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Semantics and Syntax of Non-Standard Coordination

Author
Paperno, Denis

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Semantics and Syntax of Non-Standard Coordination

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Abstract of the Dissertation

Semantics and Syntax of Non-Standard Coordination

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Doctor of Philosophy in Linguistics

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Professor Edward L. Keenan, Chair

Summary. The dissertation follows the goal of bridging syntactic typology with formal semantics, taking the typological variation in NP coordination patterns as a challenge for semantic theory. I add the understudied coordination of unlike NPs (Hybrid Coordination) to the already complicated typology of conjunction. Syntactic and semantic properties of Hybrid Coordination in Rusian and Comitative Coordination in Q'anjob'al are two original empirical case studies of this dissertation. The main theoretical claims of the dissertation concern the semantics of conjunction. I propose two ways of relating sentential conjunction and NP conjunction semantically, and argue that each of them is beneficial for different coordination constructions in different languages.

One of the challenging and exciting phenomena that linguists deal with is language diversity. Take the case of noun phrase conjunction like *John and Bill* or *every student and most professors*. Some languages use the same word 'and' for combining noun phrases (*John and Bill*), verbs (*John sings and dances*), sentences (*John left and Bill arrived*), and more. Other languages use different conjunctions for different kinds of phrases; for example, Beng (a Mandé language from Côte d'Ivoire) uses one conjunction for nouns and adjectives and others for sentences; Malagasy makes a comparable distinstion between its conjunctions.

Some languages have been reported not to allow conjoining noun phrases at all. To express the meaning of *John and Bill are talking*, one has to phrase the idea differently: *John is talking with Bill*, so that 'with' is used to paraphrase 'and'. In still other languages 'with' is used as 'and;' is such a language, the sentence *John and Bill are talking* is expressed literally as *John with Bill are talking*, containing a plural-referring phrase *John with Bill*. Still other languages such as Japanese use a doubling strategy, glossed as *with John with Bill are talking*.

There is another dimension to the syntactic diversity of coordinated noun phrases, presented by the phenomenon of Hybrid Coordination. In the examples above, the referents of coordinated noun phrases had the same role in the situation, or at least symmetric roles. In *John and Bill are talking*, John and Bill are both talkers. But in Russian, it is possible, under certain conditions, to conjoin elements with different roles:

(1) Ljubov′ — èto kogda [kto-to i kogo-to] ljubit.
love is when someone.NOM and someone.ACC loves
'Love is when someone loves somebody'

In this example, the conjuncts *kto-to* and *kogo-to* have the roles of subject and object of *love*, and the love relation, as one recognizes, need not be symmetric.

The syntactic diversity of conjunction briefly outlined above poses a challenge to the semantic theory. Do all the diverse conjunction patterns mean exactly the same thing? (more precisely: are they all compositionally interpreted in the same way?) Or is syntactic diversity reflected in semantic diversity? In cases when the same conjunction can conjoin sentences and noun phrases, how is it interpreted in these two usages? Is the semantic relation between sentential and nominal conjunction the same in all languages? To put all these questions more generally, how much semantic unity is behind the syntactic diversity?

The first, introductory, chapter of my thesis summarizes research on typological diversity

of NP conjunction, characterizing the place of the coordination constructions covered in the thesis in the general typology of coordination. The chapter gives an overview of theories of the meaning of sentential and NP conjunction in logic and natural language semantics.

The second chapter deals with some of the questions raised by the typology of conjunction. My conclusions are that there is semantic diversity in all relevant respects. The chapter is based on a case study of Q'anjob'al, a Mayan language spoken in Guatemala, which employs both a comitative conjunction *yetoq* 'with', and a European-style conjunction *i* 'and', freely applicable to various syntactic categories. Following McNally's analysis of Russian, I argue that *and*- and *with*-coordination have different meanings, even though they are interchangeable in many contexts. In many languages, *with*-coordination can conjoin only noun phrases but not sentences. But in Q'anjob'al, *yetoq* 'with' can combine sentences and other kinds of phrases. This usage is restricted compared to other words for 'and' (*i*, *k'al*), and replacing *yetoq* with *i* or *k'al* does change the meaning of the compound sentence slightly. I propose to treat the sentential usage of *yetoq* as a metaphorical extension of its basic sum meaning.

The third chapter of the dissertation covers another class of unusual conjunction patterns, the Hybrid Coordination construction, as found in Russian and a variety of geographically proximal languages, mostly, but not exclusively, Slavic. Languages that have been reported to have Hybrid Coordination or similar constructions include also Armenian, Chinese, and Romanian. I discuss cross-linguistic differences between superficially similar patterns of coordination of unlikes, including patterns from Russian and other languages, including English, Armenian, Mandarin, and Q'anjob'al, and establish Hybrid Coordination as an areal phenomenon limited to Eastern Europe. The chapter overviews syntactic properties of Hybrid Coordination in Russian and proposes a syntactic analysis of Hybrid Coordination. The chapter evaluates alternative syntactic proposals on the topic and develops an explicit syntactic analysis of Russian Hybrid Coordination. The formal syntactic analysis is expressed in a variety of categorial grammar, but is easily translated into other

more conventional notations.

Chapter 4 describes interpretational properties of the Hybrid Coordination construction in Russian. The chapter proposes the Resumption Hypothesis, a semantic generalization that covers known and novel semantic observations on the interpretation of HC. The chapter states that non-hybrid and Hybrid NP conjunction patterns are interpreted in essentially the same way.

Finally, Chapter 5 discusses the benefits of game theoretic approach — presented as a variety of dynamic semantics — in the analysis of the semantic properties of conjunction, from sentential to NP coordination to the Hybrid case. While the second chapter of my thesis argues for semantic diversity across languages and constructions that mirrors syntactic diversity, chapters 4 and 5 go in the opposite direction, establishing an underlying semantic unity of several coordination constructions. The chapter develops a compositional semantic analysis of conjunction which unifies sentence conjunction, standard NP conjunction, and Hybrid Coordination. The semantic proposal relies on ideas from logic and computer science and takes a dynamic approach to meaning. For the purposes of the chapter, I choose game dynamics as a model of semantics as pretheoretically more accessible than translation of natural language into first order logic, and follow the tradition of game-theoretic semantics in modeling quantificational independence. I attribute conjunction the most general meaning of parallel processing; other components of meaning, such as sum formation, can be analyzed as supplied by context.

The dissertation of Denis Paperno is approved.

Sam Cumming

Jessica Rett

Edward P. Stabler

Edward L. Keenan, Committee Chair

University of California, Los Angeles

2012

To my parents

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List of Abreviations

APAX	contrastive conjunction *apax*
AXA	contrastive conjunction *axa*
DEF	definite article
F	feminine gender
HC	Hybrid Coordination
HUMAN	numeral affix for human objects
KAL	conjunction *k'al*
M	masculine gender
NI	negative concord marker
NMLZ	nominalizing affix
REC	reciprocal
REFL	reflexive

Nominal Case

ABS	absolutive case
ACC	accusative case
DAT	dative case
GEN	genitive case
INSTR	instrumental case
NOM	nominative case

Verbal morphology and tense, aspect, and modality

AF	affix
AUX	auxiliary
COMP	completive (perfective) aspect
DIR	directional marker
FUT	future tense
GER	gerund
INC	incompletive (imperfective) aspect
INF	infinitive
IRR	irrealis marker
LOC	locative marker
MOD	modal marker
PASS	passive
POT	potential "aspect" (often translates as future tense)
PROG	progressive aspect
ST	status marker
SUBJ	subjunctive

Classifiers

3OLD	3rd person classifier/pronoun for old/respected men
3ROCK	3rd person classifier/pronoun for rocks and stone-like objects
3WOMAN	3rd person classifier/pronoun for female humans
3MAN	3rd person classifier/pronoun for male humans
3ANIMAL	3rd person classifier/pronoun for animals and animal-derived objects
CLF	classifier

Person and number markers

1S	1st person singular clitic
B2S	2nd person singular absolutive clitic
B1P	1st person plural absolutive clitic
A1P	1st person plural ergative clitic
A2S	2nd person singular ergative clitic
A2P	2nd person plural ergative clitic
2S	independent 2nd person singular pronoun
1S	independent 1st person singular pronoun
OWN	emphatic 3rd person possessive marker
A3	3rd person ergative prefix
A1S	1st person singular ergative prefix
PL	plural
SG	singular

Acknowledgments

My UCLA adventure began on a sunny afternoon in February 2007. I was in my apartment in the snow-covered Moscow, and my phone rang. I took the call and I heard: "Hello Denis, this is Ed Keenan. I would like to invite you to join our graduate program at UCLA". I was stunned. Ed Keenan himself was talking to me, a classic of the field whose works I had been reading as an undergraduate making pages of notes in my thick notebook! During my years at UCLA, Ed never failed to give good advice, to inspire, and to support. With generosity I still can't believe, Ed invited me to be his co-author and co-editor, so I had the opportunity to learn from Ed not only in classroom or in conversations but also in direct collaboration. It was Ed who initially encouraged me to develop my interest in Hybrid Coordination, leading eventually to the project fulfilled in this dissertation. Ed spent countless hours reading numerous drafts of my work, going over them with me, and suggesting improvements on all levels. I have been lucky to constantly feel Ed's soft but steady guidance, without which no part of this work would have been possible.

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Jessica Rett's class, and our conversations, sparked my interest in Dynamic Semantics. Jessica has been the most thorough reader of many of my works in the last years, and Jessica's input has been constantly helping me improve the structure of my work and the quality of my argument. In case of doubt, I consulted Jessica's *Writing Advice for Graduate Students*, a concise guideline on linguistic writing that has been of great help for me.

Most theoretical claims of this thesis took their shape through discussions with Sam Cumming, who was always open to any ideas I would come up with, and who offered a fresh

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My interest in Hybrid Coordination arose from joint work with Rui Pedro Chaves. Without Rui, my dissertation topic would probably have been completely different.

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Location matters. I did most of my dissertation writing at my desk in the UCLA Linguistics Department's lively Reading Room, and would spend days in Powell and Young libraries. One of the best places for writing was Vanya and Natasha's apartment, where I occasionally worked, distraction-free, sipping a cup of Pu-erh. It was at their place that I completed final revisions to this dissertation.

I would like to give my sincerest thanks to my family for their love and care. My graduate study at UCLA was made possible through the example of, and the support from, Irina and Slava, who encouraged my interest in linguistics and helped me throughout my education. I am grateful to Mom — for everything I have achieved, — to my extended family, and above all to Asya and Joseph for being there.

Vita

2006	Specialist in Theoretical and Applied Linguistics Lomonosov Moscow State University, Moscow, Russia.
2009	M.A. in Linguistics, UCLA, Los Angeles, CA.

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CHAPTER 1

Introduction

In this dissertation we study the compositional semantic interpretation of coordination. This of course implies a syntactic analysis of coordination, as that is what we compositionally interpret. We draw extensively on two types of relatively understudied coordination – comitative coordination as in Q'anjob'al (chapter 2) and Hybrid Coordination as in Russian (chapters 3, 4) as this enables us to bring new data to bear on the analysis of coordination. By coordination one understands, pretheoretically, ways of combining two or more units of the same kind into a larger unit of that kind, e.g. combining two or more noun phrases into one noun phrase, or sentences into a compound sentence, adjectival constituents into compound adjective phrases, etc., as in:

(1) a. **Neither** [a borrower]$_{NP}$ **nor** [a lender]$_{NP}$ be; For [loan oft loses **both** itself$_{NP}$ **and** friend$_{NP}$]$_S$, **and** [borrowing dulls the edge of husbandry]$_S$.
(W. Shakespeare, Hamlet. Act I, Sc. III)

b. There is nothing **either** good$_A$ **or** bad$_A$, but thinking makes it so.
(Act II, Sc. II).

There are many ways of combining syntactic units of the same type, such as noun compounding (*brick wall*, *immigration policy*, *downtown LA*) or possessive formation (e.g. 'my house' *rumah saja*, lit. 'house I' in Indonesian). Among these, only some could qualify as coordination, namely those characterized by a certain degree of symmetry (cf. Zamparelli (to appear) for a discussion of coordination/subordination distinction). Indeed, one can

typically substitute either conjunct for the whole coordinate structure, and also interchange the order of conjuncts without affecting its syntactic well-formedness and meaningfullness.

In addition, to keep our study manageable — coordination is a huge topic — I limit myself to *and* type coordination (translation equivalents of English *and*) and to conjunctions which combine both NPs and Sentences. (1) above illustrates some general coordination constructions, and (2) and (3) illustrate NP-level and S-level and from English and Vietnamese respectively.[1]

(2) a. John and Mary are smart.

b. John smokes and Mary drinks.

(3) a. Con chó và thằng nhỏ
CLF dog and CLF kid
'The dog and the kid'

b. Con cú bay ra và thằng nhỏ té xuống dốc
CLF owl fly gop.out and CLF kid stumble down slope
'The owl flies out and the kid stumbles down the slope'

cited from (Ohori, 2004, 43–44: ex. 6,8)[2]

Third, the main focus of my study is the role of conjunction in semantic composition. As I endorse the program of semantic compositionality, syntactic properties of coordination structures are discussed where necessary. Indeed, before compositional semantic analysis

[1]I abstract away from the question of typological validity of phrasal categories. For instance, it is a controversial issue whether noun phrases (NPs) should be treated as determiner phrases in some or all languages; throughout the dissertation, *noun phrase* stands for what other scholars might classify as a determiner phrase (DP). What constitutes a noun phrase may also be problematic on different grounds, namely that in some languages there might not be significant properties distinguishing nouns from other categories, such as verbs (cf. Jelinek and Demers (1994) on the lack of noun vs. verb distinction in Straits Salish). However, languages discussed in this dissertation do not present this kind of problem.

Similarly, I stick to the descriptive label *sentence* (S) for what others may call an inflectional phrase (IP), a tense phrase (TP), or a complementizer phrase (CP). These fine-grained syntactic distinctions are orthogonal for most of the discussion in this dissertation. Only where syntactic analysis is under discussion I use more specific syntactic labels (such as CP) when necessary.

[2]In examples cited from other authors — except for Russian examples — I retain their glossing and transcription conventions.

can be performed, one has to establish the syntactic structure that is subject to semantic interpretation. This is an especially important issue for Hybrid Coordination, as discussed in chapter 3.

Lastly, I concentrate primarily on lesser-studied coordination patterns. Conjunctions – and the English *and* in particular – have been studied from many perspectives, producing many alternative treatments, and novel data from less studied, marginal or exotic constructions can help shed light on the plausibility of these proposals.

The central questions addressed in this dissertation are as follows:

1. What is the relation between the meanings of *and* in sentential vs. NP coordination, as in (3)?

2. Do different NP-*and*'s (in the same language or in different languages) stand in the same relation to Sentential coordination?

3. Do different *and*'s (in the same language or in different languages) mean the same thing?

In answering these questions, I focus on two unusual coordination phenomena. One is the typologically uncommon expression of sentential conjunction using the preposition 'with', as in the Mayan language Q'anjob'al. The other is coordination of unlike categories, or Hybrid Coordination, as attested in Russian and other languages.

The two cases of unusual coordination patterns discussed in this dissertation present a single contrastive study, as they allow us to look at the relation between sentential and NP coordination from two different perspectives. Hybrid Coordination is a construction derived (historically) from conjunction of sentences with sluicing, even though there are reasons to analyze it structurally as conjunction of heterogeneous NPs, adverbs, or prepositional phrases (see Chapter 3). Comitative coordination, on the other hand, is typically a pattern of NP conjunction and extension of comitative patterns to sentences is typologically rare. One

instance of such extension is found in Q'anjob'al, as described in Chapter 2. So in the two case studies we deal with opposite directions of syntactic development/structural reanalysis: in the case of Q'anjob'al, a nominal conjunction pattern is generalized to sentences, while in the case of Hybrid Coordination a special variety of sentential conjunction probably was reanalyzed as constituent conjunction. Since sentential and NP conjunction have received different sets of analyses (see 1.2, 1.3), so it is plausible that contrasts also exist between "originally nominal" and "originally sentential" conjunction patterns. And indeed, while in both cases I analyze the denotation of 'and' as the same in both NP and sentential coordination, the proposed denotations for the coordinators *yetoq* in Q'anjob'al and *i* in Russian differ, suggesting a negative answer to the last question listed above.

1.1 Syntactic typology of NP conjunction

Noun phrase conjunction like *John and Bill* or *every student and most professors* shows considerable cross-linguistic diversity (Haspelmath, 2004). Some languages use the same word 'and' for combining noun phrases (*John and Bill*), verbs (*John sings and dances*), sentences (*John left and Bill arrived*), and more. Other languages use different conjunctions for different kinds of phrases; for example, Beng (a Mandé language from Côte d'Ivoire) uses one conjunction for nouns and adjectives and others for sentences; Malagasy makes a similar distinction between its conjunctions. Such differentiation is quite common: of the 301 languages studied in Haspelmath (2011), 125 (over 40%) use different coordination patterns in NPs vs. verb phrases and clauses, compare

(4) a. doo ŋɔ mini m ba
man this and my father
'this man and my father'

b. O biɛ ka kɔɣisi.
he be.bad and be.thin
'He is bad and thin.'

c. Gbuɣima ŋubiri nimdi ka jansi diri kɔdu.
lion.pl chew.impf meat and monkey.pl eat.impf banana
'Lions eat meat and monkeys eat bananas.'

Dagbani (Olawsky, 1999, 41,51), quoted in Haspelmath (2011)

1.1.1 *With*-languages, *and*-languages

Some languages have been reported not to allow coordinated noun phrases at all (Stassen, 2000). This claim is quite strong, and deserves some elaboration. For Stassen, coordinate NPs are one of the instances of *NP-conjunction*, defined on semantic grounds as follows:

> A sentence contains a case of NP-conjunction if
>
> (a) it describes a single occurrence of an event (action, state, process, etc.), and if
>
> (b) the event is predicated simultaneously of two (and no more) participant referents, which are conceived of as separate individuals.
>
> (Stassen, 2000, 4)

Stassen classifies cases of NP-conjunction into two classes, coordinate and comitative. A coordinate strategy of NP-conjunction is such that the two constituents are encoded by "NPs with equal structural rank" (Stassen, 2000, 7), and a comitative strategy usese NPs with "unequal structural rank". The paradigm examples for the two strategies are the following English sentences:

(5) a. John and Mary left — coordinate strategy
b. John left with Mary — comitative strategy

So languages without coordinate NPs are strictly those which can't express group construal of coordinate NPs; other kinds of semantic interpretation of coordinate NPs (e.g. listing or

disjunction) can be observed even in *with*-languages.

The notion of "structural rank" in Stassen's definitions is highly theory-dependent,[3] but the idea behind the two strategies is straightforward: if one of the NPs in "NP-conjunction" behaves as a separate, oblique, dependent in the clause, it counts as comitative; for example, *with Mary* is comitative since its structural properties are those of obliques, such as instrumental *with a knife*. If neither NP in "conjunction" behaves like an oblique (as in English *John and Mary*), the strategy qualifies as coordinate.

1.1.2 Markers of NP coordination

NP coordination can be marked in different ways, where a specialized conjunction like the English *and* is only one option. Mithun (1988) lists several sources of conjunction markers, and by far the most frequent option turns out to be zero marking. Coordinated NPs are simply juxtaposed, without an overt coordinator:

(6) a. Kačerán, Kormsčen viek-án
Kačerán Kormsčen RFL-chase
'Kačerán and Kormsčen chased one another' (Ona-Šelknám)

(Tonelli, 1926, 72), cited from Stassen (2000, 8: ex. 14).

b. Jim Judy-č n^{y}-iyu:-pč
Jim Judy-subj 1=obj/3=subj-see-tns
'Jim and Judy saw me' (Mojave) (Munro, 1976, 162: ex.59)

c. Bonnie-sh Pam-sh Heather-sh mkip-ly ayem-sh
Bonnie-sj Pam-sj Heather-sj which-in go+pl-prf
'Bone, Pam, and Heather went somewhere' (Maricopa)

(Gordon, 1986, 67: ex. 280)

[3]Some syntacticians may argue that no two NPs have equal structural rank, even in classical NP coordination like the English *John and Mary*. Indeed, under X′ theory no two phrases can have isomorphic structural positions, which might be interpreted as all NPs in any given structure having different structural ranks.

Perhaps intonation rather than total absence of marking expresses the meaning of *and* in such cases; indeed, Mithun (1988) identifies not one but two distinct intonational patterns for asyndetic NP conjunction. Even so, the existence of the zero-marking strategy (or "coordination by intonation", as Mithun put it) is not surprising. Juxtaposition is a widespread if not universal way of combining sentences and other constituents, and is usually interpreted as conjunction:

(7) a. Love is a friction, a chemistry

b. Men are from Mars, women are from Venus

Even in languages with a conjunction 'and' — such as Russian — referential NPs can occasionally be combined asyndetically, compare two examples from classical Russian poetry:

(8) a. Smešalis′ v kuču koni, ljudi
mixed in heap horses people
People and horses all mixed together. (Mikhail Lermontov, *Borodino*)

b. Šved, russkij — kolet, rubit, režet
Swede Russian stabs slashes cuts
The Swedes and the Russians slab, slash, and cut.
(Aleksandr Pushkin, *Poltava*)

In other words, juxtaposition is in many instances synonymous with overt *and*-conjunction, and it is only natural that it can be used for NP coordination. In fact, it is the restricted distribution of juxtaposition (in languages like English) that requires special explanation. Heath (2004, 70) proposes one possible solution: in the absence of an overt coordinator, a sequence of two NPs can be ambiguous between many structural options ("apposition, possessor-possessed, compound, or distinct arguments that happen to be adjacent in the clause"). Overt coordination markers are "useful" as they help avoid the ambiguity; Heath discusses Koyraboro Senni (Songay of Gao) where juxtaposition is indeed used for possessive

structures and compounds, and NP conjunction uses an overt marker *nda* (which doubles as a preposition 'with'). However, it remains an open issue whether asyndetic NP coordination is actually correlated with presence of other juxtaposition constructions typologically. A potential counterargument to Heath's idea is that prosody may often be sufficient to disambiguate coordination from other structural options.

1.1.3 Comitative coordination

In languages without a coordinate strategy of NP-conjunction ("with-languages"), in order to express the meaning of *John and Bill are talking*, one has to phrase the idea differently: *John is talking with Bill*, so that a comitative adposition 'with' is used to paraphrase 'and'.

In some languages there is also an option to use an adposition (or affix, etc.) meaning 'with' not just to paraphrase 'and' but in the function of a conjunction; in such a language, the sentence *John and Bill are talking* is expressed literally as *John with Bill are talking*, containing a plural-referring phrase *John with Bill*. This option can be called *comitative coordination*, and is in the focus of chapter 2. Comitative coordination is likely the most common diachronic source of an (overt) NP coordinator. For the geographical distribution of comitative conjunction, see Stassen (2011).

Comitative coordination is typically restricted in its syntactic distribution. Since the comitative coordinators grammaticize from adpositions, they combine noun phrases, but rarely extend to conjoining arbitrary syntactic categories, such as verb phrases or clauses. Tamazight (Berber) is among the typical cases; while "[c]oordination of sentences or verbs is not usually marked with a conjunction" (Penchoen, 1973, 84), NPs are conjoined using a preposition *d-* 'with':

(9) la ttɛ awan i-uryaz-ənns i-tḥərraṭṭ d-umwər d-urwa
ext. she help to man of her in plowing with harvesting with threshing
'She helps her husband plow, (and) harvest, and thresh'

(Penchoen, 1973, 83)

An expansion of comitative coordination to sentences is observed in Sarcee (Cook, 1984, 97), where *mìh(ílà)* (the comitative postposition *ìhílà* affixed to 3sg "specified" pronoun *mi-*) can function as a clause coordinator:

(10) táágù γàtc'ádìnìj-là mìh díítc'íts'ì ìgūstīγà? yìsxałlà
three-times he-was-to-hit-her it-with fourth-time just then he-hit-her
'He almost hit her three times. After that (then) he hit her right at the fourth time.' (Cook, 1984, p.97, ex. 18b)

One questions whether *mìh* in Sarcee indeed functions as a conjunction or rather a sentence modifier 'with that', compare Russian *vmeste s tem* 'together with that':

(11) Vmeste s tem v nej projavljajutsja drugie čerty.
together with that in it appear other traits
'At the same time, it shows other traits as well.'

(Grigory Revzin, Neoklassicizm v russkoj arxiteture načala XX veka. Arxiv arxitektury: vyp. II. Obščestvo istorikov arxitektury pri Sojuze arxitektorov Rossii. Moscow, 1992. p. 110)

Heine and Kuteva (2002, 82-83) cite examples from Swahili and Mauritius creole (French-based) where the preposition 'with' (in the latter case, derived from the French *avec*) also extends to sentential coordination.

Comitative coordination is very common in Mayan languages. For example, Chol uses the preposition *)ik'ot* 'y, con' ('and, with') as a coordinator (Schumann, 1973, 80). In the case of the Q'anjob'al preposition/conjunction *yetoq* 'with, and' we observe the generalization of the comitative pattern in a purer form than in Sarcee above, which does not involve a pronoun. Comitative coordination in Q'anjob'al is analyzed in detail in chapter 2.

Even in languages that do not use *with* as a conjunction, it often has uses that semantically correspond to a connective between two clauses, compare:

(12) Avec un bon prof, on fait beaucoup de progrès (Mari, 2000, 295)
with a good prof one makes much of progress
'With a good professor, one makes a lot of progress' ≈
'*When* one has a good professor, one makes a lot of progress'

Such examples are interesting on their own, but they do not constitute coordination either formally (*avec* above is still a preposition selecting for an NP, and forming a sentential PP adjunct) or semantically (the semantic relation expressed by *avec* in (12) and paraphrased by *when* is inherently asymmetrical).

Perhaps more surprising than grammaticization of a comitative marker into a coordinator is a reverse change, as attested in at least two Daghestanian languages. Helma van den Berg (2004) cites usage of a coordinate construction to express comitative meaning in Dargi and Hunzib:

(13) a. ože ok'aak' žini-s halmağ-no žu-n
boy(ABS) wander.PRES self-GEN friend(ABS)-and self(ABS)-and
'The boy wanders with his friend (lit. the boy wanders, and his friend and self)' (Hunzib, van den Berg (2004, 222, ex. 92b′)

b. Malla.Nasradin t'ent'-ra sa.y-ra q'adi-či hay.iʔ-ubli sa.y
Malla.Nasradin(ABS) fly(ABS)-and self:M(ABS)-and cadi-SUP set.off:M-GER be:M
'Malla Nasradin set off with the fly (lit. Malla Nasradin set off, the fly and self)' (Hunzib, van den Berg (2004, 220, ex. 83)

1.1.4 Syntactic Status of Comitative Conjunction

Comitative coordination syntactically behaves like ordinary NP conjunction in many ways. McNally (1993), who argued that in Russian, DPs can combine with comitative PPs to form

a complex plural NP, offered various syntactic arguments to this effect, based on extensive Russian data; we will see Q'anjob'al analogues of many such examples below in chapter 2. Comitative coordinated NPs in the subject position show properties of a syntactic subject, thus a constituent (as opposed to a subject plus oblique collocation). *With*-coordinated NPs in Russian can bind reciprocals and reflexives, and can control the subject of adverbial participles:

(14) a. Prorabotav celyj den', Anna s Petej pošli domoj
having-worked whole day, Anna.NOM with Peter.INSTR went.PL home
[Having worked all day]$_{i,j}$, Anna$_i$ and Peter$_j$ went home.

(McNally, 1993, 355, ex. 19a)

(implies that Anna and Peter worked all day, not just Anna)

b. Prorabotav celyj den', Anna pošla domoj s Petej
having-worked whole day, Anna.NOM went.FSG home with Peter.INSTR
[Having worked all day]$_i$, Anna$_i$ went home with Peter$_j$.

(McNally, 1993, 355, ex. 19b)

c. Anna s Natašej videli sebja v zerkale.
Anna.NOM with Natasha.INSTR saw.PL self in mirror
Anna and Natasha saw themselves in the mirror.

(McNally, 1993, 355, ex. 18a)

d. Anna s Petej čitajut svoi knigi.
Anna.NOM with Peter.INSTR read.3PL self's books.ACC
Anna and Peter are reading their books.

(McNally, 1993, 355, ex. 18b)

We will see below similar syntactic diagnostics applying to Q'anjob'al phrases conjoined with *yetoq* 'with'.

1.1.5 Other sources of NP conjunction markers

A number of languages use quantifier words — 'two', 'both', or 'all' — in NP coordination. Munro (1975) analyzes coordinator 'two' in Yuman languages as a variety of comitative coordination; 'the man and the woman' in Yuman languages can be expressed literally as 'the man being two with the woman':

(15) ʔi:pa-nʸ-č θinʸaʔa:k-nʸ-m havik-k hakolcə tayem-m
man-dem-subj woman-dem-with two-same Needles go=pl-tns
'The man and the woman went to Needles' (Munro, 1975, 2: ex. 3)

Thus Yuman 'two'-conjunction is quite analogous to 'with'-conjunction in other languages; 'being two with' is not unrelated semantically to 'together with'.

In Bantoid and some Mandé languages (Vydrin, 2010, which is the source of examples (16) and (17)), there is a dedicated set of pronouns that serve as coordinators in NP conjunction; one may think of these elements as conjunctions inflected for person. In example (16) from Dan-Gweetaa, the coordinate structure is marked with the 'co-ordinative pronoun' *yāä̈*, which contains the 1st person plural exclusive morpheme *yi̱*. So the 'co-ordinative pronoun' expresses number and person of the whole coordinate NP.

(16) Yāä̈ Gbä̈tö̈ yá nū
1CO Gbato 1PL.EXCL.PRF come
'I and Gbato, we have come' (Vydrin, 2010)

In (16) the first conjunct is a 1st person singular pronoun that undergoes pro-drop and is not overtly expressed; but the first conjunct, be it a full NP or a pronoun, can be overt:

(17) a. Sí̋tä̈ wāä̈ D̃ä̃ä̃ ɗú wö̀ wō kó gɔ̃-lɤ̃
Sita 3CO Dan daughter 3PL.EXI PL.REFL RECP.CMM head-tie.NEUT
ɗɔ̃̋ɔ̃zi̱ā̃dō ká.
Saturday with

'Sita and Dan's daughter plait each other's hair on Saturdays.' (Dan-Gweetaa)

b. Māē kò kāē nì
1SG.FOC 1PL.CONJ1 2PL.CONJ2 PL
'I and you (pl.)' (Mano)

Other sources of coordinators include elements with meanings 'also', 'too', and 'moreover,' compare Japanese:

(18) hon mo zasshi mo
book also magazine also
'books and magazines,' "with the implicature 'not only books but also magazines'"
(Ohori, 2004, 50: ex. 35)

1.1.6 *With*-doubling

Still other languages use adposition doubling to form coordinated noun phrases, glossed as *with John with Bill are talking*, compare Japanese:

(19) John *to* Mary *to* Tom (*to*) ga kita.
John and Mary and Tom (and) NOM came
'John and Mary and Tom came.' (Kuno, 1973, 112, ex. 2a)

Note that the same marker *to* is used as a comitative 'with' in Japanese:

(20) ware to kite/ asobeya oya no/ nai suzume
me with come/ play parent not-have sparrow
'Come, parentless sparrows, and make merry with me.'
(haiku by Issa, cited from (Shibatani and Kageyama, 1986, 198: ex. 10))

In Japanese, *with*-doubling is optional in NP coordination; in other languages, marker doubling is what differentiates coordinate structures from comitative ones, as in Upper Kuskokwim Athabaskan, as analyzed by Kibrik (2004):

(21) a. TIMOTHY ʔiɬ se ʔiɬ kayih ts'ideghilts'eʔ
Timothy with me with house we.stayed
'Timothy and I stayed at home.' (Kibrik, 2004, 539: ex. 2)

b. zido didisnaka ʔiɬ
she.stays her.parents with
'She stays with her parents' (Kibrik, 2004, 540: ex. 6)

1.1.7 Hybrid Coordination

Another class of unusual conjunction patterns covered in this dissertation is the Hybrid Coordination construction(s), as found in Russian and a variety of geographically close languages, mostly Slavic, but not exclusively. It has been noted that even in English it is sometimes possible to coordinate constituents of different syntactic categories, e.g. an NP and a prepositional phrase:

(22) a. What and to whom has John written? (Grosu, 1987, 433: ex. 19a)

b. John has kissed Mary only in his own apartment and only after 11 pm (so far)
(Grosu, 1987, 429: ex. 9a)

c. John eats unúsually expensive food and in unúsually expensive restaurants.
(Grosu, 1987, 446: ex. 42a)

d. John refuses to drink ANY whiskey or with ANY lobsters.
(Grosu, 1985, 233: ex. 7a)

We note that the conjuncts in these cases are not fully non-parallel, they share something other than a syntactic category. In (22-a) both conjuncts are wh-phrases, in (22-b–d) they share focused lexical material (*only*, *unúsually expensive*, *ANY*).

One observes that coordination of unlikes ('heterogeneous', as Grosu (1987) characterized it, or 'hybrid', as per Chaves and Paperno (2007), coordination) is fairly restricted. In English, one can coordinate only optional syntactic elements, such as sentential adjuncts

or optional objects of *drink* and *eat*. Languages like Russian are more flexible; sentential subjects, which are generally not optional, can easily enter Hybrid Coordination:

(23) a. Bog ego znaet, kto i začem stroil takie dači.
god it knows who and why built such countryhomes
'Only God knows who built such countryhomes and why.'

b. Ni=kto i ni=čem pomoč′ ne mog
NI=who and NI=what.INSTR help.INF not could
'Nobody was able to help in any way'

c. Učat drug druga vse i vsemu, a glavnoe —
teach each other everyone.NOM and everything.ACC and main
postojanno
constantly
'Everyone teaches each other everything, and most importantly, it's constant'

Languages that are reported to have similar constructions include all major Slavic languages, but also some non-Slavic ones such as Armenian, Chinese, Hungarian, and Romanian. As we will see, not all of these languages present the same patterns; I will argue that in some of these languages coordination of unlikes is spurious, best analyzed as clausal coordination with ellipsis. I will discuss syntactic properties of Hybrid Coordination in Russian (and, briefly, in other languages) in Chapter 3. I will describe semantic properties of HC and propose a compositional semantic analysis in Chapter 4. Lastly, in Chapter 5 I will attempt to unify Hybrid Coordination semantically with a range of other coordination constructions.

1.2 Conjunction in sentential logic

The way we model the semantic contribution of conjunctions depends crucially on the meaning attributed to the constituents the conjunction connects. So whatever the domain is in which conjoinable categories denote, conjunctions denote functions on that domain: functions from pairs of propositions to propositions, from pairs of quantifiers to quantifiers,

$\phi \wedge \psi$	ψ =T	ψ =F
ϕ =T	T	F
ϕ =F	F	F

$\phi \vee \psi$	ψ =T	ψ =F
ϕ =T	T	T
ϕ =F	T	F

Table 1.1: Truth tables for conjunction and disjunction

from pairs of properties to properties, etc.

There are at least three general conceptions of what sentence interpretation is in natural or logical languages that are relevant for the purposes of this work:

- **Fregean tradition.** Sentences (of a logical or natural language) are interpreted as truth values (or perhaps as propositions).
- **Game-theoretical tradition.** Jaakko Hintikka argued that sentences in logic and natural language are interpreted as games; truth of a formula can be characterized game-theoretically as having a winning strategy.
- **Dynamic semantics.** Sentence is interpreted as an update of context or common ground; truth can be defined as possibility of update.

In the tradition going back to Gottlob Frege, the denotation of a sentence is a truth value. There are at least two truth values, *true* and *false*, standardly noted as T and F, 1 and 0, or $\top$ and $\bot$. Given this, sentential connectives are interpreted as functions from pairs of truth values to truth values. The truth functional meanings attributed to $\wedge$ and $\vee$, translations of the English *and* and *or* in propositional logic, are expressed in tables in 1.1, also known as *truth tables*. As the tables indicate, the conjunction of two formulas is true iff both conjuncts are true, and false otherwise; the disjunction of two formulas is false iff they are both false, and true otherwise.

Conjunction and disjunction can be formalized in many alternative ways. For instance, game semantics Hintikka (1979) interprets each logical formula as an argument between

Verifier and Falsifier. To verify a conjunction of two formulae, Verifier lets Falsifier choose one of them, and proceeds to verify it. In the case of disjunction, Verifier is free to choose one of the disjuncts, and proving it true verifies the formula. So in game semantics conjunction and disjunction are choices of subformula made in the verification game.

A separate problem in the semantics of conjunction is anaphora across conjuncts, as in

(24) a. John came early and he left early.
b. My TA called me last night and he wanted to talk about the exam.
c. But there is a Being and He can forgive everything. (Dostoevsky, *The Brothers Karamazov*, translated by Constance Garnett)

Anaphora is a challenge for the classical theory of sentential conjunction as applied to natural language. Most importantly, classical sentential conjunction is commutative ($\phi \wedge \psi \equiv \psi \wedge \phi$), but anaphoric dependencies make coordinate structure asymmetrical, compare:

(25) a. But there is a Being and He can forgive everything. $\neq$
b. But He can forgive everything and there is a Being.

The two sentences share a reading with a contextually interpreted *He* (referring to a contextually salient individual). This reading, natural for (25-b), is not easily accessible for (25-a) in isolation this reading since *a Being* is a natural antecedent for *He*. On the other hand, (25-b) also has a reading where *He* is bound to *a Being*, which (25-a) lacks. There are different ways to handle anaphoric dependency; one option is to postulate a discrepancy between the surface syntax and the semantic structure, representing the semantic structure of e.g. (24-a) as

(26) John $\lambda x.(x$ came early and he^x left early)

Another path, taken by dynamic theories such as DPL (Groenendijk and Stokhoff, 1991), is to modify the interpretation of logical formulae, allowing a quantifier in the first conjunct to bind a variable in the second conjunct. Under this approach, truth values prove insufficient as the interpretation of sentences, since the interpretation of a sentence also has to include information on the new antecedents it introduces. Still, the notion of truth, if not basic, is defined both in game semantics and in dynamic semantics; truth conditionally, their formalizations of conjunction and disjunction are equivalent to the classical truth-functional ones (at least for sentences, i.e. formulae without open variables).

1.3 Semantics of NP Conjunction

1.3.1 Extension of truth functional theory to higher types

But how about conjoined constituents other than sentences? For instance, what is the denotation of noun phrases and their conjunctions? The core cases of noun phrases refer to entities (in the real world or the world of discourse), so entities can be taken as the simplest denotation for NPs. Noun phrases combine with predicates to form sentences, so denotations of predicates are commonly analyzed as functions from entities to truth values. For example, the predicate `white` maps any entity x to true iff x is white, and maps x to false otherwise.[4]

It turns out that not all NPs in natural language are referential. In many cases, NPs can be given a generalized quantifier as the interpretation (more precisely: a *type* $\langle 1 \rangle$ generalized quantifier), which is simply a function from predicates to truth values. For instance, *every boy* denotes a function that maps a predicate p (say, `6 feet tall`) to *true* iff p is true of each boy, and maps p to *false* otherwise. Referential NPs can be treated as a special type

[4]We're ignoring the difficult problem of presupposition for the moment. Indeed, *white* only applies to physical objects, and not to abstract entities (like *anger* or *gravity*), which can have a color only in some metaphorical sense. So one could say that *white* in fact denotes a partial function, mapping white objects to true, non-white objects to false, and undefined on non-physical objects.

of generalized quantifiers, named *Montagovian individuals*. A Montagovian individual for the entity x (written I_x) maps a predicate to whatever the predicate maps x:

(27) $I_x = \lambda P.P(x)$

Denotations are assumed to have types, divided into basic and functional. All entities are of type $\mathtt{e}$, truth values are of type $\mathtt{t}$; both of them are basic types (there might be more basic types). For any types s, s', functions from s to s' are of type $\langle s, s' \rangle$. For example, predicates have type $\langle \mathtt{e}, \mathtt{t} \rangle$ (functions from entities to truth values), and generalized quantifiers have type $\langle \langle \mathtt{e}, \mathtt{t} \rangle, \mathtt{t} \rangle$ (functions from predicates to truth values).

With this notion of semantic types, we are in the position to extend truth functional conjunction across different types beyond $\mathtt{t}$ (denotations of sentences). The exposition here follows the standard proposal in Rooth and Partee (1983) and Gazdar (1980) and is equivalent to the order-theoretic formulation in Keenan and Faltz (1985).

(28) a. If s is a conjoinable type, $\langle s', s \rangle$ is a conjoinable type.
b. For P, Q of conjoinable type $\langle s', s \rangle$, $P \wedge Q \equiv \lambda X_{s'}.P(X) \wedge Q(X)$.

In other words, function application distributes over conjunction until the conjuncts are both of type $\mathtt{t}$, to which the truth functional denotation of conjunction can apply. So if NPs *John* and *Mary* denote generalized quantifiers $I_j \equiv \lambda P.P(\mathtt{j})$ and $I_m \equiv \lambda P.P(\mathtt{m})$, *John and Mary* denotes $I_j \wedge I_m$, predicting that

(29) a. John and Mary are smart.
is equivalent to
b. John is smart and Mary is smart.
c. $(I_j \wedge I_m)\mathtt{smart} \equiv (I_j(\mathtt{smart})) \wedge (I_m(\mathtt{smart})) \equiv \mathtt{smart}(\mathtt{j}) \wedge \mathtt{smart}(\mathtt{m})$

Interpretations of conjoined structures that can be obtained using this approach are called *Boolean*. A problem for this approach comes from non-Boolean readings of conjunction; for NPs non-Boolean readings are also known as collective, compare the example

(30) John and Mary are a nice couple

which is not equivalent to

(31) *John is a nice couple and Mary is a nice couple

as the Boolean reading would predict.

1.3.2 Mereological approach to conjunction

In an alternative theory of NP conjunction, *and* denotes an operation on entities rather than on truth values Link (1987, 1983); Landman (1989a). Link's sum operator $\oplus$ is a standard instantiation of the idea that *and* maps multiple entities to their sum. The main motivation for the mereological theory of *and* is precisely the collective predicates like *be a nice couple* that problematic for the Boolean approach to conjunction. For example,

(32) a. John and Mary are a nice couple
is taken to denote
b. $\texttt{nice.couple}(\texttt{j} \oplus \texttt{m})$,
paraphrased as
c. 'the plurality/group consisting of John and Mary are a nice couple'

Such examples of non-Boolean coordination of noun phrases is the main agument for the mereological theory of conjunction. On the other hand, the plurality forming operation (assumed to be the meaning of *and*) is only applicable to NPs that denote entities. When

it comes to coordination of quantified NPs, sum formation is no longer applicable unless mereology is extended to generalized quantifiers. For example, the sentence

(33) And each regret and each goodbye was a mistake too great to hide.

does not predicate the property *a mistake too great to hide* to a plurality of regrets and goodbyes; rather, (33) conveys that each individual regret or goodbye was such a mistake, without any implications for pluralities of regrets or goodbyes.

There are various alternative views on the ontological status of pluralities. Some scholars prefer to treat referents of plural NPs as sets of entities (Winter, 2001; Schwarzschild, 1996; Does, 1993). In this case group formation is formalized simply as set union. A more elaborate idea (Link, 1983) is that plural individuals are a special case of entities, and include singular entities as proper parts rather than as set members. This mereological approach requires 'and' to denote sum forming operation.

Furthermore, it has been proposed that there are two kinds of pluralities (and, correspondingly, two kinds of plurality formation). Some pluralities can be called groups Landman (1989a,b), or 'impure atoms' Link (1998)), and others are pure sums and can include groups as atomic parts. The main motivation for group/sum distinction comes from examples like

(34) a. The cards below seven and the cards from seven up are separated.
(Landman, 1989a, 574: ex. 27)

b. The cards below ten and the cards from ten up are separated.

