Situating Events in Language

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Abstract

It is currently acknowledged that events constitute an integral part of the metaphysics and semantic machinery for interpreting natural language utterances [5, 4]. Most research into event semantics since Davidson and Parsons [23] has focused on questions relating to either aspectual classifications (Akstionsarten) or temporal semantics. One area that has received far less attention is the issue of *event localization*, that is, the problem of spatially situating events. In this paper, I discuss the procedures for identifying where events, as expressed in natural language, are located in space. Aspects of the semantics of event localization have been recently proposed, including the notion of the "shape" of a movement [7, 38], as well as treating movement verbs as "path creation" predicates [28]. In this paper, I build on these and some additional observations to outline a more general semantics of event localization. I then outline a procedure that extends the path metaphor used for motion predicates, distinguishing between the event locus and the spatial aspect of an event. In the process, I discuss how localization is supervenient upon the participants in the events, but not as straightforwardly as one might expect.

Keywords: Spatial language, Event semantics, Qualitative spatial reasoning

1 Introduction

The problem of temporally situating events in language has been approached by a number of philosophical techniques, including Davidson's particularist

theory of event individuation [5, 4] and Kim's property exemplification theory [15]. Both of these theories have been developed within linguistic semantic traditions, as well (cf. [23, 2] and others). However, the problem of event localization (spatially situating events) has not been discussed as extensively in the semantics literature. This paper discusses an issue of some importance to both qualitative spatial reasoning (QSR) as well as natural language semantics. The aim of this brief note is to discuss procedures for identifying where events, as expressed in natural language, are located in space. While much fundamental work has been done on modeling the topological and orientational relations between objects viewed as regions ([29, 3, 6, 1]), the theoretical foundations for a similar calculus of relations for locating eventualities is less developed. Similarly, in linguistic semantics research, the question of where events are spatially located has also been generally neglected, when compared to the effort devoted to the temporal and aspectual interpretation of eventualities. Some notable exceptions to this involve the analysis of motion events, where identification of the path is an inherent aspect of the semantics of the predicate and associated composition with spatial prepositional phrases ([7, 37, 22, 38, 28]).

For the purpose of this paper, *event localization* will refer to the process of identifying the spatial extent of an event, activity, or situation, what we refer to as its *minimum embedding space*. The focus here will be on the interpretation of natural language descriptions of events, and not on event recognition and classification from other modalities, such as sensor arrays or visual input. We argue that the localization of an event appears to depend on three major semantic factors: (i) the internal structure of the event; (ii) its semantic type; and (iii) the specific role that the event participants play in the event. Localization can be defined as the computation of the minimum embedding space, the *event locus*, for the participants in an event. This is the minimum bounding region within which the event transpires, including all relevant participants. Within this space, it is often the case that a relative location is linguistically singled out, what we call the *spatial aspect* of the event. As we demonstrate, when this happens, a semantic distinction is introduced between the locus (figure) and its aspect (ground). Finally, we outline the localization procedure for both motion and some non-motion predicates in language.

2 Previous Work on Locating Events

To begin, consider the distinction typically made in linguistics in how time and space are interpreted semantically. In earlier philosophical discussions, it was widely assumed (e.g., Vendler [36]) that events are interpreted relative to times, while objects are interpreted relative to locations. For example, the eventualities in (1a) can each be temporally situated, giving rise to distinct interpretations in tense, aspect, or genericity.

(1) a. Maria *left* for Warsaw.
b. Piotr *finished* his book.
c. Fred *was eating* a sandwich.
d. Barbara *had invited* me before Eva *wrote* me.

Vendler distinguishes such temporal localizations for events from object localizations. Consider the sentences in (2), where the objects participate in an inherent spatial relation, which can be temporally anchored.

(2) a. My dog is in the backyard.
b. There's milk in the glass.
c. The projector is on the table.
d. The screen is behind me.

Yet, just as it is possible to temporally anchor the spatial relations in (2), it is clear that language allows for events to be anchored in space with regularity (cf. (3)).

