ON THE LEXICON-INFORMATION STRUCTURE INTERFACE*

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1.   Introduction

Word order variation is tied to differences in both lexical projection and Information Structure. Both of these components are at the core of our theory of the lexicon-syntax interface. This paper offers an application of this theory to the dative and benefactive alternations, thus demonstrating the effect of lexical definition on both syntax and Information Structure.

The English dative and benefactive alternations exhibit a wide range of possible interpretations. We offer here the outline of an account of the possible—and impossible—interpretations of these constructions. Our account is based on a minimal lexical entry and extends to both the syntactic and Information Structure facts of the four alternants of these constructions.

We will be examining here a small set of the English data, illustrated in (1) and (2).

(1)   Dative:
    a.   Jane gave a book to Mary.
    b.   Jane gave Mary a book.

(2)   Benefactive:
    a.   Jane sewed a shirt for Mary.
    b.   Jane sewed Mary a shirt.

Our aim is to derive the syntactic structures of these alternants and their range of properties from the lexical meaning components of the verbs involved. Our main claim is that the same meaning components, associated with distinct syntactic elements, merge the structures of the four alternants.

In this paper, we first present the basics of our theory of the lexicon-syntax interface in Section 2. Section 3 demonstrates how this theory derives the dative structures and their interpretations. Section 4 shows how the Information Structure facts follow. And in Section 5, our analysis is applied to the benefactive alternation. We conclude with Section 6.

2.   A Theory of the lexicon-syntax interface: Atom Theory

The theory within which our analysis is couched is the Atom Theory of Erteschik-Shir and Rapoport (1997, 2005, 2010, etc.). The theory of the lexicon-syntax interface takes as basic assumptions that (1) in principle, verb behaviour is flexible and so the range of a verb's shades of meaning should be derived from a single lexical entry; and (2) the meaning components of the verb's lexical entry are entailed in every use of that verb. These assumptions are summarized in (3).

(3)   Fundamental assumptions of Atom Theory
    a.   The range of a verb's behaviour derives from a single lexical entry
    b.   The components of a verb's lexical entry are entailed in every use of that verb.

The lexical semantic entry of a verb consists solely of one or two meaning components, termed ATOMS. These atoms are taken from a constrained inventory: either Manner or Result. The basic types are listed in (4).

(4)   Basic atom types
    Manner: Means, Manner, Matter, Instrument
    Result: **S**tate, **L**ocation

    (**L**ocation atoms can be lexically specified as, for example:
    source, goal, path, direction, spatial location, point of contact.)

This minimal lexical semantic representation is paired with an unrestricted projection, or merge, in syntax. Thus, the projection of one verb's atoms into syntax can yield more than one syntactic structure, each with its own properties. As a briefly-sketched example, consider the verb *melt*, whose lexical entry consists of two atoms, Manner and Result:[1]

(5)   melt**v**:
    Means (heat) and **S**tate (more liquid)

This single lexical entry yields both the transitive and intransitive uses of the verb:

(6)   a.   Jane melted the cheese.
    b.   The cheese melted.

The primary restriction imposed in this system is an interpretive one: each semantic atom, like all lexical elements in a structure, must be interpreted, within the constraints of

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[1] Under our view, both of a verb's Manner and Result atoms are necessarily interpreted in every structure containing that verb. (See Rapoport 2015 for arguments that there is no Manner-Result complementarity in verb composition.)
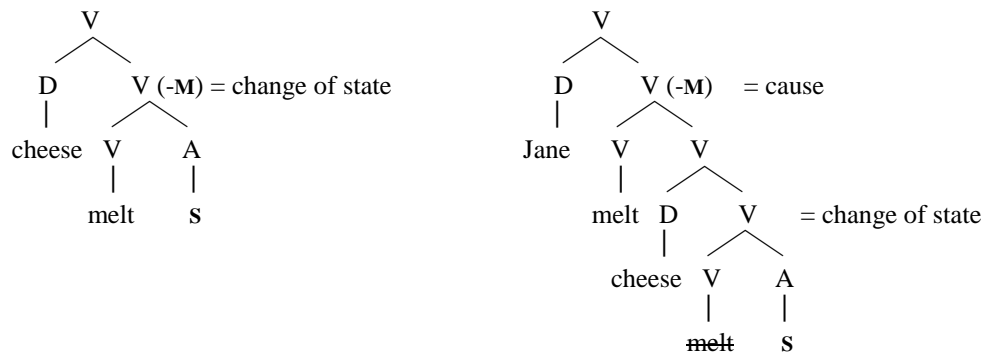
the projected structure. In the case of *melt*, the interpretations of the syntactic structures underlying the two sentences of (6) are as in (7).

