

Annotating Linguistic Reference in the New Testament

Sean Boisen <[myfirstname]@logos.com>

Joint work with Steve Runge and Peter Venable

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Advanced Technology for Eternal Truth

Outline

- The Problem
- Referential Semantics
- Annotation
- Interpretation
- Use Cases
- Conclusions

The Problem

- How many times is Jesus mentioned in [John 1:1-18](#) (prologue)?
 - once
- How many times is Mary (the mother of Jesus) mentioned in [John 2:1-12](#) (the wedding at Cana)?
 - never
- How many times is Jesus mentioned in [Mark 6:30-44](#) (the feeding of the five thousand)?
 - once
- Where in the Gospels is it said that "Jesus had compassion" on someone?
 - never

The Problem Explicated (I)

How many times is Jesus mentioned in [John 1:1-18](#) (prologue)?

- 32 references, but only one occurrence of "Jesus"

1 In the beginning was the Word, and the Word was with God, and the Word was God. 2 He was in the beginning with God. 3 All things were made through him, and without him was not any thing made that was made. 4 In him was life, and the life was the light of men. 5 The light shines in the darkness, and the darkness has not overcome it. 6 There was a man sent from God, whose name was John. 7 He came as a witness, to bear witness about the light, that all might believe through him. 8 He was not the light, but came to bear witness about the light. 9 The true light, which enlightens everyone, was coming into the world. 10 He was in the world, and the world was made through him, yet the world did not know him. 11 He came to his own, and his own people did not receive him. 12 But to all who did receive him, who believed in his name, he gave the right to become children of God, 13 who were born, not of blood nor of the will of the flesh nor of the will of man, but of God. 14 And the Word became flesh and dwelt among us, and we have seen his glory, glory as of the only Son from the Father, full of grace and truth. 15 (John bore witness about him, and cried out, "This was he of whom I said, 'He who comes after me ranks before me, because he was before me.' ") 16 And from his fullness we have all received, grace upon grace. 17 For the law was given through Moses; grace and truth came through **Jesus Christ**. 18 No one has ever seen God; the only God, who is at the Father's side, he has made him known.

The Problem Explicated (2)

How many times is Mary (the mother of Jesus) mentioned in [John 2:1-12](#) (the wedding at Cana)?

- Never *by name*: instead,
 - "the mother of Jesus", "his mother"
 - "her"
 - "Woman" (direct address)
- (6 mentions altogether)

The Problem Explicated (3)

How many times is Jesus mentioned in [Mark 6:30-44](#) (the feeding of the five thousand)?

- Once by *name*: "the apostles returned to Jesus and ..."
- Twelve times by *pronoun*:

"told <u>him</u> "	" <u>he</u> went ashore"	" <u>he</u> had compassion on them"
" <u>he</u> began to teach"	" <u>his</u> disciples came to <u>him</u> "	" <u>he</u> answered them"
"they said to <u>him</u> "	" <u>he</u> said to them"	" <u>he</u> commanded them"
" <u>he</u> looked up to heaven"	" <u>he</u> divided the two fish"	

The Problem Explicated (4)

Where in the Gospels is it said that Jesus "had compassion" on someone?

