the anticausative end of the causative-anticausative scale.[13]

This literature review suggests a relationship between the anticausative use of a verb and the semantic role of its transitive subject. At the causative end of the scale, we expect a high frequency of agents, at the anticausative end we expect a high frequency of causes. Across the scale we expect a positive correlation between anticausative rate and cause rate: The more frequently the transitive subject of a verb is a cause (as opposed to agent or instrument), the more frequently the verb is used as an anticausative (as opposed to transitive causative). The most elaborate empirical studies in this domain are McKoon and Macfarland (2000) and Wright (2001) based on English corpus data. However, in neither study are the transitive subjects analyzed in terms of semantic roles, but only in terms of ontological classes. Further, the absolute numbers for the transitive uses are often extremely low (e.g., 1 for *blossom*, 2 for *bloom*, *rust*, *wilt*, 4 for *wither* in Wright [2001]). The available data is not only sufficient to motivate further investigation, but it clearly requires a comprehensive empirical study that involves more data on the transitive uses. Therefore, we conducted a systematic study on 50 French change-of-state verbs, where we considered semantic roles and also analyzed a sufficient number of transitive uses even in the case of verbs that rarely form transitive causatives. The hypothesis that we tested in this empirical study is that there is a correlation between cause rate and anticausative rate: The more frequently the transitive subject of a verb is a cause (as opposed to agent or instrument), the more frequently the verb is used as an anticausative (as opposed to transitive causative).

3 Methodology

In this section, we describe the selection procedure for the 50 verbs examined in the study, and the annotation of their corpus occurrences.

13 Although the crosslinguistic validity of the observed link between internally caused verbs and ontological classes is an open question, it should be mentioned that similar preferences for Greek internally caused verbs are reported in Alexiadou (2014: 885–886).

3.1 Verb selection

Our study is based on French deadjectival verbs of change of state. This choice is motivated by the fact that these verbs typically instantiate the 'become' semantics that favors the participation in the causative-anticausative alternation, but also display important variation with respect to the frequency of the transitive causative and anticausative uses. The formation of French deadjectival verbs is known to bring into play a variety of affixes (Bonami and Thuilier 2019; Lignon 2013; Namer 2013; Roger 2003; Sagot and Fort 2009; Willems 1979), but the syntactic aspects of this rivalry, including the possibility of forming anticausatives, have rarely been studied as such (with the exception of Junker 1987; Mazziotta and Martin 2013). While we focus on the relation between the frequency of causative and anticausative uses and subject role assignment, some observations can be provided with respect to anticausative alternation and (un)markedness as possible discriminant factors between deadjectival affixes.

We compiled a sample of deadjectival verbs from *Les Verbes Français* (LVF) (Dubois and Dubois-Charlier 1997), which is a lexical resource describing the semantic and syntactic properties of 12,310 verbs in French. We manually filtered verbs that were transitive (at least in one possible use) and could formally have an adjective as a base, which resulted in the selection of 1,166 verbs. We then examined more closely a random sample of 500 of these verbs to select those which (in at least one of their meanings) could be interpreted as denoting a change of state in relation to the adjectival base. The result state can be the one described by the base, as in the case of verbs ending in *-iser* (*stabiliser* 'stabilize', derived from *stable* 'stable'), or the opposite state for some verbs prefixed with *dé-* (*dessaouler* 'sober up', derived from *saoul* 'drunk') or *é-* (*ébruter* 'smooth down', derived from *brut* 'raw'). Many deadjectival verbs denote degree achievements and have a '(make) become (more) + base' semantic structure (Hay et al. 1999; Huyghe 2015; Kearns 2007; Kennedy and Levin 2008). Subjectivity can also be part of the interpretation and the change of state can be restricted to a change of appearance, as is the case with verbs such as *amincir* in (12).

(12) *La vue en plongée* *amincit* *le visage*
the view in high angle make.slimmer.PRS.IND.3SG the face
'The high-angle shot makes the face look slimmer'
(Wikipedia.org; frTenTen17)

It is well known that many deadjectival affixes used to form change-of-state verbs can select both nominal and adjectival bases. This can result in the double

Table 3: Morphological properties of a sample of deadjectival verbs extracted from LVF.

Converted	*a-*	*dé-*	*é-*	*en-*	*ra-*	*re-*	*-ifier*	*-iser*	Total
61	31	22	5	11	11	2	30	194	367

analyzability of some verbs, which can be morphosemantically related to an adjective or a noun. For instance, it is uncertain whether *atomiser* 'atomize' in French should be analyzed as 'make/become atomic' or 'make/become an atom'. Furthermore, morphological clues are not always congruent with semantic interpretation (Namer 2013). In the present study, we included by default candidate verbs analyzable as both deadjectival and denominal, considering that the important factor to control in our data was the change-of-state denotation, which was preserved regardless of the lexical class of the base. We finally collected 367 verbs with various morphological profiles, as shown in Table 3.

Out of the original 367 verbs, we randomly selected 50 verbs for corpus annotation, under the following conditions. First, in order to avoid any formal bias and to ensure morphological diversity, we unbalanced the morphological distribution between the original and the final samples, so that most of the affixes could be represented in our data. Second, a minimal frequency was required to allow for extensive corpus annotation (also considering that some tokens would not be relevant for the annotation). Some verbs from LVF do not frequently occur in corpora, and those with only a few tokens in our reference corpus had to be discarded. The final sample includes 17 verbs ending in *-iser*, 17 converted verbs, 5 verbs ending in *-ifier*, 5 verbs prefixed with *a-*, 3 verbs prefixed with *dé-*, 2 verbs prefixed with *ra-* and 1 verb prefixed with *en-*. We examined corpus occurrences of these 50 verbs, following the methodology described in the next subsection. In addition, we ensured that the 50 verbs were distributed across the causative-anticausative scale and did not just cover a small part of the scale.

3.2 Data annotation

We annotated verb occurrences retrieved from the *frTenTen17* corpus, which is a 5.7 billion word corpus consisting of texts collected from the Internet (Jakubíček et al. 2013). For each selected verb, we analyzed 50 relevant tokens (randomly chosen from the total set of relevant tokens) and annotated them with respect to syntactic construction (causative vs. anticausative), anticausative marking (RAC vs. UAC), and

semantic role of the subject in transitive use (agent, instrument, cause). The relevant tokens excluded the following constructions, which lie outside of the distinction between causative and anticausative:

- transitive uses that are not causative (i.e., instances without a change-of-state meaning);
- passive constructions;
- infinitives used with *se faire* 'get' + past participle (similar to passive constructions);
- true reflexives (considering that French reflexive markers are arguably not arguments, see Creissels 2007; Grimshaw 1982; Kayne 1975);
- intrinsic reflexives (i.e., reflexives that do not have a syntactically or semantically related non-reflexive use).

