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Quantifying over hidden (parts of) events

Marcin Wągiel, Masaryk University in Brno & University of Wrocław, Department of Linguistics and Baltic Languages & SEI Slavicus – Centre for Corpus and Experimental Research on Slavic Languages, Žerotínovo nám. 617/9, 601 77 Brno & plac Uniwersytecki 1, 50-137 Wrocław, CZ, marcin.wagiel@phil.muni.cz

In this paper, I investigate certain intriguing properties of two types of quantificational adjectives exemplified by the English *two-time* and *double* and their interactions with event semantics. I explore their semantic behavior in phrases such as *two-time champion* and *double murder* and show that they operate on hidden eventive components within the semantics of the modified NPs. Building on Zobel's (2017) analysis of social roles and Wągiel's (2018) theory of subatomic quantification, I propose an analysis that accounts for their puzzling properties. In particular, I argue that *two-time* counts events of acquiring of a salient and conventionalized social role by an individual, whereas *double* is a subatomic quantifier that counts essential parts of an event.

1 Introduction

It is typically assumed that from a semantic point of view nominals are somewhat simpler compared to most verbs. Since Davidson (1967), a lot of evidence has pointed at what Parsons (1990) dubbed *subatomic semantics* in the verbal domain. This subatomic semantics corresponds to not immediately visible, yet rich internal structure relating underlying events with entities participating in those events. This, in turn, allows for decomposition of events into subevents that can be modified by certain adverbials and even quantified over (e.g., Cusic 1981; Andrews 1983; Cinque 1999; Zhang 2017). By contrast, for a long time the meaning of nominal expressions seemed less complex and more straightforward. However, it is well-known that certain deverbal nouns have an eventive component, which results in their argument-taking abilities, and thus verb-like semantic structure (Grimshaw 2011). Moreover, in the last decade or so the literature on various other types of nouns has further indicated that also other classes of nominal expressions are semantically complex. For instance, gradable nouns such as *idiot* have been argued to involve a degree ingredient in their meaning (Morzycki 2009). Perhaps even more interestingly, the interaction with privative adjectives such as *fake* suggests a dual content semantics for common nouns (Del Pinal 2015), whereas various types of partitive expressions reveal that even regular singular count nouns seem to encode complex internal part-whole structures (Wągiel 2018).

Meanwhile, in recent years various ways in which adjectival modifiers can interact with event semantics have been explored in order to better understand how natural language can express the quantity of entities participating in a given eventuality (e.g., Zimmermann 2003; Schäfer 2007; Gehrke & McNally 2015). In this paper, I will examine two intriguing, yet surprisingly understudied, classes of quantificational expressions exemplified in (1). I will use the terms *numerical frequency adjectives* for expressions such as *two-time*, see (1), and *multipliers* for adjectives like *double*, see (1b).

(1) a. two-time champion
b. double murder

A puzzling property of the two classes of adjectival expressions in question is that they give rise to non-trivial quantificational effects. Though they both involve some sort of numerical quantification, i.e., they relate to a particular number, e.g., the number *2* in the case of (1), they differ semantically from cardinal numerals in a significant way. While expressions such as *two champions* and *two murders* simply denote (sets of) pluralities of two individuals and events, respectively, (1a) and (1b) do not. Rather, they seem to designate singular individuals/events with some curious properties. For instance, consider different truth conditions of the sentences in (2) and (3).

(2) a. Kim met two champions. ⇒ 2 individuals
b. Kim met a two-time champion. ⇏ 2 individuals

(3) a. Kim witnessed two murders. ⇒ 2 events
b. Kim witnessed a double murder. ⇏ 2 events

While (2a) describes a situation in which Kim met two persons, (3a) means that she met a single individual with two championships. Likewise, for (3a) to be true Kim had to participate as a witness in two independent murdering events, whereas (3b) states that she witnessed a single event in which two people were killed.

The intuition that numerical frequency adjectives and multipliers do not yield pluralities of individuals/events is corroborated by the fact that NPs modified by such expressions can be pluralized and further modified by cardinal numerals. For instance, (4a) describes an event of Kim meeting two distinct individuals, whereas (4b) would be true if Kim witnessed two independent events.

(4) a. Kim met two two-time champions.
b. Kim witnessed two double murders.

The examples discussed above indicate that although, similarly to cardinal numerals, both classes of quantificational adjectives in question syntactically modify the NP, unlike cardinal numerals, they do not quantify over referents of the modified NP, but rather over objects of some other type. Therefore, the following questions arise: What are these objects and how do expressions such as *two-time* and *double* access them?

I will attempt to answer these questions by arguing that, in fact, the phrases in (1a) and (1b) show that the internal structure of nominal expressions is richer than typically assumed and that extending natural language ontology is needed in order to account for the non-trivial semantic effects discussed above. In particular, I will propose that numerical frequency adjectives and multipliers target hidden (parts of) events encoded in nominal semantics. Expressions such as *two-time* combine with nominals denoting properties of social roles (Zobel 2017) and quantify over events of acquiring a particular role by an individual that performs that role. On the other hand, multipliers such as *double* trigger subatomic quantification (Wągiel 2018), and thus count essential parts of an event, i.e., parts having a property comparable to the property of the whole. When combining with an event-denoting expression, they quantify over essential subevents, i.e., parts of an event that are conceived of as having a property comparable to that of the whole.

The paper is outlined as follows. In Section 2, I will investigate three sets of interesting properties of *two-time* and *double*. Specifically, I will discuss certain types of inference they give rise to, their scopal properties as well as their distribution. In Section 3, I will describe a theoretical framework that I adopt for the purpose of the analysis. In particular, I will introduce rather non-standard assumptions concerning subatomic part-whole structures in the domain of events as well as the ontological category of social roles. In Section 4, I will present my proposal,

which builds on the idea that numerical frequency adjectives quantify over events of acquiring of a role by an individual, whereas multipliers are subatomic quantifiers, i.e., expressions that count essential parts of a whole. Finally, Section 5 will conclude the paper.

2 Properties of *two-time* and *double*

In this section, I will explore linguistic properties of the two types of English quantificational adjectives introduced above, specifically numerical frequency adjectives and multipliers, which will be exemplified by *two-time* and *double*, respectively. Despite the fact that such expressions are cross-linguistically widespread, see (5) and (6), they remain surprisingly understudied (but see Dočekal & Wągiel 2018 and Wągiel 2019; 2020 for notable exceptions).

