

From N to N: The anatomy of a construction¹

Joost Zwarts

UiL OTS, Utrecht University

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This paper develops a detailed and unified analysis of semantics of the *from-N-to-N* construction, based on a small number of ingredients, none of which are specific to this construction itself, but which are idiomatically packaged in this construction. Letting the construction uniformly apply to the product of the two nouns not only captures their strong relation, but it also obviates a role for a ‘reduplicative’ mechanism of some sort in this particular construction.

0 Introduction

What I call the *from-N-to-N* (FNTN) construction here is a pattern in English that involves the prepositions *from* and *to* with two bare nominals:²

- (1) a. The men wandered from room to room.
- b. Eva read it from cover to cover.
- c. The whole thing was nonsense from start to finish.
- d. Those working practices and skills were handed down from mother to daughter.

It is a member of a larger family of related constructions of the form (P)NPN that have recently been discussed in the literature under different headings. Haïk (2008) calls them symmetric structures, Jackendoff (2008) uses the term NPN construction, they feature as pluractional adverbials in Beck and Von Stechow (2007), as instances of syntactic

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² The FNTN examples and data in this paper are mostly taken from the British National Corpus, as accessed through <http://corpus.byu.edu/bnc/> (Davies 2004-). The sources of examples from the Internet have an identifying number that refers to an URL in the Appendix.

reduplication in Travis (2001,2003), and are also analyzed in detail in Poß (2010). Other relevant references are Matsuyama (2004), Stockall (2001), Oehrle (1998), Pi (1995), Postma (1995), and Williams (1994a). However, only a few of these authors discuss specifically the FNTN construction and if they do then it usually plays only a minor part. This paper, however, focusses almost exclusively on FNTN, but it raises issues that are relevant also for other (P)NPN constructions.

An important idea in many of these earlier discussions is that there is a connection between doubling on the form side and some sort of iteration on the meaning side. Travis (2001,2003), following Pi (1995), explicitly analyzes the NPN construction as involving ‘syntactic reduplication’, implemented by a syntactic copy operation involving movement. The question is whether such an analysis would work for examples like those in (1), which also feature *non-identical* nouns.

A closely related issue concerns the *arity* of an NPN construction: is it a one-place function (with *doubling* of that one argument over two positions) or is it a two-place function (with arguments that sometimes *happen* to be identical). Both possibilities are represented in the literature, although not always for exactly the same construction. Jackendoff (2008:26) represents the lexical entry of *after* in noun phrases like *student after student* as in (2a). In the semantics, there is only one argument slot X, but this single argument slot is linked (through coindexation) to two syntactic N positions, both of which are again linked to phonological words.

- (2) a. Meaning MANY X_i s IN SUCCESSION [or however it is encoded]
 Syntax [_{NP} N_i P_j N_i]
 Phonology Wd_i after_j Wd_i
- b. [[from-to]] = [$\lambda x.\lambda y.\lambda P_{\text{evt}}.\lambda z.\lambda e.P(z)(e)$ & e starts at x & e ends at y]

The two-place analysis in (2b) can be found in Beck & Von Stechow (2007:247). In this representation λx and λy correspond to the two nominal slots that could be identical, but also different. The result, after application, is a function from verb meanings to verb meanings, roughly speaking.

The term *construction* for FNTN is a descriptive term, for an ‘abstract idiom’ (Williams 1994), a lexical unit with open positions, which is characterized by specific grammatical and semantic properties. No commitment is made to the idea that the whole of grammar reduces to a network of constructions (as in Construction Grammar). However, independently of one’s theoretical standpoint, there is the question whether the properties of this construction are entirely idiosyncratic, or whether we can derive at least some of them from independently given and general principles.

The goal of this paper is to address these questions by developing an analysis of FNTN, that involves not only cases like those in (1a), that show both noun doubling and plurality, but also non-iterative cases like (1b), as well as cases that involve non-identical nouns, as in (1c) and (1d). I argue that FNTN must be treated as a *two*-place discontinuous preposition and that there is no convincing evidence for ‘syntactic reduplication’ in this particular construction (although this may be different for other NPN constructions). I also show how FNTN can have an internal semantic composition, without being compositional and how its interpretive properties can be made to follow from general principles.

The structure of this paper is as follows. I will describe the variety of FNTN examples in section 1 and some other properties in section 2. The basic compositional structure of FNTN will be laid out in section 3. Plurality is then added to this basic structure in section 4 and definiteness in section 5. Section 6 demonstrates that the resulting analysis obviates the need for a mechanism of syntactic doubling in FNTN.

1 The variety of FNTN

Consider again the examples in (1) above. On the form side there are instances with identical nouns (*from room to room, from cover to cover*) and instances with non-identical nouns (*from start to finish, from mother to daughter*). On the semantic side we can distinguish between a *plural* interpretation in (1a) and (1d) and a *dual* interpretation in (1b) and (1c). The dual interpretations involve *two* objects (a start and a finish, front and back cover) and typically one single movement, transition, or interval between them (a ‘single transition’ in Jackendoff’s 2008 terms). The plural interpretations in (1a) and

(1d), on the other hand, have more than two objects and more than one connection between them. Let us take a closer look at the four cases that we find.

FNTN examples with identical nouns and plural interpretations seem quite common. We find examples such as those in (3).

- (3) a. Numbers do fluctuate from year to year.
- b. The criteria for this will vary from state to state.
- c. It had been passed from hand to hand along a chain of trusted men.
- d. Local authorities appointed volunteers to go from door to door.
- e. Quickly she would flick through his exercise books, glancing from page to page as they flew by.
- f. She had watched girl friends drift from affair to affair.

Each of these sentences describes a situation in which there are more than two, in fact, typically many, objects and in which a moving theme follows a path touching all those objects, or in which some property shows variation across those objects. The objects involved can have an intrinsic linear ordering along some dimension (e.g. moments, hours, days, weeks, months, seasons, years (3a), generations (3c), ages, pages (3e), maybe doors (3d)), but most of the time they form an unordered set that may receive some sequential ordering only by the action described in the sentence, as in (3b) and (3f). There are no clear restrictions on the type of nouns that are used in this way.

Cases with identical nouns can also have a dual interpretation, that obtains when there are exactly two distinct entities corresponding to the nouns in the construction:

- (4) a. The first European to cross Arabia from coast to coast was born 19 January 1789 in Cork.
- b. They wave their heads from side to side.
- c. To learn to juggle, take one ball and practise tossing it from hand to hand in an easy arc.
- d. It's two and a half miles from door to door.

- e. There is every reason to believe that nerve fibres can also transmit messages from cell to cell with different codes.

In each case there is a pair of entities involved, often the opposite extremes of some larger contextually given domain or structure. In (4a) the two coasts referred to are clearly opposite ends of the Arabian peninsula (along a prominent dimension), in (4b) the left and right side of a human body are paired, in (4c) the two hands, in (4d) the doors at the end of a particular journey, and in (4e) the cells at the ends of a nerve fibre. Other examples of such opposite extremity nouns that we find here are *foot, ear, arm, end, point, cover, horizon, wall, pole, bank* (of a river), *corner, edge, sea, shore, tip*.

The sentence as a whole can express a movement from one entity to the other, as in (4a), but it can also have an extent meaning, as in (4d). In many cases there is a ‘single transition’, but it is possible to go back and forth between the two poles, as in (4b) and (4c). However, (4b) and (4c) should still be seen as dual interpretations, because there are only two sides and two hands involved. Notice also that the same nouns can allow singular and plural interpretations. Compare the meaning of *from hand to hand* in (3c) and (4c) and *from door to door* in (3d) and (4d).

FNTN examples with non-identical nouns usually get dual interpretations.

- (5) a. A badly-balanced packet of tapioca crashed from shelf to floor.
- b. She looked from father to son.
- c. Slicing through the building almost from front to rear is the planar glass roof, supported by a simple bowstring steel truss frame.
- d. living is a lifelong process, from birth to death.
- e. We are anxious to know where this large quantity could be transferred from ship to shore.
- f. She went from chair to bed. [1]

Opposite extremities of a certain given dimension seem to present the most frequent case. We mostly find antipodals like *start/finish, beginning/end, dawn/dusk, morning/night, top/bottom, front/back, bottom/top, back/front, head/foot, head/toe, top/toe, nose/tail*,

front/rear, floor/ceiling, ceiling/floor, as well as counterdirectionals like *left/right, right/left, east/west, north/south, west/east, south/north*. However, non-antipodal pairs occur too, as (5a), (5b), (5e), and (5f) show.