 English Standard Version 9 results in 9 verses

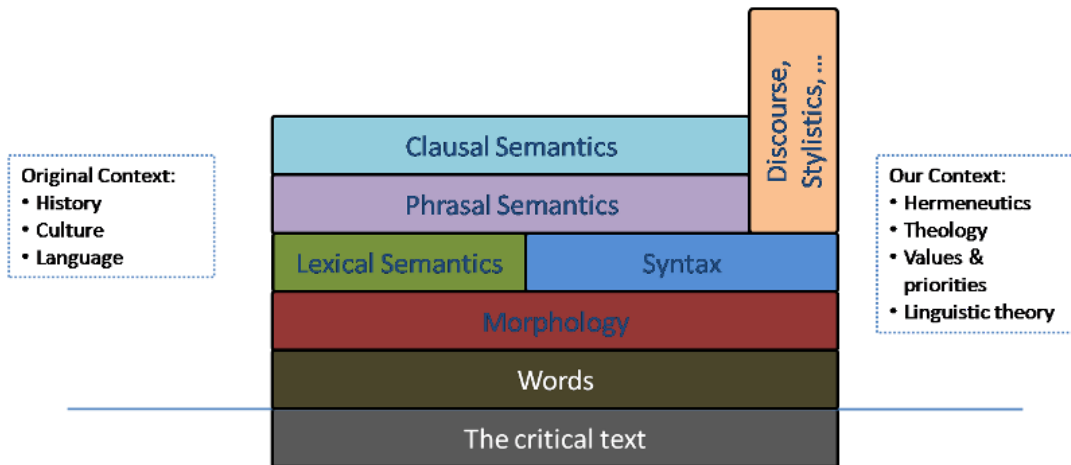
- Matt 9:36 When he saw the crowds, he had compassion for them, because they were harassed and helpless, like sheep without a shepherd.
- 14:14 When he went ashore he saw a great crowd, and he had compassion on them and healed their sick.
- 15:32 Then Jesus called his disciples to him and said, "I have compassion on the crowd because they have been with me now three days and have nothing to eat. And I am unwilling to send them away hungry, lest they faint on the way."
- Mark 6:34 When he went ashore he saw a great crowd, and he had compassion on them, because they were like sheep without a shepherd. And he began to teach them many things.
- 8: 2 "I have compassion on the crowd, because they have been with me now three days and have nothing to eat.
- 9:22 And it has often cast him into fire and into water, to destroy him. But if you can do anything, have compassion on us and help us."
- Luke 7:13 And when the Lord saw her, he had compassion on her and said to her, "Do not weep."
- 10:33 But a Samaritan, as he journeyed, came to where he was, and when he saw him, he had compassion.
- 15:20 And he arose and came to his father. But while he was still a long way off, his father saw him and felt compassion, and ran and embraced him and kissed him.

The Deeper Problem

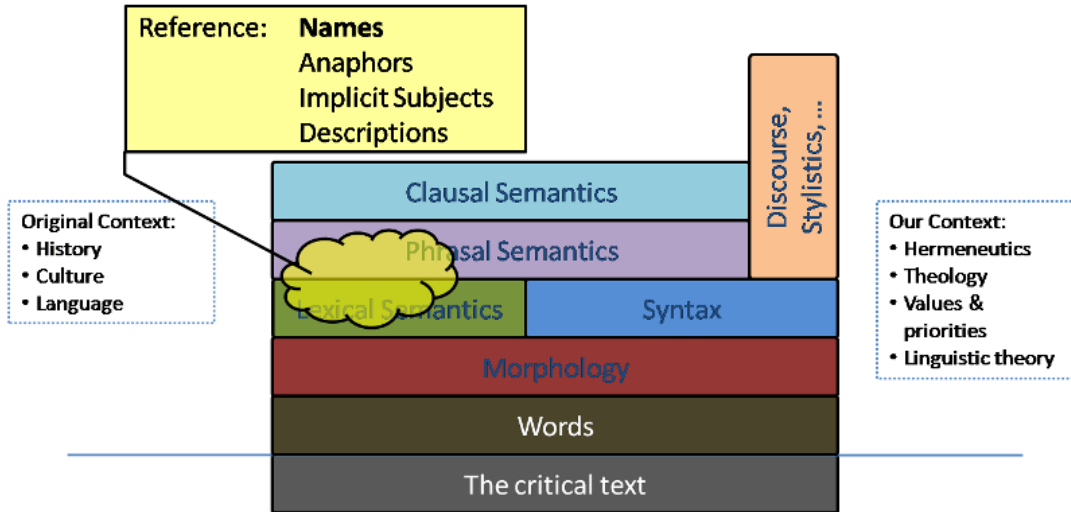
- Word search only matches specific lemmas
- Proximity search doesn't count the right things
- Syntactic search doesn't identify who/what/where
- The Bible Knowledgebase only includes one kind of linguistic reference: names

the easiest case: largely context independent and uniquely self-identifying
- Other kinds of referring expressions
 - require *context* to determine the referent
 - go beyond the word level to larger syntactic constituents
- Without more complete semantic information about reference, this level of information is *invisible*

