

Formalizing spatial-causal polysemy of Agent prepositions*

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Abstract Current formal approaches to *by*-phrases in passives analyze the Agent preposition *by* as semantically vacuous: the denotation of *by* is merely such that its argument fulfills the same function as the external argument in the corresponding active sentence. This leads to a view of agentive *by* as essentially homonymous with spatial and temporal *by*. We argue, on the basis of work in the cognitive linguistic tradition and a new analysis of the French Agent prepositions *par* and *de*, that Agent markers do have non-trivial semantic content, and are polysemous rather than homonymous with their spatial counterparts. To formalize this we propose to model these prepositions with general schematic denotations of a polymorphic type $\langle \eta, \langle \theta, t \rangle \rangle$, which can be instantiated with a concrete type in a specific syntactic and semantic context, such as $\langle e, \langle e, t \rangle \rangle$ for the spatial meaning of *by*. The use as an Agent preposition is simply one of these instantiations, with type $\langle e, \langle s, t \rangle \rangle$ (where *s* stands for events). The concrete meaning in context depends on both the general, polymorphically typed denotation and the specific type in the given context. In this way our proposal integrates a useful insight from cognitive linguistics in a semantic formalization of the passive, and opens up possibilities for similar accounts of other highly grammaticalized prepositions.

Keywords: *by*-phrases, passive, prepositions, polysemy, causation, proto-agentivity

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1 Introduction

Formal analyses of *by*-phrases in passives tend to treat the Agent preposition *by* as a purely functional element, for example akin to a case marker (Collins 2018; cf. also Bruening 2013). In all accounts known to us, the denotation of *by* is merely what is needed to ensure that its argument plays the same role as the external argument in the corresponding active sentence; *by* does not project any additional meaning.

We see three problems with these approaches. First of all, they effectively take the Agent preposition *by* as accidentally homonymous with other uses of *by* (e.g., spatial *by the house*; temporal *by five o'clock*). They do not clarify the relation between these other uses of *by* and its use as an Agent preposition. This is problematic because the syncretism is not, in fact, accidental; Croft (2012: pp. 222–226) has shown that Agent markers cross-linguistically tend to derive from prepositions with an ablative (‘from’) or perlocative (‘through’) meaning.¹ The underlying reason for this would be that causation is cognitively represented as a chain, with causes preceding effects and thus being marked as something ‘through’ or ‘from’ which an effect arises. However, if Agent prepositions are purely functional elements, there is a priori no reason why other prepositions, such as *to* or *for*, could not become Agent markers as well. Ideally, the formal analysis would predict that such developments occur only very rarely.

A second argument against these approaches comes from languages that have multiple Agent prepositions, like French. In French passives, the Agent can be introduced by both *par* ‘through, by’ (1a) and *de* ‘from, of, by’ (1b):²

- (1) a. *le chien est lavé* ^{1.00}*par*/^{-0.96}*de Marie*³
 the dog is washed *par/ de Marie*

‘The dog was washed by Marie.’

(Straub 1974: p. 584)

¹ This is also the case for English *by*. Before obtaining a proximative sense, *by* had a perlocative meaning, which survives in expressions like *I went by that road* (Palancar 2002: p. 184).

² Note that *de le* shortens to *du*, *de les* shortens to *des*, and *de* reduces to *d’* before vowels. We are only interested in *de* followed by proper DPs here; for the use of *de* followed by a bare NP see Martin 2005. French *de* and *par* have cognates in at least Spanish (Suñer 1981) and Portuguese (Moody 1972: pp. 64–66), with very similar behavior. Our analysis readily translates to these languages, but we focus here on French, as the behavior of the two prepositions seems to have been discussed in most detail for this language.

³ Because the difference in acceptability between *de* and *par* can be subtle in many of the examples discussed here, we use superscript numbers to indicate acceptability. These numbers are averaged Likert scores from an informal survey and range from –1 (not acceptable)

- b. *le mois de février est précédé {du /?par le } mois*
 the month of February is preceded *de=the/ par* the month
de janvier
 of January

‘February is preceded by January.’ (Straub 1974: p. 591⁴)

In some sentences, both prepositions are felicitous, but in different contexts. The choice between *par* and *de* depends on the relation of the Agent to the event. In (2), the presence of the parents has little effect when *de* is used; they may simply be observing from off the field. By contrast, when *par* is used, their presence changes the interpretation of the event: they are now more likely to be actively participating in the match.

- (2) *les enfants vont jouer au foot accompagnés* ^{0.87}*de*/^{0.94}*par* *leurs*
 the children go play_soccer accompanied *de/ par* their
parents
 parents

‘The children are going to play soccer accompanied by their parents.’
de ⇒ the parents are not very involved; they may be only watching;
par ⇒ the parents may be playing with the children.

Table 1 gives an impression of the kind of verbs the French Agent prepositions *de* and *par* are typically used with.

to 1 (acceptable). They are only meant to give a quick impression of the general tendency of the survey responses; for full details about the distribution of the responses, as well as more information about the survey, see Appendix A. Standard judgment marks are used for sentences that we did not test in our survey.

⁴ *Par* is ungrammatical in this example according to Straub (1974), but for speakers we consulted it was acceptable to varying extents in a similar context (see (25a) below). Over the years, *par* has become more and more the default preposition. In our tests, speakers only strongly rejected *par* with positional verbs like *précéder* ‘precede’ and *suivre* ‘follow’, and then only when the context is clearly stative (cf. (1b)). When we critique earlier work, it should be kept in mind that previous analyses may have been correct for older stages of the language, even when they do not apply anymore.

⁵ Gaatone (1998: p. 203) and Spang-Hanssen (1963: pp. 74–76) list many verbs similar to *surplomber* ‘overlook’: *cerner* ‘surround’, *encadrer* ‘frame’, *encercler* ‘encircle’, *enclore* ‘enclose’, *entourer* ‘surround’, *envelopper* ‘wrap’, *environner* ‘surround’; *auréoler* ‘halo’, *couronner* ‘crown’; *border* ‘border’, *couper* ‘cut’, *(re)couvrir* ‘cover’, *flanquer* ‘flank’, *jalonner* ‘stake out’.

<i>par</i>	<i>briser</i> ‘break’; <i>construire</i> ‘build’; <i>écrire</i> ‘write’; <i>laver</i> ‘wash’; <i>tuer</i> ‘kill’
<i>par/de</i>	<i>aimer</i> ‘love’; <i>respecter</i> ‘respect’; <i>abandonner</i> ‘abandon’; <i>délaisser</i> ‘abandon’; <i>accompagner</i> ‘accompany’; <i>précéder</i> ‘precede’ (dynamic); <i>suivre</i> ‘follow’ (dynamic); <i>surplomber</i> ‘overlook’ ⁵
<i>de</i>	<i>précéder</i> ‘precede’ (stative); <i>suivre</i> ‘follow’ (stative)

Table 1 Example verbs grouped by Agent preposition.

We will argue that *de* marks arguments that are less proto-agentive in the event, while *par* marks arguments that are more proto-agentive (in the sense of Dowty 1991 and the scalar notion of transitivity of Hopper & Thompson 1980).⁶ This also explains the distribution in (1). However, it is difficult to incorporate such information transparently in analyses that treat *by* as a case marker and use the identity function $\lambda x.x$ as its denotation (e.g., Collins 2018), as the event is then not available as an argument of the denotation of the Agent preposition.

A third issue is that current approaches to *by*-phrases are tailor-made for passive sentences (Bruening 2013, Collins 2018, Angelopoulos, Collins & Terzi 2020). However, Agent prepositions are often part of a more general causative pattern of use. For example, *by* can also be used to mark means (*by bus*, *by force*), and French *de* and *par* also have related causal meanings. As we will see below, the denotations proposed for the Agent preposition in accounts of the passive cannot be used in such contexts, because these contexts lack the specific syntactic environment of the passive for which they were developed. The agentive and other causal uses of these prepositions are effectively taken to be accidentally homonymous. However, the semantic contribution of the preposition in these contexts is roughly the same: as we will show below, *de* is associated with stativity in this environment, whereas *par* is associated with dynamicity, a distinction related to proto-agentivity. This suggests that we should be aiming at a more general semantics for these prepositions, independent of the syntactic structure of the passive. Such an analysis is expected based on Croft 2012, mentioned above, since the notion

⁶ Since these implications survive negation, we assume that this aspect of their meaning is presuppositional. For example, the following is only felicitous if *de* is stressed and used meta-linguistically: *Les enfants ne vont jouer au foot accompagnés de leurs parents; leurs parents participeront aussi* ‘The children are not going to play soccer accompanied by their parents; their parents will also participate’.

of a causal chain is not limited to passives but generalizes to other causal contexts.

In sum, we seek an account of *by*-phrases with the following properties:

- (3) a. The analysis should predict that Agent prepositions only develop from prepositions with specific spatial meanings.
- b. The analysis should allow Agent prepositions to express properties of the Agent in relation to the event.
- c. The analysis should be general enough to apply to causal uses of Agent prepositions outside passives as well.

We will propose an analysis that satisfies these criteria. Since the prepositions *de* and *par* motivate the need for all three criteria, we specifically focus on French in this article. [Section 2](#) provides cognitive linguistic background and presents the technical details of the proposal. At the end of this section we show how the account can be generalized from passives to causal adjuncts: it will be useful to discuss *de* and *par* first in this context, before discussing French passives in detail in [Section 3](#). [Section 4](#) discusses related work; descriptive work on French *de* and *par* as well as formal analyses of *by*-phrases and prepositional polysemy. [Section 5](#) summarizes and concludes. [Appendix A](#) describes an informal survey which we used to confirm our judgments for our examples from French.

2 Integrating cognitive linguistic insights: The proposal

As already mentioned in the introduction and discussed in more detail in [Section 4.2](#), formal accounts of *by*-phrases have tended to effectively take the Agent preposition use of *by* as homonymous with the spatial and temporal uses of this preposition. This is in contrast to much work in the cognitive linguistic tradition, which holds that different uses of prepositions are related in a principled way (e.g., [Tyler & Evans 2003](#), [Croft 2012](#)):

[Principled polysemy] holds that a particular form [...] is conventionally associated with a number of distinct but related meanings. [...] In essence [...] our proposal is that (the vast majority of) distinct meaning components associated with a lexical item [...] are related to each other in a systematic and motivated way. (Tyler & Evans 2003: pp. 37-38)

2.1 Incorporating principled polysemy

To incorporate this idea, we propose that these prepositions receive a single denotation, which is general enough to derive, given contextual clues, the different specific meanings of the preposition. Typically, the general meaning has to do with space, since many prepositions can be shown to have developed non-spatial meanings from a spatial origin. In the case of English *by* (e.g. *the house by the lake*), the general meaning would involve *close proximity* of the Figure (*the house*) to the Ground (*the lake*). However, this close proximity is to be understood in an abstract, not necessarily physical way. Thus, for example, moments in time can also be seen as in close proximity to each other.