(5) a. two-time
b. zweimalig (German)
c. kétszeres (Hungarian)
d. dwukrotny (Polish)
e. dukart (Lithuanian)
f. ni-do (Japanese)

(6) a. double
b. doppelt (German)
c. dupla (Hungarian)
d. podwójny (Polish)
e. dvigubas (Lithuanian)
f. ni-jū (Japanese)

In English (as well as in many other European languages), only *two-time* is morphologically transparent. It clearly consists of a numeral component, e.g., *two-*, accompanied with the morpheme *-time*. On the other hand, since *double* and other English multipliers are borrowings stemming originally from Latin, their internal structure is opaque. Nevertheless, in some other languages, e.g., in Slavic and Baltic, they are clearly derivationally complex and demonstrate a formal relationship with numerals. For instance, the Polish form *podwójny* 'double' comprises the root *dw-* present also in the cardinal numeral *dwa* 'two'. Likewise, the Japanese *ni-jū* 'double' consists of the numeral *ni* 'two'. Consequently, it seems safe to assume that both numerical frequency adjectives and multipliers are similar to numerals in that at some level they involve reference to numbers.

Below, I will focus on three aspects of the two types of quantificational adjectives in question. First of all, I will investigate certain non-trivial inferences licensed by these expressions. Second, I will explore their scopal properties. Finally, I will discuss their distribution based on the results of a conducted corpus study. As for multipliers, in this paper I will restrict my focus to phrases in which *double* combines with an event-denoting NP.

2.1 Entailment patterns

Let us first discuss sentences with NPs in which numerical frequency adjectives modify deverbal nouns describing a participant of an event denoted by the verb such nouns are related to. Consider the entailments in (7)–(9).

(7) a. Kim is a two-time Pulitzer Prize winner.
b. ⊨ Kim won Pulitzer Prize twice.

(8) a. Kim is a two-time cancer survivor.
b. ⊨ Kim survived cancer twice.

(9) a. Kim is a two-time Boston Marathon qualifier.
b. ⊨ Kim qualified for Boston Marathon twice.

In each of the pairs above, the sentence with the NP modified by the numerical frequency adjective, i.e., (7a), (8a) and (9a), entails that Kim participated in *n*-many complete events described by the verb from which the relevant participant noun was derived, where *n* is specified by the numerical frequency adjective. So in (7b), (8b) and (9b), Kim took part in two winning, two surviving and two qualifying events, respectively. Therefore, at first sight it might seem plausible to deduce that expressions such as *two-time* simply quantify over eventualities encoded in the deverbal root of the modified noun. Crucially, however, numerical frequency adjectives can also combine with nominals that are not derived from verbs. For instance, let us reflect on the examples in (10)–(12).

(10) a. Kim is a two-time champion.
b. ⊨ Kim became a champion twice.

(11) a. Kim is a two-time senator.
b. ⊨ Kim became a senator twice.

(12) a. Kim is a two-time captain for the Yellowjackets.
b. ⊨ Kim became a captain for the Yellowjackets twice.

The fact that (10a) entails (10b) suggests that there is a hidden event of acquiring the property of being a champion in play and that, in the absence of any overt deverbal morphology, that event is introduced by the adjective *two-time*. In a similar vein, the relationship between (11a) and (11b), on the one hand, and between (12a) and (12b), on the other, indicates the relevance of an act of gaining a socially relevant role or capacity by Kim, i.e., becoming a senator and a captain, respectively. Of course, this perspective also extends to the examples with deverbal participant nouns in (7)–(9) since, e.g., Kim's winning Pulitzer Prize is equivalent to her becoming a Pulitzer Prize winner. Therefore, I conclude that numerical frequency adjectives operate on hidden events of acquiring a certain property or a role by specifying the number of such "becoming" events.

Let us now turn to the behavior of multipliers. Consider the entailment pattern demonstrated in (13)–(15).

(13) a. That crime was a double murder.
b. ⊨ That crime consisted of two parts.

(14) a. That strike was a double kick.
b. ⊨ That strike consisted of two parts.

(15) a. That play was a double play.
b. ⊨ That play consisted of two parts.

The entailments illustrated above indicate a concealed complex inner part-whole structure of the events denoted by the entire NP modified by *double*. In particular, one infers from (13a) that in the murdering event there were two victims. But this means that there were two parts of that event each of which could be described as a murder in its own right. These parts could be defined temporally as subevents or spatially as regions of space occupied by the casualties. For instance, in a knife-stabbing scenario killing each of the two victims would be a part defined temporally, i.e., as a particular subevent. On the other hand, in a bombing scenario, where two persons die simultaneously as a result of an instantaneous explosion, the two relevant parts would be defined spatially, i.e., as regions of space occupied by the victims. In a similar vein, (14a) and (15a) entail that that strike and that play, respectively, involve two subevents that somehow seem essential for the whole event, see (14b) and (15b).

Notice that the same effect is also attested in sentences with nominals denoting individuals, see (16)–(18) (Wągiel 2019; 2020).

(16) a. The Pschent is a double crown.
b. ⊨ The Pschent consists of two parts.

(17) a. The Burgenator is a double burger.
b. ⊨ The Burgenator consists of two parts.

(18) a. That weapon is a double shotgun.
b. ⊨ That weapon consists of two parts.

For instance, the sentence in (16a) entails that the Pschent is a crown consisting of two elements having a property comparable to that of the whole, see (16b), namely an ancient Egyptian crown that combines the White Hedjet Crown of Upper Egypt and the Red Deshret Crown of Lower Egypt. Similarly, (17a) and (18a) mean that the objects referred to by the subject DPs comprise two relevant parts, specifically two patties and two barrels, respectively.

Given the entailments discussed above, it follows that phrases including numerical frequency adjectives and multipliers such as (1a) and (1b) designate, respectively, a plurality of two events

of acquiring a property denoted by the modified NP and a plurality of two essential comparable parts constituting an event (or an individual) denoted by the modified NP.

2.2 Scopal properties

The second set of phenomena to be discussed here concerns scope. Interestingly, the quantificational effects of both *two-time* and *double* are anchored to a particular entity or event designated by the modified nominal. In other words, the expressions in question cannot outscope the NP, which results in a collective-like behavior. For instance, consider the available interpretations of the sentences in (19).

(19) a. Kim and Ida met a two-time champion.
b. Kim and Ida met two champions.

It is well-known that a sentence such as (19b) can mean either that Kim and Ida met two champions in total or that they met two champions each. One might expect that the occurrence of the numerical frequency adjective inside the object DP would result in a similar ambiguity. However, while (19a) can mean that Kim and Ida either met one champion in total or one champion each, it is impossible to distribute championships over different individuals. Thus, Kim and Ida had to meet a champion with two titles and a reading on which they met two different one-time champions is unavailable. This shows that *two-time* displays no scopal ambiguities and its meaning is anchored to an entity denoted by the modified noun.