When we turn to non-identical nouns, plural interpretations are hard to find, that is, interpretations that are based on a set of more than two entities connected by one path. We find here examples involving primarily lineal kinship nouns:

- (6) a. Money was handed down from father to son.
- b. Songs and styles of singing are handed down from mother to daughter.
- c. The hydra's psychic spores would remain dormant in human brains for untold generations, passed from parent to child.
- d. It has been passed from master to pupil for generations. [2]
- e. The crippling results are handed down from adult to child for generations. [3]

In these examples there is a sequence of more than two persons, along which some metaphorical movement is occurring. The sentential (and wider) contexts suggests a repeated transmission along generations, not always kinship (as (6d) shows) and not always with relational nouns (as seen in (6e)).

Notice that the phrase *from father to son* can be used in a plural way (6a), but also in a dual way (5b). In the dual example there are two individuals given in the context, the father and his son, and the subject is shifting her gaze between those two individuals. In the plural example there is an indefinite stretch of generations. The phrase *from corner to corner* also allows both a dual and a plural use, as illustrated in (7a). Even though a room has usually four corners, there is a distinct dual use that involves one single transition between two *opposite* corners and a plural use that involves all the corners of the room:

- (7) a. Take a roll of toilet paper and unroll it along a straight line across from corner to corner of the room. Then do the same for the other two corners ... [4]
- b. The College Kid moves all about the room in a slow, controlled, flowing movement, going from corner to corner of the room. [5]

One thing is immediately clear from the variety of FNTN examples shown above: the FNTN construction can not be characterized entirely in terms of a combination of doubling on the formal side with plurality on the meaning side, as some authors seem to suggest. Some instances have non-identical nouns and some instances are not plural (even if they are identical). The challenge is to formulate an analysis of FNTN that can capture this variety in form and meaning in a coherent way. Before turning to the semantics of such an analysis, in sections 3-5, I would first like to mention a few more noteworthy properties of this construction, in order to get a more complete picture.

2 Some more properties of the FNTN construction

As was also pointed out by earlier authors, the construction in general is productive. There is no limit to the nouns that can be used to form new instances. This is true for cases like *from i-pod to i-pod*, *from website to website*, with identical nouns, but also for the variant with different nouns, like *from grill to spoiler*, *from design to implementation*, *from master to pupil*. On the other hand, it is clear that there are instances of the from-N-to-N construction that have gained a special status as fixed expressions of some sort. This is not only true for semantically opaque idioms like *from pillar to post* or *from hand to mouth*, but also for cases like *from dawn to dusk*, *from strength to strength*, *from head to toe* that are special because of their specific combination of nouns. Also, there might be (idiomatic) constraints on the order in which the different nouns occur (a well-known property of binomials, Benor & Levy 2006). By trying to work out a productive and compositional semantics for the construction as a whole, I am setting aside those cases that require special lexical stipulations or extra constraints of some sort to explain additional or divergent properties.

Jackendoff (2008:12) gives the following examples to point out that the *from* in this construction can be dropped:

- (8) a. Adult coloration is highly variable (from) snake to snake.
- b. (From) situation to situation, conditions change.

When and why this happens is something for further study. I am assuming that the variant with *from* is somehow basic and the omission of the *from* requires additional mechanisms yet to be worked out over and above what I am going to say here.³

The nominals in the FNTN construction are bare (determinerless), but there can be prenominal adjectives and postnominal PPs, identical or different, on one of the nouns or on both:

- (9) a. Cartoonists may portray the international businessman flitting from five-star hotel to five-star hotel.
- b. There are modern and traditional attractions for all tastes, from seaside pier to wildlife park.
- c. Red-capped cardinals flitted from branch to light branch.
- d. You could hear it from end to end of the hall.
- e. She makes passes over the dead creature from tip of tail to tip of nose.

This shows that the nominals in the construction are not full noun phrases (terms, DPs), but common nouns (CNs, NPs).

It is possible for the *to N* part to occur more than once:

- (10) a. travel around the country from auction to auction to auction
- b. riding in a car from house to store to house countless times [6]
- c. They passed on their knowledge from father to son to son. [7]

(10a) involves a indefinite number of auctions, (10b) seems to involve a ‘loop’ (Pi 1995) between two objects that is traveled repeatedly, (10c) a longer sequence of generations.

The FNTN constructions with bare nominals contrast with the corresponding constructions with full indefinite or definite noun phrases in different ways.

- (11) a. Bob went from room to room.

³ This variant of FNTN should not be confused with a separate N-to-N construction (e.g. *bumper to bumper*) that never involves *from* and that expresses juxtaposition of two objects.

- a'. Bob went from a room to a room.
- a''. Bob went from the room to the room.
- b. The dress went from mother to daughter.
- b'. The dress went from a mother to a daughter.
- b''. The dress went from the mother to the daughter.

First, the plurality in the bare version in (11a) is clearly lost in the full versions in (11a') and (11a''). Both (11a') and (11a'') can only refer to single transitions between two rooms (or maybe from a room back to itself). Second, we can see a referential relation between *mother* and *daughter* in the bare version in (11b) ('every mother to her daughter') that is not nearly so strong in the full indefinite version in (11b'). The definite version in (11b'') seems equivalent to (11b). These examples show that the bare FNTN construction is not just a version of the full FNTN construction with articles omitted.

There is another version of the construction, that has a reduplicative pattern with *one* accompanying the first noun and an anaphoric adjective (*other*, *next*) on the next (optional) noun (Beck & Von Stechow 2007, Jackendoff 2008):

- (12) a. Bob went from one room to another (room).
- b. Bob went from one room to the other (room).
- c. Bob went from one room to the next (room).

This is an interesting construction in many respects, but it should be distinguished from the bare FNTN construction. The nouns are always identical but the meaning is not necessarily plural, as (13) shows, unlike its counterpart *from room to room*.

- (13) The reception room is divided into dining and dancing areas, but sound easily went from one room to another. [8]

Therefore, the construction illustrated in (12) cannot be taken as the basis of the FNTN construction, in the same way as Beck & Von Stechow derive *dog after dog* from *one dog after the other dog* by a process of deletion. This would only capture the version of

FNTN with identical nouns but it would wrongly predict that *from room to room* can have a dual meaning, which it hasn't. My strategy is therefore to treat FNTN as a construction in its own right, leaving the analysis of the construction in (12) to another occasion.

3 The basic compositional structure of FNTN

In order to define the range of meanings that FNTN can have, I adopt a standard Davidsonian event semantics, in which adverbials, including FNTN phrases, are predicates over an event argument of the verb. However, what is special about FNTN predicates is that they apply not directly to an event, but to the *trace* (trajectory, contour) of that event in some domain, mostly space, but other domains are possible too (Krifka 1998, Gawron 2006). In the following representations, τ is the function that maps an event to its trace:

- (14) a. The men wandered from room to room.
 $\exists e [\text{wandered}(e)(\text{the-men}) \wedge \text{from-room-to-room}(\tau(e))]$
- b. Living is a lifelong process, from birth to death.
 $\exists e [\text{be-lifelong-process}(e)(\text{living}) \wedge \text{from-birth-to-death}(\tau(e))]$
- c. The first European to cross Arabia from coast to coast
 $\exists e [\text{cross}(e)(\text{arabia})(\text{the-first-european}) \wedge \text{from-coast-to-coast}(\tau(e))]$
- d. Money was handed down from father to son
 $\exists e [\text{be-handed-down}(e)(\text{money}) \wedge \text{from-father-to-son}(\tau(e))]$

That trace is a *path*, which should be taken very generally here, as an ordered sequence of positions in some domain (Zwarts 2005). In (14a) it is the path along which the men are wandering, in (14b) it is the temporal period during which living is a lifelong process, in (14c), the path that crosses peninsula Arabia, in (14d) a path of transmissions of money along generations.

