Quantificational States & Argument Separation

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Under Davidsonian proposals, the semantics of relational Vs goes from (1a) $\rightarrow$ (1b) $\rightarrow$ (1c). Similarly (in principle) for relational As (2a-c), Ps (3a-c) and Ns (4a-c).

(1) Shem kicked Shaun.
   a. kick( x, y )
   b. kick( x, y, e )
   c. kicking(e) & $\theta_1(e, x) & \theta_2(e, y)$

(2) Shem is envious of Shaun.
   a. envious-of( x, y )
   b. envious-of( x, y, e )
   c. envy(e) & $\theta_1(e, x) & \theta_2(e, y)$

(3) Shem is near Shaun.
   a. near( x, y )
   b. near( x, y, e )
   c. proximity(e) & $\theta_1(e, x) & \theta_2(e, y)$

(4) Shem is a relative of Shaun.
   a. relative-of( x, y )
   b. relative-of( x, y, e )
   c. kinship(e) & $\theta_1(e, x) & \theta_2(e, y)$

Consider now quantifiers, widely taken to express relations between properties (5a)/(6a). Are state variables motivated here too (5b)/(6b)? Is argument separation desirable, or even possible (5c)/(6b)?

(5) All men complain.
   a. ALL( X, Y )
   b. ALL( X, Y, e )
   c. P(e) & $\theta_1(e, X) & \theta_2(e, Y)$

(6) Men always complain.
   a. ALWAYS( X, Y )
   b. ALWAYS( X, Y, e )
   c. P(e) & $\theta_1(e, X) & \theta_2(e, Y)$

The answers are far from clear.

- With V, A, P and N we have some intuitive grasp on the events/states involved, and plausible relations to them. With quantification these notions are obscure.

- Surely if anything would seem to embody a pure relation between individuals, it’s a Q-relation, which simply evaluates cardinalities, proportions, etc. of sets of individuals (7a,b). What happens to this relation with a state interposed (7c,d)?

(7) a. EVERY( X, Y )
   b. X \ Y
   c. EVERY(e) & $\theta_1(e, X) & \theta_2(e, Y)$
   d. X \ Y

(8) Some animal is eating.
   S₃ = [s₁ in s₃: co-instantiated, [x | x in s₁: animal, x: yes],
   [y | y in s₁: at l: eating, y, b: yes; y]

In this framework, the motivation is largely “architectural”. Ss describe situations. Hence quantificational Ss must describe quantificational situations. Hence there must be quantificational situations to describe.

In a Davidsonian framework, we can find motivation in elements that express relations to eventualities: causatives, perception verbs and adverbial quantifiers.

1.1 Causing Quantificational States

Davidson (1967a) proposes that causation is a relation between eventualities (9) (which include both events and states)

(9) CAUSE( e, e’ )

(10) a. John’s sneezing made Mary leave.
   b. John’s sneezing $\Rightarrow$ ie[sneeze[John,e]]
   c. Mary leave $\Rightarrow$ $\exists e'[leave(Mary,e')]$
   d. John’s sneezing made Mary leave $\Rightarrow$
   $\exists e’[leave(Mary,e’) & CAUSE( ie[sneeze[John,e]] , e’)]$

If this view is adopted, reference to Q-states seems motivated. Consider (11-12) from Johnston (1994):

(11) a. Leopold always robs a bank because he needs money fast.
   b. Frankie always misses the bus because he is a slow runner.
   (cf. Because he is a slow runner Frankie always misses the bus.)
(12) John always sold shares because he needed the money.
   a. ‘Each event of John’s selling shares was caused by a state of John’s
      needing money’
   b. ‘John’s need for money caused a certain behavioral pattern, viz.: John’s
      always selling shares.’
      (cf. Because he needed the money John always sold shares.)

In (11a)/(12a) individual states cause individual events. But (11b) and (12b), a state
causes a “quantificational pattern”. Consider also (13):

(13) a. [a dog’s biting him in childhood] made
    John always become nervous when a dog was near him.
   b. [Fido’s conditioning] caused his salivating.

Always binds all events variables in its scope; hence without a state corresponding to
always itself, CAUSE will have no second event to relate to (14). We appear to need something like (15):

(14) CAUSE(e) [a-dog’s-biting-John(e)], ??)
      ALWAYS(e’, John-become-nervous(e’), ?*, a-dog-near-John(e’))

(15) ∃ e [CAUSE(e) [a-dog’s-biting-John(e)] , e] &
      ALWAYS(e’, John-become-nervous(e’), ?*, a-dog-near-John(e’), e)

1.2 Perceiving Quantificational States

Higginbotham (1983) and Vlach (1983) argue that perception is a relation between
individuals (x, y), where the latter (y) is an eventuality (16).

(16) SEE/HEAR(x, y, e)

(17) a. John heard Mary leave. 
   b. Mary leave. 
   c. John heard Mary leave. 
   d. John heard Mary leave. 

Again, if this view is adopted, reference to Q-states seems natural. Consider (18a,b).

