

Distributional modification, not quantification

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1 Introduction

Natural language affords various well-studied strategies for composing propositions about the quantity of entities that participate in a given event or have a given property:

- **Quantification:** Quantity relation between sets (e.g. Barwise and Cooper 1981) or propositions containing coindexed variables (e.g. Kamp 1981).

- (1) a. Most birds fly.
b. Mary always carries an umbrella if she thinks it is going to rain.

- **Modification:** (Non-proportional) quantities can be conceived of as properties of masses or sets (e.g. Milsark 1974).

- (2) a. two birds
b. some rain

- **Predication over kinds, modeled as entities:** Can carry implications about quantity (e.g. Carlson 1977).

- (3) The platypus lays eggs.

We argue for a fourth strategy:

- **Distributional modification:** A modifier contributes a **property** not of sets of individuals but rather of **descriptions of kinds** and contributes the entailment that the kind description in question is realized not by a single token but rather by a **set** of tokens with a particular sort of distribution (Gehrke and McNally 2011, Gehrke and McNally 2015).

- Exemplified by the so-called frequency adjectives (FAs): *daily, monthly, etc.; (in)frequent, sporadic, periodic; occasional, odd, and rare* (see also Bolinger 1967, Stump 1981, Larson 1998, Zimmermann 2003).¹

- (4) a. The occasional sailor strolled by.
= Occasionally, a sailor strolled by. (Bolinger 1967)
b. The storm was punctuated by a sporadic crash of thunder.
= Sporadically, the storm was punctuated by a crash of thunder. (Stump 1981)
c. She wrote me frequent letters. = Frequently, she wrote me letters.

Plan:

- Overview of the FA data
- Analysis (of part of) this data
- Arguments for the modifier analysis over quantificational analyses (e.g. Stump 1981, Larson 1998, Zimmermann 2003)

¹Some data are taken from the British National Corpus (BNC), the Corpus of Contemporary American English (COCA), the Corpus of Global Web-Based English (GloWbE), and Google books corpus of American English, all available at <http://corpus.byu.edu>; others from Google searches. Examples from the corpus.byu.edu site will be identified simply by the name of the source corpus; examples from Google searches will be identified by their full URL.

2 Data

FAs have been attributed different readings (internal, generic, adverbial; see below). Challenges:

- How to account for the apparent wide scope of a DP-internal adjective in examples like (4), when it can be paraphrased “quantificationally”?
- How to provide a general account for the different readings?

The data are extremely complex:

- FAs fall into two distinct classes: Temporal(ly) vs. non-temporal(ly distributing).
 - Non-temporal (5a): *occasional*₁, *odd*, *rare*
 - Temporal (5b): *daily*, *monthly*, etc.; (*in*)*frequent*, *sporadic*, *periodic*; *occasional*₂
- (5) a. a glimpse of commerce – the **occasional/odd/rare** office, barbershop, or Vietnamese strip mall...
- b. ??a glimpse of commerce – the **weekly/frequent/infrequent/periodic/sporadic** office, barbershop, or Vietnamese strip mall...

- We need a slightly different semantics for each class.
- “Quantificational” paraphrases can come about in different ways:
 1. Non-temporal FA as a second order kind description modifier (4a)
 2. Temporal FA as an (intersective) event kind predicate (4b)
 3. Temporal FA with a non-event noun, “incorporation” (4c)
(under certain conditions, cf. Gehrke and McNally 2014, and below)

We analyze only non-temporal FAs today.

The internal reading:

- (6) a. A frequent sailor (= one who sails frequently) won the regatta.
b. A frequent recipient of awards (= one who frequently receives awards) took the Rotary Club prize again.

- Paraphrase of [FA N]: “N who/that V’s / is V’d FA-ly”
- Only possible with temporal FAs

- (7) a. a daily/weekly Internet user = one who uses the Internet daily/weekly
b. a frequent/infrequent/sporadic/periodic visitor = one who visits frequently/etc.
c. a(n) occasional reader of the newspaper = one who reads the newspaper occasionally
- (8) a. an odd user/visitor/reader \neq one who uses/visits/reads on odd occasions
b. a rare writer/winner/employee \neq one who writes/wins/is employed rarely

We therefore set aside this reading today; see Gehrke and McNally (2015) for an analysis.