(7) a. Jane caused (by means of heat) the cheese to go to a more-liquid state.
  b. The cheese went (by means of heat) to a more-liquid state

The range of a verb's uses thus results from different merge possibilities, rather than from different lexical entries.

Verbal atoms project in syntax, typically merging as either a complement to the verbal head or as a modifier of a verbal predicate. These two possibilities are illustrated by the following structures, projected from the single lexical entry of the verb *melt*:[2,3]

(8) a. The cheese melted.   b. Jane melted the cheese.

```
          V                                    V
        /   \                                /   \
      D      V (-M) = change of state       D      V (-M)   = cause
      |     /  \                            |     /  \
   cheese  V    A                         Jane  V    V
           |    |                               |   /  \
          melt  S                             melt  D    V    = change of state
                                                    |   /  \
                                                 cheese V    A
                                                        |    |
                                                       m̶e̶l̶t̶   S
```

The **S**tate atom in (8) projects as the complement to the verb head; the **M**anner atom (its adjunct status represented, for ease of presentation, in parentheses) as a modifier of the lower and upper predicates in the structure, respectively. Each atom is interpreted according to its mode of projection in the syntactic structure. The transitive structure illustrates the fact that each atom, together with the verbal head, may project a separate subevent.[4]

The structures themselves have interpretations, following Hale and Keyser (1993, etc.). Each verbal subevent is interpreted according to the particular complement:

(9) The interpretations of structural relations:
  a. [V V] = a verbal event with a complement verbal event
      → an event entailing another event = 'cause'

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[2] The structures here include only the VP level. The complex structure contains two V copies that form a chain, the head of which is pronounced.

[3] Here, the STATE atom is structurally represented by its categorial realization A and the MANNER atom as M for presentation purposes.

[4] Transitivity generally requires two atoms.

b.　　[V A] = a verbal event with a complement state
　　　　→ an event entailing a state = 'change of state'

Each merged syntactic structure thus yields aspectual as well as argument properties. Via a combination of structural relations and the position of lexical atoms, we derive the interpretations in (7), two structures derived from one lexical entry.

The syntactic structures, however freely derived, are nonetheless constrained in this system—via interpretation. We propose an extended principle of Full Interpretation (FI), in which not only every element in a structure, but every atom of that element, must have an interpretation in a clause. When applied to a verb, for instance, FI requires that all lexically-defined components of a verb be both merged in the structure headed by that verb and interpreted:

(10)　a.　　The Principle of Full Interpretation as applied to verbs:
　　　　Every atom of a verb must merge in every structure projected by that verb.

　　　b.　　The Principle of Full Interpretation as applied to atoms:
　　　　Every atom of a syntactic structure must be interpreted.

Thus, a structure containing an uninterpreted atom is ungrammatical. In this way FI ensures that a verb's meaning is entailed in every use of that verb (as argued in Rapoport 2015). As Cowper (1991) puts it, lexical structure contains no optional elements: "If something is part of the conceptual structure of a lexical item, then that aspect of the meaning must always be present."

In sum: under Atom Theory, apparent polysemy results from projection possibilities; all of a verb's uses are derived from its single lexical entry. Projection from the lexicon to syntax is free. The constraint on verb behavior is on the interpretation of the projected syntactic structures.

In this view of the lexicon-syntax interface, there are no theta-roles or lexical theta-role lists and no argument or event structures. Nor are there the corresponding lexical operations, given FI, or linking rules, given free projection. The system is minimal, consisting of atoms and their interpretation.

We turn next to the projection of the two alternants of the dative alternation.

