

Two Types of Modified Cardinals

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SUMMARY

This paper examines two types of the modified cardinal construction, showing that both involve coercion of the modified element to the semantic type of a singular noun, an analysis that suggests an explanation for the obligatory occurrence of the indefinite article *a*.

1. The Data

- ◆ The modified cardinal construction (Ionin & Matushansky 2004, 2006; see also Jackendoff 1977; Gawron 2002; Kayne 2005; among others):

- (1) a. A lucky three students got fellowships
b. We spent a busy three weeks preparing for the expedition
c. An incredible eight thousand soldiers died at Gettysburg
d. Fred wrote a meager two pages

⇒ We will see below that (1a-d) exemplify 4 distinct sub-types of the modified cardinal construction, falling within 2 basic types.

- ◆ Two unusual and correlated properties:

- Adjective precedes rather than follows cardinal number:

- (2) a. *lucky three students b. three lucky students
c. a lucky three students d. *a three lucky students

- Required presence of indefinite article with (apparently) plural noun:

- (3) a. *a students b. students
c. *a three students d. three students
e. *a lucky students f. lucky students
g. a lucky three students h. *lucky three students

⇒ In requirement for indefinite article (or other overt determiner), modified cardinals exhibit precisely the behavior of singular count nouns

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2. Two Basic Types

Type 1: Adjective modifies the following nominal expression itself (quality reading)

- (1) a. A lucky three students got fellowships
b. We spent a busy three weeks preparing for the expedition
- (4) a. With the win, the team earned an important three points in the standings
b. I opened the door and found a bedraggled four hikers on my doorstep
c. It's a long five miles to the store
d. I started the book, but I put it down after a boring few pages

Type 2: Adjective modifies the quantity or amount of the following nominal expression (quantity reading)

- (1) c. An incredible eight thousand soldiers died at Gettysburg
d. Fred wrote a meager two pages
- (5) a. Babe Ruth hit an amazing four home runs in one game
b. John made a healthy two hundred dollars on the transaction
c. We received a remarkable ninety applications for the position
d. The storm lasted for an astonishing four days

- ◆ Distinct entailment patterns:

- (6) a. A lucky three students got fellowships
⇒ The three students who got fellowships were lucky
b. We spent a busy three weeks preparing for the expedition
⇒ The three weeks we spent preparing for the expedition were busy
c. An incredible eight thousand soldiers died at Gettysburg
⇒ The eight thousand soldiers who died at Gettysburg were incredible
d. Fred wrote a meager two pages
?⇒ The two pages that Fred wrote were meager

- ◆ Ambiguity possible between Type 1 and Type 2 readings:

- (7) David Blaine spent an amazing six weeks locked in a Plexiglas case
 - Type 1: *amazing* describes the six weeks ('what an amazing experience!')
 - Type 2: *amazing* describes the amount of time ('who'd have thought he could stay there so long?')

- ◆ For purposes of exposition, I take adjectives such as *lucky* to be functions from sets to sets (type $\langle et, et \rangle$)

$$(15) \quad \llbracket \text{lucky} \rrbracket = \lambda P \lambda x. P(x) \wedge \text{lucky}(x)$$

- ◆ I take cardinal numbers to be of type d (degrees). I further propose the existence of a (phonologically null) head COUNT that introduces a degree argument and links it to an individual argument:

$$(16) \quad \text{a. } \llbracket \text{three} \rrbracket = 3$$

$$\text{b. } \llbracket \text{COUNT} \rrbracket = \lambda d \lambda X. \text{COUNT}(x) = d$$

- As type $\langle d, et \rangle$, COUNT can combine with plural predicate (type $\langle et \rangle$) via variable identification (Kratzer 1996)

- ◆ For the canonical word order in (17a), this yields (17b) and (17c) as the logical form and semantic interpretation:

$$(17) \quad \text{a. three lucky students}$$

$$\text{b. } [{}_{XP} \text{three } [{}_{X'} \text{COUNT } [\text{lucky students}]]]$$

$$\text{c. } (\llbracket \text{COUNT} \rrbracket \cap \llbracket \text{lucky students} \rrbracket) (\llbracket \text{three} \rrbracket)$$

$$\lambda X. *(\text{lucky}(\text{student})(X)) \wedge \text{COUNT}(X) = 3$$

⇒ Here I follow recent approaches to indefinites (Heim 1982; Reinhart 1997; Krifka 1999; Landman 2004; Ionin & Matushansky 2006) in taking them to be of predicative type, with quantificational force originating externally.