(3) a. The party was in the basement.
b. The committee held a vote in the conference room.
c. The dog walked on the carpet with his dirty paws.
d. Sophie danced in her bedroom.

Still, Vendler (1967) believed that the predicative operations involved in locating objects in space should not be associated with events. This "to each their own" philosophy forces the spatial properties of events (as well as the temporal aspects of objects) to be derivative in nature. We return to this below, with Davidson's ([5]) introduction of events as first-class objects in semantics.

Briefly, two approaches to temporal anchoring can be distinguished: (i) time as modality; and (i) the method of temporal arguments. For the former approach, a sentence such as *John was happy* is treated as a proposition scoped by an operator, P: $P(happy(john))$ ([24, 14, 21]). The method of temporal arguments reifies the temporal index which is used to anchor the evaluation of the proposition:

(4) $\exists t[hungry(john, t) \wedge t < now]$

This method was first explored in Russell [32] and Kim [16], but did not become common until McCarthy and Hayes [20] incorporated it into the situation calculus for automatic reasoning systems. By individuating the proposition as an event, Davidson's proposal is similar, in that it employs the "method of arguments" with an additional parameter, e.

The methods available for locating events in space are similar to those employed for time: namely, using a modality or adding an argument. Treating space as a modality has been explored since Rescher and Garson [31]. For example, to express the location in the sentence, *John met Mary*, a modal operator P_α can be employed, denoting an accessibility relation to a different location, e.g., "some location other than here":

(5) $P_\alpha(meet(john, mary))$

The method of "spatial arguments", on the other hand, introduces a location argument to the predicate, as shown below:

(6) $\exists l[meet(john, mary, l) \wedge in(l, \text{Boston})]$

This has been standard within situation calculus fragments for naive theories of physics (e.g., Hayes [9]), and is the starting point for defining topological relations within the qualitative spatial reasoning (QSR) community [29, 3] as well.

It is also the approach taken by Davidson [4] in his semantics of action sentences. Starting with the assumption that an event is a first-order individual, e, participating in the argument structure of a predicate, $P(x_1, \ldots, x_n, e)$, Davidson identifies the location of an event as a relation between the event variable and an introduced location argument, l, e.g., $loc(e, l)$. For example, consider the sentence and logical form below, ignoring for now, issues of tense.

(7) a. John sang in a field.
b. $\exists e \exists l[sing(j, e) \wedge in(e, l) \wedge field(l)]$

Regardless of the specific spatial relation present (*on*, *under*, *in back of*), Davidson's program is focused on relating the event to an object or location, rather than actually localizing the action itself. To illustrate this, consider the sentences in (8) and the predicated locations of the contained events.

(8) a. Mary ate her lunch under a bridge.
$\exists e \exists l[eat\_lunch(m, e) \wedge under(e, l) \wedge bridge(l)]$
b. The robbery happened behind a building.
$\exists e \exists l[robbery(e) \wedge behind(e, l) \wedge building(l)]$

Notice that the events are positioned *relative* to the other objects and are not actually located *in* space.

Because of their grammatical and semantic import, linguistic interest in identifying the locations of events has focused largely on motion verbs and the role played by paths. Jackendoff [11, 13] elaborates a semantics for motion verbs incorporating explicit reference to the *path* traversed by the mover, from source to destination (goal) locations. Talmy's ([33, 34]) work develops a similar conceptual template, where the path followed by the figure is integral to the conceptualization of the motion event frame. Hence, the path can be identified as the central element in defining the location of the event. Related to this idea, both Zwarts [37] and Pustejovsky and Moszkowicz [28] develop mechanisms for dynamically creating the path traversed by a mover in a manner of motion predicate, such as *run* or *drive*. Starting with this approach, the localization of a motion event, therefore, is at least minimally associated with the path created by virtue of the activity.

