Micro Machinery
=== T-to-O bridge === "Folk" vocabulary (and/or other sciences)
Macro Machinery

Our delineation
Micro: applies to expressions any size ≤ sentences
Macro: applies only to (sequences of?) sentences? speaker-meanings?

Some controversial associations
Micro = semantics; Macro = pragmatics
Micro = arbitrary facts about particular speaker communities; Macro = generalizations that depend only on universal phenomena like cooperation and general rationality
Micro = exceptionless conventional norms; Macro = more defeasible
Macro = broader willingness to count as "dynamic"
Macro = more directly interfaces with folk/observational concepts?

Classical Menu of Pronouns

(α) Bound by quantifier

1. Every [apostle]^{1} asked [Jesus]^{3} to bless him$_{1}$.

Order of indices will be arbitrary, and will often suppress unused indices.

(β) Anaphoric on some linguistic antecedent, perhaps in an earlier sentence

2. [Judas]^{1} asked Jesus to bless him$_{1}$.
3. After [Judas/one apostle]^{1} made a deal with the Romans, he$_{1}$ was ashamed.
4. (a) [Judas]^{1} stepped forward. (b) He$_{1}$ kissed Jesus.

(γ) Demonstrative or indexical pronouns, depending on extra-linguistic context

5. She$_{2}$ (*pointing to Mary Magdalene*) is staring at me/us$_{4}$.

Regarding (α), different technical treatments are possible, but a popular and now familiar choice is to use "assignment functions" that associate pronoun indices with different semantic values.

1 asked Jesus to bless 1
<1 ↦ Peter, 2 ↦ …>, <1 ↦ James, …>, <1 ↦ Matthew, …>, …

Using the machinery of assignment functions *just in this way* perhaps needn't impact how we understand the T-to-O bridge.

But it becomes attractive to extend the explanatory role of this machinery to apply to cases like (β) and (γ) too. Consider:

6. (a) [Mary]^2 washed Jesus' feet. (b) Every [apostle]^1 criticized her$_2$.

1 criticized 2
<1 ↦ Peter, 2 ↦ Mary, …>, <1 ↦ James, 2 ↦ Mary, …>, <1 ↦ Matthew, 2 ↦ Mary, …>, …

Here assignment functions play the same formal role in interpreting the unbound pronoun "her" in (6b) that they play in interpreting bound pronouns (and "traces" occupying the surface position of quantifier phrases). But we want to constrain what assignment functions are operative (e.g., not having 2 ↦ Jesus). Since "her" isn't bound by a quantifier, those constraints have to come from somewhere else. We assume they are supplied by "the conversational context." In cases (β), we'll think of sentences as not just *depending on* conversational context but also as *affecting it* for later discourse.

Making these choices starts to commit us about how we folk-interpret the part of our technical machinery that involves assignment functions.

Donkey Anaphora

Around 1980, attention focused on a range of pronoun constructions that were especially difficult to handle using the classical tools and explanatory strategies.

7. Every [apostle]^1 owned [a donkey]^5 and says Jesus made him$_1$ buy it$_5$.
7′. $(\forall x_1$ apostle $x_1)$ $(\exists x_5$ donkey $x_5)$ $(x_1$ owned $x_5 \wedge x_1$ says Jesus made x_1 buy $x_5)$
7″. $(\exists x_5$ donkey $x_5)$ $(\forall x_1$ apostle $x_1)$ $(x_1$ owned $x_5 \wedge x_1$ says Jesus made x_1 buy $x_5)$

8. Every [apostle who owned [a donkey]^5]^1 says Jesus made him$_1$ buy it$_5$.

Scope Islands

9. Jesus feared/acknowledged that some [apostle]^1 committed every [sin]^6.
9′. Jesus feared/acknowledged that $(\exists x_1$ apostle $x_1)$ $(\forall x_6$ sin $x_6)$ x_1 committed x_6.
9″. $(\exists x_1$ apostle $x_1)$ Jesus feared/acknowledged that $(\forall x_6$ sin $x_6)$ x_1 committed x_6.
9‴. Jesus feared/acknowledged that $(\forall x_6$ sin $x_6)$ $(\exists x_1$ apostle $x_1)$ x_1 committed x_6.

10. Jesus blessed/acknowledged some [apostle who committed every [sin]^6]^1.
10′. $(\forall x_6$ sin $x_6)$ Jesus blessed/ack some apostle who committed x_6.
10″. $(\forall x_6$ sin $x_6)$ $(\exists x_1$ apostle $x_1 \wedge x_1$ committed $x_6)$ Jesus blessed/ack x_1.