The FNTN construction is often used to express variation or extension of a property over a non-spatial dimension, as we see in the examples in (15):

- (15) a. There are modern and traditional attractions for all tastes, from seaside pier to wildlife park.
- b. Numbers do fluctuate from year to year.
- c. The criteria for this will vary from state to state.

It is not immediately obvious how such examples can be represented in terms of a path, but it is not impossible. (15a) seems to give us two extremes of a range of attractions that we pass through, metaphorically speaking (cf. Talmy's 1996 notion of *fictive motion*). The notion of path is more abstract in (15b) and (15c). An event of fluctuation or variation is like a mathematical function, mapping from a domain (years or states) to a codomain (numbers or criteria). We could see the domain of such a function as the counterpart of a path, a sequence of points that we traverse in order to determine whether the values associated to those points by the function show variation. In a sense, we travel through a number of years (or states) to check the numbers (or criteria) there. What the logical form of such sentences is, is an open question, but it seems reasonable to assume that variation events can have a path-like trace that can be characterized by a FNTN construction.

What is important for my purposes is that an FNTN PP can be studied as denoting a set of paths, assuming that the mapping to events is taken care of by the following general type-shift operator, allowing PPs to function as VP modifiers in the standard way:⁴

$$(16) \mathbf{M} =_{\text{def}} \lambda P. \lambda E. \lambda e [E(e) \wedge P(\tau(e))]$$

This operator \mathbf{M} intersects the set of events denoted by the VP with the set of events that have their trace in the set of paths denoted by the PP.

If we now turn to the internal semantics of FNTN, then the first thing to stress is that the construction can not be compositionally build up from the items *from* and *to*, even though it seems to combine a *from* PP and a *to* PP. The ability to take bare nominals

⁴ See Winter & Zwarts (2011) for a recent compositional treatment of event modification.

(in a productive way) is not a property of either *from* or *to*, but only of the combination of the two. Examples like *Alex came from prison* and *Robin went to school* are limited to a specific set of items and seem to have a quite different type of semantics (Stvan 1998). Maybe, the possibility of bareness comes from the coordination-like combination of a *from* PP and a *to* PP (analogous to the bareness in coordinations like *mother and child*, Heycock & Zamparelli 2003, Le Bruyn & De Swart 2011)? That might play a role, but it is certainly not sufficient, given that other ‘compound’ prepositions do not productively form PNP patterns (e.g. **out (of) N in(to) N*). I therefore assume that we are clearly dealing with a schematic idiom, a construction which is partly specified and partly open, and we have to provide the semantics of that construction as a whole.

Still, this idiomatic nature does not mean that the meaning of FNTN is not built up out of smaller semantic parts. We will not go down here to the finest spatial details, because we are interested in the general semantic structure of this function. For more details about the spatial properties of paths, but also for general background and definitions concerning paths, I have to refer to Zwarts (2005).

First of all, the function that we need to define can be seen as a combination of the more basic one-place prepositional functions **F** ‘from’ and **T** ‘to’. **F** and **T** can each be taken as mapping an object to a set of paths. **F** maps an object x to the the set of paths that *start* at (on, in) x and **T** maps an object y to the set of paths that *end* at (on, in) y . The locative relations on which **F** and **T** are based should be taken as quite general, but at least very close to x and y . The two functions **F** and **T** can be combined to represent a function that takes a *pair* of two objects and yields the set of paths that connect the members of the pair, which we define by concatenation:

$$(17) \mathbf{F}+\mathbf{T} =_{\text{def}} \lambda\langle x,y\rangle.\lambda p.\exists p_1.\exists p_2[\mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge p=p_1+p_2]$$

If the end point of a path p is identical to the starting point of a path q , then the concatenation of p and q (written as $p+q$) can be defined, which consists of connecting p and q head to tail.

The function in (17) is somewhat similar to the definition that Beck & Von Stechow (2007) give (see (2b) above), but there are two differences. Most importantly,

(17) incorporates the insight that the functions, being based on the path preposition *from* and *to* is defined in terms of paths, and that events come in only indirectly. Of less importance is that (17) applies to objects of the product type $e \times e$, which corresponds to pairs of entities. It can be seen as the meaning of the discontinuous preposition *from ... to* in compound PPs like *from London to Paris*, *from the cradle to the grave*, or *from wall street to main street*. Applying the function in (17) to pairs seems a variant of applying it in a curried way, one object at a time. One reason for working with pairs is conceptual: the two arguments of FNTN do not seem to be processed in a clearly asymmetric way, like the subject and object arguments of a verb, but parallel, as part of one ‘package’. The other reason is that product type arguments allow for a transparent treatment of relational nouns, as I show later on. Note that the definition in (17) allows the two objects x and y to be the same, leading to a circular path, going from an object back to itself, as in *a round trip from London to London*.

For the FNTN construction under discussion here, we need to shift the arguments of this function to a higher type, because the two nominals that figure in FNTN are bare, i.e. they lack a determiner. The simplest way to represent that the construction requires bare nominals is by assuming that FNTN does not apply to expressions of type e , but of type (e,t) or $(e,(e,t))$ (for relational nouns). This shift can be seen as a generalization of the type-shift that is necessary in Van Geenhoven’s (1998) approach to represent verbs that combine with incorporating (typically bare) nominals. For reasons that will become clearer later on, I will decompose this shift into two more basic components (cf. Chung & Ladusaw 2003). One component (**R**) takes care of *restricting* the argument and the other component (**E**) of *closing* it by existential quantification. This split allows for a kind of ‘modular’ setup of the interpretation of FNTN, in which different components can be recognized and varied. The following definition is tailored for the purposes of this paper, but it can be generalized.

(18) If F is an expression of type $(e \times e, (e,t))$ (i.e. a function from pairs to sets), v_1, v_2, v_3 are variables of type e , and P is an expression of type $(e \times e, t)$, then

a. $\mathbf{R}(P)(F) =_{\text{def}} \lambda \langle v_1, v_2 \rangle . \lambda v_3 [P(\langle v_1, v_2 \rangle) \wedge F(\langle v_1, v_2 \rangle)(v_3)]$

b. $\mathbf{E}(F) =_{\text{def}} \lambda v_3 . \exists \langle v_1, v_2 \rangle . F(\langle v_1, v_2 \rangle)(v_3)$

R restricts the pair argument of **F** with the given predicate **P**, which is of type $(e_1 \times e_2, t)$, a set of pairs, and **E** binds the pair argument with an existential quantifier. Using these four basic building blocks **F**, **T**, **R**, and **E**, the meaning of FNTN can be represented as in (19):

$$\begin{aligned}
 (19) \quad & \lambda X. \mathbf{E}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T})) \\
 & = \lambda X. \lambda p. \exists \langle x, y \rangle [X(\langle x, y \rangle) \wedge \mathbf{F}+\mathbf{T}(\langle x, y \rangle)(p)] \\
 & = \lambda X. \lambda p. \exists \langle x, y \rangle [X(\langle x, y \rangle) \wedge \exists p_1. \exists p_2 [\mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge p = p_1 + p_2]]
 \end{aligned}$$

What we ultimately get in (19) is a function that takes a set of pairs, picks out one pair from this set, and maps this pair of individuals to the set of paths that lead from one member to the other member of the pair. In this way the basic meaning of FNTN is composed of a small number of familiar ingredients (although we have to make some important amendments later on).

