Exploring the relation between argument structure and distributivity

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1 Introduction

Some predicates, when applied to a plural subject such as *Alice and Bob*, are understood DISTRIBUTIVELY, meaning that the predicate is understood to be individually true of (to 'distribute' down to) each member of the subject, as in 1. Other predicates are understood NONDISTRIBUTIVELY, meaning that they are NOT understood to be individually true of each member of the subject, as in 2 (unless we re-interpret the verb *meet* to have an implicit object). Still other predicates (sometimes called MIXED predicates; Link 1983) can be understood in both ways, as in 3.

(1) **Understood distributively:** Alice and Bob smiled
CONVEYS: Alice smiled and Bob smiled

(2) **Understood nondistributively:** Alice and Bob met
DOES NOT CONVEY: Alice met and Bob met

(3) **Can be understood in both ways:** Alice and Bob lifted the table
   a. COULD CONVEY: Alice lifted the table, Bob lifted the table
   b. COULD CONVEY: jointly lifted the table without each individually doing so

The main goal of this paper is to understand which predicates are understood in which way(s) and why. When we encounter a new predicate, how do we predict whether it will act like *smile*, like *meet*, or like *lift the table*?

First, some terminology and parameters. I refer to UNDERSTANDINGS of predicates rather than READINGS because I do not want to suggest that different understandings of

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a predicate necessarily correspond to different semantic representations. I describe understandings such as 2 and 3b as NONDISTRIBUTIVE rather than COLLECTIVE to avoid the notions of collaboration or joint responsibility sometimes associated with the latter term (Landman 2000, Champollion 2010). The term NONDISTRIBUTIVE also lumps together understandings sometimes described in the literature as CUMULATIVE (Scha 1981) with those described as COLLECTIVE, following many authors (Roberts 1987, Link 1998, Kratzer 2007; *contra* Landman 2000, Champollion 2010) who do not distinguish between these notions. Finally, while distributivity arises with all sorts of plural subjects (*children, some children, the children*), as well as group nouns such as *committee* (de Vries 2015), I focus on conjoined names such as *Alice and Bob* because these are least susceptible to the NONMAXIMALITY EFFECTS observed by Dowty 1987: *the children smiled* can be uttered felicitously if only some or most of the children actually smiled, while *Alice and Bob smiled* is only felicitous if each of them smiles – otherwise why mention them both?

Against this background, we return to the main question: which predicates go which way(s), and why? Researchers agree that the potential for distributivity of a given predicate depends fundamentally on what we know about the event it describes (e.g. Roberts 1987, Dowty 1987; to my knowledge, no author in the literature would outright disagree). *Smile* is understood distributively because people have their own faces, and so cannot *smile* jointly without each individually doing so. *Meet* is understood nondistributively because it describes a social action that an individual person cannot carry out unilaterally. *Lift the table* can be understood in both ways because it can be undertaken individually or jointly.

But the effect of such world knowledge is usually stated by fiat. Some authors use MEANING POSTULATES (Scha 1981) – constraints on the models that we consider, in a model-theoretic framework – requiring us to only entertain models in which a predicate such as *smile* distributes to each member of the subject. Others posit that a predicate such as *smile* only allows ATOMIC individuals such as *Alice* in its denotation, so that when *smile* is applied to a plurality such as *Alice and Bob*, it is required to be individually true of each member (Link 1983, Landman 1989). These strategies capture the effect of world knowledge, but do not explain it.

If we stipulate each predicate's distributivity potential, we do not predict or explain any patterns in the understandings available to various predicates – leaving unexplained at

least one hypothesized pattern: what I call LINK'S OBSERVATION, from Link 1983.

(4) **LINK'S OBSERVATION:** Predicates built from many intransitive verbs (e.g. *smile, walk, die*) can only be understood distributively, while predicates built from many transitive verbs (e.g. *lift the table, carry the piano*) can be understood nondistributively as well as distributively

After observing that *carry the piano* (built from a transitive verb) can be understood both distributively and nondistributively, Link writes: 'Common nouns and intransitive verbs like *die*, however, seem to admit only atoms in their extension. I call such predicates DISTRIBUTIVE' (Link 1983: 132). He reiterates (Link 1983: 141): 'Most of the basic count nouns like *child* are taken as distributive, similarly IV [intransitive verb] phrases like *die* or *see*'. In other words, Link hints at a connection between a predicate's argument structure and its potential for distributivity.

Is Link's observation true? There are certainly exceptions to it. We have already seen that the intransitive verb *meet* is understood nondistributively, as in 2. There are also predicates built from transitive verbs that only make sense distributively, such as 5: since individuals have their own sensory perception, it is very difficult to imagine a way for them to jointly *hear the noise* without each individually doing so.

(5) Alice and Bob heard the noise

a. ✓**Distributive**: each heard the noise

b. ✗**Nondistributive:** jointly heard the noise without each individually doing so

Of course, a predicate built from a transitive verb includes not just a verb, but also an object, which may itself affect the distributivity potential of the full predicate. In particular, restricting our attention to objects that are singular count nouns, it matters whether the object is definite or indefinite – and moreover, whether the action described by the verb can be repeated on the same object. If the predicate's object is definite and the action cannot plausibly be repeated on the same object (*eat the cookie*), then the predicate does not make sense distributively: since the same cookie cannot generally be eaten more than once, the distributive understanding 6a is implausible. In contrast, if the object is definite and the

action *can* be plausibly repeated on the same object (*lift the table*), then a distributive understanding is sensible, as in 7a, and also 5a above: the same table can be lifted multiple times; the same noise can be heard by multiple people.

