Aspect Selectors, Scales and Contextual Operators: An Analysis of *by* Temporal Adjuncts[1]

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1. Introduction

Many temporal adjuncts select for specific aspectual classes; these adjuncts include measure adverbials like *for an hour* and interval adverbials like *in an hour*. While such adjuncts have traditionally served as diagnostics of telicity, it is only relatively recently that aspectual theorists have elucidated the relationship between the scalar-semantic meanings of these adjuncts and the internal structure of the event representations to which they apply (see Dowty 1979, Herweg 1991, Krifka 1998, *inter alia*). Krifka (1998) proposes that both measure adverbials and interval adverbials operate on representations that involve motion along a path. It seems entirely plausible that these adverbials should have path-based meanings, since they concern the 'run times' of processes. It is less clear whether path schemas can be applied to the semantics of aspectually sensitive temporal adverbs in general, and particularly those that denote time points. One such adverbial is the *by* time adverbial (BTA), which will be the focus of our attention in this paper. An example of the BTA is given in (1):

> (1)   But at least Burger King has signed on, and says that **by year end** it won't be
>   using any shell eggs. (WSJ)

In (1), the year's end represents a point at which a state (absence of shell eggs) is subject to verification. In the semantic analysis that we will propose here, the BTA resembles another

aspectually sensitive temporal adverb, *still* (Michaelis 1993). Both adverbial types have apparently paradoxical behavior: they denote time points but have interval-based semantics. The paradox disappears when we assume that the BTA, like adverbial *still*, denotes a point and presupposes an interval, specifically, a path schema. In the case of the BTA in particular, we will argue, these path schemas represent conventional sequences of development, e.g., schedules. We will use corpus data to survey the variety of discourse contexts in which such sequences are invoked. In this way we further substantiate Krifka's claim that aspectual meaning involves path structures that represent both movement through space and qualitative changes in entities over time.

We will explore patterns of BTA use by examining tokens from the *Wall Street Journal* (WSJ) corpus (Marcus et al. 1993)[2]. One fact that is initially puzzling about the corpus data is that while, for example, English pedagogical grammars (Fuchs and Bonner 2006: 32-40, Van Zante et al. 2000: 65) focus on its use in past-perfect predications, perfect-form predications, as in (2), account for only four percent of the BTA tokens in the WSJ:

(2)   Baron Elie de Rothschild, the family 's elder spokesman, explains that **by the end of the 19th century**, Berlin had replaced Frankfurt as Germany's financial center. (WSJ)

Other contexts in which BTAs occurred are as follows. Seven percent occurred in simple past-tense predications, both stative and dynamic, as in (3-4), respectively:

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[2] The WSJ data used in this study were retrieved from the Penn Treebank II corpus by means of the search tool Tgrep. Treebank II supplements standard syntactic tags (NP, PP, S, etc.) with functional tags that express argument-adjunct relations. The Tgrep string used defined BTAs as PPs headed by *by* that also bear the functional tag TMP, for 'time adverbial'.

(3)   The airports in San Jose and Oakland were both fully operational **by noon yesterday**, the Federal Aviation Administration said. (WSJ)

(4)   And **by late Friday afternoon**, actually after the close, we decided that was the wrong tone to take. (WSJ)

Two percent occurred in past-tense progressive predications, as in (5):

(5)   Japanese stocks dropped early Monday, but **by late morning** were turning around. (WSJ)

Sixteen percent occurred in gerunds and event nominals, as in (6-7), respectively:

(6)   Some projections show Mexico importing crude **by the end of the century**. (WSJ)

(7)   Mr. Ehrlich predicted unprecedented famine **by 1980**. (WSJ)

Thirty-six percent occurred in *to*-marked infinitival complements, as in (8):

(8)   Hughes said it expects the sale to close **by year end**. (WSJ)

Finally, thirty-one percent occurred in complements of modal verbs, including *will*, as in (1) above. Such examples raise three questions. First, how can we reconcile the BTA's apparently wide combinatoric potential with the presumption that it selects for a specific aspectual class? Second, what accounts for the prevalence of modal and infinitival predications, as in (1) and (8) respectively, which collectively account for 67 percent of the BTA tokens? Third, why should an author ever use a BTA when there are more specific forms of time reference available, in particular, adverbial expressions like *on Monday* or *in the afternoon*? We will argue that adequate answers to these questions require reference to lexical and grammatical aspect (Bickel 1997), frame semantics (Fillmore 1985), pragmatic scales (Kay 1990) and coercion (De Swart 1998). We will claim that the BTA takes a state predication as its argument and that it denotes a

sampling point located just after the potential or actual inception of this state. Further, we will propose, this state is understood in relation to a contextually evoked path schema, construed as either a schedule or a natural course of development. As a consequence, we will suggest, BTAs are contextual operators, in the sense of Kay (1997).