Since expressions such as *two-time* appear to be a special class of frequency adjectives like *frequent* and *occasional* (see, e.g., Stump 1981; Zimmermann 2003; Schäfer 2007; Gehrke & McNally 2015), it is reasonable to test whether they share some of their properties. Interestingly, unlike frequency adjectives such as *occasional* (but similarly to *frequent*), *two-time* does not give rise to adverbial interpretations (first observed by Bolinger 1967), compare (20) and (21).

(20) a. An occasional sailor strolled by.
b. = Occasionally, a sailor strolled by. (Gehrke & Mcnally 2015: 845)

(21) a. A two-time senator strolled by.
b. ≠ Two times, a senator strolled by.

While (20a) is synonymous to (20b), (21a) cannot be understood as equivalent to (21b). Similarly to frequency adjectives such as *frequent*, *two-time* triggers only the so-called internal reading, see (22)–(23).

(22) a. A frequent sailor won the regatta.
b. = Someone who sails frequently won the regatta. (Gehrke & Mcnally 2015: 840)

(23) a. A two-time winner lost the regatta.
b. = Someone who won two times lost the regatta.

Perhaps it is worth noting that this is somewhat reminiscent of the fact that multiplicatives like *two times* differ from frequency adverbs such as *often* in that they lack relational readings, compare (24) and (25) (Doetjes 2007).

(24) Quand il est à Paris, Pierre va souvent au Louvre.
when he is in Paris Pierre goes often to.the Louvre
(i) 'Often when he is in Paris, Pierre goes to the Louvre.'
(ii) 'Whenever he is in Paris, Pierre goes often to the Louvre.' (Doetjes 2007: 686)

(25) Quand il est à Paris, Pierre va trois fois au Louvre.
when he is in Paris Pierre goes three times to.the Louvre
'Whenever he is in Paris, Pierre goes three times to the Louvre.' (Doetjes 2007: 705)

Turning to multipliers, their quantificational effects are also anchored to an event described by the modified NP. For instance, consider (26).

(26) a. Kim and Ida witnessed a double murder.
b. Kim and Ida witnessed two murders.

While (26b) is true either if Kim and Ida witnessed a total of two or a total of four murders, (26a) does not show a comparable ambiguity that would result in distributing the victims over different eventualities. Again, the meaning of *double* is anchored to a singular event. Consequently, the sentence cannot mean, e.g., that Kim witnessed the murder of Jack, whereas Ida witnessed the murder of Steve.

Let us now compare the semantic behavior in (26), as discussed above, with adverbial numeric quantification in the VP domain. It is well known that, depending on a position in a sentence, multiplicatives such as *twice* can count either entire events or event-internal acts, i.e., subevents that are relevant parts of a whole (e.g., Cusic 1981; Andrews 1983; Cinque 1999; Zhang 2017). To illustrate, let us consider the ambiguity of the sentence in (27).

(27) The salesman rang the doorbell twice. (Cusic 1981: 61)

On the event-external reading, (27) means that on two separate occasions the salesman rang the bell once, whereas the event-internal interpretation states that on one occasion they rang the bell two times. Furthermore, in a configuration such as (28) the preverbal multiplicative, i.e., *twice*, unambiguously counts the number of independent knocking events, whereas the postverbal *three times* quantifies over their parts, i.e., particular knocks within each of those knocking events (Cinque 1999).

(28) John twice knocked on the door three times. (Cinque 1999: 27)

Importantly, though there are two pluralities in (28), the sentence does not have an interpretation that would resemble a cumulative reading. On such an interpretation the sentence would be true if there were (exactly) two separate knocking eventualities and the total number of knocks were three, i.e., on one occasion John knocked once and on another he knocked twice. Hence, similarly to *double* in (26a), the quantificational effect of the postverbal *three times* in (28) is event-internal.

2.3 Distribution

In order to determine the distributional properties of *two-time* and *double*, I conducted a corpus study based on the Corpus of Contemporary American English (COCA), which is a representative corpus of English containing more than one billion words of text from various genres (Davies 2009). The study was complemented with a series of Google queries.

Let us first discuss the distribution of *two-time*. Based on the list of most frequent nominal collocates in the COCA, I conclude that *two-time* combines with nouns denoting social roles or capacities that can be classified into four groups. The first class consists of nouns describing award recipients or generally persons whose achievements received some sort of formal recognition, e.g., *champion*, *winner*, *laureate*, *honoree*, *medalist*, *titleholder* and *recipient*, see (29) for some attested COCA examples.

(29) COCA examples
- a. […] the Cowboys looked like anything but a two-time champion hungry for an unprecedented third straight Super Bowl.
- b. A two-time winner of the Nobel prize, Curie discovered radium […]
- c. He's a two-time medalist, presently ranked second in the world, according to the World Cup rankings […]
- d. He is also a two-time recipient of the Excellent Research Awards from the National Science Council of Taiwan.

The second class is closely related to the first one and comprises competition participants, e.g., *nominee*, *finalist*, *Olympian*, *qualifier*, *runner-up*, *competitor*, *candidate* and *loser*, as illustrated by the sentences in (30).

(30) COCA examples
- a. Ken is a two-time nominee for documentary feature, and his film might be the one to beat in that highly competitive race this year […]
- b. He was a two-time finalist in the Funniest Person in Austin contest and recently performed at the uber-prestigious Just for Laughs festival in Montreal.
- c. She is a seven-time major champion and a two-time runner-up in Australia but is currently ranked only 36th.

d. Scattered bits of reporting suggest that ministry has always been a secret dream of the two-time presidential candidate.

The third class describes positions with a term, e.g., *president*, *governor*, *prime minister*, *senator* and *captain*, see some attested examples in (31).

(31) COCA examples
a. So at age 59, after three decades as a male professor and two-time president of the faculty senate, Professor Wally Bacon became Professor Meredith Bacon.
b. You gave us George W. Bush, your two-time governor, who lied us into Iraq […]
c. […] there were few demonstrations of support and few expressions of regret for the two-time prime minister.
d. Ms. Roskot was full of drive and discipline, the two-time captain of her high school lacrosse team on Long Island.

Finally, nouns in the fourth class designate other socially salient capacities that are typically related to some kind of conventionalized situation, e.g., *felon*, *graduate*, *divorcee*, *husband*, *patient* and *survivor*, see (32).