(6) A&B ate the cookie

a. ✗**Distributive**: each ate it
b. ✓**Nondistributive:** jointly ate it

(7) A&B lifted the table

a. ✓**Distributive**: each lifted it
b. ✓**Nondistributive:** jointly lifted it

If a predicate's object is *indefinite* and the action described by the verb cannot be repeated on the same object (*eat a cookie*), then the only sensible distributive understanding will be one in which the indefinite covaries with each member of the subject – in 8b, each person eats a different cookie (what Dotlačil 2010 calls a distributive understanding WITH COVARIATION.) The distributive understanding WITHOUT COVARIATION, 8a, is implausible given that the same cookie cannot generally be eaten multiple times.

(8) A&B ate a cookie

a. ✗**Distributive without covariation:** one cookie, each ate it
b. ✓**Distributive with covariation:** each ate a different cookie
c. ✓**Nondistributive:** one cookie, jointly ate it

If the object is indefinite and the action *can* be repeated on the same object (*lift a table*), then two distributive understandings may be available, one with covariation, as in 9a; and one without, as in 9b (Winter 2002).

(9) A&B lifted a table

a. ✓**Distributive without covariation:** one table, each lifted it
b. ✓**Distributive with covariation:** each lifted a different table
c. ✓**Nondistributive:** one table, jointly lifted it

In other words, definiteness and repeatability interact to constrain the distributive understandings available to predicates built from transitive verbs. But in addition to whatever distributive understanding(s) are available to such predicates depending on these factors, it is striking that many predicates built from transitive verbs can be understood NONDISTRIBUTIVELY, as captured by Link's observation. For example, all of the predicates in 10 can be understood nondistributively: predicated of *Alice and Bob*, it is possible for Alice and Bob to carry out the event described by the predicate through their combined efforts, without each individually doing so.

(10) carry the piano, lift the table, fill the tub, break a vase, eat a cookie ...

In contrast, many intransitive verbs only make sense distributively: all of the predicates in 11, when applied to *Alice and Bob*, are understood to be true of Alice and of Bob. It is very difficult to imagine a way for these predicates to be understood nondistributively. The contrast between 10 and 11 constitutes Link's observation.

(11) run, swim, jump, walk, die, sleep, arrive, enter, exit, fall, blink, sneeze, read ...

Before I myself became aware of Link's observation, I was struck by the same tendency while attempting to code the verbs of Levin (1993) for their distributivity potential. Levin organizes over three thousand English verbs into a series of classes based on shared aspects of their meaning – verbs of putting, filling, building, saying, and so on. For every transitive verb in this database, I coded its distributivity potential using a conjoined subject (*Alice and Bob*) and a semantically plausible, singular, indefinite object (e.g. *eat a cookie, write a paper*), because definite objects raise the issue of whether the action described by the verb can be repeated on the same object. I noted whether the predicate could only plausibly be understood distributively (for example, it is difficult to imagine a way for two people to jointly *hear a noise* without each individually doing so, so it was coded as exclusively distributive), or whether it could also be understood nondistributively (two people could *eat a cookie* between the two of them without each individually doing so, for example by each eating a different half of it, so it was coded as allowing a nondistributive understanding). For every intransitive verb, I coded its distributivity potential using a conjoined subject (*Alice and Bob*), noting again whether the predicate could only plausibly be

understood distributively (*smile, walk*) or whether it could also be understood nondistributively (*meet, differ*). Quite often, verbs within a given Levin class would pattern together – not surprising, given that these classes reflect regularities in the types of events described by such verbs. But sometimes not all verbs in a given class would behave the same way, so I coded each one individually.

As a side note, some transitive verbs can also be used as intransitive verbs, if they undergo the causative-inchoative alternation (*she broke the vase/the vase broke*). I simply coded these as transitive verbs. But it is worth noting that, when used as intransitive verbs (*the vase broke*), these verbs pattern like other intransitive verbs in that they overwhelmingly tend to be understood distributively: if two vases break, they generally each do so. There are a few exceptions (if *the paths separated*, it is not necessarily true that they each did so); but the trend is striking here just as among the basic intransitive verbs.

Based on this coding scheme, I found the results reported in Table 1: consistent with Link's observation, predicates built from many intransitive verbs are only understood distributively, whereas predicates built from many transitive verbs can be understood nondistributively as well as distributively.

Table 1: Coding the distributivity potential of VPs built from the verbs of Levin (1993)

	Only distributive	**Can be nondistributive**	**Not sure**	**Total**
Intransitive verb	656 (84%) e.g. *smile*	109 (14%) e.g. *meet*	23 (2%)	788
VP w/ transitive verb	182 (8%) e.g. *hear a noise*	2057 (90%) e.g. *lift a table*	64 (2%)	2303

These findings give weight to Link's observation – raising the question of why it should be so. If a predicate's potential for distributivity is grounded in world knowledge about the event it describes, why would it also correlate with the predicate's argument structure?