The remainder of this study will be structured as follows. In Section 2, we discuss the sense of *by* at issue here. In Section 3, we discuss the usage patterns that reference and pedagogical grammars predict for BTAs and how the corpus data fail to conform to those predictions. In Section 4, we propose that BTAs select for the class of states. In Section 5, we show that we can assimilate apparently non-stative BTA tokens to stative examples by regarding them as cases of stative coercion. In Section 6, we argue that BTAs are discourse-indexical expressions, insofar as they induce the interpreter to retrieve an event sequence or schedule that includes the denoted state. Section 7 contains brief concluding remarks.

2. Which sense of *by*?

The second edition of the *Oxford English Dictionary* lists thirty-nine adverbial senses of the preposition *by*. The sense of interest here is the twentieth sense, in which *by* takes a nominal denoting a time point as its argument and the resulting PP means 'no later than'. This sense is distinct from that listed as the seventeenth sense of *by* in the OED, in which the *by*-phrase indicates *extent*, as in (9):

(9)   In point of fact, this catharsis was overdue **by decades**. (WSJ)

In (9), the *by*-headed PP indicates degree of difference, just as the measure expressions *two inches* and *five dollars* do in the comparative expressions *two inches taller* and *five dollars cheaper*. As it happens, the *by*-headed PP in (9) was erroneously given the part-of-speech tag PP-TMP by a Treebank II tagger, rather than the appropriate tag, PP-EXT. This error is understandable, since in both cases the complement of *by* is a time expression, but on closer

inspection it is obvious that the two *by*-adverbials not only have distinct types of complement daughters (time-point NPs in the case of BTAs and coextensive-measure NPs in the case of *by*-adverbials of extent) but also combine with different types of predicates: extent-measure *by*-adverbials combine with 'predicates of surpassing', e.g., comparative adjectives, whereas BTAs do not.

3. How are BTAs used?

As mentioned, pedagogical grammars tend to associate the BTA with the past-perfect construction. Certainly, the BTA and the past perfect interact in a transparent and compositional way: assuming the Reichenbachian representation of the past perfect (Reichenbach 1947, Hornstein 1991), one would say that the BTA marks the R point (reference time) that follows an E point (event time). But the use of a past-perfect predication is neither a necessary nor sufficient condition for BTA use. That it is not necessary is shown by the fact that of 315 BTA tokens examined, only 12 were found in perfect-form predications. That it is not sufficient is shown by the fact that there are otherwise-acceptable past-perfect sentences that do not welcome BTAs. One such sentence is the attested (10), found in a Google search. The past perfect in this example is a continuative perfect: the sentence asserts the existence of a state phase (that of unwillingness) whose terminus is 1983:

> (10)   Until 1983, France […] had been unwilling to extradite ETA members to Spain.
> (Google)

If we replace the time adverbial *until 1983* with a comparable BTA, the result is anomaly, as shown by (10'):

> (10')   *By 1983, France had been unwilling to extradite ETA members to Spain.

Why is (10') anomalous? The reference grammars give some clues. Quirk et al. (1985: 692) describe BTAs as expressing "the time at which the result of an event is in existence". If BTAs

mark resultant states, then we can easily explain the anomaly in (10') by observing that the state of unwillingness is not resultant state, and that it therefore does not satisfy the BTA. At the same time, however, resultant states cannot be the whole story. As mentioned in Section 1, a plurality (36 percent) of BTA tokens appear in infinitival complements. Further, in the vast majority of such cases, these infinitival clauses are complements of control and raising verbs that presuppose a desired or expected event, e.g., *require*, *order*, *want*, *hope*, *expect* and *plan*. An additional trend suggesting a close association between the BTA and futurity is that involving modal verbs. As mentioned in Section 1, the second largest group of BTA tokens consists of those with modal head verbs, as in (11-12):