- ◆ Turning to the modified cardinal word order, to achieve the single-unit interpretation I introduce the group formation operator \uparrow of Landman (2004), which maps plural individuals to the corresponding group atoms:

$$(18) \quad a \sqcup b \sqcup c \text{ is a plural individual, the “sum” of } a, b \text{ and } c$$

$$\uparrow(a \sqcup b \sqcup c) \text{ is interpreted as “} a, b \text{ and } c \text{ as a unit,” an atom in its own right}$$

⇒ I assume that the application of the group formation operator is constrained to sets of individuals that can be construed as single units (e.g. a sequence of consecutive days)

- ◆ For the modified cardinal word order:

$$(19) \quad \text{a. a lucky three students} \quad (1a)$$

$$\text{b. } [\text{lucky } [{}_{XP} \text{three } [{}_{X'} \text{COUNT } [{}_{NP} \text{students}]]]]$$

$$\text{c. } \llbracket \text{lucky} \rrbracket (\uparrow((\llbracket \text{COUNT} \rrbracket \cap \llbracket \text{students} \rrbracket) (\llbracket \text{three} \rrbracket)))$$

$$\lambda x. \text{lucky}(x) \wedge \exists Y. * \text{student}(Y) \wedge \text{COUNT}(Y) = 3 \wedge x = \uparrow Y$$

- ◆ What rules out the following derivation, where the adjective directly modifies the plural individual (thus failing to account for the single-unit interpretation)?

$$(20) \quad \text{a. a lucky three students}$$

$$\text{b. } [\text{lucky } [{}_{XP} \text{three } [{}_{X'} \text{COUNT } [\text{students}]]]]$$

$$\text{c. } \llbracket \text{lucky} \rrbracket ((\llbracket \text{COUNT} \rrbracket \cap \llbracket \text{students} \rrbracket) (\llbracket \text{three} \rrbracket))$$

$$\lambda X. \text{lucky}(X) \wedge * \text{student}(X) \wedge \text{COUNT}(X) = 3$$

⇒ I propose that adjectives such as *lucky* are modifiers of sets of singular individuals, and thus cannot combine with a plural predicate such as *three students* due to a sortal mismatch, which can be remedied by the application of the group formation operator.

- Under this analysis, *lucky students* is $*(\text{lucky}(\text{student}))$ not $\text{lucky}(*\text{student})$

- ◆ Having provided an analysis of example (1a), I return to example (1b) below.

5. Type 2 Modified Cardinals

- ◆ In the Type 2 construction, a single-unit interpretation is not required:

$$(21) \quad \text{I spent } \underline{\text{an incredible twelve hours}} \text{ grading the final exam}$$

- Need not be 12 consecutive hours

- ◆ Below, note the parallels between the (a) examples and the (b) and (c) examples:

$$(22) \quad \text{a. An } \underline{\text{incredible eight thousand soldiers}} \text{ died at Gettysburg}$$

$$\text{b. An } \underline{\text{incredible number of soldiers}} \text{ died at Gettysburg}$$

$$\text{c. } \underline{\text{It is incredible how many soldiers}} \text{ died at Gettysburg}$$

$$(23) \quad \text{a. We received } \underline{\text{a remarkable 90 applications}} \text{ for the position}$$

$$\text{b. We received } \underline{\text{a remarkable number}} \text{ of applications for the position}$$

$$\text{c. } \underline{\text{It is remarkable how many applications}} \text{ we received for the position}$$

Proposal: In Type 2 modified cardinal examples such as *an incredible eight thousand soldiers*, the cardinal number itself is coerced to the type of the singular functional noun *number*

Analysis:

- ◆ I start with an analysis of (22b), involving the functional noun *number*.