Linguistic Analysis and Biblical Interpretation



Linguistic Analysis and Biblical Interpretation (2)



The Missing Piece: Referential Semantics

- Indicate the referents for all types of referring expressions (not just names)
- Allow search by entity, regardless of mention type
- Show different descriptions for the same entity: in John's Prologue,
 - the Word
 - the [true] light
 - the only Son from the Father
 - the only God, who is at the Father's side
- Integrate genuine *semantic* search with lemmas, morphology, and syntax

NT Referents

- Annotate all the concrete referents in the New Testament
 - tied to the Greek text
 - with consistent identity
 - adding other attributes where possible
- Incorporate specific instances in the Bible Knowledgebase (type, label, description, etc.)
- Identify non-specific expressions:
 - Generics
 - Underspecified groups

Annotating Referents

- Same types of entities already included in the BK: people, places, things
- Anaphors:
 - personal pronouns (he, him)
 - possessive pronouns (his)
 - relatives (the one who ...)
- Verbs and participles with morphology that identifies the subject
- Descriptions

Annotating Referents (2)

- Apply human intelligence to resolve
 - Context:
 - Pronouns are typical in narrative after the scene is set
 - Anaphors may have several candidate referents
 - World knowledge:
 - Only certain classes of entities can speak or act in particular ways
 - Interpretation:
 - Don't go beyond the plain sense of the text
 - Only feasible with manual annotation
- Annotate larger spans where not semantically predictable
 - \$fruit + "of the" + \$vine ≠ \$wine

Annotation Tool

and ran out wine said the mother of Jesus to him wine no they have

Text	καὶ	ὑστερήσαντος	οἴνου	λέγει	ἡ	μήτηρ	τοῦ	Ἰησοῦ	πρὸς	αὐτόν	Οἶνον	οὐκ	ἔχουσιν
Morph	CLN	VAAP-SGM	NGSM	VPAI3S	DNSF	NNSF	DGSM	NGSM	P	RP3ASM	NASM	TN	VPAI3P
Louw	89.87	57.37	6.197	33.69	92.24	10.16	92.24	93.169	90.58	92.11	6.197	69.3	57.1
Referent01			\$wine			#mother		#Jesus		#Jesus	\$wine		#weddingGuest
Referent02						#Mary.1							

When the wine ran out, the mother of Jesus said to him, “They have no wine.” (Jn 2.3)

Incorporating Entities into the BK

- Concrete instances of people and places are added to the Bible Knowledgebase:
 - Syro-Phoenician woman
 - Centurion
- Same kinds of attributes:
 - Family relationships
 - Links to dictionary content or Wikipedia
 - Group membership, ethnicity, social role
- Given a human-readable label, these can be presented in the same way as named individuals

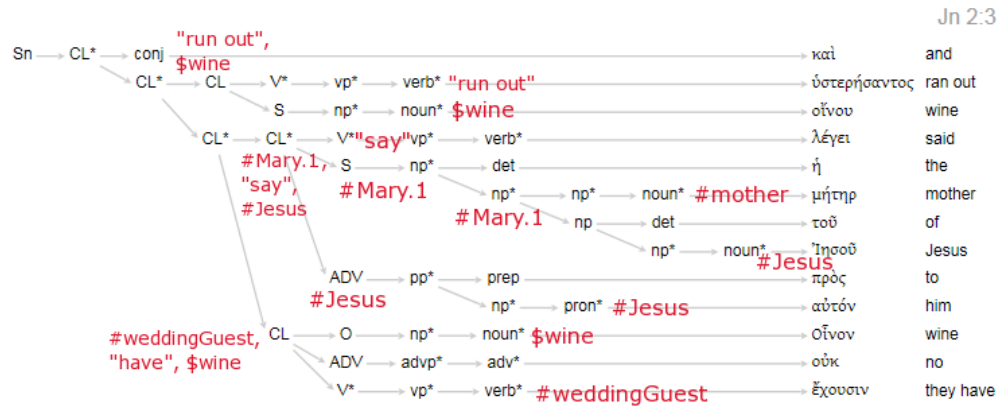
Non-Specific Expressions

- Generics: "no one lights a lamp"
- Addressees: "Strive to enter by the narrow gate"
 - Includes OT quotes: "Prepare the way of the Lord"
- Contextually-defined groups: "the crowd", "the Pharisees"
- Abstract concepts: "parable", "riches", "faith", "kingdom of heaven"