(11)   That should happen **by today**, he said. (WSJ)

(12)   Then it turned up, and by one estimate the number will be up to about 109,000 regulators **by next year.** (WSJ)

Thus it would appear that BTAs select states that are not only resultant states but also desired or predicted states. The latter condition is in fact captured by Huddleston and Pullum's (2002:655) characterization of BTAs as coding "time deadlines". The fact that many BTA tokens express literal deadlines seems to validate this characterization:

(13)   He said Chrysler fully expects to have them installed across its light-truck line **by the Sept. 1, 1991, deadline**. (WSJ)

(14)   Mr. Bush has called for an agreement **by next September** at the latest. (WSJ)

Frequently, however, it is difficult to characterize the BTA as denoting a deadline. In the (15), for example, the BTA appears instead to encode the final state of a process of accretion:

(15)   Some atmospheric scientists think that even if CFCs were released into the atmosphere at an accelerating rate, the amount of ozone depletion would be only 10% **by the middle of the next century**. (WSJ)

That state of ozone depletion is not one subject to direct human control; thus, it seems inaccurate to characterize *the middle of the next century* as a deadline. While it might be accurate to characterize it instead as a point at which the state in question is expected (by atmospheric scientists) to be in force, the expectations of the participants described play a limited role in examples like (16-18):

(16)   The incentives boosted sales for a while, but the pace had cooled **by last month**. (WSJ)

(17)   **By the early 1980s**, its glory had faded like the yellow bricks of its broad façade. (WSJ)

(18)   Shearson Lehman Hutton Inc. **by yesterday afternoon** had already written new TV ads. (WSJ)

In (16-18), the BTAs appear to denote author-selected rather than participant-selected sampling points. For example, ***last month*** and *the early 1980s* in (16-17), respectively, are mentioned simply because they are reference times that are relevant to the narratives in question, not because anyone is aiming to ensure that the denoted states (slow sales, faded glory) are in force at those times. Further, while in (18) Shearson Lehman Hutton Inc. might have intended to have new TV ads at the time described as *yesterday afternoon*, they need not have so intended: yesterday afternoon is the author's sampling point, and not necessarily a time that figured in any participant's planning. Such sampling points have a retrospective quality to them in that they are located within a state of aftermath following the occurrence of an event or event series; this state

of aftermath is that denoted by perfect-form predications, whether they are existential perfects, as in (16), or resultative perfects, as in (17-18) (Herweg 1991, Michaelis 2004). However, the BTA sample is not necessarily taken after the fact, as shown by (19-21):

(19) U.S. oil supplies, however, had peaked in 1970 and 1971 and **by 1973** were declining. (WSJ)

(20) Stunned, Mr. Breeden turned to his market-monitoring computer, which **by then** was next to his desk. (WSJ)

(21) And **by the early 1980s** U.S. capitalists had ample reason to welcome junk bonds, to look the other way. (WSJ)

In (19-21), the BTA denotes a point located within, rather than subsequent to, a process (19) or state (20-21). Thus, a BTA need not select a state of aftermath. In addition, as we have seen, the BTA need not denote a time point that figured in any participant's schedule. Instead, we propose, the BTA denotes the first point at which some observer—whether the author or a participant— got, expects to get or hopes to get a positive answer to the question *Is state x in force?*

4. BTAs as state selectors

In describing the truth conditions on English progressive predications, Dowty (1977) proposes the 'bet test', a version of which runs as follows. Say that I wager with a friend that at midnight it will be snowing, and we later find out that midnight was the *first* moment at which it was snowing. Have I won my bet? For Dowty, the answer is no, since the semantics of the progressive require reference time to be located *during* the process denoted by its gerundial complement. The same 'noninitial moment' condition appears to apply to BTAs, but because of the deontic nature of many BTA uses, it seems fitting to replace the bet with a curfew in the test scenario. Say, for example, that a soldier is ordered to be back on base by midnight, and at

midnight is seen returning to base. Has the soldier violated curfew? We believe that the answer is yes. Thus, what the progressive construction and the BTA have in common is that both constructions locate reference time within the situation denoted by the lexical verb, prohibiting reference time from being the *first* moment of that situation. And in both cases, we submit, this constraint follows from a central property of state predications: states include the reference times for which they are asserted to hold (Partee 1984).