If a single kind of pluralities is allowed, the coordinate phrases (*the cards below seven and the cards from seven up*, *the cards below ten and the cards from ten up*) both refer to the same plurality, the plurality of all cards; but the sentences in (34) are not synonymous. One

solution is to treat *the cards below seven* as groups (impure atoms), and their conjunction as sums; then the coordinate NPs in (34) have different semantic representations such as $S(\uparrow(\sigma x.*x<7)+\uparrow(\sigma x.*x\geq 7))$ and $S(\uparrow(\sigma x.*x<10)+\uparrow(\sigma x.*x\geq 10))$ (Landman, 1989a, 578, ex. 37); in Landman's notation, $\uparrow$ maps a sum to the corresponding group (or 'impure atom'), and $+$ is the sum operation; so the two examples refer to different pluralities ("the sum of two groups: cards below 7 and cards from 7 up;" "the sum of two groups: cards below 10 and cards from 10 up").

Mari (2005) argues that neither mereological sums nor groups as entities greater than the sums of their wholes are fully adequate for all readings of plural NPs. Mari proposes a different concept of groups, which she labels "collectivity as dependence" (CODEP). According to Mari (2005, 190: ex. 2), (35) has among others a CODEP interpretation:

(35) The boys sing.
COllectivity as DEPendence interpretation: 'each of the boys necessarily sings, and they are all coordinating their singings with one another' (Mari, 2005, 191)

If entities form a CODEP group, one predicts that their participation in events would covary, thereby capturing the 'togetherness' intuition underlying the relevant reading of (35).

1.3.3 Non-group conjunction

It is not uncommon for a language to restrict group construal of conjunction to just some of the coordinators translating 'and'. For instance, Japanese uses two other NP coordinators in addition to *to*, *ni* and *ya*:

(36) John *ni* Mary *ni* Tom ga kita.
John and Mary and Tom NOM came
'John and Mary and Tom came.' (Kuno, 1973, 112, ex. 2b)

(37) John *ya* Mary *ya* Tom ga kita.
John and Mary and Tom NOM came
'John and Mary and Tom came.' (Kuno, 1973, 112, ex. 2c)

All three conjunctions are used "almost exclusively to connect nouns" (Kuno, 1973, 112). But in contrast to *to*, conjunctions *ni* and *ya* do not allow for group readings, compare:

(38) a. John to Mary ga kekkonsita.
John and Mary NOM married
'John and Mary became man and wife' /
'John got married and Mary got married'. (Kuno, 1973, 114: ex. 12)

b. John ni Mary ga kekkonsita.
John and Mary NOM married
*'John and Mary became man and wife' /
OK'John got married and Mary got married'. (Kuno, 1973, 114: ex. 15a)

c. John ya Mary ga kekkonsita.
John and Mary NOM married
*'John and Mary became man and wife' /
OK'John got married and Mary got married'. (Kuno, 1973, 114: ex. 15b)

(Ohori (2004) documents more coordination patterns in Japanese, including coordinators *mo*, *yara*, and *toka*; all of them can be translated as *and* but have different pragmatics.) Similar to Japanese *ya* and *ni*, emphatic conjunction patterns like English *both ... and*, Russian *i ... i* 'both ... and' (as opposed to plain *and*, *i*) disfavor group readings of conjunction; in (39), the natural reading implies the existence of two lifting events, one where Peter lifted the piano and another where John did:

(39) a. Both Peter and John lifted a piano (♯ together)

b. I Petja, i Vanja podnjali pianino.
and Peter and John lifted Piano.
'Both Peter and John lifted a piano'

The restriction of such coordinators to non-group construal must be related to their pragmatic peculiarities. For Japanese, the pragmatic idiosyncrasies of *ni* and *ya* are described as follows: "*Ni* is used for listing. Usually, it requires more than two NPs to be enumerated. Thus, (15a), with only two items, is slightly awkward. *Ya* is used for giving examples. Therefore, (15b) means that John and Mary (and others) got married, or that John and Mary among others got married" (Kuno, 1973, 114). English *both ... and* and Russian *i ... i* have a perceived emphatic or contrastive character. Exactly how the pragmatics of conjunction disallows group construals is left for future study. Perhaps the inherent contrastive character of *both ... and* is key. Assume that *both ... and* contrasts the coordinate structure with each conjunct, so that *Both John and Mary are lawyers* implies by contrast that not only Mary is a lawyer. Then ♯*Both John and Mary are a nice couple* should imply, by contrast, ♯*Not only Mary is a nice couple*. But the latter statement is semantically anomalous, so group construal of emphatic conjunctions would lead to anomalous inferences (pragmatic or semantic) and hence be infelicitous. In other words, as long as a coordinator is pragmatically marked, this alone could prevent collective readings of coordinate NPs, so we cannot conclude that such conjunctions are denotationally different.

This is not to say that all conjunctions (of NPs) necessarily denote Boolean operators with only pragmatic differences between synonymous ones. For instance, Russian *to ... to* clearly involves quantification over events in its meaning:

(40) On s detstva taskal domoj to košek, to sobak
he from childhood dragged home TO cats TO dogs
'Since childhood, he took home at times cats and at times dogs'

1.3.4 Unifying Boolean and Mereological Approaches to Conjunction

Since both approaches to the denotation of *and* outlined above have their application, several proposals have been put forward to connect the two. Winter (2001) takes the Boolean theory

of coordination as a point of departure; he models properties and plural entities alike, as sets of entities. Winter observes that one can find the plurality denoted by a quantified NP among the sets (or predicates) that the generalized quantifier denotation of the NP is true of. For instance,

(41) a. $[\![\textit{all the boys}]\!]^{M,g}$ contains the set $\{\text{boy}_1,\text{boy}_2,\ldots\text{boy}_k\}$

b. $[\![\textit{two boys}]\!]^{M,g}$ contains sets $\{\text{boy}_1,\text{boy}_2\}$, $\{\text{boy}_1,\text{boy}_3\}$ etc.

c. $[\![\textit{John and Mary}]\!]^{M,g}$ contains the set $\{\mathbf{j},\mathbf{m}\}$.

Certainly, a generalized quantifier denoted by e.g. *John and Mary* is also true of many other sets, including all supersets of $\{\mathbf{j},\mathbf{m}\}$. Winter proposes that the pluralities that NPs can refer to are minimal sets in the NP's generalized quantifier denotation; indeed, the generalized quantifier $[\![\textit{all the boys}]\!]^{M,g}$ is true of the sets that contain all boys, and the set of all boys is the minimal such set; $[\![\textit{two boys}]\!]^{M,g}$ is true of all sets that contain at least two boys, and the sets of just two boys are minimal such sets. Taking the minimal set in the denotation of a coordination of individual-denoting NPs like *John and Mary* is equivalent to sum formation.

There is another simple, if artificial, way of unifying 'Boolean' and 'mereological' instances of conjunction. While Boolean 'and' denotes a greatest lower bound (based on the partial order defined by the implication relation $\Rightarrow$), sum formation is defined as the least upper bound (based on the part-whole partial order $\sqsubseteq$). Then sum formation is their greatest lower bound as defined by the reverse part-of relation ($\sqsubseteq^{-1}=\sqsupseteq$).[5] However, this move will not take us very far if we consider non-Boolean coordination of other types, in

[5]One can even implement the reverse part-of relation as a subset of the Boolean order defined by subset relation. Indeed, represent each individual (singular or plural) x as the powerset of its complement $e_x = \{P \mid \forall y \in P, AT(y) \wedge \neg y \sqsubseteq x\}$. So for a model with three elements $\{x, y, z\}$, the atomic individual is represented as $e_x = \{\emptyset, \{y\}, \{z\}, \{y, z\}\}$ Then plurality formation reduces to set intersection as in Boolean conjunction. Non-Boolean character of plurality-forming *and* could be captured in this formalization. Indeed, set union (least upper bound) and complement, though defined set theoretically, would not in general produce a representation of an entity. For instance, representation of any plurality would contain the empty set, and its complement would not, so complementation does not map (plural) entities to entities.

particular that of quantified NPs.

1.3.5 Branching quantification

A special case of non-Boolean conjunction arises when coordinated NPs are properly quantified (so that the mereological treatment of conjunction does not immediately apply), but occur in the context of a group predicate (so the Boolean approach to conjunction is also not appropriate):

(42) Most men and most women admire each other (Westerståhl, 1987, 292, ex. 14)

Such examples (or rather a particular interpretation thereof) have been discussed in logical literature under the rubric of *branching quantification* (Barwise, 1979; Westerståhl, 1987; Sher, 1990; Peters and Westerståhl, 2006). Branching quantification is a rather exotic phenomenon in natural language; it would be desirable to derive the branching interpretation from regular denotations of conjunction and quantifiers. This issue will be considered in Chapter 5.

1.3.6 Summary: NP vs. Sentential Conjunction

To summarize, both the Boolean and the mereological approaches to conjunction have their downsides. The Boolean approach handles immediately coordinated quantified NPs that the mereological approach has some problems with. The mereological approach, on the other hand, is designed to treat plurality readings of coordinated NPs, for which the Boolean denotation of *and* is not suitable.

The two approaches to conjunction differ in what they take as primitive. Coordination of sentences is primitive in the Boolean approach, extended to NPs. In case *and* is uniformly interpreted as the greatest lower bound operator $\wedge$, NP vs. sentential conjunction are still

	collective	quantified NPs	Branching
Boolean	??	OK	??
Mereological	OK	??	??

Table 1.2: Comparison of the Boolean and mereological approaches

not equal because the partial orders wrt which $\wedge$ is defined are not equal. Indeed, the order of truth values ($1 > 0$) is primitive, and the (implication) order on quantifiers (representing NP denotations) is defined in terms of it.

On the other hand, in the mereological approach, NP coordination is taken to be primitive, not related to coordination of sentences. But why wouldn't plurality formation be extended to sentence meanings? This could be done in multiple ways.

Lasersohn (1995) proposes that sentences are predicates of eventualities, and eventualities have a mereological structure (which Lasersohn models set-theoretically). Lasersohn's generalized conjunction is just plurality (set) formation when applied to entities and eventualities. Its extension to other types is defined as follows.

Take f, f' of type $X_1 \to \ldots (X_n \to \{0,1\}$; $[f\&f'](x_1)\ldots(x_n) = 1$ iff for some $a_1, \ldots, a_n$, $b_1, \ldots, b_n$, and for all i $(1 \leq i \leq n)$:

1. if X_i is the type U of entities or V of eventualities, $x_i = \{a_i, b_i\}$
2. if X_i is neither the type U of entities nor V of eventualities, $x_i = a_i = b_i$
3. $f(a_1)\ldots(a_n) = 1$
4. $f'(b_1)\ldots(b_n) = 1$

Otherwise $[f\&f'](x_1)\ldots(x_n) = 0$ (Lasersohn, 1995, 278). So in particular, for sentences treated as event predicates, a conjunction of two sentences (e.g. *It rains and it is cold*) is true of an eventuality e iff e is a group of two eventualities e', e'' of which individual sentences hold (*it rains*(e'), *it is cold*(e'')). Lasersohn's approach to sentential conjunction

most naturally applies to assertions that can be thought of as predicating properties of the current state of affairs.

Plurality formation could also be extended metaphorically: initially defined on the entities, plurality formation could apply to other domains. For instance, if utterances are actions (speech acts), they can be grouped together, so a conjunction of questions like

(43) a. Why are you sad and where's your necklace?
could be interpreted as
b. I perform a group of two actions, ask you why you are sad and ask where your necklace is.

Speech acts may be equated with speech events, but they don't have to; one can think of speech acts as abstract entities, and of speech events as realizations of a platonic speech act. The idea that speech acts can be conjoined is explored by Krifka (2001). Krifka cites examples like following as illustration.

(44) You are an idiot! And you are a crook! (Krifka, 2001, 43f)

Semantically, a conjunction of speech acts is "equivalent to the consecutive performance of those acts" (Krifka, 2001, 13). Krifka argues that speech act conjunction differs from Boolean conjunction as speech acts do not have Boolean structure; Boolean operations of disjunction (least upper bound) and negation (complement) are generally not defined for speech acts. Krifka observes that while a conjunction of curses (44) is a curse, a disjunction is not:

(45) You are an idiot, or you are a crook! (Krifka, 2001, 55)

Krifka notes that this lack of other Boolean counterparts assimilates speech act conjunction

to the plurality-forming denotation of *and* in NP coordination. One could take a step further and propose that speech act conjunction is nothing else but formation of plural speech acts. This connection will be built upon in Chapter 2 where I analyze sentential comitative conjunction as speech act conjunction.

1.4 Synonymous coordinators with different denotations: The case of comitative coordination in Russian

Let me now discuss a study of conjunction of immediate relevance for the goals of this dissertation, and for the study of comitative coordination in Q'anjob'al in chapter 2. In an enlightening syntactic and semantic treatment of comitative coordination in Russian, McNally (1993) argued that in Russian, comitative coordination and ordinary coordination, though often synonymous, have distinct denotations. The conjunction *i* 'and', McNally argues, forms mereological sums of NP denotations, while the comitative coordinator *s* 'with' forms *groups*. The details of McNally's analysis (group vs. sum formation) is less important for my purposes than establishing an interpretational contrast between quasi-synonymous conjunction patterns.

1.4.1 Collective vs. Distributive Contrast: Semantic or Pragmatic?

The semantic side of McNally's theory is as follows. A comitative coordinate NP denotes a group in the sense of Landman (Landman, 1989a,b); the comitative marker (*s* in Russian) functions as a group forming operator and contrasts semantically with the ordinary coordinator (*i* in Russian).

Contrasts between *s* 'with' and *i* 'and' lie at the heart of McNally's argument. Much of McNally's discussion is centered on how examples with *s*, as opposed to examples with *i*, involve some kind of 'togetherness' and relatedness (which she treats as an implicature).

But more importantly, McNally found comitative coordination (in some contexts) to favor collective, as opposed to distributive, interpretation, again contrasting with ordinary coordination (*i*). The Russian example below serves to illustrate this. Under the collective interpretation, there were two occasions under which the two co-authors received a shared literary prize. Under the distributive one, each of the authors has received two prizes (without necessarily sharing them with anyone).

(46) a. Il′f i Petrov dvaždy nagraždalis′ Leninskoj premiej
Ilf and Petrov twice awarded.PLPASS Lenin prize.INSTR
'Ilf and Petrov have been awarded the Lenin prize twice'

(collective and distributive interpretations equally possible)

b. Il′f s Petrovym dvaždy nagraždalis′ Leninskoj premiej
Ilf with Petrov twice awarded.PLPASS Lenin prize.INSTR
'Ilf and Petrov have been awarded the Lenin prize twice'

(collective interpretation much more prominent)

(this particular example is also biased toward the collective reading by common knowledge that Ilf and Petrov were co-authors). Similarly, in (47), the *s* example was reported to be unambiguously collective ('the two guys lifted the piano together'), while the *i* example was ambiguous between the collective and the distributive interpretation (i.e. Peter and Boris might have each lifted the piano on different occasions):

(47) a. Boris s Petej podnjali rojal'.
Boris.NOM with Peter.INSTR lifted.PL piano
Boris and Peter lifted the piano.

b. Boris i Petja podnjali rojal'.
Boris.NOM and PeterNOM lifted.PL piano
Boris and Peter lifted the piano.

McNally also cites similar examples from Polish. She then argued that the difference between Russian *i* and *s* can be accounted for in terms of sum vs. group formation (Landman,

1989a), respectively. McNally's analysis was criticized by Dalrymple et al. (1998a), who rejected data like (47) as valid semantic evidence. Dalrymple et al. proposed an alternative analysis, in which that comitative and ordinary coordination have identical denotation (sum formation), and differ only pragmatically (compare McNally's 'togetherness' implicature): *with*-cooordination of two NPs makes the sum of their denotations a more salient referent than the individual denotations. *And*-coordination, according to Dalrymple et al., also denotes the sum operator but does not make the resulting sum as salient. This can explain the collective (the NP refers to the salient sum) vs. distributive (the NP refers to the salient parts) contrast in (47). And indeed, as Dalrymple et al. point out, both examples in (47) (and in many similar pairs) receive just the collective interpretation for many speakers. They also found a variety of contexts in which both kinds of coordination are interpreted distributively. Dalrymple et al. concluded that collectivity and distributivity are interpretational properties that depend on the context, not just on the meaning of the conjoined phrase.

(48) a. Petja s Vasej vyigrali $100.
Petja.NOM with Vasja.INSTR won.PL $100.
'Petja and Vasja won $100.'

b. Petja i Vasja vyigrali $100.
Petja.NOM and Vasja.NOM won.PL $100.
'Petja and Vasja won $100.'

(Dalrymple et al., 1998a, p. 600; ex. 7,8)

(both just the collective interpretation for at least some speakers)

(49) Vasja s Petej pomogali pensioneram
Vasja.NOM with Petja.INSTR helped.PL pensioners.
'Petja and Vasja helped old age pensioners.'

(both distributive and collective readings available)

(Dalrymple et al., 1998a, p. 600; ex. 9b)

Dalrymple et al. also discuss certain cases – contexts with reciprocals, 'different', prefix *raz-* 'different ways', and distributive *po* (compare to binomial *each* in *We ate one sandwich each*) which seem to combine 'distributively' to both *and-* and *with*-coordinated NPs:

(50) a. Po pjat′ let strogogo režima Udal′covu s Naval′nym
PO five years strict regime Udaltsov.DAT with Navalny.INSTR
'Udaltsov and Navalny to be sentenced for five years in a high security camp'

`http://slon.ru/russia/anatomiya_reaktsii-788705.xhtml`

b. Po pjat′ let strogogo režima Udal′covu i Naval′nomu
PO five years strict regime Udaltsov.DAT and Navalny.DAT
'Udaltsov and Navalny to be sentenced for five years in a high security camp'

So Dalrymple et al. convincingly argue that the collective vs. distributive contrasts do not follow McNally's theory exactly, and could be explained as a pragmatic rather than semantic effect.

1.4.2 Semantic arguments

However, McNally presents two other, more convincing arguments for distinct denotations of the two coordination constructions. Both kinds of data find exact analogues in Q'anjob'al, and will be discussed in chapter 2. The first piece of evidence is examples with coordination of NPs that are in turn coordinate. For the lack of a better label I will call these 'counting bottles' examples. Thus, compare (McNally, 1993, 376):

(51) a. Anna s Petej i Maša s Borej prinesli po
Anna.NOM with Peter.INSTR and Masha.NOM with Boris.INSTR brought PO
butylke vina k užinu.
bottle wine.GEN to dinner
'Anna and Peter and Masha and Boris each brought a bottle of wine to dinner'

(natural reading: a situation in which two bottles total were brought)

b. Anna i Petja i Maša i Borja prinesli po butylke
Anna.NOM and Peter.NOM and Masha.NOM and Boris.NOM brought PO bottle
vina k užinu.
wine.GEN to dinner
'Anna and Peter and Masha and Boris each brought a bottle of wine to dinner'

(natural reading: a situation in which four bottles total were brought)

This example constitutes the most substantial argument by McNally for treating the comitative coordination as group formation, as opposed to sums that she attributed to ordinary coordination; according to McNally, (51-a) refers to a sum of two groups (couples), while (51-b) talks about a sum of four atomic individuals (= a sum of two sums of two individuals). Dalrymple et al. refrain from discussing the 'counting bottles' argument but suggest that the contrast may be prominence-driven.

The second piece of evidence comes from another restriction on comitative coordination. McNally argues that comitative coordination in Russian only combines NPs that have an e-type denotation and excludes properly quantificational ones; the same restriction is observed with the Polish comitative preposition *z* as exemplified with example (52-c):

(52) a. Każdyj student i każdyj professor – idioty
every student and every professor idiots
'Every student.NOM and every professor.NOM are idiots'

b. *Każdyj student s każdym professorom – idioty. (Russian)
every student.NOM with every professor.INSTR idiots

c. *Każdy chlopak z każdą dziewczyną odtańcyli polkę na środku pokoju.
every boy.NOM with every girl.INSTR danced.PL polka in middle room
'Every boy and every girl danced the polka in the middle of the room.' (Polish)

(McNally, 1993, 367, ex. 35a)

(In (52-c), note the plural verb agreement that forces the coordination reading; a singular agreement would give rise to the proper comitative interpretation, 'every boy danced with

every girl'.)

If, according to Dalrymple et al., *s* and *i* have identical denotations, the contrast between NPs interpreted in different semantic types is left unexplained.

I can add to this argument another observation. Properly quantified NPs represent just one type of non-type `e` noun phrase. Predicative NPs are another type, and we find that they, too, can not be conjoined with a comitative *s*:

(53) a. Petja – professor i poèt.
Peter.NOM professor.NOM and poet.NOM
Peter is a professor and a poet.

b. *Petja – professor s poètom.
Peter.NOM professor.NOM with poet.INSTR

Indeed, if *s* and *i* have the same denotation, why should one and not the other be sensitive to the semantic type of the noun phrase? McNally's conclusion seems justified: "comitative coordination is interpreted strictly as coordination on type e, rather than as the generalized conjunction associated with **i** and *and*" (McNally, 1993, 367); "generalized conjunction" = cross-categorial Boolean conjunction as in Rooth and Partee (1983). This conclusion (but not necessarily McNally's hypothesis about sum vs. group forming functions of *i* and *s*) lays the foundation of our discussion of comitative conjunction in Q'anjob'al in Chapter 2.

CHAPTER 2

Comitative Coordination in Q'anjob'al

In this chapter I argue that the cross-linguistic morpho-syntactic diversity of expressions for 'and' corresponds to a diversity of semantic interpretations. My work is based on a case study of Q'anjob'al (Mayan, Guatemala) which presents several ways of expressing 'and'. Q'anjob'al employs both a comitative conjunction *yetoq* 'with', and Stadard Average European-sort conjunctions *k'al* and *i* 'and', freely applicable to various syntactic categories. While some coordinators like Q'anjob'al *i* and English *and* can be given a unified order-theoretic denotation (Keenan and Faltz, 1985; Rooth and Partee, 1983), where NP coordination is a pointwise extension of the clausal case, I propose to treat the sentential usage of *yetoq* as a metaphorical extension of its basic plurality-forming meaning from the entity-denoting NPs to discourse units. This analysis of *yetoq* supports the hypothesis that sentential and NP coordination can be related in different ways in different languages.

2.1 Overview of the chapter

The chapter argues for semantic diversity of conjunction patterns, based on a case study of Q'anjob'al, a Mayan language spoken in Guatemala. In particular, I argue that the sum operation, as a denotation of *and*, can be extended metaphorically to sentence denotations, producing an equivalent of the JOINT schema from Mann and Thompson (1988) or the *Parallel* coherence relation of Asher and Lascarides (2003).

The syntactic diversity of conjunction outlined in the Introduction poses a challenge to

the semantic theory of conjunction. Are all the diverse conjunction patterns compositionally interpreted in the same way? Or is syntactic diversity reflected in semantic diversity? In cases when the same conjunction can conjoin sentences and noun phrases, how is it interpreted in these two usages? Is the semantic relation between sentential and nominal conjunction the same in all languages? To put all these questions more generally, how much semantic unity is behind the morphosyntactic diversity?

Q'anjob'al presents a suitable testing ground for these questions. It employs both a comitative conjunction *yetoq* 'with', and European-style conjunctions *k'al* and *i* 'and', freely applicable to various syntactic categories. What makes the case of Q'anjob'al especially interesting is that a comitative marker in Q'anjob'al generalizes to sentential coordination:

(1) a. q-jay-k' ix Ewul y-etoq naq Xhun yek'al
POT-come-LOC 3WOMAN Ewul A3-with 3MAN Xhun tomorrow
'Ewul and Xhun will come tomorrow.' (Denis 5-31:21)

b. x-k'ayil naq Xhun masanil s-tumin i / y-etoq / k'al
COMP-lose 3MAN Xhun all own-money and / A3-with / KAL
x-b'eq-lay-kan naq y-uj y-istil
COMP-leave-PASS-LOC 3MAN A3-by A3-wife
'Xhun lost all his money and his wife left him.' (Denis 4-21:4,5)

I will argue that *and*- and *with*-coordination patterns in Q'anjob'al have different meanings: comitative conjunction in Q'anjob'al is inherently non-Boolean in all of its uses, while *i* 'and' has the Boolean denotation of the English *and*. The arguments for NP conjunction follow Louise McNally's arguments on Russian (McNally, 1993), supporting crosslinguistic validity of comitative conjunction phenomena.

This allows us to establish tentative answers to the semantic questions raised by the typology of conjunction. I provide a core semantics for comitative constructions which extends naturally to comitative coordination as sum formation. I show, contra Dalyrmple et al.'s (1998a) critique of McNally's analysis of comitative coordination in Russian, that,

though subtle, there is a distinction between comitative coordination and ordinary boolean coordination. A major piece of new evidence comes from extensions of comitative coordination to the predicative and clausal case, beyond coordination of NPs. I show that the basic system of double coordination in Q'anjob'al and Russian is very much the same, despite the very different typological profiles of the two languages. This heightens the typological interest of comitative coordination construction as a source of coordination independent of the purely boolean one. I derive semantic restrictions on sentential *yetoq* from its basic meaning of sum formation, and argue that the semantic relation between clausal and nominal *with*-coordination is special, distinct from the relation between Boolean conjunction of clauses and NPs.

Examples in this chapter come from the collection of over 9,000 Q'anjob'al words and sentences compiled by the Q'anjob'al project members (Bervoets et al., 2011). With Q'anjob'al examples, I give references to these notes identified by name of the contributor and date, followed by example number(s).

The chapter starts with a brief typological characterization of Q'anjob'al, and a discussion of the usage of the comitative marker *-etoq*, section 2.2. I discuss the usage of *yetoq* as a coordinator in section 2.3, and propose a semantic analysis of Q'anjob'al comitative coordination patterns in section 2.4. I argue that in Q'anjob'al, as in Russian, comitative coordination contrasts with ordinary coordination, forming groups of entities of type `e` but extending to other types, in particular utterances.

2.2 Background information

2.2.1 Some Features of Q'anjob'al Morphosyntax

Q'anjob'al is a predominantly head-initial language — verb-initial, with prepositions rather than postpositions, and possessors following the head nouns. The basic word order in a

clause is Aux-V-S-DO-Obl, but the surface order varies due to various fronting constructions, including WH-movement, focalization, and topicalization. Topicalized NPs (but not focalized ones or interrogatives) are doubled with a resumptive element in situ. A special verb suffix ("agent focus marker") marks transitive verbs whose subject has been fronted, but the suffix has other uses as well.

Q'anjob'al has rich person agreement: predicates agree with subjects and direct objects, prepositions and possessed nouns with their dependent NPs. There are two series of agreement markers, traditionally called "A" and "B". Series "B" expresses agreement with intransitive subjects and direct objects ("absolutive"); series "A" is "ergative", expressing agreement with transitive subjects, possessors, and dependent NPs in prepositional phrases.

NPs usually have classifiers on the left edge, e.g. *naq* 'male human', *te'* 'plant or plant-derived object', *no'* 'animal or animal-derived object'. Classifiers also form a noun phrase on their own, functioning as 3rd person pronouns.

The reflexive pronoun is *b'a*. It can occupy normal nominal positions, but in the most common direct object function, it appears immediately after the verb (the only other case of direct objects preceding the subject in Q'anjob'al is object incorporation, which is not productive in our consultant's (Ms. Francisco) dialect). This construction has the surface order VOS, in exception to the general VSO pattern of Q'anjob'al.

Embedded clauses can be accompanied with the complementizer *tol*, and typically occur sentence-finally. *Tol* preceded by the preposition *yuj* gives the meaning of 'because'. Our consultant perceives *yuj tol* 'because' as a single word, but I gloss it below as a two word expression, in accordance with its quite transparent etymology.

2.2.2 Coordinating conjunctions of Q'anjob'al

There are several coordinating conjunctions in Q'anjob'al. The most common translations of *and* and *or*, at least in the dialect spoken by our consultant, are Spanish borrowings, *i*

	Sg	Pl
1st	wetoq	jetoq
2nd	hetoq	he yetoq
3rd	yetoq	

Table 2.1: Paradigm of the preposition *-etoq* 'with'

'and' and *o* 'or'; as well as *ni* 'nor', which is found in negative contexts. There are also several indigenous conjunctions, including *palta* 'but', *k'al* 'and', and *apax* (contrastive) 'and'. The literature also reports some conjunctions that our consultant did not confirm: *kax* 'and' (Baquiax Barreno et al., 2005, 208), *haxpax* 'and' and *mi* 'or'[1] (Montejo and de Nicolás Pedro, 1996, 97). *Ik'al*, a combination of native and Spanish words for 'and', is also used as a conjunction. There seem to be subtle differences between *i*, *ik'al*, and *k'al*, on which I can say nothing definite.

In addition to these conjunctions, the comitative preposition *-etoq* can serve as a coordination marker. Comitative constructions in Q'anjob'al use the preposition *yetoq*. Many prepositions in Q'anjob'al agree with their sister noun phrases, so morphologically *yetoq* consists of the stem *-etoq* and a personal prefix; I call it by the most frequent form (3rd person), marked *y-*, but *yetoq* does have a full personal paradigm (Table 2.1).

Here is one example of such comitative coordination in Q'anjob'al:[2]

[1]Ms. Francisco widely uses *mi* as a modal marker of uncertainty, including in the contexts of the disjunction *o*, but does not employ *mi* as a disjunction proper.

[2]Q'anjob'al orthography is transparently phonemic, with letters generally corresponding to the familiar IPA values. Still, I need to note several less obvious orthographic conventions. ' marks glottalized plosives (*b', t', tz', tx', ch', k', q'*) or stands for a glottal stop; to avoid redundancy, word-initial glottal stops are not marked. *h* marks beginnings of words that start with a vowel when in a phrasal context; a glottal stop is epenthesized in such words phrase-initially. *ch* and *xh* are an alveopalatal affricate and fricative, repectively. *tx* and *x* stand for a retroflex affricate and fricative, respectively. *tz* is an alveodental affricate. *q* and *q'* are voiceless uvular fricative and glottalized stop, respectively. *j* stands for a velar fricative and *y* for a palatal glide.

(2) Ch-b'ey ix Malin y-etoq naq Xhun.
INC-walk 3WOMAN Malin A3-with 3MAN Xhun
'Mary and John walk' (Mel 02-07:3)

NPs coordinated with *yetoq* are found in all major syntactic positions – as subjects (2), objects, possessors (3) etc.

(3) No' tz'ikin ix Niki i / y-etoq naq Michael x-'el jupupoq
3ANIMAL bird 3WOMAN Niki and / A3-with 3MAN Michael COMP-away fly
no'
3ANIMAL
'Niki and Michael's bird flew away.'

While comitative constructions are a frequent source of nominal coordination (Mithun, 1988, 339), this pattern rarely generalizes to other categories[3]. E.g. in Russian, *i* 'and', like its English counterpart, can conjoin a variety of categories; in contrast, *s* 'with' is generally restricted to conjoining noun phrases. For example, *i* but not *s* coordinate verb phrases, while both can coordinate noun phrases:

(4) a. Petja plačet i / *s smeëtsja.
Peter.NOM cries and / with laughs
Peter cries and laughs.

b. Petja i Maša – idioty.
Peter.NOM and Mary.NOM idiots
Peter and Mary are idiots.

c. Petja s Mašej – idioty.
Peter.NOM with Mary.INSTR idiots
Peter and Mary are idiots.

But in Q'anjob'al *with*-coordination does generalize to other kinds of constituents. This

[3]Such generalization is attested, cf. Cook (1984, 97), and is observed, with some limitations, in Q'anjob'al. For discussion, see sections 2.3.4 and 2.4.5 below; see also Chapter 1 for a discussion of syntactic typology.

usage is restricted and peripheral, but crucial for the theoretical questions raised in this chapter. Uses of *yetoq* with adjectives and sentences will be analyzed in detail below.

In what follows, I will call constructions with *i*, *ik'al*, and *k'al ordinary coordination*, or *and*-coordination. In contrast, coordinated structures using *yetoq* are called *comitative coordination*, or *with*-coordination. Although these markers are presumably of different syntactic categories (*yetoq* is at least originally a preposition), I will call them uniformly *coordinators* (Haspelmath, 2004).

2.2.3 *Yetoq*: Range of uses

This chapter is dedicated to the use of *yetoq* as a coordinator, but it also lives a full life as a preposition. *Yetoq* allows various oblique uses, most commonly instrumental (5-a), comitative proper (5-c) and the function related to comitative which is sometimes called *sociative* and which Arkhipov (2009a, 202–206) calls 'copredicative', there the comitative phrase refers to a 'Satellite' of the main Agent of the clause (5-b):

(5) a. X-chuk naq w-ichin y-etoq q'oqoch.
COMP-poke 3MAN A1S-back A3-with stick
'He poked my back with a walking stick.' (instrument)

(Kathleen 05-25:1)

b. x-in jay-ik' b'ay q'in y-etoq jun *botella tequila*
COMP-hin come-LOC to party A3-with one bottle tequila
'I came to the party with a bottle of tequila.' (copredicative)

(Denis 04-06:49)

c. X-in b'itni y-etoq cham Francisco.
COMP-1S sing A3-with 3OLD Francisco
'Mr. Francisco and I sang.' (comitative) (Mel 179:1)

See Lakoff and Johnson (1980) on the possible metaphorical relation between these usages. In a usage that can be seen as a variety of comitative proper, *yetoq* also marks symmetric

co-arguments of certain predicates, such as the argument introduced by the (implicitly) reciprocal predicates like 'same' and 'different' and those of overt reciprocals:

(6) a. lajan q-y-un jay-ik' ix Ewul yetoq naq Xhun yek'al.
same POT-A3-do come-LOC 3WOMAN Ewul A3-with 3MAN Xhun tomorrow
'Ewul and Xhun will come tomorrow at the same time' (Denis 05-31:22)

b. tx'ojtx'oj x-y-un lak-on ix Malin ch'en ch'en yetoq naq Xhun.
different COMP-A3-do lift-AF 3WOMAN Malin 3ROCK rock A3-with 3MAN Xhun
'Malin and Xhun lifted a rock at different times.' (Denis 05-31:47)

c. Ch-w-ochlej hin b'a y-etoq ix Malin.
INC-A1S-like.REC 1S self A3-with 3WOMAN Malin
'Malin and I like each other,' lit. 'I like each other with Malin'

(Meaghan 06-08:18)

Not that while English translations in (6) feature a coordinate structure, the Q'anjob'al uses a comitative adjunct. In (6-a,b), English *as* is the closest translation equivalent to *yetoq* (*Ewul will come at the same time as Xhun*).

2.3 *Yetoq* as a coordinator

2.3.1 The problem of constituency

How do we know that cases of coordination we talk about aren't only apparent? Perhaps there is no coordinate structure involved but rather a collocation of a subject NP and a comitative adjunct, which do not form a constituent but merely occur next to each other thanks to the verb-initial syntax of Q'anjob'al. Indeed, the core examples are often ambiguous between a comitative proper and a coordination construction, e.g. (2) could be construed alternatively as 'Malin and Xhun walk' and 'Malin walks with Xhun'. The two parses are even near synonymous. But they are not fully synonymous, as has been noticed: for *Malin walks with Xhun* to be true, the two need to walk together; for *Malin and Xhun*

walk, there is no 'togetherness' requirement, they could walk at different locations and the sentence is still true. The separation test shows that the two interpretations correspond to different structures. In Q'anjob'al, an NP immediately followed by a comitative PP can receive the meaning of English *and*, but a comitative PP separated from another NP can only be interpreted as an adjunct, similar to English *with* phrases. The change in interpretation that follows changes in linear order suggests a difference in constituency:

(7) a. q-jay-ik' ix Ewul y-etoq naq Xhun yek'al
POT-come-LOC 3WOMAN Ewul A3-with 3MAN Xhun tomorrow
'Ewul and Xhun will come tomorrow.' (Denis 5-31:21)

b. q-jay-ik' ix Ewul yek'al y-etoq naq Xhun
POT-come-LOC 3WOMAN Ewul tomorrow A3-with 3MAN Xhun
'Ewul will come tomorrow with Xhun.' (Denis 5-31:20)

The difference between the two sentences is the same as between their English translation. In (7-b), there will be an event in the future in which Ewul and Xhun came together; *with*-phrase is a comitative adjunct (and so is the prepositional phrase *yetoq naq Xhun*). In (7-a), where *yetoq* (and *and*) are immediately framed by NPs on both sides, the coordinate interpretation is possible, so that unity of event is not required; it is possible that Ewul and Xhun will both come but not necessarily together.

2.3.2 Loss of agreement in comitative coordination

There are further properties of *yetoq* used as coordinator that move it away from the original prepositional status. One of these is optional agreement. Prepositions that have person prefixes always agree with their objects, and *-etoq*, in its preposition function, is no exception. Yet the agreement pattern can be disrupted in the coordination construction: while *-etoq* normally agrees with the NP after it (8-b), another option is for *-etoq* to bear the default 3rd person agreement prefix when the conjunct after it is a 1st or 2nd person (locutor)

pronoun:

(8) a. naq Xhun y-etoq ayach / hach ch-in he kaq-a'
3MAN Xhun A3-with 2S / B2S INC-1S A2P hate-ST
'Xhun and you (sg) hate me.' (Denis 05-24:58)

b. ayin hetoq x-j-il jun no' lab'aj
1S A2Ptoq COMP-A1P-see one 3ANIMAL snake
'I and you(sg) saw a snake' (Denis 05-10:57)

Still, the use of *yetoq* as a frozen, non-agreeing form doesn't seem to be well established in the language. Although Ms. Francisco did produce examples like (8-b), she hesitated between the independent and the clitic forms of the pronoun after *yetoq*, and at times judged both versions as degraded.

2.3.3 Binding facts

A coordinated noun phrase with *yetoq* can antecede a reflexive pronoun *b'a* or a reflexive possessor. This is evidence that a *with*-conjoined phrase and not just the first NP is the subject, so the NP and the comitative PP form a syntactic unit, as opposed to a collocation of syntactically unrelated phrases. There is no overt dedicated reflexive possessor morpheme, but there is, one could say, a phonologically null one. Whenever a noun marked for 3rd person possessor (*y-* or emphatic 3rd person possessor *s-*), or an unmarked relational (inherently possessed) noun (e.g. *mam* 'father') occurs without an overt possessor DP, the possessor is interpreted as coreferent with the subject:

(9) a. ch-'ek' tzunon-oq naq Yakin y-intaq (s-)y-istil
INC-LOC follow-IRR 3MAN Yakin A3-after (OWN-)A3-wife
Yakin$_i$ follows his$_{i,*j}$ wife. (Denis 05-17:8)

b. x-'ok wayich naq Xhun y-in (s)-mam
COMP-LOC sleep 3MAN Xhun A3-in (OWN-)-father
Xhun$_i$ had a dream about his$_{i,*j}$ father. (Denis 05-17:32)

With-coordinated DPs can antecede such reflexive possessors, note a contrast with an adjunct comitative PP:

(10) a. yan low-on ix Malin y-etoq naq Xhun s-tx'ix
PROG eat-AF 3WOMAN Malin A3-with 3MAN Xhun OWN-tamale
'[Malin and Xhun]$_i$ are eating their$_{i,*j}$ tamales' (Denis 05-31:36)

b. ch-lo' ix Malin s-tx'ix y-etoq naq Xhun
INC-eat 3WOMAN Malin OWN-tamale A3-with 3MAN Xhun
Malin$_i$ is eating her$_{i,*j}$ tamales with Xhun. (Denis 05-31:41)

There is no such contrast with other coordinators in this respect, compare:

(11) x-y-il b'a ix Malin y-etoq/ i/ k'al/ i-k'al naq Xhun yul
COMP-A3-see REFL 3WOMAN Malin A3-with/ and/ KAL/ and-KAL 3MAN Xhun A3-on
ch'en nen
3ROCK mirror
Malin and Xhun saw themselves in the mirror (Denis 05-31:33)

This is another argument for treating *yetoq*-coordinated NPs as a syntactic constituent.

2.3.4 Clausal coordination

Finally, one sometimes finds *yetoq* as a sentential coordinator. In these cases *yetoq* can not be regarded as a comitative adjunct marker. This usage is relatively peripheral; other sentential coordinators (e.g. *palta* 'but', *apax* (contrastive) 'and') are much more common.

But in this function, comitative coordination is still different from *i*. *Yetoq* seems to be more restricted than *i*; *yetoq* is only acceptable between clauses which contribute to a common theme (cf. the notions of Theme and Maximal Common theme in Asher et al. (1997); cf. also Asher (2004)), so (12-a) is infelicitous outside of an appropriate discourse context (explicit or implicit). This usage of *yetoq* can be roughly paraphrased in English as *and in addition to that*:

(12) a. x-kankan naq Xhun b'ay na [OK]i / #y-etoq x-toq y-istil naq
COMP-stay 3MAN Xhun to house [OK]and / #A3-with COMP-go A3-wife 3MAN
b'ay txomb'al
to market
'Xhun stayed home and (#in addition to that) his wife went to the market'

(Denis 4-21:7,9)

b. x-k'ayil naq Xhun masanil s-tumin i / y-etoq
COMP-lose 3MAN Xhun all own-money and / A3-with
x-b'eq-lay-kan naq y-uj y-istil
COMP-leave-PASS-LOC 3MAN A3-by A3-wife
(discussing how Xhun is unhappy)

'Xhun lost all his money and ([OK]in addition to that) his wife left him.'

(Denis 4-21:4,5)

c. merwal ch-kus naq Xhun y-uj tol x-k'ayil naq masanil s-tumin
very INC-sad 3MAN Xhun A3-by that COMP-lose 3MAN all own-money
y-etoq x-kam masanil yawb'ejal naq
A3-with COMP-die all crops 3MAN
'Xhun is sad because he lost all his money and ([OK]in addition to that) his crops died.'

d. k'am tzetalyetal ch-w-aq'a y-etoq k'am maktxel b'ay ch-w-aq'a
no what INC-A1S-give A3-with no who to INC-A1S-give
'I have nothing to give and ([OK]in addition to that) nobody to give things to'

(Denis 04-14:1,9)

In (12-b,c), the shared point is Xhun's lack of luck; in (12-b), Xhun is also the grammatical subject. In (12-c), Xhun is a possessor in one clause and a grammatical subject in the other. So we see that *yetoq* is not sensitive to sameness of subject but to pragmatic properties of utterances; *yetoq* is a discourse/clausal connective rather than a switch reference marker, which are widespread in languages of Americas, cf. Haiman and Munro (1983).

In clausal coordination, *yetoq* can be translated roughly as 'and also', 'and in addition to that', or 'furthermore'. As (12) illustrates, two clauses conjoined with *yetoq* must cumulatively contribute to the same point; no such requirement exists for *i* 'and'. For (12-b), the

common theme is 'John is out of luck'. The two clauses together elaborate on the theme.

Note that a similar coherence restriction applies to the English *with* when used as a (subordinating) clausal connective:

(13) a. John went to the bank, with Joe agreeing to help fund the project
b. #John went to the bank, with his wife going to the market.

Let me use another illustration of how the usage of *yetoq* is restricted. As a clausal connective, *yetoq* generally is not acceptable if used to relate clauses describing simultaneous actions (or successive actions, for that matter):

(14) X-low naq Xhun i / #y-etoq x-tx'aj ix y-istil naq sek'
COMP-eat 3MAN Xhun and / #A3-with COMP-wash 3WOMAN A3-wife 3MAN dish
'Xhun ate and his wife did the dishes'

But a proper pragmatic context can make a difference in whether *yetoq* is acceptable in a sentence like (14). Let us assume the following context. Let it be shared knowledge that I hate when Xhun eats at my place, and I don't like anyone doing the dishes there. I learn that in my absence Xhun and his wife came over, Xhun ate and his wife did the dishes; both of these facts make me angry. In this setting, one can felicitously utter (15):

(15) Ch-tit wowal y-uj tol x-low naq Xhun kay ti i / OKy-etoq
INC-come A1S-fight A3-by that COMP-eat 3MAN Xhun over here and / OKA3-with
x-tx'aj-aj ix s-y-istil naq sek'
COMP-wash 3WOMAN OWN-A3-wife 3MAN dish
'I'm angry because Xhun ate and his wife did the dishes over here.'