One problem with (8) is that "a donkey" is inside the relative clause "who owns a donkey", which seems to be a scope island. So that indefinite phrase can't be interpreted as really having syntactic scope that surrounds and extends beyond the relative clause, reaching as far as the "it" whose meaning seems to depend on it.

Even if We Ignore Scope Islands…

Even if we allow ourself to arrange things so that "a donkey" *has* large enough syntactic scope to reach the pronoun "it", this will tend to produce meanings that differ from how we in fact understand sentences like (8).

> 11. Jesus made [[Peter]^{1} buy [a donkey]^{5}] and Mary kept him$_{1}$ [from beating it$_{5}$].
> 11′. ($\exists x_5$ donkey x_5) (Jesus made (Peter buys x_5) $\wedge$ …)
> 11″. Jesus made ($\exists x_5$ donkey x_5) (Peter buys x_5 $\wedge$ Mary kept …)
>
> 12. [Peter]^{1} owns few [donkeys]^{5}, but they$_{5}$ fear him$_{1}$.
> 12′. (FEW x_5 donkey x_5) (Peter owns x_5 $\wedge$ x_5 fears Peter).

Similar difficulties achieving the right meaning for (8) and (13) just by moving the quantifiers around.

> 13. Every [apostle who owns [a donkey]^{5}]^{1} beats it$_{5}$.
>
> 14. ($\forall x_1$ apostle x_1) ($\exists x_5$ x_5 is a donkey x_1 owns) x_1 beats x_5
> *Says every apostle owns a donkey*
>
> 14′. ($\forall x_1$ apostle x_1) ($\exists x_5$ donkey x_5) (if x_1 owns x_5 then x_1 beats x_5)
> 14″. ($\exists x_5$ donkey x_5) ($\forall x_1$ x_1 is an apostle who owns x_5) x_1 beats x_5
> *These are too easily satisfied*

none	none	🐴	🐴🐴	🐴🐴🐴🐴
Peter	James	Matthew	Andrew	Judas

> 15. Every [apostle who hired [a maid]^{5}]^{1} paid her$_{5}$.
> 15′. Every [apostle who had [a coin]^{7}]^{1} offered it$_{7}$ to Jesus.
> 15″. Every [apostle who met [a maid]^{5} and had [a coin]^{7}]^{1} used it$_{7}$ to hire her$_{5}$.
>
> 16. ($\forall x_5$ donkey x_5) ($\forall x_1$ x_1 is an apostle who owns x_5) x_1 beats x_5
> 16′. ($\forall x_1$ apostle x_1) ($\forall x_5$ x_5 is donkey owned by x_1) x_1 beats x_5
> *These have the right meanings, but why does "a donkey" get interpreted here as* $\forall x_5$*, elsewhere as* $\exists x_5$*?*

Also that solution doesn't fully generalize

17. Most [apostles who own [a donkey]^{5}]^{1} beat it$_5$.
True in the above scenario

18. ($\forall x_5$ donkey x_5) (MOST x_1 x_1 is an apostle who owns x_5) x_1 beats x_5 *False*
18′. (MOST x_1 apostle x_1) ($\forall x_5$ x_5 is donkey owned by x_1) x_1 beats x_5 *False*

19. (MOST x_5 donkey x_5) ($\forall x_1$ x_1 is an apostle who owns x_5) x_1 beats x_5 *False*
19′. ($\forall x_1$ apostle x_1) (MOST x_5 x_5 is donkey owned by x_1) x_1 beats x_5 *False*

Lewis "Adverbs of Quantification" 1975:
20. (MOST (x_1,x_5) x_5 is a donkey $\wedge$ x_1 is an apostle who owns x_5) x_1 beats x_5
False

Descriptive or "D/E-Type" Treatments of Syntactically Unbound Pronouns

13. Every [apostle who owns [a donkey]^{5}]^{1} beats it$_5$.
13′. Every [apostle who owns [a donkey]^{5}]^{1} beats [the/every donkey he$_1$ owns].
13″. Every [apostle who owns [a donkey]^{5}]^{1} beats [the donkey].

21. Peter has some [sheep], but Matthew's __ are closer.
21′. # Peter is a shepherd, but Matthew's __ are closer.

22. # Every [apostle who is a shepherd]^{1} beats it$_?$.