In the remainder of this paper, I use Link's observation as a wedge to investigate the broader question of which predicates are understood in which way(s) and why. In §2, I sketch the theoretical analysis of distributivity used to frame the investigation, as well as some other alternatives from the literature. In §3, I propose that Link's observation arises as a byproduct of the behavior of predicates built from two major classes of transitive

verbs: CAUSATIVE verbs (§3.1; C.S. Smith 1970, Dowty 1979, Levin 1993); and verbs with objects construed as INCREMENTAL (§3.2; Tenny 1987, Krifka 1989, Dowty 1991, Krifka 1992). I argue that causative predicates (*open the door*) can always be understood nondistributively because, as a general fact about causation (predicted by the counterfactual analysis of Lewis 1973), multiple parties' contributions may be individually insufficient, but jointly sufficient, to cause the result (§3.1). Moreover, I argue that incremental-object predicates (*eat the cookie*) can always be understood nondistributively because, as a general fact about such predicates (predicted by the LEXICAL CUMULATIVITY assumption of Krifka 1989 and Kratzer 2007), multiple parties may each affect a different part of the object, only jointly affecting the whole thing (§3.2). Because predicates built from both of these large classes of transitive verbs can be understood nondistributively, Link's observation arises as an epiphenomenon. To conclude (§4), I suggest that by deriving Link's observation, we stake out some order within an otherwise idiosyncratic realm.

2 Theoretical background

Our analysis of a predicate's distributivity potential depends on our assumptions about where, semantically or pragmatically, distributivity comes from. This section briefly overviews some influential analyses of distributivity in the literature. I ultimately endorse a version of the Cover analysis of Gillon (1987) and Schwarzschild (1996), because I see it as the most unified and flexible.

For researchers in the tradition of Landman (1989), all distributive understandings are derived by the pluralization operator, $\star$, from Link (1983). On this approach, a verb such as *smile* denotes a set of individuals (*Alice, Bob*) who smile – parallel to a singular count noun such as *child*, which denotes a set of individual children. In order to be applied to a plurality such as *Alice and Bob*, a verb like *smile* would need to be pluralized using the plural operator, $\star$ – just as *child* needs to be pluralized to apply to pluralities of children. For any predicate P, if $\star P$ is true of the plurality *Alice and Bob*, it is because the unstarred predicate P is true of Alice and of Bob individually; and if P is true of Alice and of Bob individually, then $\star P$ is true of their sum. On these assumptions, the $\star$ operator simultaneously makes a predicate P plural and distributive – framing distributivity and

plurality as 'two sides of one and the same same coin' (Landman 1989a: 591).

On this view, *smile* is lexically restricted to only apply to ATOMS such as *Alice*. *Meet* is lexically restricted to only apply to a special sort of individual known as a GROUP (Link 1983, Landman 1989), similar to a group noun such as *faculty* (a plurality such as *Alice and Bob* can be turned into a group using Link's group-forming operator $\uparrow$). *Lift the table* admits both atoms and groups; so 12 is ambiguous between a distributive, plural interpretation and a nondistributive, singular, group interpretation.

(12) Alice and Bob lifted the table

a. **Distributive:** $\star$lift the table$(Alice \oplus Bob)$

b. **Nondistributive**: lift the table$(\uparrow (Alice \oplus Bob))$

In contrast, for Scha (1981), all distributive understandings stem from MEANING POSTULATES – restrictions on the models we entertain in a model-theoretic framework. *Smile* is associated with a meaning postulate requiring us to only consider models in which it is understood to distribute to every individual in its subject, reflecting the world knowledge that individuals can only *smile* individually. Today, this approach is not widely accepted, because it does not handle predicates that can be understood nondistributively as well as distributively, such as *lift the table* or *eat a cookie*. Meaning postulates cannot be optional (Roberts 1987), so it is not clear how meaning postulates could be used for such predicates. While no current authors follow Scha in attributing all distributivity to meaning postulates, this idea still lives on in approaches to distributivity that posit two distinct sources of it.

For many authors (Link 1991 and its English translation Link 1998: Ch. 2; Roberts 1987, Lasersohn 1995, Winter 2000, *et seq*, Champollion 2010 *et seq*, de Vries 2015, de Vries 2017), there are two distinct sources of distributivity. Some distributive inferences stem purely from extralinguistic knowledge (captured using meaning postulates), while other distributive inferences are derived in the semantic representation using an optional, covert operator (essentially a silent version of *each*) which ensures that the predicate is applied separately to every member of the subject. This operator is sometimes known as the D operator (Link 1991, Roberts 1987), and sometimes subsumed under the star operator $\star$ of Link (1983) discussed above.

This two-pronged approach can be seen as a synthesis of the two proposals we have

already seen: the meaning postulate proposal for inferences attributed only to lexical or world knowledge; and the star operator approach for inferences attributed to the presence of an operator (see de Vries 2017 for discussion). Generally, authors in this tradition use meaning postulates for predicates that appear to be consistently understood distributively (*smile*; based on the idea that meaning postulates cannot be optional), and use the optional operator for predicates that can be understood in multiple ways (*eat a cookie, lift the table*), particularly those requiring an operator in the predicate (e.g. an indefinite, a numeral) to 'covary' with each member of the subject, as in the DISTRIBUTIVE WITH COVARIATION examples (*eat a cookie*) sketched above.