3.　　The Dative alternation

The semantics and syntax of the dative alternation have been extensively examined in the literature. (To list just a few studies: Green 1974; Oehrle 1976; Larson 1988; Pesetsky 1995; Harley 2002; Rappaport Hovav and Levin 2008; Hallman 2015; Beavers and Koontz-Garboden, 2020; and Pinker 1989.) Building on the observations and insights of these works, we derive the properties of the dative alternation from the alternate modes of projection of the dative verb's lexical atoms.

Dative verbs are lexically defined by a Manner (M-)atom and a Location (L-)atom:

(11) The lexical entry of dative verbs:
   M-atom: a distinct lexical definition for each verb
   L-atom: a basic L, a simple Location

This single [M,L] lexical entry projects both structures of the alternation. Each dative verb is characterized by its M-atom; the L-atom in the lexical entry of dative verbs is identical in all. It is this L-atom that is at the core of our analysis. As with atoms in general, the L-atom is interpreted according to both its structural position and the element with which it is structurally associated. The different associations of the dative verbs' L-atoms, and so their distinct interpretations, yield the two alternants of the dative alternation.

3.1   The Prepositional dative structure

Consider the verb *give* as an example of a dative verb, and one of its possible projections, the prepositional dative structure.

(12) Jane gave a book to Mary.
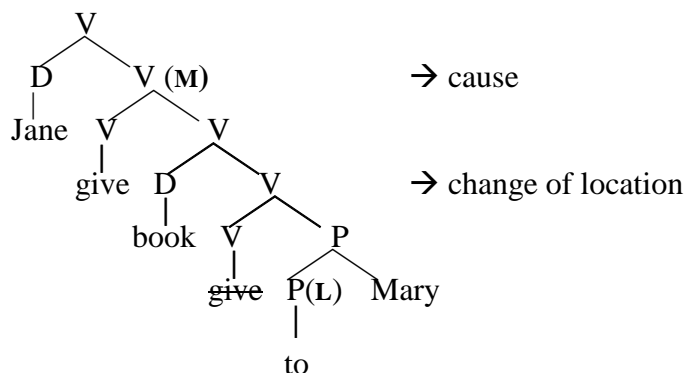
Structure (12) consists of two predications (two subevents), each headed by a copy of V. The lower predicate contains the Location atom, which projects categorially as P and is realized as *to*. This preposition's complement (*Mary* in (6)(12)) is thus interpreted as a location; that is, as the goal of the causing event. (See also Beavers and Koontz-Garboden 2020.)
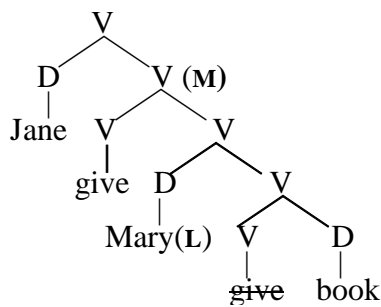
The upper predicate, interpreted as 'cause', contains *give*'s Manner atom, which modifies this causing event. The subject of the cause predicate, *Jane*, is therefore interpreted as effecting the change described by the lower predicate. (See also Rappaport Hovav and Levin 2008.) The resulting interpretation of (12) is (roughly) 'Jane caused a book to go to Mary'.

Note that there is no 'goal' argument specified. The Location atom receives its interpretation according to its structural position. In a different structure, this atom may have a different interpretation. And in fact, this is what happens in the double-object structure, an alternate projected from *give*'s same [M,L] lexical entry.

3.2 The Double-object (DOC) structure

Consider the structure in (13).