(32) COCA examples
a. […] after all, Jimmy, you're just a one-hit wonder, a two-time felon, three-time divorce[e], no talent ex-junkie.
b. The 20/20 stint was to promote Lohan's […] movie *Liz & Dick* in which she portrays Elizabeth Taylor and her stormy romance to two-time husband and co-star Richard Burton.
c. A two-time graduate of Boulder Outdoor Survival School in Utah, Kristine had hiked 20 miles a day with only a knife, tin cup and water purification drops […]
d. As a two-time survivor of breast cancer and a journalist, I found Help Me Live to be informative, touching, and even funny […]

All of the expressions discussed above are human nouns that designate social functions, capacities or roles. Crucially, it must be possible to acquire a given role repetitively so that there can be multiple "becoming" events associated with that role. This property can be detected by the *became again* VP test and it gives rise to the distributional constraint illustrated in (33)–(34).

(33) a. Kim became a {champion / senator / felon} again.
b. Kim is a two-time {champion / senator / felon}.

(34) a. #Kim became a(n) {person / adult / German} again.
b. #Kim is a two-time {person / adult / German}.

Since the roles of a champion, a senator and a felon are properties that can be acquired repetitively, (33a) is felicitous, and thus (33b) works fine. On the other hand, the reason why the sentences

in (34b) are weird is that being a person, an adult and a German are not properties one can repetitively gain, as demonstrated in (34a).

Furthermore, nominals in each of the four classes discussed above, recall (29)–(32), describe conventionalized roles that are typically acquired during a codified ceremony, e.g., an awards ceremony, an inauguration or a wedding. This suggests the importance of social convention in defining which roles are sufficiently significant to keep track of when individuals assume them. Consequently, only nominals designating socially salient functions are predicted to be felicitous with numerical frequency adjectives, see (35).

(35) a. ??Kim is a two-time designated driver.
b. ??Kim is a two-time birthday girl.
c. ??Kim is a two-time life of the party.

Though being a designated driver, see (35a), a birthday girl, (35b), and a life of the party, (35c), are all social roles that one can perform multiple times, out of the blue all of the sentences above sound odd. The reason is that it simply seems that the properties in question are not socially salient enough to be associated with a conventionalized ceremony, which would justify counting how many times an individual acquired them. However, in a proper context nouns denoting "insignificant" stage properties such as *passenger* (Barker 1999) can also be modified by *two-time*. For instance, consider the fragment in (36).

(36) Soaring like an eagle in a 10-story high balloon 1,500 feet above the earth without a cockpit, radio or control tower is simply an indescribable feeling […] "It's a total rush," said Crystal Lake's Cheryl Marino, 19, a two-time passenger.[1]

Similarly, the roles of a visitor and a driver can count as salient enough if a proper context is set, see (37)–(38).

(37) Mr. Kristof has lived on four continents, reported on six, and traveled to more than 140 countries, plus all 50 states, every Chinese province and every main Japanese island. He's also one of the very few Americans to be at least a two-time visitor to every member of the so-called "Axis of Evil".[2]

(38) NASCAR has designated White one of its Top Fifty Drivers […] A two-time driver for Chevrolet's racing ream, White raced from 1954–1965.[3]

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[1] Source: Mayer, Larry (1991). Up, up and away! Explore the high life in a balloon. *Chicago Tribune*, July 21 1991, https://www.chicagotribune.com/news/ct-xpm-1991-07-21-9103210393-story.html.

[2] Source: Columnist Biography: Nicholas D. Kristof. *The New York Times*, https://archive.nytimes.com/www.nytimes.com/ref/opinion/KRISTOF-BIO.html.

[3] Source: Jones, Anne B. & Rex White (2014). *All Around the Track: Oral Histories of Drivers, Mechanics, Officials, Owners, Journalists and Others in Motorsports Past and Present*. Jefferson: McFarland & Company, p. 65, https://books.google.cz/books?id=e9JB3ax1iPgC.

Finally, in the context of a global pandemic, the second COVID-19-caused hospital admission of a single person is worth reporting, as witnessed in (39).

(39) The story of Janice Brown, two-time coronavirus patient, parallels the story of the hospital that treated her.[4]

Let us now investigate the distribution of multipliers when they combine with event-denoting expressions. Based on the COCA collocation list complemented with a number of Google searches, I conclude that *double* selects for nominals that can designate complex eventualities.[5] In general, such expressions fall into three classes. The first class contains nominals denoting actions affecting multiple objects, e.g., *murder*, *homicide*, *date* and *play*, see (40) for sentences excerpted from the COCA.

(40) COCA examples
- a. […] the house was the scene of a double murder: a young girl killing both of her parents then running into the forest.
- b. A double homicide is when two people are killed, Denny.
- c. Fine, but only if you agree that your first date will be a double date with me and Genevieve on a week-long trip to Turk's.
- d. […] this sort of rhetoric amounts to something of a racial double play, allowing Obama and Cosby to cater both to culturally conservative blacks and to whites […]

Nominal expressions in the second class describe actions involving quick repetitions, e.g., *jump*, *kick*, *somersault*, *flip* and *shift*, and (41) gives some attested examples.

(41) COCA examples
- a. The top skaters often land as many as seven, some in combination with double or triple jumps.
- b. […] the pit viper strikes the soldier dead for the offense. Executes a gravity-defying flying double kick that snaps the soldier's neck.
- c. "So I just jump and poof into a wolf?" he continues his barrage of questions as he executes a perfect double flip.
- d. "Most of the waitresses who worked a double shift walked 27 miles a day, mostly in circles," […]

Finally, the third and final class consists of eventualities that can have multiple aspects or consequences, e.g., *whammy*, *crisis*, *victory* and *defeat*, see (42).

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[4] Source: Mejia, Brittny (2020). A patient's return to hospital COVID-19. *Los Angeles Times*, May 13 2020, https://www.latimes.com/california/story/2020-05-13/coronavirus-test-second-infection-hospital.

[5] Notice, however, that multipliers seem to combine with entity-denoting expressions more often. For discussion, see Wągiel (2020; 2021b: Ch. 4).

(42) COCA examples

a. Carbo suffered a double whammy with the collapse of natural gas prices coupled with the environmental uproar surrounding fracking.

b. For many gays, AIDS was a double crisis: they had the virus and they were being blamed for the epidemic.

c. But for African-American Matthew Henson it was a double victory: a triumph over both a hostile land and the prejudices of a white-dominated society.

d. The day's two Democratic primaries have Hillary Clinton hoping to avoid a double defeat, and Bernie Sanders hoping to pull out a pair of wins.