In order to serve as arguments of the FNTN function in (19), a pair of nouns has to be interpreted as a set of pairs. In the simplest case, we can take the cartesian product of the denotations of the two sets. If we have the (e, t) predicates **room**, **chair**, and **bed**, then **room** \times **room** is a set of pairs of rooms and **chair** \times **bed** is a set of pairs of a chair and a bed, and these are the kinds of denotations to which (19) can apply, giving the following results:

$$\begin{aligned}
 (20) \quad & \text{a. } \lambda X. \mathbf{E}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T}))(\mathbf{room} \times \mathbf{room}) = \mathbf{E}(\mathbf{R}(\mathbf{room} \times \mathbf{room})(\mathbf{F}+\mathbf{T})) = \\
 & \lambda p. \exists \langle x, y \rangle [\mathbf{room}(x) \wedge \mathbf{room}(y) \wedge \mathbf{F}+\mathbf{T}(\langle x, y \rangle)(p)] = \\
 & \text{‘the set of paths from some room to some other room’} \\
 & \text{b. } \lambda X. \mathbf{E}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T}))(\mathbf{chair} \times \mathbf{bed}) = \mathbf{E}(\mathbf{R}(\mathbf{chair} \times \mathbf{bed})(\mathbf{F}+\mathbf{T})) = \\
 & \lambda p. \exists \langle x, y \rangle [\mathbf{chair}(x) \wedge \mathbf{bed}(y) \wedge \mathbf{F}+\mathbf{T}(\langle x, y \rangle)(p)] \\
 & \text{‘the set of paths from some chair to some bed’}
 \end{aligned}$$

In order to evaluate how these path predicates contribute to the truth conditions of a full sentence, consider the examples in (21). Through the modifier function in (16), the predicates in (20) can apply to the verb’s event trace, as made explicit in (22):

- (21) a. He went from room to room.
 b. She went from chair to bed. (=5f)
- (22) a. $\exists e [\mathbf{go}(e)(\mathbf{he}) \wedge \exists \langle x,y \rangle [\mathbf{room}(x) \wedge \mathbf{room}(y) \wedge \mathbf{F+T}(\langle x,y \rangle)(\tau(e))]]$
 $\Leftrightarrow \exists e,x,y,p_1,p_2 [\mathbf{go}(e)(\mathbf{he}) \wedge \mathbf{room}(x) \wedge \mathbf{room}(y) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge \tau(e)=p_1+p_2]]$
 ‘There is an event of him going that follows a path that starts in a room and ends in a room.’
- b. $\exists e [\mathbf{go}(e)(\mathbf{she}) \wedge \exists \langle x,y \rangle [\mathbf{chair}(x) \wedge \mathbf{bed}(y) \wedge \mathbf{F+T}(\langle x,y \rangle)(\tau(e))]]$
 $\Leftrightarrow \exists e,x,y,p_1,p_2 [\mathbf{go}(e)(\mathbf{she}) \wedge \mathbf{chair}(x) \wedge \mathbf{bed}(y) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge \tau(e)=p_1+p_2]]$
 ‘There is an event of her going that follows a path that starts at a chair and ends at a chair.’

The FNTN construction only adds the condition that the path of the event starts at some member of N_1 and stops at some member of N_2 .

However, this is still insufficient to get the right interpretations of (21a) and (21b). (21a) has a plural interpretation: there is not just one transition between two rooms, but several rooms are traversed. Imagine the situation of a hotel with many rooms and a guest going from room 23 to room 119. If those two rooms are not already salient in the context, then it is impossible to use (21a) for that situation (although we can apply *He went from a room to room* or *He went from one room to another*). Clearly, the bare FNTN construction requires plurality. However, (21b) does not have a plural interpretation, but it shows something else: the sentence is only felicitous if a chair and a bed are already saliently given in the context. The passage right before this sentence mentions *her bed* and *her wheelchair*, setting up unique referents for the nominals in (21b). But imagine the situation of a sleeping dorm with many beds and chairs. It would be infelicitous to describe the single movement of a nurse with (21b), although it would be possible to say *She went from a chair to a bed*, with indefinite articles. In other words,

the nominals in (21b) must have some sort of definite referential force that is not yet represented in (22b).

We have to add plurality and definiteness to the representation in (19), but not at the same time, it seems. Let us start with the plural and then consider how definiteness can be brought in.

4 Plurality in FNTN

In order to derive the plural interpretation of (21a), I assume a plural operator **P** over paths:

(23) If P is a non-empty set of paths, then $\mathbf{P}(P) =_{\text{def}} *P - P$.

(If P is a set of paths, then $*P$ is the smallest set of paths such that $P \subseteq *P$, and if $p \in *P$ and $q \in *P$, then $p+q \in *P$.)

$*P$ is the closure of P under concatenation of paths. We subtract the atomic paths, leaving us with the paths that are really concatenations of more basic paths. This operator can now be used to define the plural FNTN meaning in (24):

(24) $\lambda X.\mathbf{P}(\mathbf{E}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T})))$

Suppose that (25a) below contains the atomic paths $r_1 \rightarrow r_2$, $r_2 \rightarrow r_3$, and $r_2 \rightarrow r_1$, then (25b) = $\mathbf{P}((25a))$ contains the composite paths $r_1 \rightarrow r_2 \rightarrow r_3$, $r_1 \rightarrow r_2 \rightarrow r_1$, $r_2 \rightarrow r_1 \rightarrow r_2$, $r_1 \rightarrow r_2 \rightarrow r_1 \rightarrow r_2$, etcetera.

(25) a. $\mathbf{E}(\mathbf{R}(\mathbf{room} \times \mathbf{room})(\mathbf{F}+\mathbf{T}))$

b. $\mathbf{P}(\mathbf{E}(\mathbf{R}(\mathbf{room} \times \mathbf{room})(\mathbf{F}+\mathbf{T})))$

The plural denotation that we want for *from room to room* then contains not only paths that go back and forth between two rooms, but also paths that involve three or more different rooms. There is a natural constraint on when **P** can fruitfully operate on a given

set of paths P . If we can find paths p and q in P such that the end point of p is identical to the starting point of q , then the concatenation $p+q$ is possible. This possibility depends on the choice of the restrictors. Clearly, the plural operator \mathbf{P} works fine for cases with identical predicates, like *from room to room*, because the end point of every single room-to-room path is also the starting point of another room-to-room path. But if the predicates are different, as in *from chair to bed*, then \mathbf{P} gives an empty set. The reason is that a chair-to-bed path can never make a connection to another chair-to-bed path. In this way, we have a natural explanation for why FNTN examples with non-identical nouns are typically non-plural (but not always, as we will see later on).

Instead of (22a), we now have the representation in (26) for *He went from room to room*. To make this logical form somewhat easier to parse, I have made explicit that the plural operator \mathbf{P} applies to a lambda term (A) that corresponds to the set of paths that start and end in a room.

$$(26) \exists e [\mathbf{go}(e)(\mathbf{he}) \wedge \mathbf{P}(\mathbf{E}(\mathbf{R}(\mathbf{room} \times \mathbf{room})(\mathbf{F}+\mathbf{T})))(\tau(e))]$$

$$\Leftrightarrow \exists e [\mathbf{go}(e)(\mathbf{he}) \wedge \mathbf{P}(\mathbf{A})(\tau(e))]$$

$$\mathbf{A} = \lambda p. \exists x, y, p_1, p_2 [\mathbf{room}(x) \wedge \mathbf{room}(y) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge p = p_1 + p_2]$$

‘There is an event of him going that follows a path that consists of at least two subpaths that start in a room and end in a room.’

The truth conditions spelled out in (26) require an event e that is associated to a trace $\tau(e)$ that consists of a concatenation of at least two elementary paths that start and end in a room. This is what we need to capture the plurality of *He went from room to room*.

However, note that there is no verbal plurality operator in (26). What is pluralized is the path in the FNTN adverbial. No assumptions have been made about the structure of the event e that is quantified over in (26), i.e. whether it is a single event or a sum or concatenation of events. For this sentence we could assume that e corresponds to one extended activity of going, but one that is spatially articulated. But there are also cases where the plurality of FNTN clearly corresponds to an iteration of individual events, multiple jumps and multiple migrations, for example:

- (27) a. It jumped from tree to tree.
 b. They migrated from country to country.

How this iteration of events is analyzed is independent of the proposal made here. We could either assume that verbs like *jump* and *migrate* are lexically plural (Krifka 1989, Landman 1996), that there is some sort of concatenation operator that forms complex singular events (Rothstein 2004), or a general plural operator (Beck & Von Stechow 2007, Beck 2012). (28) makes the event plurality explicit by the * operator.