In addition to capturing the spatial trace of the object in motion, several researchers have pointed out that identifying the shape of the path during motion is also critical for fully interpreting the semantics of movement. Eschenbach et al [7] discusses the orientation associated with the trajectory, something they refer to as *oriented curves*. Motivated more by linguistic considerations, Zwarts [38] introduces the notion of an *event shape*, which is the trajectory associated with an event in space represented by a path. He defines a shape function, which is a partial function assigning unique paths to those events involving motion or extension in physical space. This work suggests that the localization of an event makes reference to orientational as

well as configurational factors. Zwarts also points out that the scalar semantics of degree predicates (such as *widen*) can be analyzed through the use of path composition rules [38], as well.

Beyond the work mentioned above, there has been little effort to articulate a general semantics for event localization that incorporates non-motion predicates. In this paper, I will propose some initial thoughts on what such a model should look like. The approach I take here is based on two distinct but interacting observations. First, I extend the path metaphor to non-movement events. This forces us to look at the various regions associated with the event participants, and the interactions between the participants. Secondly, I draw a distinction between the "relative spatial anchoring" of Davidson's analysis, and the actual event localization, which is the minimal location within which the action or event takes place. I argue that this is analogous to the distinction between an event's tense and its aspect within the temporal domain. On this view, Davidson's relative locational interpretation can be viewed as the reference location of the event, i.e., the *spatial aspect*. Similarly, the actual region encompassing the event is analogous to the tense (event time), and it is this region that we refer to as the *event locus*.

In the next section, we will see that the determination of the event locus is supervenient on the participants of the event, but not as transparently or predictably as might be expected.

3 Events in Space

Where something happens is obviously dependent on the participants of the event. If Mary gives John a book, then the "transfer of possession" event can be seen as being computed as that region involving the three event participants, i.e., Mary, John, and the book. What is not so clear is which participant locations contribute to the resulting event location; it is also not obvious what aspects of the participants are relevant to this computation.

Before we examine better how events occupy space, we review some of the assumptions we are making from the qualitative spatial semantics community. A spatial ontology makes reference to at least the following formal spatial notions:

(9) a. **Domain objects**: points, lines, planes, and volumes;

b. **Properties of these objects**: convexity, concavity, other shape

constraints

c. **Basic Relations**: i. topological, ii. orientational, iii. metric.

Topological relations are those defined by the relation of *connectedness*, a concept we explore more in the next chapter. One of the most popular models for this domain is the Region Connection Calculus 8 (RCC8) [29], a calculus of relations consisting of eight jointly exhaustive and pairwise disjoint relations. We can identify the following relations between two objects, A and B, construed as *regions*:

(10) a. Disconnected (DC): A and B do not touch each other.
b. Externally Connected (EC): A and B touch each other at their boundaries.
c. Partial Overlap (PO): A and B overlap each other in Euclidean space.
d. Equal (EQ): A and B occupy the exact same Euclidean space.
e. Tangential Proper Part (TPP): A is inside B and touches the boundary of B.
f. Non-tangential Proper Part (NTPP): A is inside B and does not touch the boundary of B.
g. Tangential Proper Part (TPPi): B is inside A and touches the boundary of A.
h. Non-tangential Proper Part Inverse (NTPPi): B is inside A and does not touch the boundary of A.

While these relations are not expressive enough to capture the meanings inherent in linguistic spatial relations, they provide an excellent starting point from which to consider differential meaning and behavior in language, as we will see below.

The issue of where an event happens is perhaps most relevant for motion verbs and predicates, since they directly denote activities defined in terms of spatial displacement. The vocabulary and grammar for describing movement is one of the most basic and richly developed domains in language. Following Talmy (1975, 2000), linguists generally assume that a motion situation makes reference to the following meaning components.

(11) a. The *event* or situation involved in the change of location ;
b. The object that is undergoing movement (the *figure*);

c. The region (or *path*) traversed through the motion;
d. A distinguished point or region of the path (the *ground*);
e. The *manner* in which the change of location is carried out;
f. The *medium* through which the motion takes place.