(13) Jane gave Mary a book.

```
              V
          /       \
        D          V (M)
        |        /      \
       Jane    V         V
               |       /    \
              give   D        V
                     |      /    \
                 Mary(L)  V        D
                          |        |
                        g̶i̶v̶e̶   book
```

As seen in (13), in the DOC structure, the Location atom is merged differently from the alternate prepositional dative structure. Here, *give*'s L-atom projects as a modifier of the lower subject, Mary. We view this DP modification as specification or identification (and see Higginbotham 1985). Thus, when in subject position, *Mary* is identified with the L-atom and so defines the location: the L-atom is interpreted as wherever Mary is. The DP in predicate position, *a book*, is thus understood to be related to the location defined by the subject *Mary*. In other words, wherever Mary is, she is the possessor of the book. (See Jackendoff 1990, who argues for a metaphorical-structural extension of being in a location to being in someone's possession.[5])

As above, the upper predicate and its subject *Jane* are interpreted as 'cause' and 'causer', yielding the basic interpretation of (13): 'Jane caused Mary to possess a book'. (For discussion, see Hale and Keyser 2002, a.o.)

Atom Theory thus derives each of the dative alternants, each with its distinct structure and interpretation, according to the structural position of the L-atom. Due to the flexibility of atom projection, a single lexical entry can yield more than one structure.

4. Information Structure

The dative alternation is motivated by Information Structure considerations. (See Erteschik-Shir 1979[6]). The contrast in Information Structure (IS) and in IS-related facts between the two alternants derives in Atom Theory from the distinct L-atom interpretations. In order to demonstrate how this works, we first provide a rudimentary background of our view of Information Structure.

Following Erteschik-Shir (1997), all sentences contain a topic and a focus: A topic

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[5] See also Harley (2002); Rapoport (2014); Manzini and Franco (2016); and Erteschik-Shir and Rapoport (2010).

[6] And see Borschev and Partee's 2002 Perspective Structure.

(Reinhart 1981) is what the sentence is about; a focus is what the speaker intends to draw the attention of the addressee to.

In addition, all sentences are specified for a spatio-temporal parameter, of which the sentence is predicated. This spatio-temporal parameter forms the topic of predication, the stage topic.[7]

With stage-level predicates, this parameter is the here-and-now of the discourse; the sentence itself is the focus:

(14) IS with stage-level predicate:
      [at a certain time/place] = STAGE TOPIC [someone did something] = FOCUS

With individual-level (I-level) predicates, in contrast, it is the subject that identifies the spatio-temporal parameter: 'at all times and places at which the subject exists'; the predicate is the focus. Consider the I-level predication of *Mary is intelligent*, for example.

(15) IS with individual-level predicate:
      [Mary]=STAGE TOPIC [is intelligent]=FOCUS

This sentence has the interpretation 'At all times and places where Mary is, she is intelligent'. (See Erteschik-Shir and Rapoport 2011; Irimia & Rapoport, 2022). In this way, the subject of I-level predicates itself defines a stage topic.

4.1 The Information Structure of the DOC

In this section, we demonstrate how Atom Theory yields Information Structure. We begin with the particular IS of the DOC, returning to example (13) *Jane gave Mary a book*, and show how it results from L-atom identification.

As shown in (13), the L-atom of the dative verb is merged as a modifier of the DOC subject, *Mary*, and is thus identified with it, as sketched in (16).

(16) L-atom interpretation in DOC:
      Jane gave [Mary(= L) a book]

Recall that the identification of the lower subject *Mary* with the L-atom specifies L as 'wherever Mary is'. Thus, the DP subject defines a stage topic in the same way as argued for the I-level (15). The identification of the lower subject with L thus yields an I-level property.

I-level predicates are location-independent. As Chierchia (1995) and McNally (1998) note, a subject ascribed an I-level property keeps that property, regardless of (any change in) the subject's (spatiotemporal) location.

In Brandt (2000), we find support for the characterization of the lower predication of the DOC as I-level. Consider the following:

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[7] The stage topic is similar to Klein's 2008 situation topic.

(17) Otto gave/sold/handed Anna the keys in the bar yesterday.

Unless we are explicitly informed otherwise (that is unless, as with I-level predicates in general, relevant circumstances are claimed to have changed), we understand that the keys are with Anna still, wherever she is. In other words, the lower subject *Anna* defines the spatio-temporal parameters of the predication.

This, we claim, is true of the lower DOC subject in general: given its interpretation as stage topic and its position as subject of this lower predicate, it defines a particular individual-level predication: possession. The (referent of the) lower subject, wherever they happen to be, possesses the theme.