Furthermore, we only annotated transitive occurrences with overtly expressed objects, and ignored infinitives for which a subject could not be contextually reconstructed (i.e., was not syntactically bound in the context, or could not be pragmatically inferred from the context).

We use the cover term *causer* for the entity which brings about the change of state in a transitive causative. To annotate the semantic role of these causers we used the basic set of labels in (13), relevant to the hypotheses discussed in the literature and our own hypothesis given in (6).[14]

(13) a. *agent* (= animate intentional causer)
b. *cause* (= inanimate causer or animate unintentional causer that is not controlled by an agent)
c. *instrument* (= entity that is controlled by an agent to bring about the event)

Animate intentional causers were annotated as agents. Ontologically, these are mainly humans, but we also annotated as agents intentionally acting groups or organizations (e.g., *the government*). To classify a transitive subject as an instrument, an agent controlling that instrument had to be overtly expressed in the local linguistic context. In case the subject of a transitive causative verb was inanimate or not acting intentionally, and was not explicitly controlled by an agent, we considered it to be a cause, as in (14). Note that according to this definition, causes can be animate or inanimate (see Section 2.3 for a discussion).

14 See Section 2.3 for a detailed description of these semantic roles and Section 2.4 for their presumed relevance to anticausative formation.

(14) *L'inversion* *du calendrier électoral* *minore* […]
The reversal of. the electoral calendar minimize.PRS.IND.3SG
la portée *du scrutin* *législatif*
the impact of.the vote legislative
'The reversal of the electoral calendar minimizes […] the impact of the legislative vote'
(pcf.fr; frTenTen17)

If it could not be contextually decided whether the subject was intentional or controlled by an agent, we used an underspecified label allowing for role ambiguity (e.g., agent/cause or cause/instrument). Underspecified cases were not considered for the evaluation of the hypothesis, i.e., they were excluded from the samples of relevant tokens that we eventually analyzed.

When verbs had a very high proportion of anticausative uses, and very few transitive causative tokens were found among the 50 first relevant occurrences of the verb, we went further through the randomized data and annotated the first relevant transitive uses, so as to get a minimum of 20 transitive subjects to compute the cause rate. For instance, the 50 first relevant tokens of *raréfier* 'rarefy' in the randomized sample included 48 anticausative uses (as illustrated in (15)), and we consequently annotated the next 18 causative uses with respect to subject role (e.g., cause in (16)). Note that, even in such cases, only the first 50 tokens were included in the calculation of the anticausative rate, to ensure a homogeneous analysis of the frequency of anticausative uses throughout the data.

(15) *Nos ressources* *naturelles* *se raréfient*
Our resources natural SE become.rare.PRS.IND.3SG
'Our natural resources are getting scarce'
(cdurable.info; frTenTen17)

(16) *La sécheresse* *qui sévit* *raréfie*
the drought that ravage.PRS.IND.3SG make.rare.PRS.IND.3SG
les points *d'eau*
the points of water
'The ongoing drought is making water points scarce'
(tamtamdesbaronnies.com; frTenTen17)

The data to be annotated was shared between the two authors of the paper. Single annotations were carried out in the most obvious cases. Doubtful cases were discussed between the two authors and jointly evaluated. Eventually, a total of 2,658 tokens were annotated, including the initial 2,500 random tokens and 158 extra cases necessary to calculate cause rates.

4 Results

This section presents the results of our corpus annotation, and successively examines (i) anticausative rates (depending on the frequency with which verbs are used as anticausatives as opposed to transitive causatives), (ii) cause rates (depending on the frequency of causes as transitive subjects as opposed to agents or instruments), (iii) the relation between cause rates and anticausative rates.

4.1 Causative and anticausative uses

The corpus annotation of change-of-state verbs reveals heterogeneous situations with respect to transitive causative vs. anticausative uses. First, it confirms that the proportion of causative and anticausative uses varies between change-of-state verbs. The observed anticausative rates, i.e., the proportion of anticausative uses in the annotated data, range from 0 for verbs such as *légaliser* 'legalize' and *étanchéifier* 'seal' to 0.98 for verbs such as *grandir* 'grow' and *vieillir* 'grow old', with many verbs falling in between (e.g., *affiner* 'refine' at 0.14, *chauffer* 'heat' at 0.32, *bonifier* 'enhance' at 0.60, *grossir* 'fatten' at 0.78, see complete data in Appendix). The average anticausative rate is 0.38 and the median is 0.32. Anticausative uses can be reflexively marked or unmarked, with 21 verbs allowing only marked forms (e.g., *immobiliser* 'immobilize'), 11 verbs allowing only unmarked forms (e.g., *mûrir* 'ripen'), and 8 verbs allowing both (e.g., *noircir* 'blacken'). Out of the 48 possible anticausative forms (*noircir* and *se noircir* being counted as two different forms), 19 (39.6 %) are unmarked anticausatives and 29 (60.4 %) are reflexively marked anticausatives. Anticausative uses have a total of 956 occurrences in our data, out of which 493 (51.5 %) are unmarked and 463 (48.5 %) are reflexively marked. It appears that unmarked anticausative forms are less common than marked ones, but when they are attested, they are more frequently used than marked anticausative forms – in other words, unmarked anticausatives are associated with less types but more tokens than marked anticausatives. The three possible constructions, respectively transitive causative, reflexive anticausative and unmarked anticausative are exemplified in (17), (18) and (19).

(17) Transitive causative: *légaliser*

l'ancienne ministre	*de la santé,*	*qui*
the former minister	of the health	who
légalisa	*l'IVG*	

legalize.PFV.PST.IND.3SG the abortion
en 1974 était *de retour*
in 1974 be.IPFV.PST.IND.3SG back
aux affaires *entre 1993 et 1995 (…)*
to.the business between 1993 and 1995
'the former Health Minister, who legalized abortion in 1974, was back to business between 1993 and 1995'
(courrierinternational.com; frTenTen17)

(18) Reflexive anticausative: *s'imperméabiliser*
Celui-ci *devient* *réfractaire à l'eau,*
this one become.PRS.IND.3SG refractory to the water
soit parce qu'il *s'imperméabilise*
either because it SE.waterproof.PRS.IND.3SG
soit parce qu'il *ne possède plus*
either because it NEG have.PRS.IND.3SG NEG
la propriété *de s'humidifier.*
the property of SE.humidify.INF
'It becomes refractory to water, either because it becomes waterproof or because it no longer has the property of moistening'
(over-blog.org; frTenTen17)

(19) Unmarked anticausative: *verticaliser*
Je vous *rappelle* *qu'il*
I you remind.PRS.IND.1SG that.it
s'agit *là* *d'un (excellent)*
be.a.question.PRS.IND.3SG there of.a excellent
fauteuil MANUEL, *pas d'un superbe électrique* *qui*
armchair manual NEG of.a superb electric that
verticalise *et* *fait lit!*
verticalize.PRS.IND.3SG and turn.into.PRS.IND.3SG bed
'I remind you that this is an (excellent) MANUAL armchair, not a superb electric chair that can straighten up and turn into a bed!'
(36mots.fr; frTenTen17)

As a confirmation of Heidinger (2019), we observe a negative correlation between the frequency of anticausative use and the frequency of anticausative reflexive marking (i.e., the more frequently a verb is used as an anticausative, the less frequently its anticausative uses are marked) (see also Section 2.2), with a Pearson correlation coefficient of $r(38) = -0.64$ ($p < 0.0001$). Some morphological preferences can be observed with respect to both the propensity to be used as an anticausative and the

Table 4: Anticausative and anticausative marking rates according to morphological properties of verbs.