(28) $\exists e [*jump(e)(it) \wedge P(E(R(tree \times tree)(F+T)))(\tau(e))]$

‘There is a plurality of events of it jumping and that plurality corresponds to a path that consists of at least two subpaths that start at a tree and end at a tree.’

This plurality is in a sense induced (although indirectly) by the plural FNTN adverbial, which requires events that have paths that consist of different tree-to-tree parts.

The plural FNTN construction is a member of the larger class of pluractional adverbials discussed in Beck & Von Stechow (2007) and Beck (2012) in the sense that FNTN is used to describe an event that is divided into subevents in a particular way. When we compare (27a) with the reduplicative expressions in (29a) and (29b) then we see similarities, but also differences.

- (29) a. It jumped and jumped.
 b. It jumped again and again.
 c. It jumped and jumped again and again.
 d. It jumped from tree to tree again and again.

All these expressions are only true when there are multiple jumps and this is expressed by repeating part of the structure. (29c) and (29d) show that these expressions can also reinforce each other to express one level of plurality. However, while the sentences in (29a) and (29b) only express a plurality of jumps, (27a) has an essential spatial

component: it describes a path with respect to a plurality of objects. (27a) entails the sentences in (29) but is not equivalent to them.

There are many FNTN examples with relational nouns, which require extra work, for which the pairs are useful. Relations like **father**, **son** (*from father to son*) and **neighbour** (*from neighbour to neighbour*), being of type $(e, (e, t))$, have an internal argument that needs to be dealt with in order to allow them to function as restrictions (of type $(e \times e, t)$). There are two ways to do this.

We can assume a general operation that turns a relational noun into a sortal noun, by existentially closing the internal argument. For example, *father* can be interpreted as the set of individuals who are the father of someone, i.e. $\lambda x. \exists y. \mathbf{father}(y)(x)$.⁵ However, in many contexts relational nouns that occur without an explicit internal argument have stronger interpretations (see Staroverov 2007, Matushansky & Ionin 2011, Le Bruyn & De Swart 2013 for recent discussions). The plural *the neighbors* is interpreted reciprocally, denoting a group of people who are neighbors of each other. The conjunction *a husband and wife* can denote a pair of a husband and *his* wife. The proverb *like father, like son* concerns two people who are in a father-son relation. In other conjunction examples, the internal arguments of the relational nouns are identified with one contextually given referent, as in *the start and finish* (of one and the same event) or *a son and daughter* (of one and the same contextually given parent or pair of parents).

In order to account for this, I formulate the following two operators, that take relations and form pairs.⁶

(30) If R and R' are expressions of type $(e, (e, t))$, x and y are variables of type e , and c is a contextually specified constant of type e , then

a. $R \times_r R' =_{\text{def}} \lambda \langle x, y \rangle [R(y)(x) \wedge R'(x)(y)]$

b. $R \times_c R' =_{\text{def}} \lambda \langle x, y \rangle [R(c)(x) \wedge R'(c)(y)]$

⁵ See Blom, De Groote, Winter & Zwarts (2011) for a direct way of representing such optionality (for verbs) in the type system of Abstract Categorical Grammar.

⁶ Given that strengthened interpretations of intransitively used relational nouns also occur in coordinations (*father and son*) and other parallel structures (*like father like son*), it seems plausible that these product operations are not only necessary for FNTN, but for a larger family of structures in which two relations need to be synchronized in a particular way.

(31a-c) illustrate the reciprocal interpretation and (31d-e) the interpretation on the basis of a contextually given referent:⁷

- (31) a. **neighbour** \times_r **neighbour** = $\lambda\langle x,y \rangle$ [**neighbour**(y)(x) \wedge **neighbour**(x)(y)]
 b. **father** \times_r **son** = $\lambda\langle x,y \rangle$ [**father**(y)(x) \wedge **son**(x)(y)]
 c. **husband** \times_r **wife** = $\lambda\langle x,y \rangle$ [**husband**(y)(x) \wedge **wife**(x)(y)]
 d. **neighbour** \times_c **neighbour** = $\lambda\langle x,y \rangle$ [**neighbour**(c)(x) \wedge **neighbour**(c)(y)]
 e. **start** \times_c **finish** = $\lambda\langle x,y \rangle$ [**start**(c)(x) \wedge **finish**(c)(y)]

Both operators \times_r and \times_c freely apply to all relations. However, sometimes the result is not felicitous, like the products **start** \times_r **finish** and **husband** \times_c **wife**, that are empty sets, and sometimes the result is non-empty, but less obvious. For example, the product **father** \times_c **son** gives us pairs $\langle x,y \rangle$ of a grandfather and a his grandson, related through the contextually given person c that is x's child and y's parent. In general, reciprocal interpretations can occur with converse relations (fathers and sons, parents and children, masters and slaves, buyers and sellers, husbands and wives) and with symmetric relations (neighbours, partners, relatives).

Applications of the plural FNTN function in (24) to some of the sets of pairs in (31) are exemplified in (32):

- (32) a. from neighbour to neighbour (reciprocal in (i), contextual in (ii)):
 (i) $\lambda X.P(E(R(X)(F+T)))(\mathbf{neighbour} \times_r \mathbf{neighbour})$
 = $\mathbf{P}(\lambda p.\exists\langle x,y \rangle$ [**neighbour**(y)(x) \wedge **neighbour**(x)(y) \wedge **F+T**(x)(y)(p)])
 ‘sequences of paths from a person to his/her neighbour’
 (ii) $\lambda X.P(E(R(X)(F+T)))(\mathbf{neighbour} \times_c \mathbf{neighbour})$
 = $\mathbf{P}(\lambda p.\exists\langle x,y \rangle$ [**neighbour**(c)(x) \wedge **neighbour**(c)(y) \wedge **F+T**(x)(y)(p)])
 ‘sequences of paths from one neighbour of c to another neighbour of c’

⁷ The definition does not exclude pairs in which $x = y$. Adding that is superfluous, since definition (13) of **F+T** already includes the condition that $x \neq y$. Note that the sets of pairs defined in (23a) and (23d) are identical to $\lambda\langle x,y \rangle$ [**neighbour**(y)(x)] = $\lambda\langle x,y \rangle$ [**neighbour**(x)(y)] and $\lambda\langle x,y \rangle$ [**husband**(y)(x)] = $\lambda\langle x,y \rangle$ [**wife**(y)(x)], respectively, because the paired relations are each other's exact inverses.

- b. from father to son (reciprocal interpretation):
 $\lambda X.P(\mathbf{E}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T}))) (\mathbf{father} \times_r \mathbf{son})$
 $= \mathbf{P}(\lambda p.\exists \langle x,y \rangle [\mathbf{father}(y)(x) \wedge \mathbf{son}(x)(y) \wedge \mathbf{F}+\mathbf{T}(x)(y)(p)])$
 ‘sequences of paths from one father to his son’

To see how this would work for a full sentence, consider the following example:

(33) Money was handed down from father to son.

$$\begin{aligned} & \exists e [* \mathbf{be-handed-down}(e)(\mathbf{money}) \wedge \mathbf{P}(\mathbf{E}(\mathbf{R}(\mathbf{father} \times_r \mathbf{son})(\mathbf{F}+\mathbf{T}))) (\tau(e))] \\ & \Leftrightarrow \exists e [* \mathbf{be-handed-down}(e)(\mathbf{money}) \wedge \mathbf{P}(\mathbf{A})(\tau(e))] \\ & \quad \text{with } \mathbf{A} = \lambda p.\exists x,y,p_1,p_2 [\mathbf{father}(x,y) \wedge \mathbf{son}(y,x) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge \\ & \quad p=p_1+p_2] \end{aligned}$$

‘There is a plurality of events of money being handed down and that plurality corresponds to a path that consists of at least two subpaths that go from a father to his son.’