The progressive and the BTA differ in that the former is a *stativizer*, while the latter is a *state selector*. What does it mean to call the progressive a stativizer? Following De Swart (1998) and Herweg (1991), we assume that the progressive shifts dynamic eventualities to states. This characterization is supported by the fact that progressive predications pass numerous stativity diagnostics, including various tests involving temporal overlap (Michaelis 2004). The same can be said of perfect predications, and thus we assume that the perfect denotes a state—that state which follows the occurrence of the event denoted by the participial complement (Herweg 1991, Michaelis 2004).

If the BTA is a state selector, then it stands to reason that it should combine with progressive predications, as in (19) above, perfect predications (16-18) and simplex state predications (20-21). But one puzzle remains: why should the BTA combine with verbs that neither denote states nor have undergone stativization? Three such combinations are exemplified in (22-24):

(22) A slight recovery in the stock market gave currency traders confidence to push the dollar higher before the unit dropped back **by day's end**. (WSJ)

(23) The big futures buying triggered stock-index buy programs that eventually trimmed the Dow's loss to 31 points **by 11 a.m**. (WSJ)

(24) That index […] gained 17.97 % **by Sept. 30 this year**. (WSJ)

In (22-24), BTAs modify the perfective predicates *drop back*, *trim* and *gain*, respectively. If the BTA is in fact a state selector we would expect that the verb forms in question would be past-perfect forms, e.g., *had dropped*, or perhaps progressive forms (e.g., *was dropping*). A similar problem is raised by the infinitival complements that collectively account for the majority of BTA tokens in the WSJ corpus: these tend to be perfective predicates, as in (11): *That should happen by today*. What then allows for the appearance of nonstativized perfective verbs in clauses containing BTAs? A clue is provided by *after*-clauses. In *after*-clauses like that in (25), the past-perfect and simple-past forms are free variants:

(25)   After she (had) caught sight of him, she crossed the street.

In temporal discourse, an *after*-clause establishes an interval during which the main-clause event takes place, but in order to do so, the *after*-clause must encode a state, since only a state can overlap a next-mentioned event. Thus, the *after*-clause in (25) denotes a state that starts at a time just after the time of the event of her catching sight of him. In other words, when *after* combines with a dynamic verb like *catch sight of*, that verb expresses the initiating event of the *after*-clause state. A similar analysis can be applied to the perfective BTA examples in (22-24). In the case of (24), for example, the combination of a perfective verb and the BTA induces the interpreter to recover a state that starts just after the time at which the index gained 17.97 percent. The time point expressed by *Sept. 30 this year* is then understood as located within this inferred state. In the next section, we will discuss the mechanism by which such inferences take place, coercion, and discuss the evidence that supports our contention that BTAs are stative coercion triggers.

5. Coercion

Coercion effects are semantic enrichments that interpreters perform in order to resolve conflict between the semantic type selected for by a given operator (construction) and the semantic type expressed by the lexical item with which that operator has combined in a given context (De

Swart 1998, Jackendoff 1997: Chapter 3). Coercion is an interpretive procedure that like presupposition is triggered by linguistic form. Via coercion, all aspectual-class selectors are also potential aspectual-class shifters. Examples of coercion include those in which event-denoting predicates are interpreted as states and *vice versa*. For example, the state predication *I knew the answer* receives an inceptive-event reading in combination with the event-selecting adverbial *suddenly* (De Swart 1998: 359). Conversely, as argued by Michaelis (1996, 2004), the event verb *eat* gets a resultant-state reading in combination with the state-selecting adverbial *already* in (26). Compare the preterite-form sentence with (27), in which a stativizing construction, the perfect, compositionally yields the stative type sought by *already*, and no coercion is required:

(26)   I already ate. (coerced state)

(27)   I've already eaten. (compositionally derived state)

We propose that perfective predications containing BTAs, whether they are tensed as in (22-24) above or tenseless, as in imperatives and infinitival complements, have coerced resultant-state interpretations identical to that in (26). This proposal unifies BTA uses that otherwise require distinct analyses: BTAs in stative predications, progressive predications, perfect predications and perfective predications, both tensed and infinitival. In addition to this argument from parsimony, there is linguistic evidence that supports the stative coercion proposal. This evidence comes from constraints on present-time adverbial reference in simple-past tense perfective predications, as illustrated in (28-29):