Typically, in qualitative physics work, change of location can refer to one of four kinds of movement:

(12) a. **Translation**: motion along a path
b. **Rotation**: movement of a body around an axis
c. **oscillation**: periodic motion back and forth
d. **deformation** : bending, stretching, and twisting of an object

In our discussion, we will be concerned mostly with the translational motion of an object, although aspects of the other motion types will be discussed when needed to describe other parameter of meaning, such as manner.

Verbs describing translational movement do not constitute one undifferentiated semantic class in languages. It has long been observed (Talmy, 1985) that languages utilize a small number of distinct strategies for expressing concepts of motion. Talmy and others have noticed that there are two basic constructions associated with the expression of motion: *verb-framed* and *satellite-framed* patterns. This has also been referred to as the *path* vs. *manner-of-motion* verb distinction. The former strategy is illustrated in (13b) and the latter in (13a) (where m indicates a manner verb, and p indicates a path verb).

(13) a. The ball rolled_m.
b. The ball crossed_p the room.

With either verb class, adjunction can make reference to the missing aspect of motion, by introducing a path to a manner verb (as in (14a)) or the manner to a path verb (in (14b)).

(14) a. The ball rolled_m $[\text{across the room}]_p$.
b. The ball crossed_p the room $[\text{rolling}]_m$.

When thinking about how event localization is computed compositionally, we need to ensure that the location of the event in (14a) is identical to that in (14b), even though the participants are expressed as performing different

activities. We refer to the resulting location as the *event locus*, l_e. The sentences in (14a) and (14b) both make reference to the path, which can be construed as the locus, l_e. In the section below, we see how this is computed.

Typically, path verbs make no explicit mention of the traversed path, but instead reference a distinguished location, as shown in (15) below.

(15) a. Mary arrived$_p$ in Paris.
b. John left$_p$ the room.

In such cases, the event locus, l_e, is distinct from the ground location, i.e., *Paris* in (15a) and *the room* in (15b). In the next section, we analyze these ground NPs as "reference" locations, which we will refer to as *spatial aspects*.

Moving beyond pure motion-denoting predicates, there are events that incorporate motion as part of their meaning. These include anything from activities such as *write* and *stir*, to assembly and disassembly predicates, such as *gather* and *disperse*. We discuss these classes briefly in the next sections.

Finally, let us consider briefly spatial configuration predicates, such as *touch*, *connect*, and the spatial prepositions *on*, *in*, and directional and orientational prepositions such as *above*, *under*, and *behind*.

(16) a. The table touches the floor.
b. Mary is behind the tree.
c. The book is in the box.

What is interesting about such relations, from the perspective of event localization, is that they are not uniform in the way they denote the event locus. For example, the event localization for (16a) involves the area of contact between the two objects, but also the area covered by the objects themselves (the locus). How do we distinguish these? In (16b), the locus seems to include both the tree (the spatial aspect) and the relative region behind it. Finally, in (16c), the containing region of the box seems to define both the locus and the spatial aspect. These distinctions will be made precise in the next two sections.

4 A Procedure for Event Localization

As mentioned above, there are two observations that will be spelled out in this section: (i) the path metaphor can be extended to account for the localization of many non-movement activities; and (ii) event localization is

formally analogous to grammatical tense, while spatial adjunction is analogous to grammatical aspect.

While Davidson's theory of action has had enormous influence on the way linguists and cognitive scientists approach the modification of events, including spatial predication, alternative views were voiced as early as Kim [17]. Motivated in large part by his theory of event identity, contra Davidson [5], Kim incorporated localization as an integral component to the definition of an event. Assume that an event is a structured object, exemplifying a property (or n-adic relation), at a time, t, as illustrated in (17).