The special pragmatic flavor of *yetoq* described above is hardly unique, and similar pragmatic effects have been reported for coordinators in other languages; for instance, Kendall (1976, 156) reports common topic ("overt or assumed") to be a necessary condition for sentences

conjoined with the particle *pe:* in Yavapai.

This usage of *yetoq*, with associated pragmatics, extends to coordinating phrases smaller than clauses, i.e. to predicates, in a natural way:

(16) mextol yetoq anlom naq Xhun
teacher A3-with doctor 3MAN Xhun
'Xhun is a doctor and (in addition to that) a teacher.' (Denis 04-06:30)

2.3.5 Q'anjob'al vs. Russian

Comitative coordination in Q'anjob'al is a fairly common typological option, but extension to sentential conjunction is less common. Why? What prevents a comitative coordinator in other languages — e.g. Russian — from extending to clausal coordination? Perhaps case morphology is part of the answer;[4] Q'anjob'al lacks nominal case, while Russian has a rich Indo-European case system. Comitative preposition *s* 'with' in Russian assigns instrumental case to the NP, so that comitative coordination construction superficially contrasts with ordinary coordination. In Q'anjob'al, the absence of morphological case may have facilitated generalization of comitative pattern beyond noun phrases. So in Russian comitative coordination is restricted to case-bearing phrases - nouns and adjectives, but not sentences.

S 'with' as a predicate coordinator still works in Russian with adjectives (exactly as in Q'anjob'al), which are marked for case:

(17) a. Èta čaška belaja s čërnym
this cup.NOM white.NOM with black.INSTR
'This cup is white and black'

b. #Èta čaška belaja i čërnaja
this cup.NOM white.NOM and black.NOM
#This cup is both white and black'

[4]Suggested by Jessica Rett, p.c.

The morphological factor could also help explain the difference in number of conjuncts: while in Russian only two are possible, in Q'anjob'al there can be more. This could be generalization of the syntactic pattern of regular conjunctions (*i*, *k'al*, *o*), facilitated by the lack of formal differentiation (i.e. case marking). Note that neither in Q'anjob'al nor in Russian is the comitative coordinator able to iterate more than once, compare (18-c,f); this remains unexplained by any existing semantic proposal.

The difference in number of conjuncts is illustrated by (18-b,e):

(18) a. mextol heb' naq Xhun, naq Yakin i ix Malin
teacher PL 3MAN Xhun 3MAN Yakin and 3WOMAN Malin
'Xhun, Yakin and Malin are teachers.' (Denis 04-06:42)

b. mextol heb' naq Xhun, naq Yakin y-etoq ix Malin
teacher PL 3MAN Xhun 3MAN Yakin A3-with 3WOMAN Malin
'Xhun, Yakin and Malin are teachers.' (Denis 04-06:43)

c. *mextol heb' naq Xhun y-etoq naq Yakin y-etoq ix Malin
teacher PL 3MAN Xhun A3-with 3MAN Yakin A3-with 3WOMAN Malin
'Xhun, Yakin and Malin are teachers.' (Denis 04-06:45)

d. Pridut Petja, Maša i Nataša.
will.come Peter.NOM Mary.NOM and Natasha.NOM
'Peter, Mary and Natasha will come.'

e. *Pridut Petja, Maša s Natašej.
will.come Peter.NOM Mary.NOM with Natasha.INSTR
'Peter, Mary and Natasha will come.'

f. *Anna s Mašej s Natašej pridut
Anna.NOM with Mary.INSTR with Natasha.INSTR come.3PL
(McNally, 1993, 351, ex. 9)

The Russian example in (18-d) is ungrammatical if pronounced with the neutral conjunction intonation as (18-c); if pronounced with a list intonation and a prosodic break after the first conjunct, the sentence becomes grammatical but construed as asyndetic, similar to (19-b) (constructed) and (19-c) (natural):

(19) a. [OK]Pridut Petja, [BREAK] Maša s Natašej.
will.come Peter.NOM Mary.NOM with Natasha.INSTR
'Peter, Mary and Natasha will come.'

b. [OK]Pridut Petja, [BREAK] Maša.
will.come Peter.NOM Mary.NOM
'Peter, Mary will come.'

c. S det′mi reguljarno zanimalis′ defektologi, logopedy, [BREAK]
with children regularly attended defectologists logopedicians
psixolog.
psychologist
Defectologists, logopedicians, and a psychologist regularly attended the children. (NCRL)

2.3.6 Other coordinators: *k'al, ik'al*

The data cited above might be affected by linguistic interference. The discussion primarily focused on semantic contrasts between *yetoq* and the Spanish borrowing *i*. All these contrasts turn out to be stronger for the native *k'al* 'and', and could be an linguistic interference effect. Indeed, Spanish *y* is a neutral conjunction in most contexts, serving as a universal translation for *and*. While Spanish does have a comitative coordination construction, it is rather restricted; comitative coordination is not allowed except in the subject position (a fact which Camacho (2000) attempted to explain).

2.4 Analysis

In this section I adapt to Q'anjobal McNally's (1993) idea that the meaning of Russian comitative coordination is restricted to e-type plurality formation. While certain aspects of McNally's analysis have been challenged (Dalrymple et al., 1998a), her core arguments for a semantic difference between *and*- and *with*-coordination remain convincing. I accept that idea, but make a slight digression from McNally's original analysis by taking the denotation of comitative coordination to be sum formation rather than group formation (the difference

between sums and groups will not be relevant for our discussion). I follow Keenan and Faltz (1985) in attributing a boolean denotation to ordinary coordination. I cite data in support of distinct denotations of *and*- and *with*-coordination, and show how the contrasts follow from the postulated denotational difference. Supporting data from Q'anjob'al are mostly parallel to McNally's Russian data. Then I move on to establish the semantic link between the two uses of the comitative marker, as a preposition and as a coordinator. Finally, I analyze uses of comitative coordination beyond noun phrase coordination. I show that in these uses *with*-coordination still contrasts with *and*-coordination. I then derive the meanings of *yetoq* as a clausal and adjectival coordinator from its basic sum denotation, explaining the contrasts with *and*-coordination.

2.4.1 Sums and comitatives: the semantic connection

Sum/group formation as a denotation for comitative coordination makes perfect sense as a development of the comitative marker proper; comitative coordination is a natural semantic generalization from the core comitative use. In recent typological research, the function of a comitative marker is defined as adding a co-participant to a predicate so that "the same type of participation is ascribed to each member of the participant set" (Arkhipov, 2009b). One way to formalize "the same type of participation" is by forming a plurality of the comitative participant and the subject, and apply the predicate to that plurality:

(20) a. $\texttt{dance with John}' = \lambda x.\texttt{dance}(\texttt{j}' \oplus x)$

b. $\texttt{with John}' = \lambda P \lambda x.P(\texttt{j}' \oplus x)$

The denotation of comitative coordinate noun phrase may be taken to be a plural Montagovian individual:

(21) a. $\texttt{Mary with John}' = \lambda P.P(\texttt{j}' \oplus \texttt{m}')$

b. $\texttt{with John}' = \lambda x \lambda P.P(\texttt{j}' \oplus x)$

(in (21) and (20), $\oplus$ stands for the relevant plurality forming operator; I leave open for now the question of its exact nature, whether it should be merely mereological sum formation or an operation that builds in some kind of 'togetherness' as in Mari (2005))

Given this formalization of comitative adjunct construction (*John sings with Mary*), it is expected to be synonymous with the coordinate construction (*John and Mary sing*). But we saw these are not fully equivalent. The difference could be captured by an optional distributivity operator, applicable to coordinate NPs but not to comitative adjunct structures which do not involve a plural-denoting phrase in their semantic composition, hence no phrase with which the distributivity operator can combine.

We see that the meaning of the comitative PP in both cases is quite similar, differing only in the order of arguments taken (compare (21-b) vs. (20-b)). On the other hand, (21-a) is precisely the Montagovian lift of the plural individual $\texttt{j}' \oplus \texttt{m}'$. The sum operator and the comitative preposition are just two easy semantic steps apart, the steps being type lift and argument permutation; see also Ionin and Matushansky (2003) for an attempt at syntactic unification of different comitative constructions.

Note though that comitative adjuncts always contribute collective readings while coordination, including comitative can be interpreted distributively. This difference in meaning can be attributed to the difference in structural position. In particular, one can argue that comitative adjuncts always scope below aspect operators, which can be thought of a mediators of distributivity.

2.4.2 *Yetoq* in NP conjunction

2.4.2.1 Distributivity

In most contexts, our consultant judged *yetoq* to be the most natural way to conjoin two referential NPs, more neutral than other coordinators with similar meanings (*i*, *k'al*, *ik'al*). In some contexts where a coordinate phrase crucially involves forming a group rather than simple boolean combination of generalized quantifiers, *yetoq* is preferable over *i*, and *k'al* is degraded.[5] Reciprocals are a clear case of plural predicates, and there *yetoq* is a preferred conjunction, *i* also being acceptable:

(22) ch-y-ochej b'a naq Xhun y-etoq / i / *k'al / *i-k'al ix Malin.
INC-A3-like REFL 3MAN Xhun A3-with / and / *KAL / *and-KAL 3WOMAN Malin
'Xhun and Malin like each other'. (Denis 5-10:41)

In Q'anjob'al as in Russian, while cases of neutralization are common, in some contexts comitative coordination (*yetoq*) is associated with a collective reading, where the ordinary coordination (*i* or *k'al*) would be ambiguous between the collective and the distributive interpretation:

(23) a. x-a sa jun chej b'ay naq Xhun y-etoq naq Yakin.
COMP-A2s give one horse to 3MAN Xhun A3-with 3MAN Yakin
'You gave a horse to Xhun and Yakin.' (they share a horse)

(Denis 08-01)

b. x-a sa jun chej b'ay naq Xhun i / k'al naq Yakin.
COMP-A2s give one horse to 3MAN Xhun and / KAL 3MAN Yakin
'You gave a horse to Xhun and Yakin.' (possibly different horses; the distributive interpretation is more prominent in the case of *k'al* than *i*)

[5]We are left to wonder why the kinds of type shifting we discussed above are not available in these contexts. A distant analogy that comes to mind is the emphatic *both... and* which does not allow a plurality reading (*(*both) John and Bill were the only survivors*) even though generally synonymous to simple *and*, or pure distributive quantifiers.

(Denis 08-01)

If a predicate is neither distributive nor plural and can combine with both, this is indeed a pattern we expect. The simplest semantic computations give the collective reading for comitative coordination and the distributive reading for ordinary coordination:

(24) a. $\lambda z.\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, z)(\texttt{x}' \oplus \texttt{y}')=$

$\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, \texttt{x}' \oplus \texttt{y}')$

b. $(I_{\texttt{x}'} \wedge I_{\texttt{y}'})\lambda z.\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, z)=$

$I_{\texttt{x}'}(\lambda z.\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, z))\wedge$

$\wedge I_{\texttt{m}'}(\lambda z.\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, z))=$

$\exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, \texttt{x}')) \wedge \exists h \in \texttt{horse}' : \texttt{gave}(\texttt{you}', h, \texttt{y}'))$

The collective reading of ordinary conjoined NPs, if it is indeed a separate reading, can be obtained through Winter's operator $\mathbb{c}$ (Winter, 2001, 52ff.):

(25) $\mathbb{c} = \lambda Q \lambda P \exists x \in \min(Q).P(x)$

Here, $x \in \min(Q)$ means x is a minimal set that Q is true of, i.e. $Q(x) = 1$ and $\forall x' \subset x, Q(x') = 0$. The generalized quantifier $\lambda P.P(\texttt{m}') \wedge P(\texttt{j}')$ (*John and Mary*) is true of all sets that include John and Mary. There is just one minimal set satisfying $\lambda P.P(\texttt{m}') \wedge P(\texttt{j}')$, and that set is $\{\texttt{m}', \texttt{j}'\}$. For $\lambda P.P(\texttt{m}') \wedge (P(\texttt{b}' \vee P(\texttt{j}'))$ (*Mary and Bill or John*), there are two minimal sets: $\{\texttt{m}', \texttt{j}'\}$ and $\{\texttt{m}', \texttt{b}'\}$. In these examples minimal sets correspond well to the possible plural referents of coordinated noun phrases. Our assumptions also predict (correctly) that the distributive reading for comitative coordination is not available here: the operator *dist* that produces these readings is a type shifter employed with distributive predicates (type `ettt`), while in this simple case we deal with ordinary one-place predicates (type `et`).

This concludes our first pieces of evidence that in Q'anjob'al as in Russian *yetoq* differs from other coordinators semantically and not just syntactically. However, since the contrast in question might be the preference for a particular interpretation rather than its availability, the source of such a contrast may not be semantic but pragmatic in nature, and the evidence is only suggestive.

2.4.2.2 Distributive Markers

In the 'counting bottles' examples like (51) reported by McNally, one finds the exact same semantic contrast in Q'anjob'al as in Russian:

(26) a. ix Ewul y-etoq naq Xhun i ix Malin y-etoq naq Yakin
3woman Ewul a3-with 3man Xhun and 3woman Malin a3-with 3man Yakin
x-y-i-teq heb' jujun sab'ejal.
Comp-a3-bring-Dir Pl one.each present
'Ewul and Xhun and Malin and Yakin brought a present each'

(2 presents total) (Denis 5-31:50)

b. ix Ewul i naq Xhun i ix Malin i naq Yakin
3woman Ewul i 3man Xhun and 3woman Malin i 3man Yakin
x-y-i-teq heb' jujun sab'ejal.
Comp-a3-bring-Dir Pl one.each present
'Ewul and Xhun and Malin and Yakin brought a present each'

(4 presents total) (Denis 5-31:49)

(In Q'anjob'al as in Russian, sentences like (26-b) can in principle receive a '2 present' (one present per couple) reading, but this reading is marginal; the Q'anjob'al and the Russian speakers I consulted only rarely acknowledged it) One may think that we deal here with simply a structural contrast, rather than semantic. Perhaps in (26-b) the coordinate structure is 'flat' rather than recursive: not a conjunction of two coordinate NPs, with four structurally equal conjuncts and *i* repeated three times. In contrast, in (26-a) the structural grouping can't be flat, due to the different coordinators used. The same logic could be used

to undermine McNally's original Russian argument. Q'anjob'al, I argue, provides means to test and reject the idea of a 'flat' structure. If *yetoq* is replaced with *k'al*, the 'flat' structure is still excluded (coordinators are different). Yet the truth conditions remain the same as in (26-b):

(27) x-y-i-teq ix Ewul k'al naq Xhun i ix Malin k'al naq
COMP-A3-bring-DIR 3WOMAN Ewul KAL 3MAN Xhun and 3WOMAN Malin KAL 3MAN
Yakin jujun sab'ejal
Yakin one.each present
'Ewul and Xhun and Malin and Yakin brought a present each'
(4 presents total) (Denis 06-08:1)

The interpretational properties of 'counting bottles' examples follow immediately from the denotations of *and*- and *with*-coordinators. Distributive numerals in Q'anjob'al and *po* in Russian require a quantified or plural term in the sentence, and force a distributive reading of that quantifier or plurality. Quantifiers may be thought of as one of the denotations of plural noun phrases, so the role of *po* in Russian and *jujun* in Q'anjob'al is to force the quantifier reading ('distributive') as opposed to the plurality reading ('collective'). This includes shifting the type of a predicate: a predicate over entities becomes a predicate over quantifiers.

So the predicate *xyiteq ... jujun sab'ejal* 'bring a present each' denotes

(28) $\lambda Q.Q(\lambda x.\exists p.\texttt{present}(p) \wedge \texttt{brought}(x,p))$

(defined just for distributive generalized quantifiers Q). Note that distributive contexts, which require a quantifier, contrast with collective contexts which require a plural argument but exclude distributive quantifiers (**Each man gathered*). The denotations of the long conjoined NPs are both distributive quantifiers:

(29) a. $I_E \wedge I_X \wedge I_M \wedge I_Y$ (*and*-coordination)

b. $I_{E \oplus I} \wedge I_{M \oplus Y}$ (comitative coordination)

(individual-denoting NPs, including *with*-coordinated ones, are of type `e`, and are raised to Montagovian individuals when entering *and*-coordinate structures in order to be conjoinable (Rooth and Partee, 1983). This is due to type mismatch with *and*, which combines with Boolean types only.) This predicts the following denotations for the 'counting bottles' examples in (28):

(30) a. $(and)\ [I_E \wedge I_X \wedge I_M \wedge I_Y]\,(\lambda x.\exists p.\texttt{present}(p) \wedge \texttt{brought}(x, p))$

b. $(with)\ [I_{E \oplus X} \wedge I_{M \oplus Y}]\,(\lambda x.\exists p.\texttt{present}(p) \wedge \texttt{brought}(x, p))$

equivalent, respectively, to

(31) a. $\exists p.\texttt{gift}(p) \wedge \texttt{brought}(E, p) \wedge \exists p'.\texttt{gift}(p') \wedge \texttt{brought}(X, p') \wedge \exists p''.\texttt{gift}(p'') \wedge \texttt{brought}(M, p'') \wedge \exists p'''.\texttt{gift}(p''') \wedge \texttt{brought}(Y, p''')$

b. $\exists p.\texttt{gift}(p) \wedge \texttt{brought}(E \oplus X, p) \wedge \exists p'.\texttt{gift}(p') \wedge \texttt{brought}(M \oplus Y, p')$

These denotations seem to be correct. It is clear from the formulas above that (31-a) introduces four and (31-b) two existentially bound variables for gifts.

2.4.2.3 Referentiality

Now let us turn to another argument of McNally's that Dalrymple et al. left unchallenged. McNally argued that comitative coordination applies only to NPs of a particular semantic type - type `e`. This formalizes the observation that NPs in comitative coordination are referential; properly quantified NPs are excluded.[6]

[6]For Russian, I supported this generalization with additional data from predicative NPs. But Q'anjob'al allows *with*-coordinated predicative NPs because comitative coordination extends far beyond the NP do-

In Q'anjob'al, too, DPs with the distributive universal quantifier *jujun* 'every' can't be conjoined with *yetoq*, suggesting that *yetoq* operates on type `e` but not `ett`:

(32) miman ix jujun heb' kuywom [OK]i / *y-etoq jujun heb' ulawom
big woman every PL student [OK]and / *A3-with every PL guest
'every student and every guest is fat' (lit. 'is a big woman')

(Denis 3-30:42,44)

No such contrast is found with the cumulative universal quantifier *masanil* 'all', which can be analyzed as yielding the name of the maximal group (type `e`):

(33) miman ix masanil heb' kuywom i / y-etoq masanil heb' ulawom
big woman every PL student and / A3-with every PL guest
'all students and all guests are fat' (Denis 3-30:40,41)

Another example of nonreferential DP comes in a negative existential sentence:

(34) k'am hin tx'i [OK]ni / [OK]i / [OK]o / *y-etoq hin mis
no 1S dog nor / and / or / *A3-with 1S cat
'I have neither a dog nor a cat' (Denis 6-27:59-62)

2.4.3 Referentiality and Binding

The evidence presented so far suggests that coordinate NPs with *yetoq* are referential, not quantificational. Yet we saw on 2.2 that comitative coordinate NPs can antecede reflexives and reciprocals. Jeff Runner (p.c.) suggests that this is potentially problematic for the group formation account of coordination: if the coordinate NPs are not quantificational, how can they bind anaphors? I believe that this objection has little bearing on the issue. On the empirical side, there are no known cases of anaphors that could not be bound by referential expressions (*John shot himself*). On the conceptual side, there is quite a variety

main, see 2.3.4, 2.4.5.

of possible solutions to this issue. For instance, if anaphors indeed require a generalized quantifier to bind them, then, following a standard account Partee (1986), all referential NPs have to be type shifted to Montagovian individuals; the same would apply to comitative conjoined NPs. Another option is rejecting variable binding as the semantic theory of anaphor interpretation. Indeed, if one adopts an alternative theory where anaphors are treated as arity reducers.

2.4.4 Non-Boolean Conjunction with Adjectives

Yetoq can coordinate adjectives, and is preferable over *i*, in certain contexts. Compare the following examples from Q'anjob'al and Russian:

(35) Q'eq i / y-etoq / *k'al jun uk'b'al
black and / A3-with / *KAL one cup
'This cup is black and white.'

(36) a. Èta čaška belaja s čërnym
this cup.NOM white.NOM with black.INSTR
'this cup is black and white.'

b. #Èta čaška belaja i čërnaja
this cup.NOM white.NOM and black.INSTR

Examples (36), (35) do not represent boolean coordination of predicates. Indeed, Boolean $\wedge$ would yield a contradictory predicate 'be simultaneously black and white'. This contradiction is apparently the source of decreased acceptability of *i* 'and', which I treat as boolean.[7] So what exactly is the meaning of coordination in such examples?

Intuitively, an object x is *black and white* iff x consists of white parts and black parts, and no parts of any other color. If we take the denotation of a coordinator to be that of sum/group formation, the desired reading is derived straightforwardly under Flexible

[7]The predicate can be construed as noncontradictory if *black* is coerced to mean 'partially black' and *white* is coerced to mean 'partially white'.

Function Argument Application (Hagstrom, 1998) (similar sentences puzzled Link (1987)), assuming adjectives in question have a basic denotation in type `et`.

(37)

expression	q'eqin	yetoq	saqin
denotation	`black`	$\lambda z.\lambda y.y \oplus z$	`white`
semantic type	`et`	`e(ee)`	`et`

yetoq saqin	q'eqin yetoq saqin
$\lambda F.\exists z.\texttt{white}(z) \wedge F = \lambda y.y \oplus z$	$\lambda x.\exists y, z.\texttt{black}(y) \wedge \texttt{white}(z) \wedge x = y \oplus z$
`(ee)t`	`et`

There are other plausible approaches to non-Boolean coordination of adjectives and other categories; non-Boolean coordination of adjectives motivated the coordination theory by Krifka (1990). Lasersohn (1995) proposes to treat colors as abstract entities that can form sums. However we represent it formally, we note that non-Boolean coordination of adjectives invites comitative marking. It comes as no surprise that, conversely, if conjunction of adjectives is interpreted as Boolean, it can not be marked with the comitative coordinator, either in Q'anjob'al or in Russian:

(38) a. q-in q'ajab' b'ay jun cham jelan $^{\text{OK}}$i / *y-etoq icham mextol
POT-1S talk to one 3OLD wise $^{\text{OK}}$and / *A3-with old teacher
'I'll talk to a wise and old teacher.' (Denis 04-06:26,27)

b. Ètot učitel′ – staryj i mudryj
this teacher.NOM old.NOM and wise.NOM
'This teacher is old and wise.'

c. *Ètot učitel′ – staryj s mudrym
this teacher.NOM old.NOM with wise.INSTR

Adjective coordination thus provides a novel piece of evidence for treating comitative coordination as denotationally different from ordinary coordination – more precisely, as denoting the sum operator as opposed to Boolean 'and'.

2.4.5 The Clausal Case: *Yetoq* in Discourse Structure

In this section I make a proposal on how *yetoq* extends to conjoining sentences semantically, and why its distribution in this function is tightly restricted. I mentioned above that *yetoq* as a clausal coordinator has a peculiar component to its meaning. For *yetoq* to be used felicitously, the clauses it conjoins must relate to a common point to which they make a joint contribution. *Yetoq* as a clausal coordinator can be compared to clausal connectives like English *also*, *in addition to that*, *moreover*, *for another thing*, or (colloquial) *plus*. These connectives are used to add new a point that serves the same or similar effect as the preceding piece of discourse; as Knott (1996, 134) writes in analyzing the functions of discourse connective in English, the writer who uses *furthermore* is guided by the need "to find a collection of facts which stands in the relationship of PRAGMATIC ADDITIVITY with each other". I believe that this discourse function (adding a new clause to the preceding discourse unit) and the idea of summation (transparent in *plus* and *in addition to that*) are immediately related to the sum operation as the denotation of coordinator *yetoq*.

There seems to be no exact counterpart for *yetoq* in English. The English *and* has a very wide range of uses, only a subset of which corresponds to *yetoq*. In many cases *and* has a sequential flavor and can be substituted for *then* or *after this* (Knott, 1996). *Yetoq*, as we've seen, doesn't have this kind of usage as Q'anjob'al relies on a specialized sequential linker *tay* 'then'. In other contexts, English *and* can be substituted for *whereas*, *furthermore*, or *in addition*. Of these, *yetoq* corresponds more or less to the latter two; *whereas* in English "signals a contrast between two propositions" (Knott, 1996, 106) while *yetoq* marks clauses that make a common point, not contrasting points. *In addition* is more general than *moreover*, *furthermore* etc., which are sensitive to what Knott (1996) calls the Semantic/Pragmatic Source of Coherence. *Moreover/furthermore/for another thing*, classified as 'pragmatic', only connect propositions that have similar "intended effects" (Knott, 1996, 136), or argumentative force; *in addition* can also combine discourse units

with similar content:

(39) a. It looks as though Dan was preparing to sail. He had taken off took off the sail cover and threaded the sheets; in addition /for another thing, he checked the motor.

b. Dan set about making the boat ready. He took off the sail cover and threaded the sheets; in addition /#furthermore, he checked the motor.

Examples and judgements in (39) are taken from (Knott, 1996, 175). Our Q'anjob'al consultant hesitated to accept *yetoq* connecting related statements that aren't used to make an argument, compare an analogue of (39-b) where *yetoq* is not the most natural connective but it is not firmly rejected either:

(40) x-chayil ix yich wat'n-on jos *a la Mexicana*; x-polay ix
COMP-start 3WOMAN A3-bottom cook-AF egg *a la Mexicana* COMP-chop 3WOMAN
jun te' pajich, jun an *sebolla*, kab' liman *cilantro* i kab' ich; tay/ i/
one CLF tomato one CLF onion two bunch cilantro and two jalapeño then/ and/
?**y-etoq** x-y-a'ontoq ix xhaltin y-ib'an q'a sekon'aytoq ix jab'
a3-with COMP-A3-put 3WOMAN pan A3-on fire pour 3WOMAN little
aceite y-ul
oil A3-in
'She started to cook *huevos a la Mexicana*: she chopped a tomato, an onion, two bunches of cilantro and two jalapeño peppers, and then/in addition she put a pan with some oil on fire.'

Yetoq is more appropriate — indeed, preferred – when combining sentences with similar argumentative force, compare an analogue of (39-a):

(41) *Huevos a la Mexicana* k'alta ch-wat'nej ix hin txutx y-uj tol
Huevos a la Mexicana MOD INC-cook 3WOMAN hin mother A3-by that
x-w-il pol-on ix an tomate an *sebolla* i an *cilantro* **y-etoq** / i /
COMP-A1S-see chop-AF ix CLF tomato CLF onion and CLF cilantro A3-with / and /

tay x-w-il y-a'-on-toq ix ch'en xhaltin y-ib'an q'a.
then COMP-A1S-see A3-make-AF-DIR 3WOMAN 3ROCK pan A3-on fire.
'Mom must be cooking *huevos a la Mexicana* because I saw her chopping tomatoes, onion, and cilantro, and I saw her put the pan on fire.'

Still, *yetoq* is not fully equivalent to either *in addition* or *furthermore* because they are tolerant to contrast between clauses it connects as long as they serve the same argumentative purpose, while *yetoq* is also allergic to formal contrast (change of sentence topic):

(42) a. We should swap Liz and Kim. Liz is excellent in defence, whereas/ in addition,/ furthermore, Kim is much better in goal (Knott, 1996, 175)

b. ajwal ch-ku-k'exlej heb' ix unin y-uj tol ix Malin watx' tz'isli
MOD INC-A1P-swap PL 3WOMAN child A3-by that 3WOMAN Malin good sow
ix apax / axa / i / *y-etoq ix Lucin watx' tejli ix.
3WOMAN APAX / AXA / and / *A3-with 3WOMAN Lucin good knit 3WOMAN
'Lets swap the girls because Malin is good at sewing and Lucin is good at knitting.'

In (42-b), the subject of the last clause is topicalized and doubled with a resumptive pronoun; *apax/ axa* here mark contrastive topicalization. It seems that English clausal connectives are less sensitive to formal contrast (instantiated here by contrastive topicalization) than Q'anjob'al, even though they are sensitive to violation of expectation.[89]

The role of various inter-sentential connectives can be formalized in theories of discourse structure, such as the Rhetorical Structure Theory (RST) or Segmented Discourse

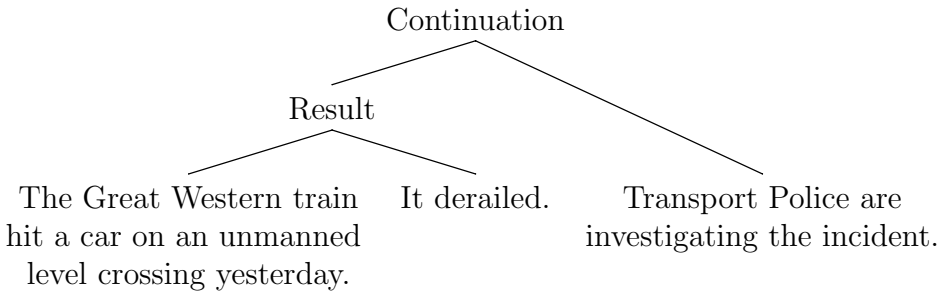
[8]Q'anjob'al is hardly unique in this respect. The Russian conjunctions *i/a* 'and' are also sensitive to the presence of contrastive topic:

(i) Nikto tebe ne pomožet: Petja spit, a/ *i Maša ušla.
nobody you not will.help Peter sleeps A/ *and Mary left
'No one is going to help you: Peter is asleep and Mary has left.'

[9]The distinction between formal contrast and violation of expectation has been discussed at least since Ducrot (1984).

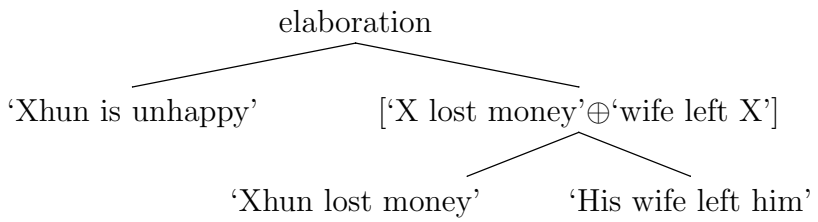
Representation Theory (SDRT), which assume that discourse is not a mere sequence of utterances but has internal structure (Mann and Thompson, 1988; Asher and Lascarides, 2003). Parts of discourse, starting from clauses as its minimal elements, are connected with each other through *rhetorical relations* (aka discourse relations or coherence relations) such as BACKGROUND, MOTIVATION, CONCLUSION, etc. (Mann and Thompson, 1988). Rhetorical relations define a hierarchical structure of the discourse, which is reminiscent of the hierarchical syntactic structure of a sentence. I take a simple discourse from Sporleder and Lascarides (2008) as an illustration:

(43)



Intuitively, what I labeled above informally as "contributing to the same point" can be represented as bearing the same (discourse) relation to the rest of the discourse structure, e.g. the (sub)utterances can be *elaborations* on the same preceding discourse. The role of *yetoq* then is to guarantee that the clauses it links stand in the same relation to the rest of the discourse. A natural implementation of this role, provided that *yetoq* otherwise denotes sum formation, is to assume that *yetoq* as a clausal linker combines two utterances into a sum-like unit. They, as a unit, are linked to the rest of the discourse through a single discourse relation, schematically:

(44)



The rhetorical relations of this mini-discourse can be paraphrased roughly in the following way: 'Xhun is unhappy because of the *sum* of two facts, that he lost money and that his wife left him.' Note that the discourse structure in (44) is isomorphic to the one argued for by Knott (1996, 110, fig. 6.9(i)) for the English *furthermore* (which is a close equivalent of *yetoq*). In analyzing the discourse

(45) United are bound to win. They have a great team; furthermore, they're playing at home (Knott, 1996, 109, ex. 6.18),

Knott argues for a discourse structure similar to one in (44) and rejects an alternative analysis whereby each of the premises combined by *furthermore* bears a separate rhetorical relation to the conclusion.

2.4.6 The Joint Schema

The function of *yetoq* can tentatively be identified with the JOINT schema of Mann and Thompson (1988), which is also a symmetric structural connective (in contrast to the many antisymmetrical rhetorical relations that Mann and Thompson establish). Directed (semantically headed) relations such as PURPOSE, OTHERWISE etc., are clearly semantically different from the case of *yetoq*. In addition to JOINT, Mann and Thompson distinguish two more non-headed (in M&T's terminology, 'multinuclear') discourse relations: SEQUENCE and CONTRAST; in other theories of discourse coherence, 'multinuclear' relations correspond to Coordinators, interpreted either as a family of relations (Asher, 1993) or as an

umbrella discourse relation that Txurruka (2003) proposes as the meaning of *and* in natural language. Among the multi-nuclear relations, SEQUENCE, for which M&T give a recipe as an example, presents a 'succession relationship between the situations' (Mann and Thompson, 1988, 278); other scholars such as Asher and Lascarides (2003) label this or similar relation NARRATION. As we saw above, *yetoq* can not be used to encode sequential actions, so it is incompatible with *Sequence*. *Yetoq* is also excluded from any contexts that imply contrast (either formal contrast or violation of expectation) between clauses, for example:

(46) a. Tzetal ch-y-un heb' ha mamin?
what INC-A3-do PL A2S grandfather
'What are your grandparents doing?'

b. ix hin chikay yan mulnaj ix, (axa/ apax/ i/ *yetoq)
3WOMAN 1S grandmother PROG work 3WOMAN (AXA/ APAX/ and/ *A3-with)
cham hin mamin ayik' cham b'ay na.
3OLD 1S grandfather be.located 3OLD to house
'My grandmother is working, my grandfather is at home.'

(47) ajwal ch-ku-k'exlej heb' naq unin y-uj tol merwal jelan naq Yakin
MOD INC-A1P-swap PL 3MAN child A3-by that very intelligent 3MAN Yakin
(axa/ apax/ i/ *yetoq) naq Xhun k'un k'ixwi naq.
(AXA/ APAX/ and/ *A3-with) 3MAN Xhun shy 3MAN
(in the context of a competitive game)

'We should swap the boys because Yakin is very smart and Xhun is shy.'

We observe that the change of topic (e.g. grandmother vs. grandfather in (46)) is sufficient motivation for contrast, preventing the usage of clausal *yetoq*, even though the two clauses seem to combine as equals and make a joint contribution to the discourse — in (46), they form a joint answer to the question, and in (47), a joint justification for the suggestion. We conclude that JOINT, defined negatively so as to exclude contrast and other relations — 'no relation is claimed to hold between units' (Mann and Thompson, 1988, 278) — is the best fit for the discourse role of *yetoq* in Q'anjob'al in Mann and Thompson's Rhetorical Structure Theory. In place of JOINT, other theories of discourse structure employ a relation

called *Parallel* whose semantics might fit *yetoq* even better than JOINT, as it entails that the clauses linked with it "are semantically similar" (Asher and Lascarides, 2003, 168); *Parallel* "holds between two constituents only if there is a common theme of those constituents" (Asher, 2004, 163).

2.4.7 Metaphorical Extension of Sums

How far can the idea that the sentential usage of *yetoq* is a metaphorical extension of group/sum formation get us? Let us see which properties of conjunction of referential NPs (the typical surface expression of sum formation) find counterparts in the JOINT schema. As with any metaphorical extension, we cannot expect that the match would be perfect, but we do find significant similarities. The most natural extension of sums is indeed JOINT, which we established as the closest counterpart to *yetoq*-conjunction among the repertoire of M&T's rhetorical relations.

To start with, sums are generally symmetric: *John and Bill* is the same as *Bill and John*. In the Introduction, we even assumed semantic symmetry as one of the defining properties of coordination constructions. So it is expected that an extension of sums denotes a symmetrical, non-directed ('multinuclear') rhetorical relation.

When it comes to the role of *yetoq*-conjoined phrases in the discourse, it turns out to be parallel to that of conjoined NPs in a sentence. In one case, coordinate NPs share a thematic relation that connects them to some predicate in the utterance. In the other, coordinate clauses share a rhetorical relation that connects them to another point in the discourse.

We saw that *yetoq* can not be used to encode temporal succession (SEQUENCE or NARRATION). But temporal order is also absent from the semantics of NP conjunction even when the sentence refers to two events each associated with one of the conjuncts:

(48) President Obama and former President Clinton visited the Orlando area.

(48) does not imply any temporal order in which the president and the former president visited the Orlando area: they could have had a joint visit (perhaps a preferred interpretation) or separate visits, either simultaneous or sequential, in any order.

Conjunction of referential NPs (which we take here to be the closest instantiation of sum formation in natural language) is also inherently non-contrastive; *and* in these cases is never substitutable for contrastive coordinators. For instance, English has a contrastive conjunction *but*; Russian has two contrastive conjunctions *a* and *no*; none of these can conjoin referential NPs:[10]

(49) a. He and / *but Mary will take a good care of you.

b. Petja i/ *a/ *no Maša o tebe pozabotjatsja.
Peter and/ *A/ *NO Mary about you care.FUT
'Peter and Mary will take a good care of you.'

So it is not surprising that sentential *yetoq*-conjunction also avoids contrast, as we observed in the previous section. To sum up, we derive to a certain extent the property of *yetoq* of connecting two clauses that jointly contribute to a common point and do not contrast with each other or invoke a temporal order; this seems to narrow down the function of sums of discourse units to the JOINT rhetorical schema.

The analogy between *yetoq*-conjunction and sum formation on individuals also allows us to predict that *yetoq*-conjoined sentences, like *yetoq*-conjoined NPs, may tend to be interpreted collectively. But what counts as a 'collective' reading of coordinated sentences?

[10] As we discussed earlier, the sum operation is not an adequate formalization for conjunction of non-referential (e.g. properly quantificational) NPs. Interestingly, such NPs allow contrastive coordination, compare:

(i) a. John but [not Bill] kissed Mary. (Keenan and Faltz, 1985, 39)
b. [Not Bill] but John kissed Mary.
c. Why do [many earthquakes] but [few volcanic eruptions] occur in the [H]imalaya[s]? (from `wiki.answers.com`)

Building on the analogy with NP conjunction, we may call the interpretation of sentential conjunction collective if the semantic property that the context predicates of a conjunction fails to hold of each individual conjunct. In the case of NPs, *John and Bill are a nice couple* predicates a certain property ('be a nice couple') of John and Bill; this property does not hold for John or Bill (neither of them is a couple). In the case of sentential conjunction, a conjunction of clauses may have entailments that individual clauses don't have, so entailment is an analog of a collective property of clauses that does not distribute to their conjuncts. And indeed, one finds such a contrast in 'collectivity' between *yetoq* and *i* in sentential usage: *yetoq* prefers 'collective', *i* distributive interpretation in sentential coordination (the third expression for 'and', *k'al* was not accepted in sentential coordination, even though it otherwise tends to behave as strictly Boolean). Consider the following sentence under two different scenarios:

(50) x-nupay naq Xhun y-etoq ix printzesa y-uj tol xnachaj el jun
marry 3MAN Xhun A3-with 3WOMAN princess A3-by that solved one
rompecavesa y-etoq / i / *k'al x-y-a' kam naq jun nawal
puzzle A3-with / and / KAL COMP-A3-make die 3MAN one spirit
Xhun will marry a princess because he solved the puzzle and killed the evil spirit

a. Under the **first scenario**, the king proclaimed that a hero will marry the princess if he both solves a difficult puzzle and defeats the *nawal*. Under the first scenario *yetoq* is preferred, *i* also acceptable.

b. **Second scenario**: a hero is required to do one outstanding deed to marry the princess. The deed could be solving the puzzle or defeating the nawal, and Xhun happened to do both. Under the second scenario *i* is preferred, *yetoq* is not as good but also acceptable.

The first scenario invites a collective interpretation of conjunction: it is the sum of two facts that qualifies Xhun to marry the princess; any one of the conjuncts would not be a sufficient motivation for Xhun to ask for the princess's hand. In the second scenario the

sum is redundant as any of the conjuncts would suffice for the argument. So mentioning the sum of two facts has less pragmatic motivation here. The collective vs. non-collective interpretation of *yetoq* and *i* in (50) is analogous to the contrasts in (23), repeated here:

(51) a. x-a sa jun chej b'ay naq Xhun y-etoq naq Yakin.
COMP-A2S give one horse to 3MAN Xhun A3-with 3MAN Yakin
'You gave a horse to Xhun and Yakin.' (they share a horse)

(Denis 08-01)

b. x-a sa jun chej b'ay naq Xhun i / k'al naq Yakin.
COMP-A2S give one horse to 3MAN Xhun and / KAL 3MAN Yakin
'You gave a horse to Xhun and Yakin.' (possibly different horses)

(Denis 08-01)

2.4.8 *Yetoq*-Conjunction and Speech Act Conjunction

I proposed in the last section that the clause-level usage of the coordinator *yetoq* can be treated as an analogue of plurality forming operator on discourse units. Should we equate those discourse units with speech acts? If so, it would be natural to identify clausal conjunction with *yetoq* as speech act conjunction (Krifka, 2001). Like the clausal conjunctions with *yetoq* or the corresponding sentential connectives in English (*moreover*, *for another thing*), Krifka's examples of non-Boolean speech act conjunction include pairs of utterances which are tightly related to each other and are not just any random speech acts that could be uttered in sequence:

(52) a. My dog loves chicken soup. And my cat likes chopped liver.

b. Which dish did Al make? And which dish did Bill make?

c. Eat the chicken soup! And drink the hot tea!

d. How beautiful this is! And how peaceful!

e. I hereby baptize you John. And I hereby baptize yóu Mary.

f. You are an idiot! And you are a crook!

(Krifka, 2001, 13: ex. 43)

So speech act conjunction combines assertions, questions, commands, exclamations, baptisms, and curses. We have already seen examples of *yetoq* combining assertions; but other types of speech act conjunction can also be replicated using *yetoq*:[11]

(53) a. Tzet yuxan kusiltaq hel-i y-etoq / i tzet yuxan kaq y-il-i y-ul
why sad A2S.see-ST A3-with / and why red A3-see-ST A3-in
ha sat?
A2S eye
'Why are you sad and why are your eyes red?' (questions)

b. Ch-w-i'il ha b'i Xhun i / y-etoq ch-w-i'il ha b'i
INC-A1S-get.DIR A2S name Xhun and / A3-with INC-A1S-get.DIR A2S name
Yakin.
Yakin
'I name you Xhun and I name you Yakin' (baptisms)

c. Suk hach! y-etoq lajan y-ok ha kab'il axka no txitam!
idiot B2S A3-with equal A3-inside A2S smell as 3ANIMAL pig
'You are an idiot! and you smell like a pig!' (curses)

d. Watx' y-il-i! Y-etoq tz'inini xa'al!
good A3-see-ST A3-with very quiet
'It was so beautiful, and so peaceful!' (exclamations)

e. Lo' ha pat y-etoq uk' a'ej!
eat A2S tortilla A3-with drink water
'Eat your tortillas and drink water!' (commands)

[11]The consultant judged the closest equivalents of *which*-questions in Krifka's example (e) reproduced above infelicitous when combined with *yetoq*. Tentatively, combinations of such questions invoke more than speech act conjunction/summation; their structural and lexical parallelism invites a relation of contrast between the two questions (for instance, the questions could be rhetorical, emphasizing a previously known fact that Al created a sophisticated culinary masterpiece and Bill microwaved a frozen dinner from the supermarket). Overt expression of contrast differs crosslinguistically. In English, contrast is unmarked on the segmental level, but questions in (e) are likely to be pronounced with a contrastive stress on *Al* and *Bill*; in Russian, the equivalent of example (e) would use a contrastive conjunction *a* instead of the non-contrastive *i*; and in Q'anjob'al, the coordinator *yetoq* seems to be inherently non-contrastive. Note that in Mann and Thompson (1988) that I draw upon to explain the discourse role of *yetoq*, Contrast forms a separate rhetorical relation.