The verb has been pluralized, to make explicit that the predicate **be-handed-down** also covers sequences of atomic transmission events. Application of the plural operator **P** is restricted by the denotation it applies to, as we already saw. It works well for identical predicates, like in *from neighbour to neighbour*, because the end point of every neighbour-to-neighbour path is also the starting point of another neighbour-to-neighbour path. For cases with non-identical predicates, this is rarely true, because an A-to-B path will generally not connect to another A-to-B path, *unless* B’s can also be A’s. That is exactly what is happening in *from father to son*: a path p connecting a father to his son can be concatenated with a path q connecting a father to his son because the son in p is the father in q . Therefore, (31b) is a non-empty sets of paths. However, it is impossible to chain one husband-to-wife path to another husband-to-wife path (or a start-to-finish path to a start-to-finish path), because husbands and wives (and starts and finishes) are disjoint. As a result we do not get plural readings for *from husband to wife* and *from start to finish*.

The conditions for chaining require more study. We can get a plural, chained reading also with the sortal nouns *adult* and *child*, in *from adult to child*, even though adults and children are usually disjoint sets. On the other hand, it seems difficult to force *from start to finish* into a plural interpretation by applying it to a situation (say, a relay race or a serial) where the finish of one path is the start of another path (e.g. *carry a baton from start to finish*). The ambiguity of *start* and *finish* in such a situation (applying to the whole relay or serial or to its parts) might be the reason for this. Maybe the expression *from finisher to starter* might give rise to a plural reading similar to *from father to son*.

5 Definiteness in FNTN

We made the observation in section 4 that some instances of FNTN are not plural, but definite:

- (34) a. She went from chair to bed.
 b. She looked from father to son.
 c. He crossed Arabia from coast to coast.

In order to represent this definiteness, I introduce a definite counterpart **D** of the indefinite **E** operator:

- (35) If **F** is an expression of type $(e \times e, (e, t))$ (i.e. a function from pairs to sets), v_1, v_2, v_3 are variables of type e , then

$$\mathbf{D}(\mathbf{F}) =_{\text{def}} \lambda v_3. \exists! \langle v_1, v_2 \rangle. \mathbf{F}(\langle v_1, v_2 \rangle)(v_3)$$

This gives the following set of paths for *from chair to bed*:

- (36) $\mathbf{D}(\mathbf{R}(\mathbf{chair} \times \mathbf{bed})(\mathbf{F} + \mathbf{T})) =$
 $\lambda p. \exists! \langle x, y \rangle [\mathbf{chair}(x) \wedge \mathbf{bed}(y) \wedge \mathbf{F} + \mathbf{T}(\langle x, y \rangle)(p)]$

$\exists!$ requires that there is a unique chair and a unique bed in the domain.⁸ The meanings of (34a) and (34b) are represented in (37).

- (37) a. $\exists e [\mathbf{go}(e)(\mathbf{she}) \wedge \mathbf{D}(\mathbf{R}(\mathbf{chair} \times \mathbf{bed})(\mathbf{F}+\mathbf{T}))(\tau(e))]$
 $\Leftrightarrow \exists e, p [\mathbf{go}(e)(\mathbf{she}) \wedge \tau(e) = p \wedge \exists!x, y [\mathbf{chair}(x) \wedge \mathbf{bed}(x) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge p = p_1 + p_2]$
 ‘There is an event of her going and the path of that event starts at a uniquely given chair and it ends at a uniquely given bed.’
- b. $\exists e [\mathbf{look}(e)(\mathbf{she}) \wedge \mathbf{D}(\mathbf{R}(\mathbf{father} \times_r \mathbf{son})(\mathbf{F}+\mathbf{T}))(\tau(e))]$ ⁹
 $\Leftrightarrow \exists e, p [\mathbf{look}(e)(\mathbf{she}) \wedge \tau(e) = p \wedge \exists!x, y [\mathbf{father}(x, y) \wedge \mathbf{son}(y, x) \wedge \mathbf{F}(x)(p_1) \wedge \mathbf{T}(y)(p_2) \wedge p = p_1 + p_2]$
 ‘There is an event of her looking and the path of that event starts at a unique father and his unique son.’

The application of the uniqueness operator $\exists!$ requires some care when there are two identical relational nouns, as in *from coast to coast*, *from door to door*, *from hand to hand*, *from bank to bank*, which refer to the two coasts, doors, hands and banks of one continent, commuting route, body, or river. For example, the description $\lambda\langle x, y \rangle [\mathbf{bank}(c)(x) \wedge \mathbf{bank}(c)(y)]$, gives us, for one contextual given river *c*, the *two* pairs $\langle \text{left bank, right bank} \rangle$ and $\langle \text{right bank, bank left} \rangle$, while $\exists!$ demands one pair. This problem is related to a broader problem with uniqueness, sometimes discussed under the heading of weak definiteness (Ojeda 1993, Poesio 1994, Birner & Ward 1994, Barker 2004, Carlson & Sussman 2005, Aguilar Guevara & Zwarts 2011). We can use *to the hospital*, *with my toe*, or *on the shelf*, even in situations in which there is more than one hospital, more than one toe, and more than one shelf and this is also true for the FNTN examples *from hospital to nursing home*, *from head to toe*, *from shelf to floor*. Still we would like to treat these examples as involving definite referential force.¹⁰

⁸ Notice that the uniqueness can only be satisfied by the nouns. There are always multiple paths between a chair and a bed.

⁹ Notice that I am assuming (see Talmy 1996) that perception verbs like *look* can be associated to events.

¹⁰ Aguilar Guevara & Zwarts (2011) analyze some of these weak definites (with nouns like *hospital* or *shelf*) as involving unique reference to *kinds*.

However, it is unlikely that this analysis extends to nouns like *bank*, *hand*, or *coast* that refer to two equivalent parts of a bigger object. I assume that these nouns have a parameter that uniquely fixes the reference for a given noun. For example, the noun *bank* corresponds to a predicate **bank_i** with an index *i* that specifies whether we are dealing with the left or the right bank of the river. The same is true for other pairwise occurring parts falling under the same predicate. Uniqueness for a phrase like *the bank* is then guaranteed by fixing both the river and a direction. In the FNTN *from coast to coast*, with two occurrences of the same noun, these indices are then contrastively specified in opposite ways:¹¹

$$(38) \text{ from coast to coast: } \lambda X. \mathbf{D}(\mathbf{R}(X)(\mathbf{F}+\mathbf{T}))(\mathbf{coast}_i \times_c \mathbf{coast}_j) \\ = \lambda p. \exists! \langle x, y \rangle [\mathbf{coast}_i(c)(x) \wedge \mathbf{coast}_j(c)(y) \wedge \mathbf{F}+\mathbf{T}(x)(y)(p)] \\ \text{'paths from one coast of } c \text{ to the other coast of } c \text{'}$$

For a body of land with two opposite coasts, the existence of a unique pair $\langle a, b \rangle$ is guaranteed such that *a* is the *i*-coast of *c* and *b* is its *j*-coast.

As a result of this analysis, pluralization by **P** of this set of paths is not possible. The reason is that paths from the *i*-coast to the *j*-coast will give no connection to other paths going from the *i*-coast to the *j*-coast, because starting points and end points are disjoint. But what about the plurality that we see in (39)?

- (39) a. They wave their heads from side to side.
 b. To learn to juggle, take one ball and practise tossing it from hand to hand in an easy arc.
 c. Some babies switch back and forth from breast to bottle without difficulty.
 [9]

In my analysis there is no plurality at the level of the PPs *from side to side* and *from hand to hand*, but only a single transition between two (more or less) unique objects. However,

¹¹ Interestingly, *from the bank to the bank* (in a river context) is strange, a fact that I will come back to at the end of this article.

as we already saw in the previous section, there is also the possibility of pluralizing events, in the verbal domain. What we have to assume to allow the sentences in (39) to have a plural interpretation is that the FNTN adverbial applies to a single wave, toss or switch event and that that event description is then pluralized, using a pluractional operator along the lines of Beck & Von Stechow (2007) or Beck (2012), to allow for these back and forth readings. The same pluralization is available for the plural FNTN construction (*jump from tree to tree*) that we discussed in the previous section, but without effect, because the event is already plural (and recursive plurality, a repetition of a repetition of events, seems not possible with a covert pluralization operator).