By deriving the lower subject's topichood, we are in line with, for example, Kayne (1983), Larson (1988), Basilico (1998), and Brandt (1999). Since the lower subject is a (stage) topic, the theme must be a focus. We thus extend our claim to one in which the lower predication of the DOC has a fixed Information Structure (Erteschik-Shir 1979; Basilico 1998; Brandt 1999, 2000; and Jiménez Fernández 2009). Our basic example, (13) above, has the IS in (18).

(18) The fixed IS of the DOC's lower predication:
      Jane gave [Mary-**STAGE TOPIC** a book-**FOCUS**]

This restricted IS contrasts with that of the prepositional *to*-dative, which is unconstrained with respect to possible topic and focus; these possibilities sketched in (19).

(19) The unconstrained IS of the *to*-dative's lower predication:
      a.   Jane gave [a book-**TOP** to Mary-**FOC**]
      b.   Jane gave [a book-**FOC** to Mary-**TOP**]
      c.   Jane-**TOP** [gave a book to Mary]-**FOC**

One contrast in IS can be illustrated by a *wh*-question-answer pair, since the answer of a *wh*-question must be a focus (see Erteschik-Shir 1979). Consider the following:

(20) Q: Where is the book?
      A: *to*-dative: Jane gave the book to Mary.
            DOC: #Jane gave Mary the book.

As (20) shows, the prepositional dative, in which an IS option such as (19a) is possible, is an acceptable answer. The DOC, on the other hand, does not have an IS in which *Mary* is the focus and therefore, the DOC as answer is infelicitous.

Another piece of evidence for the IS contrast is found in the existence presupposition of topics (see Erteschik-Shir 1997; Brandt 1999). Consider the following contrast:

(21)   (Jane dislikes her children and is decades away from having grandchildren.)
    a.   *to*-dative: Jane bequeathed her fortune to her grandchildren.
    b   DOC: # Jane bequeathed her grandchildren her fortune.

Since the DOC's lower subject is constrained to be a topic, a context is required in which its existence is given. In (21), the grandchildren do not yet exist and so the DOC is impossible. The *to*-dative, in contrast, is not so constrained, allows an IS in which *her grandchildren* is not a topic, and the *to*-dative is therefore acceptable in this context.

More evidence for the IS-constrained lower structure of the DOC is found in the literature, such as the facts of *wh*-extraction (Erteschik-Shir 1979), weak pronouns, and scope restrictions (Brandt 1999).[8] Space considerations restrict us to the two illustrations above, but they are sufficient to demonstrate the distinctions in Information Structure exhibited by the two dative alternants.

Under our analysis, these IS distinctions are derived directly by the atom's syntactic association. We have shown, in particular, that L-atom association in the DOC yields its IS. In sum:

(22)   ATOM ASSOCIATION: INFORMATION STRUCTURE:
       Jane gave [Mary(L) the book] → Jane gave [Mary=**STAGETOPIC** the book=**FOC**]

The Information Structure facts are similar for the benefactive. We turn next to the derivation of this second alternation type.

5.   The Benefactive alternation

An Atom Theory analysis also derives the alternants of the benefactive. We begin with the verb type: benefactive double-object structures occur primarily with creation verbs. (See Green 1974, Levin 1993, Jezek 2014, Fellbaum 2005, a.o.[9]) We focus here on one type of creation verb: explicit creation (see Geuder 2000; Levinson 2010; Rapoport and Zarka 2021), as exemplified by the verbs *sew*, *knit*, *write, draw, paint.*

Creation verbs in general describe the causing, by the process named by the verb, of the coming into existence of the referent of the verb's direct object. Such verbs take

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[8] We note that despite the fact that topics are specific, a non-specific lower subject in the DOC is somewhat acceptable:
  (i)   Jane gave some/?a/?sm girl a book.
  (ii) The angry voters sent some/sm congressmen a letter. (from Basilico 1998, 582)
Basilico (1998) argues that certain embedded I-level predications lack the requirement that their subjects be specific. We believe that this possibility is due to that of an IS in which the whole VP is focussed (without the subordinate division into topic and focus):
  (iii) What did Jane do? Jane-TOPIC [gave sm girl a book]-FOCUS.
This also explains why, for some people, extraction of the lower subject is not so bad:
  (iv) ?Who did Jane give a book?