The generic reading:

- (9) a. A(n) monthly/frequent/occasional check-up is essential.
b. A(n) yearly/infrequent/rare visitor is not a problem.

- c. A daily/sporadic cup of coffee is harmless.
- d. The odd glitch is tolerable.
- e. ...there is little evidence to show that the rare drink will impair the healthy growth of a baby. (<http://answers.yahoo.com/question/index?qid=20110501003637AAeLyDj>)

- Paraphrase (Stump 1981): nominal post-modifier *now and then, from time to time, every day* etc.; (10)

- (10)
- a. A check-up on a monthly/frequent/occasional basis is essential.
 - b. A visitor on a yearly/infrequent basis is not a problem.
 - c. A cup of coffee on a sporadic basis is harmless.
 - d. A glitch on odd occasions is tolerable.
 - e. A drink on rare occasions will (not) impair the healthy growth of a baby.

- Natural when FA-DP is an argument to a generic predicate (e.g. (9)) (Stump 1981; Schäfer 2007), and when DP is interpretable as generic independently of the presence of the FA:

- (11)
- a. A check-up is / Check-ups are essential.
 - b. A visitor is / Visitors are not a problem.
 - c. A cup of coffee is / Cups of coffee are harmless.

- With episodic predicates, the FA is unacceptable or not paraphrasable as in (11):

- (12)
- a. ??An occasional cup of coffee has left circular stains on the table. (Stump 1981)
 - b. The Premier Division-based Scotland side were only beaten, in fact, by a goal of almost tragic proportions, conceded when an infrequent error was characteristically punished by Riedle. (BNC)
 ≠ An error on an infrequent basis was characteristically punished by Riedle.

- Schäfer (2007): Restricted to (in)definites, semantically bleached possessives:

- (13)
- a. An/The/Your occasional beer is good for you.
 - b. ??Each occasional beer is good for you.
 - c. ??Two/??Many occasional beers are good for you.

- The restrictions are more refined: Temporal FAs prohibit definite marking (14); non-temporal FAs require it (15); only *occasional* allows both (13a).

- (14)
- a. ??The/??Your daily shower is good for you.
 - b. ??The/??Your infrequent/frequent beer is good for you.
 - c. ??The/??Your sporadic/periodic inspection is necessary.

- (15)
- a. An odd glitch is/Odd glitches are tolerable.
 ≠ The occurrence of glitches on odd occasions is tolerable.
 - b. A rare drink/Rare drinks will not impair the healthy growth of a baby.
 ≠ A drink on rare occasions will not impair the healthy growth of a baby.

- With the FAs in (14), the generic reading is systematically available only with event nouns. With other nouns: they have to be coercible into event descriptions (cf. Schäfer 2007):

- (16)
- a. A frequent cup of coffee helps keep John awake.
 = Drinking a cup of coffee frequently helps keep John awake.
 - b. Occasional newspaper articles are part of John's job.
 = (e.g.) Writing/Editing newspaper articles occasionally is part of John's job.

The adverbial reading:

- (17) a. The occasional sailor strolled by.
= Occasionally, a sailor strolled by. (Bolinger 1967)
- b. The storm was punctuated by a sporadic crash of thunder.
= Sporadically, the storm was punctuated by a crash of thunder. (Stump 1981)
- c. She wrote me frequent letters. = Frequently, she wrote me letters.
- Stump (1981); Zimmermann (2003); Schäfer (2007): Like generic reading, restricted to (in)definites, semantically bleached possessives:
- (18) a. We saw an/the/your occasional car on the road.
= Occasionally, we saw a car on the road.
- b. ??We saw each occasional car on the road.
≠ Occasionally, we saw each car on the road.
- c. ??We saw two/some/many occasional cars on the road.
≠ Occasionally, we saw two/some/many cars on the road.
- Again, the restrictions are more refined: Temporal and non-temporal FAs show the same restrictions as with the generic reading ((19)-(21)).
- (19) a. **The/??An** odd sailor strolled by.
= On odd occasions, **a** sailor strolled by.
- b. He might point out **the[/??an]** odd bird or tell us the name of a plant, but these park excursions were not botanical treks. (COCA)
= On odd occasions, he might point out a bird...
- c. ...Brown himself did imbibe **the[/??an]** odd drink (he appears not to have been a temperance advocate)... (COCA)
= On odd occasions, Brown himself did imbibe a drink...
- (20) a. The pier is still used by **the[/??a]** rare passenger. (Google books)
= Rarely, the pier is still used by a passenger.
- b. she runs her family's Sea-View Motel and Restaurant on a patch of northern Florida coastline...that sees only **the[/??a]** rare tourist. (COCA)
= ...that rarely sees a tourist
- c. In Hinsonville, **the[/??a]** rare family had just one parent, and that condition was usually quickly altered by the second marriage of the widow or widower. (Google books)
= Rarely, a family had just one parent.
- (21) a. **The** occasional sailor strolled by.
= Occasionally, **a** sailor strolled by.
- b. **An** occasional sailor strolled by.
= Occasionally, **a** sailor strolled by.
- Temporal FAs show same restriction to event nouns as found on generic reading (22), (23)²
- (23) a. An (in)frequent/sporadic/periodic sailor strolled by.
≠ (In)frequently/Sporadically/Periodically, a sailor strolled by.

²This second class of FAs allows an adverbial paraphrase with non-event nouns only under particular conditions (22) Gehrke and McNally (for details and an account, see 2014): 1. Unique discernible events, uniformity across subevents, temporal continuity within events (Atomic Event-Entity Mapping); 2. Stereotypicality; 3. The noun phrase must be a bare plural.

- (22) a. She baked frequent batches of cookies/ ??a frequent batch of cookies/ ??frequent cookies.
- b. She sent me frequent letters / ??a frequent letter / ??frequent posters.

- b. The (in)frequent/sporadic/periodic sailor strolled by.
 \neq (In)frequently/Sporadically/Periodically, a sailor strolled by.
- c. Frequent sailors strolled by.
 \neq Frequently, a sailor/sailors strolled by.
- (24) a. A daily/weekly/monthly sailor strolled by.
 \neq Daily/Weekly/Monthly, a sailor strolled by.
- b. The daily/weekly/monthly sailor strolled by.
 \neq Daily/Weekly/Monthly, a sailor strolled by.

Type of FA	Temporal	Nontemporal	Both
	<i>(in)frequent, periodic, sporadic daily, etc.</i>	<i>odd, rare</i>	<i>occasional</i>
Internal reading	✓	*	✓
Adverbial reading with non-event nouns	*	✓	✓
Determiner used with the generic and/or adverbial reading	✓ <i>a</i> ?? <i>the</i>	?? <i>a</i> ✓ <i>the</i>	✓ <i>a</i> ✓ <i>the</i>
Nontemporal distribution	*	✓	✓
Predicative use on relevant reading	✓	*	✓

Table 1: Summary of empirical generalizations

3 Analysis

3.1 Background assumptions

We make reference to token (ordinary) entities and events, as well as to kinds of entities and events (Carlson 1977)

- Tokens realize kinds (Carlson 1977), e.g. $\mathbf{R}(x_o, \mathbf{dog}) \approx x_o$ **realizes** a token of the kind **dog**.
- **Nouns denote descriptions of kinds** that can be converted into properties of token entities via functional morphology, resulting in a Predicative Noun Phrase (PNP), adapting a proposal in Zamparelli (1995) (see e.g. McNally and Boleda 2004; Déprez 2005; Espinal 2010; Müller-Reichau 2011, and references cited there for related proposals) (25); converting a PNP to a DP creates a referential/quantificational expression.
- **Verbs** work analogously, aspect (or tense) supplying the realization relation (e.g. Landman and Morzycki 2003; Ginzburg 2005; Sailer 2010; Gehrke 2013, 2015; Arsenijević, Boleda, Gehrke, and McNally 2014) (26).