Our approach makes use of polymorphic types as described by Morrill (1994: p. 162). The general denotation of the preposition has a polymorphic type $\langle \eta, \langle \theta, t \rangle \rangle$, in which the type variables η and θ can be instantiated with concrete types depending on the syntactic context. In the general schematic denotation in (4) we use f and g for Figure and Ground, respectively. The exact formalization of “ f is in close proximity to g ” depends on assumptions about the cognitive representation of abstract space. For example, Bierwisch (1999: p. 44) assumes that spatial representation is based on locations in a three-dimensional space, and Zwarts & Winter (2000) develop a more general model based on n -dimensional vectors. In such models, close proximity could be defined in terms of Euclidean distance.

$$(4) \quad \llbracket \text{by} \rrbracket_{\langle \eta, \langle \theta, t \rangle \rangle} = \lambda g_{\eta} \lambda f_{\theta}. f \text{ is in close proximity to } g$$

To see how instantiation of a polymorphic type works, consider the physical spatial meaning in *the house by the lake*. For this phrase, the type would be instantiated with $\eta = e$, $\theta = e$, which triggers the specific meaning: applying the abstract notion of close proximity to a context with two concrete entities of type $\langle e \rangle$ gives rise to the specifically physical interpretation of nearness (5a). In the case of the causal meaning (*written by Mary*), the preposition describes the relation between a concrete entity and an event, and must therefore be instantiated with $\eta = e$, $\theta = s$ (5b).⁷ We do not take a strong position on what Initiator(x, e) entails exactly. For our purposes this category

⁷ This is similar to the “dual analysis” based on reanalysis put forward by Dowty (2003). Formalizing the temporal meaning could be done in a richer type system with separate types for time expressions. This meaning would then express that an event is “in close proximity” to a moment, that is, happens shortly before or after that moment. We focus on causal meanings here.

can be quite broad; for example, $\text{Initiator}(x, e)$ could be taken to mean that x is highest on Fillmore's (1968) subject selection scale in e .

- (5) a. $\llbracket \text{by}_{\text{spatial}} \rrbracket_{\langle e, \langle e, t \rangle \rangle} = \lambda x \lambda y. y$ is in close proximity to x
 interpretation: y is physically near x
- b. $\llbracket \text{by}_{\text{causal}} \rrbracket_{\langle e, \langle s, t \rangle \rangle} = \lambda x \lambda e. e$ is in close proximity to x
 interpretation: $\text{Initiator}(x, e)$

This approach leads to a clear division of labor. The formal syntactic and semantic context, by using certain types, enforces the required type of the specific instantiation of the polymorphic denotation. This ensures, for example, that we do not interpret *by* spatially in Agent phrases in passives: the context requires an instantiation of type $\langle e, \langle s, t \rangle \rangle$, not $\langle e, \langle e, t \rangle \rangle$. In this way, the formal theory heavily constrains which interpretation a highly polysemous preposition receives.

Without a story about how the different senses of a preposition are related, this formal machinery is still not much more than a way to describe massive homonymy. Using insights from cognitive linguistics we can then explain how the meaning of the concrete instantiations in (5) can be derived from the general, schematic denotation in (4) and the type provided by the formal context. For the spatial meaning, the explanation will usually be quite simple, since the general denotation is described in abstract spatial terms like “close proximity” in (4). For other domains, one needs to consider how that domain is mapped onto the spatial domain or, alternatively, how the spatial representation module is recycled to represent that domain.⁸

There is a long history of research into the spatial representation of causation.⁹ Causation is usually considered to build on the spatial notions of Source and Goal, possibly through an intermediary temporal representation and the common *post hoc ergo propter hoc* fallacy (Radden 1985: pp. 186–194):

⁸ For mapping one domain onto another, see Lakoff & Johnson 1980 and subsequent work. For the spatial representation module, see Bierwisch 1999, and for the notion of recycling, see Rooryck 2019 building on Biberauer 2019.

⁹ The discussion below follows Radden 1985, but similar ideas appear in Dirven 1995 and other sources. Talmy 1988 develops the framework of force dynamics which represents causes as vectorial forces, a theory which we will use in Section 2.3.

- (6) a. Source, Start, Cause: *from Paris, from 8:30, die from hunger*
 b. Goal, Endpoint, Purpose: *to Dijon, Monday to Friday, dress to impress*

Causation can also build on the notion of Path, in which case multiple interpretations are possible (Radden 1985: pp. 198–200):

- (7) a. Spatial Path: *pass by a newsstand*
 b. Means: *work by candlelight*
 c. Permissive Cause: *printed by permission*
 d. Agentive Cause: *bitten by a dog*

Croft (2012: pp. 222–226) develops the notion of a causal chain, which contains the different entities that influence each other in an event. A causal chain encompasses the causal Sources, Goals, and Paths. For example, the causal chain for (8a) is given in (8b):

- (8) a. *The coconut was broken for John by Sue with a hammer.*
 b. Sue → hammer → coconut → John (cf. Croft 2012: p. 222)

Based on the mapping of the causal domain onto the spatial domain proposed by Radden (1985), we expect that Source prepositions mark Causes at the origin of the causal chain (e.g., Agents but not Instruments) and that Goal prepositions mark, for instance, Beneficiaries. Path prepositions may be used to mark Means or Instruments, which are between the origin of the causal chain and the Patient. Due to language change, these categories may shift somewhat, so that Path prepositions like *by* commonly mark Agents that appear to be at the origin of the causal chain as well. However, these changes are very limited; for example, we do not expect Path prepositions to mark Beneficiaries. These predictions regarding the causal meaning of spatial prepositions have been confirmed in typological studies (Croft 2012: p. 225 and references therein). The fact that unrelated languages display the same mappings between spatial and causal concepts suggests a cognitive reality. This forms the basis for a cognitive linguistic argument for the relation between an abstract spatial denotation (4) and its causal instantiation (5b) (and thereby also the relation with the physical spatial instantiation (5a)). We develop this argument further for French in Section 3.5.

In the following subsections we describe how the proposal in (4) can be made to work in passives (Section 2.2) and illustrate its generality by applying it to prepositions in causal adjuncts (Section 2.3).

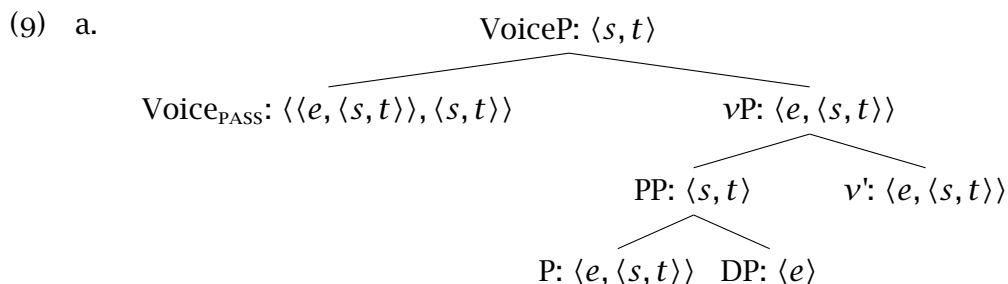
2.2 *By*-phrases in passives

To apply the denotation in (5b) to passive sentences, we largely adopt the approach to *by*-phrases of Angelopoulos, Collins & Terzi (2020) (see Section 4.2 for a discussion of the differences, as well as a comparison with other strategies). In this approach, the *by*-phrase takes the same place as the external argument in an active sentence. Given that a *by*-phrase expresses a relation between an Agent and an event, we argue that the denotation of *by* must be of type $\langle e, \langle s, t \rangle \rangle$, following the denotation in (5b), repeated here:

$$(5b) \quad \llbracket \text{by}_{\text{causal}} \rrbracket_{\langle e, \langle s, t \rangle \rangle} = \lambda x \lambda e. e \text{ is in close proximity to } x$$

interpretation: Initiator(x, e)

As a result, the *by*-phrase is of type $\langle s, t \rangle$. In the compositional analysis in (9a), we assume a vP projection selected by an active or passive Voice head (nothing hinges on this assumption; we make it to simplify our comparison with other accounts in Section 4.2). The *by*-phrase combines with the v' projection using Event Identification (Kratzer 1996: p. 122). It fills the syntactic position of the external argument, thus preventing a *by*-phrase from occurring in active sentences, without saturating the semantic argument. All that is left for the Voice head is to perform existential closure (9b), which is redundant in the case of a passive with *by*-phrase but necessary in a passive without *by*-phrase.



b. $\llbracket \text{Voice}_{\text{PASS}} \rrbracket = \lambda p \lambda e. \exists x : p(x)(e)$

Example (10) provides an example of the derivation of a passive with a *by*-phrase. We gloss over the derivation of the v' projection here. The existential closure introduced by $\text{Voice}_{\text{PASS}}$ is needed in passives without *by*-phrases, but becomes redundant in this derivation when the variable it introduces is identified with the argument of *by*. This can be ensured via a principle such as Chomsky's (1981) theta criterion: an event can only have one Initiator (Landman 2000: p. 68; Williams 2015: p. 287; cf. Dowty 1989: pp. 85, 99–103).

- (10) a. $\llbracket v' \text{ the book was sent} \rrbracket = \lambda x \lambda e. \mathbf{send}(e) \ \& \ \mathbf{Initiator}(x, e)$
 $\quad \quad \quad \& \ \mathbf{Patient}(\iota y. \mathbf{book}(y), e)$
- b. $\llbracket \text{by John} \rrbracket = \lambda e. \mathbf{Initiator}(\iota y. \mathbf{John}(y), e)$
- c. $\llbracket vP \rrbracket = \lambda x \lambda e. \mathbf{send}(e) \ \& \ \mathbf{Initiator}(x, e) \ \& \ \mathbf{Patient}(\iota y. \mathbf{book}(y), e)$
 $\quad \quad \quad \& \ \mathbf{Initiator}(\iota y. \mathbf{John}(y), e)$ (Event Identification)
- d. $\llbracket \text{VoiceP} \rrbracket$
 $\quad = \lambda e. \exists x : \mathbf{send}(e) \ \& \ \mathbf{Initiator}(x, e) \ \& \ \mathbf{Patient}(\iota y. \mathbf{book}(y), e)$
 $\quad \quad \quad \& \ \mathbf{Initiator}(\iota y. \mathbf{John}(y), e)$
 $\quad = \lambda e. \mathbf{send}(e) \ \& \ \mathbf{Patient}(\iota y. \mathbf{book}(y), e) \ \& \ \mathbf{Initiator}(\iota y. \mathbf{John}(y), e)$
 $\quad \quad \quad$ (theta criterion)

The analysis in (9) places *by* somewhat on the border between a purely lexical and a purely functional preposition. On the one hand, its type is regular and it carries semantic content related to the general meaning in (4); on the other hand, the *by*-phrase appears in the same syntactic specifier position as the external argument in active sentences. This intermediate status is in line with the fact that *by* has both lexical (e.g., spatial) and functional (e.g., agentive) uses.