All of the expressions discussed above describe situations with a complex internal part-whole structure. How it is conceptualized depends on a particular class. For instance, in the case of actions involving quick repetitions such as repeated kicks, jumps or flips a sequence of movements is perceived as a single event consisting of two essential subevents. Therefore, such eventive part-whole structures are construed in terms of temporal partitions. However, other types of complex eventualities could be partitioned along the spatial dimension, e.g., if the participating objects were affected simultaneously but occupied different regions of space. The role of multipliers is, thus, to determine how complex the internal structure of a given eventuality is irrespective of how exactly that structure is defined.

2.4 Data Summary

Let us now summarize the findings presented in this section. Both numerical adjectives and multipliers are cross-linguistically widespread expressions that involve reference to the corresponding number, e.g., the number 2 in the case of *two-time* and *double*. Crucially, it turns out that they both operate on hidden components within the semantic structure of the entire NP. Numerical frequency adjectives such as *two-time* differ from frequency adjectives such as *occasional* in that they lack adverbial readings, and thus they pattern with *frequent*. They combine with nouns denoting socially salient roles that are typically officially acquired in the course of a conventionalized ceremony. Consequently, expressions such as *two-time* quantify over covert events of acquiring of a given role by an individual. On the other hand, multipliers combine with nominals denoting complex events and operate on their internal part-whole structure. In doing so, they quantify over essential parts of an event, i.e., the parts that are conceived of as inherent to a particular event or even having a property comparable to that of the whole. In both cases, the quantificational effects of *two-time* and *double* are anchored to a particular individual or event, i.e., the expressions in question do not enter any scopal relationships. Finally, both what counts as a socially salient role and what is an essential part might be context-dependent.

With the empirical landscape clarified, let us now turn to the issue of how the intriguing semantic behavior of numerical frequency adjectives and multipliers can be accounted for.

Before I present my proposal, let me spell out the conceptual framework that I will employ in the analysis.

3 Background assumptions

In this section, I will introduce a number of theoretical assumptions necessary for the analysis to be proposed in the next section. In particular, I will briefly discuss the semantics of event-denoting nominals, the assumed mechanism of numeric quantification as well as the meaning of role nouns.

3.1 Events

In general, I adopt a standard neo-Davidsonian framework (e.g., Carlson 1984; Dowty 1989; Parsons 1990). For that reason, I assume an extended ontology with the domain of events D_v. Events belong to the independent ontological category of the primitive type v and are conceived of as concrete spatiotemporal particulars, i.e., objects with a location and time (the idea dating back to Davidson 1967). Furthermore, events are associated with individuals participating in them via thematic roles such as AGENT, THEME, INSTR (for 'instrument') and BEN (for 'beneficiary') etc., which are part of the subatomic semantics of event-denoting expressions.

Furthermore, following Grimshaw (2011) I take all deverbal nominals with the exception of participant and result nouns to denote properties of events. In addition, I assume that similarly to event-denoting verbs they encode thematic roles. For instance, consider (43).

(43) a. $[\![\text{murder}]\!] = \lambda x_e \lambda y_e \lambda e_v [\text{MURDER}(e) \wedge \text{AGENT}(e) = y \wedge \text{THEME}(e) = x]$
b. $[\![\text{murder of Kim}]\!] = \lambda y_e \lambda e_v [\text{MURDER}(e) \wedge \text{AGENT}(e) = y \wedge \text{THEME}(e) = \text{K}]$
c. $[\![\text{murder of Kim by Ida}]\!] = \lambda e_v [\text{MURDER}(e) \wedge \text{AGENT}(e) = \text{I} \wedge \text{THEME}(e) = \text{K}]$

While the noun *murder* is a function of type $\langle e,\langle e,\langle v,t\rangle\rangle\rangle$, see (43a), the PPs *of Kim* and *by Ida* saturate the theme, see (43b), and the agent argument, see (43c), respectively. In the absence of linguistic expressions saturating the individual arguments, I assume that the variables corresponding to the agent and the theme get existentially bound in the course of composition.

Finally, in the spirit of Bach (1986) I assume that, similarly to individuals, events display part-whole relations. This means that we can talk about pluralities of events in an analogous manner as we talk about pluralities of individuals. For instance, let us assume that the plural noun *murders* has the denotation as in (44), where * is the pluralization operator defined as a closure under sum formation (Link 1983).[6] In other words, it takes a set of singular events and

[6] I assume that in the absence of overt material saturating the theme and the agent these arguments are existentially closed.

yields a set containing these singular events as well as all pluralities one can obtain by summing them up. As a result, the noun *murders* can be used to refer to a plurality of murdering events.

(44) $[\![\text{murders}]\!] = \lambda e_v \exists x_e \exists y_e\ [^*\textsc{murder}(e) \wedge \textsc{agent}(e) = y \wedge \textsc{theme}(e) = x]$

With the basics related to the domain of events in place, let us now move on to the assumptions concerning quantification.

3.2 Numeric quantification

Following the standard literature on numerals (e.g., Rothstein 2017), I assume the domain of numbers D_n. I take numbers to be independent ontological objects of type n which, unlike individuals or events, are ordered. Furthermore, I posit that at some level numerals relate to abstract number concepts (the idea dating back to Scha 1981), and thus can be used to refer to objects of type n. In fact, for the purpose of this paper I will simply presume that basic cardinal numerals are names of numbers, i.e., that their meaning is as in (45).

(45) $[\![\text{two}]\!] = 2$

As for numeric quantification, I adopt the main idea behind the theory of Krifka (1989) that counting is performed via additive extensive measure functions, i.e., operations that associate individuals or events with natural numbers, see (46), where $\circ$ and $\sqcup$ stand for *overlap* and *sum formation*, respectively.

(46) μ is an additive measure function iff it satisfies the following requirement
$\forall x \forall y[\neg \circ(x,y) \rightarrow [\mu(x \sqcup y) = \mu(x) + \mu(y)]]$

The general idea is that when a measure function μ is applied to a plurality of objects of any type, it maps it onto a natural number corresponding to the number of objects constituting the plurality in question. For instance, for a plurality of two murders, it yields the number 2.

The final set of assumptions concerns augmenting the ontology with an additional category of roles. Since such an extension is rather non-standard, I will discuss the arguments for adopting it in slightly more detail.