Verb morphology	AC rate	AC marking rate
Converted in *-er*	0.29	0.57
Converted in *-ir*	0.82	0.07
Prefixed with *a-*	0.36	1.00
Prefixed with *dé-*	0.00	1.00
Prefixed with *en-*	0.52	1.00
Prefixed with *ra-*	0.60	0.62
Suffixed with *-ifier*	0.31	1.00
Suffixed with *-iser*	0.20	0.98
Average	0.38	0.66

reflexive marking of the anticausative, as can be seen in Table 4. In particular, converted verbs from the 2nd conjugation class in *-ir* (as opposed to converted verbs from the 1st conjugation class in *-er*) seem to be predominantly used as anticausatives (in an unmarked form), which is in line with previous observations by Junker (1987). Based on the data collected for *-iser*, which is the most productive affix to form deadjectival verbs, it may be hypothesized that morphological productivity correlates with a high frequency of causative uses and with the reflexive marking of anticausative uses. However, more research is necessary to provide quantitative evidence of generalized morphological predilections with respect to the frequency of the alternation's two members and reflexive anticausative marking.

4.2 Semantic roles of the transitive subject

Before examining the relationship between the anticausative use of a verb and the semantic role of its transitive subject, we present the distribution of semantic roles in the transitive causative subjects of the annotated occurrences. A total of 1,702 transitive causative subjects were annotated, out of which 65.1 % were agents, 0.2 % instruments, and 34.7 % causes. It appears that instruments as strictly defined in our study, i.e., with an explicit intention of instrumentalization and an agent present in the local linguistic context, are very rarely found, and that subjects denoting inanimate entities are mostly causes.[15] Examples of agent, instrument and cause subjects of transitive causative verbs are given respectively in (20), (21) and (22).

15 In the literature about the limits of anticausative formation, causes are almost exclusively represented by linguistic expressions that denote natural forces such as storms, earthquakes, lightnings, etc. (Alexiadou et al. 2015; Levin and Rappaport Hovav 1995; Reinhart 2002). Implicit correlations

(20) *C'est* *pendant* *cette période* *qu'il*
it be.PRS.IND.3SG during that period that he
francise *son prénom* *en « Alexandre ».*
make.French.PRS.IND.3SG his name to Alexandre
'It was during that period that he frenchified his name to Alexandre'
(fr.wikipedia.org; frTenTen17)

(21) *Choisissez* *une nuance* *assombrissant*
chose.PRS.IMP.2SG a shade darkening
la couleur *précédemment* *choisie.*
the color previously selected
'Choose a shade that will darken the color previously selected'
(blogs.microsoft.fr; frTenTen17)

(22) *Cette fracture* *énergétique* *aggrave*
this divide energy.related make.worse.PRS.IND.3SG
encore *la situation* *de sous-développement*
further the situation of underdevelopment
et la pauvreté *des plus faibles.*
and the poverty of.the most weak
'The energy divide further worsens the situation of underdevelopment and poverty of the weakest'
(legrand.com; frTenTen17)

As in the case of anticausative rate, verbs vary considerably with respect to transitive subject roles. In our annotated sample, some verbs almost exclusively select agents as their transitive subjects (e.g., *collectiviser* 'collectivize', *décompacter* 'decompress'), whereas others almost exclusively select cause subjects (e.g., *aggraver* 'make worse', *pâlir* 'bleach'). However, many verbs do not show any clear preferences between agents and causes, as in the case of *courber* 'bend' (43.2 % cause subjects), *délégitimer* 'delegitimize' (48.0 % cause subjects), *radoucir* 'mellow' (50.0 % cause subjects), *ovaliser* 'make oval' (52.4 % cause subjects), and *durcir* 'harden' (55.0 % cause subjects) (see complete data in Appendix).

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between semantic role assigning and selectional restrictions might be inferred, and it is debatable whether causes are effectively restricted to natural forces, and more broadly if selectional restrictions on transitive subjects influence the possibility of forming anticausatives. Actually, our corpus data illustrate the ontological diversity of causes. We annotated a subsample of 400 cause subjects using a coarse-grained ontology (Barque et al. 2020) and found that the dominant class was that of cognitive objects (e.g., *hypothèse* 'hypothesis', *loi* 'law', *idéologie* 'doctrine') with 37.5 % of the annotated data, followed by actions (12.25 %), artifacts (11.25 %), events (10.5 %), and states (10.25 %). Natural elements were marginal and only represented 5.75 % of the annotated cause subjects.

Morphological properties may have an influence on subject role assignment. An important difference can be observed in our data between converted verbs in *-ir* and converted verbs in *-er* with respect to subject roles in transitive uses. The former select more frequently causes than the latter, with cause rates (i.e., proportions of cause subjects among transitive subjects) of 0.53 and 0.26, respectively. It can also be noted that suffixes *-iser* and *-ifier* have similar cause rates, whereas cause rates seem more variable among prefixes *a-*, *en-*, *dé-* and *ra-* (with an average cause rate of 0.35 for suffixes and 0.44 for prefixes). As previously noted, these tendencies need to be confirmed through more extensive research.