Dynamic Treatments of Syntactically Unbound Pronouns

A **context or infoset** represents the conversationally open possibilities about what the discourse plus the world is like. Discourse possibilities include such matters as: what objects are witnesses for / designated by various pronouns? (We don't want to incorporate those into how the conversation is representing the world, because some of the discourse updates the machinery generates will be merely hypothetical.) In this presentation, we'll ignore intensionality and just sketch how the framework handles the interpretation of pronouns.

For that purpose, we can let the open possibilities be all the assignment functions that are "plausible" given how the conversation has proceeded so far.

6. (a) [Mary]^2 washed Jesus' feet. (b) Every [apostle]^1 criticized her$_2$.

1 criticized 2
<1 ↦ Peter, 2 ↦ Mary>, <1 ↦ James, 2 ↦ Mary>, <1 ↦ Matthew, 2 ↦ Mary>, …

Every apostle criticized 2
if every apostle did criticize Mary <2 ↦ Mary>
else no assignments

Instead of (6b) and (its matrix clause) being interpreted as having truth-values relative to an assignment function, we can understand them as having as their semantic values *functions from* assignment functions to truth-values. Now there's a straightforward translation between functions from As to truth-values and sets of As; so we could also think of the sentences as having *sets of assignment functions* as their semantic values: all those assignment functions that render the sentence true.

At a given point in the conversation, say after we've asserted (6a) but before (6b), we have one set of plausible assignment functions. Somehow it will have been secured that they all map pronoun index 2 to Mary. On the classical picture, we can then interpret (6b) as having for its meaning another set of assignment functions that we *intersect with*, or *use to filter*, the assignment functions we had before (6b) was asserted.

The innovation of the dynamic approach is to say, instead of letting (6b) have an autonomously-determined meaning, that we then connect up with the current state of the conversation in an fixed way (intersecting it), why don't we instead let (6b)'s meaning be a *function* from the current state of the conversation to the desired new state. In boring cases, this function can do the same thing we just described: select from the assignment functions that are currently plausible, keeping some and discarding others. In other cases, though, it might be more exotic, and give us back assignment functions after asserting a sentence that we didn't have before it.

One way to think of this is to let a sentence's meaning be a function from an assignment function not merely to a truth-value, but rather to a set of assignment functions: perhaps just the singleton set of the assignment function it took as input, or perhaps a larger or a smaller (empty) set.

23. (a) [Mary]^2 washed Jesus' feet. (b) Some [apostles]^1 criticized her$_2$.

After (a): <2 ↦ Mary>
Meaning of (b): $\lambda g.\ \{\ g[1\mapsto x_1] \mid x_1 \text{ criticized } g(2)\ \}$
After (b): <1 ↦ Peter, 2 ↦ Mary>, ~~<1 ↦ James, 2 ↦ Mary>~~, <1 ↦ Matthew, 2 ↦ Mary>, …
$G \rightsquigarrow G' = \bigcup \{ [\![b]\!] (g) \mid g \in G\}$

Compositional Clauses

$[\![\varphi \text{ and } \psi]\!] = \lambda g.\ \{ g^{**} \mid \exists g^{*} (g^{*} \in [\![\varphi]\!](g) \wedge g^{**} \in [\![\psi]\!](g^{*})) \}$
$= \lambda g.\ \bigcup \{ [\![\psi]\!](g^{*}) \mid g^{*} \in [\![\varphi]\!](g) \}$

$[\![\bot]\!] = \lambda g.\ \{ \}$

$[\![\text{if } \varphi \text{ then } \psi]\!] = \lambda g.\ \{ g \}$ if every descendent left by φ has some descendent left by ψ else $\{ \}$
$= \{ g \mid (\forall g^{*} \in [\![\varphi]\!](g)) \exists g^{**} (g^{**} \in [\![\psi]\!](g^{*})) \}$

$[\![\text{not } \varphi]\!] = [\![\text{if } \varphi \text{ then } \bot]\!]$
$[\![\varphi \text{ or } \psi]\!] = [\![\text{if not } \varphi \text{ then } \psi]\!]$
$[\![\top]\!] = [\![\text{not } \bot]\!] = \lambda g.\ \{ g \}$

$[\![\exists x_1 \varphi]\!] = [\![\text{ANY 1 and } \psi]\!]$, where $[\![\text{ANY 1}]\!] = \underline{\lambda g.\{ g[1 \mapsto e] \mid e \in \text{domain of quant} \}}$
$[\![\text{every } x_1 \varphi \psi]\!] = [\![\text{not } (\exists x_1 \varphi \wedge \text{not } \psi)]\!]$
$= \lambda g.\ \{ g \}$ if for every $e \in$ domain of quant where $g[1 \mapsto e]$ has a descendent left by φ, every such descendent has some descendent left by ψ; else $\{ \}$

(i) End result of asserting (b) is to update the conversational infoset from G (a set of assignment functions) to G′ (another set). In this case, that transformation can be decomposed into the effect that (b) has on each member of G. **Observation 1**: In other cases (Veltman's treatment of epistemic modals), this isn't true: a sentence's contribution might be argued to depend more holistically on G.