[9] Fellbaum (2005) shows the unexpectedly wide range of verbs found in benefactive constructions.

effected objects (Piñón, 2008). Creation verbs thus describe the coming into existence of some element on a stage.[10]

For this reason, we analyze explicit creation verbs as equivalent to transitive *appear*. (See also Copley & Harley 2015.) The interpretation of creation verbs is due to *appear*'s **L**-atom type, found in the lexical representation of the creation verb itself.

We first examine the lexical entry and projected structure of *appear*, presented in (23) and (24), respectively.

(23) appear:
    L: an unspecified stage

(24) Mary appeared.

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            V
          /   \
        D       V
        |      /  \
      Mary    V    P
              |    |
           appear  L
```
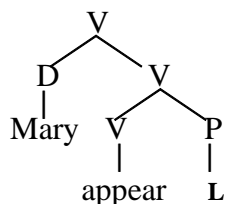
In (24), *appear*'s stage L projects syntactically as P.[11] This stage L is interpreted as the point of appearance, that point here being relative to the current spatio-temporal location of the clause, the clause's stage topic. The interpretation of (24) is thus: 'Mary appeared (=came into existence) on this stage'.

Creation verbs are lexically defined by a **M**anner atom and a **L**ocation atom, as shown in (25).

(25) The lexical entry of creation verbs:
    M-atom: a distinct lexical definition for each verb
           (often an Instrument or the Manner of its manipulation)
   **L**-atom: an unspecified series of stages = a plural stage[12]

This semantic lexical entry yields the interpretation that the creation process evolves over a series of new stages. For instance, in the creation sentence *Jane sewed a shirt*, whose structure is in (26), the shirt is understood as being sewn over time, resulting in its appearance as a completed shirt on a new stage. This interpretation is derived from the structure which, as noted, is a transitive version of that of *appear*:

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[10] See also Basilico (1998), in which these verb classes are presentative, on a par with existentials.

[11] Although this categorial realization is not necessary in this theory, as noted above.

[12] See Erteschik-Shir and Rapoport (2005) for an analysis of singular and plural atom types.

(26) Creation: Jane sewed a shirt.
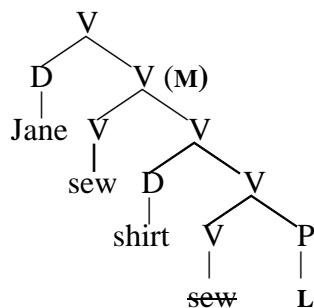
In the predication embedded under the creation verb, L is interpreted as a new stage: here, the point of creation; that is, the final of a series of new stages (over which the sewing process evolves). A shirt is introduced on this new stage: a shirt is created.

The interpretation of (26) is thus: 'Jane caused (by sewing) a shirt to appear on a new stage.' The sentence *Jane sewed a shirt for Mary* is identical, but for the addition of the *for*-adjunct phrase, which is interpreted as a benefactive.[13]

Thus the lexical entry which derives the interpretation of creation verbs owes much to its inclusion of the stage **L**-atom of *appear*, plural in these creation cases. This same atom, when merged differently, yields the benefactive alternant.

5.1 The Benefactive double-object (BOC) Structure

The structure of the BOC is as shown in (27).

(27) Jane sewed Mary a shirt.
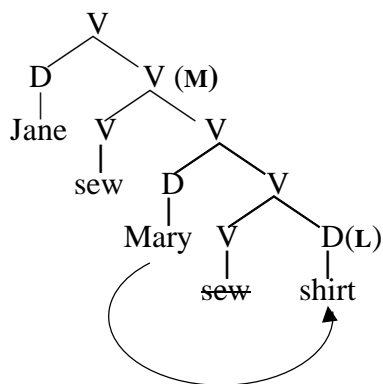
In this BOC structure, the **L**-atom, the series of unspecified stages, modifies the theme, *a shirt*. The interpretation, as above, is of a shirt coming into existence over a series of stages. The lower subject *Mary* is linked to the plural stage with the resulting interpretation that Mary, the intended recipient of the created item, is associated with the

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[13] We will have little to add here about the semantics of *for*.

process of creation throughout. Together with the interpretation of the **M**-atom as a modifier of the causing action, the interpretation of (27) is thus: 'Jane caused, by sewing, a shirt to come into existence on a stage associated with Mary'; that is, the creation is effected with reference to Mary. A benefactive interpretation, in other words.

These sentences contain no benefactive verb *per se*. No verbal lexical entry directly derives the benefactive interpretation under our analysis. Rather, the lower BOC subject is interpreted as a beneficiary via its association with the stage **L**-atom of a creation verb.