Krifka's formalization of the meaning of speech act conjunction is quite liberal: "The conjunction of acts is obviously equivalent to the consecutive performance of those acts" (Krifka, 2001, 13). This leaves open the question of whether, and why, there is any similarity restriction on the conjunct speech acts (Krifka's examples, quoted above, present conjunctions of speech acts with identical illocutionary force, but he does not comment on whether this is a general restriction). Correspondingly, whether *yetoq*-conjunction should be identified with speech act conjunction depends on how the theory of speech act conjunction is refined.

For some cases, such as coordination of questions or commands, it is indeed natural to qualify the coordinated entities semantically as speech acts. But speech act conjunction might not necessarily work for all cases; a problematic property here is embeddability of speech acts. If sentential *yetoq* connects speech acts, one could expect that we won't find it in embedded contexts. But such a restriction does not seem revant. For instance, a pair of sentences conjoined with *yetoq* can be an antecedent of a conditional, as in the following sentence a mother could say to her child:

(54) sita ch-a b'esaj y-ul ha cuarto y-etoq ch-eyil-teq junoq A y-ul
if INC-A2S clean.up A3-in A2S room A3-with INC-A2S.get.DIR-DIR any A A3-in
ha calificación tay q-in man jun ha carro ti.
A2S exam then IRR-1S buy one A2S car this
'If you clean up your room and get an A, I'll buy you this car'

Another child may overhear this condition and hope that his friend gets the car, thereby embedding the *yetoq*-coordinated part under a modal:

(55) ajwal ch-b'es-aj naq y-ul s-cuarto y-etoq ch-y-iyil-teq naq junoq
MOD INC-clean-up 3MAN A3-in OWN-room A3-with INC-A3-get.DIR-DIR 3MAN any
A y-ul s-calificación axka tu ch-je hin saqchi y-etoq s-carro naq.
A A3-in OWN-exam as that INC-can 1S play with OWN-car 3MAN
'I hope he cleans up his room and gets an A, that way I'll be able to play with his

car'

On can report the mother's attitude, in which case the *yetoq*-conjoined sentences can be embedded under 'want':

(56) ch-y-ochej ix txutx ch-a b'es-aj y-ul ha cuarto y-etoq
INC-A3-like 3WOMAN mother INC-A2S clean-up A3-in A2S room A3-with
ch-eyil-teq junoq A y-ul ha calificación.
INC-A2S.get.DIR-DIR any A A3-in A2S exam
'Mom wants you to clean up your room and to get an A on the exam.'

Such examples are problematic if one assumes that (i) *yetoq* operates on speech acts, and (ii) speech act operators are always root clause phenomena. So one of these assumptions has to go. One option is to reject (ii) and admit that speech acts can be embedded rather freely; this is actually what the spirit of the rhetorical structure theory might lead us to believe. Mann and Thompson (1988) designed RST so that it allows not to distinguish between utterances constituting a text and parts of a complex sentence. For example, CONDITION is one of Mann and Thompson's rhetorical relations; one can think of the conditional operator as embedding a (hypothetical) assertion. Note also the discussion of shifts in the interpretation of indexical expressions as in Schlenker (2003); Anand and Nevins (2004) that assimilates reported attitudes, speech acts, and thoughts, thereby creating (analogs of) embedded speech acts. Some students of discourse coherence explicitly assume that rhetorical relations such as EXPLANATION, ELABORATION etc. "take speech acts as arguments" (Txurruka, 2003, 266), even if the speech acts in question are parts of a complex sentence connected syntactically by a complementizer like *because*; others take discourse relations "to be binary relations between propositions" rather than speech acts (Asher et al., 1997, 22).

Another option is to loosen (i) and allow it denote sum formation not only on speech acts but also on other entities that discourse fragments relate to — for example, propositions

or facts; interestingly, our paraphrase for the sentential *yetoq* with assertions has been *the sum of the* ***facts*** *that*.

Conclusion

This chapter supports the idea that coordination is semantically diverse, both within a language and crosslinguistically. The special value of Q'anjob'al data is determined by two facts. First and foremost, we find in Q'anjob'al a rare case of extension of comitative conjunction to coordination of sentences. This makes possible a semantic study of the grammaticization of conjunction patterns. Second, Q'anjob'al, a language without genetic or geographic links to the better-studied Russian, shows exactly the same coordination contrasts as in Russian.

I argued that *yetoq* in NP coordination is uniformly plurality forming, in contrast to other coordinators used in Q'anjob'al. Plurality formation extends to speech acts and perhaps also to facts or propositions in the sentential usage of *yetoq*. The exposition remained agnostic as to which flavor of plurality is the most adequate for comitative coordination. It seems that for most purposes, sum vs. group formation would fare equally well. But if we are to capture the subtle 'togetherness' component reported for Russian comitative coordination Dalrymple et al. (1998a); McNally (1993), and the newly observed similarity of discourse function of *yetoq*-coordination/speech act conjunction, it might be beneficial to adopt a formalization of groups like that in Mari (2005) where group members are required to share relevant properties in a predictable way.

The analysis of *yetoq* proposed here supports the hypothesis that sentential and NP coordination can be related in different ways in different languages. While some coordinators like Q'anjob'al *i* and English *and* can be given a unified order-theoretic denotation (Keenan and Faltz, 1985; Rooth and Partee, 1983), where NP coordination is a pointwise extension of the clausal case, I propose to treat the sentential usage of *yetoq* a metaphorical extension of

its basic sum meaning from the NP case to discourse units. The discourse function of *yetoq* can be identified with the JOINT schema of Rhetorical Structure theory, best paraphrased in English as *in addition*, and tentatively related to speech act conjunction (Krifka, 2001).

CHAPTER 3

On the syntax of Hybrid Coordination

This chapter discusses the phenomenon of Hybrid Coordination (HC) in Russian. I introduce essential properties of Hybrid Coordination in sections 1 through 4. In section 5, I discuss crosslinguistic spread of heterogeneous coordination constructions, and and establish the unique status of HC in Eastern European languages. Section 6 reviews existing analytical approaches to HC. Finally, I propose a novel syntactic derivation of HC, grounded in the mathematically well understood framework of categorial grammar, in section 7. My proposal is simple and fully explicit, and can be extended to non-wh coordination (section 8).

3.1 Notion of Hybrid Coordination (HC)

In Russian, and to some extent in English, it is possible to conjoin phrases of different syntactic roles, or even of different syntactic categories (e.g. a pronoun and an adverb), using the word *and* (*i* in Russian).

Such constructions are somewhat peripheral but widely attested in actual usage. The National Corpus of Russian Language (NCRL)[1] provides numerous examples of this kind:

(1) Ponjal li kto-nibud′ i čto-nibud′?
understood whether anyone.NOM and anything.ACC
Did anyone understand anything?

[1]National Corpus of Russian Language `http://ruscorpora.ru/`.

(2) Vam nikto i ničego ne predlagal eščë
you.DAT NI-who.NOM and NI-what.ACC not offered still
Nobody has offered you anything yet.

(3) Zdes′ vsem i vsegda kofe podavala ona sama
here everyone.DAT and always coffee served she.NOM self
Here she always served coffee herself to everyone.

(4) . . . nekomu i nekogo nenavidet′
. . . nobody.to.DATand nobody.to.ACCchate.INF
[In Buddhism there is no hate because] there's nobody to hate anyone and nobody to be hated.

English has similar examples of coordination, compare:

(5) a. Kto i kuda napravljaetsja?
who.NOM and where.to is.directed
Who is going where?

b. What and from whom does John steal? (Grosu, 1987)

Hybrid Coordination – at least prima facie – runs contrary to the common assumption in various syntactic frameworks that only items of the same syntactic category may coordinate. This widespread claim has been revisited by Sag and Weisler (1985), who presented examples like

(6) a. Pat is either stupid or a liar.

b. Pat is healthy and of sound mind. (Sag and Weisler, 1985, 117, ex. 2a and 2c)

where the first conjunct is an adjective (phrase) and the second is an NP and a PP respectively. However, the conjuncts in (6) are not as heterogeneous as the syntactic labels lead us to believe. Indeed, in both examples the conjuncts may be syntactically heterogeneous but semantically both are predicates, of the same type `et`, and are therefore conjoinable

per Rooth and Partee (1983). On the syntactic side, it is possible to assign phrases in (6) a more generic category than the conventional *AP*, *NP*, and *PP*. Sag and Weisler (1985) do this by employing feature decomposition of syntactic categories, coupled with underspecified feature combinations. In their account, the superficially unlike conjuncts in (6) share the feature [+PRD] ('predicate'), and the conjoined structure in (6)a receives the category X^2[+PRD]. This underspecified category suffices to satisfy the selection requirements of the main verb such as *be* or *become*.

Hybrid Coordination poses a further challenge to Coordination of Likes principle because the conjuncts differ even more that in Sag et al.'s examples: not only the syntactic categories don't match but also the semantic roles of the conjuncts differ. In the examples cited in this chapter, one finds conjoined pairs of a theme and an agent, addressee and time, agent and goal, etc.

3.2 Properties of Hybrid Coordination

The most frequent case Hybrid Coordination in Russian involves conjoined question words:

(7) Kto i gde videl papu?
who and where saw Dad
'Who saw Dad and where?'

The unlike phrases conjoined may be an argument and a modifier of the same predicate, two arguments of one predicate, of two modifiers of different kinds, e.g. temporal and locative modifiers:

(8) Kto i kodga videl papu?
who and when saw Dad
'Who saw Dad and when?'

(9) Kto i kogo videl?
who and whom saw
'Who saw whom?'

(10) Gde i kodga ty videl papu?
where and when thou saw dad
'Where did you see Dad and when?'

Hybrid Coordination of wh-phrases is well attested in natural usage. In the National Corpus of Russian Language (209,203,107 word tokens), conjunctions of sentential adjuncts may be common (*gde i kogda* 'when and where', 396 hits, *kogda i začem* 'when and why', 21 hits, *kogda i dlja čego* 'when and for what purpose', 6 hits) but so are combinations of an argument and an adjunct (*kto i kogda* 'who and when', 120 hits, *kto i gde* 'who and where', 51 hits) or two arguments (*kto i komu* 'who and to whom', 7 hits, *čto i komu* 'what and to whom', 47 hits). So frequencies of individual instances of Hybrid Coordination are non-negligible, comparable to corpus frequencies of wordforms like *samoučka* 'self-styled man' (190 hits), *fonare* 'street lamp (prepositional case)' (181), *odnokašnika* 'classmate (accusative/genitive)' (66), *parallelepiped* 'parallelepiped' (59), *drandulet* 'clunker' (32), *rasstegaj* 'type of open-topped pie' (31), *infuzorija* 'infusoria' (27), toponym *Pinsk* (22). At the same time, HC is clearly not nearly as frequent as other productive coordination constructions (even the rare *to li ... to li* 'perhaps ... or perhaps' produces thousands of corpus hits). Still, the hybrid *i* is more widespread than the obsolescent but still recognizable *ali* 'or' and the obsolete *niže* 'nor', which produce 16 and 13 hits respectively in the disambiguated subcorpus of NCRL[2]. Coordination of wh-words alone is more frequent if we combine *kto i kogda* (7), *kto i čto* (1), *čto i komu* (1), *komu i čto* (2), *kto i čem* (1), *kto i kak* (4), etc. (counts are based on the same subcorpus).

Conjoined wh-words have enjoyed special attention in the literature Kazenin (2000); Gribanova (2009). However, other kinds of quantifier expressions can be conjoined as well.

[2]Both conjunctions are homonymous with more frequent content words, hence the use of the subcorpus with disambiguation, size of 5,944,188 word tokens.

Existential quantifiers expressed by indefinite pronouns of various kinds are also found in Hybrid Coordination, although much less frequently than plain wh-words:

(11) a. Dopustim, kto-libo i kogo-libo pobedil.
assume someone.Nom and someone.Acc defeated
'Assume that someone defeated someone.' (elicited)

b. Ne xochu kogo-to i v chem-to konkretno uprekat′
not want.1SG someone and in something specifically reproach
'I do not want to reproach anyone for anything specifically' (NCRL)

c. ukradennye kem-to i gde-to krepen'kie pachki s chaem
stolen someone.Instr and somewhere crisp packs with tea
'Crisp tea packs that someone stole somewhere' (NCRL)

d. Ponyal li kto-nibud' i chto-nibud'?
understood whether anyone and anything
'Did anybody understand anything?' (NCRL, A. Platonov's Chevengur)

Another kind of quantifier (relatively frequent) that is found in Hybrid Coordination is *vs*-words: universal quantifiers *vse* 'everyone', *vsë* 'everything' *vezde* 'everywhere', *vsegda* 'always' etc.:

(12) Vse i vsex pobedili.
everybody.Nom and everybody.Acc defeated
'Everybody defeated everybody.' (elicited)

Conjunctions of negation-sensitive elements ("negative concord items") with the prefix *ni-* constitute another category of examples of Hybrid Coordination:

(13) Nikto i nikogo ne pobedil
nobody-nom and nobody-acc not defeated
'No one defeated anybody.' (elicited)

HC with negative concord elements is quite common; *nikto i nikogda* 'nobody and never', with 308 hits in NCRL, happens to be even more frequent than its wh-counterpart *kto i kogda* 'who and when' (120 hits).

Already Kazenin (2000, 15) proposed to analyze conjoined ni-words similarly to conjoined wh-words, even though he does not elaborate on this point. Gribanova (2009) admits the existence of examples with conjoined ni-words but does not try to extend her analysis to them.

One more kind of quantifier commonly found in Hybrid Coordination constructions is expressed by *ne*-pronouns. These are peculiar on both formal and semantic grounds. Syntactically, they are found in clauses with an infinitival predicate and an (optional) dative subject. Semantically, unlike all other quantifiers, they convey a modal operator. One may translate *ne*-pronouns roughly as 'there is no X (for Y) to V':

(14) a. Ej $< \cdots >$ nekomu zvonit′
she.Dat nobody.to.Dat call.Inf
'She has nobody to call' = 'There's nobody she could call.' (NCRL)

b. Nekomu i nekogo pobedit'.
Nobody.to-dat and nobody.to-acc defeat.Inf
'There's nobody to defeat anyone and nobody to be defeated.' (elicited)

It would be pointless to list all the kinds of quantifiers that can participate in HC because this class is open. It contains all the quantifier expressions based on wh-words, and, as Bylinina and Testelets (2004) have shown, new members are constantly joining this class through the grammaticalization of sluicing constructions such as *Save on God knows what ~~you may save on~~* (real example from an Amazon advertizement). Let me quote just one real HC example with a sluicing-based, free choice series wh+*ugodno* (*ugodno* is literally an archaic word for '(would) like', but with wh-words it means '(what) ever' or 'any'):

(15) V gorode mozhno zhdat′ chego ugodno i ot kogo ugodno
in city possible wait what ever and from who ever
'In the city, you can expect anything from anyone' (NCRL)

As we observe, all these examples involve identical quantifiers in both conjuncts. Indeed, this is a grammatical requirement: in HC with quantifiers, the quantifier forces must match. A mismatch makes the sentence ungrammatical:

(16) *Vse i kogo-to obideli
everyone-nom and someone-acc offended

3.2.1 Order and number of conjuncts

As Kazenin (2000, 13) pointed out with regard to conjoined wh-words, the order of conjuncts is free:

(17) Kto i kogo priglasil? / Kogo i kto priglasil?
who.N and who.A invited / who.A and who.N invited
'Who invited whom?'

This statement is true but oversimplifies the pattern. Even though both orders are acceptable, it has been reported (Krejdlin, 1983) that there is a preferred one. This preferable order is the same for both conjoined wh-words and multiply fronted wh-words. The order preference, as described by Kreidlin, reflects the following hierarchy (Krejdlin states it in different terms): S > DO > IO > Modifiers, where '>' means 'preferably comes earlier.' Judgements on this issue are delicate but Kreidlin's description seems to be correct, even though the contrasts may be not so strong as he stated. What is clear is that coordination of quantifiers other than wh-words also shows flexible order of conjuncts, cf.:

(18) a. Nikto i nikogda ne delal ètogo
nobody and never not did this

b. Nikogda i nikto ne delal ètogo
never and nobody not did this
'Nobody has ever done this.'

c. Vse i vsex znajut
everyone.Nom and everyone.Acc know

d. Vsex i vse znajut.
everyone-acc and everyone-nom know
'Everybody knows everybody.'

In these examples the order given first (subject initial) sounds more natural, in full accordance with Kreidlin's observations on wh-words. The other order is also attested, but has an expressive or poetic flavor, as marked word order often does. It may be worth mentioning for the sake of illustration that out of the first ten Google hits for *nikogda i nikto* (as of May 2009) five were from (different) lyrics. In comparison, the first ten hits for *nikto i nikogda* contain only two fragments from (different) lyrics. This is of course not real statistics but it is suggestive that the reverse order is marked.

Finally, Hybrid Coordination may contain more than two conjuncts, just like an ordinary coordination structure:

(19) a. Ona... vspominaet, kto, čto i kogda ej govoril
she recalls who what and when her.DAT told
'She recalls who told her what and when' (NCRL)

b. ...čtoby nikto, nikogda i ni v chëm ne upreknul eë
that nobody never and ni in what not reproach her
'... so that no one could reproach her for anything.' (NCRL)

3.2.2 Hybrid Coordination and series of pronouns

We have observed that the quantifier words found in HC are wh-words or are morphologically based on wh-words. The exceptions to this are universal vs-words and their combinations with negation ne. Notice however that even though these do not include wh-morphemes,

	animate	inanimate	determiner	time
interrogative	kto	čto	kakoj	kogda
negative concord	nikto	ničto	nikakoj	nikogda
NPI	kto-libo	čto-libo	kakoj-libo	kogda-libo
'all'	vse	vsë	vsjakij	vsegda
' not all'	ne vse	ne vsë	ne vsjakij	ne vsegda
free choice	kto ugodno	čto ugodno	kakoj ugodno	kogda ugodno
'no X to'	nekogo	nečego	–	nekogda
'each'	–	–	každyj	–
relative 'which'	kotoryj	kotoryj	–	–

Table 3.1: Table 1: Series of Quantifier Words

they are in a systematic paradigmatic relation to wh-words. This paradigmatic relation is illustrated in Table 3.1.

All the quantifiers in this table except the latter two rows show systematic correspondence between place quantifiers in *-de*, temporal quantifiers in *-gda*, determiners in *-ak-*, and object quantifiers without overt suffixes. One exception to the regularity of the pronoun series is the paradigm gap in the *ne*-series, which lacks a determiner. This gap may have a historical explanation based on the existence of two competing series in *ne-*, compare Šimík and Kondrashova (to appear)). Belonging to one of these paradigms seems to have a grammatical effect: the quantifiers that are not in the paradigmatic relation to wh-words do not participate in HC, or at least do not fit there so easily. This can be tested on two near-minimal pairs. *Vse* 'all' and *každyj* 'each' are near synonyms, but only vse forms a paradigm comparable to that of wh-words. HC with *každyj* is degraded:

(20) a. Vse i vsex pobedili.
everybody.nom and everybody.acc defeated
'Everybody defeated everybody'

vs.

b. ?Každyj i každogo pobedil
each.nom and each.acc defeated
'Everybody defeated everybody'

Another near-minimal pair consists of plain wh-words, which can function as relative pronouns, and kotoryj, a specialized relative pronoun. Even though it is historically related to wh-pronouns2, kotoryj does not have paradigmatic counterparts that would stand in a regular functional and formal correspondence to it (such as **kotorogda* 'when'). Plain wh-words can be conjoined in relative clauses (perhaps in a correlative construction), *kotoryj* can not:

(21) Unižaet tot i togo, kto i kogo pobedil.
humiliates that.NOM and that.ACC who and whom defeated
'Who defeated someone, that person humiliates this person'

(22) *Ya vstretil mal′čika i devočku, kotoryj i kotoruju pobedil.
I met boy and girl which:Nom and which:Acc defeated
'I met a boy and a girl of which the latter defeated the former'

3.2.3 Clausemate status

In all the examples considered so far, the conjoined constituents were clausemate. One may wonder whether it is an essential property of the construction. Answering this definitively is difficult because, as is well-known, long distance movement is not possible in standard Russian. It is, however, not completely excluded in colloquial Russian. I can cite two examples, both observed in informal unprepared speech:[3]

[3]The first example comes from a phone call to a radio show at Svoboda station, 21 November 2008. Transcript is available at `http://www.krotov.info/yakov/3_vera/3_radio/20081122.htm`. The second example was uttered by the author's wife in a natural conversation in 2009.

(23) Pochemu vsë-taki i spiski$_i$ utveržDaetsja čto t_i mirotočat?
why still also copies asserts.PASS that cry.with.myrrh
'But why do copies (of icons) also cry with myrrh, as is asserted?'

(24) On ne zametit, čtó$_i$ ona boitsya, čto on zametit t_i.
he not notices what she is.afraid that he notices
'He won't notice what she's afraid he will notice.'

Clauses with some complementizers are more tolerant to extraction than others. While clauses with *čto* 'that' with a constituent moved out of them (like the ones just cited) are extremely rare and are usually judged unacceptable, similar sentences with chtoby, a subjunctive complementizer, are generally judged to be better. To the extent that long distance wh-movement is possible at all, sentences with conjoined wh-words moved out of an embedded clause are acceptable as well:

(25) a. Kto$_i$ i kogo$_j$ t_i xočet, čtoby Petja priglasil t_j?
who.NOM and who.ACC wants that Peter invites
'Who wants Peter to invite whom?' (analogous to 62 in Kazenin (2000, 14))

b. Kto$_i$ i kogo$_j$ ty xočeš′, čtoby t_i priglasil t_j?
who.NOM and who.ACC you want that invites
'Who do you want to invite whom?'

3.3 Other possible cases of coordination of unlikes

The first thorough examination of Hybrid Coordination in Russian belongs to Sannikov (1989). He classified coordination into three types: Functional, Communicative, and Lexical Semantic, based on what is common to the coordinated terms. All the cases of Hybrid Coordination fall into the class of Lexical Semantic coordination; Communicative type also includes structures that look like coordination of unlike categories, but all of Sannikov's examples for Communicative coordination seem to instantiate some kind of ellipsis. Lexical Semantic Coordination has several subtypes, including the two we have already considered:

coordination of question words and coordination of quantifier words of other kinds. The third class of Lexical Semantic coordination is coordination of two constituents with similar lexical semantics:

(26) Govorit lingvist i o lingviste
speaks linguist and about linguist
'A linguist speaks about a linguist'

The support for this as coordination of unlike categories is, however, much weaker. Many of Sannikov's examples must be dismissed since the coordinated constituents are both modifiers. Such examples can be analyzed as ordinary coordination, e.g. *v Moskve i bez dela* 'in Moscow and without business' (Sannikov, 1989, 18) where the two conjuncts actually have nothing in common in their lexical semantics. The remaining ones seem to constitute a more coherent class where not mere similarity in lexical semantics holds but identity of roots of the conjuncts, cf.:

(27) a. Ya govorju s lingvistom i o lingviste
I speak with linguist and about linguist
'I talk to a linguist about a linguist' (Sannikov, 1989, 16)

b. Ya govorju s lingvistom i o lingvistike
I speak with linguist and about linguistics
'I talk to a linguist about linguistics' (Sannikov, 1989, 18)

c. *Ya govorju s lingvistom i o jazykovede
I speak with linguist and about linguist
'I talk to a linguist about a linguist' (Sannikov, 1989, 17)

d. *Ya govorju s lingvistom i o xudožnike
I speak with linguist and about artist
'I talk to a linguist about an artist' (Sannikov, 1989, 17)

It is striking is that in all these examples the conjunction is on the right periphery of the sentence, suggesting that the second conjunct may be an elliptical clause. Some of them can

indeed be shown to be elliptical, and none of the others show the pattern of conjoining two arguments. This makes the status of Hybrid Coordination with ordinary lexemes dubious. It is, however, possible to find naturally occurring examples where two conjuncts are co-arguments (this is very rare), and even those where the conjunction is in the beginning or in the middle of a sentence (these are even rarer). Here are a few:

(28) a. ... mnogoe i mnogim nado dokazat′, Ženečka
much:ACC and many:DAT need prove Eugen
'... One has to prove many things to many people, dear Eugen.' (NCRL)

b. Lermontov ... nemnogoe i nemnogim pokazyval iz napisannogo
Lermontov few.ACC and few.DAT showed from written
'Lermontov showed few of the poems he wrote to few people.' (from Merinskii's *Memories on Lermontov*, available online at www.lib.ru)

c. No ved′ mama menja odna i odnu rastila
but emph Mom me one.NOM and one.ACC raised
'But when Mom was raising me she was a single parent and I was her only child.' (found with Rambler search engine)

Notice that these examples also involve coordination of quantifier words, even though not pronominal ones. Sannikov (1989, 23) also speaks tentatively about two other kinds of coordination of unlikes, Modal and Emphatic. He proposes to treat them as subtypes of Lexical Semantic coordination. In examples of these kinds that Sannikov considers, conjuncts bear the same focus-sensitive operator ('only,' 'even') which sometimes conveys epistemic modality ('evidently,' 'allegedly,' etc.). This provides motivation for the terms *Emphatic* and *Modal*:

(29) a. Govorit tol′ko Petja i tol′ko o Vane
speaks only Peter and only about John
'Peter speaks about John and nobody else speaks about anybody else'

b. Govorit daže Petja i daže o Vane
speaks even Peter and even about John

'Peter speaks about John even thought it would be very unlikely'

c. Govorit, vidimo, Petja i, vidimo, o Vane
speaks seemingly Peter and seemingly about John
'It seems that Peter speaks about John (assuming that it is known that someone speaks about someone)'

Interestingly (Sannikov does not discuss this possibility) the focus-associated operator may be signalled by intonation only. The falling accent (IK-3 in the classification by Bryzgunova (1980)) marking contrastive focus can license Hybrid Coordination:

(30) Govorit PETJA i o VANE
speaks Peter and about John
'It's Peter speaking about John, as opposed to anyone else speaking about anyone else.'

3.4 How Unlike are Heterogeneous Conjuncts?

If in Hybrid Coordination, by definition, is coordination of unlike categories with heterogeneous thematic roles, how is the phenomenon constrained? Should we expect that arbitrary subconstituents of the same sentence can be conjoined? For instance, why wouldn't just any subject and object be conjoined? One could imagine, for instance, that a sentence like **John and Bill saw* could be grammatical and mean 'John saw Bill'. In fact, not only the English **John and Bill saw* but also the Russian

(31) *Petja i Mašu uvidel.
Peter.NOM and Mary.ACC saw
Intended: 'Peter saw Mary'.

is ungrammatical under the normal prosody associated with coordinate structures.[4]

[4]However, *i* can also function as a focus particle 'even, also', accompanied by a falling prosodic contour on the focused constituent following *i*; I identify this contour with IK-4 in the classification by Bryzgunova

But in all the examples we've seen, the conjuncts, if bearing different categories or different morphological case, were not completely different. Indeed, heterogeneous conjuncts always have some feature in common:

- they are all wh-phrases
- they are all universally quantified phrases
- they are all negative concord items
- they are indefinites
- they all bear contrastive focus etc.

(1980). Orthographically, occurrences of the focus *i* may look as if *i* conjoined unlike categories. In the face of homophony of the focus particle *i* and the conjunction *i* in Slavic, it is not surprising that Penn (1999) proposed to treat *i* in Serbo-Croatian Hybrid Coordination as a focus particle; cf. Peretrukhin (1979) for a similar hypothesis for Russian. Such an analysis of HC is, however, untenable. For example, it may seem that *i* in the following example:

(i) Budet i na NAŠEJ ulice prazdnik.
will.be too on OUR street holiday
'There will be a celebration on our street, too' (popular saying).

conjoins a verb and a prepositional phrase. But in fact, there is no coordinate structure here at all, *Budet i na NAŠEJ ulice* may not even form a constituent. Indeed, *i na NAŠEJ ulice* does not have to be adjacent to *budet*, and can be moved around without change in meaning or grammaticality:

(ii) a. Budet prazdnik i na NAŠEJ ulice.
will.be holiday too on OUR street
'There will be a celebration on our street, too'.
b. I na NAŠEJ ulice budet prazdnik.
too on OUR street will.be holiday
'There will be a celebration on our street, too'.

I in Hybrid coordination differs both prosodically and syntactically from the focus particle *i*, see discussion in Chaves and Paperno (2007). The conjunct following the conjunction *i* does not have to bear a falling contour and can not be freely separated from the coordinate structure.

While in Russian differentiating conjunction *i* from the focus particle requires taking into account prosodic, semantic and syntactic factors, Czech makes the formal distinction easy. Gruet-Skrabalova (2011) observes that in Czech the conjunction 'and' used in HC is *a*, segmentally distinct from the focus particle *i*.

This commonality can be given syntactic interpretation if each such subtype corresponds to a syntactic feature specific to that subtype. It has been argued that wh-phrases bear a special wh-feature that triggers movement. Similar claims have been proposed for foci (bear a focus feature), negative concord items (check a negative feature), and universal quantifiers (have a distributive feature). If this is correct, Hybrid conjuncts are not heterogeneous but share a movement feature, making Hybrid Coordination much less exotic. Indeed, even in conventional coordinate structures conjuncts share some features but not necessarily others. For example, NP coordination usually combines phrases with matching case (accusative, nominative), but the features of person, gender and number (i.e. the so called ϕ-features) don't always match:

(32) La ciudad y los perros
the.FSG city and the.MPL dogs
(Spanish, title of a novel by Mario Vargas Llosa)

Is it possible to further unify subtypes of Hybrid Coordination even further? Do all subtypes share the same syntactic feature? It could be focus; Grosu (1987) proposes that in all instances of heterogeneous coordination in English each conjunct "must include a subelement in focus". (Gazdik, 2011, 49) agrees that focus might be the key element in Hungarian Hybrid Coordination, but admits that the property of being extracted, or being a 'filler' (in HPSG) is also a contender for being the unifying feature. The analysis proposed at the end of this chapter roughly follows the latter idea.

3.5 HC beyond Russian

Heterogeneous coordination that includes obligatory arguments is attested not only in Russian but also in other languages of Eastern Europe, mostly Slavic, and including all branches of Slavic, compare:

(33) a. Dlaczego nikt i niczego nie tłumaczy?
why nobody and nothing not translates
'Why is nobody translating anything?'

(Polish, Jan Wójcik's *Balcerowi następcy*)

b. Xto i koho tut vbyrajet′sja nyščyty?
who and whom here is.going.to eradicate
'Who, and whom, is going to destroy here?'

(Ukrainian, Oleksandr Dovženko's *Potomky Zaporožciv*)

c. Kto i to kakvo kupi?
who and TO what bought
'Who bought something and what was it that they bought?' (Bulgarian)

(Tomaszewicz, 2011, 192: ex. 22)

Other languages reported to have the same construction are Romanian Comorovski (1996) and Hungarian (Gazdik, 2011):

(34) a. Ki és mikor ment moziba?
who and when go.PST cinema.ILL
Who went to the cinema and when? (Gazdik, 2011, 4, ex. 3)

b. Kinek és mit mondtál?
who.DAT and what say.PST.2SG
To whom did you say something and what was it? (Gazdik, 2011, 44, ex. 125)

c. Cine și ce a văzut?
who and what AUX seen
'Who saw what?' (Gazdik, 2011, 23, ex. 38)

Like Russian, other languages of Eastern Europe do not restrict HC to wh-phrases but allow for various kinds of coordinated quantifiers, cf. HC with universal quantifiers, free choice items, and negative pronouns in Hungarian (Lipták, 2001, 127, ex. 75–77):

(35) a. Ide 'mindenki és 'mindig bejöhet.
here everyone-NOM and always PV-come-POT-3SG
'Everyone can enter here and this holds for all times.'

b. Ide 'bárki és 'bármikor bejöhet.
here anyone-NOM and any time PV-come-POT-3SG
'Anyone can enter here and this holds for all times.'

c. Ide 'senki és 'semmikor nem jöhet be.
here no-one-NOM and never not come-POT-3SG PV
'No-one can enter here and this holds for all times.'

(Lipták uses ' to mark phrasal stress.)

Conjunction of heterogeneous (contrastively) focused elements is also observed:

(36) Jan by chtěl pozvat [MARII a DO KINA].
John CL:COND wanted invite Mary-ACC and to cinema
'John would like to invite Mary to the movie.' (Czech) (Gruet-Skrabalova, 2011)

Languages of Eastern Europe share other properties of HC with Russian, many allow freedom of order in HC but have order preferences, see e.g. Gruet-Skrabalova (2011) on Czech. Gracanin-Yuksek and Citko (to appear) discuss cross-linguistic variation with respect to the order of conjuncts in HC; the order of conjuncts in Bulgarian and Hungarian is reported to be more restricted than in Russian.

3.5.1 English vs. Russian Hybrid Coordination

As shown by Grosu (1987), in English all conjuncts in HC must be optional elements of the clause, compare:

(37) a. What and from whom does John steal?

b. What does John steal? (oblique object optional)

c. From whom does John steal? (direct object optional)

d. What and where did John eat?

e. *What and where did John devour? (obligatory direct object)

This property of Hybrid Coordination in English has been confirmed by experimental evidence and incorporated into a Categorial Grammar analysis by Neil Whitman (2002). But Russian Hybrid coordination does not have this restriction.

(38) a. Kto i kuda napravljaetsja?
whoNOM and where.to is.directed
Who is going where? (HC acceptable)

b. *Kto napravljaetsja?
whoNOM is.directed
Who is going? (directional is obligatory)

c. *Kuda napravljaetsja?
where.to is.directed
*Where is going? (subject is obligatory)

In Russian, as the last example confirms, the conjoined elements do not have to be optional, so Whitman's analysis does not apply. True, even in Russian there is a tendency for at least one conjunct of HC construction to be an optional element of the sentence, but it is merely a tendency. An analysis of Russian HC in the categorial grammar framework is proposed later in this chapter.

But why should Hybrid Coordination be restricted in English more than in Russian? I believe there are two factors that make Hybrid Coordination more likely to arise in Russian. First, Russian but not English, independently allows for multiple movement, such as multiple wh-movement:

(39) Kto$_i$ kuda$_k$ t_i napravljaetsja t_k?
whoNOM where.to is.directed
Who is going where?

So structures with multiple gaps in a single sentence are readily available in Russian, and coordinated wh-phrases just add another way of filling multiple gaps, in addition to the non-

coordinated option in (39). Second, in contrast to English, Russian to some degree allows omission of obligatory arguments, which makes the line between optional and obligatory arguments softer.[5]

3.5.2 Searching for HC beyond Europe

Is Hybrid Coordination a distinctive feature of a cluster of Eastern European languages including Russian, or is it a more widespread phenomenon?

To answer this, I elicited sentences and grammaticality judgements in three languages from different linguistic families and different continents, which exhibit coordination patterns superficially similar to Hybrid Coordination in Russian. In all three languages the "Hybrid" coordination patterns turned out to be very restricted compared to Russian and

[5]Whether Russian is a pro-drop language is highly controversial. Clearly, personal pronouns (easily 1st and 2nd, occasionally 3rd person) are sometimes omitted, as in

(i) Otlično ponimaju staruju damu
perfectly undersand.1SG old lady
'I understand the old lady perfectly well'
(from author Boris Akunin's blog)

But the omission of pronouns is not as free as in uncontroversially pro-drop languages like Japanese or Spanish. Omitting 3rd person pronouns feels marked, is typically associated with colloquial speech or low register, and subject to contextual constraints. In written Russian, 3rd person pronouns are mostly overt:

(ii) Èto byl Sašin papa. Oj-oj-oj kak *(on) rasserdilsja!
this was Sasha's daddy oh-oh-oh how *(he) got.angry
This was Sasha's daddy. Oh how mad he got!
(from *Sasha i Masha*, Anni Schmidt's stories translated by I. Trofimova; note that even the colloquial stylization of the stories does not license pro-drop.)

One case where pronouns can be omitted even in formal language are subjects of embedded clauses coreferent with matrix subjects.

(iii) On znal, čto pered auditoriej čitaet stixi poslednij raz
he knew that in.front.of audience reads poems last time
'He knew that it was his last time reading poetry in front of an audience.'

One could interpret this pattern in terms of a null logophoric pronoun. For more on the issue of pro-drop in Russian see Avrutin and Rohrbacher (1997); Franks (1995) and references therein.

other Slavic languages. I was able to discover properties strongly suggesting that in those languages we deal with ellipsis, as has been argued for by some students of HC. Russian, in contrast, does not share all of these properties.

A crosslinguistic study by Neil Whitman[6] reports the existence of heterogeneous coordination patterns in Mandarin Chinese in examples like the following:

(40) Xiao3ming2 shei3 yiji shen2me shi2hou4 kan4jian4 le?
Xiaoming who and when see ASP
'Whom and when did Xiaoming see?'

Even in this study, just one speaker of the three judged questions with heterogeneous conjoined wh-words acceptable. I consulted two native speakers of Mandarin Chinese, and neither of them confirmed any of the heterogeneous coordination examples reported by Whitman. The speakers felt the sentences to be downright unacceptable, incomplete, or at least elliptical.

For Eastern Armenian, I found several relevant examples from corpora (eanc.org), featuring both interrogatives, negative indefinites, and universal quantifiers. Even though at least some of these examples turn out to be translations from Russian or other Slavic languages, a native speaker did confirm their acceptability. Further research is required to elucidate the structural and interpretational properties of Hybrid Coordination in Armenian.

(41) Ov ew owm ēr ėganov xp'owm
who.NOM and whom.ACC AUX pitchfork.INSTR beat
Who struck whom with a pitchfork? (from EANC[7])

I also consulted a Western Armenian speaker who failed to approve the kinds of examples that are found in the East Armenian corpus. First, typical cases of coordination of unlikes

[6]The Online Coordinated WH Project, `http://literalmindedlinguistics.com/Coord_Wh/home.html`
[7]East Armenian National Corpus, `http://www.eanc.net/`.

(e.g. subject + sentential adjunct) were judged unacceptable.

(42) *ov jev ur kənats?
who and where went
'Who went where?'

Second, and more interestingly, when apparent coordination is acceptable, they show signs of biclausal structure. One of these is voice mismatch: in what appears to be subject + adjunct coordination, the subject may be marked as a normal transitive subject of an active sentence, while the rest of the sentence is passive:

(43) ov jev vorun oknutjamp as ʃenk-əbidi ʃinvi
who.NOM and who.GEN help.INSTR this building-DEF FUT build.PASS.3S
'who and with whose help is this building going to build?'

I treat this mismatch as a clear sign of a biclausal, elliptical structure. As the following example illustrates, nominative subjects can not occur in passive clauses:

(44) *ov as ʃenk-əbidi ʃinvi
whoNOM this building-DEF FUT build.PASS.3S
'who and with whose help is this building going to build?'

Similar cases were found in Q'anjob'al (Mayan). Superficially, Q'anjob'al seems to have a rich heterogeneous coordination pattern. Subjects and objects, arguments and adjuncts, interrogatives, indefinites, and negative indefinites all seem conjoinable. However, like Western Armenian, Q'anjob'al allows voice mismatches in HC, strongly suggesting a biclausal, elliptical, analysis:

(45) maktxel i mak b'ay x'a'-lay no' saqin tx'i'?
who and who to gave-PASS 3ANIMAL white dog
'Who, and to whom, gave a white dog?', literally

'Who, and to whom was the white dog given?'

In addition Q'anjob'al shows morphosyntactic marking correlated with surface constituent order. The implementation is different from Mandarin: fronted transitive subjects trigger special morphological marking on the verb (traditionally called "agent focus"). It turns out that agent focus marking in heterogeneous coordination correlates with subjecthood of only the second conjunct, suggesting again that the first conjunct is part of a separate (elliptical) clause. Indeed, consider the following example which is almost identical to the last one, except for the order of wh words. When the subject comes as the second conjunct, the verb after it can no longer be passive; moreover, it is in the "agent focus" form indication that the transitive subject has been extracted from the clause:

(46) mak b'ay i maktxel x'a'-on no' saqin tx'i'?
who to and who gave-AF 3ANIMAL white dog
To whom and who gave the white dog?

In short, only the last conjunct in Q'anjob'al HC-like structures shows syntactic ties to the following clause, suggesting that the preceding conjuncts belong to separate clauses, one of them elliptical.

3.5.3 Back to true HC: Some cross-linguistic contrasts

We see good reasons to disqualify potential cases of coordination of unlikes in Western Armenian, Mandarin, and Q'anjob'al. This tells us that Hybrid Coordination in languages of Eastern Europe is indeed special. Note that Russian does not show either voice mismatches or asymmetric morphosyntactic word order marking effects that we observe in Western Armenian, Mandarin, and Q'anjob'al. The order of conjuncts in Russian HC is free, even though there are order preferences, cf. Krejdlin (1983). Voice mismatch leads to ungrammaticality (under the hybrid construal of the sentence):

(47) Vam nikto i ničego ne predlagal eščë
youDAT NI-whoNOM and NI-whatACC not offered still
Nobody has offered you anything yet.

(48) *Vam nikto i ničto ne predlagalos′ eščë
youDAT NI-whoNOM and NI-whatNOM not offered still
*Nobody has offered you anything yet.

better as standard coordination, when *ničto* is construed as nominative:

'Nobody and nothing has been offered to you yet.'

Furthermore, I found clear naturally occurring examples where both heterogeneous conjuncts show syntactic connection with the rest of the sentence that the ellipsis hypothesis fails to explain. Stranding (partial wh-movement) is a clear indication, compare

(49) Čto i komu on xorošego sdelal?
what.ACC and who.DAT he good.GEN did
'What good did he do, and to whom?'

where *čto* 'what' and *xorošego* 'good' form a discontinous noun phrase separated by wh-movement of *čto*. Omitting the first conjunct leads to ungrammaticality, suggesting that the second conjunct does not form a complete clause:

(50) *Komu on xorošego sdelal?
who.DAT he good.GEN did
'To whom did he do good?'

Note also that the interrogative *čto* 'what' is unique in assigning genitive case to adjective modifiers, so it has to be syntactically related to *xorošego* in (49). "Restoring" the putative "ellipsis" in the last example sentence can be saved by changing the case of the adjective *xorošego* 'good' because only the interrogative *čto* 'what' governs a genitive case of the adjective; with indefinite counterparts of *čto* 'what', adjectives show agreeing case:

(51) Komu on čto-libo xorošee sdelal?
who.DAT he something good.ACC did
'To whom did he do good?'

A different kind of example of syntactic connection between the first conjunct in HC and the rest of the clause comes from Hungarian 'object' agreement, as first noted by Lipták (2001). Hungarian has two sets of verb agreement suffixes: one is default, and the other is used with transitive verbs if their direct object is definite. Interrogatives do not count as definite, and an object interrogative does not trigger definite agreement. 3rd person pronouns, even dropped ones, are definite and trigger definite agreement. So consider Hybrid coordinate structure where the first conjunct is a direct object:

(52) Nem érdekel, hogy mit és hogyan készítesz
not interests, that what and how prepare.2SG.INDEF
'I am not interested in what you do and how.' (Gazdik, 2011, 48: ex. 143)

Note that the verb agreement is indefinite, as one expects for an interrogative object *mit*. However, if one interprets this example as biclausal and elliptical, the second conjunct should have a definite (if implicit) object, compare an overt conjunction of two questions where indeed definite agreement is obligatory:

(53) Nem érdekel, hogy mit készítesz és hogyan
not interests, that what prepare.2SG.INDEF and how
készíted//*készítesz
prepare.2SG.DEF//*prepare.2SG.INDEF
'I am not interested in what you do and how.' (Gazdik, 2011, 47: ex. 142)

So the agreement pattern in Hungarian supports treating Hybrid Coordination as true rather than spurious coordination of sentence-internal interrogative constituents, as opposed to sentential conjunction coupled with ellipsis. In a sense, the Hungarian pattern of verbal morphology matching the wh conjuncts is the opposite of voice morphology mismatches in

Western Armenian and Q'anjob'al.