(17) $[(x_1, \ldots, x_n, t), P^n]$

We can identify the location of an object in the event as: $loc(x, t) = r_x$. Then, for purposes of event identity, we can construe an event with its localization as:

(18) $[(x_1, \ldots, x_n, r_{x_1}, \ldots, r_{x_n}, t), P^n]$ or $= [([x_i], [r_{x_i}], t), P^n]$

According to Kim [18], what we are calling the event localization, l_e, is supervenient on the object locations, $r_{x_1}, \ldots, r_{x_n}$, as defined above. This is a significant step beyond Davidson's approach since it introduces the supervenience of the event participants directly into consideration of the event location. However, since this problem was not as central to Kim's general program for defining property exemplication in the role of causation, this line of inquiry is not further developed in subsequent work, leaving most of our questions unanswered. First, how are the individual participant regions, r_{x_i}, composed or combined to create the proper minimum embedding space over the course of an event? Second, which participants are relevant in the composition of the embedding space for the event and which should be ignored? Finally, what happens when the participants to events are abstract objects or complex types? It is unfortunate that Kim's ideas about the spatial extent of events were never fully developed, since this perspective on locating events merits further consideration.

The approach adopted by Zwarts [37, 38] can be seen as developing some of Kim's original insights into localization, as applied to movement predicates. Similarly, the generalization of the path metaphor, as taken up in [28, 19] can be viewed as essentially an extension of these ideas, as well. For the present discussion, we adopt the analysis given in [28] to introduce the localization of a motion event.

First, we assume that path verbs such as *arrive* and *leave* are inherently different from basic manner-of-motion predicates, such as *move*, *roll*, and *walk*, in that they make explicit reference to the location that is being moved away from or toward along an explicit path, p. Manner verbs assume a change of location while making no explicit mention of a distinguished place. Path verbs can be identified as transitions, while manner-of-motion verbs can be seen as processes.

Adopting the analysis of manner-of-motion predicates from [28], we say that a process "leaves a trail" as it is executed. For motion verbs such as *walk* or *run*, this trail is the created object of the path which the mover traverses. This argument is unexpressed in the syntax but present in the inspection of any state or trace of the process. Following [28], we treat the path as a program variable, $\hat{p}$, to the motion verb, dynamically creating the trail as an 'initiated" object from the resource locations, z, as illustrated below:

(19) a. **move**: $e_N \rightarrow (e_A \rightarrow (e_N \rightarrow s \times s))$
b. $\lambda z \lambda \hat{p} \lambda x[walk(x, z, \hat{p})]$

We can identify the event localization for a motion predicate as the minimum embedding space, μ, for the moving object, x, traced over the course of the event. This includes both the path, $\hat{p}$, and the object localization for x, r_x. We denote this composition as $\hat{p} \otimes r_x$. For an event, e, with participants, x_i, the minimum embedding space can be computed, somewhat informally, as follows:

(20) a. r_{x_i}: The Kimian spatial extent of an object, x_i;
b. $\hat{p}$: The path created by the motion in e;
c. R_e: an embedding space (ES) for e, defined as a region containing $\hat{p}$ and r_{x_i} in a specific configuration, $\hat{p} \otimes r_{x_i}$;
d. μ, the event locus: the minimum embedding space for e.[1]

Now that we have established *where* a motion event is localized, i.e., its locus, we consider how a *reference location* can be introduced relative to the locus. As mentioned before, we refer to this region as the *spatial aspect* for the event, because it appears to function in much the same way as grammatical aspect in the temporal domain. Let us spell out this comparison.

[1]Where μ can be defined as:
$\forall e \forall R_e \forall \mu[[ES(R_e, e) \wedge Min(\mu, R_e)] \leftrightarrow [\mu \subseteq R_e \wedge \forall y[y \subseteq R_e \rightarrow \mu \subseteq y]]]$.

Tense is an ordered k-partitioning of the temporal domain, $\mathcal{D}_{\mathcal{T}}$; further, it is a nominal ordering (past, present, future). Now, grammatical aspect can be seen as a binary partitioning relative to this partition. This is one way of interpreting Reichenbach's (1947) calculus, utilizing Event (E), Reference (R), and Speech (S) times for classifying tense-aspect combinations in language [30]. To illustrate just part of this system, notice how Event and Reference times align to distinguish three relative orderings:

(21) a. Simple Past: $E = R$, $R < S$. John $\mathbf{ate}_{E,R}$ dinner.
b. Past Perfect. $E < R$, $R < S$. John $\mathbf{had\ eaten}_{E}$ dinner before noon_{R}.
c. Past Progressive: $R \subseteq E$, $E < S$. John $[\mathbf{was\ eating}_{E}]_{R}$ dinner.