2.3 Prepositions in causal adjuncts

Before turning to the interpretation of French *de* and *par* in passives in Section 3, we want to illustrate the generality of our proposal by showing how it can be used to capture distributional facts about prepositions in causal adjuncts. The example we work out here is the observation by Copley & Harley (2015) that English *from* marks causes that are forces, rather than causes that are situations:

- (11) a. *The floor broke **from** the *(weight of the) elephant.*
(Copley & Harley 2015: p. 141)
- b. *The window broke **from** John*(’s hitting it).*
(Copley & Harley 2015: p. 141)

Based on this and many other facts, Copley & Harley (2015, 2022) develop a semantic framework with primitive types for situations (type $\langle s \rangle$) and forces (type $\langle f \rangle$), rather than events (in this subsection we thus use s for situations rather than events). Conceptually, a situation “includes individuals and their property attributions” (Copley & Harley 2022: p. 12; cf. Barwise & Perry 1983), and a force is an input of energy that arises from a situation.

Formally, a force is a function that maps situations to situations: $f(s_0) = s_1$. In this framework, a causal event is not a composite of a cause and a result, but a force that, as a function, maps one situation to another (12). The distribution of *from* can now be captured in terms of a type constraint: *from* in causal adjuncts has type $\langle f, \langle s, t \rangle \rangle$ but not $\langle e, \langle s, t \rangle \rangle$ or $\langle s, \langle s, t \rangle \rangle$.



French *de* and *par* are sensitive to the same distinction between situations and forces. The examples in (13) show that *de* can be used to name causes that are situations (e.g., *faim* ‘hunger’), while it cannot be used to name causes that are forces (e.g., *un tremblement de terre* ‘an earthquake’). Instead, a majority of speakers use *par* for this purpose:

- (13) a. *Jean est mort* ^{1.00}*de*/^{-0.87}*par* {*faim* / *vieillesse* / *la maladie*
 Jean is dead *de/ par* hunger / old_age / the disease
de Parkinson}
 of Parkinson

‘Jean died of/from hunger/old age/Parkinson’s disease.’

- b. *la fenêtre s’est cassée* ^{-0.90}*de*/^{0.37}*par* {*un tremblement de*
 the window REFL=is broken *de/ par* an earthquake
terre / l’impact du ballon}
 / the=impact of=the ball

‘The window broke due to an earthquake/the impact of the ball.’

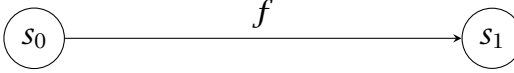
We therefore propose that *de* is instantiated with type $\langle s, \langle s, t \rangle \rangle$, but *par*, for most speakers, with type $\langle f, \langle s, t \rangle \rangle$.¹⁰ This can be formalized with the concrete denotations in (14b) and (15b), based on the general, schematic denotations in the (a) examples. In these denotations, $\text{net}(s)$ is the net force generated in situation s (Copley & Harley 2022: p. 14). The approach is analogous to that for *by* in (4-5), though here we need a type system that distinguishes forces from situations to capture the distribution of *de* and *par* in a type constraint.

¹⁰ Thus the type of English *from* matches that of *par*, and not that of *de*, as we might expect based on spatial meaning. This could be because English partitions the causal space differently with a contrast between *from* and *of*, while the immediate parallel for French *par*, English *through*, is not as frequent in causal adjuncts.

- (14) a. $\llbracket \text{par} \rrbracket_{\langle \eta, \langle \theta, t \rangle \rangle} = \lambda g \eta \lambda f \theta. \text{figure } f \text{ is through/via ground } g$
 b. $\llbracket \text{par}_{\text{causal}} \rrbracket_{\langle f, \langle s, t \rangle \rangle} = \lambda f \lambda s. \text{situation } s \text{ is through/via force } f$
 interpretation: s comes about through f
 formally: $\exists s_0 : \text{net}(s_0) = f \ \& \ f(s_0) = s$ ¹¹
- (15) a. $\llbracket \text{de} \rrbracket_{\langle \eta, \langle \theta, t \rangle \rangle} = \lambda g \eta \lambda f \theta. \text{figure } f \text{ is from/of ground } g$
 b. $\llbracket \text{de}_{\text{causal}} \rrbracket_{\langle s, \langle s', t \rangle \rangle} = \lambda s \lambda s'. \text{situation } s' \text{ is from/of situation } s$
 interpretation: s' arises from s
 formally: $(\text{net}(s))(s) = s'$

In words, *par* f expresses that f is the net force of a situation s_0 , and that f maps s_0 to the situation s described in the clause. Thus, in (13b), the earthquake (or the impact of the ball) is the net force f of a situation s_0 , so that $f(s_0) = s$ is a situation in which the window is broken. By contrast, *de* s expresses that the net force of s maps s to the situation s' described in the clause. In (13a), s contains Jean, who suffers from hunger (old age, Parkinson's), and is such that its net force brings about s' in which Jean has died.

To be sure, both sentences with *de* and sentences with *par* represent the causal event as in (12). However, *par* names the force, and *de* the causing situation. This is not accidental. Recall from Section 2.1 that when a preposition develops a causal meaning, the position in the causal chain marked by that preposition depends on its spatial meaning (Croft 2012: pp. 222–226). Similarly, we can see (12) as a spatial representation of a causal event. In this representation, s_0 can be seen as a Source, and f as a Path. The choice of preposition for each argument is based on its spatial meaning:

- (16)
- | | |
|-------------------------|--|
| Causal representation: |  |
| Spatial representation: | Source Path |
| Lexical representation: | <i>de</i> 'from, of' <i>par</i> 'through' |

¹¹ Copley & Harley (2015: p. 142) give *from* the denotation $\lambda f \lambda s. \text{net}(\text{pred}(s)) = f$, with $\text{pred}(s)$ defined as the predecessor situation of s . This denotation is roughly the same as the one in (14b), but we do not assume that a situation's predecessor is identifiable.

In this way, the conceptualization of causation using forces provides a cognitive linguistic account for the derived meanings in (14–15). As such, it accounts for the fact that *de* marks situations and *par* marks forces.¹²

3 Polymorphically typed semantics for *de* and *par* in passives

In this section we extend the analysis of Section 2.3 to the agentive meanings of *de* and *par*. The main part of this section consists of a description of the distribution of *de* and *par* in passives. As already mentioned in the introduction, *de* is preferred for less proto-agentive arguments, whereas *par* is used for more proto-agentive arguments. Note that this distribution fits to the use of *de* to mark situations and the use of *par* to mark forces in causal adjuncts (Section 2.3), because forces are associated with dynamic events, which have higher transitivity according to Hopper & Thompson (1980). In Sections 3.1 to 3.4 we show that various aspects of proto-agentivity play a role in the choice between *de* and *par* in passives. Section 3.5 then shows how these facts can be accounted for in the analysis proposed in Section 2.2, and address the question why *de* and *par* might be sensitive to proto-agentivity.

The factors we found to be relevant for the choice between *de* and *par* are a combination of proto-Agent properties (Dowty 1991: p. 572) and proto-transitivity properties (Hopper & Thompson 1980).¹³ All relevant factors are relational properties in the sense of Næss (2007: pp. 30–32); they concern the relation of the Agent to the event. They are the stative/dynamic contrast (“kinesis” in Hopper & Thompson 1980), telicity (“punctuality”), volitionality,

¹² As pointed out to us by Louise McNally (p.c.), it is also possible to account for the distribution of *de* and *par* by giving *de* a highly underspecified meaning, similar to English *of* (e.g. Partee 1997). *De* could then be excluded from marking forces because there is already a dedicated preposition for forces, namely *par*. This proposal is in principle compatible with ours, but we prefer the semantics for *de* in (15). First of all, French *de* is much more clearly spatial than English *of*, also covering the meaning of *from*. More importantly, however, *de* is not unmarked: in passives, the use of *de* is highly restricted, and *par*, rather than *de*, is used as the default Agent preposition.

¹³ There are correlations with proto-Patient properties and affectedness (Beavers 2011), but these are indirect. For example, *par* will be used more with highly affected Patients, but this is because *par* is used to mark Agents that bring about a change and these Agents go together with highly affected Patients. To see that *par* does not directly express affectedness of the Patient, consider that there are many verbs which take *par* while their Patient is the least affected in the hierarchy of Beavers (2011: p. 358), such as *voir* ‘see’, *considérer* ‘consider’, and *lorgner* ‘ogle’.

and bringing about a change (“agency”, “potency”).¹⁴ Of these, the property of bringing about a change is primary, in the sense that if a verb can imply a change, the use of *par* will force it to do so.

We will not address the question where the threshold of “high” and “low” proto-agentivity lies, exactly. In intermediate cases, where the Agent has some but not all properties of proto-Agents, it is to be expected that speakers show quite some variation as to their preference for one preposition or the other, and factors like style and register may also come into play. This should be the topic of a more descriptively oriented study. Among our survey participants (Appendix A) we could not clearly distinguish clusters of speakers with similar preferences. Here we are therefore only concerned with establishing the fact that there is a proto-agentivity threshold that determines the choice between the two prepositions, and proposing a theory to account for it.

3.1 Change: Prototypically transitive verbs

Prototypically transitive verbs by definition take an Agent that is high in proto-agentivity. In this subsection we treat verbs that imply at least that the Agent brings about a change (whether physical or not). We use Beavers’s (2011) conception of *affectedness* to define change. For Beavers, affectedness involves (a) a Theme participant undergoing a change and (b) a scale participant measuring the change.¹⁵ Since we are dealing with passive sentences, we use the term “Patient” rather than “Theme”, except when discussing Incremental and Holistic Themes below (though our use of the term “Patient” is broad enough to cover these categories as well).

In prototypically transitive events, the Agent volitionally and telically causes a physical change in a Patient, as in (1a), repeated below. In this example the Patient/Theme is the dog and the scale is being-washed or cleanliness:

(1a) *le chien est lavé* ^{1.00}*par*/^{-0.96}*de Marie*
 the dog is washed *par/ de Marie*

‘The dog was washed by Marie.’

(Straub 1974: p. 584)

¹⁴ As an anonymous reviewer points out, based on these properties we may expect the degree of transitivity to depend on aspect. As a result, some of the judgments we give in this article may be different if the aspect of the sentence is changed.

¹⁵ However, we cannot depend on Beavers (2011) too directly, as he explicitly limits himself to dynamic predicates, while many of our examples involve stative predicates.