3.3 Roles

Recent research on restrictive *as*-phrases and German copular clauses (Zobel 2017) as well as on Slavic derived social collective nouns (Wągiel 2021a) provides arguments for distinguishing between two types of human nouns, specifically class nouns like *man* and role nouns such as *judge*. The division corresponds to the distinction between individuals and abstract social roles advocated in the literature on theoretical computer science, knowledge representation and conceptual modelling (e.g., Sowa 1984; Steimann 2000; Loebe 2007). Roles differ from

individuals in that they are independent social constructs representing functions, potentials and obligations of individuals who bear them. As such they occupy social space, which is an intricate web of expectations, duties, entitlements, prohibitions and other social dependencies (Wągiel 2021a). Though such a perspective is not widely adopted in natural language semantics, a similar notion of capacity has been proposed by de Swart et al. (2007), whereas Anderson & Löbner (2018) postulate the relevance of roles as part of higher-level social ontology.

As demonstrated by Zobel (2017), there are a number of linguistic phenomena sensitive to the distinction between class and role nouns. For instance, in languages such as German, Dutch and French role nouns can appear without the indefinite article in copular clauses while class nouns can never occur bare in this position (de Swart et al. 2007; Geist 2014). In English, a use of a role nominal without the indefinite article is also possible, but only for nominals designating single roles, as in (47).

(47) Sue is chair of the committee. (de Swart et al. 2007: 219)

Furthermore, predicates such as *earn 3,000 euros* are infelicitous in constructions with *as*-phrases containing class nouns, as witnessed by the contrast in (48).

(48) a. #Paul earns 3,000 euros as a man.
b. Paul earns 3,000 euros as a judge. (Zobel 2017: 439)

In addition, there is an interesting difference in logical arguments of the form in (49)–(50). In the first premise in (49a), the descriptive content of the definite description consists of a class noun. As a result, the conclusion in (49c) is valid. On the other hand, if the first premise contains a role noun, as in (50a), the parallel inference does not arise, see (50c).

(49) a. The man (over there) is on strike.
b. The man (over there) is the hangman.
c. ⊨ The hangman is on strike. (Zobel 2017: 439)

(50) a. The judge is on strike.
b. The judge is the hangman.
c. ⊭ The hangman is on strike. (Landman 1989: 724)

Note also that there might be certain properties of roles that do not apply to the individuals that bear them. For instance, in (51) being outmoded and dangerous does not pertain to any person but rather to the abstract object denoted by the DP *this role*.

(51) I submit that this role is outmoded and dangerous. (Zobel 2017: 450)

Finally, there is no simple one-to-one correspondence between roles and their bearers since a single role can be performed by several individuals or even by no individual at all, compare the sentences in (52).

(52) a. The three core players and their organizations are executive director of the Tri-County regional planning commission.
b. I long for the day when no one is head of the house. (Zobel 2017: 449)

Given the contrasts discussed above, it seems that the evidence for the significance of roles in natural language is robust. Let us now discuss how they can be modelled within a formal system. In this paper, I will follow Zobel (2017) in simply assuming an additional domain alongside the more traditional domains of individuals and eventualities. In particular, I assume the domain of roles modelled as primitive ontological objects of type $r \in D_r$.[7] As social constructs independent of their bearers, roles are conceptualized as capacities or functions of individuals. Consequently, role nouns differ from class nouns in that they denote properties of roles rather than properties of individuals. While nouns such as *man* are predicates of type $\langle e,t \rangle$, see (53a), nouns like *judge* are expressions of type $\langle r,t \rangle$, see (53b).

(53) a. $[\![\text{man}]\!] = \lambda x_e[\text{MAN}(x)]$
b. $[\![\text{judge}]\!] = \lambda r_r[\text{JUDGE}(r)]$

Crucially, despite the fact that individuals and roles are ontologically distinct objects, they are tightly related since the former typically perform the latter. In Zobel's system, this relationship is captured by the shifting operation called PLAY, which for a set of roles returns a set of individuals associated with those roles via events in which they perform them.

With all the background assumptions in place, let us now proceed to the formal account of the semantics of *two-time* and *double*.

4 Proposal

In this section, I will propose a semantics for numerical frequency adjectives and multipliers that will attempt to account for their non-trivial semantic behavior discussed in Section 2. The core idea behind the analysis is that both *two-time* and *double* target hidden components that are part of the semantic structure encoded by the nominal expressions they combine with. The former are sensitive to prominent social roles, whereas the later operate on subatomic structures of the events denoted by the modified NP. Let us begin with the proposal for *two-time*.

4.1 Accounting for *two-time*

I propose that numerical frequency adjectives such as *two-time* quantify over events of acquiring of a socially salient, conventionalized role by an individual. For this purpose, let us define the

[7] For an alternative analysis based on frame semantics, where roles are captured as higher-level abstract offices within layered ontology, see Anderson & Löbner (2018).

measure function #(*P*), see (54), where IND specifies eventualities that are conceptualized as countable individuated units in the extension of *P*.

(54) #(*P*) is an additive measure function standardized by the following requirement
$\forall P_{\langle v,t\rangle} \forall e_v [\#(P)(e) = 1 \text{ iff } \text{IND}(P)(e)]$

In prose, for a property of events *P*, the operation # would return a measure function yielding a number of eventualities individuated as singular spatio-temporal particulars of which *P* is predicated. In atomicity-based accounts, such eventualities would of course be modeled as atomic events. However, there are also alternative approaches that postulate the notion of an integrated whole (defined one way or another) instead of that of an atom (see, e.g., Moltmann 1997; Grimm 2012; Wągiel 2018). Furthermore, given the arguments that atomicity-based approaches fail to provide a satisfactory account for numeric quantification over parts of singular objects (see Wągiel 2018: Ch. 7), I do not want to commit here to such a view.[8] Therefore, I will simply assume that whatever the mechanism of individuating units in the extension of *P* for the purpose of counting is the proper one, IND(*P*) yields a set of such units.

Let us add four more components. First of all, I assume the thematic role BEN (for "beneficiary"), which yields the individual for whose benefit the action was performed. Second, I propose a special type of eventualities, which I call "becoming" events. Formally, they are specified by the operator BC (for "become"), which relates eventualities and roles in such a way that the beneficiary of the becoming event acquires the relevant role.[9] The third ingredient that I postulate is the measure function #(BC)(*r*), which allows for the quantification over becoming events. Specifically, it yields a number of acts of assigning a role to a beneficiary individual. Finally, I posit a special higher-order property that defines conventionalized roles by which I mean socially salient capacities whose acquisition is typically associated with some kind of ceremony or other type of formal recognition. I will represent this property with $\text{CONV}_c(P)$, where the subscript *c* corresponds to a free variable whose value is provided by the context.

I postulate that in English the four components introduced above are encoded in the morpheme *-time*, which is shared by all numerical frequency adjectives in this language. The proposed semantics is provided in (55).