- (25) a. $[[[_{NP}[_{N} \mathbf{car}]]]]: \lambda x_k [\mathbf{car}(x_k)]$
 b. $[[[_{PNP}[_{NP} \mathbf{car}]]]]: \lambda y_o \exists x_k [\mathbf{car}(x_k) \wedge \mathbf{R}(y_o, x_k)]$

- (26) a. $[[[_{VP}[_{V} \mathbf{strolled\ by}]]]]: \lambda x_\alpha \lambda e_k [\mathbf{strolled_by}(e_k, x_\alpha)]$, where α ranges over both kinds and tokens.
 b. $[[[_{AspP}[_{VP} \mathbf{strolled\ by}]]]]: \lambda x_\alpha \lambda e_o \exists e_k [\mathbf{strolled_by}(e_k, x_\alpha) \wedge \mathbf{R}(e_o, e_k)]$, where α ranges over both kinds and tokens.

Kind realization:

- The realization relation **R** must be able to hold sometimes between a kind and a *set* of tokens (Gehrke and McNally 2011).
- FAs impose conditions on the distribution of these sets of tokens at a given index *i*.
 - Represented with a **distribution** function that yields the distribution *dist* of a set of entities at the given index, with values like *high*, *low*, *daily*, etc.):
distribution($\{y : \mathbf{R}(y, x_k) \text{ at } i\} = \text{dist}$)
 - Must also guarantee that the members of the set be properly individuable and that the distribution be sufficiently regular (see Stump 1981, Zimmermann 2003, and Schäfer 2007 for various alternatives); we set aside this issue here.

3.2 A semantics for non-temporal FAs

Nontemporal FAs are kind description modifiers (but do not create conceptually distinct subkinds!):

$$(27) \quad \llbracket \mathbf{FA}_{nontemp} \rrbracket: \lambda P \lambda x_k [(\mathbf{FA}(P))(x_k)]$$

Why a second-order modifier:

- Nontemporal FAs lack a predicative use:

(28) ??The sailor was occasional/odd (on relevant reading)/rare.

- They do not coordinate with intersective modifiers:

(29) a. ??The museum had the odd/rare and brief visit from school groups.
b. ??The occasional and fast car drove by.

- Changing the order of these FAs with respect to other modifiers clearly produces a corresponding change in interpretation, something typical of predicate modifiers:

(30) Only the odd/rare/occasional 2-door car will have enough leg room in the back seat.
≠ Only the 2-door odd/rare/occasional car will have enough leg room in the back seat.

Satisfaction conditions:

$$(31) \quad \forall P, x_k, i [(\mathbf{FA}_{nontemp}(P))(x_k) \text{ at } i \leftrightarrow [P(x_k) \wedge \mathbf{distribution}(\{y : \mathbf{R}(y, x_k) \text{ at } i\}) = \text{dist}]]$$

An example:

(32) a. $\llbracket \text{odd} \rrbracket: \lambda P \lambda x_k [(\mathbf{odd}(P))(x_k)]$
b. $\llbracket \text{odd car} \rrbracket: \lambda x_k [(\mathbf{odd}(\mathbf{car}))(x_k)]$
c. $\forall x_k, i [(\mathbf{odd}(\mathbf{car}))(x_k) \text{ at } i \leftrightarrow [\mathbf{car}(x_k) \wedge \mathbf{distribution}(\{y : \mathbf{R}(y, x_k) \text{ at } i\}) = \text{low}]]$

Why necessarily definite and singular?

(33) the/??an odd car/odd cars

- The nominal that the FA combines with denotes the set of kinds described by that nominal.

- This set includes the general kind and any recognizable subkinds.
 - E.g. *car* denotes the set that includes the kind described by *car*, but also the subkinds described by *station wagon*, *sportscar*, *Mercedes*, etc.
 - But whenever we convert the kind description to a description of tokens, there is always only one unique kind that the tokens are entailed to be realizing: the maximally general kind.
 - For example, the (nongeneric) nominal *cars* denotes the set of token individuals that are of the car kind. It may be that all of these cars belonged to one particular subkind of car (e.g. station wagon), but this is not *entailed*.
 - Though we cannot provide a deep answer as to why this restriction to the unique maximal kind arises, it is an obvious consequence of having to choose some kind for the tokens to stand in the realization relation to, and natural language does not seem to be able to express at once, with a single, noncoordinated nominal, realization relations to multiple kinds.
 - Although the effect of adding a (nontemporal) FA is not to convert a kind-level description to a token-level description, its effect is similar: it takes a kind description and imposes conditions on the realizations of the corresponding kind.
 - In order for those conditions to be met, the identity of the kind that will participate in the realization relation must be established: it will be the unique, most general kind described by the nominal the FA combines with.
- When the FA combines with a kind description, it returns the description of the unique kind upon whose realizations distributional conditions are being imposed. Thus, nominals containing these FAs reject any determiner that does not entail uniqueness.