Table 1 above gives more examples of highly transitive verbs which only take *par*. We also consider verbs of maintaining to belong to this group:

- (17) *le bord supérieur du filet est maintenu* {^{1.00}*par*
the edge upper of=the net is maintained *par*
des /^{-0.81}*des* } *flotteurs et demeure à la surface*
of=the/ de=the floats and remains on the surface

‘The upper edge of the net is buoyed with floats and remains on the surface.’¹⁶

This is a case of entrainment causation (cf. Michotte 1946 in citation by Copley & Harley 2022: pp. 4-5; see also the discussion of “maintenance” by Neeleman & van de Koot 2012: pp. 38-43 and “stative causers” by Kratzer 2000 and Pylkkänen 1999). In entrainment causation, the effect occurs during the cause rather than after the cause (which is *launching causation*). For example, in *push the cup to the edge of the table*, the cup is at the edge *after* the pushing (launching causation), but in *push the cup along the edge of the table*, the cup is along the edge *during* the pushing (entrainment causation). In the latter case, there is no change in the along-the-edge-ness of the cup, which is nevertheless brought about by the pushing. Entrainment causation thus provides a middle ground between a lack of causation (in which no participant is causally affected) and launching causation (in which a change in the described state can be observed). Similarly, in (17) there is no physical change, but there is physical causation. The scale measures whether the net is on the surface (or, alternatively, the depth of the net), and the Agent is needed to keep the Patient at the same position on that scale. There is also volitionality, since the floats are placed purposefully. These features entail relatively high proto-agentivity, which explains the preference for *par*.

Verbs with Incremental and Holistic Themes (Dowty 1991: pp. 567-571) also belong to this group. With an Incremental Theme, the scale to measure change is directly derived from the extent of the Theme (18). Clearly, the Agent is highly proto-agentive due to the clear change it brings about in the Theme.

¹⁶ <http://tsb.gc.ca/fra/rapports-reports/marine/2004/mo4wo225/mo4wo225.html>, retrieved January 30, 2023.

- (18) *le gâteau a été mangé / cuit par/*de Jean*¹⁷
 the cake has been eaten / baked *par/ de* Jean

‘The cake was eaten/baked by Jean.’

With a Holistic Theme, the Theme is conceived of as a path that can map onto a scale on which change can be measured. Thus, in (19a), the degree to which the route has been followed is measured by the point on the route, and similarly for (19b).

- (19) a. *voici la route suivie {^{1.00}par les /^{-0.45}des } premiers*
 see=here the route followed *par the/ de=the* first
explorateurs qui sont arrivés en Amérique
 explorers who are arrived in America

‘This is the route followed by the first explorers who arrived in America.’
 (based on Gaatone 1998: p. 203)

- b. *le désert était traversé ^{0.96}par/^{-0.77}de la caravane*¹⁸
 the desert was crossed *par/ de* the caravan

‘The desert was crossed by the caravan.’

While one could argue that the route in (19a) only comes into existence in and because of the described event, the desert in (19b) cannot be said to be brought about or affected by the caravan. In this case the change is not in the Patient but in the Agent itself. In this sense the Agent is still involved in bringing about a change, namely in its own position (also cf. Dowty’s (1991: p. 572) proto-Agent property “movement (relative to the position of another participant)”).

In sum, while the exact cut-off point will vary between speakers, it is clear that there is a group of highly transitive verbs that require *par*. This group contains at least telic verbs that entail physical change, verbs of maintaining, and verbs with Incremental/Holistic Themes.

¹⁷ This example was not included in our survey, but is uncontroversial.

¹⁸ *Traverser* ‘traverse’ also occurs with *de*, but then selects a bare NP without article: *un espace traversé de/*des tensions politiques* ‘a field riddled with political tensions’. This is a genitive of substance (Martin 2005) and is unrelated.

3.2 Change on a contextually inferred scale

With some verbs that do not imply a change in and of themselves, change can be implied by the use of *par* when a scale can be inferred based on the context. We are only aware of examples of stative verbs, so all the examples in this subsection are cases of entrainment causation.

Inferred scales are particularly frequent with emotion verbs. Being stative, emotion verbs have been reported as preferring or requiring *de* (Clédat 1900 and, to a lesser extent, Straub 1974), but we now see that *par* is available with these verbs as well and appears to be taking over as the default. Nevertheless, *de* remains quite acceptable for most speakers in our survey. It is now used in particular when the emotion is presented as not having any effect. Thus, in (20a), the love of the grandfather has no effect beyond his own emotional state. By contrast, in (20b), the love of the grandfather is the cause of concrete actions, which affect the Patient:¹⁹

- (20) a. *elle est adorée* ^{0.60}*de*/^{0.77}*par* *son grand-père qui devient*
 she is loved *de/ par* her grandfather who becomes
toujours émotionnel quand il regarde ses photos
 always emotional when he looks_at her photos

‘She is loved by her grandfather, who always gets emotional when he looks at her photos.’

- b. *elle est adorée* ^{0.60}*de*/^{0.77}*par* *son grand-père qui l’emmène*
 she is loved *de/ par* her grandfather who her=takes
toujours manger des glaces et lui offre d’énormes
 always eat of=the ice_creams and her gives of=huge
cadeaux pour son anniversaire
 presents for her birthday

‘She is loved by her grandfather, who always takes her to eat ice cream and gives her huge presents for her birthday.’

The mention of concrete actions on the part of the Agent (here Experiencer) in (20b) suggests that the *adorer* event implies a change on a being-spoiled scale. No scale for change can be inferred in (20a). The lower degree

¹⁹ One may compare *He sneezed the napkin off the table*, where *sneeze* atypically brings about a change on a contextually inferred location scale (Beavers 2011: p. 360; Boas 2003: pp. 260–277). Bar-Asher Siegal & Boneh (2020: pp. 38–43) also discuss contextually inferred effects.

of proto-agentivity in (20a) compared to (20b) explains why *de* is more, and *par* less acceptable in (20a) than (20b). When the context is not rich enough, either preposition will be felicitous, but the use of *de* will suggest that the event is relatively inconsequential.²⁰

The judgments for (21–22) are similar, but the difference is not as large:

- (21) a. *le prêtre était très aimé* ^{0.92} *de*/^{0.70} *par* *ses paroissiens*
 the priest was very loved *de/ par* his parishioners
parce qu'il était toujours attentif à leurs besoins
 because=he was always attentive to their needs

'The priest was much loved by his parishioners because he was always attentive to their needs.'

- b. *le prêtre était très aimé* ^{0.83} *de*/^{0.77} *par* *ses paroissiens; ils*
 the priest was very loved *de/ par* his parishioners; they
lui donnaient toujours des tartes et des bouteilles
 him gave always of=the cakes and of=the bottles
de vin
 of wine

'The priest was much loved by his parishioners; they always gave him cakes and bottles of wine.'

- (22) a. *il était évident qu'il s'agissait d'un roi très respecté*
 it was evident that=it REFL=dealt of=a king very respected
^{0.77} *de*/^{0.89} *par* *sa communauté et de/par la société dans*
de/ par his community and *de/par* the society in
son ensemble
 its whole

'It was clear that this was a king who was much respected by his community and the society as a whole.'

²⁰ The choice of Agent preposition with emotion verbs has received quite some attention in the literature on Romance languages. Moody (1972: p. 66) suggests that the loving is Platonic in Portuguese *Nora é amada de todos* 'Nora is loved by all', but that with *por* (French *par*) "an entirely different event may be implied". For Clédât (1900: pp. 222–223), *adoré par* is only felicitous in the sense of 'worship' (*Les animaux [sic] sont adorés par certains peuples* 'Animals are worshiped by certain nations'), which may imply consequences such as offerings or vegetarianism. For Clédât, *de* is required in both contexts in (20). This must reflect an older stage of the language, however, since Straub (1974: p. 586) already reported that *Le garçon est adoré par le grand-père* 'The boy is loved by his grandfather' is felicitous.

- b. *le roi était très respecté* ^{0.64}*de*/^{0.81}*par* *ses sujets qui*
 the king was very respected *de/ par* his subjects who
lui apportaient du tribut chaque année
 him brought of=the tribute every year

‘The king was much respected by his subjects who brought him tribute every year.’

We hypothesize that this has to do with the greater stativity of these verbs. For example, *aimer* and *respecter* combine well with *ne ... plus* ‘no longer’, while *adorer* does not (e.g., *il {n’aime/ne respecte/??n’adore} plus le professeur* ‘he does not love/respect/worship the professor anymore’; cf. Katz 2003 for this test in English).

There are more types of verbs that can imply change on a contextually inferred scale. We already discussed (2) with *accompagner* ‘accompany’ in the introduction. When the parents are involved in the event, they are marked by *par*; *de* is preferred when they are less involved, for example when they are merely watching:

- (2) *les enfants vont jouer au foot accompagnés* ^{0.87}*de*/^{0.94}*par* *leurs*
 the children go play_soccer accompanied *de/ par* their
parents
 parents

‘The children are going to play soccer accompanied by their parents.’
de ⇒ the parents are not very involved; they may be only watching;
par ⇒ the parents may be playing with the children.

When the parents join in the event with *par*, this does not necessarily imply a change, but it might: the game may get rougher, for example. There is a potential for change, and this is already enough to trigger the use of *par*, since *de* would imply that the accompaniment by the parents has no effect at all.²¹

A minimal pair can be constructed along the lines of (23).²² In (23a), the policeman is guarding the inmate, which is seen as a form of (non-physical) af-

²¹ Rappaport Hovav & Levin (2001: pp. 787–788) and Beavers (2011: pp. 357–365) also discuss potential change. The contexts are slightly different, but nevertheless lend support to the idea that sentences in which there is a potential for change are more transitive than sentences in which there is no such potential.

²² We thank an anonymous reviewer for suggesting this contrast.

fecting. We can understand this in two ways. Either the policeman psychologically affects the inmate, or there is a potential for change: if the inmate tries to escape, the policeman will try to prevent this. By contrast, (23b) involves a *former* inmate who merely happens to be accompanied by a policeman. Most of our informants found both *de* and *par* acceptable in both sentences, but several commented that *par* foregrounds the aspect of surveillance.²³

- (23) a. *le détenu se rend au poste médical accompagné*
 the prisoner REFL goes to=the station medical accompanied
^{0.96}*par*/^{0.79}*d'* *un policier*
par/ de a policeman

‘The prisoner is going to the medical station accompanied by a policeman.’

- b. *l'ex-détenu est apparu devant le tribunal,*
 the=ex=prisoner is appeared before the courthouse
accompagné {^{0.89}*par* *le* /^{0.79}*du* } *policier qui l'avait*
 accompanied *par* the/ *de*=the policeman who him=had
arrêté
 arrested

‘The former prisoner appeared in front of the courthouse accompanied by the policeman who had arrested him.’

For some speakers, the possibility of implying a change on a contextually inferred scale is not limited to animate Agents. In (24b), the inanimate mountain chain keeps the value of the village on the scale measuring the speed with which emergency services arrive below a threshold. By contrast, there is no such scale in (24a), where any effect of the surrounding mountains is explicitly denied. Thus, (24b) implies a change on a contextually inferred scale (the lateness of the emergency services).