(55) $[\![\text{-time}]\!] = \lambda n_n \lambda P_{\langle r,t\rangle:\text{CONV}_c(P)} \lambda x_e \lambda r_r \exists e_v [\text{BC}(e,r) \wedge \text{BEN}(e) = x \wedge P(r) \wedge \#(\text{BC})(r)(e) = n]$

According to (55), *-time* denotes a function that requires a numerical input and returns an expression that counts the number of events of acquiring of a conventionalized, socially salient role (specified by the modified NP) by an individual. Typically, the general world knowledge concerning social life determines whether a particular role noun meets the $\text{CONV}_c(P)$

[8] This is especially relevant in the context of the analysis of *double* proposed in Section 4.2.

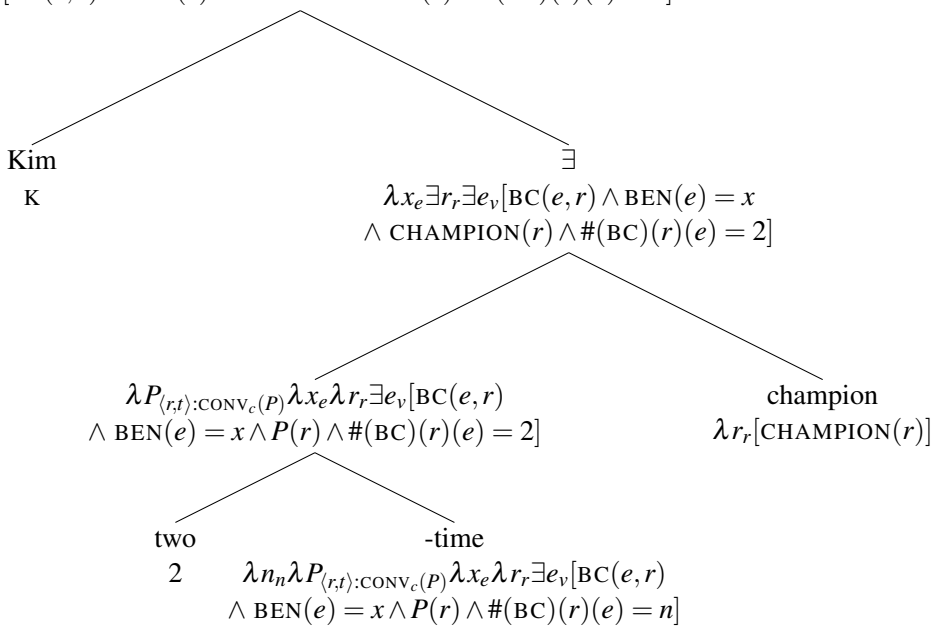
[9] One can think of the postulate of BC as somewhat similar to the idea of primitive predicates in the theory of the bipartite structure of verb meaning (Dowty 1979; Rappaport Hovav & Levin 1998).

presupposition. However, a special context can also provide sufficient background for satisfying this condition, recall the discussion of (36)–(39) in Section 2.3.

Let us now demonstrate step by step how the semantics in (55) allows us to derive the truth conditions of a simple sentence such as (10a), repeated here as (56). Consider the tree in (57) (for the sake of clarity, I ignore the intricacies related to tense and aspect etc.).

(56) Kim is a two-time champion.

(57) $\exists r_r \exists e_v[\text{BC}(e,r) \wedge \text{BEN}(e) = \text{K} \wedge \text{CHAMPION}(r) \wedge \#(\text{BC})(r)(e) = 2]$



First, the numeral *two*, which is an expression of type *n*, recall (45), combines with the morpheme *-time* in order to saturate its number argument, recall (55). As a result, we obtain a modifier that takes a predicate true of conventionalized roles and returns a quantificational expression equipped with the measure function #(BC) that would yield the number 2 for a plurality of two events if during each of those events an individual defined as its beneficiary acquired a role described by the modified role predicate. Next, *two-time* combines with the noun *champion*, which denotes a property of roles. Since common world knowledge provides that the role of a champion is tightly associated with a conventionalized becoming event, the definedness condition of *two-time*, i.e., the presupposition $\text{CONV}_c(P)$, is met and the result of the composition is a function from individuals to a function from roles to truth values. At this point, I assume existential closure over the role variable. In particular, the phrase *two-time champion* denotes a set of individuals who participated as a beneficiary in two events of acquiring the role of a champion. Finally, after combining with the subject proper noun *Kim* we obtain the truth conditions of the entire sentence. Specifically, (56) is true if Kim became a champion twice, which are the correct truth conditions.

Having discussed the proposed semantics of *two-time*, let us now turn to the analysis of *double*.

4.2 Accounting for *double*

While *two-time* counts events that are merely not immediately apparent, multipliers are expressions of a very different kind. That is because modifiers such as *double* are subatomic quantifiers, i.e., they do not target wholes but rather quantify over parts of an event denoted by the modified noun. As argued by Wągiel (2018), singular count nouns denoting entities encode complex internal part-whole structures that can be targeted by certain kinds of partitive expressions. In this paper, I propose that such subatomic structures also exist in the domain of events. In particular, I argue that singular events involve internal part-whole relations that are structured (see Simons 1987) and that natural language is sensitive to this phenomenon. For instance, proportional partitives modified by ordinal numerals enforce an interpretation based on the notion of subatomic structured parthood, see (58).

(58) The first half of the trip was wonderful.

Crucially, the phrase *first half* in (58) does not designate an arbitrary part of the trip, but rather it specifies a structured sequence of subevents defined in terms of temporal contiguity. Consequently, the sentence is true only if what was wonderful constitutes a convex, i.e., gapless, chunk of the event.

In order to account for the subatomic quantificational effects of expressions such as *double*, I propose that they introduce the measure function $\boxplus(P)$ defined in (59), where $\text{ESNTL}_c(P)$ yields parts that are perceived as essential for an event relative to a property P and context c.

(59) $\boxplus(P)$ is an additive measure function standardized by the following requirement
$\forall P_{\langle v,t\rangle} \forall e_v [\text{IND}(P)(e) \rightarrow \boxplus(P)(e) = \#(\lambda e' [e' \sqsubseteq e \wedge \text{ESNTL}_c(P)(e')])]$

The $\boxplus(P)$ measure function counts only parts of individuated singular, i.e., countable, events. Numeric quantification is ensured by employing the # operation. As a result, $\boxplus(P)$ provides a cardinality of parts of an event that are essential for an ascription of P. Typically such parts seem to have a property comparable to that of the whole, e.g., a double murder consists of two subevents each of which can be characterized as a murder in its own right, as discussed in Section 2.1. However, it is not always the case. To see why, let us consider the examples in (60).[10]

(60) a. The six-time Canadian champion executed a double Axel and then a triple Lutz which was heavily two-footed.[11]
b. A Double Burpee is when you perform 2 pushups after you kick your feet out during the burpee.[12]

[10] See also Wągiel (2021: Ch. 4.2) for more examples of this type, but with *double* modifying entity-denoting nominals.