(28)   You probably already heard this (*by) **now**. I found out earlier this afternoon. (google)

(29)   If you're a frequent reader, you probably noticed (*by) **now** that I'm a passionate guy. (google)

The grammaticality contrasts in (28-29) show that the BTA *by now* does something that the adverb *now* by itself would not: it imposes a present-perfect reading on a predication that would otherwise have a past-tense perfective reading. This present-perfect reading shifts reference time to the present, thereby allowing for present-time adverbial reference. If we presume that the BTA is a state selector, we can explain why (28-29) have present-perfect readings when the BTA *by now* is present, but not otherwise: the BTA selects for a resultant state, and when such a state is lacking in the verb's Aktionsart representation, the interpreter adds one in the interest of semantic-conflict resolution.

6. BTAs as Contextual Operators

We have already addressed the first of the three questions we raised in Section 1: how can we reconcile the apparently wide combinatoric potential of the BTA with the claim that it is a state selector? Our answer is that the BTA is not only a state selector but also a stative coercion trigger. In this section, we will address the second and third questions, respectively: what accounts for the strong association between the BTA and futurate (modal and other infinitival) contexts and why do speakers use BTAs when time-denoting PPs headed by *at* provide more precise temporal specifications, and are equally compatible with state predications? As a first step toward answering these questions, let us consider the contrast in (30-31):

(30)   At midnight, I was lying on the couch.

(31)   By midnight, I was lying on the couch.

While both (30) and (31) assert that a state held at midnight, only (31) requires us to view that state as one of a series of causally connected states. Thus, we propose that a BTA instructs the interpreter to map the denoted state to a point on a canonical time scale. This point is the first feasible sampling point described in Section 3. By *canonical* here we mean whatever granularity of intervals the situation requires (e.g., days, hours, etc). These intervals are associated with situations, each of which represents a stage within an event series. The event-series

characterization applies even in cases of deontic meaning like imperatives, e.g., *Be home by midnight*. What is the event series in this case? It could be (a) the process that culminates in return to one's point of origin, which might entail, e.g., hailing a cab at 11:30pm, or (b) a sequence of hypothetical returns by the addressee, each of which occurs at a different time prior to midnight. In either case, midnight represents a first feasible sampling point for the state of being at home. Of course, the speaker who uses the imperative *Be home by midnight* intends not merely to observe the time of return but also to influence it. Since tracking emergent states of affairs generally subserves planning, it stands to reason that futurate predications, both modal and desiderative, should be prevalent in the BTA data.

The sampling point denoted by a BTA might be one that, in the speaker's view, is seen by most as infeasible (that is, unlikely to yield a positive result for the state in question). Thus, one potential implicature of an assertion containing a BTA is that the state is early with respect to some canonical developmental sequence. This is shown by the following sentences, the latter of which comes from the Switchboard corpus of conversational English (Godrey et al. 1992):

(32)   But while traffic was heavy early in the commute over the Golden Gate, **by 8 a.m**. it already had thinned out. (WSJ)

(33)   Speaker A: Well then, it will be mostly reruns, I guess.

Speaker B: And **by the end of February**, the way they do it nowadays. (Switchboard)

As indicated by his use of *already*, the author of (32) believes that his readers will be surprised to learn that Golden Gate Bridge traffic is light at 8am. Whether or not they actually are, they will interpret (32) against a frame in which states of traffic density are associated with times of day. In (33), Speaker B asserts that, perhaps contrary to Speaker A's expectations, February is a point at which a television viewer will find programming that consists largely of reruns. Again,

whether or not February strikes Speaker A as an early eventuation point for this state of affairs, she must still assess (33) against a canonical developmental sequence—in this case, one involving the broadcast industry's normal patterns of program production. Both commuting and television broadcasting cycles are frames, in the sense of Fillmore 1985, that enable the interpreters of these sentences to evaluate them against the appropriate developmental sequences.