4.3 Relation between anticausative formation and transitive subject role

We now turn to the analysis of the relationship between the anticausative use of a verb and the semantic role of its transitive subject. The hypothesis that we test against our data is that cause rate and anticausative rate correlate: The more frequently the transitive subject of a verb is a cause (as opposed to agent or

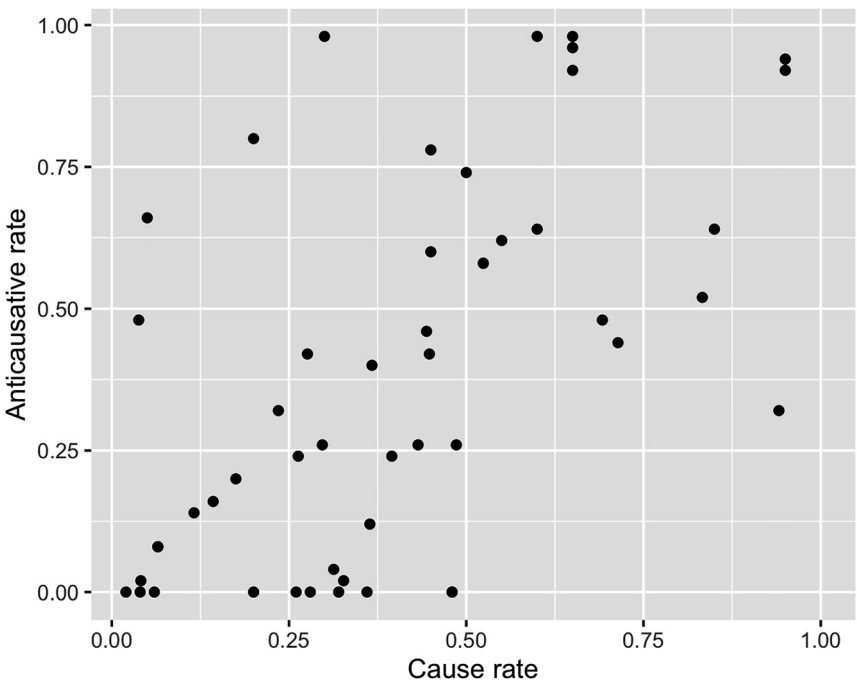

Figure 1: Cause and anticausative rates for a sample of 50 French change-of-state verbs.

instrument), the more frequently the verb is used as an anticausative (as opposed to transitive causative). The results of our annotation of 50 French change-of-state verbs are presented in Figure 1, where each data point represents a verb.

An immediate observation is that the possibility of forming anticausatives is not categorically related to the selection of cause subjects in transitive uses.[16] Firstly, the logical implication between anticausative formation and cause role assignment in transitive uses is at best unidirectional. Many verbs allowing for causes in our data do not seem to form anticausatives, hence the anticausative formation may entail the possibility of having causes as external arguments, but not reciprocally (confirming Alexiadou et al. 2015; Fellbaum and Zribi-Hertz 1989; Horvath and Siloni 2011; Levin and Rappaport Hovav 1995; Zúñiga and Kittilä 2019, who consider the underspecification of the causer as a necessary but not a sufficient condition for anticausative formation). Secondly, some verbs with a rather low cause rate (i.e., often selecting agent subjects in their transitive uses) mostly form anticausatives, whereas some verbs with a non-negligible cause rate (i.e., regularly selecting cause subjects in their transitive uses) appear to rarely form anticausatives (e.g., *bleuir* 'make/become blue' with 0.05 cause rate and 0.66 anticausative rate, and *aggraver* 'make/become worse' with 0.94 cause rate and 0.32 anticausative rate). Therefore, our data include verbs with a higher cause rate but a lower anticausative rate than others. However, such cases seem to be in the minority. Our sample includes many verbs which behave as predicted by our hypothesis: *Jaunir* 'make/become yellow' has a high anticausative rate (0.94) and a high cause rate (0.95), *électrifier* 'electrify' does not form anticausatives (in our corpus search) and has a low cause rate (0.04), and there are several verbs with both anticausative and cause rates in the midrange (e.g., *rajeunir* 'rejuvenate' with 0.46 anticausative rate and 0.44 cause rate, *amincir* 'make/become thin' with 0.64 anticausative rate and 0.60 cause rate). Hence, despite apparent counterexamples, such as *bleuir* and *aggraver* mentioned above, a general tendency for covariation emerges when the data are considered as a whole. Indeed, the dataset shows a positive significant correlation between anticausative rate and cause rate, with a Pearson correlation coefficient of $r(48) = 0.57$ ($p < 0.0001$).

To further investigate the relationship between the propensity to combine with a cause subject in transitive uses and the frequency of forming anticausatives, we conducted a logistic regression analysis based on the 2,500 tokens we annotated with respect to causative vs. anticausative use, with the anticausative tagging as the response variable and the cause rate of each verb as the predictor variable. The regression model explains a significant amount of variance, and it was found that

16 This is in line with the observations by McKoon and Macfarland (2000) and Wright (2001) who also show that the link between (i) ontological classes and (ii) frequency of transitive and anticausative uses is not categorical but a tendency.

Table 5: Coefficients of the logistic regression model.

	Estimate	Std. Error	*z*-value	*p*-value
Intercept	−1.9358	0.0939	−20.61	<2e−16
Cause rate	3.4960	0.1930	18.11	<2e−16

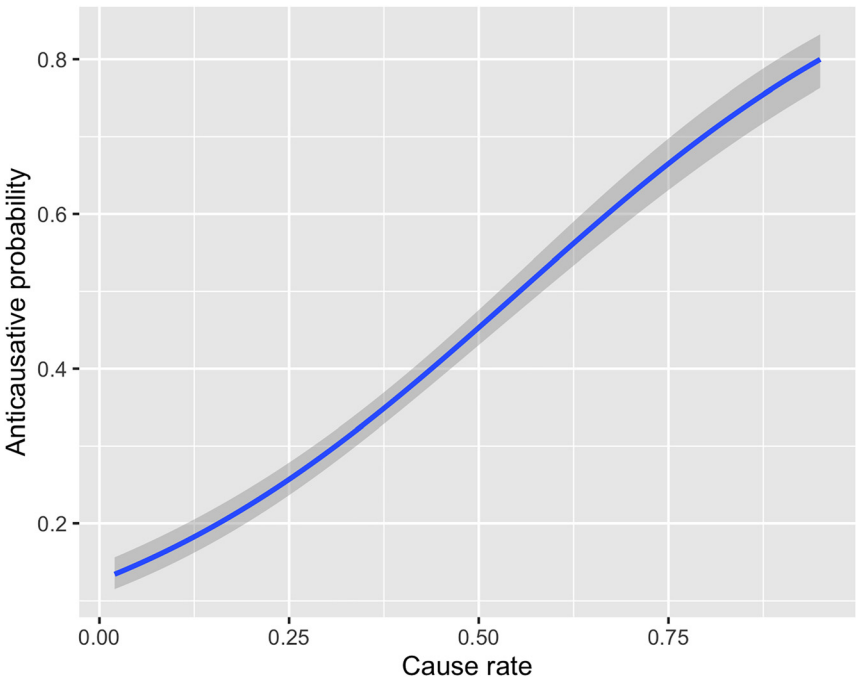

Figure 2: Prediction of the logistic regression model.

the cause rate could significantly predict the probability of anticausative formation. The coefficients of the logistic regression are presented in Table 5, and the predictions of the model are plotted in Figure 2. Our hypothesis (the cause-anticausative correlation) is therefore confirmed by empirical observation and statistical analysis.