An interesting aspect of this type of event pluralization of dual FNTN, that might distinguish it from plural FNTN is clearly illustrated in (39c). The PP *from breast to bottle* gives only paths that have a direction from breast to bottle and it does not allow concatenation of paths in that denotation, because the reverse direction is missing. Still, the sentence as a whole describes movements back and forth in both directions, even if we replace *back and forth* with other pluralizing elements, like *again and again* or the verb *keep*. This suggests that event pluralization of this type does not require that events have to connect to form sequences.

All of this taken together means that we have only two senses for FNTN. The construction is either definite and non-plural, or plural and indefinite:

(40) $\lambda X.P(E(R(X)(F+T)))$: pluralization of paths + indefinite reference

e.g. *from room to room, from father to son*

$\lambda X.D(R(X)(F+T))$: no pluralization of paths + definite reference

e.g. *from start to finish, from coast to coast*

We have already seen why the combination of **P** and **D** is ruled out in cases like *from coast to coast* and *from start to finish*. The question is now why we do not find indefinite reference without pluralization. In other words, why is it that *from room to room* cannot refer to a set of paths connecting an arbitrary pair of rooms?

I would like to suggest that this is due to a mechanism of referential strengthening in FNTN, not unlike the strengthening that we see in other articleless constructions.¹² In the absence of any articles in this construction, the choice between **E** and **D** has to be driven by semantic or pragmatic principles. Let us assume that **E** is strengthened to **D** in a particular context, but only if that does not lead to an empty denotation for the construction as a whole. If **E** is in the scope of **P**, then strengthening to **D** is not possible, because, as we have seen, **P+D** leads to an empty set of paths. As a result, FNTN is either plural with indefinite force or dual with definite force.

What kind of principle is this referential strengthening? It can be seen as an informativeness/relevance implicature in Neo-Gricean pragmatics (Horn 1984, Levinson 2000), that enriches the basic meaning of an expression, especially if it contrasts with a more complex counterpart. Stvan (1998) has identified different such implicatures for determinerless PPs in English, like *in church* and De Swart & Zwarts (2009) observe how strengthening operates in different ways in a range of determinerless constructions. It is also similar to the so-called Strongest Meaning Hypothesis, the idea that certain items, like the reciprocal *each other*, are interpreted in the strongest way possible given the lexical items involved (Dalrymple et al. 1998, Winter 2001). One is also reminded of *Maximize Presupposition* (Sauerland 2008, Singh 2009, Schlenker 2012), which instructs the speaker to use the form with the strongest presuppositions: given the uniqueness of the sun in our sky, *the sun* is then preferred over *a sun* because *the* expresses that presupposition. However, Maximize Presupposition involves a choice by the speaker between different linguistic items on a scale (*the, a*), which does not play a role in the FNTN construction. The presuppositions of the nominals *are* maximized, not by the speaker's choice of the definite article, but by the omission of articles.

The semantics of FNTN can now be seen as a combination of the following elementary components:

- (41) a. combination of **F** and **T** to define paths between pairs

¹² See Stvan (1998) for determinerless PPs, Heycock & Zamparelli (2003) for determinerless conjunction and De Swart & Zwarts (2009) for a variety of determinerless constructions.

- b. pair argument of **F+T** not saturated but restricted (**R**) by pairs of bare nominals
- c. existential closure (**E**), strengthened to uniqueness (**D**), if possible
- d. optional pluralization (**P**)

FNTN is analyzed now as a function that applies to identical and non-identical nouns in the same way. Both are combined into sets of pairs using product operators that apply to *two* nouns, implying that we have a two-place semantics that fits all the cases. As a result, there does not seem to be any need for a doubling operation for the cases with identical nouns. But maybe there are other arguments for doubling? This is what the next section will discuss.

5 A role for doubling

If there is a role for an operation of doubling or ‘reduplication’ in the analysis of FNTN, that is for an operation that copies *one* argument over two different positions, then obviously it could only cover part of the FNTN construction, namely those cases in which the nouns are identical. The idea would be that even though there is a two-place non-doubling version of FNTN that could cover all of the examples, we still need doubling because there are phenomena that would require a mechanism that copies one nominal over two positions. The purpose of this section is to show that this is not the case for FNTN.

What would the analysis of FNTN look like if took just one single noun as an argument and not a pair? Take the phrase *from room to room*. Instead of applying the *from ... to* function to the product of two noun meanings (42a), we apply it to one single noun meaning, that is then ‘copied’ in the semantics by two identical variables (42b). Semantically, everything else remains the same.

- (42) a. $\lambda X.E(\mathbf{R}(X)(\mathbf{F+T}))(\mathbf{room}\times\mathbf{room})$
 b. $\lambda X.E(\mathbf{R}(X\times X)(\mathbf{F+T}))(\mathbf{room})$

In the syntax corresponding to (42b) there should also be a mechanism that copies the phrase *room* over the two slots in the *from N₁ to N₂* construction. How this is done depends on syntactic assumptions. Pi (1995), for example, analyzes doubling in terms of movement from position N₂ to position N₁. This is not straightforward, since the landing site is a complement position. Pi therefore assumes the structure [from [N₁ [to N₂]]], which might not be the most obvious syntactic structure for this PP. In the framework of Abstract Categorical Grammar (De Groot 2001, Muskens 2003, Winter & Zwarts 2011, Blom et al. 2011), which allows lambda abstraction in syntactic and phonological representations, the form of this reduplicative FNTN construction would be roughly like λv [from v to v], with one lambda operator binding two positions.¹³ Applying this function to the noun [room] leads to the phrase [from room to room]. In this way *one* noun can end up being realized in *two* positions in the form and in the meaning (i.e. restricting both the starting and end points of the paths).

One reason for using this kind of doubling could have to do with processing, with the way linguistic resources are used. Instead of having two identical signs in working memory as part of the computation of a FNTN construct, we only store one sign, but let it play its role multiple times. This seems like a valid reason, but it is one outside of the grammatical system as such. Furthermore, a grammar that has to handle copying of strings of indefinite length is beyond context-freeness (Pullum & Rawlins 2007), which creates its own computational problems.

A more grammatical version of this argument might come from repetitions of the *to* part:

- (43) a. from auction to auction to auction (=10a)
 b. You go from room to room to room to room. [10]

At first sight it seems unnatural to have three-place (four-place, five-place, etc.) versions of FNTN, when we could have a one-place function, with a flexible repetition option in the formal part. However, we also find these repetitions with different nouns:

¹³ Hoeksema & Janda (1988) suggested that the form of a reduplicative suffix RED can be represented as $\lambda u.u u$, i.e. as a function that maps a string to the concatenation of that string with itself.

- (44) a. from father to son to son (=10c)
 b. from house to store to house (=10b)
 c. from grandfather to father to son [11]

This shows that we need a generalization to three-place (and possibly n-place) versions of FNTN anyway, so that a potential argument for reduplication disappears.

Examples like the following might be more relevant for reduplication:

- (45) a. Red-capped cardinals flitted from branch to light branch. (=9c)
 b. I was to follow her tracks from card to cryptic card through all the boxes.
 c. only the angry eyes moving in impotent fury from face to watching face

Interestingly, the adjective in the second nominal seems to behave as if it also applied to the first nominal (Pi 1995, Travis 2001, 2003, Jackendoff 2008). So, in (44a), the cardinals followed a path along several branches, each of which was light. In Pi (1995) and Travis (2001,2003) this is treated as a *partial copying*, by moving only part of the phrase *light branch* to the initial position. One might also consider treating it as some sort of phonological deletion under identity. Whatever the precise mechanism, it seems clear that this phenomenon then points strongly towards one expression being syntactically expressed in two positions, sometimes only partially.

But again, the argument for a special doubling construction is not as strong as it looks. The plural path semantics defined in this paper already strongly works in the direction of explaining why a modifier on one noun can extend semantically to the other noun. The basic semantics for *from branch to light branch* defines the set of paths that lead from a branch to a light branch. In order to pluralize this set we have to concatenate a branch-to-light-branch path to another branch-to-light-branch path, but that is only possible if the second path starts at a light branch (which is possible, because the set of branches will also contain light branches). The result is that in paths in the plural

denotation of *from branch to light branch* there is *at most* one non-light branch, namely the branch where the path starts.¹⁴

A much stronger and more direct argument for reduplication might come from beyond the domain of FNTN, in the bigger family of NPN constructions. In addition to the construction with the paired *from* and *to*, there are closely related constructions with the prepositions *after*, *by*, *for*, *to*, *upon* (Jackendoff 2008):

- (46) a. Generation after generation will come.
b. I only wanna learn this bit by bit.
c. So he repeated it word for word.
d. He put his hands together, palm to palm, then drew them slowly apart.
e. we did increase the pupil to teacher ratio.
f. The country was hit by wave upon wave of strikes.