In a similar fashion, event localization as expressed in language can be seen as involving both an initial partitioning over the spatial domain, $\mathcal{D}_{\mathcal{S}}$, creating an event locus (l_e), as well as an optional subsequent partitioning relative to this partition, generating a spatial aspect (or reference location, l_r). Movement events provide a simple illustration of this process, since the locus is a fairly direct composition of the path $\hat{p}$ and the mover x, $\hat{p} \otimes r_{x_i}$.[2] There are two basic strategies available to motion verbs for referencing spatial regions pertaining to an event, and in the process create a partition relative to the locus. These are presented below in (22).

(22) a. ANALYTIC ASPECT: verb selects a spatial argument;
Mary left *the room*. John entered *the hall*.
b. SYNTHETIC ASPECT: verb is modified through PP adjunction;
Mary swam *in the pool*. John walked *to the corner*.

Path predicates that select a spatial sub-region of the locus as an argument are examples of the strategy in (22a) above, while both manner of motion and path predicates license PP adjunction in (22b). Some examples of how the locus is distinguished from spatial aspect are presented below.

(23) a. Simple Locus: $l_e = l_r$. John $\mathbf{walked}_{l_e, l_r}$.
b. Relative Aspect: $l_e <_d l_r$. John $\mathbf{walked}_{l_e}$ under the tree_{l_r}.

[2]Support for this comes from a somewhat related analysis, where Reichenbach's reference frame for the temporal domain is extended to spatial frames of reference Tenbrink [35]. That analysis , however, was not applied to event localization, although it should extend naturally.

c. Embedded Aspect: $l_e \subseteq l_r$. John **walked**$_{l_e}$ in the building$_{l_r}$.
d. Completive Aspect: **EC**(l_e, l_r), **end**$(l_r, \hat{p})$. John **arrived**$_{l_e}$ home$_{l_r}$. John **walked**$_{l_e}$ to the park$_{l_r}$.[3]
e. Ingressive Aspect: **EC**(l_r, l_e), **begin**$(l_r, \hat{p})$. John **walked**$_{l_e}$ from the park$_{l_r}$.

As pointed out in [28], we can characterize the locus as being *telic* or *atelic*, depending on the nature of $\hat{p}$ (which is dependent on the verb in composition with the PP).[4] In the next section we illustrate how the localization procedure extends to non-movement events.

5 Non-Movement Event Localization

In this section, we briefly consider what is required to extend the localization procedure to non-movement events. The discussion will be somewhat programmatic in nature, due to space limitations. Since the path metaphor has already been applied to the semantics of creation and destruction predicates [26, 27] within the dynamic logic framework outlined in [28], we begin our discussion with this semantic class. On this view, verbs of change, such as *build*, *knit*, *destroy*, and *break*, can be seen as involving the creation or destruction of an object, seen as the *path* resulting from the event. For a verb such as *knit* (*John knitted a sweater.*), this path is the created object brought about by order-preserving transformations as executed in the directed process [27].

Thus, the event localization for creation predicates can be analyzed as the minimum embedding space for the created object traced over the course of the event, along with the other event participants. This is the created object as path, $\hat{p}$, in composition with the object localization of the agent argument, x, i.e., $\hat{p} \otimes r_x$. Applying this to other creation predicates, this also accounts for the dynamically changing spatial extent of a table or a house, as it is being constructed over a period of time (24).

(24) a. Simple Locus: $l_e = l_r$. John **built**$_{l_e, l_r}$ a house$_{\hat{p}}$.
b. Embedded Aspect: $l_e \subseteq l_r$. John **built**$_{l_e}$ a table$_{\hat{p}}$ in the basement$_{l_r}$.