Recall from Section 2.4 that the most elaborate empirical studies on the present topic are McKoon and Macfarland (2000) and Wright (2001). Direct comparison between these two studies and the results presented here is difficult for several reasons: (i) Both studies are based on English corpus data, (ii) in neither study are the transitive subjects analyzed in terms of semantic roles, but only in terms of

ontological classes, (iii) the absolute numbers for the transitive uses are often extremely low. However, the correlation observed between cause rate and anticausative rate corresponds to what we expected based on McKoon and Macfarland (2000) and Wright (2001). Both studies suggest a connection between the frequency of transitive and anticausative use on the one hand and the ontological class of the transitive subjects on the other, which we tentatively translated in terms of semantic roles (since a high frequency of non-human subjects implies a high frequency of non-agentive subjects).

5 Discussion: explaining the cause-anticausative correlation

The results presented in Section 4.3 raise the question as to why the cause rate and the anticausative rate are correlated. In what follows, we propose an account based on (i) the tendency that agents are more frequently expressed as transitive subjects than causes and (ii) the assumption that verbs differ with respect to causer types (some denote events typically caused by agents, others denote events typically caused by causes, with everything in between).[17] The internal structure of this section is as follows. In Section 5.1, we report psycholinguistic evidence in support of the idea that agents are more frequently expressed as transitive subjects than causes. In Section 5.2, we show how the observed correlation between cause rate and anticausative rate can be explained using psycholinguistic evidence. In Section 5.3, we provide additional support for the account by discussing some of the reasons why agents are more frequently expressed as transitive subjects than causes (drawing on findings from experimental psychology, psycholinguistic research, pragmatics and semantics, and cross-linguistic restrictions on the semantic role of subjects and adjuncts).

5.1 Psycholinguistic studies: from extralinguistic events to linguistic representations

Psycholinguistic literature provides concrete evidence that different types of causers differ considerably with respect to whether they are expressed as the transitive

17 Due to their extremely low frequency (see Section 4.2), instrument subjects will not be considered in this discussion.

subject in the verbalization of an event. Crucially, experiments on the description of visually presented events show that agentive causers are much more likely to appear as transitive subjects than non-agentive causers. In Wolff (2003, experiment 3) participants of a forced-choice experiment (adult native speakers of English) saw visual animations of events, where the causer was either intentional or unintentional. The participants then had to choose between lexical or periphrastic causatives as descriptions of the event (e.g., *The girl popped the balloon* vs. *The girl caused the balloon to pop*). The main result showed that transitive causatives were chosen significantly more often in the case of an intentional causer, while periphrastic causatives were chosen more often in the case of an unintentional causer (Wolff 2003: 25). The nature of the event therefore strongly influenced the construction used to describe the event. Given that anticausatives were not presented as options in the forced-choice experiment, no direct comparison with our corpus data can be made, but the results still showed a close link between agenthood and transitive causatives. Song and Wolff (2003) used the visual stimuli of experiment 3 in Wolff (2003), but participants (adult native speakers of English) could freely describe the event. Again, the type of description used varied according to the properties of the causer: Events with intentional causers were typically described in a single sentence as transitive causatives, while events with unintentional causers were typically described with more than one sentence using a coordinating conjunction (e.g., *A girl bounced a ball near a vase and the vase broke.*). Fausey et al. (2010) presented videos of changes of state, which were intentionally or accidentally caused by a human, to adult speakers of English and Japanese. Participants had to answer the question "What happened?" by typing a description of what they saw. Descriptions were coded as "agentive" (= transitive) or "non-agentive" for the analysis. The main result was that events with accidental causes were described much less often using transitives (both in English and Japanese) compared to events with agents: 97 % (English)/97 % (Japanese) of intentional events were described with a transitive; 69 % (English)/52 % (Japanese) of accidental events were described with a transitive (Fausey et al. 2010: 4).[18] In a later study, Fausey and Boroditsky (2011) compared English with Spanish using the same experimental methods. The main result was again that events with accidental causes were described far less frequently using transitives (both in English and Spanish). While intentional events were described equally often using transitives by both

18 The similarity (intentional events) and difference (accidental events) between English and Japanese with respect to the frequency of transitive descriptions was further explored in an experiment on memory. While there was no difference with respect to the humans in intentional events, English speakers correctly remembered the humans in accidental events better than did Japanese speakers (Fausey et al. 2010: 5).

English and Spanish speakers (96 % and 92 %), accidental events, on the other hand, were more often described using transitives by English speakers than by Spanish speakers (75 % vs. 60 %).

In Muentener and Lakusta (2011: Experiment 1), participants (3.5 to 4-year-old children; English) saw visual animations of events with three different types of causers: Intentional human, unintentional human, and inanimate. After watching the film participants were asked to tell the experimenter "what happened." In the resulting oral descriptions, the use of transitive causatives strongly depended on the types of causer in the event: 68 % of the events with intentional humans as causers were described with transitive causatives while it was only 53 % with unintentional humans and 48 % with inanimates. In Silleresi et al. (2022), participants (Italian-speaking adults and children) watched videos showing one of four event types: (i) Causer as a hand agent (only hand was seen), (ii) causer as a body agent (whole body was seen), (iii) causer as an inanimate cause, or (iv) no causer shown. The oral descriptions were transcribed and coded for the construction of the lexical verb: Active transitive, passive, and anticausative. While events with agents were typically expressed as transitive causatives, events with inanimate causes and no visible causer were typically (inanimate causes) or only (no visible causer) expressed as anticausatives.[19]

The experimental research shows that causes and agents have different likelihoods of ending up in the subject position of a transitive causative sentence, and the likelihood is lower for causes than for agents. In Section 5.2, we explicate why this difference is important for the cause-anticausative correlation.

5.2 A thought experiment

In this section, we show how the observed correlation between cause rate and anticausative rate can be accounted for by building on the psycholinguistic evidence reported in Section 5.1. Psycholinguistic studies show that agents and causes have different likelihoods to end up as transitive subjects. This likelihood

19 The line of psycholinguistic research reported in the previous paragraphs is of utmost importance for our account because it provides evidence that cannot be gained from corpus data. More specifically, these experiments do not only detail the linguistic description, but also provide us with relevant information about the (extralinguistic) event that is being described. In corpus data, on the other hand, our knowledge of the extralinguistic event that is described is limited, and especially if the causer of the event is not expressed, we know very little about the causer. In the experimental data, however, we know whether the causer is agentive or non-agentive even in cases where it is not linguistically expressed.

influences both the anticausative rate and the cause rate of a verb, which is why these two parameters co-vary and are positively correlated. To explicate our account of the correlation, we consider two types of extralinguistic events (caused by an agent vs. caused by a cause) and two ways to linguistically express these events (transitive causative vs. anticausative). For our hypothetical scenario, we assume that 80 % of the extralinguistic agents and 20 % of the extralinguistic causes end up as transitive subjects. While the general direction of this asymmetry is based on the psycholinguistic evidence reported in Section 5.1, our estimate for the likelihood of causes to be expressed as transitive subjects is lower than what is reported in these studies. We expect that in the non-experimental setting of everyday communication attention and memory decreases the salience of causes to a greater extent than that of agents (see also Section 5.3.1). We further assume three different types of verbs: Verbs denoting events, which have equally often agents and causes as causers (= balanced verb), verbs denoting events typically caused by agents, and, finally, verbs denoting events typically caused by causes.