- Gawron (2002) notes contrasts such as the following, evidence that *a number* denotes a number, not an individual or group:

$$(24) \quad \text{a. A valuable group of glasses was broken}$$

$$\text{b. } * \text{A valuable number of glasses were broken}$$

- Based on this, I propose that *number* denotes the set of numbers (type <dt>):

$$(25) \quad \llbracket \text{number} \rrbracket = \lambda d. d \in D_{d:\text{CARDINALITY}}$$

- In the relevant usage, I take *incredible* to be a modifier of sets of degrees, with propositional content (cf. Morzycki 2007):

$$(26) \quad \llbracket \text{incredible number} \rrbracket = \lambda d. d \in D_{d:\text{CARDINALITY}} \wedge \text{incredible}(\hat{\exists} d'. d = d_c + d' \wedge d' \text{ is large}),$$

where d_c is the expected value with respect to the context C

- This yields (27) as the semantics of *an incredible number of soldiers*:

$$(27) \quad \begin{aligned} & \text{a. an incredible number of soldiers} \\ & \text{b. } [_{XP} (\text{an incredible number}) [_{X'} \text{of} [\text{soldiers}]]] \\ & \text{c. } (\llbracket \text{COUNT} \rrbracket \cap \llbracket \text{soldiers} \rrbracket) (\llbracket \text{incredible number} \rrbracket) \\ & \quad \lambda X. * \text{soldier}(X) \wedge \exists d. \text{COUNT}(X) = d \wedge d \in D_{d:\text{CARDINALITY}} \wedge \\ & \quad \text{incredible}(\hat{\exists} d'. d = d_c + d' \wedge d' \text{ is large}) \end{aligned}$$

- *an incredible number* a constituent (cf. Jackendoff 1977; Gawron 2002)
- Degree argument existentially bound (choice function approach per Reinhart 1997 would also be possible)
- Following Schwarzschild (2006), I take *of* to be the spell-out of COUNT (nothing depends on this assumption)

- ◆ Translating this to the modified cardinal construction:

- To allow adjectival modification, the cardinal number is coerced to the type of a set of degrees, specifically the singleton set that contains it:

$$(28) \quad \llbracket (\text{eight thousand})_{\langle dt \rangle} \rrbracket = \lambda d. d \in D_{d:\text{CARDINALITY}} \wedge d = 8000$$

- We then have:

$$(29) \quad \begin{aligned} & \text{a. an incredible eight thousand soldiers} && \text{(1c)} \\ & \text{b. } [_{XP} (\text{an incredible eight thousand}) [_{X'} \text{COUNT} [\text{soldiers}]]] \\ & \text{c. } (\llbracket \text{COUNT} \rrbracket \cap \llbracket \text{soldiers} \rrbracket) (\llbracket \text{incredible eight thousand} \rrbracket) \\ & \quad \lambda X. * \text{soldier}(X) \wedge \exists d. \text{COUNT}(X) = d \wedge d \in D_{d:\text{CARDINALITY}} \wedge \\ & \quad \text{incredible}(\hat{\exists} d'. d = d_c + d' \wedge d' \text{ is large}) \wedge d = 8000 \end{aligned}$$

- ◆ Having provided an analysis of example (1c), I return to example (1d) below.

6. Measure Phrases in Type 1 and Type 2 Modified Cardinals

- ◆ An additional complication is presented by Type 1 modified cardinals such as *a busy three weeks* and *a long five miles*, and Type 2 cases such as *a meager two pages* and *an amazing six weeks*

- ◆ In (7), on the quantity (Type 2) reading, *amazing* does not characterize *six* as a number of weeks to spend in a Plexiglas case, but rather *six weeks* as an amount of time to do so; (30a) is a closer paraphrase of (7) than (30b):

(7) David Blaine spent an amazing six weeks in a Plexiglas case

- (30) a. David Blaine spent an amazing amount of time in a Plexiglas case
b. David Blaine spent an amazing number of weeks in a Plexiglas case

- ◆ Similarly, (1d) is most easily read with *meager* modifying not *two* as a number of pages, but *two pages* as an amount of writing or text. This can be seen in (31a), where the substance quantified by *two paragraphs* is made overt. Again, (31b) is a closer paraphrase than (31c).