[11] Source: 2004 Canadian Figure Skating Championships: Highlights, *Golden Skate*, January 13 2004, https://www.goldenskate.com/2004/01/2004-canadian-national-figure-skating-championships-highlights/.

[12] Source: Ballantyne, Craig (2013). Picking the perfect finisher, *Early to Rise*, May 5 2013, https://www.earlytorise.com/the-perfect-finisher/.

The expressions *axel* and *lutz* refer to figure skating elements in which a skater jumps, spins in the air once and successfully lands. Crucially, the phrases *double axel* and *triple lutz* in (60a) would not be true of an event in which the agent propels themself, spins in the air, lands and repeats the entire sequence since that would count as performing a single axel twice and a single lutz three times, respectively. Instead, the expressions in question designate events of a single jump with two and three spins in the air, respectively. Though performing every part of the sequence is necessary for a skating element to be evaluated as a double axel/lutz, the spin seems to be the most difficult action, and thus is perceived as what I dub the essential part. In a similar vein, *double burpee* in (60b) does not refer to an exercise in which one repeats the entire sequence of moves (that would be two burpees), but rather to a burpee with two push-ups after the squat thrust.

For the reason discussed above, I keep the notion of "essential part" somewhat underspecified. Though what counts as such a part is often conventionalized, different conceptualizations are possible under different circumstances, recall the discussion of temporal and spatial partitioning in Section 2.1. Therefore, for the purpose of this paper, I believe that it is sufficient to define it as in (61), where *c* stands for "context".[13]

(61) $\text{ESNTL}_c(P)$ is true of a part of an event e in the extension of P that is conceived of as essential for an ascription of P to e in the context c

Since English multipliers are morphologically opaque, I assume that there is no reason to decompose them and that the reference to the number 2 is already encoded in the semantics of *double*, as provided in (62).

(62) $[\![\text{double}]\!] = \lambda P_{\langle v,t\rangle} \lambda e_v [P(e) \wedge \boxplus(P)(e) = 2]$

Thus, *double* is a subatomic quantifier that is dedicated to counting essential parts of an event relative to the property denoted by the modified event-denoting nominal.

With all the ingredients in place let us now consider how the pieces fit in. The tree in (64) gives a derivation of the sentence in (13a), repeated here as (63) (again ignoring all the issues related to tense etc.).

(63) That crime was a double murder.

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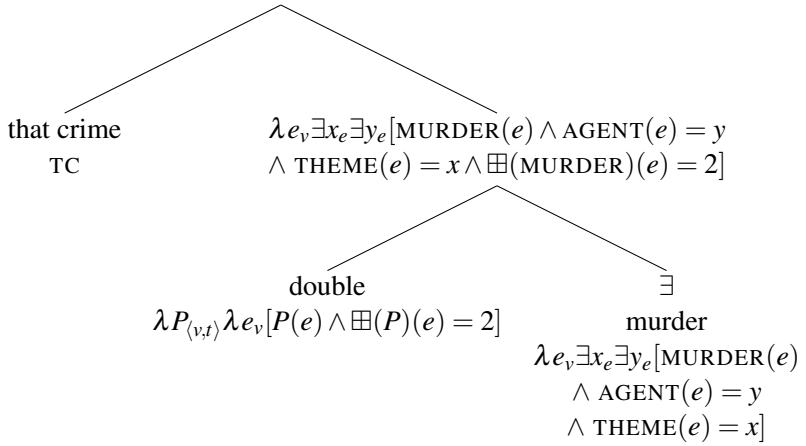
[13] Notice, however, that even if there were no examples such as (60), the idea that essential parts are parts that simply have the property of the whole, arguably as in the case of *double murder*, would still be problematic, especially when coupled with an atomicity-based approach. To see this, assume that in (59) $\text{IND}(P)$ yielded a set of P-atoms and $\text{ESNTL}_c(P)$ were true of a proper part of an event that itself had the property P. For instance, take a double murder event e, which has the property P of being a murder event. If its two murder parts e' and e'' had the property P themselves, then by definition e could not be a P-atom because it would have proper parts (e' and e'') that would also be in the extension of P. Consequently, $\boxplus(P)$ could not work and, even worse, every *double* NP would be incorrectly predicted to be uncountable.

(64) $\exists x_e \exists y_e [\text{MURDER}(\text{TC}) \wedge \text{AGENT}(\text{TC}) = y \wedge \text{THEME}(\text{TC}) = x \wedge \boxplus(\text{MURDER})(\text{TC}) = 2]$



I assume that since there is no lexical material specifying the agent and the theme of murdering events designated by the deverbal noun *murder*, recall (43a), the corresponding individual variables are existentially closed before *murder* combines with *double*. The modifier *double*, recall (62), takes a predicate of events and returns a function with the in-built measure function $\boxplus(P)$ which yields the number *2* for each event that consists of two essential parts, i.e., subevents that typically have a property comparable to the property of the whole event. Therefore, after *double* and *murder* combine, the resulting phrase is an expression denoting a set of double murders. Finally, the subject DP *that crime* refers to an object of type *v* and as such it fits the event argument slot of *double murder*. Consequently, we obtain the meaning of the whole sentence. Specifically, (63) is true if that crime was a murder consisting of two parts each of which can be conceived of as a murdering event in its own right, i.e., a murder with two victims.

5 Conclusion

This paper sheds new light on event quantification in the adjectival domain by investigating so-far understudied expressions such as *two-time champion* and *double murder*. The semantic behavior of the modifiers *two-time* and *double* indicates that nominal semantics is more complex than typically assumed and calls for adopting a richer ontology and a more nuanced mechanisms of quantification. Numerical frequency adjectives such as *two-time* quantify over events of acquiring a socially salient, conventionalized role by an individual, whereas multipliers like *double* are subatomic quantifiers that count essential parts of an event within its complex internal part-whole structure. The results seem to support the conclusions of the recent research on the distinction between class nouns and role nouns by Zobel (2017) as well as subatomic part-whole structures by Wągiel (2018).

Abbreviations

COCA: Corpus of Contemporary American English.

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The author has no competing interests to declare.

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