The generic reading

Predication of a kind, à la Carlson (1977):

- (34) a. The odd glitch is tolerable.
 b. **tolerable**($\iota x_k[(\text{odd}(\text{glitch}))(x_k)]$)

In prose: The kind of thing that is a glitch, the members of whose set-realization have a low distribution, is tolerable.

An example involving coercion of the nominal to an event description:

- (35) a. The occasional beer is healthy. = V-ing a beer on an occasional basis is healthy.
 b. **healthy**($\iota e_k[\mathbf{E}(\text{occasional}(\text{beer}))(e_k)]$)

In prose: The kind of event that is a beer V-ing, realized by a set of events with a low distribution, is healthy.

The adverbial reading

- Preliminary: token event descriptions using kind terms typically require a token of the kind to participate in the event in question (e.g. in (36), a token bird of the deictically indicated kind).

(36) That kind of bird made a nest on my roof.

- How could this work for *the occasional sailor*? The distribution condition on the set of tokens that realize this kind make it impossible for such a set to participate in one token event of the sort described by the verb.

- But nothing would prohibit it from participating in the *kind* of event described by the verb, if the latter could be instantiated by multiple event tokens.

→ Sentences with the adverbial reading correspond to propositions about event kinds.

Satisfaction conditions for sentences that are used to make assertions about event kinds:

$$(37) \quad \forall e_k, x_\alpha, P, i [P(e_k, x) \text{ at } i \leftrightarrow \exists e, x_\alpha [\mathbf{R}(e, e_k) \wedge P(e, x_\alpha) \text{ at } i]]$$

In prose: In order for an event kind predication to hold at some index i , at least one realization of the event kind should exist at i .

- Each element of the set that realizes the participant should participate in a token event of the relevant event kind.
- In such cases, it will follow automatically that the corresponding token events will satisfy the same distribution as the token participants.
- Thus, for (38a) to be true, there will have to be a set of token strolling events with a distribution that *occasional/odd/rare* require.
- This is precisely what the adverbial paraphrase expresses.

$$(38) \quad \begin{array}{l} \text{a. The occasional(odd/rare sailor strolled by.} \\ \text{b. } \exists e_k [\mathbf{strolled_by}(e_k, \iota x_k [(\mathbf{occasional}(\mathbf{sailor}))(x_k))]] \end{array}$$

⇒ With one semantics for the FA we account for both the generic and adverbial “readings”.

⇒ The different paraphrases are simply a byproduct of other elements in the sentences in which they occur.

4 Modification vs. quantification

The quantifier analysis of the adverbial reading: FAs under the adverbial reading are complex determiners, and thus different from FAs under the internal or generic readings (which are not directly accounted for; see Stump 1981; Larson 1998; Zimmermann 2003).

- Strategy similar to Kennedy and Stanley (2009).
- We use the analysis in Zimmermann (2003) to illustrate.
- FAs under the adverbial reading syntactically incorporate into the determiner, as in (39) (Zimmermann 2003, 271, minor details modified).

$$(39) \quad [\text{IP}[\text{QP}[\text{Q the/an+occasional}_1][\text{NP } t_1 \text{ sailor}]]_2[\text{VP } t_2 \text{ strolled by}]]$$

- The result is a complex pluractional quantifier INFREQ over event-individual pairs that are found within a larger, contextually identified event (40a); satisfaction conditions in prose in (40b) (adapted from Zimmermann 2003, 272, minor details modified).

$$(40) \quad \begin{array}{l} \text{a. } \llbracket \text{an/the occasional N VP} \rrbracket: \\ \quad (\mathbf{INFREQ}\langle e, x \rangle : \mathbf{part-of}(e, e^*) \wedge N(x))[\mathbf{VP}(e, x)] \\ \text{b. There are some pairs } \langle e, x \rangle, \text{ with } e \text{ part of a contextually given event } e^*, \text{ and } x \text{ having} \\ \quad \text{property } \mathbf{N}, \text{ such that } e \text{ is an event of } x \text{ VP-ing, and any two events of } x \text{ VP-ing occur at} \\ \quad \text{separate points in time.} \end{array}$$

Two main sorts of arguments in favor of the quantifier analysis:

- The FA appears to scope over the entire sentence, as the paraphrases show.
- The FA does not behave like a “typical adjective” in some respects (coordination with and relative order with respect to other adjectives, etc.; recall (29)-(30)).