Thus, the benefactive alternation, like the dative alternation, is derived via different **L**-atom associations in syntactic structure. The DOC and the BOC are therefore similar. However, the two constructions are not identical, due to distinct modes of L-merge. This distinction accounts for a variety of facts, including the following distinction in the possibility of the passive:

(28) a. dative (DOC):   Mary was given a shirt.
      b. benefactive (BOC): *Mary was sewn a shirt.(27)

Whereas the dative allows the lower (possessor) subject to be passivized, as shown in (28a), the benefactive does not (28b). This distinction is due to the **L**-atom's structural position in each case: In the DOC, the **L**-atom directly modifies the lower subject *Mary*, the [Mary=**L**] of structure (13). The **L**-atom thus moves together with *Mary* in the passive; *Mary* is interpreted as the possessor of a shirt.

In the BOC, in contrast, the **L**-atom projects separately from the lower subject *Mary* that is associated with it (as shown in (27)). The lower subject *Mary* thus moves without L in the passive, resulting in its having no interpretation in the structure (association with an atom being impossible, we assume, over a predication boundary). The ungrammaticality of the BOC passive follows.

While there are, then, some differences between the two double-object structures, there are also similarities, as expected given that in both, the lower subject is associated with an **L**-atom. One such similarity is the Information Structure constraint on the BOC, as illustrated by the following (cf. the DOC's (20) and (21), respectively, above):

(29) *Wh*-question and focus answer:
      Q: Who was the shirt intended for?
      A: *for*-benefactive: Jane sewed the shirt for Mary.
         BOC: #Jane sewed Mary the shirt.

(30) Existence presupposition of topics:
      (John is years away from meeting his bride, but is hopeful.)
      a. John designed a dress for his bride.
      b. #John designed his bride a dress.

The subject's association with the **L**-atom thus yields a particular Information Structure and so the associated properties. We expect, then, that similar facts will be found with a wider range of creation constructions to which our Atom Theory account

can be extended. For example, constructions of implicit creation (see Fellbaum 2005), such as *cut me a slice of bread* (see also Levinson 2010 and the analysis in Rapoport and Zarka 2021) and cognate object constructions (as analyzed in Massam 1990), such as *sing me a song*, along with their Information Structure properties, are derived from their verbs' ʟ-atom association in the way outlined above.[14]

6. Conclusion

We have demonstrated here the possibilities offered by Atom Theory via an analysis of the dative and benefactive alternants.

Our analysis employing the minimal apparatus available in this theory does not make use of different templates, different prepositions, or the derivation of one alternant from the other. (See, for example, Green 1974; Oehrle 1976; Larson 1988; Pesetsky 1995; Harley 2002; Hallman 2015; Beavers & Koontz-Garboden 2020; and others).

Taking as a basic tenet of our approach that a single verbal lexical entry allows flexible behavior, we have shown how the various structures are directly derived in Atom Theory from the unique atomic definition of each dative or creation verb, together with the particular realization of the ʟocation-atom in each syntactic structure. The range of interpretations and Information Structures follows. We expect that such atom definition and atom projection are responsible for similarities and differences in these alternations across languages.

Our program thus demonstrates the impact of lexical analysis on Information Structure and so, more generally, on conceptualizations of the architecture of grammar.

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[14] Our analysis can also be extended to verbs of acquisition, such as *buy* and *get*, whose L-atom type also allows for the distinct associations required for the alternation.

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