²³ The difference may be brought out better if the context in (23a) were such that the inmate is more likely to escape (and therefore needs surveillance). For example: *Le détenu se rend aux funérailles de sa mère pendant sa liberté conditionnelle, accompagné par/#d' un policier* ‘The prisoner is going to his mother’s funeral during his parole, accompanied by a policeman.’ A similar contrast is discussed by Moody (1972: p. 66) for Portuguese: *O presidente fugiu seguido da/pela polícia* ‘The president fled followed by the police.’ When *da* is used, the police “did not act upon the president” (e.g., after a coup the president is followed by the police forces loyal to him); but with *pela* (French *par*), the police “pursued” the president (e.g., after the president has escaped with the country’s treasure).

- (24) a. *le village est entouré* ^{0.87} *d'* / ^{0.73} *par* *une chaîne de*
the village is surrounded *de/ par* a chain of
montagnes, mais néanmoins bien relié au reste
mountains but nevertheless well connected to=the rest
du pays
of=the country

'The village is surrounded by a mountain chain, but nevertheless well-connected to the rest of the country.'

- b. *le village est entouré* ^{0.79} *d'* / ^{0.77} *par* *une chaîne de*
the village is surrounded *de/ par* a chain of
montagnes, à cause de laquelle les services d'urgence
mountains at cause of which the services of=emergency
arrivent toujours trop tard
arrive always too late

'The village is surrounded by a mountain chain, because of which the emergency services always arrive too late.'

Our judgments for this pair were confirmed by only a few survey respondents; for most, *de* and *par* were equally acceptable. This may be because as a non-animate Agent, the mountain chain in (24) does not have volitionality, while differences in volitionality could be a contributing factor to the choice of Agent preposition for the previous examples in this section.

3.3 Volitionality: *suivre* 'follow'

There are also verbs for which the difference in interpretation expressed by *de* and *par* does not involve change but volitionality. This is most clear with verbs like *suivre* 'follow' and *précéder* 'precede', that have both a dynamic and a stative, generic reading.²⁴ The clearest difference exists between a purely locative and a goal-oriented, volitional interpretation. The use of *par* is not quite acceptable for all speakers in the former case (25a), while it is required for the standard reading of (25b).²⁵

²⁴ For *suivre* in the meaning of 'follow a path' rather than 'follow something/someone', see (19a) above.

²⁵ The use of *de* suggests a purely spatial relation between the criminal and the detective (thus decreasing the Agent's proto-agentivity). Such a reading was meant to be excluded by *qui voulait le prendre en flagrant délit* 'who wanted to catch him red-handed', but, judging from

- (25) a. *lundi est précédé* ^{0.83}*de*/^{0.50}*par* *dimanche et le mois*
 Monday is preceded *de/ par* Sunday and the month
de février est précédé {^{0.83}*du* /^{0.50}*par* le } *mois de*
 of February is preceded *de=the/ par* the month of
janvier
 January

‘Monday is preceded by Sunday and February is preceded by January.’

- b. *le criminel est suivi* {^{0.35}*du* /^{0.98}*par* le } *detective qui*
 the criminal is followed *de=the/ par* the detective who
voulait le prendre en flagrant délit
 wanted him take red-handed

‘The criminal is followed by the detective who wanted to catch him red-handed.’

Example (25a), together with minimal pairs like (26), suggests that *de* is used more in generic contexts. We share this intuition, but believe this to be a side effect of properties of proto-agentivity. Generic statements can be used to mention things that depend on convention (25a, 26a), whereas a concrete statement like (26b) more often involves volitionality; in this case the author’s volitional choice to order the chapters in this way.

- (26) a. *le dernier chapitre est suivi* ^{0.98}*d’*/^{0.31}*par* *une table des*
 the last chapter is followed *de/ par* a table of=the
matières
 contents

‘The last chapter is followed by a table of contents.’

survey comments, some informants marked *de* as acceptable here because the relation may still be purely spatial, for example if the detective is unknowingly, accidentally following the criminal. Informants also suggested that *de* would be more appropriate in case someone taking a walk is ‘followed by’ a friend or their dog.

- b. *cette introduction est suivie* ^{0.77}*de*/^{0.64}*par* *l'étude de la*
 this introduction is followed *de/ par* the=study of the
*structure atomique et électronique des atomes*²⁶
 structure atomic and electronic of=the atoms

'This introduction is followed by the study of the atomic and electronic structure of atoms.'

To show that the generic flavor of (25a, 26a) is only a side effect, consider the pair in (27). These sentences are equally generic, yet *de* is clearly preferred in (27a), while the difference is smaller in (27b).

- (27) a. *pour mettre en place l'échiquier,* *on place les pions*
 to set in place the=chess_board one places the pawns
sur la deuxième rangée, suivis {^{0.89}*des* /^{0.50}*par* *les*}
 on the second rank followed *de=the/ par* the
autres pièces sur la première rangée
 other pieces on the first rank

'To set up the chess board, we place the pawns on the second rank, followed by the other pieces on the first rank.'

- b. *dans l'ouverture,* *nous avançons d'abord quelques pions,*
 in the=opening_game we advance at_first some pawns
suivis {^{0.77}*des* /^{0.68}*par* *les*} *cavaliers*
 followed *de=the/ par* the knights

'In the opening game, we first advance some pawns, followed by the knights.'

The difference between these sentences lies in the volitionality of the presupposed chess player. In (27a), there is no strong reason to set up the pawns first. It may be slightly more practical (setting up the other pieces first would require lifting the pawns over the other pieces to place them on the second rank), but nothing would go wrong if one were to set up the pieces in a different order instead, for example from left to right. In (27b) however, the player has good reason to advance the pawns first: they can be used to control the center, while at the same time preparing the queen and bishops for development. There is clear purpose behind the decision to advance the

²⁶ Based on <https://www.programmes.uliege.be/cocoon/20212022/cours/CHIM9275-1.html>, retrieved December 8, 2021.

pawns first, even though this purpose (and hence volitionality) is ascribed to the presupposed player rather than the pieces themselves.

The same type of volitionality, and hence proto-agentivity, also explains the preference for *par* in (28b): sending out the infantry before the cavalry is part of a well-thought-out strategy. By contrast, the order in (28a) is determined by protocol, and involves less purpose and volitionality.

- (28) a. *au défilé militaire du 14 juillet, l'infanterie était suivie par de la cavalerie*
 at=the parade military of=the 14 July the=infantry was followed *par/ de* the cavalry

‘In the military parade of July 14, the infantry was followed by the cavalry.’

- b. *Napoléon envoya l'infanterie au combat, suivie par de la cavalerie*
 Napoleon sent_out the=infantry to=the battle followed *par/ de* the cavalry

‘Napoleon sent out the infantry to battle, followed by the cavalry.’

Example (29) presents an interesting case:

- (29) *ce pianiste est toujours suivi par d' admirateurs*
 this pianist is always followed *par/ de*=a crowd of=admirers

‘This pianist is always followed by a crowd of admirers.’

de ⇒ the admirers are physically behind the pianist;

par ⇒ the admirers could also be following the pianist’s career.

(based on Gaatone 1998: p. 203)

Both *de* and *par* are felicitous here, but *de* suggests a spatial relation, whereas *par* suggests that the admirers are following the pianist’s *career*. There are no obvious differences in the proto-transitive properties of verbal aspect, volitionality, telicity, or bringing about a change. It may be that the difference in interpretation is simply due to the frequent use of *de* with *suivre* in purely locative contexts similar to (25a), but this explanation is ad hoc. It rather seems to us that there is a subtle difference in volitionality. With *de*, it is likely that the crowd does not consist of the same members

in each instance of the habitual event: if the pianist is on tour, the crowd will likely be different in each city. A reading in which the members of the crowd change regularly is much less likely with *par*, it seems to us. Here we understand a dedicated group of admirers that persistently follows the pianist's career. This dedication could be understood as relating to a higher degree of volitionality, and hence proto-agentivity. However, it is clear that more minimal pairs with better contexts would have to be tested to verify this.

3.4 Telicity: *abandonner* 'abandon' and *délaisser* 'leave behind'

Finally, with some verbs, the choice between *de* and *par* tells us something about telicity. It has long been recognized that *de* is not always permitted when a goal PP is added, making the event telic:²⁷

- (30) a. *un enfant abandonné de/par ses parents*
a child abandoned *de/par* its parents
'a child abandoned by its parents' (Authier-Revuz 1972: p. 50)
- b. *un enfant abandonné *de/par ses parents sous le porche*
a child abandoned *de/par* its parents under the porch
'a child abandoned by its parents under the porch'
(Authier-Revuz 1972: p. 50)

In (30b), there has clearly been an event of physically abandoning the child, whereas (30a) could be used for a neglected child (and that is certainly the interpretation triggered by *de*). We attempted to capture this contrast in a minimal pair with a difference between children needing food and accommodation due to their parents' abandonment (telic; (31a)) and children needing help with homework and social problems (atelic; (31b)). Another minimal pair tested a similar opposition with *délaisser* 'abandon, neglect': (32a) is telic; (32b) atelic (*laisser* 'leave' behaves the same).

²⁷ These examples were not included in our survey, but are uncontroversial.

- (31) a. *notre organisation soutient les enfants abandonnés*
 our organization helps the children abandoned
^{-0.12}*de/*^{1.00}*par leurs parents avec un logement*
de/ par their parents with an accommodation
et de la nourriture
 and of the food

‘Our organization helps children abandoned by their parents with housing and food.’

- b. *notre organisation vient en aide aux enfants abandonnés*
 our organization comes in aid to=the children abandoned
^{-0.07}*de/*^{0.92}*par leurs parents, et les aide à faire leurs*
de/ par their parents and them helps at doing their
devoirs et résoudre leurs problèmes sociaux
 homework and resolving their problems social

‘Our organization comes to the aid of children abandoned by their parents and helps them with doing their homework and resolving social problems.’

- (32) a. *quand l’alarme a sonné, Notre Dame a été vite*
 when the=alarm has sounded Notre Dame has been quickly
délaissée {^{0.10}*des* /^{0.83}*par les*} *touristes qui s’y*
 abandoned *de=the/ par* the tourists who REFL=there
trouvaient
 found

‘When the alarm rang, the Notre Dame was quickly abandoned by the tourists who were there.’

- b. *voici une photo de Notre-Dame délaissé [sic]* ^{0.28}*de/*^{0.85}*par*
 see=this a photo of Notre Dame abandoned *de/ par*
*ses touristes en plein confinement pendant COVID*²⁸
 its tourists in full quarantine during COVID

‘This is a photo of the Notre Dame, abandoned of its tourists in full lockdown during COVID.’

²⁸ Based on <https://twitter.com/chouettephoto/status/1344600099113074691>, retrieved March 18, 2022.

Though acceptability scores for *de* varied widely between speakers in our survey, this preposition seems to be slightly worse for most speakers in the (a) examples than in the (b) examples. It may be that better contexts can be constructed to make *de* more acceptable in the atelic (b) sentences. The difference in acceptability for *par* is very small, perhaps because *par* acts as the default Agent preposition.