Finally, for Gillon (1987) and Schwarzschild (1996) – building on the work of Higginbotham – all distributivity inferences are explained in terms of a theoretical device called a COVER: a contextually supplied set of subparts of the subject. Any time a predicate is applied to a plural subject, it is analyzed to be individually true of every cell of the Cover. A sentence such as *the suitcases are too heavy* is analyzed to mean that for every cell of a contextually supplied set of subparts of *the suitcases*, the predicate *too heavy* is true of that cell. If the suitcases are placed in a single cell together, then they are *too heavy* as a group without necessarily being *too heavy* individually; if they are each placed in their own cell, then they are *too heavy* individually.

The setting of the Cover depends on the discourse context (do we care about the weight of the suitcases individually, or together?) as well as our world knowledge about the event or state described by the predicate. In the realm of adjectives, individuals can be *heavy* jointly or individually, so both settings of the Cover make sense. In contrast, if two individuals are *green*, it is generally because they each are (it is difficult to imagine a way for individuals to be *green* jointly but not individually); so for a sentence such as *the suitcases are green*, only a distributive setting of the Cover (placing each suitcase in its own cell) is plausible. Returning to the realm of VPs, people can generally only *smile* individually, so for a sentence like *Alice and Bob smiled*, we decide on a Cover placing each individual in its own cell. People can *lift the table* individually or jointly, so we entertain a Cover placing each individual in its own cell, as well as one placing them all in the same cell. This analysis allows us to explain all distributive and nondistributive understandings in a unified, fundamentally pragmatic fashion.

Stepping back, the goal of this paper is to understand which predicates go which way(s) and why. I believe that this investigation is best framed against the Cover analysis. The other analyses capture a predicate's distributivity potential quite rigidly: if we use meaning postulates or a lexical requirement for atoms in a predicate's denotation, we predict a predicate such as *smile* to be understood distributively in all contexts. But as pointed out by Winter and Scha (2015), in an unconventional context such as 13, we may be able to understand *smile* nondistributively, given that lips can work together to create a smile while individual humans generally cannot.

(13) Alice's lips smiled — adapted Winter and Scha (2015)
?? **Distributive**: Alice's lips each smiled
✓**Nondistributive:** Alice's lips jointly smiled without each individually doing so

Such pragmatic flexibility poses a challenge for the more rigid theories, but is predicted and handled on the Cover analysis. In contrast to other approaches, the Cover analysis does not attach any stipulations to individual lexical items; instead, the distributivity potential of any predicate stems purely from pragmatic reasoning about the setting of the Cover.

Moreover, on the two-pronged analysis (in which some distributivity comes from meaning postulates while other distributivity comes from an operator), the present investigation becomes more complicated. We would have to first separate the distributive understandings to be modeled with meaning postulates (which, as 13 shows, might be too rigid in any case) from those to be modeled with an optional operator, and then explain not just which meaning postulates we need and why, but also when and why the D operator is present or absent. In contrast, on the Cover analysis, we can explore the distributivity potential of all predicates in a unified manner, drawing on information about the discourse and the world at the same time.

Therefore, the current exploration – of which predicates are understood distributively or nondistributively and why – can be seen as an investigation of how we decide which Cover(s) to entertain, given what we know about the event described by the predicate. Since the Cover analysis leaves everything to pragmatic reasoning, the real task lies in explaining how this pragmatic reasoning works. The rest of the paper takes up this challenge, using Link's observation as a demarcated first step.

3 Explaining Link's observation as an epiphenomenon

If a predicate's potential for distributivity is grounded in world knowledge about the event it describes, why would it also be related to whether the predicate is built from an intransitive verb or a transitive one? Perhaps it is because predicates built from intransitive verbs and transitive verbs describe different sorts of events, about which we have different world knowledge. In particular, there is converging evidence from the acquisition literature (e.g. Naigles 1990, Gropen et al 1991), the typology literature (e.g. Dixon 1979, Hopper and Thompson 1980), and the lexical semantics literature (e.g. Dowty 1991) that transitive verbs prototypically describe events in which an agent AFFECTS another entity in some way; while intransitive verbs describe events involving only one basic participant, which either acts autonomously or is affected by another entity that goes unmentioned.

In other words, the idea is that verbs with similar argument structures describe classes of events sharing certain commonalities (e.g. Levin 1993). Assuming that a predicate's potential for distributivity depends on world knowledge about the event it describes, we expect predicates describing similar sorts of events to pattern together in their potential for distributivity. Thus, I propose that the apparent connection between argument structure and distributivity is an indirect one, driven by our world knowledge about the types of events that tend to be described by transitive verbs versus intransitive ones.

In particular, I argue that Link's observation is driven by the behavior of predicates built from two major classes of transitive verbs: (i) CAUSATIVE verbs (*lift the table*), and (ii) INCREMENTAL-OBJECT verbs (*eat the cookie*).

Causative verbs (C.S. Smith 1970, Dowty 1979) describe events in which the subject causes the object to undergo a change: in 14, Alice causes the vase to break.

(14) Alice broke the vase

Many causatives undergo the CAUSATIVE-INCHOATIVE alternation (C.S. Smith 1970), meaning that the verb can have two arguments (one argument which causes the change, one which undergoes it; 14); or only one argument (which undergoes the change; *the vase broke*). While all verbs undergoing this alternation are considered causative, some causative verbs do not alternate: for example, *kill* is widely considered causative, but

does not alternate. Another diagnostic for whether a verb is causative is to ask whether a sentence built from that verb entails that its object undergoes the change described by the verb (Levin and Rappaport Hovav 1991, Levin and Rappaport Hovav 2011). If Alice broke the vase, the vase broke; if Alice killed the chicken, the chicken is dead; and so on.