Of the languages considered in this section, the Hybrid Coordination construction in languages of Eastern Europe (Slavic and Russian in particular, Hungarian, perhaps Eastern Armenian) appear to be a unique case of true heterogeneous coordination. Similar constructions to a very limited extent may be found in other European languages, such as English, German and French. To summarize, true coordination of unlikes is a rare phenomenon, restricted to a bounded geographic area.

3.6 Approaches to Hybrid Coordination

3.6.1 Ellipsis Hypothesis

An intuitive account of Hybrid Coordination is that it is an instance of ellipsis, analogous to sluicing (Giannakidou and Merchant, 1998) as in

(54) Who arrived to the city and when?

For conjoined wh words in Slavic, the ellipsis approach has been recently advocated by Tomaszewicz (2011). However, there are serious arguments against the ellipsis analysis (Kazenin, 2000), which make it very hard to maintain in the case of Russian HC:

- free ordering of conjuncts is not observed in sluicing constructions:

(55) a. Kto i kodga prixodil?
whoNOM and when came
b. Kodga i kto prixodil?
c. Kto prixodil i kogda?
d. ??Kogda prixodil i kto?

- it is possible to coordinate two obligatory arguments in HC, which does not work in sluicing (cf. analogous observation on Hungarian in Gazdik (2011, 45)):

(56) a. Kto i kuda napravljaetsja?
who$_{NOM}$ and where.to is.directed
Who is going where?

b. ??Kto napravljaetsja i kuda?

- the pronoun that must be posited to make ellipsis account work is non reconstructable:

(57) a. *kto ~~pobedil~~ i kogo *on* pobedil?
who$_{NOM}$ ~~defeated~~ and who$_{ACC}$ he$_{NOM}$ defeated

b. kto i kogo pobedil?
who$_{NOM}$ and who$_{ACC}$ defeated
Who defeated whom?

- in the last section, we've seen evidence for a syntactic link between both heterogeneous conjuncts and the rest of the sentence.

Furthermore, analogy with sluicing works well only with wh-words, and fails in case of other quantifiers. Compare an ungrammatical result of constructing a 'sluicing' sentence with universal quantifiers:

(58) a. vse i vsex nenavidjat
everyone$_{NOM}$ and everyone$_{ACC}$ hate
Everyone hates everyone

b. *vse nenavidjat i vsex
everyone$_{NOM}$ hate and everyone$_{ACC}$

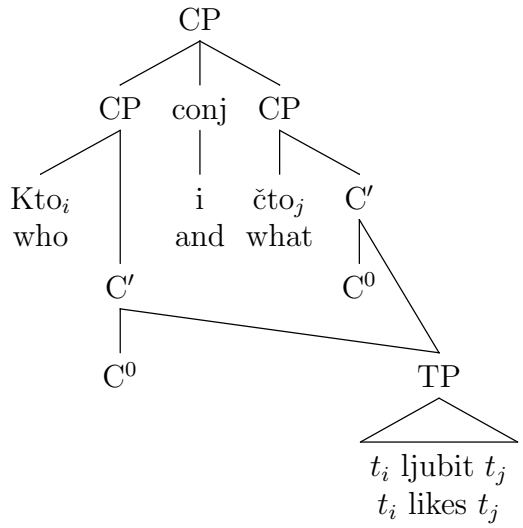
3.6.2 Multidominance

In several of papers, Barbara Citko and Martina Gracanin-Yuksek (Gracanin-Yuksek, 2007; Gracanin-Yuksek and Citko, to appear) offered a very different approach to conjoined wh-words in Slavic languages. In their account, patterns with hybrid coordinated wh-words are essentially an instantiation of clausal coordination, like in the ellipsis analysis. Of course only one clause has a full-fledged surface realization; the reason for this is however not a deletion operation (ellipsis) of one of the two clauses. Instead, the conjoined wh-questions are assumed to share most of their structure except the wh-words, so that structurally there is just one full clause to be realized. For example, a question with conjoined wh-words as in

(59) Kto i čto ljubit?
Who$_{\text{NOM}}$ and what$_{\text{ACC}}$ likes?
Who likes what?

could have a (schematic) tree diagram representation like this:

(60)



Citko and Gracanin-Yuksek argue that material of the two clauses can be shared in different ways but let us omit the details here. The empirical arguments for the syntactic account in

Gracanin-Yuksek (2007, 2012) are based on the distribution of clitics in questions with conjoined interrogatives in Serbo-Croatian (interestingly, Gruet-Skrabalova (2011) uses similar observations on Czech clitics to argue for a monoclausal account of HC without multidominance). But even Gracanin-Yuksek (2007) herself, as well as Gracanin-Yuksek and Citko (to appear), admit that multidominance structures that they argue for can not account for all the relevant data, and that, in addition to multidominance (if that exists), true coordination of unlikes must also be an available structure; see especially the interesting discussion in Gracanin-Yuksek (2007, 192ff.). We turn to this analytical option in the next section.

3.6.3 In-situ Coordination / sideward movement

Some scholars who analyzed conjoined wh-words take the simplistic line that wh-words are coordinated in situ rather than move from an underlying base position. Such was the treatment of Romanian wh-phrases in Hybrid coordination by Comorovski (1996) – the first account of coordination of unlikes in the tradition of formal semantics. Comorovski treated conjoined wh-words as a polyadic existential quantifier which binds multiple variables sitting in situ. This approach however runs into several kinds of analytical issues. First, syntactic dependency between conjoined wh-words and gaps/variables in the rest of the clause needs to be accounted for. Second, Comorovski's account has limited empirical coverage: it applies to single wh-words but not to larger phrases, which are also attested in Hybrid Coordination[8]. Third, postulating covert variables in syntax is a move whose consequences can not be fully assessed. Finally, taking into account other types of conjuncts, such as universal quantifiers, requires further modifications to Comorovski's proposal. To summarize, Comorovski's 'base-generation' proposal relies on silent elements that syntactically fill an empty argument position to which a wh-phrase corresponds, and are semantically interpreted as variables bound by that wh-phrases. In other words, Comorovski's 'variables'

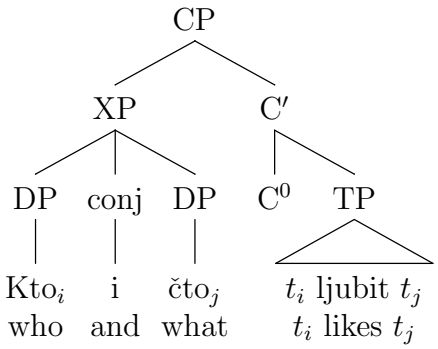
[8]Comorovski (p.c.) stipulates that if the conjunct wh-phrases are longer the contentful part reconstructs back into the in situ position(s).

behave as nothing else than traces. All of this makes a movement analysis more plausible. The polyadic quantification approach to HC in Paperno (2010) can be seen as an extension of Comorovski's semantic analysis, with the necessary changes.

Some analog of movement is needed for a proper account of syntax of HC because hybrid conjuncts satisfy selection requirements of the main predicates, e.g. *kto i kogo* 'who$_{\text{NOM}}$and who$_{\text{ACC}}$' combines with ordinary transitive verbs, *vse i vsem* 'everybody$_{\text{NOM}}$and exerybody$_{\text{DAT}}$' combines with verbs that take a dative object, etc.

Zhang (2007) proposed sideward movement as a way to account for the syntactic dependencies between conjoined wh-words and the rest of the sentence. She did not give up basic assumptions about tree structure, as in multidominance theories, but instead abandoned the idea (common in generative grammar) that movement always displaces a constituent in to a higher (c-commanding) position.

(61)



The treatment of Russian Hybrid Coordination in Chaves and Paperno (2007) is in a sense analogous to Zhang's sideward movement account. Even though the analysis is stated in the non-derivational framework of HPSG, Chaves and Paperno use a representational analog of movement (filler-gap dependency), where fillers (≈ moved constituents) do not c-command their gaps (≈ traces). Note though that in the HPSG framework fillers are not required to c-command gaps, and in general, c-command relation does not play as important a role in HPSG as it does in Government and Binding or Minimalism.

Chaves and Paperno (2007) was the first account of Hybrid Coordination that not only postulated the existence of conjoined unlike categories, but also provided an explicit formal analysis of how they are conjoined. One disadvantage of this analysis is its excessive complexity. The variety of HPSG's techniques invoked by Chaves and Paperno might make their analysis impenetrable to scholars not familiar with the framework. Below I propose an analysis that maintains the spirit of Chaves and Paperno's proposal but is much simpler and less stipulative.

3.7 Categorial Analysis

In this section, I propose an analysis of Hybrid Coordination in categorial grammar, improving on the HPSG account by Chaves and Paperno (2007). The proposal relies on the type logical approach to extraction (Vermaat, 2006). Type logical grammar is a strong lexicalist syntactic framework, which can be seen as an instantiation of the principles and parameters architecture. Two big advantages of categorial grammar over competing frameworks are that it is well understood mathematically and offers a straightforward syntax-semantics interface.

Type logical grammar (Lambek, 1961) represents syntactic derivation as a logical proof, where pairings of word sequences and syntactic categories are treated as statements. The official term for such statements is *sequents*. For example, *John* may be paired with the category np, written formally as a sequent $John \vdash np$. *Walks* has the category of a verb phrase, encoded $np\backslash s$. Statements about categories of phrases can be derived from statements on their constituents, e.g.

$$\frac{John \vdash np \quad walks \vdash np\backslash s}{John \circ walks \vdash s}\ \backslash E \tag{62}$$

via deduction rules. The last example uses the rule of *backslash elimination*, coded $\backslash E$.

Derivations of sentences work exactly as proofs in mathematical logic, following formal deduction rules. The objects manipulated in such logical calculations are syntactic categories, also called *types*. The grammar is a logic on strings and categories (types), and the whole framework is known as type logical grammar.

We saw in the last example that syntactic category names are not unanalyzable but are built from other categories via type constructors, which include:

- backslash: $A\backslash B$ is the category of elements that produce category B when combined with a constituent of category A on the left;
- forward slash: B/A is the category of elements that produce category B when combined with a constituent of category A on the right;
- modal constructors $\diamondsuit$ and $\square$ take the role of syntactic features. In particular, they are used (in this version of categorial grammar) to simulate syntactic movement; roughly, traces (gaps) are of type $\diamondsuit\square A$ where A is the category of the category of the missing constituent. $\diamondsuit$-marked types percolate until the gap they stand for is filled with a constituent of type
- $WH(A, B, C)$: a constituent that fills a gap of type A in the constituent of type B giving a constituent of type C.

Syntactic derivation is a form of logical deduction, governed by deduction rules (analogous to rules like *modus ponens* in sentential logic). Here are some rules used in type logical deduction. Slash elimination rules:

$$\frac{\Gamma \vdash A/B \quad \Delta \vdash B}{\Gamma \circ \Delta \vdash A} /E$$

$$\frac{\Delta \vdash B \quad \Gamma \vdash B\backslash A}{\Delta \circ \Gamma \vdash A} \backslash E$$

$\circ$ in the above rules is an operation on constituents that stands roughly for string concatenation. In the domain of syntactic types, concatenation corresponds to a different operation, $\bullet$, governed by rules

$$\frac{\Delta \vdash A \bullet B \quad \Gamma[(A \circ B)] \vdash C}{\Gamma[\Delta] \vdash C} \bullet E$$

$$\frac{\Gamma \vdash A \quad \Delta \vdash B}{\Gamma \circ \Delta \vdash A \bullet B} \bullet I$$

The operators $/, \backslash, \circ, \bullet$ are standard in the Lambek calculus. To model movement, Vermaat makes uses of additional *displacement postulates*, including:

$$\frac{\Gamma[\Delta_1 \circ (\Delta_2 \circ \blacklozenge \Delta_3)] \vdash C}{\Gamma[(\Delta_1 \circ \Delta_2) \circ \blacklozenge \Delta_3] \vdash C} Pr1$$

$$\frac{\Gamma[(\Delta_1 \circ \blacklozenge \Delta_3) \circ \Delta_2] \vdash C}{\Gamma[(\Delta_1 \circ \Delta_2) \circ \blacklozenge \Delta_3] \vdash C} Pr2$$

Essentially, displacement postulates allow the syntactic category of a moved constituent (marked with a $\diamond$) percolate up the three, until it eventually associates with a corresponding filler. This last step is accounted for by WH-type rules. To account for syntactic variation in the syntax of interrogatives, Vermaat proposes three such rules, including the following rule for overt extraction from the right branch:

$$\frac{\Gamma \vdash WH^r_{ex}(A, B, C) \quad \Delta \circ A \vdash B}{\Gamma \circ \Delta \vdash C} WH^r_{ex}$$

Willemijn Vermaat (2006) used this type logical system to analyze the syntax of wh-questions in various languages. Her analysis successfully applies to wh in situ languages and wh-movement languages, captures various wh movement phenomena such as multiple wh-movement and island constraints.

My analysis formalizes the idea that one can conjoin phrases that undergo the same type of extraction, e.g. two wh-phrases. This assumes that each of the other types of phrases in HC, e.g. universal quantifiers or negative pronouns, are subject to a special kind of movement. This goes along with numerous proposals in generative grammar, cf. the theory of Brown (1996) that negative (*ni-*) pronouns in Russian undergo movement to the specifier of NegP.

The category of standard coordination is often generalized as

(63) *i* 'and' $X\backslash X/X$,

where X stands for any category. For Hybrid Coordination the schema is more elaborate:

(64) *i* 'and' $F(X,B,C)\backslash F(X \bullet Y,B,C)/F(Y,B,C)$

where F stands for an extraction feature like WH, and X, Y, B, C are any categories.[9] A derivation of a question with conjoined interrogatives is given below for

(65) čto i komu ja dal?
what.ACC and who.DAT I.NOM gave
'What and to whom did I give?'

Combination of unlike categories under conjunction follows standard categorial rules:

[9]Another option is to assign conjunctions a special category (*i* 'and' *conj*) and generalize coordination as a deduction rule:

(i) a. Standard coordination rule:

$$\frac{I \vdash conj, X_1 \vdash A, ..., X_k \vdash A}{X_1 \circ ... \circ I \circ X_k \vdash A}$$

b. Hybrid coordination rule:

$$\frac{I \vdash conj, X_1 \vdash F(A_1,B,C), ..., X_k \vdash F(A_k,B,C)}{X_1 \circ ... \circ I \circ X_k \vdash F(A_1 \bullet ... \bullet A_k,B,C)}$$

(66)
$$\dfrac{\check{c}to \vdash WH^r_{ex}(\Diamond\Box_{\text{ACC}}, s, wh) \qquad \dfrac{i \vdash F(X,B,C)\backslash F(X \bullet Y,B,C)/F(Y,B,C) \quad komu \vdash WH^r_{ex}(\Diamond\Box_{\text{DAT}}, s, wh)}{i \circ komu \vdash WH^r_{ex}(\Diamond\Box_{\text{ACC}}, s, wh)\backslash WH^r_{ex}(\Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}, s, wh)}\ /E}{\check{c}to \circ i \circ komu \vdash WH^r_{ex}(\Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}, s, wh)}\ \backslash E$$

and the derivation of the rest of the sentence follows exactly Vermaat's analysis of multiple extraction, utilizing in addition an Associativity rule (Lambek, 1958):

$$\dfrac{\dfrac{\Diamond\Box_{\text{ACC}} \vdash \Diamond\Box_{\text{ACC}} \quad \Diamond\Box_{\text{DAT}} \vdash \Diamond\Box_{\text{DAT}}}{\Diamond\Box_{\text{DAT}} \circ \Diamond\Box_{\text{ACC}} \vdash \Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}}\ \bullet I \qquad \dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{dal \vdash ((\text{NOM}\backslash s)/\text{ACC})/\text{DAT} \quad \Diamond\Box_{\text{DAT}} \vdash \text{DAT}}{dal \circ \Diamond\Box_{\text{DAT}} \vdash (\text{NOM}\backslash s)/\text{ACC}}\ /E \quad \Diamond\Box_{\text{ACC}} \vdash \text{ACC}}{(dal \circ \Diamond\Box_{\text{DAT}}) \circ \Diamond\Box_{\text{ACC}} \vdash \text{NOM}\backslash s}\ /E}{ja \vdash \text{NOM}}\ \backslash E}{ja \circ ((dal \circ \Diamond\Box_{\text{DAT}}) \circ \Diamond\Box_{\text{ACC}}) \vdash s}\ Pr1}{(ja \circ (dal \circ \Diamond\Box_{\text{DAT}})) \circ \Diamond\Box_{\text{ACC}} \vdash s}\ Pr2}{((ja \circ dal) \circ \Diamond\Box_{\text{DAT}}) \circ \Diamond\Box_{\text{ACC}} \vdash s}\ Ass1}{(ja \circ dal) \circ (\Diamond\Box_{\text{DAT}} \circ \Diamond\Box_{\text{ACC}}) \vdash s}\ \bullet E}{(ja \circ dal) \circ (\Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}) \vdash s}$$

The coordinated wh phrase then combines with the sentence that has dual gaps via Vermaat's standard WH (ex-situ) rule:

$$\dfrac{(ja \circ dal) \circ (\Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}) \vdash s \qquad \check{c}to \circ i \circ komu \vdash WH^r_{ex}(\Diamond\Box_{\text{DAT}} \bullet \Diamond\Box_{\text{ACC}}, s, wh)}{\check{c}to \circ i \circ komu \circ ja \circ dal \vdash wh}\ WH^r_{ex}$$

3.8 Non-wh Coordinands in HC

In the last section, I have provided an analysis of heterogeneously coordinated interrogative phrases. But, as we've seen, in Russian HC extends beyond wh elements; universal quantifiers, negative concord items, etc., can be conjoined in a similar fashion. How will the analysis extend to these cases?

One option is to take the interrogative case as basic and derive the others from it. As we saw in 3.2.2, HC is most natural with elements that are morphologically related to wh-words. So we could derive indefinites, universals etc. with a rule that adds respective morphology:

(67) a. kto 'who' → kto-to 'someone'

b. gde 'where' → gde-to 'somewhere'

c. kto i gde 'who and where' → kto-to i gde-to 'someone and somewhere'

This kind of rule also has to change the syntactic category of the constituent it applies to. For instance, indefinites do not produce wh-questions but declarative sentences:

(68) $komu \vdash WH^r_{ex}(\Diamond\Box\text{DAT}, s, \mathbf{wh}) \rightarrow komu\text{-}to \vdash WH^r_{ex}(\Diamond\Box\text{DAT}, s, \mathbf{s})$

Another possibility is to assign a different extraction feature/type constructor to each subtype of constituent that can participate in HC, for instance *WH* for interrogatives, *IND* for indefinites, *ALL* for universals etc. Then syntactic composition of non-interrogative HC could be isomorphic to the interrogative case modulo the extraction feature:

(69) $$\dfrac{\check{c}to\text{-}to \vdash IND^r(\Diamond\Box\text{ACC}, s, s) \quad \dfrac{i \vdash F(X,B,C)\backslash F(X \circ Y, B, C)/F(Y,B,C) \quad komu\text{-}to \vdash IND^r(\Diamond\Box\text{DAT}, s, s)}{i \circ komu\text{-}to \vdash IND^r(\Diamond\Box\text{ACC}, s, s)\backslash IND^r(\Diamond\Box\text{DAT} \circ \Diamond\Box\text{ACC}, s, s)}\,\backslash E}{\check{c}to\text{-}to \circ i \circ komu\text{-}to \vdash IND^r(\Diamond\Box\text{DAT} \circ \Diamond\Box\text{ACC}, s, s)}\,/E$$

Conclusion

Syntactic derivation of HC poses difficulties for many syntactic theories, and attempts to explain away coordination of unlikes via mechanisms like ellipsis or sharing are understandable. In this chapter, I presented evidence that coordination of unlike categories is possible, even if it is (apparently) an exotic property of Russian and neighboring languages of Eastern Europe. I also proposed a way to treat Hybrid Coordination in categorial grammar — a tightly restricted and well-understood theory of syntax. I will rely on this proposal for semantic analysis in the following chapter.

This is a welcome result from the viewpoint of a generative grammarian. Categorial grammars can be interpreted as a formalization of the Principles and Parameters approach to Universal Grammar (cf. Lecomte and Retoré, 1999; Vermaat, 2006). Moreover, there has been a huge progress in understanding the relation between categorial grammars and

minimalist grammars; a class of categorial grammars (extending the Lambek calculus) is equivalent to minimalist grammars (Amblard et al., 2010; Amblard, 2011).

Additional appeal of categorial grammars comes from their clean and simple syntax semantics interface. The categorial grammar approach allows for a simple, rule-by-rule compositional semantics which is problematic for alternative syntactic accounts for Hybrid Coordination like multidominance (Gracanin-Yuksek, 2007). Recall that viable analyses of Hybrid Coordination involve either multidominance structures or multiple sideward movement, as illustrated above in (61). Neither approach is directly compatible with the standard compositional mechanism for interpreting extraction (Heim and Kratzer, 1998), because the syntactic structures involved are non-standard. But type logical derivations as in the last example are immediately interpretable via the Curry-Howard correspondence (van Benthem, 1983). For example, *ja dal* 'I gave' in the last example is, by general principles, interpreted as a two-place predicate $\lambda x.\lambda y.\mathbf{gave}(x)(y)(\mathbf{I})$. This binary predicate then combines with the binary quantifier denoted by the Hybrid Coordinated constituent *čto i komu* (Paperno, 2010), resulting in the correct denotation $WH\langle x, y\rangle.\mathbf{gave}(x)(y)(\mathbf{I})$ ('for which pair of x and y did I give x to y?').

This chapter elucidates the core syntactic properties of HC. Still, many syntactic issues remain open open. The most important of them is the problem of why these and not other kinds of constituents can be hybrid conjuncts. Paradigmatic relation of quantifiers to wh-words clearly correlates with the ability for those quantifiers to participate in hybrid coordination (I call this observation the Paradigm Puzzle). This generalization can be easily incorporated into the two kinds of analysis that I outlined, but it may have a deeper explanation. I would speculate that HC arose historically as a generalization of an ellipsis pattern in wh-questions. It is plausible that it would generalize more easily to syntactic items that are morphologically related to wh-words. An additional factor here could be that the construction was originally based on combinations of two modifiers (such as *where and when*, a combination possible even in languages that do not otherwise allow for HC),

expanding to modifier + argument and argument + argument coordination. Of course, this generalization pattern can be reproduced only with those quantifiers which have at least two adjunct forms and an argument form. This property already points toward the quantifiers whose paradigm is sufficiently parallel to the paradigm of wh-words. For other syntactic properties of HC, such as restrictions on modification and prosodic weight restrictions on conjuncts, see Chaves and Paperno (2007); some of them still lack a principled explanation.

CHAPTER 4

Semantic properties of Hybrid Coordination

This chapter reports observations on the semantic interpretation of HC. I review several approaches to a compositional semantics for HC, argue that the one I call the Resumption Hypothesis is the most adequate of these in terms of simplicity and descriptive adequacy, and provide a compositional treatment for the Resumption Hypothesis. Nonetheless there are some shortcomings with the Resumption Hypothesis, and I will propose a potential replacement for it in the following Chapter 5 while extending the analysis to a few other coordination patterns.

4.1 Emphasis

Up to now, little had been known about the interpretation of Hybrid Coordination. Most of the research generally ignored meaning, focusing on syntactic properties of Hybrid Coordination. Some scholars explicitly assumed that examples of HC are always equivalent to minimally different examples without coordination (Peretrukhin, 1979; Chaves and Paperno, 2007). This may be a good first approximation, but in general it is not true. Omitting the coordinator *i* does not always produce an equivalent sentence, even though the contrast may be subtle.

In some cases the only difference perceived is pragmatic: a coordinate structure, compared to a non-coordinate one, bears some kind of emphasis. As Sannikov notes, the sentence

(1) Ja govorju [s poétom i o poéte].
I talk with poet and about poet.
'I talk with a poet about a poet' (Sannikov, 1989, 19, ex. 35a)

emphasizes lexical homogeneity of the conjuncts, as opposed to the neutral

(2) Ja govorju s poétom o poéte.
I talk with poet about poet.
'I talk with a poet about a poet' (Sannikov, 1989, 19, ex. 35b)

Sannikov spells out the meaning of (1) as 'I'm talking, and the topic under discussion and the interlocutor are equally poets' (Sannikov, 1989, 19). In a similar vein, the following sentences with HC (natural examples from Russian fiction) are perceived as emphatic in contrast with their non-coordinated counterparts:

(3) a. Nikto i nikogda ne vidal ego smejuščimsja
NI-who and NI-when not saw him laughing
'Nobody has ever seen him laughing.' (Ivan Panaev)

b. Nikto nikogda ne vidal ego smejuščimsja
NI-who NI-when not saw him laughing
'Nobody has ever seen him laughing.' (modified (a))

c. Doživëš′ do pobedy — vsë i vsem dokažeš′.
live.FUT.2SG until victory — everything.ACC and everyone.DAT prove.FUT.2SG
'Live until the victory, and then you'll be able to prove everything to everyone'.

(Konstantin Simonov, *Live and dead*)

d. Doživëš′ do pobedy — vsë vsem dokažeš′.
live.FUT.2SG until victory — everything.ACC everyone.DAT prove.FUT.2SG
'Live until the victory, and then you'll be able to prove everything to everyone'.

(less emphatic)

e. Vam, napr., skažut, čto kto-to i gde-to vzjatku dal
you.DAT e.g. say.FUT that someone and somewhere bribe gave
'For example, they tell you that somewhere someone paid a bribe.'

(Nikolai Dobroljubov)

f. Vam, napr., skažut, čto kto-to gde-to vzjatku dal
you.DAT e.g. say.FUT that someone somewhere bribe gave
'For example, they tell you that somewhere someone paid a bribe.'

Emphasis can be seen as nothing else but focus. If so, the emphatic character of HC is related to the observation by Grosu that heterogeneous conjuncts in English always "include a subelement in focus" (Grosu, 1987, 425); compare also the observation that in Hungarian universally quantified phrases can enter heterogeneous coordination only if stressed, cf.:

(4) Ide *[mindenki és mindig]/ MINDENKI és MINDIG bejöhet.
here everyone and always EVERYONE and ALWAYS enter-can.
'EVERYONE can ALWAYS enter here' (Lipták, 2001, 127, ex. 76), gloss and translation follows Gazdik (2011, 49, ex. 147)

However, interpretive contrasts between HC and corresponding non-coordinated structures go beyond mere emphasis; in some cases omitting *i* leads to a difference in felicity or even truth conditions.

4.2 The Interpretation of Conjoined Wh-words

4.2.1 Single Pair vs. Pair List Question Readings

Comorovski (1996), who analyzed, among other things, Romanian wh-questions, discovered a non-trivial contrast between heterogeneously coordinated and non-coordinated wh-constituents. Kazenin (2000) observed that Russian shows exactly the same contrast which can be illustrated with the following examples:

(5) a. Kto i kogo pobedil?
who and whom defeated
'Who was the winner and who was the loser?'

b. Kto kogo pobedil?
who whom defeated
'Who defeated whom?'

c. Kto pobedil?
who won
'Who won?'

As reflected in the translation, the question with coordinated wh-words (5-a) is not fully equivalent to a conventional multiple wh-question (5-b). The difference is pragmatic: the felicity of each form of the question depends what the speaker who asks the question knows. Two scenarios, known as the Single Pair scenario and the Pair List scenario, draw a sharp divide between the two types of questions. Under the Single Pair scenario (where (5-a) but not (5-b) can be uttered) the speaker knows there was exactly one relevant event of defeat and, accordingly, expects one pair of arguments in the answer. In one form of a Pair List scenario (where (5-b) but not (5-a) can be uttered) the speaker knows that there have been multiple events of defeat, knows all the winners and all the losers, and requests to fill in the pairing between the winners and the respective losers they defeated. This presumes that the answer would contain multiple winner-loser pairs.[1] The distinction, known as Single Pair reading vs. Pair List reading, makes questions with coordinated wh-phrases similar to simple wh-questions like (5-c), which are also most naturally uttered if the speaker assumes there has been just one winning event and requests the identity of the single winner (analogous to the Single Pair scenario). On the other hand, (5-c) is not felicitous if the speakers knows of many distinct winning events and asks to identify the winner in each (analogous to the Pair List Scenario).

[1]The two scenarios just discussed are chosen as diagnostic for the Single Pair vs. Pair List readings of multiple wh-questions, but they do not exhaust the range of possible scenarios in which questions in (5) can be felicitously uttered. The speaker can be in many other possible knowledge states, which fail to make as clear cut distinctions between forms of felicitous questions; for example, she may know that there was just one relevant fight, know both sides of the fight, and know that one of them defeated the other. Then the request is to identify the winner and the loser of a particular fight (as in the Single Pair Scenario) among the already known participant set (as in the Pair List Scenario above). In this setting, both forms of question are acceptable, even though (5-b) (= Pair List) is somewhat better.

The Pair List reading of questions is often characterized in terms of the type of answer that the question requires, i.e. whether the answer should list pairs, cf. Krifka (2001, 1), Gazdik (2011, 4), Hagstrom (1998) etc. This is a natural simplification, convenient for expository purposes, but it idealizes the conversational situation in at least two ways (both common in the study of questions). First, only direct answers in a particular form ('Who left?' — 'John left.') count as answers, while in practice partial or suggestive answers are pragmatically admissible (e.g. 'Who left?' — 'It might have been John.'). Second, only those answers count that are compatible with the asker's presumptions (e.g. existence of multiple pairs). But such presumptions might be false, and a pragmatically adequate answer may refute them ('Which dish did every guest make?' — 'Nobody made anything'). Speakers are generally not aware of these theoretical idealizations, so asking whether a particular question can be seconded with a single pair or a pair list answer can easily lead to false positives in both directions, depending on the respondents pragmatic imagination. For example, a single pair answer could be a partial response to a Pair List question, expressing all the relevant information known to the responder (in which case it is more cooperative to indicate lack of further knowledge explicitly, "I don't know about the rest") or an answer refuting the Pair List presumption (in which case it may be more cooperative to state that explicitly, "Nobody else made anything"). In practice, to elicit more accurate judgements, it is helpful to present speakers with full scenarios specifying the asker's background knowledge/assumptions, rather than mere question-answer pairs; I follow Grebenyova (2004) in relying on scenarios as a diagnostic.

4.2.2 Rhetorical Reading

There is another, previously unnoticed, contrast between coordinated wh-words and (conventional) multiple wh-words. The contrast lies in the availability of a rhetorical question reading, also known as negative bias reading. It is known that multiple wh-questions like (6-b) usually can not function as rhetorical questions. Questions with conjoined wh-

questions like (6-a) can be used as rhetorical questions, and often are:

(6) a. Kto i kogda platit nalogi?
who and when pays taxes
rhetorical reading available: 'Nobody ever pays taxes.'

b. Kto kogda platit nalogi?
who when pays taxes
rhetorical reading not available, only 'Who pays taxes when?'

c. Kto platit nalogi?
who pays taxes
rhetorical reading available: 'Nobody pays taxes.'

Notice that single wh-questions like (6-c) can also be used as rhetorical questions. In this respect again, coordinated wh-words behave like single wh-words.

4.2.3 Exclamative Reading

There is another known difference between single wh-questions and multiple wh-questions (suggested to me by Jessica Rett). Single wh-questions allow for exclamative readings as in (7-a), multiple wh-questions do not. It is hard to construct a sentence with multiple wh-words that would potentially invite an exclamative reading, and (7-c) represents my best attempt. It can only be interpreted as a question and not as an exclamation. The minimally different sentence with conjoined wh-words (7-b), in contrast, has an exclamative interpretation available:

(7) a. Kakie ljudi mne zadavali voprosy!
what people me asked questions
exclamative reading: 'how clever were were the guys who asked me questions!'

b. ?Kakie ljudi i kakie voprosy mne zadavali!
what people and what questions me asked
exclamative reading available: 'how clever were were the guys who asked me questions and how clever were the questions themselves!'

	Conjoined WH	Single WH	Multiple WH
List scenario	no	no	yes
Rhetorical reading	yes	yes	no
Exclamative reading	?yes	yes	no

Table 4.1: Interpretational contrasts of wh-questions

c. #Kakie ljudi kakie voprosy mne zadavali!
what people what questions me asked
(exclamative reading not available at all)

(I must admit that (7-b) in question does not sound perfect under any reading, either as a question or as an exclamation (as expressed by the question mark '?'). This may be due to the tendency for conjuncts in Hybrid Coordination to be one phonological word in length. But to the extent that this example is acceptable at all, it can have an exclamative reading.)

It is not clear how much weight the contrast in the availability of exclamative reading should have in our argument, given that not a single exclamative example of the kind of (7-b) has been found in real usage. Nonetheless, I find it necessary to report this contrast.

4.2.4 Preliminary Summary

The data considered so far can be summarized in the following table. One can generalize that with respect to the three criteria considered the HC questions pattern with single wh-questions, as opposed to multiple wh-questions.

The similarities in the meaning of conjoined wh-phrases and single wh-phrases are striking. This may have come out naturally if questions with conjoined wh-words were in reality an instance of elliptical conjunction of two single wh-questions. Indeed, conjoined questions would have inherited the properties of single wh-questions they contain. Such an explanation is likely correct historically, but can not work synchronically. To begin with, the ellipsis

hypothesis is an untenable assumption on syntactic grounds as Kazenin (2000) has shown. And even with regard to interpretation the ellipsis hypothesis does not correctly predict all the facts. Take the full non-elliptical version of (6-a), as well as its more natural equivalent:

(8) a. Kto platit nalogi i kogda on platit nalogi?
who pays taxes and when he pays taxes
'Who pays taxes and when does he pay taxes?'

b. Kto platit nalogi i kogda on èto delaet?
who pays taxes and when he this does
'Who pays taxes and when does he do so?'

It turns out that even though both of these are (more or less) equivalent to (6-a), neither of them can be felicitously uttered as a rhetorical question. So there must be a separate interpretational mechanism responsible for the similarity of single wh-words and conjoined wh-words.

It is plausible that the facts in (8) may receive an independent explanation; if so, the evidence of (8) might be only suggestive, not decisive. There are two plausible lines of explanation, based on either prosody or presupposition. One may argue that the felicity of questions in rhetorical use is in part determined by their length measured in some phonological units, perhaps mediated by a special prosodic pattern of rhetorical questions. If this is the case, ellipsis may indeed affect length and hence the availability of rhetorical reading. Alternatively, one might argue that overt but not elided structure triggers existential presupposition in (8), so it the presence of the overt pronoun *on* 'he' or the agreement marking on *platit* that is responsible for the unappropriateness of examples in (8) as rhetorical questions.

4.3 Towards an Analysis: Resumption Hypothesis

4.3.1 Earlier Work

Kazenin (2000) was the first who tried to explain the semantic effect of single-pair reading, appealing to coordinate structure blocking quantifier raising following a proposal by Kiss (1993). Recently, Gribanova (2009) proposed that coordinate structure prevents the absorption of wh-quantifiers in the sense of Higginbotham and May (1981). These analyses, however, concentrate on deriving the difference between pair list and single-pair readings as in (5-a) and (5-b), and are not explicit about what exactly the interpretation of conjoined wh-words is. The proper treatment of wh-questions, and especially multiple wh-questions, remains an open issue, compare Kiss (1993); Hagstrom (1998); Šimík (2009, 2010) for a diversity of approaches. But regardless of the details of how the meaning of wh-words is represented, one can make the following generalization: the coordination of wh-words behaves as if it represented a single wh-quantifier. The domain of quantification for such a quantifier is unusual and consists of pairs (or tuples). For instance, *kto i gde* 'who and where' ranges over pairs of animate beings and places, so that a question containing this coordinate phrase (kto i gde živët? 'who lives where?') requests information on the pair of which a predicate (in this case the binary 'live at') is true, and the corresponding exclamative sentence expresses surprise by a property of the pair; cf. ordered pairs as the domain of Japanese multiple exclamatives as analyzed by Ono (2006).

4.3.2 The Resumption Hypothesis

The interpretation of conjoined wh-words is equivalent to a binary (or polyadic) quantifier of a special kind, the one produced by the resumption of a wh-quantifier. A quantifier in universe M is defined as a predicate on predicates in M. For instance, if M=2=$\{0,1\}$, then unary quantifiers on M are predicates on the set $\{Id_M, \lambda x.1, \lambda x.0, \lambda x.\neg x\}$. Assume

that we deal with *global* quantifiers, i.e. quantifiers defined on all universes (Peters and Westerståhl, 2006, 80). Resumption $Res^k(Q)$ of a quantifier Q is defined as Q applied to the universe of k-tuples. For instance, $Res^3(\forall)$, Res^3 applied to the universal quantifier $\forall$, is a universal quantifier over triples $\lambda P.\forall\langle x,y,z\rangle P(\langle x,y,z\rangle)$. Resumption is attributed to the interpretation of quantificational adverbs (Peters and Westerståhl, 2006, 352–354). For example, *mostly* in *Men are mostly taller than women* could be viewed as binary resumption of the quantifier $MOST$ $Res^2(MOST)$. The sentence then can be paraphrased as 'for most pairs $\langle x,y\rangle$ where x is a man and y a woman, x is taller than y.'

So let us explore the possibility of interpreting conjoined wh-words via quantifier resumption. Wh-quantifiers are not quantifiers in the usual sense, but many properties of quantifiers can be extended to them. While quantifiers are functions from properties on a universe M to truth values, wh-quantifiers are functions from properties on a universe M to questions. Questions are defined in various ways, usually as properties of propositions; for one alternative, see Rexach (1997).

Res^2 applied to a wh-quantifier produces a wh-quantifier over pairs, paraphrased in English roughly as 'for what pair $\langle x,y\rangle$.' The actual representation of such a resumptive wh-quantifier may be different, depending on one's choice of representation for single wh-words. Options include: a single existential quantifier over pairs (in Karttunen-style semantics), a single Q-morpheme attaching to a conjoined phrase (in Hagstrom-style analysis), or absence of any special operator (in Hamblin alternative semantics). In contrast, non-conjoined multiple wh-words (*Which student read which book?*) are interpreted as a complex quantifier combination, roughly paraphrased in English as 'for each x, what y' ('for each student x, identify the books y that x read'); again, representations may vary to a great extent.

If we assume that conjoined wh-phrases represent a single polyadic (resumptive) wh-quantifier, all the instances of parallelism with single wh-questions immediately follow from this assumption. Already (May, 1989, 414) proposed resumption as an interpretive mechanism for certain multiple wh-questions, so the resumption interpretation of conjoined wh-

words is not completely unprecedented. Generalizing our observations on conjoined wh-words, one can propose a further hypothesis, call it the Resumption Hypothesis: a (single) resumptive quantifier over pairs (or tuples) is the proper interpretation of Hybrid Coordination with quantifiers. Before considering more semantic data, let us outline the alternative ways in which quantifier combinations may be interpreted.

4.3.3 Some a priori possible interpretation mechanisms

Let us list some a priori possible types of interpretation of two quantifiers F, G applied to a binary predicate R which have been proposed in the linguistic literature. First, two quantifiers can be in a scopal, or distributive relation ($F > G$ or $G > F$), which means that one of them is applied to R as an arity reducer, and the other is applied to the result, yielding $F(G(R))$. This is the most familiar kind of quantifier combination. Take the generalized quantifiers denoted by the English noun phrases *two girls* and *three boys*. If these two quantifiers are interpreted distributively (two girls > three boys) in the sentence *Two girls know three boys*, it is true iff there are two girls such that each of them knows three boys (perhaps, but not necessarily, different three boys for each girl). One model for this is represented in the Figure 4.1 where arrows represent the relation of knowing:

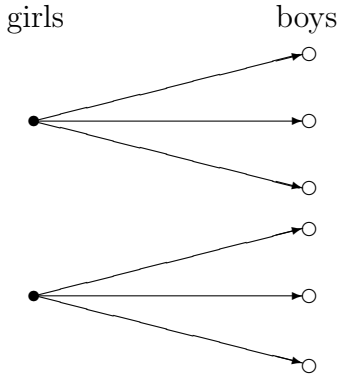


Figure 4.1: Scopal (distributive) reading, 2 > 3

Another type of interpretation of two quantifiers, the cumulative interpretation (Peters

and Westerståhl, 2006, 631), involves quantifying separately over the domain and the range of the relation, or over the domain and range of a subset thereof, as definition (9) implies:

(9) $(F, G)^{cum}(R) \Longleftrightarrow \exists X \exists Y [F(X) \& G(Y) \& [\forall x \in X \exists y \in Y : \langle x, y \rangle \in R_{FG}] \&$
$[\forall y \in Y \exists x \in X : \langle x, y \rangle \in R_{FG}]]$

where R_{FG} is defined as R relativized to the conservativity domains of F and G: $R_{FG} = R \cap (P_F \times P_G)$ if $F = Q_F(P_F)$ and $G = Q_G(P_G)$ for conservative Q_F and Q_G.

The cumulative interpretation of a pair of quantifiers can be forced with expressions like 'between them', as in

(10) The directors only received £1000 between them

In the case of *Two girls know three boys*, the cumulative reading is true if there are two girls, there are three boys, and they are all involved in the knowing relation in some way, even though each of the two girls does not have to know each of the three boys. One situation where this is true is schematically rendered on the following figure:

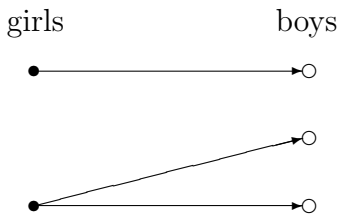


Figure 4.2: Cumulative reading of *two girls* and *three boys*

Branching reading, symbolized as $(F \times G)$, is similar to the cumulative one except each pair must be included in the relation, and the two sets of arguments must be maximal. Thus, for the sentence *Two girls and three boys all know each other* the branching reading

is true if there is a set of two girls and a set of three boys, each of the two girls knows each of the three boys, each of the three boys knows each of the two girls, and no additional girls or boys can be added to the respective groups while maintaining the complete mutual knowledge between the members of the two groups. Figure 4.3 illustrates such a setting.

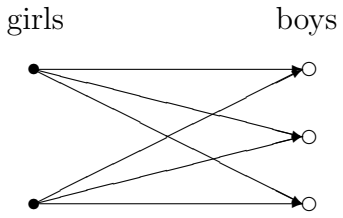


Figure 4.3: Branching reading of *two girls* and *three boys*

The following formula from Beghelli et al. (1997, adapted from Sher 1990) defines the branching reading:

(11) $(F, G)^{branching}(R) \Longleftrightarrow \exists X \exists Y[F(X) \& G(Y) \& (X \times Y \subseteq R_{FG}) \&$
$\forall X' \forall Y'[X \times Y \subseteq X' \times Y' \subseteq R_{FG} \Rightarrow X \times Y = X' \times Y']]$

where R_{FG} is defined as R relativized to the conservativity domains of F and G: $R_{FG} = R \cap (P_F \times P_G)$ if $F = Q_F(P_F)$ and $G = Q_G(P_G)$ for conservative Q_F, Q_G. (Barwise (1979) proposed a slightly different definition of branching, but the two definitions are equivalent with respect to the example under discussion, and the difference between these notions would not affect the argument here.)

Based on somewhat different sets of data, Fauconnier (1975) and Szabolcsi et al. (1997) argue that in English sentences with transitive verbs, subject and object quantified NPs are not interpreted via branching. But Barwise (1979) suggests more convincing examples of branching quantification in English based on sentences with coordinate quantified NP, so

let us not exclude branching as an interpretive option.