3.5 French *de* and *par* in passives: discussion

In the previous subsections we have shown that the choice between *de* and *par* depends on several properties of the relation between the Agent and the event. The most important factors are bringing about a change (Sections 3.1 and 3.2), volitionality (Section 3.3), telicity (Section 3.4), and the stative/dynamic contrast. When both *de* and *par* are possible, we found that the choice is influenced by one or more of the first three of these properties. The stative/dynamic contrast is a property of clauses that plays in the background of many sentences, but we are not aware of any sentences where the choice between *de* and *par* is only or primarily conditioned by this property.

It seems to us that the property of bringing about a change is primary: if a predicate can imply a change, the use of *par* will force it to do so. Thus, if a predicate *can* imply all of change, volitionality, and telicity, the use of *par* will imply change but not necessarily volitionality or telicity. As evidence for this, note that entrainment causation can be seen as change without telicity (Copley & Harley 2022), and that cases of entrainment causation with clear changes require *par* (recall (17), above). Similarly, non-volitional Agents that bring about a change still require *par* as well:

- (33) *le chien est lavé par/*de Marie, bien qu'elle n'en*
 the dog is washed *par/ de* Marie although=she not=of.them
*avait pas envie*²⁹
 had NEG desire

‘The dog was washed by Marie, though she didn’t want to (wash it).’

We conclude the following for sentences in which both *de* and *par* are allowed:

²⁹ This example, built on (1a), was not included in our survey, but is uncontroversial.

- (34) a. If change could be implied by the event, *par* will imply change and *de* will imply lack of change. The scale to measure change may be inferred contextually. *Par* does not necessarily imply any other properties of proto-agentivity.
- b. If change is excluded by the event, *par* will imply a higher level of volitionality and/or telicity than *de*.

The differences in proto-agentivity presupposed by *de* and *par* can be expressed very transparently with the approach to *by*-phrases proposed in Section 2.2. We argued there that Agent prepositions have denotations of type $\langle e, \langle s, t \rangle \rangle$, and thus naturally lend themselves to express properties of the relation between the Agent and the event. Assuming the polymorphic denotations of *de* and *par* from (14a) and (15a), the concrete meanings in passives can be given as in (35). As discussed for (5b), we use $\text{Initiator}(x, e)$ quite broadly here; our interest is in the difference in presupposed proto-agentivity.

$$(14a) \quad \llbracket \text{par} \rrbracket_{\langle \eta, \langle \theta, t \rangle \rangle} = \lambda g_{\eta} \lambda f_{\theta}. f \text{ is through/via } g$$

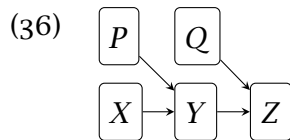
$$(15a) \quad \llbracket \text{de} \rrbracket_{\langle \eta, \langle \theta, t \rangle \rangle} = \lambda g_{\eta} \lambda f_{\theta}. f \text{ is from/of } g$$

- (35) a. $\llbracket \text{par}_{\text{agentive}} \rrbracket_{\langle e, \langle s, t \rangle \rangle}$
 $= \lambda x \lambda e. e \text{ is through/via } x$
 interpretation: $\text{Initiator}(x, e)$
 presupposed: x has high proto-agentivity in e
- b. $\llbracket \text{de}_{\text{agentive}} \rrbracket_{\langle e, \langle s, t \rangle \rangle}$
 $= \lambda x \lambda e. e \text{ is from/of } x$
 interpretation: $\text{Initiator}(x, e)$
 presupposed: x has low proto-agentivity in e

Why would *de* ‘from, of’ imply low proto-agentivity and *par* ‘through, via’ high proto-agentivity? Ultimately, the answer depends on how humans conceptualize causation using spatial notions. We can only sketch the outline of a possible answer here. Consider again the notion of the causal chain in which arguments are either antecedent or subsequent to the Patient (Section 2.1). Croft (2012: pp. 222–226) showed that arguments antecedent to the Patient (Agent, Instrument, etc.) are typically marked by ablative or perlocative prepositions (‘from’, ‘through’), whereas arguments subsequent to the Patient (Beneficiary, Goal, etc.) are typically marked by allative prepositions

(‘to’, ‘for’). We suggest that the causal meaning of a preposition is not only determined by the relative position expressed by its spatial meaning, but also by the *distance* it expresses. In particular, *par* ‘through, via’ places the Figure at a smaller distance from the Ground than *de* ‘from, of’, and would therefore be used for Agents at a smaller “causal distance” from the Patient. This smaller causal distance would then be interpreted as a greater ability for the Agent to affect the Patient, and hence, as a higher degree of proto-agentivity. This argument based on the causal chain can be extended to other causal prepositions; for instance, *avec* ‘with’ expresses an even smaller distance than *par* and can be used for Instruments, which stand between the Agent and the Patient in the causal chain.

Another way to understand the difference in meaning between *par* and *de* builds on causal models (e.g. Halpern & Pearl 2005). Causal models are directed graphs representing the dependency of variables on each other, as in (36):



In this model, *Z* depends on *X* only through *Y*. It can be proven, but is intuitively clear, that the set of cases (i.e., variable assignments) in which *Z* depends on *X* is a subset of the set of cases in which it depends on *Y*. For example, the formula for *Y* may disregard the value of *X* for certain values of *P*; in this case, *Z* still depends on *Y*, but not on *X*.³⁰ Therefore, a greater distance between two variables in the causal model corresponds to a smaller dependency of the effect on the cause. If *Z* were to represent a scale on which change is measured, and *X* and *Y* represent actions by Agents or other causing arguments, a greater distance therefore corresponds to a smaller degree to which an Agent can affect the Patient. This is another way in which the link between the distance expressed by *de* ‘from, of’ can be related to the implication of low proto-agentivity in its causal uses.

It is important to note that in different languages, prepositions with very similar spatial meanings may have different causal meanings. Staps & Beukenhorst (2024) argue that in Biblical Hebrew, the preposition *min* ‘from’ marks

³⁰ We leave more complex models out of consideration here (e.g., if *Q* were to also depend on *X*, so that *Z* depends on *X* through two paths). It is not clear that natural languages can describe such models without periphrasis.

Causes that are more “dominant” than those marked by *bə* ‘in’. Dominant causers are, among other things, not effected by other participants (thus, Agents can be dominant, but Instruments cannot), and have a greater potential to bring about an effect in other participants (e.g., the Patient). In French, *de* is intuitively *less* dominant than *par*, even though it has roughly the same spatial meaning as Biblical Hebrew *min*. Thus, it becomes clear that there are different ways to express causal relationships in spatial terms. This is not necessarily a problem. One may compare this situation with the two conceptualizations of time described by Lakoff & Johnson (1980): one in which we are stationary and time moves (*there’s a deadline coming up*), and one in which we move through time (*the weeks behind us*). These two conceptualizations can coexist even within the same language, so there is no reason why two different spatial conceptualizations of causation could not coexist. For this reason, it is not necessary to choose between the explanation based on a causal chain and the one based on causal models above. Both are equally possible ways for speakers to spatially represent causal relations, and we have at present no reason to prefer one over the other; the two explanations may actually reinforce each other. What is crucial, however, is that both conceptualizations have a cognitive basis. In that sense, the proposal we put forward here is more constrained than one in which different senses of prepositions receive entirely unrelated semantics.

4 Related work

In this section we discuss related work. Section 4.1 compares our results to previous work on French *de* and *par*, and Section 4.2 discusses other formal accounts of *by*-phrases in passives. Finally, in Section 4.3 we compare our approach to polysemy in causal prepositions using polymorphic types to an alternative using sum types.

4.1 Related work on French *de* and *par*

The distinction between *de* and *par* has received quite some attention in the literature. Though the choice depends in part on register (*de* being more formal; Gougenheim 1938: p. 307; and nowadays felt to be archaic), our focus is here on semantic distinctions. An intuitive approach based on the difference between verbal and adjectival passives cannot be used to describe the

data.³¹ Instead, the difference is usually framed in terms of Aktionsart, with *de* co-occurring with stative events (Zumthor & von Wartburg 1947: p. 297). The most complete descriptive generalization is given by Straub (1974):

- (37) a. The Agent of a verb that denotes a non-state is always marked by *par*.
 b. Verbs denoting states with animate Agents can be marked by both *de* and *par*.
 c. Verbs denoting states with inanimate Agents always take *de*.

In our analysis we used the notion of proto-agentivity, claiming that *de* expresses low proto-agentivity while *par* is used for more prototypical Agents and as a default. This derives the intuition of (37), if we remember that the stative/dynamic contrast is related to proto-agentivity through transitivity (Hopper & Thompson 1980), and that animacy is related to proto-agentivity through the notions of volitionality and bringing about a change.

However, (37) is not precise enough, since many of the judgments from Section 3 are incompatible with it.³² As just one example, (24b) is typically seen as a state and has an inanimate Agent, yet allows *par* (contra (37c)):

- (24b) *le village est entouré* ^{0.79}*d'*/^{0.77}*par* *une chaîne de montagnes,*
 the village is surrounded *de/ par* a chain of mountains
à cause de laquelle les services d'urgence arrivent toujours
 at cause of which the services of=emergency arrive always
trop tard
 too late

‘The village is surrounded by a mountain chain, because of which the emergency services always arrive too late.’

³¹ Given the preference of *de* for statives, we might expect that adjectival passives take *de*, while verbal passives take *par*. However, some simple tests based on Hallman (2021) show that this idea does not pan out. *De*-passives can be verbal, too (cf. (2)), and combinations with adjectival morphology and coordination with adjectives do not rule out either *par*-phrases or *de*-phrases (*Le garçon est gentil et très adoré par le/du grand-père* ‘The boy is kind and very much loved by the grandfather’), nor do verbs like *sembler* ‘seem’ (*Le garçon semble adoré par le/du grand-père* ‘The boy seems loved by the grandfather’). It is not clear that the verbal-adjectival passive distinction is useful in French.

³² Many examples are also discussed by Gaatone (1998: pp. 175–210). Our analysis is compatible with his data, but we do not systematically compare our work to his since he does not propose an explanatory theory.

We explained this by appealing to the notion of entrainment causation (Section 3.1) to make a more precise distinction than that between “states” and “non-states”, and by allowing for contextually inferred scales to measure change (Section 3.2).

Another problem with (37) is that it does not predict anything regarding the choice between *de* and *par* when both are possible (37b). We resolved this by moving away from a strict rule-based approach (“if a sentence has these properties, this preposition must be used”) to a more flexible approach based on the *degree* of proto-agentivity. This approach also does more justice to the variation between speakers and to the fact that for many sentences the difference in acceptability between the two prepositions is small.