Turning to the second major class of transitive verbs, incremental-object verbs (Tenny 1987, Krifka 1989, Dowty 1991, Krifka 1992) describe events in which the object is affected in tandem with the progress of the event: in 15, there is a homomorphism between the cookie and the event of eating it, so that when the cookie is half gone, the event of eating it is half over, and when the cookie is gone, the event of eating it is over.

(15) Alice ate the cookie

Famously (e.g. Verkuyl 1972, Dowty 1979, Krifka 1989), the telicity of a predicate with an incremental object depends on whether its object is bounded: *eat the cookie* is telic while *eat cake* is atelic, because the boundedness of the count noun *cookie* gives an endpoint to the event of eating it, while the unboundedness of *cake* does not.

These two major types of predicates are not always distinguished. For example, while Dowty (1979) predates the concept of incremental-object predicates, he discusses many such predicates (e.g. *paint a picture*) under the guise of ACCOMPLISHMENTS in the sense of Vendler (1967) – and suggests that all accomplishments are causative. Conversely, Rothstein (2004) subsumes many causative predicates (*repair the computer*) under the category of accomplishments, which she analyzes as inherently incremental. Such analyses blend causatives and incremental-object predicates together.

There are, however, compelling arguments for distinguishing these two classes. For example, causative predicates entail a result state (*break the vase* entails that the vase is broken), while incremental-object predicates need not: *read the book* does not entail any change in the book (Rappaport Hovav 2008). Causative verbs usually cannot be used with implicit objects (*I broke* cannot be used to convey *I broke stuff*), while incremental-object verbs often can (*I ate* is roughly equivalent to *I ate stuff*; Rappaport Hovav 2008). Incremental-object predicates are understood as atelic with mass objects (*eat some cake* is atelic), while causatives can be understood as telic even with mass objects (*break some glass* can be telic; Levin 2000).

Some predicates can be placed into both classes: in 16, *the road* is causally affected, in that it is made free of ice; but may also be understood to be incrementally affected, in that each portion of the road may correspond to a different part of the event of de-icing it.

(16) Alice de-iced the road

But there are also predicates that only fit into one class or the other: *read the book* has an incremental object but is not causative; *assassinate the despot* is causative but does not have an incremental object. These two classes are thus treated as overlapping, but distinct.

Against this background, I propose that predicates built from these two major classes of transitive verbs describe events that can be brought about by the joint contributions of multiple participants – generalizations which can be derived from existing, widely accepted analyses of such predicates. Predicates built from these major classes of transitive verbs can thus systematically be understood nondistributively, deriving Link's observation as a byproduct.

3.1 Causative predicates

Causative predicates describe events of causation, in which the subject causes a change upon the object. Informally, it is always possible for multiple individuals to jointly bring about a result without each individually doing so – meaning that causative predicates with subjects denoting multiple individuals should always allow a nondistributive understanding. I argue that this is the intuition behind the nondistributive understanding of all of the causative predicates in 17: that Alice and Bob somehow realized the result upon the object through their combined efforts.

(17) Alice and Bob lifted the table
collapsed the tent
moved the statue
removed the stain
angered the committee
debunked the rumor
beautified the room

melted the chocolate
doubled the revenue
shortened the skirt . . .

(✓**Distributive**: each did so)

✓**Nondistributive:** jointly caused the result without each individually doing so

As foreshowed by Dowty (1987), this intuition is already captured by a leading analysis of causative verbs. Causative verbs are often said to comprise a primitive building block of meaning known as CAUS, meant to express that they describe events of causation (e.g. McCawley 1968, Dowty 1979). Most influentially (in a tradition dating back to the philosopher David Hume and revived by Lewis 1973), CAUS can be defined in terms of a *counterfactual* analysis: the idea that an event A causes (CAUS) an event B only if B would not have happened but for A. Analyzing counterfactuals in terms of possible worlds, the counterfactual analysis states that in all of the worlds most similar to the actual world in which A does not happen, B does not happen either. In other words, if *Alice opened the door*, then in the closest worlds in which Alice doesn't do anything to the door, the door does not open. The counterfactual analysis has its critics, but it makes interesting predictions about the distributivity potential of causatives (Dowty 1987).

If two events $A \wedge B$ cause a third event C, then, according to the counterfactual analysis, in the closest worlds in which $A \wedge B$ does not happen, C does not happen either. Some of the closest $\neg(A \wedge B)$ worlds might be $A \wedge (\neg B)$ worlds, or $(\neg A) \wedge B$ worlds – all predicted by the counterfactual analysis to be $\neg C$ worlds (Dowty 1987). In other words, the counterfactual analysis of causation captures an intuition: that two factors may be jointly sufficient, but individually insufficient, to cause a result.

On such an analysis, a sentence like *Alice and Bob opened the door* means that Alice and Bob did something which caused the door to open. The event of Alice and Bob doing something can be decomposed into an event of Alice doing something, and another event of Bob doing something. In the closest worlds in which nothing is done to the door by Alice or Bob, the door does not open. Some of these worlds may be ones in which Alice or Bob does something to the door alone, but the door still does not open in these worlds. In other words, the individual contributions of Alice and of Bob may be separately

insufficient, but jointly sufficient, to cause the door to open – giving rise to a nondistributive understanding of the predicate. This logic can be extended to all causative predicates, predicting all of them to allow a nondistributive understanding (in addition to whatever distributive understandings are available depending on the definiteness of the object and the repeatability of the action, as discussed above). The counterfactual analysis therefore explains why all of the causative predicates in 17 can be understood nondistributively. It can be extended to all of the 530 verbs listed by Levin which undergo the causative/inchoative alternation – over a quarter of the 2057 transitive verbs which were coded as ones that allow a nondistributive understanding.