[3] Spatial distinctions associated with *arrive* and *enter*, as well as *to* and *into* are acknowledged but not discussed in the present paper (cf. [11, 12, 22, 8, 38]).

[4] Besides the atelicity associated with source PPs, is the distinction between telic and atelic prepositions [37]: a. Mary swam *to* the beach; b. Mary swam *towards* the beach.

Notice that in (24b), the locus of the building event is determined relative to the embedding reference location, l_r, making no commitment as to where the created object, $\hat{p}$, is located after the build event; e.g., the table may have gone into the kitchen when done.[5] Compare this to our interpretation of (25).

(25) John build a fence in the backyard.

The intented final placement of the created artifact is not captured by the event localization procedure, but is rather part of the world knowledge or qualia structure associated with the object [25].

One closely related verb class that should be briefly mentioned here is the class of *placement* predicates. These include verbs such as *put*, *place*, and *plant*. Notice that the localization of the event in (26) is similar to a path predicate, such as *enter*.

(26) Mary planted a tree in the ground.

Here, the locus is composed of the path, $\hat{p}$, taken by the plant, x, while the spatial aspect is an argument selected by the predicate, i.e., l_r is the ground, where $\mathbf{end}(l_r, \hat{p})$. The semantics of the predicate ensures the entailment $r_x \subseteq l_r$; the plant ends up "in" the ground.

One problem that arises with the procedure for event localization for causative predicates (such as the change predicates above) concerns the nature of the agent argument. Namely, when the causal argument is itself an event (or complex type), the supervenience strategy fails. Consider the following pair of sentences in (27).

(27) a. Atelic Relative Aspect: $l_e <_d l_r$.
The storm **approached**$_{l_e}$ the shore$_{l_r}$.
b. Embedded Aspect with event agent: $l_e \subseteq l_r$.
The storm **destroyed**$_{l_e}$ the boat in the harbor$_{l_r}$.

While the sentence in (27a) treats the storm as a region in motion and has predictable event localization properties, the sentence in (27b) illustrates that the locus is not supervenient on the entire object localization of the causing argument (the storm), but of the local effects of this event: that is, the locus is restricted to within the harbor, $l_e \subseteq l_r$, where l_r is the harbor. This would

[5]This is consistent with the syntactic attachment of the PP.

not be possible if the locus were supervenient on the r_x associated with the storm, which would engulf the entire region. Notice that such a "locality" effect is also operative in other causative examples, such as that below:

(28) The sun killed the grass on the lawn.

With such cases, it appears that the effects of distal causation are computed locally (through a sort of transitivity operation), leaving the locus of the event to be proximate to the resulting state.

As our final verb class, we consider briefly perception predicates, such as *see* and *hear*. These pose a particularly interesting challenge to the procedure presented here because, following [10, 25], such verbs select for event complements. This introduces the problem of identifying two event distinct loci in a perception report. Consider the sentences below in (29).

(29) a. John saw an eagle in his backyard.
b. Mary heard an alarm down the street.

Following these analyses, we can distinguish the locality of the experiencing event from the event being perceived, where each seems to have a localization independent of the other. Hence, "the eagle in the backyard" is the event perceived by John, in his kitchen or wherever. Similar remarks hold for (29b), where the events have distinct loci. This is an area of considerable complexity, and merits further research, as the discussion here does it no justice.

6 Conclusion

In this brief note, I hope to have demonstrated that determining the location of an event is an area of research that has not been pursued as systematically as temporal localization of events or object localization. Contrary to a Davidsonian relativist view on localization, I introduce the distinction between an event's locus and its aspect, making an analogy to the distinction in the temporal domain between tense and aspect, or event and reference time. In the process, I have employed Kim's original notion of object supervenience to an extended path metaphor for the location of an event. Many issues remain to be addressed. One of the most significant gaps in the present analysis is the role of the *affordance space* associated with artifactual objects, in order

to determine the appropriate region associated with the appropriate use of objects. Further examination is also required to clarify the role of locality in the broader class of causative predicates.

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