Semantic Interpretation Rules

- Base annotation is on *words*
- Goal: attach semantics to the broadest span of words that has the same referent
- Strategy: bottom-up semantic composition based on the syntax
 - Interpret locally and pass information up the tree
 - Current implementation stops at the clause

Semantic Interpretation Example



When the wine ran out, the mother of Jesus said to him, "They have no wine." (Jn 2.3)

Use Cases

- Search or browse for references to particular entities
 - Identify the largest constituent: "the only Son from the Father", not just "Son"
 - Display varying descriptions for an entity
- Search for classes of referents ("crowd" regardless of which one)
- Search by group relationship
 - People who are part of a crowd
 - Individuals who are Pharisees
- Search clauses that combine entity references and verbs or actions
 - Preceding example: clauses including Jesus and a verb of communication
- Integrate semantic search with lemmas, morphology, and syntax

Example Clausal Semantics

#GodTheFather "give" ...

Direct Object	Indirect Object	Reference	Direct Object	Indirect Object	Reference
#GodTheSpirit	#Church.11	Eph 1.17	\$love	#addresseeOfJohn #John.5	1Jn 3.1
#Jesus	#Crowd.41	Jn 6.32	\$mightyDeed	#Jesus	Jn 5.36
#personJesus	#Jesus	Jn 6.37	\$revelation	#Jesus	Rev 1.1
\$body	\$seed	1Cor 15.38	\$spiritPersonal	#IsraelHouse	Rom 11.8
\$command	#Jesus	Jn 12.49	\$spiritPersonal	#Paul #Timothy	2Tim 1.7
\$cup	#Jesus	Jn 18.11	\$throne	#Jesus	Luk 1.32
\$eternalLife	#addresseeOfJohn #John.5	1Jn 5.11			

Example Clausal Semantics (2)

#Jesus "give" ...

Direct Object	Indirect Object	Reference	Direct Object	Indirect Object	Reference
\$authority	#Paul	2Cor 13.10	\$statement	#Disciples	Jn 17.14
\$eternalLife	#Crowd.41	Jn 6.27	\$statement	#Pilate	Jn 19.9
\$eternalLife	#personJesus	Jn 10.28	\$water	#personJesus	Jn 4.14
\$splendor	#Disciples #believer	Jn 17.22	\$wisdom \$statement	#Disciples	Luk 21.15

Status

- Draft annotation on Greek text is complete
- Simple semantic representation language for constants and collections
- Coordination of semantic references with Cascadia Syntax Graphs of the New Testament (Wu and Tan)
- Initial system for rule-based semantic interpretation

Conclusions

- Annotation of linguistic reference to concrete entities throughout the New Testament
 - Names, pronouns, implicit subject mentions, and descriptions
 - Consistent identity
- Semantic representation of those entities, linked to the text
 - Named, unnamed, specific and non-specific referents
 - Manual annotation extended with automated interpretation
 - Phrasal semantics attached to the largest syntactic constituent
- Coming soon: user interface to support semantic search based on linguistic reference
- 3 PM talk: more on semantic annotation at Logos

Resources and References

- Boisen, S (2007). [Deploying Semantic Technologies for Digital Publishing: A Case Study from Logos Bible Software](#). Presented May 24, 2007 at the Semantic Technology Conference.
- Boisen, S (2009). [Organizing the People, Places, and Things in the Bible](#). Presented March 27, 2009 at BibleTech:2009.

About This Presentation

- This is an XHTML document, structured and presented with [HTML Slidy](#). You can use your browser to view source and see how it works.
- Hyperlinks courtesy of [Logos Bible Software's RefTagger](#)
- The Logos staff who have contributed to the NT Referents project include Elizabeth Borries, Steve Runge and Peter Venable.