(ii) For simplicity here, we just took the semantic contribution of (b) to be a function from *individual* assignment functions to a set of assignment functions (of size 0, 1, or bigger). The effect *on the whole conversational infoset* gets derived from that.

Can contrast to the classical approach by saying: hey where you guys made $[\![b]\!]$ be just a set of assignment functions, I'm making it be *a function from an assignment function* to such a set. Or by saying: hey where you guys made $[\![b]\!]$ be a function from assignment functions to truth-values, I'm making it be a function from assignment functions to *a set of assignment functions*: the empty set in the case where your function would yield false.

(iii) Another way to represent this meaning for (b) is as a binary relation between assignment functions, or a set of those pairs of assignment functions (g, g*) where the function described in (ii) and the presentation above would map g to a set that contained g*. And if we chose this way of packaging the formalism, we could contrast to the classical approach by saying: hey where you guys made the meaning of (b) be a function that delivered truth-values when *single* assignment functions were supplied as parameters, I'm just making the meaning of (b) be a function that delivers truth-values when *pairs* of assignment functions are supplied as parameters.

Observation 2: these ways of characterizing how the view departs from a classical treatment of pronouns might play into stories these philosophers have about the T-to-O

bridge. But we shouldn't lose sight of the way their macro-level machinery differs from the classical:

Classical: $G \rightsquigarrow G \cap \{g \in G \mid [\![\varphi]\!] (g) \text{ is true}\}$

Dynamic: $G \rightsquigarrow \bigcup \{ [\![\varphi]\!] (g) \mid g \in G\}$

Observation 3: this was a sentence-focused account. To extend to an account of semantic values of sub-sentential expressions, e.g., "apostle who owns [a donkey][5]":

$\lambda g.$ { (a, g[5 ↦ d]) | a is an apostle and d is a donkey that a owns }

$\lambda g. \lambda a.$ if a is an apostle then { g[5 ↦ d] | d is a donkey that a owns } else { }

Observation 4: How "dynamic" gets understood varies, depending in part on whether one uses it primarily to mark a contrast at the macro or the mico level. Acknowledging the previous observation, the presentation sketched here can still be understood as focused on the micro-machinery. We just commented in passing on how one should adjust (and might folk-interpret) the macro-machinery to compensate. Rothschild and Yalcin discuss different macro-oriented definitions of "dynamic."

Observation 5: Consider:

24. (a) [Some apostle][1] stepped forward. (b) He_1 kissed Jesus.

A dynamic semanticist who thinks the meaning of sentences like (24b) are more richly structured than what is usually called "a proposition" will resist identifying the micro-mechanical contribution of 24b with any folk notion that gets interpreted in terms of such propositions, such as the folk term "says". But the dynamic semanticists might nonetheless want to answer questions like "What does someone who asserts (24b) say?"

- Perhaps they'll reply that: someone who asserts (24b) says that *the apostle who stepped forward kissed Jesus.* …though still denying that [[φ]] = [[The apostle who stepped forward kissed Jesus.]] They wouldn't mean the same thing by the underlined claim that a descriptivist might express with the same words.
- Or perhaps they'll say that: someone who asserts (24a) says that *some apostle stepped forward*, and someone who continues by asserting (24b) says that *he kissed Jesus*. That is, perhaps the only way to answer questions like "What does someone who asserts (24b) say?" is to exploit the dynamic capability of one's metalanguage.
- Even if they're able to answer questions like "What does someone who asserts … say?" in some cases, they might reserve the right to deny that such questions always have definite answers (even when they do assign "…" a definite micro-mechanical role).

What we've aimed to do here

1. This specific material will be background to a number of the semester's papers, so it's helpful to review it / introduce you to it.

2. Example of a choice of framework, constructed to give an explanation of a specific range of phenomena. Bracketing other phenomena that the theorist's aren't yet trying to address: intensionality, paycheck pronouns, etc. Using technical gizmos like sentences annotated with indices, sentences containing operators like $\perp$, $\exists x_1$, etc.

3. Illustrate the way work can be assigned to either the micro or the macro machinery, and choices you make about this may affect the T-to-O story you think your formal machinery motivates or comfortably combines with.