Some of these constructions only allow identical nouns (in the relevant meaning):¹⁵

- (47) a. *N after N* ‘succession of many Ns’: acre after acre, amendment after amendment, attack after attack, anecdote after anecdote, asterisk after asterisk, attempt after attempt
b. *N by N* ‘one N at a time’: bit by bit, brick by brick, bank by bank, block by block, book by book
c. *N for N* ‘one N at a time’: word for word, man for man, acre for acre, bottle for bottle
d. *N upon N* ‘(vertical) succession of many Ns’: layer upon layer, row upon row, stone upon stone, shelf upon shelf

¹⁴ One question that remains is why we do not find examples where the wide scope adjective is on the *first* noun. Interestingly, we find the same phenomenon in the expletive type of modification in the *X or no X* construction discussed in Pullum & Rawlins (2007), e.g. *rain or no damn rain*. Maybe a general tendency to order shorter constituents before longer constituents can explain this.

¹⁵ *By*, *for*, and *upon* have special uses with numerals and measure phrases. Jackendoff (2008) mentions *three feet by four feet*, *three for two*, *hundreds upon thousands*. I take these to be sufficiently different from the main pattern to be kept apart.

With *to* there is a ‘comparison’ use (e.g. *boy-(to-)girl comparison*) that always involves different nouns (Jackendoff 2008:13). The ‘contact’ use often involves identical nouns, but not always:

- (48) a. two cars, driving at speed nose to tail along the road
b. As they met, breast to chest, thighs against thighs, legs intertwined
c. A young couple stood back to front [12]

If the nouns of an NPN construction have to be identical, like those in (46), then there is a very natural way to derive this in the system, namely by doubling one noun over two positions (as also suggested in Jackendoff 2008 for *after*).

A serious analysis of these constructions (with all their many syntactic, lexical, and semantic complexities) has to be left for another occasion. What is important at this point is that by treating them in terms of syntactic doubling of one noun we seem to have a good way of explaining why they occur exclusively with identical nouns.

Yet, this is not a necessary conclusion. First of all, it could be that the sequential semantics of *after*, *upon*, *by* and *for* works in such a way that the identity of the nouns has a semantic origin. Second, it also depends on how modified examples like *night after sleepless night*, *acre upon salt-caked acre*, *page by dusty page*, *word for faltering word* are seen. In their study of the *X or no X* construction, Pullum & Rawlins (2007) argue against the idea that strings are copied in the syntax, exactly because of a particular kind of modifiers in one of the strings (*day trip or no bloody day trip*, *rain or no damn rain*). Instead of considering them as evidence in favour of *partial* copying, they used them as arguments against copying in the first place, concluding that the identity requirement is not one of strings, but of denotations (see also Potts et al. 2009). It is not clear that this will work for the NPN condition, though, because the modifiers are not necessarily expressive, but the idea that the identity that we see in (47) could be semantic in nature, offers an alternative for a treatment of these cases in terms of doubling of one nominal argument.

6 Conclusions

In this paper, I have given a detailed analysis of the *from-N-to-N* construction that is based on a small number of ingredients, none of which are specific to this construction itself, but which are idiomatically packaged in this construction. This analysis models the meaning of FNTN as a function that takes a set of pairs of nouns, in this way covering both cases with identical and cases with different nouns, leaving no room for doubling. Remaining evidence, based on modification patterns, that a one-place doubling version of FNTN is required too, is not conclusive. Evidence for doubling might come from the other NPN constructions.

A number of important issues remain for future work. The focus of this paper has been more on the internal behaviour of FNTN, and less on how FNTN phrases behave in a larger sentential context, contributing to the spatial or non-spatial meaning of the sentence. The nature of the verb plays an important role in determining the precise meaning of FNTN, expressing not only simple movement, but also extension, variation, succession, and such meanings. For examples, some verbs go together with dual FNTN meanings (like *extend*, *stretch*, and *cross*), while other verbs require plural FNTN meanings (like *fluctuate*, *vary*, and *wander*), and yet another class of verbs involves plural events with dual FNTN (like *toss* and *wave*). An explanation of such dependencies is impossible without a deeper study of the lexical semantics of such verbs and how that lexical semantics interfaces with plurality along different dimensions.

The FNTN construction partially overlaps with the large and varied domain of pluractionality as studied for instance in Beck & Von Stechow (2007) and Beck (2012). The two lines of research work in opposite directions towards the common goal of understanding how (spatial) adverbials interact with event plurality. The starting point of this paper is one particular spatial construction that can (but need not always) give rise to pluractional uses by the way it defines paths between pairs of objects. In the approach of Beck & Von Stechow the focus of attention is a plural operator and adverbials play a subsidiary role, providing information about how the part-whole structure for plurality is defined. It is tempting to see an adverbial as basically ‘pluractional’ or ‘spatial’ and approach it from that perspective, but these are only descriptive labels that ultimately

have to give way to a semantic analysis that does justice to all the components in an adverbial's meaning, not only the spatial ones, but also the pluractional ones.

One might wonder why the FNTN construction requires bare nominals. Why do we not find a plural reading with *from a room to a room* and why does *from the bank to the bank* (talking about a river) sound strange compared to *from bank to bank*? Both phenomena might have to do with the way the bare *from N to N* construction competes with the full *from D N to D N* construction. If the speaker has a choice, then the more economical *from bank to bank* is preferred over the less economical and more repetitive *from the bank to the bank*. Furthermore, the more economical *from room to room* form will also acquire the more stereotypical meaning for this construction, namely the plural one. This way of looking at the competition between bare and full constructions, along the lines of Horn (1984), Levinson (2000), and De Swart & Zwarts (2009) does not give an answer to the question why articles can be dropped in the FNTN construction (and other (P)NPN constructions), but it does open up the way for a general explanation of how the meanings are distributed over the different constructions.

The connection between FNTN and other bare constructions requires further study in this respect. This concerns not only the definiteness of the bare nominal (observed in PPs like *in jail*, coordinations like *dog and cat*, small clauses like *hat in hand*), and the enriched interpretation of relational nouns (*mother or daughter*, *like father like son*), but also other properties of such constructions (like modification, scope, lexicalization).

I only touched the surface with regard to closely related (P)NPN constructions. For example, how does FNTN relate to constructions of the form *from one N to a/the other (N)*? What makes FNTN different from other bare NPN constructions? The FNTN construction has a different grammatical origin (PP+PP) than the NPN constructions (which seem to be absolute constructions, NP+PP, Haik 2008). What is still lacking is a picture of this domain that combines the 'historical' dimension (of specific constructions having grown out of, or still participating in, more general patterns) with general semantic and pragmatic principles. Hopefully, this paper has contributed some insights that go towards such a picture.

Appendix: Sources of examples from the Internet

- 1 books.google.nl/books?isbn=1408913577
- 2 www.kung-fu-fitness-and-defence.com/kung-fu-lessons.html
- 3 www.reflectorart.com/jane/book/index.html
- 4 appliedimprov.ning.com/forum/topics/game-for-teaching-different-perspectives?xg_source=activity
- 5 amerikana365.wordpress.com/
- 6 preservationist.blogspot.com/2004_04_01_archive.html
- 7 youtu.be/nbfMnWAwi2M
- 8 www.arnoldooffermand.com/?s=rodriguez
- 9 www.askdrsears.com/topics/breastfeeding/while-working/20-tips-working-and-breastfeeding
- 10 www.okmagazine.com/ok-exclusive/heidi-klum-pranks-around
- 11 www.familytreedna.com/public/cook/default.aspx?section=news
- 12 boblinks.com/062105r.html

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