In this thought experiment, a verb that denotes events that have equally often agents and causes as causers (= balanced verb) has an anticausative rate of 0.50 and a cause rate of 0.20 (see Table 6 for the mapping from events on syntactic constructions). To see how the different linking probabilities of agents and causes can account for the cause-anticausative correlation, we have to examine the other two verb types. If a verb denotes events that are caused in 8 out of 10 times by agents, this verb has an anticausative rate of 0.32 and a cause rate of 0.06. If a

Table 6: Events and syntactic constructions for a balanced verb.

	Event type		Syntactic construction	
e_1	AGENT + THEME	⇨	$S_{[AGENT]}$ V $O_{[THEME]}$	Transitive causative
e_2	AGENT + THEME	⇨	$S_{[AGENT]}$ V $O_{[THEME]}$	Transitive causative
e_3	AGENT + THEME	⇨	$S_{[AGENT]}$ V $O_{[THEME]}$	Transitive causative
e_4	AGENT + THEME	⇨	$S_{[AGENT]}$ V $O_{[THEME]}$	Transitive causative
e_5	AGENT + THEME	⇨	$S_{[THEME]}$ V	Anticausative
e_6	CAUSE + THEME	⇨	$S_{[CAUSE]}$ V $O_{[THEME]}$	Transitive causative
e_7	CAUSE + THEME	⇨	$S_{[THEME]}$ V	Anticausative
e_8	CAUSE + THEME	⇨	$S_{[THEME]}$ V	Anticausative
e_9	CAUSE + THEME	⇨	$S_{[THEME]}$ V	Anticausative
e_{10}	CAUSE + THEME	⇨	$S_{[THEME]}$ V	Anticausative

Table 7: Cause rate and anticausative rate (three hypothetical verbs).

	Cause rate	Anticausative rate
$Verb_1$ (AG = Cause)	0.20	0.50
$Verb_2$ (AG > Cause)	0.06	0.32
$Verb_3$ (AG < Cause)	0.50	0.68

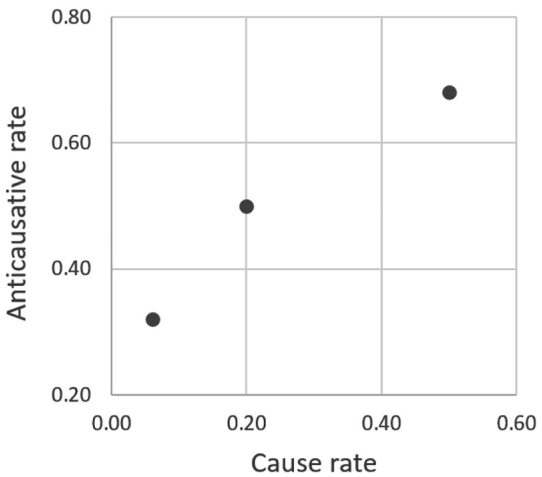

Figure 3: Cause-anticausative correlation (three hypothetical verbs).

verb denotes events that are caused in only 2 out of 10 times by agents, this verb has an anticausative rate of 0.68 and a cause rate of 0.50. Table 7 gives the anticausative rate and the cause rate for the three hypothetical verbs. Figure 3 illustrates the resulting correlation between the anticausative rate and the cause rate.

This thought experiment shows that the cause-anticausative correlation (as observed in our corpus data) can be accounted for based on (i) the general tendency that agents are more frequently expressed as transitive subjects than causes (observed in psycholinguistic studies) and (ii) the assumption that verbs differ with respect to causer types (some denote events typically caused by agents, others denote events typically caused by causes, with everything in between). In Section 5.3, we provide further support for the account by discussing some of the reasons why agents are more frequently expressed as transitive subjects than causes.

5.3 Reasons why agents are more frequently expressed as transitive subjects than causes

5.3.1 Attention and memory as a first filter

Experimental psychological research shows that visual attention in humans is sensitive to animacy in that animates are monitored more attentively than non-animate objects (see New et al. 2007 and subsequent research such as Altman et al. 2016). Animacy also plays a role in memory in that animate words are remembered better than inanimate words (Rawlinson and Kelley 2021). In terms of agents and causes, this suggests that agents are more likely to catch humans' attention than causes, and are thus more likely to be recognized as the causer of a change of state (given the strong correlation between agentivity and animacy already alluded to in previous sections). Intentionality and animacy make the causer salient, and less likely to be abstracted. Since being recognized as the causer is the first filter for being expressed as the subject of a transitive causative, there is an asymmetry between agents and causes at a pre-linguistic level. Hence, we expect that the salience of agents manifests itself linguistically in that they are more likely to be expressed than inanimate or unintentional causes.

5.3.2 The topic-worthiness of agents

Another relevant difference between agents and causes is that agents are more topic-worthy than causes. Topic-worthiness is a phenomenon located at the level of pragmatics (or information structure, to be more specific). The term *topic-worthiness* refers to the fact that not all noun phrases are equally good candidates for topichood, i.e., for being the topic of a sentence. Several features that make a good candidate for topichood have been mentioned in the literature (Dalrymple and Nikolaeva 2011). A relevant feature for our research is animacy, because animates are better candidates for the topic role than inanimates (Dahl and Fraurud 1996). This asymmetry can be motivated as follows: "We tend to think of the world as organized around animate beings which perceive and act upon their inanimate environment" (Dahl and Fraurud 1996: 160). Although this statement is about ontological classes, we assume that it also holds for semantic roles, i.e., the difference between agents and causes. Paraphrasing Dahl and Fraurud's (1996) quote, we can say that we tend to think of the world as organized around intentionally acting entities. However, not only

ontological classes, but also semantic roles have been addressed in the literature on topic-worthiness. Von Heusinger and Schumacher (2019: 124) link agentivity to topic-worthiness by stating that "an ideal topic is given, animate and agentive". Similarly, Payne (1997: 151) states that humans tend to talk about things that "act, move, control events, and have power", and that therefore "utterances in communication tend to make AGENTS highly topical." It can thus be assumed that agents are more topic-worthy than causes.