(1) d. Fred wrote a meager two pages

- (31) a. Fred wrote a meager two pages of explanation
b. Fred wrote a meager amount
c. ??Fred wrote a meager number of pages

- ◆ This suggests that the nominal expressions in (32a, 33a) do not have the structures in (32b, 33b), but rather those in (32c, 33c):

- (32) a. an amazing six weeks
b. $[_{XP} \text{an amazing six } [_{X'} \text{COUNT } [_{NP} \text{weeks}]]]$ ×
c. $[_{XP} \text{an amazing (six weeks)} [_{X'} \text{AMOUNT } [_{NP} \emptyset]]]$ ✓

- (33) a. a meager two pages (1d)
b. $[_{XP} \text{a meager two } [_{X'} \text{COUNT } [_{NP} \text{pages}]]]$ ×
c. $[_{XP} \text{a meager (two pages)} [_{X'} \text{AMOUNT } [_{NP} \emptyset]]]$ ✓

- AMOUNT is the counterpart of COUNT, a function that associates to a portion of substance a degree on an appropriate scale

$$(34) \quad \llbracket \text{AMOUNT} \rrbracket = \lambda d \lambda x. \text{AMOUNT}(x) = d$$

- *Six weeks* and *two pages* are measure phrases, each of which would ordinarily denote a degree on a scale associated with some dimension on which substances can be measured

- ◆ The corresponding semantics for (1d) are as follows, where as in the case of (1c) the measure phrase has been coerced to an element of set type (type <dt>), the type of the functional noun *amount*:

- (35) a. a meager two pages (1d)
b. $(\llbracket \text{AMOUNT} \rrbracket \cap \llbracket \emptyset \rrbracket) (\llbracket \text{meager (two pages)} \rrbracket)$
 $\lambda x. \exists d. \text{AMOUNT}(x) = d \wedge d \in D_{d:\text{SUBSTANCE DIM}} \wedge \text{meager}_C(d) \wedge d = 2 \text{ pages,}$

where $\text{meager}_C(d)$ is true if the amount d is judged meager in the context C

◆ This in turn suggests a measure phrase analysis for Type 1 modified cardinals such as (1b):

- (36) a. a busy three weeks (1b)
 b. [busy [_{XP} three weeks [_{X'} AMOUNT [_{NP} ∅]]]
 c. $\lambda x. \text{busy}(x) \wedge \exists y. \text{AMOUNT}(y) = 3 \text{ weeks} \wedge x = \uparrow y$

7. Summary

Table 1 summarizes the analysis of the two types of modified cardinals:

	Example	Analysis
Type 1	Cardinal # 1a) a lucky three students	[lucky [_{XP} three [_{X'} COUNT [_{NP} students]]]] $\lambda x. \text{lucky}(x) \wedge \exists Y. * \text{student}(Y) \wedge \text{COUNT}(Y) = 3 \wedge x = \uparrow Y$
	Measure Phrase 1b) a busy three weeks	[busy [_{XP} three weeks [_{X'} AMOUNT [_{NP} ∅]]]] $\lambda x. \text{busy}(x) \wedge \exists y. \text{AMOUNT}(y) = 3 \text{ weeks} \wedge x = \uparrow y$
Type 2	Cardinal # 1c) an incredible 8000 soldiers	[_{XP} an incredible 8 thousand [_{X'} COUNT [_{NP} soldiers]]] $\lambda X. * \text{soldier}(X) \wedge \exists d. \text{COUNT}(X) = d \wedge d \in D_{d. \text{CARDINALITY}} \wedge \text{incredible}(\wedge \exists d'. d = d_C + d' \wedge d' \text{ is large}) \wedge d = 8000$
	Measure Phrase 1d) a meager two pages	[_{XP} a meager (two pages) [_{X'} AMOUNT [_{NP} ∅]]] $\lambda x. \exists d. \text{AMOUNT}(x) = d \wedge d \in D_{d. \text{SUBSTANCE DIM}} \wedge \text{meager}_C(d) \wedge d = 2 \text{ pages}$

8. Conclusions and Questions about *a*

- ❖ In both the Type 1 (quality) and the Type 2 (quantity) modified cardinals, the adjective modifies an element that has been coerced to the semantic type of a singular noun – a set of (atomic) individuals:
 - Type 1: a lexical noun such as *student* (type ⟨et⟩)
 - Type 2: a functional noun such as *number* or *amount* (type ⟨dt⟩)
- ❖ The question of why modified cardinals require an indefinite article then reduces to the question of why singular count nouns require an indefinite article
- ❖ Why is the indefinite article required with singular nouns? No conclusive answer, but some possibilities:
 - Saturation of argument slot (Krifka 2004; Matushansky & Spector 2005)
 - Associated with shift to set type (de Swart, Winter & Zwarts 2007)

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