This analysis is reinforced by testing its further predictions. In some cases, the same verb can be understood as either causative or non-causative (Levin and Rappaport Hovav 2014): *clean* can be understood as 'causing something to become clean', or as 'carrying out some prototypical actions associated with cleaning,' such as vacuuming or dusting, without entailing that its object becomes clean. We therefore predict that when a predicate built from *clean* is understood as causative, it must allow a nondistributive understanding; but when it is NOT understood as causative, it might only make sense distributively.

This prediction is indeed consistent with the data: the causative 18 can be understood nondistributively, in a situation in which Alice and Bob only jointly make the stove clean – for example, if Alice sprays it with degreaser and Bob wipes it off. In contrast, it is much more difficult to imagine a nondistributive understanding of the non-causative 19: if Alice and Bob did some apartment-cleaning, we normally infer that they each did so.

(18) A&B cleaned the stove (so that it was spotless when they finished)
✓**Distributive**: each cleaned it (perhaps on different occasions)
✓**Nondistributive:** cleaned it jointly without each individually doing so

(19) A&B cleaned the apartment (for awhile; but it was still messy when they stopped)
✓**Distributive**: each did some apartment-cleaning
?? **Nondistributive:** jointly did some apartment-cleaning without each doing so

The contrast between 18 and 19 illustrates that a predicate's distributivity potential does not just depend on the specific verb involved, but is further shaped by whether that verb is

construed as causative, as predicted by the present analysis.

This analysis does not just apply lexical causatives such as *open the door*, but is also predicted to extend to PERIPHRASTIC causatives such as those in 20, on the assumption that these also describe events in which Alice and Bob cause a change upon the object. And indeed, periphrastic causatives seem to allow a nondistributive understanding, just as lexical causatives do.

(20) a. Alice and Bob caused the door to open
b. Alice and Bob got the door open
c. Alice and Bob made the door open
✓**Distributive**: each caused it to open (perhaps on different occasions)
✓**Nondistributive:** caused it to open only jointly

Summing up, causative predicates describe a unified class of events – those in which the subject causes a change upon the object. As a general fact about causation (predicted by the counterfactual analysis), the actions of multiple agents may be individually insufficient, but jointly sufficient, to cause some result – explaining why a large class of predicates built from transitive verbs can systematically be understood nondistributively, and indirectly contributing to Link's observation.

3.2 Incremental-object predicates

Incremental-object predicates describe events in which the subject gradually affects the object, subpart by subpart. Intuitively, it is always possible for multiple individuals to each affect a different subpart of the object, only jointly affecting the full object – meaning that incremental-object predicates with subjects denoting multiple individuals should always allow a nondistributive understanding. I propose that this is the reasoning underlying the nondistributive understanding of all the incremental-object predicates in 21: that Alice and Bob each carry out the event described by the verb on a different subpart of the object.

(21) Alice and Bob ate the cookie
wrote the book
painted the wall

ran the marathon
copy-edited the document
built the Lego castle
searched the house
vacuumed the basement
loaded the truck
recited the poem . . .

(✓*Distributive*: each did so)

✓*Nondistributive:* did so jointly but not individually (each doing a different part)

As hinted by Krifka (1992), this intuition is already predicted by a common, motivated assumption about verb meaning: the LEXICAL CUMULATIVITY assumption, named by Kratzer (2007) and invoked by Scha (1981), Krifka (1989), Krifka (1992), Champollion (2010), and others. Lexical cumulativity is the assumption that all verbs (and, in the event semantics in the tradition of Davidson 1967, all thematic roles) are inherently closed under sum[1], guaranteeing CUMULATIVE INFERENCES (Quine 1960) as in 22.

(22) **Cumulative inference:** $P(a) \wedge P(b) \rightarrow P(a \oplus b)$
'This is water and that is water, so this and that together are water'
'Alice smiled and Bob smiled, so Alice and Bob smiled'

More concretely, a verb such as *eat* can be analyzed as a set of eating events, as in 23 (where events are represented as tuples consisting of a label for the event and its thematic roles, based on Kratzer 2007). Then, for any two events $e1$ and $e2$ in this set, lexical cumulativity requires that their SUM ($e1 \oplus e2$) is also in this set. On the lexical cumulativity assumption, the sum of two *eat* events is also an *eat* event; its agent is the sum of the agent of $e1$ and the agent of $e2$, and its theme is the sum of the theme of $e1$ and the theme of $e2$. This setup guarantees the natural result that if Alice eats half the cookie and Bob eats the other half, then Alice and Bob eat the full cookie[2].

[1]Note that this assumption is directly opposed to the analysis of Landman (1989a), discussed in §2: Landman requires a verb like *smile* to only apply to individuals, not pluralities.