The relation between topic-worthiness and transitive causative use is that the subject position is the unmarked topic position (in the sense that the subject is the default topic of a sentence; Lambrecht [1994: 114]; Li and Thompson [1976: 484]; Rothstein [2004: 17]; Wehr [1984: 3]; and Wunderlich [2006]). Since agents are more topic-worthy than causes, they are more likely to end up in the subject position than causes (in languages where the subject position is the default position for topics, such as French). Due to linking rules, in languages like French, the only type of subject position available for causers is that of a transitive causative sentence. Putting a causer in subject position thus automatically yields a transitive structure. It follows that those verbs, which denote events that have more often agents than causes as causers should have a higher amount of transitive causative uses than verbs, which have more often causes than agents as causers.

5.3.3 Restrictions on semantic roles in subject and adjunct position

In many languages, causes but not agents may be expressed as adjuncts in anticausatives (see Alexiadou and Schäfer [2006: 40–41] and Kallulli [2007] for a discussion and further references). One such language is English, as illustrated in (23). While causes can be expressed as adjuncts in *from*-phrases in anticausatives (23a), agents cannot (23b) (or to put it differently: English anticausatives license causes, but not agents).

(23) a. *The window broke from the pressure/from the explosion/from Will's banging.*
b. **The window broke from John.*
(Alexiadou and Schäfer 2006: 41)

The same restriction holds for French, as shown in (24), in which causes are introduced with *sous l'effet de*, lit. 'under the effect of' (Barque et al. 2019; Zribi-Hertz 1987).

(24)

La fenêtre	*s'est cassée*	*sous l'effet de la pression.* / from the pressure
		sous l'effet de l'explosion. / from the explosion
the window	SE be.PRS.IND.3SG break.PST.PTCP	*sous l'effet des coups de Jean.* / from Jean's banging
		**sous l'effet de Jean.* / from Jean

'The window broke from the pressure / from the explosion / from Jean's banging / *from Jean'

This difference between agents and causes suggests that causes are more closely linked to the anticausative than agents.

Interestingly, the reverse picture of what we just saw also holds in some languages. The subject position of the transitive causative sentence may be available for agents, but not for causes; agents are thus more closely linked to the transitive causative construction than causes are. Wolff et al. (2009) mention that English is much more tolerant as concerns the appearance of non-agentive causes as transitive subjects than Irish, Dutch, German, Russian, Jacaltec, Cora, or Korean. We illustrate the relevant restriction on causes with data from Japanese and Jacaltec (Mayan). The Japanese data in (25) shows that inanimate causes cannot be used as subjects in transitive causatives (with the nominative *ga* marking as subject case), but need to be expressed as adjuncts marked with instrumental case.[20]

(25) a. *John ga* *kabin o* *kowasi-ta*
John-NOM vase-ACC break-PST
'John broke the vase'

b. **Jisin ga* *kabin o* *kowasi-ta*
earthquake-NOM vase-ACC break-PST
'The wind broke the vase'

20 Fausey et al. (2010: 5) report the possibility of accidental human causes as transitive subjects in Japanese. This raises the question of whether this restriction is indeed about semantic roles or selectional restrictions linked to ontology (in particular animacy).

c. *Kabin-ga* *jisin de* *koware-ta*
vase-NOM earthquake-INSTR break-PST
'The vase broke because of the earthquake'
(Yamaguchi 1998; cited after Alexiadou et al. 2015: 8)

In Jacaltec the same restriction applies: Inanimate causes cannot be the subject of a transitive causative, but must be expressed as adjuncts (26). The only difference with Japanese is that such causes are not marked with morphological case, but expressed as PPs.

(26) a. *speba naj* *te' pulta*
close he CL door
'He closed the door'
b. **speba cake* *te' pulta*
close wind CL door
'The wind closed the door'
c. *xpehi* *te' pulta* *yu cake*
closed CL door by wind
'The wind closed the door' (lit.: the door closed by the wind)
(Alexiadou and Schäfer 2006: 41)

Although this last restriction does not hold in French (recall the many inanimate cause subjects in our corpus data), we nevertheless conclude that there is an asymmetry between agents and causes in that agents are more tightly linked to the transitive causative than causes are.

Note that crosslinguistic differences with respect to the possibility of causes as transitive subjects make interesting predictions for both the anticausative rate and the cause-anticausative correlation. Verbs denoting events that are typically caused by causes are expected to have a higher anticausative rate in languages like Japanese and Jacaltec than in languages like English and French because in the former languages, events caused by causes cannot be construed with a transitive causative.[21]

21 If some languages indeed have a categorical ban on causes (animate or inanimate) as transitive subjects it directly follows that the cause-anticausative correlation is not universal. In languages without causes as transitive subjects we do not expect the semantic role of the transitive subject and the anticausative rate to correlate since causes cannot be transitive subjects. Hence, even for verbs which typically form anticausatives we expect that the few transitive causative uses have agents and not causes as subjects (unlike what we have observed for French).

In addition, some existing differences between transitive sentences with agent and cause subjects may indicate semantic proximity between transitive causatives with cause subjects and anticausatives. In a recent proposal, Martin (2020) argues that transitive causatives with agentive subjects differ from those with non-agentive (or cause) subjects in terms of event structure. The event denoted by the VP combined with an agent subject is composed of an action carried out by the agent and the theme's change of state, whereas in the case of a cause subject, it is restricted to the theme's change of state. The empirical arguments for the differentiation of the two types of transitive causatives come from their aspectual properties: The interpretation of *in*-adverbials, *begin*-sentences, and progressive sentences (Martin 2020: Section 8.5.4.1–8.5.4.3). The intentionality associated with agentivity allows for a specific profiling of process duration, which makes it easier to access preparatory phases in agentive descriptions of events. Crucially, the absence of any acting or causing entity in the VP of transitive causatives with cause subjects is a trait they share with anticausatives. Martin (2020) argues that – besides the obvious difference between non-agentive transitive causatives and ACs with respect to the presence of an external argument – a non-agentive causative VP is interpreted in the same way as its anticausative counterpart. We conclude from her analysis that non-agentive transitive causatives are semantically more similar to anticausatives than agentive transitive causatives are. As a corollary, it can be hypothesized that the more frequently a verb is used in transitive causatives with cause subjects, the more easily it will switch to anticausatives. If a verb in its transitive uses combines with cause subjects more often than another, it should be more often interpreted as a simple change of state, and consequently be more favorable to anticausative uses.