Finally, an option to consider in our case is resumption, which means, as defined above, applying a single quantifier to predicates over pairs or tuples of entities instead of ordinary predicates over entities Peters and Westerståhl (2006, 352). This is strictly speaking a single quantifier, not a way of combining two distinct quantifiers (note that the theory of May (1989, 43 and following) in which a resumptive quantifier is derived from two identical quantifiers is strictly speaking not compositional.). But since in all the examples of Hybrid Coordination two conjuncts bear identical quantifier markers, it still can make sense to speak of resumption as an interpretive mechanism.

4.3.4 Evidence from HC with Non-Interrogative Quantifiers

I will now discuss the interpretation of Hybrid Coordination with quantifiers other than wh-words. In all the examples considered, there is a non-truth-conditional difference between sentences with HC and their counterparts without coordinator *i*. Truth conditions do not change when the conjunction *i* is removed from sentences with coordinated negative concord items, universal quantifiers, or indefinite pronouns. But native speakers still report a certain contrast in such pairs of examples: the version with Hybrid Coordination is perceived as emphatic. Below I will ignore this emphasis and concentrate on the truth conditional aspect of meaning.

Let us start with a trivial example. A large class of quantifier words that can participate in Hybrid coordination are indefinites of various kinds. Under any reasonable analysis indefinites contribute an existential quantifier to the meaning of the sentence. It turns out that with existential quantifiers all the four types of interpretation are equivalent. Let me explain informally why this is the case. Assume the scopal reading holds: $\exists x \exists y R(x, y)$. Logically, the two formulae (for scopal and resumptive readings) are equivalent and mean that R is non-empty: $\exists x \exists y R(x, y) \equiv \exists \langle x, y \rangle R(x, y)$. Whenever a relation R is non-empty,

its domain and range are non-empty (verifying the cumulative combination of two existential quantifiers). Moreover, in a non-empty relation R (such that $\exists\langle x, y\rangle \in R$) there will always be a subset equal to the Cartesian product of its own domain and range (e.g. any unit subset $\{\langle x, y\rangle\} \subseteq R$, since $\{\langle x, y\rangle\} = Dom(\{\langle x, y\rangle\}) \times Ran(\{\langle x, y\rangle\}) = \{x\} \times \{y\}$) and hence there will always be a maximal such subset (under the assumption the two quantifiers range over a finite domain, which is plausible for the everyday usage of natural language). Since all the possible interpretation modes produce the same result for existentials, it is not surprising that examples with Hybrid Coordination of indefinites are truth-conditionally equivalent to examples without coordination:

(12) a. Dopustim, kto-libo i kogo-libo pobedil.
assume someone.NOM and someone.ACC defeated
'Assume that someone defeated someone.'

b. Dopustim, kto-libo kogo-libo pobedil.
assume someone.NOM someone.Acc defeated
'Assume that someone defeated someone.'

The meaning of Hybrid Coordination of indefinites is not informative because it is compatible with any of the four interpretations. Let us turn to another, more informative case of *vs*-words, which bear universal quantificational force. Universal quantifiers produce equivalent interpretation under resumption and under the composition of two identical quantifiers, either scopal or branching. In all the three cases the domain and range of the relation must contain all the individuals, and must be fully connected with each other.

(13) a. Vse i vsex pobedili.
everybody.NOM and everybody.ACC defeated
'Everybody defeated everybody.'

b. Vse vsex pobedili.
everybody.NOM everybody.ACC defeated
'Everybody defeated everybody.'

c. Vsë i so vsem svjazano.
everything and with everything related
'Everything is related to everything', equivalent to

d. Vsë so vsem svjazano.
everything with everything related
'Everything is related to everything'

e. Ja vsë i vsem prošču
I.NOM everything.ACC and everyone.DAT condone.FUT
'I will condone everything to everyone' (NCRL: Maksim Gorky, *Mužik*)

One interpretation not compatible with these is cumulative interpretation, which only requires every individual to be in the domain and in the range of the relation, but does not necessarily require full connectedness. The cumulative combination of two universal quantifiers is weaker than the other three equivalent interpretations. Here is a situation where cumulative interpretation of a sentence like (13-b) would be true: there is one person who defeated everyone, and one person who was defeated by everyone. This setting is illustrated in figure 4.4 below. Crucially, both sentences (13-a) and (13-b) can be judged false in such a setting, which allows us to exclude cumulation as the interpretive mechanism for HC.

Similarly, (13-c) could be true under the cumulative reading in the following setting. Assume that Maksim Gorky's friend A offended him, and so did B; in addition to this, A and B did a third action against Gorky together. So there were two offenders and three acts of offence. Then Gorky would forgive A for his action a, and B for the action b and the offence c shared with A, but he couldn't forgive A for c. Then the cumulative interpretation would predict (13-c) to be true (both offenders were forgiven, as were all three acts of offence), contrary to the natural judgement.

Generalizing over the two cases considered, we may say that HC is equivalent to non-coordinated quantifiers when resumption of a quantifier is equivalent to its iterative application and to their branching combination (this is a property of $\exists$, $\forall$, and Q_{odd} ('an odd number of') but no other logical (isomorphism invariant) quantifiers, as shown by West-

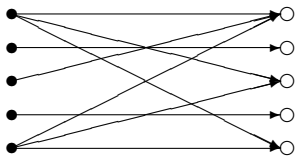


Figure 4.4: A true setting for cumulation of two universal quantifiers

erståhl (1994) for finite universes).

This means that combinations other types of quantifiers have to be more informative. Take the case of conjoined negative quantifiers on the model *ne + WH*, like *nekogo* '(there is) nobody (to)' formed from question words with the particle/prefix *ne*:

(14) a. Nekomu i nekogo pobedit'.
nobody.to.DAT and nobody.to.ACC defeat
'There's nobody to defeat someone and nobody to be defeated,' or 'Nobody can defeat anybody.'

b. *Nekomu nekogo pobedit'.
nobody.to.DAT nobody.to.ACC defeat

Coordination of two ne-quantifiers in this example produces the meaning equivalent to 'there is no pair $\langle x, y \rangle$ such that x could defeat y.' This excludes the composition of two quantifiers as an interpretational option. Indeed, a (logically possible) combination of two negative quantifiers would yield the interpretation 'nobody is such that he can defeat nobody,' equivalent to 'everybody is such that it is not the case that for no person he can defeat that person,' or 'everybody is such that for some person he can defeat that person,' in other words, 'everybody can defeat someone.' This is not the same as the actual meaning of the sentence, which is in accordance with the resumption reading, as well as cumulative and branching readings.

Negative concord items (*ni* + wh-words), as I have mentioned previously, constitute the second most frequent case of Hybrid Coordination after the interrogative words. In all such examples the conjunction *i* can be omitted without change in truth conditions:

(15) a. Nikto i nikogo ne pobedil
nobody.NOM and nobody.ACC not defeated

b. Nikto nikogo ne pobedil
nobody.NOM nobody.ACC not defeated
'Nobody defeated anybody' (equivalent)

The last illustrative example involves the downward entailing quantifier 'not all,' expressed by a combination *ne+vs*-word:

(16) a. Ne vse i ne vsex obmanyvajut
not everyone.NOM and not everyone.ACC cheat
'It is not the case that everyone cheats everyone,'

which is semantically the negation of

b. Vse i vsex obmanyvajut
everyone.NOM and everyone.ACC cheat
'Everyone cheats everyone.'

Not all speakers accept such examples with Hybrid Coordination of such quantifiers, but those who do interpret it as the negation of *vse i vsex obmanyvajut* 'everybody cheats on everybody'. This reading is exactly what the resumption of 'not all' would produce when applied to a binary relation: 'not all pairs $\langle x, y\rangle$ are such that x cheats y.' The corresponding sentence without coordination is of even less acceptable and, if interpreted at all by native speakers, has a different meaning 'not all x are such that they defeated not all y,' or, equivalently, 'someone defeated everybody:'

(17) a. Ne vse i ne vsex pobedili.
not everybody.NOM and not everybody.ACC defeated

'It is not the case that everybody defeated everybody.'

b. ??Ne vse ne vsex pobedili.
not everybody.NOM not everybody.ACC defeated
'??Not everybody defeated not everybody.'

This kind of example is the most informative of all we have considered. It allows us to narrow down the choice of interpretational principle for Hybrid Coordination to just one candidate. Since other options have already been ruled out, let me explain why the branching combination of two not all quantifiers does not work. First notice that (17-a) is true in the following setting: everybody defeated everybody with a single exception: John didn't defeat Mary but defeated everyone else, and Mary was defeated by everyone else but John. Schematically, one can represent such a relation in a diagram with one connection missing (between A and B):

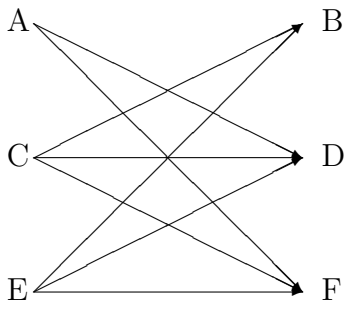


Figure 4.5: Relation consisting of all but one pairs

What does the branching combination of quantifiers F and G require to be true of relation R? It requires the existence of a maximal subrelation R' which is a crossproduct of two sets, X and Y, such that $F(X)$ and $G(Y)$ In our case F and G are 'not all.' Indeed, one can easily find crossproduct subrelations whose domain and range do not contain all the individuals. But none of such subrelations can be maximal. In fact, there are two maximal subrelations of the given one which are crossproducts of two sets. One of them is $D \times (D - \{m\})$, i.e. the crossproduct of the set of all individuals with the set of all

individuals but Mary; the other is $(D - \{j\}) \times D$, i.e. the crossproduct of the set of all individuals but John with the set of all individuals. Neither of the two subrelations satisfies the requirement that not all must be true of both its domain and its range.

To summarize, in the case of non-interrogative quantifiers, HC interpretation is equivalent to resumption of the relevant quantifier. The Resumption Hypothesis provides a reasonable approximation for the denotation of HC; alternative interpretive mechanisms considered so far proved inferior.

4.4 Replicating HC Properties in Ordinary NP Conjunction

A major finding of this paper is the fact that semantic effects of Hybrid Coordination can be replicated with ordinary coordination, even in languages other than Russian. Such contrasts are best shown in sentences with symmetric predicates (e.g. 'date' or 'intersect'), whose arguments may or may not be expressed as a conjoined constituent. Similar observations also hold for sentences with *respectively*.

(18) a. Which man and which woman are dating each other?
b. Which man is dating which woman?
c. Which man and which woman invited John and met him afterwards respectively?
d. Which man invited John to meet which woman?

(18-a) can not be felicitously uttered in a Pair List Scenario where the speaker assumes that there was more than one dating pair, (18-b) without coordination can, fully parallel with conjoined wh questions vs. multiple wh questions as discussed in 4.2.1; (18-c,d) illustrate the same contrast for NP conjunctions with *respectively*.

Questions with conjoined and non-conjoined interrogative phrases contrast in availability of rhetorical (negative bias) readings, just like hybrid conjunctions vs. multiple wh questions as discussed in 4.2.2:

(19) a. What man and what woman are married to each other?
(rhetorical reading OK)
b. What man is married to what woman? (no rhetorical reading available)

As (12d) and (12e) indicate, ordinary coordination has exactly the same properties as HC with regard to the exclamative reading: conjoined wh-phrases may convey an exclamation (e.g. 'How pretty are the two spouses!') ordinary multiple wh-question can not, compare the hybrid conjunctions vs. multiple wh questions as discussed in 4.2.3:

(20) a. ?What a man and what a woman are married to each other!
b. #What a man is married to what a woman!

Analogous examples with *respectively*, though do not sound very natural, exhibit the same contrast:

(21) a. ?What a man and what a woman dance and sing respectively!
b. #What a man performs with what a woman!

Turn now to downward entailing quantifiers discussed in 4.3.4. Recall that the negative *ne*-pronouns do not allow for negative concord and are similar in this respect to standard English *no*, while *ni*-pronouns participate in negative concord. Neither type of pronouns produce double negation readings in Hybrid Coordination, but in the absence of coordination the non-concord *ne*-pronouns produced unacceptability while *ni*-words still have the negative concord interpretation. English sentences with *no* reproduce the same contrast:

(22-a) means 'no pair x,y is dating,' and (22-b) is ungrammatical (in standard English). In the variety of English that allows cumulation of negative quantifiers (i.e. where *no*, similarly to negative pronouns in French (de Swart and Sag, 2002), supports negative concord) (22-b) is grammatical and equivalent to (22-a):

(22) a. No man and no woman are dating each other.
b. ??No man is dating no woman.

In case of *respectively* statements, judgements are quite shaky but resumptive quantification seems to be a possible interpretation with *no*:

(23) ??No man and no woman can feed a lion and hold its tail respectively.
Resumptive interpretation: no pair of a man and a woman can have a lion fed by the man and held at its tail by the woman, even if some men can feed a lion or some women can hold a lion's tail.

Observe that *no* in the negative concord variety of English behaves like the negative concord elements in Russian.

Coordination with 'not all,' a relatively infrequent quantifier, is also interpreted as if it were a single quantifier over pairs, contrasting with a sentence without coordination. Again, this contrast is the same for Russian HC (16-a) and ordinary coordination in other languages, compare (24):

(24) a. Not every man and not every woman are dating each other.
b. ??Not every man is dating not every woman.

4.5 Implementing the Resumption Hypothesis

But how should we implement the resumption semantics of conjunction? Resumptive quantification poses an obvious challenge to compositional semantic interpretation. A sentence may contain more than one quantifier word, but (under resumption) the meaning includes only one quantifier. The theory of May (1989) derives resumptive quantifiers via an operation on Logical Form, which proceeds in two steps. The first step is essentially Quantifier Absorption as in Higginbotham and May (1981), separating determiners from the NP restrictors at LF:

(25) $(Q_1 x : \Psi_1)(Q_2 y : \Psi_2)\Psi(x, y) \rightarrow (Q_1 x, Q_2 y : \Psi_1 \& \Psi_2)\Psi(x, y)$
(ex. 2.5 and 2.7 in Higginbotham and May (1981))

where Q_1 and Q_2 are two determiners. The second step, encoding resumption proper, takes a sequence of two identical quantifiers and replaces them with a polyadic one, cf.:

(26) $\forall x \forall y(x \text{ loves } y) \rightarrow \forall x, y(x \text{ loves } y)$ (May, 1989, 406).

This last step differs from usual compositional mechanisms. More seriously, the absorption operation that feeds resumption in May's theory is empirically highly problematic. Clark and Keenan (1986) in a response to Higginbotham and May (1981) show that the absorption operator leads to solidly incorrect truth conditional predictions even for cases using just existential and universal quantifiers. Higginbotham and May (1981) wrongly assume that from a cross product relation $A \times B$ one can uniquely recover both A and B. But if, say, A is empty, the other (B) is not recoverable from the crossproduct relation since $A \times B$ is the empty set, no matter what B is.

I will now outline a straightforward but compositional semantic analysis that incorporates quantifier resumption but does not employ May's machinery.

By definition, resumption is application of a quantifier to n-ary predicate instead of unary. If an analysis of Hybrid Coordination endorses resumption, then in the derivation of *nikto i nikogda* 'nobody and never' there must be formed a unit with the meaning of an n-ary predicate P such that P(x,y) iff x is animate and y is a time. Then a quantifier NO should apply to it and the main predicate, say, `sleep`, producing a proposition 'for no pair (x,y) such that x is animate and y is a time, x sleeps at time y.'

Recall that quantifiers in HC are usually morphologically complex. For instance, *nikto* 'nobody' consist of the prefix *ni* (which marks quantifier force of a negative concord item) and a wh-word *kto* 'who' which conveys animacy. We can then think of *wh* lexical items as denoting unary predicates, such as:

(27) a. *kto*: NOM: animate,
b. *čego*: GEN: inanimate,
c. *gde*: PP_{loc}: place, etc.

Coordination then takes n unary predicates and creates an n-place predicate; semantically, the resulting n-ary predicate is a Cartesian product of the underlying relations. For example, *kto i gde* 'who and where' denotes a binary predicate that holds of pairs of animate beings and places.

There can be several solutions to the problem of having multiple expression of a single quantifier, as in *nikto i nigde* 'for no pair of an animate being and a place'. Two options seem to be the best. First, one may think of the quantifier meaning to be conveyed not by a syntactic unit but by the operation of inserting one or more exponents. This solution is in the spirit of Quantifying in operation of Montague Grammar. A second solution assumes that exponents of a quantifier are meaningless agreement markers, and the quantifier itself is a null element. I will remark very briefly on how these two solutions may be built into a syntactic analysis.

4.5.1 Compositionality of Resumption: Rules with Quantifier Meanings

Hybrid Coordination concatenates two or more WH constituents and puts a conjunction *i* before the last one (just like ordinary coordination does). We can encode this in the syntactic category of the hybrid *i*, as proposed in Chapter 3:

(28) *i* 'and' $F(X,B,C)\backslash F(X \circ Y,B,C)/F(Y,B,C)$

where F is a variable over extraction features (such as WH).

On the syntactic side, Hybrid Coordination creates a hybrid category, which may be represented as an ordered list of categories: if X and Y in (28) stand for NOM and ACC, then the coordinate structure has a hybrid category, filling two gaps (nominative and accusative) in a sentence it selects. On the semantic side, Hybrid Coordination forms Cartesian products of predicates:

(29) a. *i* 'and' $F(X,B,C)\backslash F(X \circ Y,B,C)/F(Y,B,C) : \lambda P.\lambda P'.\lambda x.x \in P \times P'$

b. kto i čego: $WH(\diamondsuit_{\text{NOM}} \circ \diamondsuit_{\text{GEN}}, s, wh) : \lambda x.[x \in (\texttt{animate} \times \texttt{inanimate})]$

As discussed in Chapter 3, Hybrid conjunctions of categories paradigmatically related to interrogatives can be derived via special quantificational rules (or structure building functions, in terms of Keenan and Stabler (2003)). For instance, there are special rules for *koe*-indefinites (below), negative concord items, *ne*-indefinites, etc. On the formal side, the rules add respective series markers (*koe-*, *ni-*, *ne-* etc.) to each phonological word with a WH element (***koe-****kto i* ***koe-****čego*, ***ni****kto i* ***ni****čego* etc.). On the syntactic side, the quantifying rules change the syntactic category according to the syntactic function of the pronoun series. For instance, indefinites build declarative sentences from finite sentences with gaps, interrogatives combine with them to create questions, and *ne*-items in Russian combine with infinitives rather than finite clauses. On the semantic side, quantifying rules act like

determiners, taking a property p and create a generalized quantifier Qp where Q varies depending on the pronoun series. Examples:

(30) a. input: komu i čego: $WH(\diamondsuit\square\textsc{dat} \circ \diamondsuit\square\textsc{gen}, s, wh)$: $\lambda x.[x \in (\texttt{animate} \times \texttt{inanimate})]$; outputs:

b. Koe-rule: koe-komu i koe-čego: $WH(\diamondsuit\square\textsc{dat} \circ \diamondsuit\square\textsc{gen}, s, \mathbf{s})$:
$\lambda P.\exists x \in (\texttt{animate} \times \texttt{inanimate}).P(x) \wedge \texttt{I-know}(x)$

c. Ne-rule: nekomu i nečego: $WH(\diamondsuit\square\textsc{dat} \circ \diamondsuit\square\textsc{gen}, \mathbf{inf}, \mathbf{s})$:
$\lambda P.\neg\exists x \in (\texttt{animate} \times \texttt{inanimate}).\diamondsuit P(x)$
etc.

Note the semantic contribution of each series: the *koe*-rule adds existential quantification and specificity (encoded here by $\texttt{I-know}(x)$), *ne*-rule adds negative quantification and modality, etc.

4.5.2 Compositionality of resumption: null quantifiers

A compositional semantic analysis compatible with resumptive quantification can be stated in other terms as well, compatible with Chomskian syntax. Instead of attributing quantificational force to the action of a special rule, we can instead attribute it to a null quantificational element. I will now briefly outline how such a syntactic account may work. For expository purposes, we may replace Russian morphemes with English ones since English also possesses series of quantifiers where one part provides the quantifier (*some-*, *every-*, *no-*) and the other (*-body*, *-thing*, *-where*) contributes a restrictor and a syntactic category:

(31) a. -body, -one : animate, category DP

b. -thing : inanimate, category DP

c. -where : place, category PP

Prefixes like *some-*, *every-*, *no-*: may be analyzed as semantically vacuous, or more exactly as representing identity functions on predicates. The actual quantifiers are empty heads (0_{some}, 0_{no}, 0_{every}) which attract corresponding phrases. If this is correct, the pronoun series are all semantically identical, differing only in the syntactic features:

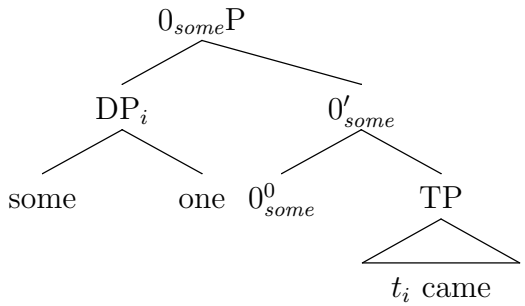
(32) a. who: $WH(\diamondsuit\Box np, s, wh) : \lambda x.x \in (\texttt{human})$

b. someone: $WH(\diamondsuit\Box np, some, s) : \lambda x.x \in (\texttt{human})$

c. everyone: $WH(\diamondsuit\Box np, every, s) : \lambda x.x \in (\texttt{human})$

Different pronoun series combine with different null quantifiers.[2] The analysis with null quantfication elements can be translated immediately into Chomskian syntax. In this case null quantificational elements (0_{every}) can be interpreted as functional heads that attract NPs with matching movement features ($\pm some$, $\pm every$ etc.). So the syntactic structure that feeds a resumptive semantic interpretation could be as follows:

(33)



In case of Hybrid Coordination, a coordinate phrase occupies the specifier position in 0_{some}P and related phrases (CP for wh-questions, 0_{every}P, etc.):

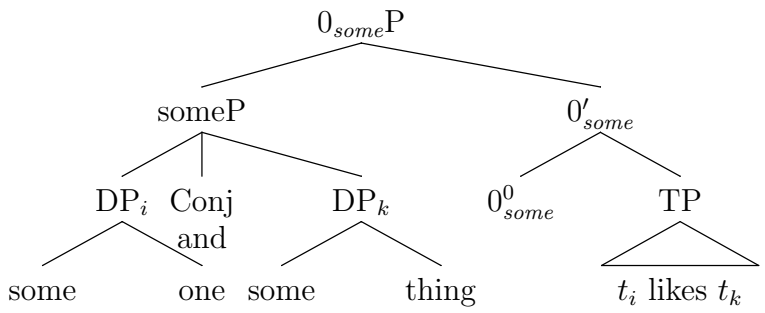
[2]In Vermaat's system, the null quantificational elements could be defined as follows:

(i) a. lexical entry for 0_{some}: ϵ: $WH(G, some, s)\backslash WH(G, s, some)$: $\lambda P\lambda P'.\exists x.P(x) \wedge P'(x)$

b. lexical entry for 0_{every}: ϵ: $WH(G, every, s)\backslash WH(G, s, every)$: $\lambda P\lambda P'.\forall x.P(x) \Rightarrow P'(x)$

etc., where G stands for any category.

(34)



The denotations of subconstituents are:

(35) a. *someone and something:* $\lambda w.w \in \texttt{human} \times \texttt{nonhuman}$

b. 0^0_{some}: $\lambda P.\lambda P'.\exists x.P(x) \wedge P'(x)$

c. t_i *likes* t_k: $\lambda\langle x, y\rangle.\texttt{like}(x, y)$.

4.5.3 Motivation and decomposition for the denotation of *i* 'and'

The compositional treatment of resumptive quantification proposed here involves two major derivational steps, independent of the exact details of the syntactic analysis. At the first step, coordination of n predicates creates a single n-ary predicate. At the second step, quantification applies which is in essence no different from the most studied case of quantification in natural language, expressed by determiners. Indeed, that language can express quantification over various types of objects, including but not limited to individuals and events, is a common assumption in the study of natural language semantics. Quantification over pairs (or n-tuples) is neither an original nor an exotic option, given that popular analyses quantify over properties, over groups of individuals, over relations between individuals, and even over choice functions.

The first step, forming n-ary predicates by coordination, may seem *ad hoc*, but it is not. In fact, crossproduct formation has been proposed as a possible denotation of *and* on independent grounds, in particular to account for sentences with *respectively*. Indeed, forming a predicate over pairs out of two unary predicates (as well as forming a pair from two

individuals) is what conjunction effectively does in *respectively* sentences and other cases of asymmetric conjunction, compare the logical forms for the following sentences proposed in Link (1998, 73, 74):

(36) a. George and Martha are drinking and dancing, respectively.
LF: $\lambda xy[\text{drink}'(x) \wedge \text{dance}'(y)](g, m) \Leftrightarrow \text{drink}'(g) \wedge \text{dance}'(m)$

b. George and Martha are husband and wife.
LF: $\lambda xy[\text{husband.of}'(x, y) \wedge \text{wife.of}'(y, x)](g, m) \Leftrightarrow$
$\text{husband.of}'(g, m) \wedge \text{wife.of}'(m, g)$

If these logical forms indeed represent semantic composition of the respective sentences, *and* has to introduce pair formation over individuals (in (36-a,b)) as well as Cartesian product of predicates (in (36-a)).

To summarize, the interpretation of Hybrid Coordination is just another instantiation of the crossproduct meaning of *and*, as found in *respectively* sentences. The Cartesian product operation can also be thought of as pair formation (also required for some *respectively* sentences) applied to unary predicates via flexible function application as in Hagstrom (1998). In any event, the interpretation of Hybrid Coordination is reduced to one of the meanings of ordinary coordination.

4.6 Some Potentially Problematic Data

We have mentioned above some putative cases of Hybrid coordination which do not include wh-words or paradigmatically related elements. Many of these are compatible with the Resumption Hypothesis. For instance, many instances of Sannikov's "lexical semantic" coordination could be seen as resumptive existential quantification, for example:

(37) Ja govorju s poétom i o poéte.
I talk with poet and about poet.
'I talk with a poet about a poet' (Sannikov, 1989, 19, ex. 35a) $\simeq$
'There is a pair of a poet x and a poet y, such that I talk to x about y'.

(38) Pokupat′ nado tol′ko svežij produkt i tol′ko v proverennyx mestax
buy.INF should only fresh product and only in proven places
'One should buy only fresh (fish) and only in proven places' (NCRL) $\simeq$
'only $\langle$`fresh`, `proven places`$\rangle$ satisfies $\lambda x, y.\Box$`buy-at`(x, y)'

But some are potentially problematic, for example:

(39) Prezirajut tróe i troíx
despise three.NOM and three.ACC
'Three people despise three people' (constructed)

(39) does not merely involve three pairs of people, as the resumptive quantifier $Res^2(\exists_{\geq 3})$ would lead us to hypothesize. In fact, the truth of (39) implies the existence of three distinct people in the domain and three people in the range of *despise* relation, while three pairs in the relation is a weaker requirement: e.g. the relation $\{\langle x_1, y_1\rangle, \langle x_1, y_2\rangle, \langle x_2, y_1\rangle\}$ whose domain and range contain just two elements, contains exactly three pairs. The same applies to the coordination of two 'many':

(40) O nëm uže mnogoe i mnogimi napisano
about him already much and many.INSTR written
'Many people wrote a lot about him' (NCRL)

which implies not just many pairs "writer, content" but also that there were many authors and a lot of content generated. If only the number of pairs were relevant, one extremely prolific author could make the sentence true, — which is not the case.

One can think that (40) and (39) do not belong to the same class as other instances of HC since they feature quantifier words that do not belong to pronominal paradigms but are rather numerals or even quantificational adjectives. This is plausible but note that quantifiers of the models *malo* + wh and *mnogo* + wh show exactly the same kind of interpretation even though they are obviously derived from interrogatives:

(41) a. Anglija dolžna Germanii i Ispanii gigantskie (i primerno ravnye)
England owes Germany and Spain giant and approximately equals
summy, a ej [malo kto i malo čto] dolžen
sums and it.DAT [little who.NOM and little what.ACC] owes
'Britain owes Germany and Spain gigantic (roughly equal) sums of money, while few [countries] owe little to Britain itself.'
(`http://bohn.ru/news/dolgi_v_evrope/2011-09-27-1527`)

b. Mnogo kto i mnogo gde, okazyvaetsja, èto slovo videl.
many who.NOM and many where it.turns.out this word saw
'It turns out that many people have seen this word in many places'
(`http://bdbd.livejournal.com/9966.html`)

The situation reported in (41-a) (illustrated with a nice diagram in the source of the example) involves few creditors and small total debt. (41-b) is taken from a blog posting that discusses a Russian historical joke based on wordplay. In different versions of the legend quoted in the posting, a naïve high court member sees the obscene Russian word *xuj* 'penis' written in public and doesn't understand it; a scholar close to the court (in different versions, Karamzin, Deržavin, or Žukovskij) explains the word *xuj* as an imperative (morphologically flawless!) of the Ukrainian *xovaty* 'to hide', and receives a generous reward from the emperor for a clever explanation. The person who sees the *graffito* and its location varies from one version of the legend to another, so (41-b) implies among other things there were many of those who saw the word; (41-b) could not be used if only the location of the *graffito* varied, however many observer-location pairs this would have produced.

A similar observation applies to modified *vs*-quantifier *daleko ne vse* 'far from all':

(42) Odnako ponimayut eto [daleko ne vse i daleko ne vsegda]
but understand this far not all and far not always
'?But far from everyone ever understands this.'

The meaning of *far from all* seems to be the postcomplement of *many*, so that *far from all As are Bs* is true whenever *Many As are not Bs* is. Truth conditions of (42) involve many occasions when one doesn't understand the topic under discussion. But the truth of the sentence implies more than just many situations of not understanding; there must be many of those failing to understand! The sentence can not be satisfied by one stupid person who fails to understand the topic on many occasions; there have to be many different times of not understanding.

Further examples that seem incompatible with the Resumption generalization contain the negative particle *ne*:

(43) K sožaleniju, ja streljal ne tol′ko na Marse in ne tol′ko po otvratitel′nym
unfortunately I shot not only on Mars and not only at disgusting
xiščnikam
predators
'Unfortunately I shot not only on Mars and not only at disgusting predators'

(A. and B. Strugatsky)

($\neq$ 'it was not only $\langle$`Mars`, `predators` that satisfies $\lambda x, y.$`I-shot-at`(x, y)')

The examples in this section invite a cumulative rather than resumptive interpretation. On the other hand, such examples are much more rare than ordinary HC, and could represent a different phenomenon. None of the naturally occurring examples involves an obligatory element (although some feature optional arguments), and could just as well fall under the rubric of ellipsis or conjunctive category conjunction (Whitman, 2005), which semantically is expected to produce the effect of cumulative quantification.

Alternatively, such examples could be interpreted as featuring a resumptive existential quantifier over a pair of pluralities. In this case, quantified phrases (e.g. phrases with numerals) have to be construed as predicates over pluralities. So our example (39) could be given a resumptive interpretation as follows:

(44) a. Prezirajut tróe i troíx
despise three.NOM and three.ACC
'Three people despise three people' (constructed)

b. $\langle X, Y\rangle \in \texttt{3people} \times \texttt{3people.despise}(X, Y)$

c. There is a pair $\langle X, Y\rangle$ where X is a group of three people and Y is a group of three people such that group X despises group Y.

Most notably, just like the cases that support the Resumption Hypothesis, exceptions to it are also easily replicated in ordinary NP conjunction, compare:

(45) a. Many boys and many girls kissed each other.
Many boys and many girls are involved in kissing; a lot of boy-girls pairs all pairs share one or few boys does not verify the sentence.

b. Not only John and not only Mary kissed each other.
There must be at least two other people involved in kissing, a kissing pair $\langle \texttt{Paul}, \texttt{Mary}\rangle$ alone would not verify the statement, cf. (44).

4.7 Conclusion

This work significantly expands the range of semantic facts about Hybrid Coordination in Russian, of which conjoined wh-words are a special case that has been discussed the most. The evidence presented complements the syntactic arguments outlined in the previous chapter: not only from the syntactic, but also from the semantic point of view Hybrid

Coordination can not be reduced to ellipsis and involves instances of true coordination of unlikes, since the presumed non-elliptical analogs of sentences with HC do not always have the same interpretation.

As we have seen, a general interpretation mechanism (pair quantification, or resumption) can account for the core instances of Hybrid Coordination involving quantificational pronouns and adverbs: the conjunction of quantifier words is always equivalent to a single quantifier over pairs or tuples. The known Single Pair reading effect of conjoined wh-words follows from this generalization, since it parallels exactly the interpretation of single wh-words. The approaches to this issue in Kazenin (2000) and Gribanova (2009) are less general, making predictions only for wh-questions, but they are in principle compatible with the generalizations stated here. Both of these approaches are negative, trying to explain why the pair list reading is not derivable in coordinate structure. Neither of the two specify how the available reading is composed, and the Resumption Hypothesis presented here fills this gap.

This chapter also suggests a way to treat the semantics of quantifier resumption in Hybrid Coordination compositionally. An important component of such a compositional account is the formation of an n-ary predicate by taking a product of several unary ones. The product operation is in its turn a possible meaning of ordinary coordination. To put it differently, ordinary and Hybrid coordination have different syntax, but the semantics of the conjunction operator can be the same in both constructions with coordination.

It is worth mentioning that hybrid coordinate structures are a rare example of syntactic units interpreted as type $\langle 2 \rangle$ quantifiers, i.e., functions from binary predicates to truth values. It is interesting, however, that none of the binary quantifiers considered in this paper (roughly *some*, *all*, *no*, and *not all*) is *unreducibly* binary in the sense of Keenan (1992): for each resumptive quantifier presented here there is always a composition of two or more unary quantifiers equivalent to it.

The instances of Hybrid Coordination considered in this chapter are characterized with the Resumption hypothesis. This generalization, based on a limited set of data (HC is quite a restricted construction), may not be the last word in the semantics of conjunction. Indeed, as we saw in the last section, we find counterexamples to the Resumption generalization as soon as we go beyond the {`some, no, every, not every`} square of opposition. Perhaps more important than the Resumption Hypothesis is the generalization that the interpretation of HC is exactly parallel to that of ordinary NP conjunction. The issues that the resumption analysis runs into are reminiscent of donkey sentences. In donkey sentences, quantification over pairs has been proposed as a semantic composition mechanism; indeed, *Every farmer who owns a donkey beats it* is equivalent to 'for every pair $\langle x, y \rangle$, if $\langle x, y \rangle$ is a pair of a farmer and a donkey he owns, then x beats y'. But it soon became clear that only some quantifiers when applied to pair quantification produce correct readings for donkey sentences, namely {`some, no, every, not every`}. For instance,

(46) Many farmers who own a donkey beat it

is true if there are many farmers who beat their donkey, not just many $\langle$`farmer,donkey`$\rangle$ pairs who satisfy the `beat` relation. In response to this challenge, anaphora scholars proposed several solutions to the issue of donkey anaphora, grounded in dynamic semantics. It is therefore not surprising that I will assume a dynamic approach to coordination in the following chapter, while expanding on the parallelism between Hybrid Coordination, ordinary NP conjunction, and sentential conjunction.

CHAPTER 5

A Game-Theoretic Perspective on Conjunction

5.1 Introduction

In this chapter I take a novel approach attacking the problem of unified analysis of 'and' in its different usages, in particular sentential and NP coordination. I propose a new, game theoretical, analysis of conjunction which provides a single logical translation of *and* in its sentential, predicate, and NP uses, including both Boolean and non-Boolean cases; the argument is based on non-standard coordination of quantified NPs. In essence I will analyze conjunction as parallel composition, based on Abramsky's (2007) game-theoretic semantics and logical syntax. This is my final proposal for the compositional treatment of *and* in English and *i* in Russian, and the one I prefer to the alternatives because of its general — and uniform — treatment of the semantics of 'and', and also because of its potential for further extensions as the logic of game theoretic semantics is enriched and generalized. I close the discussion by noting several topics that pose some challenges to the treatment I present here. These challenges have several possible responses within the game theoretic framework, but treatment detailed enough to be convincing would in effect be starting a second dissertation.

An adequate analysis of conjunction *and* should

1. provide a uniform analysis of the meaning of *and* across its various uses;

2. cover at least coordinate NPs and sentential coordination

3. apply to various instances of coordinate structures in a compositional way, and

4. capture scope independence of conjoined quantified NPs (see below).

5. allow quantifiers within a coordinate structure to bind variables outside that structure (as in the cases of traces of conjuncts in Hybrid Coordination; see more below).

5.2 Intended Empirical Coverage

Let me now spell out explicitly what set of cases exactly I would like to cover. I intend to propose a compositional semantic analysis of a class of coordination patterns, which includes the following:

- Boolean conjunction of sentences
- Collective reading of coordinate NPs
- Branching readings of coordinate NPs
- *Respectively* readings of coordinate structures
- Hybrid Coordination
- Quantifiers with overt variables in mathematical discourse

Let us discuss each of these types of conjunction interpretation in turn.

5.2.1 Plural and Branching Readings of Conjunction

A well-known problem for Boolean approach to conjunction are plural readings of conjunction, as in

(1) John and Mary are a nice couple.

These readings occur in the context of collective (group) predicates. While in many contexts *John and Mary* can be interpreted as a generalized quantifier $I_j \wedge I_m$, predicates like *meet*, *be a nice couple*, *be the only survivors* etc. force a group construal of coordinate NPs.

While *and* connecting NPs that refer to entities gives group or sum formation on those entities, *and* applied to properly quantified NPs produces a quantifier branching reading (Barwise, 1979). Sum formation can be seen as a special case of branching: essentially, plurality formation is branching of Montagovian individuals (which are a special case of generalized quantifiers). Branching readings of coordinate quantified NPs are forced only in the context of group predicates. I will focus here on examples with distributive universal quantifiers, such as:

(2) *Every man and every woman kissed (each other)*
taken in the reading 'For every man x and for every woman y, x and y kissed (each other)', or 'every man-woman pair kissed.'

In a model with k men and m women, the truth of (2) (in this particular reading) requires $k \times m$ kissing events.

(2) is the kind of example that will drive the discussion below. I choose (2) merely for presentation purposes: it is relatively simple, represents branching quantification and uses two universal quantifiers — that are immediately expressible in all semantic theories. But note that branching quantification applies not only to universals but also to other generalized quantifiers, and the two determiners do not have to be identical:

(3) Quite a few boys in my class and most girls in your class have all dated each other. (Barwise, 1979)

(4) An even number of dots and an odd number of stars are all connected by lines. (Sher, 1990, 414: 6.8)

Note that it is the distributive quantifiers (such as *every man*) that make the branching reading most readily available when coordinated. Quantified NPs that naturally receive collective interpretation (e.g. *all students*, *five boys*), get a cumulative or group construal in coordinated contexts:

(5) a. Five boys and three girls stay in two different rooms.
b. 'there is a group of five boys staying in one room and a group of three girls staying in another room'

(6) a. All the men and all the women kissed each other.
b. 'Every man kissed some woman, and every woman kissed some man'

5.2.2 *Respectively* readings

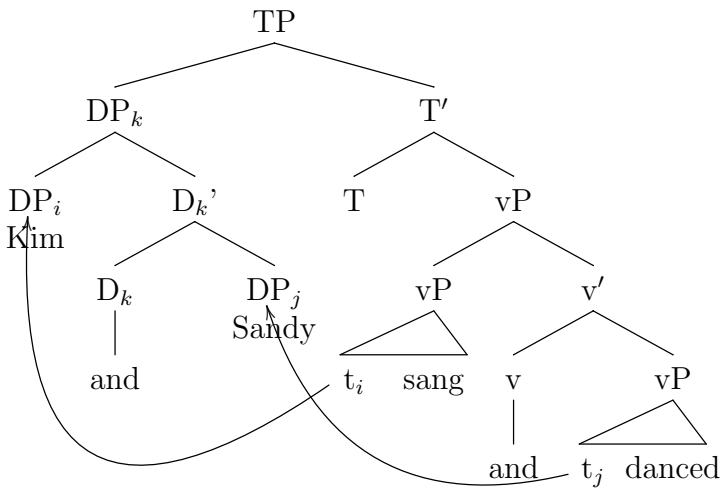
Another type of unusual coordination reading in English is forced with the adverb *respectively*. Although *respectively* constructions can involve various syntactic categories, I consider here only those with coordinate NPs and coordinate predicates:

(7) a. John and Mary are a student and a doctor, respectively ⇏John is a student and a doctor, respectively
b. Some man and some woman are a student and a doctor, respectively
c. [[Which nurse]$_i$ and [which hostess]$_j$]$_k$ t_i dated Fred and t_j married Bob respectively? (Zhang, 2007, ex. 53a)

Zhang (2007) analyzes examples with *respectively* as involving sideward movement of two NPs from coordinate sentences into two coodinate positions (Zhang, 2007, 51c):

(8) a. *Kim and Sandy sang and danced, respectively*

b.



Note that under Zhang's proposal the surface subject DP$_k$, contrary to familiar conventions in generative grammar, does not bind a trace or occur as an argument of a predicate. If Zhang's analysis of *respectively* statements is correct and the coordinate phrases each bind a different trace in coordinate predicates, *respectively* structures pose a challenge to standard assumptions about the compositional analysis of quantifiers. Indeed, it is usually assumed that quantifiers must c-command the trace they bind, but in (8) the two phrases, DP$_i$ and DP$_j$, are embedded in a coordinate structure, so the c-command relation does not hold.

5.2.3 Hybrid Coordination

Another instance of unusual coordination we'll take into account is Hybrid Coordination (coordination of unlikes), as discussed in the preceding chapters. Compare examples from the National Corpus of Russian Language:

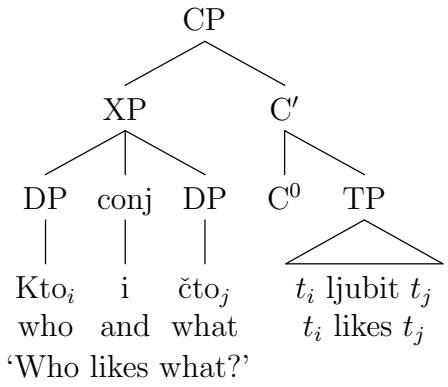
(9) a. Slučis′ èto v škole, srazu by vse i vsem
happened this in school immediately SUBJ everything.NOM and everyone.DAT
stalo izvestno
became known
'If this had happened at school, everyone would have known everything right away.'

b. Ne važno, kto i čto govorit, kto i čemu učit.
not improtant who.NOM and what.ACC says who.NOM and what.DAT teaches
'It doesn't matter who says what, who teaches what'

c. Soblaznit′ ni-kto i ni-kogo ne možet
seduce NI-who.NOM and NI-who.ACC not can
'Nobody can seduce anybody.'

For the purpose of this chapter, I will adopt the syntactic analysis for HC that has been argued for, on various grounds and for different languages, by Kazenin (2000); Chaves and Paperno (2007); Gracanin-Yuksek (2007); Zhang (2007):

(10)



If this kind of analysis is correct, Hybrid Coordination poses the same kind of challenge to semantic compositionality as *respectively* readings, since here again quantificational phrases are embedded in a coordinate structure and fail to c-command their traces. In Chapter 4 we avoided this problem using the benefits of semantic type mapping in categorial grammar. Using a hybrid category like $\diamondsuit\square nom \cdot \diamondsuit\square acc$ (hence the term *Hybrid Coordination*) that corresponds to pairs of entities, we managed to treat Hybrid Coordination semantically in terms of quantification over pairs, or resumption. For instance,

(11) a. Kto i kogo znaet?
who.NOM and who.ACC knows

'Who knows whom?'

would be interpreted as

b. $wh < x, y >$ .know′(x, y), i.e.