4.2 Related work on *by*-phrases

There are two mainstream formal semantic accounts of *by*-phrases in passives. The main difference between them is whether the *by*-phrase is an argument or an adjunct.³³ The approach on which we built our own proposal in Section 2.2 is that of Angelopoulos, Collins & Terzi (2020), who argue that the *by*-phrase is an argument of ν (the head of the light verb phrase introducing the Agent). It thus takes the same place as the external argument in an active sentence. Angelopoulos, Collins & Terzi (2020) are not explicit about a formal semantic analysis but base themselves on Collins (2018), who gives the Agent preposition the identity function as its denotation:

$$(38) \quad \llbracket \text{by}_{\text{agentive}} \rrbracket = \lambda x.x \quad (\text{Collins 2018: p. 4})$$

As a result, the denotation of the *by*-phrase is of type $\langle e \rangle$ and can compose by Function Application with the denotation of ν' , which has type $\langle e, \langle s, t \rangle \rangle$. By contrast, we argued that the type of *by* must be $\langle e, \langle s, t \rangle \rangle$ (and composes with ν' using Event Identification). Section 2.2 presented this mostly as following from our suggestion for the formalization of principled polysemy in Section 2.1, but there is an independent reason why we believe (38) is not ideal. With the denotation in (38), *by* is essentially seen as a kind of case marker, needed to mark the argument but semantically vacuous. This

³³ See Williams (2015: pp. 281–291). We focus on what he terms “Base Argument Theories”, which assume that “some syntactic part of a short passive clause, and some part of the host in a long passive, has a functional semantic argument in the deep-S role” (Williams 2015: p. 282). We do not discuss No Base Argument Theories, being unaware of formal semantic analyses in such theories.

may suffice for English *by*, but we have seen in Section 3 that French *de* and *par* are *not* semantically vacuous. Instead, they carry a presupposition concerning properties of the Agent’s relation to the event.

Since this presupposition does not concern an inherent property of the Agent (e.g., animacy) but a property of the relation of the Agent to the event, we believe the most transparent way to do this is to have the denotation of *by* take the event as an argument. It would be much less transparent to have a presupposition “*x* has high proto-agentivity in *e*” on a preposition with the meaning in (38), since it would have to be contextually inferred what event *e* refers to. We find a formalization in which the presupposition only depends on variables provided as arguments to the denotation preferable. Admittedly, this argument does not entirely rule out an analysis along the lines of (38). However, we see no immediate benefit to such an analysis, while we do believe it is worthwhile to make the reference of the presupposition to the event transparent and to systematically derive the meaning of Agent prepositions from a more general, polymorphic meaning of that preposition (as discussed in Section 2.1).

Another common approach to *by*-phrases is found in Bruening (2013) (Legate 2014 has a similar proposal). Bruening (2013) assumes a VoiceP of type $\langle e, \langle s, t \rangle \rangle$. In a regular active sentence, the $\langle e \rangle$ argument of this projection is saturated by the external argument (39a), and in a passive without a *by*-phrase, it is saturated by existential closure of an additional Pass projection above VoiceP (39b). In a passive with a *by*-phrase, the *by*-phrase is an adjunct to Voice'. It is seen as a purely functional element of type $\langle e, \langle \langle e, \langle s, t \rangle \rangle, \langle s, t \rangle \rangle \rangle$ (39c), which fills in the argument of Voice (i.e., it performs the same task as the external argument in the active voice); the passive Voice head is semantically vacuous (39d):

- (39) a. $\llbracket \text{Voice} \rrbracket_{\langle \langle s, t \rangle, \langle e, \langle s, t \rangle \rangle \rangle} = \lambda p \lambda x \lambda e. p(e) \ \& \ \text{Initiator}(e, x)$
(Bruening 2013: p. 21)
- b. $\llbracket \text{Pass} \rrbracket_{\langle \langle e, \langle s, t \rangle \rangle, \langle s, t \rangle \rangle} = \lambda p \lambda e. \exists x : p(x, e)$
(without *by*-phrase; Bruening 2013: p. 25)
- c. $\llbracket \text{by} \rrbracket_{\langle e, \langle \langle e, \langle s, t \rangle \rangle, \langle s, t \rangle \rangle \rangle} = \lambda x \lambda p \lambda e. p(x, e)$ (Bruening 2013: p. 25³⁴)
- d. $\llbracket \text{Pass} \rrbracket_{\langle \langle s, t \rangle, \langle s, t \rangle \rangle} = \lambda p \lambda e. p(e)$
(with a *by*-phrase; Bruening 2013: p. 25)

³⁴ We have modified this denotation from the original $\llbracket \text{by} \rrbracket = \lambda x \lambda p \lambda e. p(e, x)$ with the arguments to *p* swapped for consistency with the rest of the paper.

In this analysis, the denotation of the Agent preposition has access to the event argument, so our critique of Collins (2018) does not apply. However, note that this approach makes some unusual syntactic assumptions (cf. Roberts 2019: p. 437), and also fails to account for certain binding facts (Collins 2018, Angelopoulos, Collins & Terzi 2020): the Agent in a *by*-phrase can bind an anaphor in the VP (40a), which is expected if the *by*-phrase is an argument, as in Angelopoulos, Collins & Terzi (2020) and our modification of it, but unexpected if the *by*-phrase is an adjunct. Both *de* and *par* behave like English *by* with respect to binding (40b), in contrast to other French prepositions (40c):

- (40) a. *The packages were sent **by** the children_i to themselves_i.*
 (Angelopoulos, Collins & Terzi 2020: p. 11)
- b. *les enfants vont jouer au foot accompagnés **de/par** leurs*
 the children go play_soccer accompanied *de/par* their
parents_i conformément à leur_i propre volonté
 parents according to their own will
- ‘The children are going to play soccer accompanied by their parents according to their own wish.’
- c. *les enfants vont jouer au foot *avec/*sans /*chez/*pour*
 the children go play_soccer with/ without/ at / for
leurs parents_i conformément à leur_i propre volonté
 their parents(‘) according to their own will
- ‘The children are going to play soccer with/without/at/for their parents(‘) according to their own wish.’

For this reason, we adopted an account under which the *by*-phrase is an argument in Section 2.2.

4.3 Polymorphism compared to sum types

Finally, in this subsection we discuss an alternative approach to polysemy of causal prepositions. Maienborn & Herdtfelder (2017) show that German *von* ‘from, of, by’ can be used for causal adjuncts with both stative and eventive readings, which have different inferential properties. Stative (41a) implies that the hailstones are (i) on the square and (ii) white, while eventive (41b) does not imply that the shoes are (i) still on the bench or (ii) dirty.

- (41) a. *der Platz ist weiß von den Hagelkörnern*
the square is white von the hailstones

‘The square is white from the hailstones.’

(Maienborn & Herdtfelder 2017: p. 285)

- b. *die Bank ist dreckig von den Schuhen*
the bench is dirty von the shoes

‘The bench is dirty from the shoes.’

(Maienborn & Herdtfelder 2017: p. 285)

Maienborn & Herdtfelder (2017) give an account in Type Composition Logic (Asher 2011), in which these inferential properties are derived from a different type. They propose that stative *von* expresses a causal relation between TROPES (Moltmann 2007), while eventive *von* expresses a relation between EV(ent)s. Simplifying some matters that are inconsequential to our comparison here, arguments of *von* are of the sum type $EV \sqcup TROPE$: they are either of type EV, or of type TROPE. Since the actual type of the argument propagates, inferential differences can be derived from whether the argument is an event or a trope.

This approach is superficially similar to ours with a polymorphic type $\langle \eta, \langle \theta, t \rangle \rangle$ (4): one might say that EV and TROPE are two types with which η and θ can be instantiated. However, note that Maienborn & Herdtfelder (2017) are only concerned with uses of *von* in causal adjuncts. The type constraint does not generalize to Agentive *von*, let alone meanings in other domains such as that of space (*von hinten* ‘from behind’) or time (*von morgens* ‘from morning’). The type constraint could be modified to include more possible argument types, but this would lead to a rather complex lexical entry. In order to describe the full range of uses of a preposition, it seems preferable to us to separate its domain-specific meaning from its general meaning, as in the approach developed in (4). This enables the polymorphic typing approach developed here to capture this polysemy efficiently. The requirement spelled out in Section 2 that each concrete interpretation is motivated by a cognitive linguistic explanation prevents the model from over-generating.

Besides being more minimal, an approach in which a preposition’s general (polymorphic) meaning is separate from domain-specific (concrete) interpretations is also in line with other observations concerning the polysemy of prepositions. We have already seen that different languages may have different causal interpretations of what seems to be the same spatial preposition.

In an approach where general meaning is separate from concrete interpretations, we can hypothesize that in such cases the prepositions have the same general meaning, even though their concrete interpretations may differ from language to language. The overlap in concrete spatial meaning is then easily explained, while the differences in causal meaning are due to different conceptualizations of causation. In other approaches (either with a single complex lexical entry, or multiple, unrelated entries) the overlap in meaning between such prepositions is coincidental.

5 Conclusions

Common approaches to *by*-phrases in passives treat the Agent preposition as semantically vacuous: it merely rearranges the arguments so that the argument of *by* fulfills the same role as the external argument in the corresponding active sentence (Bruening 2013, Legate 2014, Collins 2018, Angelopoulos, Collins & Terzi 2020). This paper put forward three arguments against this view.

First, cross-linguistic research shows that Agent prepositions develop from prepositions with specific spatial meanings, and cognitive linguistic arguments can be given to relate these spatial meanings to the function of Agent marking (Croft 2012: pp. 222-226). However, common approaches to *by*-phrases essentially treat agentive *by* as accidentally homonymous with spatial *by*, and therefore cannot explain this cognitively motivated cross-linguistic pattern.

Second, we discussed languages with more than one Agent preposition, where the choice of the Agent preposition is semantically motivated. Building on Straub (1974) and others, we showed that French *de* ‘from, of, by’ is used for Agents with low proto-agentivity, whereas *par* ‘through, by’ is the default Agent preposition and used for Agents with high proto-agentivity. Current approaches to *by*-phrases may be able to express such differences but are, we feel, not the most transparent way to do so.

Third, common approaches to *by*-phrases in passives do not generalize to other syntactic environments in which the same preposition appears with a causal meaning. This is especially problematic in the case of French, where it can be shown that the meanings of *de* and *par* in passives are similar to those in causal adjuncts. In causal adjuncts, *de* is related to stativity (marking causes that are situations), while *par* is related to dynamicity (marking causes that are forces). Stativity and dynamicity are related to low and high

proto-agentivity, respectively, which is what *de* and *par* presuppose in passives. This parallel suggests that a formalization must not be limited to the syntactic environment of the passive.

The alternative we present builds on the notion of principled polysemy (Tyler & Evans 2003): the idea that the many different meanings of prepositions are not accidentally homonymous, but are instead related to each other through a shared core. We propose to formalize this using a polymorphically typed general denotation. This general denotation is typically an abstract form of the spatial meaning of the preposition, since spatial meanings tend to be original in processes of semantic extension. It has a polymorphic type: $\langle \eta, \langle \theta, t \rangle \rangle$, in which η and θ still have to be instantiated with concrete types to obtain a concrete interpretation.