In light of the above findings, we propose that BTAs belong to the class as *contextual operators*, as described by Kay (1990, 1997). These are lexical items and grammatical constructions whose "semantic value consists, at least in part, of instructions to find in the context a certain kind of information structure and place the information presented by the sentence within that information structure" (Kay 1997:159). Examples of contextual operators include *even*, which instructs the hearer to interpret the asserted proposition as an extreme case along a scale of eventualities (Kay 1990), *already*, which instructs the hearer to interpret the denoted state as one that holds prior to the inception of a process that typically brings it about (Michaelis 1996) and *let alone*, which instructs the hearer to interpret the asserted proposition as more informative than a contextually given proposition within a scalar model (Fillmore, Kay and O'Connor 1988).

Kay (1990) argues that one can regard the meanings of contextual operators as conventional implicatures, insofar as they do not alter truth conditions. For example, as Kay points out, appending *even* to the front of the sentence *John swims in winter* does not change its truth conditions, but rather instructs the hearer to evaluate the proposition against a scalar model of likely swimmers and place the argument 'John' at the low end of this scale (Kay 1990: 53-56). It is debatable whether the BTA can be treated in a similar vein, as triggering a conventional implicature. If it could be treated in this manner, it would presumably add its implicature to the meaning expressed by *at*-headed PPs like *at midnight*. However, (34) and (35) actually do seem to differ truth conditionally:

(34)   She gave the signal at midnight

(35)   She gave the signal by midnight.

Whereas (34) would be false if she had given the signal at, say, 11pm, (35) would be true in this situation, since the BTA *by midnight* merely places an upper bound on signal-giving times.[3] We leave open the question of whether the meaning of the BTA is properly treated as a conventional implicature, but in the meantime we will continue to assume that it is appropriately treated as a contextual operator, since BTA-bearing predications require interpreters to retrieve or construct frames containing time series. Like other contextual operators, in particular its fellow state selector *already* (Michaelis 1996), the BTA can be regarded as pragmatically ambiguous in the sense of Horn (1989): its semantic structure is schematic in comparison to the rich array of implications it can have in context. BTAs locate a state relative to a canonical time scale, and there are a variety of reasons for which one might do this. Thus, the sampling point denoted by a BTA might be an earlier than expected point of eventuation, as in (32-33) above, a deadline, as in (36), the culmination point of a process, as in (37), or a retrospective assessment point located within a state of aftermath, as in (38), repeated from (16) above:

(36)   **Deadline**: Such legislation must be enacted **by the end of the month**. (WSJ)

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[3] We presume that BTAs, like interval adverbials, are upward entailing and 'downward compatible' (Herweg 1991). For example, the sentence *She finished the job in two hours* entails upward to *She finished the job in three hours*, and is downward compatible (via suspension of its lower-bounding implicatum) with the assertion *In fact, she finished the job in one hour*. Similarly, the assertion *She got home by midnight* entails upward to *She got home by 1am* and is downward compatible with the assertion *In fact, she got home by 11pm*.

(37) **Culmination point**: A dollar invested in the stock market in 1926 would have grown to $473.29 **by the end of last June**, according to Laurence Siegel, managing director at Ibbotson Associates Inc. (WSJ)

(38) **Assessment point:** The incentives boosted sales for a while, but the pace had cooled **by last month**. (WSJ)

These uses are not distinct at the semantic level but are instead contextual implications of BTAs.

7. Conclusion

As Binnick notes, "time adverbials have just begun to be studied" (1991:300). We have suggested that one way to advance this field of study is to use corpus data, because corpus examples help us understand why speakers choose the time adverbs they do. We have shown that intuitions about the use of BTAs found in reference and pedagogical grammars are at odds with BTA use patterns in the *Wall Street Journal* corpus. We have offered a more comprehensive account of the BTA's function in which it denotes a *sampling point* located just after the potential or actual inception of a state. To account for those examples in which the BTA combines with a perfective rather than stative verb, we have proposed that it is a coercion trigger: if the predicate with which the BTA combines is nonstative, it is augmented up to a resultant-state predication. Beyond simply expressing the time at which a given state holds, BTAs instruct the hearer to interpret the situation described as the end state of a sequence of causally connected states. This case study substantiates two general claims about the meanings of grammatical constructions and the 'little words' that they contain: aspectually sensitive constructions may index contextually available knowledge structures (Michaelis 1996) and such constructions, despite having etiologies that involve semantic 'bleaching', may have rich frame-semantic content (Goldberg 1995).

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