[2]Some authors (e.g. Kratzer 2007, Champollion 2010) represent the lexical cumulativity assumption by placing the plural symbol $\star$ (from Link 1983) before all verbs and thematic roles (e.g. $\star$*eat*, $\star$*agent*), as a

(23) $\textit{eat} = \{\langle e1, agent = Alice, theme = half\ the\ cookie_1\rangle,$
$\langle e2, agent = Bob, theme = half\ the\ cookie_2\rangle,$
$\langle e1 \oplus e2, agent = Alice \oplus Bob, thm = half\ the\ cookie_1 \oplus half\ the\ cookie_2\rangle\}$

Whenever a predicate's object is construed as incremental in this way, we predict the predicate to allow an understanding in which the members of the subject each affect a different portion of the object. If the extension of an incremental-object verb includes an event of Alice and Bob affecting the full object, it is always possible for the extension of the verb to also include a subevent of Alice affecting one part of the object and Bob affecting the rest, as in 23. The lexical cumulativity assumption thus explains why all of the predicates in 21 can be understood nondistributively. Levin does not single out an incremental-object class (and anyway, this category is notoriously pragmatically flexible; Smollett 2005), but it should minimally include Levin's *spray/load*, *build*, *create*, *perform*, *fill*, and *wipe* verbs – a quite conservative estimate of 275 verbs, or over 10% of the 2057 transitive verbs coded as ones which allow a nondistributive understanding.

To test further predictions of this analysis, we consider cases in which the same predicate may or may not be understood as an incremental-object predicate (Dowty 1979, Krifka 1991, Rappaport Hovav 2008). A predicate such as *read the magazine* can be construed as an incremental-object predicate, if the magazine is fully read when the event culminates – or can be considered a simple activity predicate, if only some arbitrary portion of the magazine is read over the course of the event. Our analysis predicts that when such a predicate is understood to have an incremental object, it should allow a nondistributive understanding; whereas when it is NOT understood to have an incremental object, it might only have a distributive understanding.

And indeed, the incremental-object predicate in 24 can be understood nondistributively, for example if Alice reads one half of the magazine and Bob reads the other. In contrast, it is much more difficult to imagine a nondistributive understanding of 25, in which the magazine is not construed as an incremental object: if Alice and Bob did some

typographical reminder that these are all assumed to be closed under sum. However, this convention may cause some confusion, because other authors (e.g. Landman 1989a, de Vries 2015; see §2) use the $\star$ symbol to indicate distributivity. Authors who assume lexical cumulativity do NOT intend $\star$ to indicate distributivity. They assume that all verbs are closed under sum, but they do NOT assume that all verbs are distributive.

magazine-reading, we generally infer that they each did.

(24) Alice and Bob read the magazine (from start to finish, to check it for errors)
✓**Distributive**: each read it
✓**Nondistributive:** each read part of it, only jointly reading the whole thing

(25) Alice and Bob read the magazine (for awhile, but didn't finish it)
✓**Distributive**: each did some magazine-reading
?? **Nondistributive:** jointly did some magazine-reading, without each doing so

As predicted, the contrast between 24 and 25 shows that what matters most, even more than the specific predicate involved, is the incremental construal of its object.

The present analysis is predicted to extend to all cases in which a verb's object is construed as incremental. Sometimes, we ascribe incrementality even to the objects of verbs that are not typically classified as incremental-object verbs – particularly when the object is a numeral plural (Krifka 1992). For example, *see* is not a prototypical incremental-object verb (the subparts of a *see-the-zebra* event do not correspond to subparts of *the zebra*); but an event in which Alice *sees seven zebras* can be split into subevents in which each individual zebra is seen, culminating when seven zebras are seen in all (Krifka 1992).

Normally, *see* – even though it is a transitive verb – generally only allows a distributive understanding with a definite singular object: if Alice and Bob *saw the zebra*, we generally infer that they each did so. But when its object can be construed as incremental, as in *see seven zebras*, we predict a nondistributive understanding to be systematically available. As predicted, 26 can be understood nondistributively – for example, in a situation in which Alice sees three zebras and Bob sees four more. Again, the incremental construal of the object is more important for a predicate's distributivity than the particular verb involved.

(26) Alice and Bob saw seven zebras
✓**Distributive**: each saw seven zebras
✓**Nondistributive:** saw seven zebras between them

Summing up, incremental-object predicates describe a unified class of events – those in which there is a homomorphism between the object's affectedness and the progress of the

event of affecting it. As a general fact about such events (predicted by the lexical cumulativity assumption), multiple agents may each individually affect a different subpart of the object, only jointly affecting the whole thing. This analysis explains why a large class of predicates built from transitive verbs can systematically be understood nondistributively, driving Link's observation as a byproduct.

3.3 Intransitive verbs

We have now explored one half of Link's observation: why predicates built from many transitive verbs can be understood nondistributively. I have argued that this tendency is driven by the behavior of two major classes of predicates built from transitive verbs, causatives and those with incremental objects. But to fully understand Link's observation, we must also investigate the second half: why predicates built from many intransitive verbs (*walk, die, arrive, smile*, and so on) strongly favor a distributive understanding – and, conversely, why they disfavor a nondistributive understanding.