In this system, the exact meaning of a preposition in context will depend on three things. First, the syntactic and semantic context forces a certain type on the denotation of the preposition. Second, the interpretation is restricted to a certain domain depending on the type (e.g., the spatial domain for $\langle e, \langle e, t \rangle \rangle$ or the causal domain for $\langle e, \langle s, t \rangle \rangle$). Third, the concrete meaning within that domain depends on the way that domain is spatially conceptualized in the mind. For example, in the case of causation, causes are typically conceived of as antecedent and/or proximate to effects (e.g., Croft 2012: pp. 222–226), which can explain why prepositions like English *by* and French *de* and *par* receive the causal interpretation they do.

This approach can be extended to systems with more types than e , s , and t to derive the meanings of different prepositions in a broader range of contexts. In Section 2.3 we showed how this might work, analyzing French *de* and *par* in causal adjuncts in the force-theoretic framework of Copley & Harley (2022). We hope that the approach to the polysemy of prepositions put forward here is useful for other prepositions in other domains as well.

A Survey data

Most of the French example sentences from this article are based on real-world examples on the web or examples from the literature. Examples from the web were found through Google and Linguee and come from sources that we assumed were written by native speakers. We adapted sentences to add context to promote a certain reading and added sentences to create minimal pairs. Examples (2) and (29) were unintentionally ambiguous.

We confirmed our judgments, except for some uncontroversial examples, with a small number of native speakers in an informal survey. We invited informants whom we expected to still be familiar with a more formal or archaic register, based on age, education level, and religious background (as Bible translations tend to use a more conservative register). 21 Informants from France, Belgium, and Switzerland completed the survey, with a mean age of 49 (standard deviation 19); 16 (76%) had at least a Master's degree. Though the sample size is not large enough to expect statistically significant results, the tendencies in the data align with our own judgments. For each sentence there was also space for comments, for example to remark on differences in interpretation when respondents considered both *de* and *par* were acceptable. These comments were all in line with our own intuitions.

Each sentence was presented as-is to the participants without additional context, but with the Agent preposition replaced by a blank (e.g., *Le chien est lavé ... Marie* for (1a)). Participants were then asked to rate the acceptability of both *de* and *par* on a 6-point Likert scale ranging from *pas du tout acceptable* 'not at all acceptable' to *parfaitement acceptable* 'perfectly acceptable'. They were asked to rate a preposition as acceptable if they were familiar with its use in the given context even if they would not use it themselves.

The results are summarized in Table 2 below, in the order the sentences are discussed in Sections 2 and 3 (the raw data is given in Table 3). The table indicates for each sentence whether we expected the sentence to have relatively high or proto-agentivity (and thus, whether we expected *par* or *de*, respectively, to be more acceptable). The scores for each preposition are presented in stacked bar charts. They were also recoded to values from -1 (not at all acceptable) to 1 (perfectly acceptable) to be able to compute the mean, which we only used to give a quick impression of the general tendency in judgment marks throughout this chapter.

Example		Distribution	Mean
Causal adjuncts (Section 2.3)			
(13a)	<i>mort</i> ¹	<i>de</i>	1.00
		<i>par</i>	-0.87
(13b)	<i>cassée</i> ²	<i>de</i>	-0.90
		<i>par</i>	0.37
Change (Section 3.1)			
(1a)	<i>lavé</i> (high)	<i>de</i>	-0.96
		<i>par</i>	1.00
(17)	<i>maintenu</i> (high)	<i>de</i>	-0.81
		<i>par</i>	1.00
(19a)	<i>suivie</i> (high)	<i>de</i>	-0.45
		<i>par</i>	1.00
(19b)	<i>traversé</i> (high)	<i>de</i>	-0.77
		<i>par</i>	0.96
Contextually implied change (Section 3.2)			
(20a)	<i>adorée</i> (low)	<i>de</i>	0.60
		<i>par</i>	0.77
(20b)	<i>adorée</i> (high)	<i>de</i>	0.50
		<i>par</i>	0.92
(21a)	<i>aimé</i> (low)	<i>de</i>	0.92
		<i>par</i>	0.70
(21b)	<i>aimé</i> (high)	<i>de</i>	0.83
		<i>par</i>	0.77
(22a)	<i>respecté</i> (low)	<i>de</i>	0.77
		<i>par</i>	0.89
(22b)	<i>respecté</i> (high)	<i>de</i>	0.64
		<i>par</i>	0.81
(2)	<i>accompagnés</i>	<i>de</i>	0.87
		<i>par</i>	0.94
(23a)	<i>accompagné</i> (high)	<i>de</i>	0.79
		<i>par</i>	0.96
(23b)	<i>accompagné</i> (low)	<i>de</i>	0.79
		<i>par</i>	0.89
(24a)	<i>entouré</i> (low)	<i>de</i>	0.87
		<i>par</i>	0.73
(24b)	<i>entouré</i> (high)	<i>de</i>	0.79
		<i>par</i>	0.77

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Volitionality (Section 3.3)

(25a)	<i>précédé</i> (low)	<i>de</i>		0.83
		<i>par</i>		0.50
(25b)	<i>suivi</i> (high)	<i>de</i>		0.35
		<i>par</i>		0.98
(26a)	<i>suivi</i> (low)	<i>de</i>		0.98
		<i>par</i>		0.31
(26b)	<i>suivi</i> (high)	<i>de</i>		0.77
		<i>par</i>		0.64
(27a)	<i>suivis</i> (low)	<i>de</i>		0.89
		<i>par</i>		0.50
(27b)	<i>suivis</i> (high)	<i>de</i>		0.77
		<i>par</i>		0.68
(28a)	<i>suivie</i> (low)	<i>de</i>		0.81
		<i>par</i>		0.71
(28b)	<i>suivie</i> (high)	<i>de</i>		0.73
		<i>par</i>		0.77
(29)	<i>suivi</i> (high)	<i>de</i>		0.66
		<i>par</i>		0.98

Telicity (Section 3.4)

(31a)	<i>abandonnés</i> (high)	<i>de</i>		-0.12
		<i>par</i>		1.00
(31b)	<i>abandonnés</i> (low)	<i>de</i>		-0.07
		<i>par</i>		0.92
(32a)	<i>délaissée</i> (high)	<i>de</i>		0.10
		<i>par</i>		0.83
(32b)	<i>délaissé</i> (low)	<i>de</i>		0.28
		<i>par</i>		0.85

■ Not at all acceptable
 ■ Not acceptable
 ■ Not quite acceptable
■ Somewhat acceptable
 ■ Acceptable
 ■ Perfectly acceptable

1 Tested with *faim*.

2 Tested with *l'impact du ballon*.

Table 2: Survey data (high = high proto-agentivity; low = low proto-agentivity).

Formalizing spatial-causal polysemy

Example		---	--	-	+	++	+++
(13a) <i>mort</i>	<i>de</i>	0	0	0	0	0	21
	<i>par</i>	15	5	1	0	0	0
(13b) <i>cassée</i>	<i>de</i>	16	5	0	0	0	0
	<i>par</i>	4	2	1	0	2	12
(1a) <i>lavé</i> (high)	<i>de</i>	19	2	0	0	0	0
	<i>par</i>	0	0	0	0	0	21
(17) <i>maintenu</i> (high)	<i>de</i>	13	7	0	1	0	0
	<i>par</i>	0	0	0	0	0	21
(19a) <i>suivie</i> (high)	<i>de</i>	8	3	6	2	2	0
	<i>par</i>	0	0	0	0	0	21
(19b) <i>traversé</i> (high)	<i>de</i>	13	5	2	1	0	0
	<i>par</i>	0	0	0	0	2	19
(20a) <i>adorée</i> (low)	<i>de</i>	0	0	1	4	10	6
	<i>par</i>	0	1	0	2	4	14
(20b) <i>adorée</i> (high)	<i>de</i>	0	1	3	3	7	7
	<i>par</i>	0	0	0	1	2	18
(21a) <i>aimé</i> (low)	<i>de</i>	0	0	0	1	2	18
	<i>par</i>	0	0	2	3	4	12
(21b) <i>aimé</i> (high)	<i>de</i>	0	0	2	0	3	16
	<i>par</i>	0	0	1	1	7	12
(22a) <i>respecté</i> (low)	<i>de</i>	0	0	1	0	9	11
	<i>par</i>	0	0	0	0	6	15
(22b) <i>respecté</i> (high)	<i>de</i>	0	1	2	2	5	11
	<i>par</i>	0	1	0	1	4	15
(2) <i>accompagnés</i>	<i>de</i>	1	0	0	0	2	18
	<i>par</i>	0	0	0	0	3	18
(23a) <i>accompagné</i> (high)	<i>de</i>	0	1	1	1	2	16
	<i>par</i>	0	0	0	0	2	19
(23b) <i>accompagné</i> (low)	<i>de</i>	0	1	1	2	0	17
	<i>par</i>	0	1	0	0	2	18
(24a) <i>entouré</i> (low)	<i>de</i>	1	0	0	0	2	18
	<i>par</i>	1	0	1	1	4	14
(24b) <i>entouré</i> (high)	<i>de</i>	0	0	1	2	4	14
	<i>par</i>	0	1	0	2	4	14
(25a) <i>précédé</i> (low)	<i>de</i>	0	1	0	1	3	16
	<i>par</i>	1	0	1	7	4	8
(25b) <i>suivi</i> (high)	<i>de</i>	1	3	1	5	4	7
	<i>par</i>	0	0	0	0	1	20
(26a) <i>suivi</i> (low)	<i>de</i>	0	0	0	0	1	20
	<i>par</i>	1	3	3	3	4	7

(continued on the following page)

(continued from the previous page)

(26b)	suivi (high)	de	0	1	1	1	3	15
		par	0	1	2	3	3	12
(27a)	suivis (low)	de	0	0	1	0	3	17
		par	1	1	1	5	4	9
(27b)	suivis (high)	de	0	0	0	3	6	12
		par	0	0	3	2	4	12
(28a)	suivie (low)	de	0	0	1	1	5	14
		par	1	0	2	0	4	14
(28b)	suivie (high)	de	0	1	1	3	1	15
		par	0	0	0	4	4	13
(29)	suivi (high)	de	0	1	1	4	3	12
		par	0	0	0	0	1	20
(31a)	abandonnés (high)	de	3	7	3	3	1	4
		par	0	0	0	0	0	21
(31b)	abandonnés (low)	de	3	5	3	5	2	3
		par	0	0	1	0	1	19
(32a)	délaissée (high)	de	3	4	4	1	2	7
		par	0	0	0	1	7	13
(32b)	délaissé (low)	de	0	5	2	4	4	6
		par	0	0	1	1	3	16

Table 3: Raw data for Table 2 (--- = not at all acceptable; ...; +++ = perfectly acceptable).

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