'For which pair $< x, y >$ does x know y?'

This analysis is attractive because it's particularly simple, and derives the basic cases correctly. But in other cases it is less than fully convincing. First, the quantifier expressions involved in Hybrid Coordination constructions can be morphosyntactically complex. For example, in

(12) Daleko ne vse i daleko ne vsegda rabotajut v beluju.
far not everyone.NOM and far not always work in white
'In many cases many people don't work for just the reported salary.'

it is not a very intuitive solution to treat two structurally complex instances of *daleko ne vse* 'far from all' as a representation of a single resumptive quantifier. Second, conjoined quantifiers in Hybrid Coordination can be modified apparently independently of each other. So universal quantifiers can combine with *počti* 'almost', which may semantically modify just one of the conjuncts:

(13) Lično menja vsë i počti vsegda besit
personally me everything.NOM and almost always drives.nuts
'Everything almost always drives me nuts.'

Wh-words can combine with *imenno*, which in the case of HC may semantically modify only one of the interrogatives:

(14) Ostalos′ neizvestnym, čto imenno i komu on dolžen
remained unknown what exactly and who.DAT he owes
'It remained unknown what exactly he owed and to whom.' (NCRL)

Modifiers 'exactly' and 'almost' apply to interrogatives and universal quantifiers respectively, and are not in general compatible with common nouns. If so, we do not expect to find them as separate modifiers as coordinate quantified NPs if they are nothing but components of a larger polyadic quantifiers. So the kinds of examples in (14) and (13) motivate us to look for a semantic analysis that composes the meaning of such coordinate phrases from two distinct quantifier meanings. Resumption, which is by definition a single quantifier over pairs, is not satisfactory in this respect.

5.2.4 Analogy in mathematical language

I would like to include also another sort of quantificational expression that has not to my knowledge been subject to linguistic analysis, namely, the usage of conjunction in mathematical texts in natural language (Russian, English, Chinese and others) which contain quantifiers with overtly specified variables, compare:

(15) a. for any point x on V, $V-\{x\}$ lies in an open halfspace bounded by a hyperplane H_x that is the flat of highest contact at x.

(Motzkin, 1960, 1090)

b. Rúguǒ f bùshì chángshù hánshù, zài (a,b) zhōng zé bì cúnzài zhe x_0,
if f not constant function, among (a,b) then must exist ASP x_0,
shǐde bùshì $f(x_0) > f(a)$ jiùshì $(x_0) < f(a)$
such that not $f(x_0) > f(a)$ if $(x_0) < a$
'If f is not a constant function, there must be an $x_0 \in (a,b)$ such that $f(x_0) > f(a)$ or $(x_0) < f(a)$.' (Mandarin, Grace Kuo, p.c.)

Such quantifier expressions are not infrequently found conjoined, compare a formulation of Leibnitz's principle from Cortes (1976, 493):

(16) for any object x and for any object y, if every property F of x is a property of y, and every property of y is a property of x, then x is numerically identical to y

In these kinds of examples we observe that again, like in HC and in sentences with *respectively* readings, a quantifier embedded in a coordinate structure binds a variable outside that coordinate structure.

One could understandably dismiss these kinds of examples as not worthy of semantic analysis. True, semantics of technical texts is often artificial and does not find correspondence in more traditional usage of language. But the artificial semantics is usually attributed to jargon (e.g. no human language expresses or needs to express the concept of uncountable infinity), and the meaning of jargon is made explicit through definitions or axiomatization. This is not the case with *and* as used in (16). Sentences like (16) are in natural language (English), not in an artificial logical language whose terms are paraphrased or defined. *And* as used in (16) never gets an explicit interpretation, moreover the translation of (16) into an artificial logical language ($\forall x \forall y . y = x \leftrightarrow \dots$) does not contain an analog of *and*. Yet examples like (16) are interpretable by humans without difficulty. So there must be a compositional mechanism for interpreting such structures with overt variables and coordination of quantifiers, a mechanism not provided by explicit training in logic. What is a suitable mechanism?

5.2.5 Unification problem

As reviewed above, coordination constructions have been argued to contribute a wide range of meanings. The most widely accepted option is the Boolean $\wedge$ (Keenan and Faltz, 1985); mereological sum formation (Link, 1983) seems appropriate for many cases of ordinary NP conjunction; quantifier branching is applicable for certain examples with quantified NPs (Barwise, 1979); in the preceding chapter, I proposed quantifier resumption as the interpretational mechanism for Hybrid Coordination; and for *respectively*-constructions proposals include pair formation (Link, 1998) and 'simultaneous partial interpretation' Moltmann

(1992). The variety of proposals for different coordination constructions with the same word *and* suggests that we are missing a generalization; and indeed, naïve speakers of English (Russian) perceive the conjunction *and* (i) as the same unit regardless of the semantic flavor (branching, *respectively* reading etc.) that semantic analysis may reveal in these varieties of conjunction. Let us now proceed to discuss one option of what a unifying account can be.

5.2.6 Motivation: Existing approaches

But is there sufficient justification of taking a new path in the semantics of coordination? Are existing proposals not sufficient to account for the facts we want to cover? Let me give a review of such proposals and the problems they encounter. Consider again the example

(17) Every man and every woman kissed (each other).

The Boolean theory of conjunction predicts that *every man and every woman* denotes a generalized quantifier, and that (17) must be equivalent to **every man kissed (each other) and every woman kissed (each other).* This prediction does not hold.

A similar prediction is made by the event-based theory of generalized conjunction by Lasersohn (1995). Omitting full detail,

(18) $(\ [\![\textit{every man}]\!] \&\ [\![\textit{every woman}]\!])(\texttt{kiss-each-other})(e)=1$

in Lasersohn's theory is equivalent to

(19) $[\![\textit{every man}]\!](\texttt{kiss-each-other})(e')=1$ and
$[\![\textit{every woman}]\!](\texttt{kiss-each-other})(e'')=1$ where $e = \{e', e''\}$.

So, paraphrasing this formula in English, we get **(there was an event where) every man kissed (each other) and (there was an event where) every woman kissed (each other).*

Translation of *and* as mereological sums is not directly applicable in (19) because of a type mismatch: mereology is defined on entities but not on quantifiers (see however Krifka (1990); Gawron and Kehler (2004); Chaves (2007) for attempts to extend mereology to other semantic types).

Hoeksema (1988) proposed a way to save the mereological formalization of *and*. In his analysis, *and* is interpreted as Linkian sums, but the two NPs scope out of the conjoined structure, predicting correct truth conditions for (19).

Hoeksema's solution, however, is problematic for two reasons. First, it runs contrary to independent evidence that quantifiers normally don't scope out of a conjoined structure. Second, Hoeksema's technique falsely predicts the availability of scope dependency between the two quantifiers. In fact, conjoined quantifiers are generally scope-independent, compare:

(20) Three boys kissed three girs **no conjunction**
Scopal reading: there are three boys such that each of them kissed three girls (triples of girls kissed may vary with the boy)
Group reading: A group of three boys was engaged in kissing with a group of three girls (each of the boys may have kissed fewer than three girls).

(21) Three boys and three girls kissed (each other). **conjunction**
Scopal reading **unavailable** (triples of girls kissed may not vary with the boy)
Group reading OK.

(20) but not (21) admits a **scope dependent reading** 'there are three boys such that each of them kissed three girls' (triples of girls kissed may vary with the boy).[1]

[1]Dominique Sportiche (p.c.) suggests that in French the second coordinated NP can be overtly marked for distributivity with *chacun*, an equivalent of binomial *each* (Safir and Stowell, 1989), in which case the

(Both have a scope-independent group reading 'a group of three boys was engaged in kissing with a group of three girls' whereby each of the boys may have kissed fewer than three girls). We observe the same contrast in the availability of scopal dependency with distributive quantifiers:

(22) Every man kissed almost every woman

Scopal dependency: each man kissed a vast majority of the women;
the set of women kissed may vary arbitrarily with the man, to the degree that there might be few or no women that all men kissed.

(22) Every man and almost every woman kissed each other

No scopal dependency: there's a fixed majority of women that all men kissed.

Let us consider one model that highlights the semantic contrast between the two sentences. Imagine a setting with a large number of men and a large number of women. Assume that every woman is some man's first love. Now assume that every man kissed, and was kissed by, every woman except his first love. In this setting, no woman was kissed by all men: since every women is some man's first love, and every man kissed every woman except his first love, so for each woman there was a man who didn't kiss her. In this setting, *Every man kissed almost every woman* can be judged as true; indeed, every man kissed all but one

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quantifiers in the conjuncts can receive a scopal interpretation, e.g.:

(i) Trois garçons et trois filles chacun se sont embrassés.
three boys and three girls each REC are kissed
'Three boys kissed with three girls each,' lit. 'three boys and three girls each kissed.'

Note that the masculine singular *chacun* does not agree with feminine plural *filles* 'girls' but behaves like binominal *each* in full sentences:

(ii) Trois garçons ont mangé trois bonbons chacun.
three boys have eaten three candies each
'Three boys ate three candies apiece.'

It is curious that this occurs internal to noun phrases.

woman. On the other hand, *Every man and almost every woman kissed each other* could be judged false in the very same scenario; there's no majority of women (in fact, no women) that every man kissed.

Winter (2001) relies on the Boolean theory of conjunction as primary, but adds a shifting operator to account for plurality readings. Winter's proposal, while making correct predictions for the most basic cases, makes wrong predictions for some quantified NPs — in particular, downward monotone ones like *few*, *fewer than six* etc. When it comes to the kinds of examples we consider here, Winter's operator $\mathbb{c}$ gives as an outcome a single plurality of all men and women (or, more precisely, a Montagovian individual — a generalized quantifier based on that plurality):

(23) $\mathbb{c}(\texttt{every.man} \wedge \texttt{every.woman}) = \lambda P.P(\texttt{man} \cup \texttt{woman})$

So *Every man and every woman kissed each other* should mean

(24) 'The group of all men and all women kissed each other.'

Although the exact truth conditions of (24) are less than fully clear and depend on the interpretation of the reciprocal, which can vary a lot (Dalrymple et al., 1998b), (24) is clearly different from the reading we aim to capture, and it does not amount to $k \times n$ kissing events for k men and n women. In one interpretation, (24) would say that everyone who is a man or a woman kissed everyone else who is a man or a woman, implying $(k+n-1) \times (k+n-1)$ individual kissing events. In another interpretation, (24) would mean that everyone who is a man or a woman kissed someone else who is a man or a woman; this reciprocal meaning would imply just $n + k$ kissings.

A similar prediction is made by the event-based approach to NP conjunction by Schein (1993), who relies on a radical neo-davidsonian theory of argument structure in the spirit

of Parsons (1990). So the meaning of

(25) John and Mary met

can be expressed, according to Schein, as

(26) $\exists e$((Agent(e,j) and Agent(e,m)) & meet(e)) 'there is a meeting event in which both Mary and John were agents'.

But if we substitute universal quantifiers for referential phrases, we obtain

(27) a. Every man and every woman have met (each other)

b. $\exists e((\forall x.\texttt{man}(x) \rightarrow$Agent$(e, x)$ and $\forall y.\texttt{woman}(y) \rightarrow$Agent$(e, y))$ & meet$(e))$ 'there was a meeting event that involved every man and every woman'

This seems to imply that every person regardless of gender was involved in a certain meeting, but does not have the reading that implies the acquaintance relations just between the men and women but not necessarily among the men or among the women.

Conjoined quantified NPs have been discussed as examples of branching quantification in natural language (Sher, 1990). Barwise (1979) provided a simple formula that captures the meaning of some branching quantifiers:

(28) $\exists P, P'.Q(P) \wedge Q'(P') \wedge P \times P' \subseteq R)$,

and observed that it only applies to MON↑ quantifiers: non-upward monotone quantifiers are either degraded in branching contexts or lead to a different interpretation. In particular, for downward monotone quantifiers (MON↓) Barwise proposed a formula for 'branching' that essentially expresses cumulative quantification. Branching combination of quantified NPs

is an observationally adequate translation for *and* in sentences like *Every man and every woman kissed (each other)*, but it does not generalize beyond quantified phrases. Moreover, Barwise's formula is an *ad hoc* characterization of branching examples, not related to other uses of *and*. This makes branching combination of quantifiers an unlikely candidate for an independent meaning of *and*. After all, examples of branching quantification are quite marginal in natural language, and one expects that their interpretation should follow from general principles rather than rely on a special meaning of *and*.

And indeed, Krifka (1990) proposes a general way to extend non-Boolean meaning of 'and' to arbitrary semantic types. In particular, when applied to generalized quantifiers, Krifka's semantics of conjunction derives the branching combination of upward monotone quantifiers as introduced by Barwise (1979). Krifka postulates two basic denotations of 'and': sum formation for type `e`, and the Boolean operation $\wedge$ for type `t`. Then Krifka defines a way to approximate the meaning of 'and' for an arbitrary type $\sigma\tau$ given how 'and' applies to σ and τ. (In contrast to other accounts, Krifka's method gives only an 'approximation' for the meaning of *and* for non-basic types, leaving a significant amount of work to maximalization operators.)

Krifka's proposal relies on symmetric operations of sum formation $\oplus$ and Boolean $\wedge$, but conjunction is not always symmetrical. Indeed, it is not possible to swap the syntactic positions of NP conjuncts in *respectively* constructions and in Hybrid Coordination without a change in meaning:

(29) a. Maša i Vanja — sootvetstvenno professor i prodavec
Mary.NOM and John.NOM respectively prosessor and sales.clerk
'Mary and John are a professor and a sales clerk respectively.'

b. Vanja i Maša — sootvetstvenno professor i prodavec
John.NOM and Mary.NOM respectively prosessor and sales.clerk
'John and Mary are a professor and a sales clerk respectively.'

c. Kto i čto podderživaet?
who.NOM and what.ACC supports

'Who supports what?'

d. Čto i kogo podderživaet?
what.NOM and who.ACC supports
'What supports whom?'

Considerations of symmetry in conjunction are not a serious reservation against Krifka's proposal: it can be easily modified to cover these cases. As long as we replace sum formation, which is a primitive in Krifka's theory, with ordered pair formation, conjoined quantified NPs start denoting quantifiers on pairs (or more generally n-tuples, n being the number of conjuncts). Replacing sum formation with an asymmetrical operation is in fact an option that Krifka briefly entertains in his article. A more substantial empirical argument against Krifka's analysis is that it does not apply to mathematical statements with overtly specified variables such as *there is an x and there is a y such that $x + y = 10$*: Krifka's semantics for 'and' is defined only for types `e`, `t`, and functional semantic types built from these. So variables and variable assignments are not part of Krifka's ontology, in contrast to dynamic or game theoretic semantics where variable assignments are part of the denotations of sentences (see below). But overall, Krifka's proposal, if complicated, excels in empirical coverage compared to its alternatives; lack of account for variable-containing expressions is not a fatal drawback. So my goal here is not improve on the empirical adequacy of Krifka's theory of *and* (though I will improve on it in some respects, in particular by taking into account variable-containing expressions), but to present a proposal more general and more conceptually elegant. Conceptual improvement is possible in at least two novel ways. First, Krifka assumes both mereological and Boolean notions for 'and' to be basic (for types `e` and `t` respectively). So even though Krifka's theory handles most instances of 'and' correctly, it does not fully satisfy my goal here to find a semantic unification of sentential and NP conjunction. Second, Krifka's conjunction of generalized quantifiers is equivalent to branching in the case of upward monotone quantifiers, but why there should even be such a monotonicity restriction is left without a principled explanation. The analysis presented

below fills these gaps.

5.3 Towards a Proposal

As we saw in 5.2.6, existing theories of the meaning of 'and' either run into empirical issues, or are bound to postulate multiple basic denotations for *and*, or both. I propose that to unify coordination of sentences, quantifiers, and NPs, we need a dynamic approach to quantification and coordination. One can treat all NPs as quantifiers, and this is in fact a standard move (Barwise and Cooper, 1981). But to fully unify sentential and quantifier conjunction, we should treat quantifiers dynamically, on par with sentences, indeed as sentences. Here is, informally, how this works.

A common idea in dynamic semntics is that both quantifiers and sentences are interpreted as context updates. NPs (like *some man*) have the potential to introduce a new referent to the context. A sentence's contribution may be more complex than that of a quantifier; sentences can introduce multiple referents and facts about the state of affairs. If quantifier denotations are a variety of sentential denotations, quantifiers can be combined via sentential *and*. Below, I will provide a simple implementation of this basic idea in the framework of Game Theoretic Semantics.

The interpretation of *and* that I will rely upon is parallel combination of games (Abramsky, 2007). Abramsky provides a logical language I will use, but the the underlying idea that Abramsky implements belongs to van Benthem (2003), who proposed interpreting branching quantification through concurrent games.

I assume game semantics here merely because of its simplicity; game semantics can have huge expressive power without reference to higher order entities (such as sets or functions) in the object language. But the same proposal translates into other semantic theories as long as they treat quantifiers dynamically. For example, it can be implemented immediately in Plural Compositional DRT (Brasoveanu, 2007).

And in what way are NPs analogous to sentences? It turns out that NPs can indeed sometimes get a sentential paraphrase. For example, we can paraphrase:

(30) a. Every man is a Napoleon.
b. Take an arbitrary man; he is a Napoleon.

Here the NP *every man* is paraphrased as the sentence *Take an arbitrary man.* This gives us a way to interpret coordinated quantified phrases in exactly the same way as conjoined sentences. For example, the sentence

(31) Every man and every woman kissed each other

will receive an analysis suggested by the paraphrase

(32) Take an arbitrary man x and take an arbitrary woman y; they (x, y) kissed each other.

Similar paraphrases can be construed for existentially quantified or referential phrases like the following:

(33) a. Some man and some woman kissed each other
b. Take a man x and take a woman y; they (x, y) kissed each other.

(34) a. John and Mary are afraid.
b. Take John, and take Mary; they are afraid.

The paraphrases above translate NP coordination by sentential *and*. In this sense, my proposal here is similar to paraphrases for non-Boolean coordination in Schein (1993).

'Take an arbitrary x' is an informal description of the game theoretic semantics for the

universal quantifier $\forall x$, 'take an x' is an informal description of the game theoretic semantics for the existential quantifier $\exists x$. So the meaning of existential and universal quantifiers is nearly identical, differing only in the way the referent is chosen. (In game theoretic terms, $\exists x.\phi$ and $\forall x.\phi$ have the same game histories, but vary in which of the players is responsible for making a move; see more below.)

So far we discussed examples of ordinary conjoined NPs. Other cases of non-standard conjunction can be seen as semantically fully analogous. Compare paraphrases for Hybrid Coordination, *respectively*-coordination, and quantifier coordination in math texts:

(35) Vse$_1$ i vsem$_2$ izvestno t_2 t_1
everything$_1$.NOM and everyone$_2$.DAT is.known t_2 t_1
'take an arbitrary fact x_1 and take an arbitrary person x_2, x_2 knows x_1.'

(36) Čto-to$_1$ i komu-to$_2$ izvestno t_2 t_1
something$_1$.NOM and someone$_2$.DAT is.known t_2 t_1
'take some fact x_1 and take some person x_2, x_2 knows x_1.'

(37) a. John$_i$ and Bill$_k$ t_i sing and t_k dance, respectively

b. 'take x_i=John and take x_k=Bill, x_i sings and x_k dances'

(38) a. for any object x and for any object y....

b. 'take an abitrary object x and take an arbitrary object y, then...'

As the paraphrases suggest, we need a quite particular notion of quantifier. 'Take an arbitrary x' (the paraphrase for $\forall x$) is an instruction; so we need a theory of meaning where quantifiers are treated as instructions. In other words, we need a dynamic semantic theory. In this sense, Game Theoretic Semantics is a dynamic semantic theory (there are other opinions on what constitutes a 'dynamic' theory, compare e.g. Pagin and Westerstahl (1993)).

5.4 Towards Formalization: Game Semantics

5.4.1 Dynamic Predicate Logic

In dynamic approaches to meaning logical formulas relate to programs (instructions). For example, $\exists x.P(x)$ reads as an instruction to do two things:

- $\exists x$: assign a value to x, and
- $P(x)$: check if $P(x)$ is true.

Dynamic Predicate Logic (Groenendijk and Stokhoff, 1991) is a paradigm example of a dynamic semantic theory. In DPL, the denotation of a formula is the set of ways of following its instructions (e.g. $\exists x.P(x)$ denotes the set of ways of updating the value of x so that $P(x)$ is true).

More precisely, in DPL formulae describe transitions between information states, where the latter are modeled as variable assignment functions. So the denotation of any formula in DPL is a relation on assignments. Formula denotations can be either tests or non-trivial updates. A test R does not change the context (assignment), so for any $\langle f, g\rangle \in R$, $f = g$. Atomic formulae are tests, filtering out assignments that make the formula false:

$$[\![\phi]\!]^M = \{\langle f, f\rangle \mid \ [\![\phi]\!]^{M,f} = \top\}$$

Assignments f, g are x-variants (written $f[x]g$) iff for all variables $y \neq x$, $f(y) = f(x)$. Denotations of existentially quantified formulae allow for variable assignment change:

$$[\![\exists x.\phi]\!]^M = \{\langle f, h\rangle \mid f \text{ is an } x\text{-variant of some } g \text{ and } \langle g, h\rangle \in \ [\![\phi]\!]^M\}$$

Conjunction is interpreted as composition of relations:

$$[\![\phi \wedge \psi]\!]^M = \{\langle f, h\rangle \mid \text{for some } g, \langle f, g\rangle \in \ [\![\phi]\!]^M \text{ and } \langle g, h\rangle \in \ [\![\psi]\!]^M\}$$

We can write $\exists x$ for $\exists x.\mathbf{1}$ where $\mathbf{1}$ is any tautology (tautologies (tests) denote an identity relation $\{\langle g, g\rangle\}$). Then we observe from the definitions above that $\exists x.\phi$ is a composition of the denotations $[\![\exists x]\!]^M$ and $[\![\phi]\!]^M$; in particular, $\exists x.P(x) \equiv \exists x \wedge P(x)$. Groenendijk and Stokhoff (1991) write $[x]$ where I, for simplicity, prefer to use $\exists x \equiv \exists x.\mathbf{1}$.

Truth of a formula in DPL is a secondary notion: ϕ is true iff there's a way to follow its instructions. Formally, ϕ is true in M iff $[\![\phi]\!]^M \neq \emptyset$.

Dynamic theories of meaning were motivated mainly by the study of donkey sentences and discourse anaphora, where noun phrases are coreferent to pronouns outside their syntactic scope. Hybrid Coordination and other conjoined quantifier constructions discussed here are somewhat similar: conjoined noun phrases fill argument positions outside their syntactic scope. In fact, a very simple instance of Hybrid Coordination is immediately analyzable in DPL. DPL has a very useful feature that quantifiers do not have to c-command variables they bind, so for instance $\exists x.\phi(x)$ in DPL is equivalent to $(\exists x) \wedge \phi(x)$. Then Hybrid Coordination

(39) Kto-to i kogo-to znaet.
someone.NOM and someone.ACC knows
'Someone knows someone.'

can be straightforwardly interpreted as

(40) $(\exists x \wedge \exists y) \wedge \texttt{know}'(x, y)$.

where $(\exists x \wedge \exists y)$ is an instance of dynamic conjunction $\phi \wedge \psi$ as defined above. In DPL, (40) is equivalent to

(41) $\exists x.\exists y.\texttt{know}'(x, y)$,

with exactly the same truth conditions as those of the Russian sentence. The logical translation (40) is compositional with respect to the Russian sentence it translates. The (hybrid) coordinate structure is translated as a subformula $\exists x \wedge \exists y$, which consists of two quantifiers connected with a conjunction.

But this is as far as DPL can get us. In the theory of Groenedijk and Stokhoff, the existential quantifier $\exists$ is dynamic, but the universal quantifier $\forall$ is (externally) static. $\exists x.\phi$ changes the value of x, and the value of x can be invoked outside of the scope of $\exists x$. As a result, as we have seen, $\exists x.P(x)$ ends up being equivalent to $\exists x \wedge P(x)$ or $(\exists x.\mathbf{1}) \wedge P(x)$. But $\forall x.\phi$ in DPL is defined as a test (roughly, check whether $\forall x.\phi$ is true in the classical sense) and the value of the variable x can not be invoked outside of the syntactic scope of $\forall x$. So one can not eliminate the scope of universal quantifier the way one can do away with the existential quantifier; $(\forall x.\mathbf{1}) \wedge P(x)$ is equivalent in DPL to $P(x)$, not to $\forall x.P(x)$; $\forall x$ fails to bind x in $(\forall x.\mathbf{1}) \wedge P(x)$. So the equivalence which guaranteed compositional logical transation of a conjunction of two existential quantifiers does not hold for universal quantifiers. Therefore, to model compositional interpretation of quantifier conjunction, we need a theory that treats both existential and universal quantifiers dynamically.

5.4.2 Game Theoretic Semantics

Groenendijk and Stokhoff (1991) propose a computational interpretation of DPL that uses a single **agent** that follows programs. In particular, this agent updates variable values (when instructed by quantifiers) and does tests (e.g. for atomic formulae). The main differentiating trait of Game Theoretic Semantics (GTS) is that GTS uses two agents, and both quantifiers $(\exists, \forall)$ are dynamic, being instructions for the two agents.

In game semantics, any formula denotes a debate about its truth between the two agents. One of them, called variously 'Me', 'Verifier', or 'Eloise' $(\exists)$, tries to prove the formula true, and the other, 'Nature', 'Falsifier', or 'Abelard' $(\forall)$ aims to refute it. In an existentially

quantified statement $\exists x.\phi$, Verifier provides a verifying example (updates the value of x), then the debate proceeds for ϕ for the given x. When one debates the truth of a universally quantified formula $\forall x.\phi$, Falsifier proposes a potential counterexample for the universal claim (i.e. Falsifier updates the value of x), then the debate continues for ϕ for the given x.

In frameworks that don't use multiple agents but still treat universal quantification dynamically, Falsifier's role is mimicked by adding *all* possible values for x to the representation of the context. Recall that in DPL context is represented with an assignment function, which is clearly insufficient if we need to include all possible values for x. So the usual path taken to solve this is to storing multiple assignments — a set of assignments — as a representation of context. Correspondingly, relations on assignments as denotations of formulae no longer suffice in such theories, and they switch to still higher order models where formulae denote relations on sets of assignments; this is the path taken in Plural Dynamic Logic Van den Berg and Plural Compositional Discourse Representation Theory (Brasoveanu, 2007).

The debate between the Verifier and the Falsifier is a *game*, an interaction between agents that have preferences guiding their actions. Games, as studied in game theory, have outcomes where players receive payoffs. The debate described above is a very simple kind of game, called *zero-sum* game, where one participant's gain is balanced by another participant's loss. In the case of game theoretic semantics, games denoted by formulae have only two outcomes: just one of the two players wins in the end, and the other loses. In a game denoted by an atomic formula (e.g. $[\![P(x)]\!]^{M,g}$) Verifier wins iff the formula is true in the classical sense, i.e if $P(g(x))$ holds. In the game $[\![\exists x.P(x)]\!]^{M,g}$ Verifier wins iff she wins in the subgame $[\![P(x)]\!]^{M,g}$, i.e. iff she updates x so that $P(x)$ holds.

A semantic game $G_A(M, \phi_0, g_0)$ for a formula ϕ_0 and a (partial) assignment function g_0 includes a set of actions (positions in the game) $A = \{(\psi, g)\}$. Each action is a pair consisting of a subformula ψ of ϕ and an assignment g produced by extending the initial assignment g_0. Each move in the game is a shifting from one action to another. Sequences

of actions form possible game *histories*, or *plays*. The set of possible histories $H_{(\phi_0,g_0)}$ is defined recursively. $H_{(\phi_0,g_0)}$ includes

- the starting action (ϕ_0, g_0);
- if $((\phi_0, g_0), ..., (\phi_{n-1}, g_{n-1})) \in H_{(\phi_0,g_0)}$ and $\phi_{n-1} = \psi \wedge \xi$ or $\phi_{n-1} = \psi \vee \xi$ then $((\phi_0, g_0), ..., (\phi_{n-1}, g_{n-1}), (\psi, g_{n-1})) \in H_{(\phi_0,g_0)}$ and $((\phi_0, g_0), ..., (\phi_{n-1}, g_{n-1}), (\xi, g_{n-1})) \in H_{(\phi_0,g_0)}$;
- finally, if $((\phi_0, g_0), ..., (\phi_{n-1}, g_{n-1})) \in H_{(\phi_0,g_0)}$ and $\phi_{n-1} = \exists v.\psi$ or $\forall v.\psi$ then for all h that differ from g only with respect to v, $((\phi_0, g_0), ..., (\phi_{n-1}, g_{n-1}), (\psi, h)) \in H_{(\phi_0,g_0)}$.

The set of all terminal histories

$$Z_{(\phi_0,g_0)} = \{h \in H_{(\phi_0,g_0)} \mid \forall h' \in H_{(\phi_0,g_0)} h \text{ is a prefix of } h' \text{ iff } h = h'\}$$

corresponds to complete games. The utility functions u_V, u_F determine the payoffs for the players in each complete game, so for all terminal histories $h = ((\phi_0, g_0), \ldots, (\phi_n, g_n)) \in Z_{(\phi_0,g_0)}$, $u_V(h) = 1$ iff $[\![\phi_n]\!]^{M,g_n} = \top$ in the classical sense, and $u_V(h) = -1$ iff $[\![\phi_n]\!]^{M,g_n} = \bot$ in the classical sense; $u_F(h) = -u_V(h)$ (whenever defined) and $u_F(h)$ is defined just in case $u_V(h)$ is defined.

At each point in the game, the structure of the current subformula determines who chooses the next position. The function from (non-terminal) histories to players responsible for the next move P is defined as

$$P(((\phi_0, g_0), \ldots, (\phi_n, g_n))) = \begin{cases} V & \text{if} \phi_n = \psi \vee \xi \\ F & \text{if} \phi_n = \psi \wedge \xi \\ V & \text{if} \phi_n = \exists v.\psi \\ F & \text{if} \phi_n = \forall v.\psi \end{cases}$$

So we see that in classical game theoretic semantics conjunction and disjunction and existential and universal quantifiers are duals, only differing in which of the players selects the next position in the game.

In Game Theoretic Semantics as in Dynamic Predicate Logic the notion of truth is secondary. A formula is true iff there's a way for Verifier to win the game it denotes no matter what his opponent, Falsifier, does. A way to win is called a *winning strategy*. A strategy σ for player p is a function determining his choices in the game. Technically, σ is a strategy for player p iff σ is defined on all and only $h \in H_{(\phi_0,g_0)}$ such that $P(h) = p$, and for any $h = ((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1})) \in H_{(\phi_0,g_0)}$, $\sigma(h) = ((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}), (\phi_n, g_n)) \in H_{(\phi_0,g_0)}$.

If σ and τ are strategies for two different players, $\widehat{\sigma\tau}(H_{(\phi_0,g_0)})$ is the terminal game history $h = ((\phi_0, g_0), \ldots, (\phi_{k-1}, g_{k-1}) \in Z_{(\phi_0,g_0)}$ such that for any history

$$\gamma = ((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}))$$

that is a prefix of h and has multiple continuations $((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}), (\phi, g))$ and $((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}), (\phi', g'))$ where $(\phi, g) \neq (\phi', g')$ either $\sigma(\gamma)$ or $\tau(\gamma)$ is a prefix of h. Strategy σ for player p is a winning strategy iff for any strategy τ for the other player p', $u_p(\widehat{\sigma\tau}(H_{(\phi_0,g_0)})) = 1$

By definition, a formula ϕ is true for M, g iff Verifier has a winning strategy in the game $[\![\phi]\!]^{M,g}$. Note that in a deep sense the notion of truth is the same in DPL and in game theoretic semantics: a formula is true iff one can successfully fulfill the variable assignment update that the formula requires. The main difference is that in DPL there is no Falsifier whose potential interference we have to take into account.

Example. In the game denoted by $\forall x.P(x)$, Falsifier updates the value for variable x; after that, we get a terminal history and check if $P(x)$ is true. If it is, Verifier wins, otherwise Falsifier wins. $\forall x.P(x)$ is *true* iff Verifier has a winning strategy, i.e. iff Verifier wins $P(x)$ no matter how Falsifier updates x. So $\forall x.P(x)$ is true in GTS iff $P(x)$ holds for all values

for x. The truth of universally quantified statements in GTS turns out to be equivalent to classical truth in first order logic.

Not just quantifiers but all operators of first order logic have a game theoretic interpretation (for simplicity, I have omitted negation from the exposition above; informally, negation exchanges the roles of the two players). Furthermore, for formulas of predicate logic, game-theoretic truth is always equivalent to classical truth. In other words, game theoretic semantics is truth conditionally the same as the classical semantics of predicate logic. The semantic metalanguage that many formal semanticians of natural language use is usually based on (first or second order) predicate logic. So in principle we lose nothing by switching to game-theoretic interpretation of semantic formulae for the semantic analysis of natural language. It turns out that we can actually gain something if we add new, specifically game theoretic connectives.

5.4.3 Conjunction in GTS

In classical GTS, a conjunction $\phi \wedge \psi$ denotes a game in which Falsifier chooses one of the subgames $\xi = \phi$ or $\xi = \psi$ Then ξ is played, and whoever wins ξ, wins $\phi \wedge \psi$ (for a technical definition see above). Truth conditionally, game theoretic conjunction defined this way is equivalent to conjunction in classical logic, defined by a truth table, even though the game semantics of propositional operators $\wedge$ and $\vee$ is not truth functional. Recall that truth is defined not as a characteristic of a particular game play (= game history), but as the existence of a winning strategy. It is possible to construct a winning strategy $\sigma''$for Verifier in $\phi \wedge \psi$ from winning strategies $\sigma$for ϕ and σ' for ψ, and vice versa; informally, if Verifier can win in ϕ or ψ not matter which is played, she can win in both. In other words, Verifier has a winning strategy in $\phi \wedge \psi$ iff she has a winning strategy both in ϕ and in ψ. Indeed, let σ be a winning strategy for (ϕ, g_0) and σ' a winning strategy for (ψ, g_0). Then for any $h = ((\phi \wedge \psi, g_0), (\phi_1, g_1) \ldots, (\phi_{n-1}, g_{n-1})$, let $\sigma''(h) = ((\phi_0, g_0), \sigma((\phi_1, g_1) \ldots, (\phi_{n-1}, g_{n-1})))$ if $\sigma((\phi_1, g_1) \ldots, (\phi_{n-1}, g_{n-1}))$ is defined and

otherwise $(h) = ((\phi_0, g_0), \sigma'((\phi_1, g_1) \ldots, (\phi_{n-1}, g_{n-1})))$. σ'' is obviously a winning strategy for $\phi \wedge \psi, g$ since for any τ, $\widehat{\sigma''\tau}(H_{(\phi_0,g_0)})$ has as its suffix either $\widehat{\sigma\tau'}(H_{(\phi,g_0)})$ or $\widehat{\sigma'\tau'}(H_{(\psi,g_0)})$ for some τ'; and since σ and σ' are winning strategies, $u_V(\widehat{\sigma''\tau}(H_{(\phi_0,g_0)})) = 1$. Conversely, it is easy to construct winning strategies σ for ϕ and σ' for ψ from a winning strategy for $\phi \wedge \psi$. So by the game theoretic definition of truth, $\phi \wedge \psi$ is true (for the given M, g) iff both ϕ and ψ are true for those M, g.

This notion of game theoretic conjunction is valid, but it is not the only logical possibility. Abramsky (2007) proposes other operators for multiagent interactions inspired by multiplicative operators of linear logic:

(42) a. $\phi \,||\, \psi$: parallel composition of games
b. $\phi \cdot \psi$: sequential composition of games

Under sequential composition $\phi \cdot \psi$, ϕ is played followed by ψ. Verifier wins iff she wins both subgames ϕ and ψ. Under parallel composition $\phi \,||\, \psi$, ϕ and ψ are played in parallel; Verifier wins iff she wins both subgames ϕ and ψ. For any game play $h \in H_{\phi_0 \cdot \psi_0, g_0}$ for a sequential composition $\phi_0 \cdot \psi_0$, either $h \in H_{\phi_0,g_0}$, or

$$h = ((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}), (\psi_0, g_{k-1}), \ldots (\psi_{n-1}, g_{n-1}))$$

where $((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1})) \in Z_{\phi_0,g_0}$ and $u_V(((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}))) = 1$, and

$$((\psi_0, g_{k-1}), \ldots (\psi_{n-1}, g_{n-1})) \in H_{(\psi_0,g_{k-1})}.$$

For closed formulae, both parallel and sequential composition are truth conditionally equivalent to classical $\wedge$, so both are potential candidates as a representation of sentential conjunction in natural language.

Note that sequential composition is analogous to conjunction in DPL (= composition of relations). Now observe that, like the existential quantifiers in DPL, dynamically interpreted

quantifiers are instructions on their own, they don't need formulas in their scope (van Benthem, 2003; Abramsky, 2007). The following equivalence holds for both quantifiers:

(43) a. $\exists x.P(x) \equiv \exists x \cdot P(x)$

b. $\forall x.P(x) \equiv \forall x \cdot P(x)$

(technically, again, $\exists x$ and $\forall x$ may be taken to represent $\exists x.\top$ and $\forall x.\top$ where $\top$ stands for any tautology)

This observation sets the stage for coordinating quantifiers in the same way as sentences.

If sequential composition is relatively straightforward, parallel composition is less so. There are two ideas of formalizing what parallel games mean:

- underspecified order: the order of moves within each subgame is fixed but moves belonging to parallel subgames can be interleaved in any order, as in the game semantics of the multiplicative fragment of linear logic by Abramsky and Jagadeesan (1994);
- informational independence, whereby the two games might be played in a particular order but the players have to forget how exactly the first game was played when they play the second one. Technically, this involves counting only those strategies as legitimate winning strategies which do not differentiate game histories of the first subgame when applied to the second (parallel) subgame.

Implementing the second approach, we can define parallel composition as follows. A history $h \in H_{\phi_0||\psi_0,g_0}$ for a parallel composition $\phi_0 \,||\, \psi_0$ of ϕ_0 and ψ_0,

- either $h \in H_{\phi_0,g_0}$,
- or $h = ((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}), (\psi_0, g_{k-1}), \ldots (\psi_{n-1}, g_{n-1}))$ where
  $((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1})) \in Z_{\phi_0,g_0}$ and
  $u_V(((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}))) = 1$, and $((\psi_0, g_{k-1}), \ldots (\psi_{n-1}, g_{n-1})) \in H_{(\psi_0,g_{k-1})}$,

- or $h = ((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}), (\psi_0, g_0), \ldots (\psi_{n-1}, g_{n-1}), (\top, g_{k-1} \cup g_{n-1}))$ where $((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1})) \in Z_{\phi_0, g_0}$; $u_V(((\phi_0, g_0), \ldots (\phi_{k-1}, g_{k-1}))) = 1$, and $((\psi_0, g_0), \ldots (\psi_{n-1}, g_{n-1})) \in Z_{\psi_0, g_0}$ and $u_V(((\psi_0, g_0), \ldots (\psi_{n-1}, g_{n-1}))) = 1$.

Parallel games introduce *partial information* into the game semantics. When playing the subgame ψ of $\phi \mid\mid \psi$, players don't have access to the information on how ϕ was played, so their task becomes harder. On the other hand, if there is a winning strategy for the harder game of parallel composition, it can also work for sequential composition. So $\phi \mid\mid \psi$ implies $\phi \cdot \psi$. This fact corresponds to the observation that branching combination of quantifiers (that we encode as parallel composition) entails their ordered application (can be encoded via sequential composition).

To relate informational independence to truth, we may refine the notion of strategy σ so that a player in a subgame can not use information on the other parallel subgame to make a move. Since under our definition of parallel composition all the relevant information is encoded in the history but not in the current assignment function, we can require that for all $h = ((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}), (\phi_n, g_n))$ and $h' = ((\phi_0, g_0), \ldots, (\phi'_{n-1}, g'_{n-1}), (\phi_n, g_n))$, $\sigma(h) = \sigma(h')$ if $((\phi_0, g_0), \ldots, (\phi'_{n-1}, g'_{n-1})) = ((\phi_0, g_0), \ldots, (\phi_{n-1}, g_{n-1}))$.

Parallel composition (or informational independence otherwise formalized in semantic games) makes non-trivial changes to truth conditions only if parallel games include moves by different players. If the same player makes all choices in parallel subgames, she could just as well apply them sequentially, since any strategy would tell her in advance what she would do in each subgame; there's no partial information involved.

5.5 Formalizing semantics

5.5.1 Sentential Conjunction

I propose to represent the denotation of *and* in game theoretic terms as parallel composition. This applies to sentential and NP coordination alike, and covers other cases of non-standard coordination that I consider here.

The case of sentential conjunction is straightforward because $\phi \,||\, \psi$ is truth conditionally equivalent to $\phi \wedge \psi$. Indeed, Verifier has a winning strategy in ϕ and ψ played in parallel iff she has a winning strategy for each of them. So leaving the rest of the semantics unchanged, we lose nothing by switching to parallel composition || as the logical counterpart of conjunction in natural language.

Predicate conjunction is analogous to the sentential case, as long as we can represent predicates as interpreted as open formulae (formulae with unbound variables in them). So for instance

(44) $[\![\text{everyone dances and sings}]\!]^{M,g} = \forall x.(\texttt{sing}(x)||\texttt{dance}(x))$.

5.5.2 Quantifier Conjunction

The operator of parallel processing || has the main purpose of representing quantificational independence. We observe that not only in coordination of quantified NPs but also in coordination of sentences one typically finds quantificational independence between conjuncts:

(45) a. *Two boys and two girls like each other*
[pairs of girls don't vary with the boy]

b. *Two boys like two girls* [pairs of girls may vary with the boy]

c. *Two boys laugh and two girls are silent*

[pairs of girls don't vary with the boy]

If we treat NPs as quantifiers, NP coordination can be also represented via parallel composition, in the same way as sentential coordination. Let us adopt the notation for quantifier restriction $Q^{[A]}$ from Peters and Westerståhl (2006, p. 87) where Q is a quantifier and A is a restriction set. In the game theoretic setting quantifier restriction constrains the choice of referent. For example, $\exists^{[A]}x$ is a move by the Verifier who updates the value of variable x with a model element $a \in A$. Likewise, $\forall^{[A]}x$ is a move by the Falsifier who updates the value of variable x with a model element $a \in A$. If so, we can encode the meanings of quantified phrases like *every man* and *some man* as syntactic units of our logical language ($\exists^{[\texttt{man}]}$ and $\forall^{[\texttt{man}]}$). Building a restriction set into the game semantics of a quantifier follows van Benthem's (2003) approach to modality in game theoretic semantics.

Then the coordinate NP *every man and every woman* receives the logical translation

(46) $\quad \forall^{[\texttt{man}]}x \mid\mid \forall^{[\texttt{woman}]}y$

Note that this is a combination of semantic values for coordinated NPs *every man* ($\forall^{[\texttt{man}]}x$) and *every woman* ($\forall^{[\texttt{woman}]}x$). In game semantics this means that Falsifier updates the value of x with a male (discourse) referent, and parallel to that Falsifier updates the value of y with a female referent. In other words, x and y simultaneously receive arbitrary values from the sets of men and women, respectively.

We can attribute the sentence *Every man and every woman kissed (each other)* a logical form like the following:

(47) $\quad [\forall^{[\texttt{man}]}x \mid\mid \forall^{[\texttt{woman}]}y] \cdot \texttt{kissed-each-other}(x, y)$

where $\texttt{kissed-each-other}(x, y)$ stands for $\exists e(\texttt{kiss}(e, x, y)||\texttt{kiss}(e, y, x))$ or whatever the proper denotation of *kissed each other* is (Heim et al., 1991; Dalrymple et al., 1998b).