Some intransitive verbs (*meet, gather, split up*) describe inherently multilateral events, and thus cannot be understood distributively when predicated of *Alice and Bob*. But apart from verbs specifically describing events of multiple parties coming together or apart, the majority of intransitive verbs (*sleep, laugh, talk, run,* and so on) describe events that can be carried out by a single individual. That is why, when predicated of a plural subject, such verbs can be understood distributively. We saw above that some predicates built from a transitive verb can only be understood nondistributively, if they have a definite object and describe an action that cannot be repeated on the same object (*Alice and Bob ate the cookie* does not make sense distributively, given that the same cookie generally cannot be eaten more than once) – but, since intransitive verbs do not have objects, this complication never arises. In other words, apart from verbs like *meet*, the majority of intransitive verbs are predicted to always allow a distributive understanding, because a sentence of the form *Alice and Bob VERBed* could always describe a situation in which Alice and Bob each individually carried out the action described by the verb.

It is therefore not surprising that the majority of intransitive verbs can be understood distributively. The real question is why so many intransitive verbs are NOT easily under-

stood NONdistributively – in contrast to predicates built from many transitive verbs, which robustly allow such an understanding.

As always, I believe the answer lies in our world knowledge about the events described by these predicates. I have argued that causative and incremental-object predicates describe classes of events sharing a commonality – causation, an object/event homomorphism – that systematically allows the event to be brought about by multiple participants' joint contributions. In the realm of intransitive verbs, there are also classes of verbs describing events sharing certain commonalities – for example, Levin 1993 lists 115 locomotion verbs (*run, stroll, tiptoe*, and so on) and 263 sound verbs (*bang, snap, crackle, bark, jingle,* and so on). However, the commonalities among these events tend not to be ones allowing the event to be brought about by the joint contributions of multiple individuals. Instead, some of the commonalities among these events are ones requiring these events to be undertaken only be single individuals.

In particular, many intransitive verbs describe events that are typically carried out by an individual body or mind: *walk, run, swim, jump, smile, laugh, sniff, sigh, cough, breathe, blink, wink, cry, faint, worry, meditate, think, die*, and so on. Given that individuals have their own legs, faces, and minds, then if multiple individuals *walk, smile,* or *worry*, it is generally because they each do so. It is very difficult (although not impossible, as the *lips smiled* example 13 shows above) to imagine a way for the events described by these predicates to be carried out by multiple parties' joint contributions without the predicate also being true of each member. Like causatives and incremental-object verbs, verbs describing bodily or mental actions can be grouped by the commonalities among the events they describe – but unlike causatives and incremental-object verbs, these commonalities are not ones allowing the event to be 'split' between multiple participants. Instead, the commonalities among these events – particularly, the fact that they involve an individual body or mind – favor a distributive understanding for the predicates that describe them.

Apart from the many intransitive verbs describing bodily or mental events, there are also classes of intransitive verbs describing events that *can* be brought about by the joint contributions of multiple individuals, parallel to causative and incremental-object verbs in the realm of transitive verbs. For example, there are intransitive verbs which describe events of sound produced by contact between multiple surfaces (Levin et al 1997), such

as *jingle, rattle,* and *clang*. If two keys *jingle*, it does not necessarily follow that each key jingled (distributive); it is also possible that the keys only created a jingling sound by contact with one another (nondistributive). There are also intransitive verbs describing speech acts which can be carried out collaboratively, such as *lie* and *apologize*: if *Alice and Bob lied*, it does not necessarily follow that they each did so (distributive), because they may also have lied in a jointly issued statement (nondistributive).

Like the causative and incremental-object verbs discussed above, these verbs describe events sharing commonalities allowing them to be effected by multiple participants, and thus to be understood nondistributively. But unlike causative and incremental-object verbs – classes which have attracted significant attention in the literature because they are large, superficially diverse, and grammatically significant – the classes of verbs like *jingle* and *lie* are much smaller, encompassing only handfuls of verbs in contrast to the hundreds of verbs that count as causative or can have an incremental object. Thus, some intransitive verbs can be grouped into classes sharing commonalities that allow them to be understood nondistributively; but these classes are rather piecemeal in comparison to the vast categories of causative and incremental-object verbs among transitives.

To recap, we have explored the other half of Link's observation: why many intransitive verbs strongly favor a distributive understanding. I have suggested that this tendency is partly driven by the fact that many intransitive verbs describe events involving an individual body or mind. Moreover, although there are classes of intransitive verbs describing events that can be effected by the joint contributions of multiple individuals (verbs like *jingle* and *lie*, as well as those like *meet, split up* and so on), these classes are relatively small and patchy. In contrast, the classes of causative and incremental-object verbs among transitives are so extensive that they are argued to drive the tendency for predicates built from transitive verbs to allow a nondistributive understanding.

4 Conclusion

This paper set out to discover which predicates are understood distributively or nondistributively and why, using Link's observation as a way into the question. Summarizing, we begin from the uncontroversial idea that a predicate's potential for distributivity is

grounded in world knowledge about the event it describes. Next, we show that the events described by two large classes of transitive verbs (causatives and incremental-object predicates) can be brought about by the joint contributions of multiple parties, allowing them to be understood nondistributively. In contrast, the events described by most intransitive verbs do not allow a systematic way of being 'split' between multiple participants, so that these verbs generally default to a distributive understanding. Therefore, Link's observation arises as a byproduct of our world knowledge about the events that tend to be described by these different types of verbs.

More generally, any time a linguistic phenomenon depends on world knowledge, the real challenge is to explain what world knowledge matters and why. In taking on this challenge, we uncover the way regularities in the extralinguistic world create patterns across the lexicon that we use to describe it.

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