6 Conclusion

On the basis of corpus data for French change-of-state verbs, we have shown that there is a correlation between cause rate and anticausative rate: The more frequently the transitive subject of a verb is a cause (as opposed to agent or instrument), the more frequently the verb is used as an anticausative (as opposed to transitive causative). This study was motivated by existing research on the relevance of semantic roles for the (im)possibility of anticausative formation and empirical studies on the ontological properties of the subjects of internally caused verbs. Nevertheless, we established a new connection between two

strings of research on change-of-state verbs, which so far only co-existed side-by-side: The semantic role of transitive subjects on the one hand, and the frequency of transitive and anticausative uses on the other. Further, our data clarify the logical implication between anticausative formation and cause role assignment in transitive uses. Several verbs in our sample allow for causes but do not seem to form anticausatives. Hence, causes as transitive subjects might be a necessary, but not a sufficient condition for anticausative formation (confirming Alexiadou et al. 2015; Fellbaum and Zribi-Hertz 1989; Horvath and Siloni 2011; Levin and Rappaport Hovav 1995; Zúñiga and Kittilä 2019). The observed correlation is also in line with what we expected based on McKoon and Macfarland (2000) and Wright (2001). Both studies suggest a connection between the frequency of transitive and anticausative use on the one hand, and the ontological class of the transitive subjects on the other, which we tentatively translated in terms of semantic roles.

In addition to presenting the correlation between cause rate and anticausative rate, we proposed an account for this empirical observation. We assume that causers have different likelihoods to end up in the subject position of a transitive causative sentence depending on their semantic role. The likelihood is lower for causes than for agents. This difference directly influences both the cause rate and the anticausative rate and therefore accounts for the correlation between the two. The reasons for this difference between causes and agents are the salience of agents as event participants, their topic-worthiness, which draws them to the subject position, and the possibility for causes (vs. agents) to be expressed as adjuncts in anticausatives.

Obvious topics for future research are the crosslinguistic validity of the correlation and the interaction of the proposed factor (different likelihood of agents and causes to end up in the subject position of a transitive sentence) with other factors.

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Data availability statement: The annotated data and statistical scripts underlying this article are available online at https://osf.io/9zkqt/.

Appendix

Sample of 50 French change-of-state verbs.

Verb	Morphology	T-Causative	Anticausative	AC rate	S-agent	S-instrument	S-cause	Cause rate	AC marked	AC unmarked	AC marked rate
Affermir	a-	40	10	0.20	33	0	7	0.18	10	0	1.00
Affiner	a-	43	7	0.14	38	0	5	0.12	7	0	1.00
Aggraver	a-	34	16	0.32	2	0	32	0.94	16	0	1.00
Amincir	a-	18	32	0.64	8	0	12	0.60	32	0	1.00
Arabiser	-iser	42	8	0.16	36	0	6	0.14	8	0	1.00
Assombrir	a-	26	24	0.48	7	1	18	0.69	24	0	1.00
Baisser	conv_er	26	24	0.48	25	0	1	0.04	0	24	0.00
Bleuir	conv_ir	17	33	0.66	19	0	1	0.05	0	33	0.00
Bonifier	-ifier	20	30	0.60	11	0	10	0.45	30	0	1.00
Chauffer	conv_er	34	16	0.32	26	0	8	0.24	0	16	0.00
Collectiviser	-iser	46	4	0.08	43	0	3	0.07	4	0	1.00
Courber	conv_er	37	13	0.26	21	0	16	0.43	11	2	0.85
Crédibiliser	-iser	49	1	0.02	33	0	16	0.33	1	0	1.00
Décompacter	dé-	49	1	0.02	47	0	2	0.04	1	0	1.00
Délégitimer	dé-	50	0	0.00	26	0	24	0.48	0	0	n.a.
Dépuceler	dé-	50	0	0.00	49	0	1	0.02	0	0	n.a.
Diviniser	-iser	50	0	0,00	36	1	13	0.26	0	0	n.a.
Durcir	conv_ir	19	31	0.62	11	0	9	0.55	18	13	0.58
Électrifier	-ifier	50	0	0.00	48	0	2	0.04	0	0	n.a.
Engourdir	en-	24	26	0.52	4	0	20	0.83	26	0	1.00
Érotiser	-iser	44	6	0.12	27	1	16	0.36	6	0	1.00
Étanchéifier	-ifier	50	0	0.00	47	0	3	0.06	0	0	n.a.
Fanatiser	-iser	50	0	0.00	40	0	10	0.20	0	0	n.a.
Franciser	-iser	46	4	0.08	43	0	3	0.07	4	0	1.00

(continued)

Verb	Morphology	T-Causative	Anticausative	AC rate	S-agent	S-instrument	S-cause	Cause rate	AC marked	AC unmarked	AC marked rate
Grandir	conv_ir	1	49	0.98	7	0	13	0.65	0	49	0.00
Grossir	conv_ir	11	39	0.78	11	0	9	0.45	0	39	0.00
Immobiliser	-iser	38	12	0.24	23	0	15	0.40	12	0	1.00
Imperméabiliser	-iser	48	2	0.04	33	0	15	0.31	2	0	1.00
Inverser	conv_er	38	12	0.24	28	0	10	0.26	12	0	1.00
Jaunir	conv_ir	3	47	0.94	1	0	19	0.95	0	47	0.00
Légaliser	-iser	50	0	0.00	36	0	14	0.28	0	0	n.a.
Lexicaliser	-iser	28	22	0.44	8	0	20	0.71	22	0	1.00
Minorer	conv_er	50	0	0.00	34	0	16	0.32	0	0	n.a.
Mollir	conv_ir	1	49	0.98	14	0	6	0.30	0	49	0.00
Multiplier	conv_er	29	21	0.42	21	0	8	0.28	21	0	1.00
Mûrir	conv_ir	10	40	0.80	16	0	4	0.20	0	40	0.00
Nasaliser	-iser	37	13	0.26	19	0	18	0.49	12	1	0.92
Noircir	conv_ir	29	21	0.42	16	0	13	0.45	3	18	0.14
Ovaliser	-iser	21	29	0.58	10	0	11	0.52	27	2	0.93
Pâlir	conv_ir	4	46	0.92	1	0	19	0.95	0	46	0.00
Radoucir	ra-	13	37	0.74	10	0	10	0.50	36	1	0.97
Rajeunir	ra-	27	23	0.46	15	0	12	0.44	6	17	0.26
Raréfier	-ifier	2	48	0.96	7	0	13	0.65	48	0	1.00
Rougir	conv_ir	4	46	0.92	7	0	13	0.65	0	46	0.00
Sacraliser	-iser	50	0	0.00	32	0	18	0.36	0	0	n.a.
Singulariser	-iser	18	32	0.64	3	0	17	0.85	32	0	1.00
Stabiliser	-iser	30	20	0.40	19	0	11	0.37	20	0	1.00
Verticaliser	-iser	37	13	0.26	26	0	11	0.30	12	1	0.92
Vieillir	conv_ir	1	49	0.98	8	0	12	0.60	0	49	0.00
Vivifier	-ifier	50	0	0.00	26	0	24	0.48	0	0	n.a.

T = transitive; AC = anticausative; S = subject.

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