So a sentence with conjoined NPs *Every man and every woman kissed (each other)*, represented with a formula $[\forall^{[\texttt{man}]}x \mid\mid \forall^{[\texttt{woman}]}y]\cdot\mathbf{kissed}(x, y)$, denotes a game in which Falsifier updates the value of x with a male referent, and parallel to that updates the value of y with a female referent. The outcome of the game is determined by whether x and y kissed each other. This game semantics formalizes the informal description we started with, 'Take an arbitrary man x and take an arbitrary woman y; they kissed each other'.

5.5.3 Application to other quantifiers

But universal and existential quantifiers, even relativized to a restriction set, do not exhaust the range of quantifiers expressible in natural language (Barwise and Cooper, 1981; Keenan and Moss, 1985). Moreover, the range of natural language quantifiers goes beyond first order definable ones. So it is justified to use second order quantification (quantification over sets); in a different approach to implementing generalized quantifiers in game theoretic semantics, Pietarinen (2007) proposes to use sequences instead of sets. I will use capital letters as variables over sets/predicates; restrictions of second-order quantifiers (still marked as superscripts) are now not sets but sets of sets. For any type $\langle 1, 1\rangle$ quantifier like *most*, *two*, or *infinitely many*, call it Q, and set A, define $Q(A)$ as $\{A' \subseteq A \mid Q(A, A')\}$. Then we can introduce Q into the logic by translating a quantificational statement "Q A are B" as

(48) $\exists^{[Q(A)]}A'.\forall^{[A']}x.B(x)$

where B is the predicate expressing property B. Equivalently,

(49) $\exists A' \subseteq A.Q(A, A') \wedge \forall x \in A'.B(x)$, or $\exists A' \subseteq A.Q(A, A') \wedge A' \subseteq B$

$Q(A,B)$ implies (49) for all conservative quantifiers, so likely for all natural language determiners Keenan and Stavi (1986). Take $A' = A \cap B$; then $A' \subseteq A$ and $A' \subseteq B$ and by conservativity $Q(A,A') = Q(A, A \cap B) = Q(A,B) = \top$.

The converse holds just for the right upward monotone quantifiers (not necessarily conservative). ($\Rightarrow$) Let $\exists A' \subseteq A.Q(A,A') \wedge A' \subseteq B$ imply $Q(A,B)$ for any A, B. Then take arbitrary sets C and $C' \subseteq C$, and let $Q(A,C')$. The formula $\exists A' \subseteq A.Q(A,A') \wedge A' \subseteq C$ is true (take $A' = C'$). Then by assumption $Q(A,C)$, so Q is upward increasing. ($\Leftarrow$) Let $\exists A' \subseteq A.Q(A,A') \wedge A' \subseteq B$ be true for some A, B and a right increasing Q. Then $Q(A,A')$ and $A' \subseteq B$ imply $Q(A,B)$ by monotonicity of Q.

(Note that monotone quantifiers enjoy some nice logical properties (Makowsky and Tulipani, 1977) and can be considered basic in natural language quantification (Barwise and Cooper, 1981)) For a generalized quantifier Q

(50) $\quad Q^{[A]}x.B(x) = \exists^{[Q(A)]}A'.\forall^{[A']}x.B(x)$

$Q^{[A]}x.B(x)$ is equivalent to $Q(A,B)$ for right increasing conservative determiners. This translation again allows us to dissociate the quantifier from its scope:

(51) $\quad Q^{[A]}x.B(x) = Q^{[A]}x \cdot B(x)$

A conjunction of two such quantifiers Q_1, Q_2 produces the following formula

(52) $\quad (\exists^{[Q_1(A)]}A'.\forall^{[A']}x) \mid\mid (\exists^{[Q_2(B)]}B'.\forall^{[B']}y) \cdot R(x,y)$

which turns out truth conditionally equivalent to Barwise's (1979) branching combination for right increasing quantifiers

(53) $\quad \exists A' \exists B'.Q_1(A') \wedge Q_2(B') \wedge A' \times B' \subseteq R$

In other words, we derive quantifier branching as a compositional combination of distributively interpreted generalized quantifiers. The derivation is valid only for monotone increasing quantifiers, exactly the class of quantifiers for which Barwise proposed (53). E.g.

(54) Many a man and every other woman know each other

gets the interpretation of

(55) $(\exists^{[\texttt{many(man)}]}A'.\forall^{[A']}x) \mid\mid (\exists^{[\texttt{half(woman)}]}B'.\forall^{[B']}y) \cdot \texttt{know each other}(x,y)$

where the Verifier chooses sets A' of many men and B' that contains half the women, and then for arbitrarily and independently chosen $x \in A'$ and $y \in B'$ one checks if x and y know each other. That branching interpretation is not always available for coordinated quantified phrases (even with reciprocal predicates) must be due to the fact that most quantifiers can be interpreted collectively rather than distributively. If we take a collective interpretation of a quantifier Q to be $\exists^{[Q(A)]}A'$ instead of the distributive $\exists^{[Q(A)]}A'.\forall^{[A']}x$,

(56) Two boys and three girls like each other

could be expressed as

(57) $(\exists^{[\texttt{two(boy)}]}A \mid\mid \exists^{[\texttt{three(girl)}]}B) \cdot \texttt{like each other}(A,B)$
'There is a group of two boys A, and there is a group of three girls B, and groups A and B like each other'

This seems to correctly represent the truth conditions of (56), which are weaker than a branching combination of two quantifiers.

5.5.4 Capturing Quantifier Independence

Parallel composition is designed to handle quantifier independence; indeed, scope independence facts were the main stimuli for developing game semantics for predicate logic. Consider one of our examples of quantifier independence,

(58) Every man and almost every woman kissed each other

The vague quantifier $[\![\textit{almost every woman}]\!]^{M,g}$ can be formalized as a game where Verifier picks a sufficiently big subset W of women, and the Falsifier picks an arbitrary $x \in W$. Indeed, intuitively, *Almost every man wastes part of his life in attempts to display qualities that he does not possess* is true iff one can point to a negligible number of exceptions (set X) such that when those exceptions are taken away, all men (any x in the set $\texttt{man}-X$) waste part of their life in attempts to display qualities that they do not possess. (This effectively follows the schema for rendering arbitrary generalized quantifiers introduced above for *almost every*)

So (58) can be given a logical translation of

(59) $[\forall^{[\texttt{man}]}x \mid\mid \exists W \approx \mathit{woman} \cdot \forall^{[W]}y] \cdot \texttt{kissed}(x, y)$

or equivalently

(60) $[\forall^{[\texttt{man}]}x \mid\mid \exists^{[\texttt{almost.every(woman)}]}W \cdot \forall^{[W]}y] \cdot \texttt{kissed}(x, y)$

This denotes a game in which Falsifier picks an arbitrary man x, and parallel to that Verifier restricts the set of women to W, throwing away a few negligible exceptions. Falsifier chooses a woman $y \in W$. Since parallel games are independent, women involved in kissing don't vary with men. Any time the outcome of the game is determined by the truth of 'x

and y kissed each other', y is arbitrarily chosen from W, which in turn is independent of the choice of x. In order for Verifier to have a winning strategy in this game, there must be a fixed set W that all men kissed.

The discussion so far has been driven by universally quantified NPs, but the approach to conjunction proposed here extends to other NPs as well. A natural extension is to indefinite NPs, which can be treated as exisistential quantifiers. So $[\![\textit{some man}]\!]=\exists^{[\texttt{man}]}x$, 'pick a man x'. Coordinated indefinite NPs as in

(61) Some man and some woman kissed each other.

can be translated compositionally as a game where Verifier picks a man x, and parallel to that picks a woman y, as expressed by the formula

$$[\exists^{[\texttt{man}]}x \mid\mid \exists^{[\texttt{woman}]}y] \cdot \texttt{kissed}(x,y)$$

Extension to referential NPs is just as straightforward. It has been a standard technique since Montague to present referential NPs as a special case of quantifiers. Among various ways to accomplish this, one can referential NPs are a trivial instance of existentially (or universally) quantified NP, so that 'Mary' is interpreted as $\exists x = \texttt{m}$ or $\forall x = \texttt{m}$. This applies to all proper names: 'Brezhnev$_i$' translates into 'update the value of variable i with the referent Brezhnev', 'Honekker$_j$' into 'update the value of variable j with the referent Honekker'. If so, a sentence with NP conjunction

(62) Brezhnev and Honekker kissed

receives a translation

$$[\exists^{[\{\texttt{b}\}]}x \mid\mid \exists^{[\{\texttt{h}\}]}y] \cdot \texttt{kissed}(x,y)$$

which is true, as one easily sees, if and only if Brezhnev and Honekker kissed (more specifically: iff $\texttt{kissed}(x,y)$ is true when x stands for Brezhnev and y stands for Honekker).

So far we focused on conjunctions of similar quantifiers: two universal ones or two existential ones. Now, what if an existentially quantified NP is conjoined with a universally quantifier one?

(63) Every man and some woman are acquainted with each other.

Does (63) entail that there's one woman acquainted with all men (as our analysis would predict), or is its interpretation weaker, equivalent to *Every man is acquainted with some woman*? This turns out not to be clear empirically because native speakers of English don't find examples like (63) very natural, and some even judge them ungrammatical. Some naturally occurring instances of *every and some* non-Boolean conjunction present counterexamples to scope independence of quantifiers in coordinate structures and are discussed in the Conclusion below.

5.5.5 Back to the Resumption Generalization

As discussed in the previous chapter, coordinate NPs with determiners 'some,' 'every,' 'no,' 'not every' (these four form square of opposition), and wh-determiners can be interpreted as a resumption of these quantifiers, i.e. quantifiers over pairs $\exists\langle x, y\rangle$, $\forall\langle x, y\rangle$, etc. This set of quantifiers, as observed in Chapter 4, also happens to cover all the typical quantifier meanings involved in Hybrid Coordination. How does the game-theoretic approach developed here account for the Resumption generalization?

For starters, we have already seen that the game theoretic analysis predicts correct interpretations for universal and existential quantifiers. Indeed, there is no substantial difference (in terms of winning potential) between picking two individuals in parallel by the same player ($\exists x \mid\mid \exists y$, $\forall x \mid\mid \forall y$) and picking a pair by that player ($\exists\langle x, y\rangle$, $\forall\langle x, y\rangle$), since the other player is not involved and does not introduce indeterminacy. Our formalization of other upward monotone quantifiers also predicts (correctly) that resumption is not valid

in general (cf. examples in section 4.6), and captures the cumulative readings that many quantifiers exhibit in this case.

But more has to be said about the other cases such as wh-questions with conjoined interrogatives. There are various analyses to the semantics of wh-words, including game-theoretical. Perhaps the most popular approach, widely accepted since the classical paper by Karttunen (1978), is to treat wh-words as a variety of existential quantifiers that are bound to occur in a special position in questions: $[\![\textit{which}]\!]^{M,g}=\lambda Q.\lambda P.\exists x.[Q(x) \wedge^{\vee} P(x)]$. Wh-questions, in Karttunen's account, denote sets of true propositions with a variable bound by the wh-quantifier:

(64) $[\![\textit{Who came?}]\!]^{M,g}=\lambda p.\exists x.[\texttt{human}(x) \wedge^{\vee} p \wedge p =^{\wedge} [\texttt{came}(x)]]=$
$=\lambda p.\exists x^{\texttt{human}}[^{\vee}p \wedge p =^{\wedge} [\texttt{came}(x)]]$

If so, conjoined interrogatives should behave just like conjoined existential quantifiers, which they seem to do:

(65) a. Kto i čto slyšal?
who.NOM and what.ACC heard
'Who heard what?'

b. $[\![(65\text{-a})]\!]^{M,g}=\lambda p.[\exists^{\texttt{animate}}x \,||\, \exists^{\texttt{inanimate}}y] \cdot [^{\vee}p \wedge p =^{\wedge} [\texttt{heard}(x,y)]]=$
$=\lambda p.\exists\langle x,y\rangle^{\texttt{animate}\times\texttt{inanimate}} \cdot [^{\vee}p \wedge p =^{\wedge} [\texttt{heard}(x,y)]]$.

Negative quantifiers, as in (66), constitute crucial supporting evidence for the Resumption generalization in Chapter 4:

(66) a. No man and no woman kissed each other.

b. Not every man and not every woman kissed each other.

A proper implementation of these and other non-upward monotone quantifiers would re-

quire a careful discussion of the analysis of negation in game theoretic semantics, which goes beyond the limits of this chapter; for a discussion of properties of game-theoretic negation, see Hintikka (2002, 2006); Caicedo et al. (2009). Let me only note without going into technical details that negation in game semantics is standardly interpreted as role permutation: Verifier takes the role of Falsifier and vice versa. Changing roles and then playing parallel games is equivalent to changing roles in each of the parallel subgames. So in particular — formalizing observations on (66)— $(\neg\exists x) \mid\mid (\neg\exists y)$ is equivalent in the game logic to $\neg(\exists x \mid\mid \exists y)$, and likewise $(\neg\forall x) \mid\mid (\neg\forall y)$ is equivalent to $\neg(\forall x \mid\mid \forall y)$ (Abramsky, 2007), so game semantics has the potential to explain the lack of double negation readings with coordinate negative quantifiers; note that downward monotone quantifiers are one of the main pieces of evidence for the resumption generalization presented in Chapter 4.

5.5.6 AND vs. OR in plurality contexts

Switching to parallel composition offers us an answer to the long-standing question of why it is the conjunction *and* and not the disjunction *or* that we find in plurality forming contexts:

(67) Johnny Depp and/*or Amber Heard are dating.

The meaning of disjunction in classical game semantics is defined as follows. To prove the truth of $\phi \vee \psi$, it is sufficient to prove the truth of one of the disjuncts. So in the game denoted by $\phi \vee \psi$, Verifier chooses one of ϕ and ψ, and proceeds to verify it. So the meaning of the two versions of (67) can be represented by

(68) a. $[\exists^{[\{\texttt{Depp}\}]}x \mid\mid \exists^{[\{\texttt{Heard}\}]}y] \cdot \texttt{date}(x, y)$

b. $[\exists^{[\{\texttt{Depp}\}]}x \vee \exists^{[\{\texttt{Heard}\}]}y] \cdot \texttt{date}(x, y)$

When the game of (68-a) is played, variables x and y get values in the respective parallel subgames. But in (68-b) Verifier chooses only one subformula of $[\exists^{[\{\texttt{Depp}\}]}x \vee \exists^{\{\texttt{Heard}\}}y]$ which is then played, so only one of x and y receives a value. As a result, the truth of the atomic $\texttt{date}(x, y)$, where one variable is unbound, can not be evaluated. This is also another benefit of representing natural language conjunction as parallel combination of games rather than using the classical game theoretic conjunction ($\phi \wedge \psi$), which consists of choosing one subformula (ϕ or ψ) by Falsifier. Even though $\phi \wedge \psi$ and $\phi \mid\mid \psi$ are truth conditionally equivalent for closed formulae ϕ, ψ (as we saw above), the two are not fully equivalent. This is because the denotation of a formula that we accept here is not a truth value but a game (or, on dynamic semantics, context update potential), and the notion of truth is secondary.

5.6 Syntax Semantics Interface

5.6.1 Plural predicates

One way to unify Hybrid coordination and coordination with collective predicates is to reanalyze collective predicates. In HC, conjuncts correspond to different arguments of a predicate, and in examples with collective predicates conjuncts correspond to parts of one plural argument. A collective predicate can combine with a single plural DP, or with a conjunction of arbitrarily many DPs.

(69) a. These guys lifted a piano together. (1 argument)

b. John and Paul lifted a piano together. (2 arguments)

c. John, Paul, and these guys lifted a piano together. (3 args)

d. John, Paul, Ringo, and George lifted a piano together. (4 args)

The usual assumption is that conjoined DPs as in (69-d) translate into a single argument of the collective predicate. But one can assume, alternatively, that collective predicates have

flexible argument structure, and can take arbitrarily many arguments. Let *lift-the-piano-together* be the linkian one-place predicate that takes one plurality as an argument. Then we can take the denotation of the VP *lift the piano together* to be *lift-the-piano-together**, a predicate with flexible arity, such that *lift-the-piano-together**$(x_1, x_2, ..., x_k)$=*lift-the-piano-together*$(x_1 \oplus x_2 \oplus ... \oplus x_k)$. This move builds Link's sum operator $\oplus$ into the predicate, and makes coordination with collective predicates logically identical to Hybrid Coordination: in both cases different conjuncts correspond to different arguments of the predicate. So we can treat predicates over pluralities as having variable arity, taking one or more arguments per thematic role.

The idea of plural predicates as polymorphic is not new, and was entertained (though not accepted) by various students of plurality, e.g. Landman (1989a). Motivation for this comes from examples like (70-a) and (70-b) which turn out synonymous under the standard mereological approach to NP conjunction:

(70) a. The cards below seven and the cards from seven up are separated.
(Landman, 1989a, 574: ex. 27)

b. The cards below ten and the cards from ten up are separated.

The coordinate NPs in these two sentences seem to refer to the same set of cards and are combined with the same predicate, yet, intuitively. the meanings of the two sentences are different. Unless the predicate *be separated* is treated as binary, the meaning contrast in (70) either has to be dismissed as in Schwarzschild (1996) or explained through a more complex plural ontology which effectively amounts to representing plural predicates as non-unary. For instance, one could enrich plural ontology with pairs of entities such as the pair of the cards below ten and the cards from ten up, and treat *be separated* in (70) as a predicate on pairs; but those predicates on pairs are isomorphic to binary predicates.

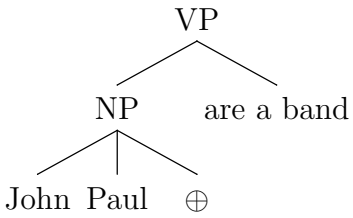
The main argument against modeling plural predicates as polyadic has been that of compositionality: if a coordinate NP is a syntactic unit, it should denote a semantic unit rather than two distinct ones, cf. (Lasersohn, 1995, 272): "It is a fact that in the English phrase *alternately cold and wet*, the string *cold and wet* forms a syntactic unit; our semantic analysis ought to reflect this fact if possible". This becomes a non-issue if we allow coordinate phrases function as polyadic quantifiers. In this case a coordinate phrase is still a semantic unit but it saturates multiple valencies of a predicate it combines with. Now I will present one implementation of this idea that bridges Chomskian syntactic framework with game theoretic semantics.

The multiple arguments of collective predicates could be represented via multiple syntactic arguments that merge in sister positions and receive the same thematic role:

(71)

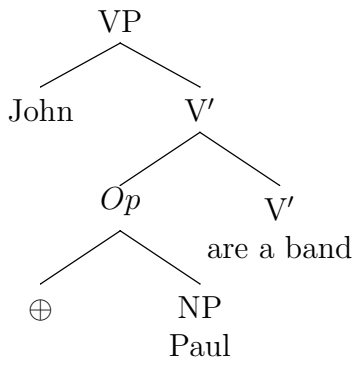
Another syntactic option, if we were to avoid multiplication of argument positions, is to combine multiple arguments with a covert operator rather than the predicate itself:

(72)



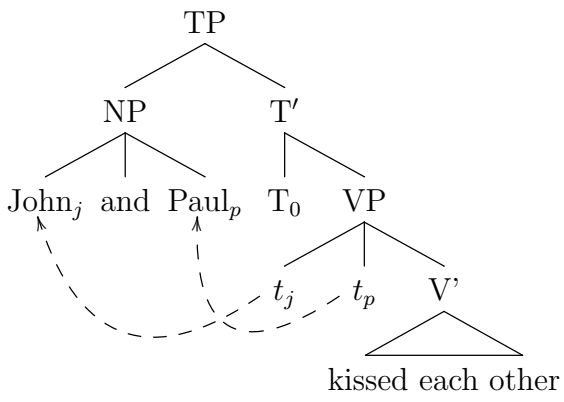
Such an operator effectively takes the role of the flexibility operator $\mathbb{c}$ (Winter, 2001, 52ff.) that allows quantified NPs to combine with collective predicates. Another possible configuration for mapping multiple arguments of collective predicates is to introduce each additional co-argument through another covert operator, as an adjunct in the syntactic structure:

(73)



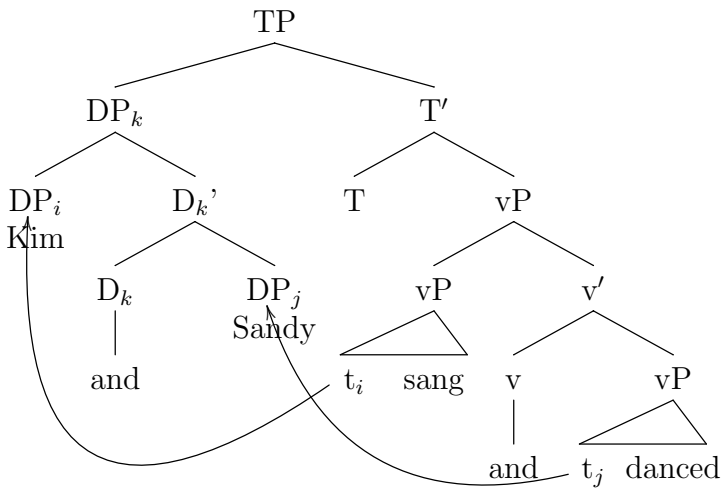
The multiple arguments of collective predicates are not pronounced in this position but rather are moved into coordinate positions, and check case or other features as a single coordinate constituent.

(74)



The idea of movement into coordinate positions follows the proposal by Niina Zhang for *respectively*-statements, which posits sideward movement into coordinate positions (Zhang, 2007, 51c):

(75)



The tree above serves as a representation of the sentence *Kim and Sandy sang and danced, respectively*). Zhang used sideward movement into coordinate positions to analyze coordination examples with *respectively* readings, as well as coordination of wh-words (an instance of Hybrid Coordination).

I propose to extend Zhang's analysis to all NP coordination (at least the non-Boolean cases). But I do not merely extend Zhang's syntactic proposal to new empirical domains, I also complement it with a compositional semantics.

5.6.2 Compositionality

Now let us apply game theoretic semantics to the syntactic structure of natural language, in particular to the syntactic structure of sentences with coordination as analyzed under the sideward movement approach. Assume the following principles of compositionality:

1. each verb is interpreted as a corresponding predicate;

2. each trace t_i as a variable i;

3. each quantified noun phrase NP_i as a quantifier binding the variable i,

4. phrase [A B] is interpreted via function application if $[\![A]\!]^{M,g}$ and $[\![B]\!]^{M,g}$ are of

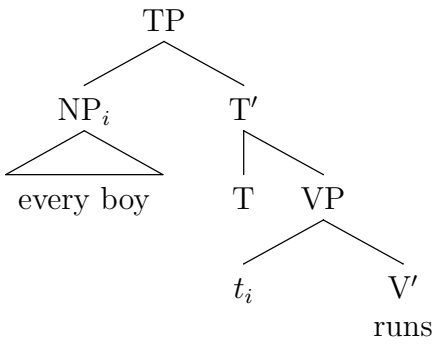
appripriate semantic types

5. [A B] is interpreted as sequential composition $[\![A]\!]^{M,g} \cdot [\![B]\!]^{M,g}$ if both A and B denote formulae.

6. finally, coordinate structures of the form [A and B] can be interpreted as parallel composition $(\phi \mid\mid \psi)$ of $[\![A]\!]^{M,g}$ and $[\![B]\!]^{M,g}$.

These principles of compositionality are mostly standard, compatible with existing ideas about compositionality in natural language. The main novelty is the introduction of game theoretic operators: sequential composition and parallel composition. Parallel composition is simply the denotation of *and*-coordinated structures (whether quantifiers or sentences). Sequential composition helps connect quantifiers with their scope; given that quantifiers are now formulae on their own, they are combined via the sentential connective $\cdot$. Semantic compositionality in action is best understood by way of example. Take a simple sentence *Every boy runs*, represented as

(76)



Elements of this structure are mapped into:

- *runs* $\longrightarrow$ predicate `runs`
- $t_i \longrightarrow$ variable i

- *every boy*$_i \longrightarrow \forall^{[\texttt{boy}]}i$ (ignoring the internal structure and semantic composition of the noun phrase)

The predicate `run` combines with the variable i via function argument application giving an atomic formula $\texttt{run}(i)$. The quantifier $\forall^{[\texttt{boy}]}i$, itself a formula, has a sister node denoting $\texttt{run}(i)$, so by the principle 5 above they are combined via sequential composition, giving

(77) $\forall^{[\texttt{boy}]}i \cdot \texttt{run}(i)$

5.6.3 Interpreting Coordinate Structures

Now let us see how the compositionality principles described above apply to various coordination patterns. Sentential coordination is the most obvious case: the meanings of coordinate clauses are simply combined via parallel composition:

(78) a. It rains and it snows.

b. $\texttt{rain}||\texttt{snow}$

Predicate coordination is fully analogous if treated as coordination of formulae with an open variable in each formula, where the variables could be the semantic correlates of traces left by ATB movement:

(79) Some man$_i$ (t_i dances and t_i sings),

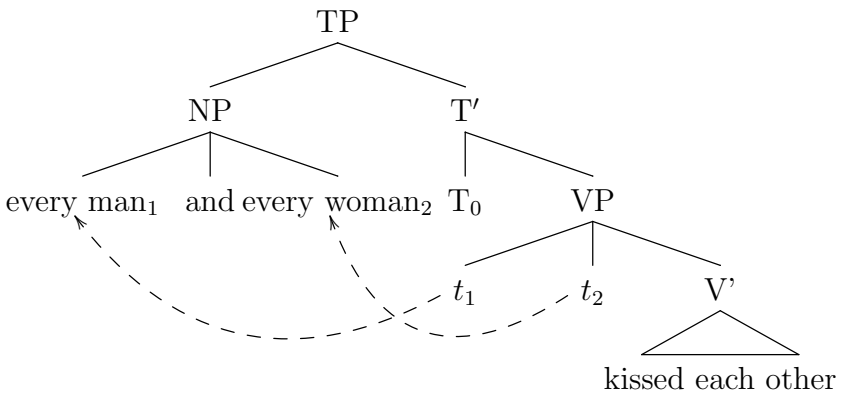
which translates into the logical formula

(80) $\exists^{[\texttt{man}]}i \cdot (\texttt{dance}(i) \,||\, \texttt{sing}(i))$

paraphrased in English as 'Pick a man i ($\exists^{[\texttt{man}]}i$), and then ($\cdot$) check if i dances, and at the same time ($||$) check if i sings'.

The compositionality principles as proposed above also apply to NP conjunction. The syntactic structure conjunction in our branching example *Every man and every woman kissed (each other)* is as follows:

(81)

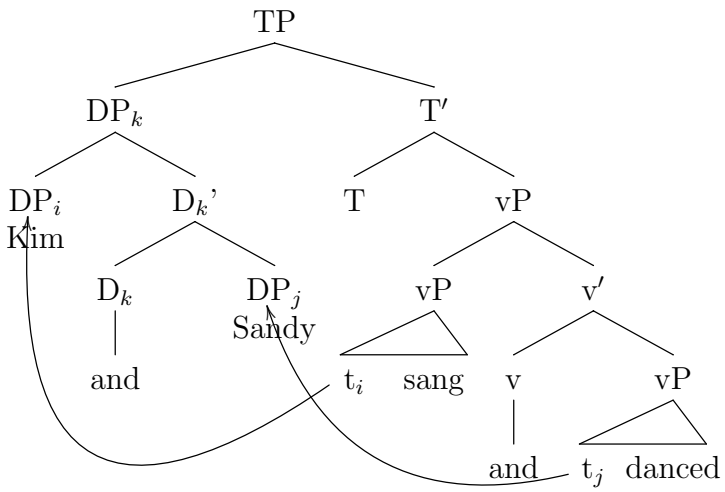


The rules of compositional interpretation translate (81) into the very formula I proposed above as its semantic representation, namely

(82) $[\forall^{[\texttt{man}]}x \mid\mid \forall^{[\texttt{man}]}y] \cdot \mathbf{kissed}(x, y)$

The compositionality rules apply to sentences with *respectively*, allowing a compositional semantic treatment without recourse to special interpretational devices such as the pair building denotation of *and* (as discussed in the previous chapter) or the plural predicate building meaning of *and* as in Chaves (2012). In fact, all instances of *and* in *respectively* sentences translate into parallel composition, provided we assume the syntactic derivation proposed by Zhang (2007):

(83)



In Zhang's account, *respectively* is a semantically vacuous[2] marker of structures with parallel extraction, which guarantees proper coindexing of quantifiers and traces. Given that referential NPs are treated as trivial quantifiers ($[\![Kim_j]\!]^M = \exists^{[\{\texttt{Kim}\}]} j$), (83) translates into the formula

(84) $[\exists^{[\{\texttt{Kim}\}]} x \mid\mid \exists^{[\{\texttt{Sandy}\}]} y] \cdot (\mathbf{sang}(x) \mid\mid \mathbf{danced}(y)))$

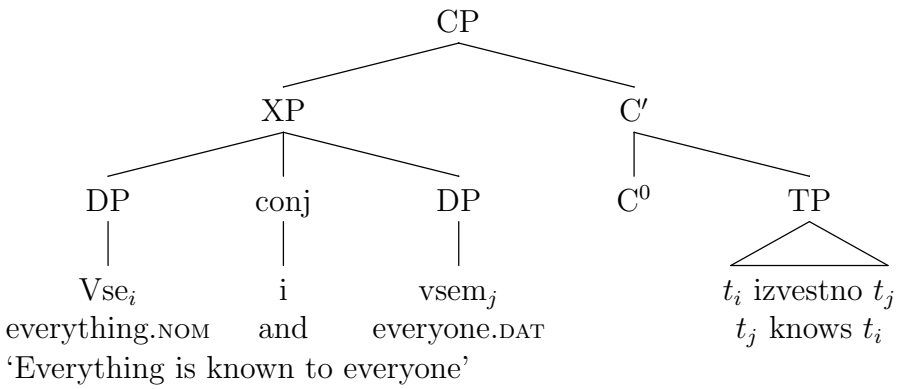
interpreted, informally, as 'take x to be Kim, and parallel to that take y to be Sandy, and then check that x sang and y danced', and equivalent to

(85) $\exists x = \texttt{Kim}.\exists y = \texttt{Sandy}.\mathbf{sang}(x) \wedge \mathbf{danced}(y)$

Hybrid Coordination — including but not limited to the wh-cases that Zhang analyzed — receives a compositional interpretation along the same lines, except the variables that translate traces occur in the same atomic formula:

[2]The semantic vacuousness of *respectively* reflects the observation, acknowledged by other scholars (Chaves, 2012), that the relevant reading can be observed in sentences without the adverb, but is forced by the overt *respectively* or *correspondingly*.

(86)



'Everything is known to everyone'

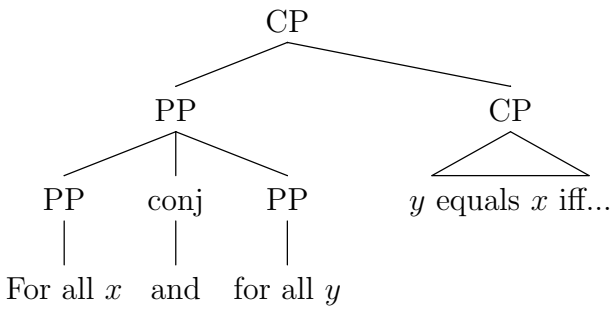
translates into

(87) $[\forall^{[\mathtt{F}]}x \mid\mid \forall^{[\mathtt{human}]}y] \cdot \mathbf{know}(y)(x)$

where F stands for the set of relevant facts that everybody knows. So (87) could be paraphrased as 'Take an arbitrary fact x, and take an arbitrary human y (where the sets of humans and facts are appropriately restricted by the context); y knows x'.

Math examples have basically the same structure as Hybrid Coordination except the quantifiers are base-generated, not moved, and the variables are overtly specified, rather than arise as a result of trace interpretation:

(88)



(88) translates into

(89) $[\forall x \mid\mid \forall y] \cdot (x = y \leftrightarrow \dots)$,

truth conditionally equivalent to

(90) $\forall x.\forall y.(x = y \leftrightarrow \dots)$

5.7 Summary

We saw that the instances of coordination patterns — sentential conjunction, branching readings, group denoting coordination, *respectively* readings, Hybrid Coordination, quantifier coordination in math texts — are served by one simple compositional mechanism that relies on game semantics. All the differences between these types of coordination constructions, however dramatic, are merely syntactic.

Parallel combination is a compositional, unified translation of *and* for sentential and NP conjunction. Originally proposed in the game-theoretic framework, the idea of parallel composition is in principle compatible with other dynamic theories such as DPL (Groenendijk and Stokhoff, 1991). However, combining quantified NPs with || is more natural in GTS, where both universal and existential quantifiers are interpreted dynamically, than in DPL, where universal quantification is static.

Parallel composition as the denotation of *and* is chosen to capture quantifier independence in coordinate structures. My proposal, presented here in game theoretic terms, can be translated into other theories that treat quantifiers dynamically. Moreover, under certain assumptions on how to render generalized quantifiers dynamically we can predict (correctly) that branching quantification is restricted to right upward monotone quantifiers.

CHAPTER 6

Conclusion and Further Issues

This dissertation explores the diversity and unity of coordination constructions in natural language. We started out with two different sets of proposals for NP and sentential conjunction. Among other proposals, it seemed that group (or sum) formation had some empirical advantages for NP conjunction, and that (function) composition (as assumed in Dynamic Predicate Logic) has an advantage in modeling anaphoric links in coordination of sentences. At the end of the day, we see that both sums and composition apply to both NP and sentential conjunction.

In Q'anjob'al, as discussed in Chapter 2, comitative conjunction *yetoq* behaves consistently as non-boolean. We saw that it is beneficial to treat its function as group formation on entities (for NP conjunction) or speech acts (for clause conjunction), which helps explain limitations on its usage in both cases.

Plurality formation, however, is not appropriate as an interpretive mechanism for Hybrid Coordination, where conjoined phrases bear different thematic roles. We established Hybrid Coordination in Russian as a true instance of phrasal conjunction in Chapter 3, and discussed its syntactic and semantic properties. Rather than group formation, pair formation or set cross product is a better candidate for the semantic contribution of conjunction in HC (cf. Heycock and Zamparelli (1999) on cross product denotation of *and* in English NP conjunction). A resumptive quantification analysis based on this idea is pursued in Chapter 4.

In Chapter 5 we came back to the idea of composition — this time, instantiated by

parallel composition of games — and saw that it has the potential of unifying syntactically diverse conjunction patterns. Not just sentential conjunction — for which composition is a standard dynamic model — but also Hybrid Coordination, quantifier branching, as well as *respectively*-constructions, can be successfully analyzed via parallel composition.

This dissertation expands our knowledge of syntactic diversity of coordination by exploring syntactic differences between what seems to be identical constructions in different languages — comitative coordination in Q'anjob'al and Russian, Hybrid Coordination in Russian and other languages. This work also makes a case for semantic diversity. On this front, the main conclusion simply put is that NP conjunction extended to sentences is not the same as sentential conjunction extended to NPs. On the other hand, I also make a case for semantic unity of various conjunction patterns; as argued in Chapter 5, coordination of NPs and sentences have common interpretive properties in what concerns quantifier (in)dependence and anaphora, and can be analyzed as the same semantic phenomenon.

There are many issues concerning conjunction that lie beyond the scope of this dissertation. For example, more has to be said about sentential uses of *and* where it seems to express something clearly different than the Boolean 'and', as in *Move, and I'll give you $100* (cf. Harnish (1983, 356), Keshet (2012) and references therein), or about the relation between speech act conjunction advocated in Chapter 2 and parallel composition operation discussed in Chapter 5: can we say that conjoined speech acts are interpreted as if they were acted out independently? (If so, that could explain some restrictions on speech act conjunction, e.g. why one can't conjoin a question and its answer even though both questions and assertions are themselves conjoinable). Is there a link between parallel composition of games and the discourse relation *Parallel* (Asher and Lascarides, 2003)? Let me add a few brief notes on three additional issues which deserve a mention here but whose careful consideration would lead us too far from our main topic.

6.1 Further issues

6.1.1 Quantifier Independence and Anaphora

In Chapter 5, we postulate parallel processing as the meaning of *and*, building quantificational independence right into the interpretation of conjunction: a quantifier in the second conjunct is scopally independent of quantifiers in the first conjunct. But it is not hard to come up with counterexamples as soon as the second conjunct contains an anaphoric pronoun bound by the quantified NP in the first conjunct:

(1) a. Every professor and almost every student of his exchanged emails over the weekend

b. Every man and three of his children entered the room together

c. The Law of Causation, the recognition of which is the main pillar of inductive philosophy, is but the familiar truth, that invariability of succession is found by observation to obtain between [every fact in nature] and [some other fact which has preceded **it**]. (John Mill)

These sentences invite scope-dependent readings. (1-a) involves overwhelmingly large groups of students that vary with professors, and (1-b) implies that triples of children accompanying the men may vary with the man. Such instances of anaphora within a coordinate NP compare to cases of the so-called 'telescoping' anaphora — cross-sentential anaphora to a universally quantifier phrase, as in

(2) Every player chooses a pawn. He puts it on square one.
(Groenendijk and Stokhoff, 1991, 91)

Note that if a sentence with such a 'telescoping' pronoun contains a quantifier, it is interpreted as quantificationally dependent on the antecedent of the pronoun, compare:

(3) Every player chooses a pawn. He puts it on one of the squares.

In (3), *one of the squares* depends on the player in question, as referred to by the pronoun *he*; the squares onto which the pawns are put vary with the players.

So we observe that in coordinate sentences and conjoined quantifiers alike, an anaphoric link to a quantifier in the first conjunct suspends quantificational independence of the second conjunct. Such examples with anaphoric pronouns are problematic for two reasons. First, they serve as counterexamples to the generalization of scope independence in coordinate structures. Second, they present a problem for the parallel processing account of coordination. Indeed, if the two games denoted by the two conjuncts are fully independent, how can a pronoun in the second conjunct be bound at all if its antecedent is in the first conjunct?

The issue of anaphora and telescoping anaphora in particular is not new. There are several possible solutions to telescoping anaphora; a usual assumption is that interpreting telescoping anaphora involves some kind of meaning shift, e.g. rebracketing in the logical form, "accommodation of a distributivity operator" (Brasoveanu, 2007, 251), etc. The simplest solution in the game theoretic framework assumed here is that the interpretation of *and* is *parallel composition* by default, but shifts to *sequential composition* if required for variable binding. Another option is to assume that a universal quantifier exceptionally takes scope over a coordinate structure if required for variable binding. Whatever the proper treatment of telescoping anaphora is, it should automatically extend to telescoping in NP conjunction and account for quantifier dependence facts in both cases.

Dependence between quantifiers in coordinate structures can be observed even in the absence of an overt pronoun:

(4) What experience makes known, is the fact of an invariable sequence between every event and some special combination of antecedent conditions, in such sort that wher-

ever and whenever that union of antecedents exists, the event does not fail to occur. (John Mill)

The "combination of antecedent conditions" mentioned in (4) clearly may vary with the event in question even though the noun phrase doesn't contain an anaphoric pronoun. One might argue, however, that there is still an anaphoric relation present semantically. For instance, in (4) the adjective *antecedent* has an implicit argument bound by the phrase *every event*$_e$, so *some special combination of antecedent conditions* should be read as *some special combination of conditions antecedent to e*.

6.1.2 Non-Boolean Conjunction of Predicates

Most of this dissertation restricted its attention to non-Boolean NP coordination. But non-Boolean coordination of other types of phrases is also well known:

(5) a. The flag is blue and white [adjectives]

b. Who are the mother and father of Isaac Newton? [relational nouns]

c. S tex por uže, možet byt′, dvesti let èti el′ i sosna
from that time already may be 200 years these.PL fir.SG and pine.SG
vmeste rastut
together grow
'It must be 200 hundred years since then that this fir and pine have been growing together' (NCRL) [common nouns]

These kinds of examples are complicated enough in any theory of conjunction. For example, Link (1983) had to give the sum operator on predicates a separate definition from the one on entities, and Krifka (1990) had to rely on extra machinery (such as maximalization operators for relational nouns).

Even though the operator of parallel composition does not naturally cover the examples in (5), it could be extended to them using some additional, independently motivated techniques. For instance, the meaning of (5-a) ('the flag has white parts, blue parts, and no other parts') could be expressed as

(6) $\exists p.[\texttt{white}(p) \wedge \exists p'.(\texttt{blue}(p') \wedge \texttt{this.flag} = p \oplus p')]$

We could paraphrase (6) with a formula where 'white and blue' corresponds to a subformula built with parallel composition operator $||$, the logical counterpart of *and*:

(7) $(\exists^{[\texttt{white}]} p \;||\; \exists^{[\texttt{blue}]} p') \cdot \texttt{this.flag} = p \oplus p'$

To obtain this interpretation, the predicates `white` and `blue` must be turned into existential quantifiers $\exists^{[\texttt{white}]}p$ and $\exists^{[\texttt{blue}]}p'$. There is an interpretive device readily available for this, Partee's (1986) type shifting operator $\underline{\text{A}}$.

6.1.3 Quantifiers and Maximality

The discussion of quantifier conjunction in the last two chapters is limited to a subset of generalized quantifiers.

In Chapter 5 we derive an equivalent of Barwise's (1979) formula for branching quantification of two quantifiers $Q(A), Q'(B)$ applied to a predicate that denotes relation R:

(8) $\exists X \subseteq A.\exists Y \subseteq B.[Q(A)(X) \wedge Q'(B)(Y) \wedge X \times Y \subseteq R]$

Already Barwise pointed out that this formula is adequate only for increasing quantifiers. Sher (1990) proposed that to extend branching to non-increasing quantifiers, we should require that X and Y in (8) not only exist but are maximal:

(9) $\exists X \subseteq A.\exists Y \subseteq B.([Q(A)(X) \wedge Q'(B)(Y) \wedge X \times Y \subseteq R] \wedge [\forall X' \supseteq X.\forall Y' \supseteq Y'[Q(A)(X') \wedge Q'(B)(Y') \wedge X' \times Y' \subseteq R] \Rightarrow (X = X' \wedge Y = Y')])$

I doubt that such a maximality condition should be part of the meaning of quantifier conjunction. Maximality characterizes the interpretation of quantified statements in natural language in various kinds of contexts (van Benthem, 1986; Robaldo, 2011). Maximality effects are easily seen with collective predicates:

(10) Fewer than 20000 demonstrators gathered at an officially sanctioned protest last week

'there is a group of fewer than 20 thousand people that gathered at an officially sanctioned protest last week, and this group is maximal'

Indeed, if a group 19,000 people gathered as part of a larger crowd of 50,000 protesters, (10) is not appropriate as a description of this situation. Maximality effects might arise even with increasing quantifiers like *some*, as can be seen in the interaction of anaphora and quantification in the following example (Evans, 1980):

(11) John owns some sheep. Harry vaccinates them.

where *them*, anaphorically linked to *some sheep* in the preceding clause, is naturally interpreted as referring to **all** sheep John owns rather than any subset that makes the first clause true. But maximality is not always present. So

(12) Fewer than 3% of the landowners own more than 97% of the privately held land

may be true even though there must necessarily be larger groups of landowners that own more than 97% of the privately held land. One example is the group of all landowners,

which owns more than 97% (in fact, 100%) of the land in question.

If maximality is defeasible, it might be not part of the semantics of quantified statements but an effect of pragmatic strengthening. So we were right not to say anything special about branching combination of non-increasing quantifiers. The semantics of branching may be the same, but an independent phenomenon of maximalization adds non-trivial complications to the interpretation of non-increasing quantifiers. This maximalization, as we note, might not even be semantic in nature.

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