Against the quantifier analysis:

- The latter argument is not convincing (and these facts are also captured by our modifier analysis): other non-intersective adjectives show similar behavior (see Gehrke and McNally 2011, for details).
- Unexpected scope facts
 - Normally, nothing prevents a quantifier in object position from taking scope over a sentence in which there is no other quantificational operator.
 - There is no reason in principle why an INFREQ operator contributed by the FA (in conjunction with the determiner) should not be able to effectively scope over the entire sentence, but in (41), it cannot.

(41) Idling beside the propped-open kitchen window he registers the occasional car swishing past, three stories below. (COCA)
≠ Occasionally, he registers a car swishing past.

- The quantifier analysis predicts that (41) should be paraphrased as in (42a) or (42b), depending on the syntactic analysis one adopts:

(42) a. There are some pairs $\langle e, x \rangle$, with e part of a contextually given event e^* , and x a car swishing past, such that e is an event of him registering x , and any two events of him registering x occur at separate points in time.
b. There are some pairs $\langle e, x \rangle$, with e part of a contextually given event e^* , and x a car, such that e is an event of him registering x swishing past, and any two events of him registering x swishing past occur at separate points in time.

- (41) entails that there are few cars swishing past, but neither of the informal representations in (42) carries this entailment.
- Rather, these representations only entail that there are few events of the subject referent registering the car (swishing past), and this could be the case if there are many cars (swishing past) and he simply fails to notice most of them.

→ The effect of the FA appears to be only over events of swishing past, rather than to events of registering.

- Contrast e.g. (43a), with *many* substituted for *the occasional*, where both scopes, corresponding to (43b)-(43c) are allowed (We illustrate with the syntax in (42a)).

(43) a. Idling beside the propped-open kitchen window he registers many cars swishing past, three stories below.
b. Many cars are such that he registers them swishing past.
c. There are many cars swishing past, and he registers that.

→ We see no independently-motivated mechanism that could produce this effect, assuming the quantifier analysis.

These sorts of examples are not problematic for the analysis proposed here:

- They receive the same analysis as examples like (38) (y_i represents the pronoun *he*; we assume a small clause analysis for illustration):

(44) $\exists e, e_k[\mathbf{register}(e, y_i, \mathbf{swishing_past}(e_k, \iota x_k[(\mathbf{occasional}(\mathbf{car}))(x_k)])))]$

- The satisfaction conditions for this sentence will guarantee that the distribution of token cars is low; this will guarantee that there are few token events of such cars swishing past.
- The sentence describes a token event of y_i registering that kind of event that is one of the occasional car swishing past.

- Unexpected determiner facts

- Assumption in the literature: the adverbial reading is only available with the (in)definite articles and semantically bleached possessives.
- Zimmermann accounts for this restriction on the hypothesis that these determiners are semantically empty.

Problem: Why must the FA be accompanied by an overt article in the first place (cf. (45))?

(45) *Occasional sailor strolled by.

- No account of the fact that there are distinct patterns of determiner distribution for temporal vs. non-temporal FAs.
- Semantic emptiness cannot account for the determiner restriction, and the difficulty of explaining how the FA would contribute quantificational or referential force when there must also be a determiner doing so reemerges.
- Since the quantifier analysis does not relate the generic and adverbial paraphrases, it has nothing to say about why any given FA shows a similar pattern of determiner restrictions on *both* the adverbial and generic readings.

5 Conclusion

- FAs are true adjectives, not quantifiers
- Analysis raises some new and interesting possibilities:
 - Kinds can be realized by sets of tokens, rather than individual tokens.
 - Some clauses are descriptions of event kinds, rather than descriptions of event tokens.
- There is generally more than one way in natural language to convey truth-conditionally equivalent information.

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