(18) a. John heard Mary frequently complain about her job.
   b. John saw Mary often leave before 5:00pm.
   c. John saw Mary often leave before 5:00pm.

In both it seems John sees/hears, not specific events, but instead a regular pattern
of behavior on Mary’s part - a state.

Frequently binds all events variables in its scope; without a state corresponding to
frequently itself, HEAR has no second event to relate to (19). We appear to need something like (20):

(19) ∃ e1 [HEAR(John, ??, e1)] &
      FREQ(e', Mary-complain-about-job(e’))

(20) ∃ e1 ∃ e' [HEAR(John, e, e') &
      FREQ(e', Mary-complain-about-job(e’))}

1.3 Quantifying Over Quantificational States

Adverbial quantifiers have been analyzed as quantifying over eventualities
(Herburger 2000). In GQ terms, this means relating sets (21/22a,b).

(21) ALWAYS{(e: P(e)), (e*: Q(e*))}

(22) a. John always eats in the hotel restaurant.
   b. ALWAYS(e: John-eats-in-4S(e)), (e*: C(e*))

If this is correct, then consider sentences involving multiple adverbial Qs (23a,b).

(23) a. Usually (when he is staying at the Four Seasons)
    John always eats at the hotel restaurant.
   b. Often (when he is feeling down)
    John will frequently visit a casino. John will frequent casinos.

In both we seem to be saying of a certain pattern of behavior on John’s part – his
always eating somewhere, his frequently visiting somewhere, etc. – that it is attested
with a certain frequency – that it is usual in certain circumstances, that it is frequent,
etc.

In (23a) always binds the eventuality variables in its scope; hence without a state
corresponding to always itself, binding by e’ in the first arg of usually is vacuous
(24). We appear to need something like (25):

(24) USUALLY(e1: ALWASY{(e: John-eats-in-4S(e)), (e*: C(e*))}, (e’1: John-stay-at-4S(e’))

(25) USUALLY(e1: ALWASY{(e: John-eats-in-4S(e)), (e*: C(e*))}, (e’1: John-stay-at-4S(e’)), e’)

(19) ⊤
2.0 Motivating Argument Separation I

Arg-separation with V provides a clear semantic basis for the syntactic notion \( \theta \)-role and underwrites theories of external merge based on it. Extending these benefits to other categories requires corresponding semantic notions.

2.1 \( \theta \)-Roles & Selection with V

In the GB period, \( \theta \)-roles played a key, if technically obscure, role in selection and projection.

(26) a. John gave Fido to Mary.

b. GIVE( x, y, z)

c. IP

\[ \begin{array}{c}
\text{NP} \\
\text{John} \\
\end{array} \]
\[ \begin{array}{c}
\text{VP} \\
\text{I} \\
\text{V'} \\
\text{PP} \\
\text{to Mary} \\
\end{array} \]
\[ \begin{array}{c}
\text{\textit{agree}} \rightarrow \text{John} \\
\text{\textit{Ag}} \rightarrow \text{[m[f]]} \\
\end{array} \]

\[ \alpha \text{ selects } \beta = \alpha \text{ assigns a } \theta \text{-role to } \beta \]

Hornstein (1999): Represent \( \theta \)-roles as syntactic features - \( \theta \)-features. Analyze selection/\( \theta \)-assignment as \( \theta \)-feature agreement (27).

(27)

\[ \text{gave} \rightarrow \lambda z \lambda y \lambda x \lambda e[\text{give}(e) & \text{Ag}(e,x) & \text{Gl}(e,y) & \text{Th}(e,z)] \]
\[ \text{Mary} \rightarrow m \text{ John} \rightarrow j \text{ Fido} \rightarrow f \]

Pesetsky and Torrego (2007): Features to come in four varieties, according to whether they are interpretable/uninterpretable or valued/unvalued (28).

<table>
<thead>
<tr>
<th></th>
<th>INTERPRETABLE</th>
<th>UNINTERPRETABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUED</td>
<td>iFVal</td>
<td>FVal</td>
</tr>
<tr>
<td>UNVALUED</td>
<td>iF</td>
<td>F</td>
</tr>
</tbody>
</table>

Consider \( \theta \)-features in P&T's terms. Suppose we have \([\alpha_0],[m],[\alpha_1]\), etc. Suppose the selection relation between a predicate and an object is feature agreement.

Questions:
- What does it mean for a \( \theta \)-feature to be \textit{interpretable} on expression \( \alpha \)?
- Which expression in (27) carries the interpretable \( \theta \)-feature?
- What does it mean for a \( \theta \)-feature to be \textit{valued} on expression \( \alpha \)?
- Which expression in (27) carries the valued \( \theta \)-feature?

Neo-Davidsonian arg-separation yields a plausible answer the first question and allows different answers to the second.

\[ \text{give}(e) & \text{Ag}(e,x) & \text{Gl}(e,y) & \text{Th}(e,z) \]

Question: What does it mean for a \( \theta \)-feature to be interpretable on expression \( \alpha \)?
Answer: It means \( \theta(e,x) \) is part of the interpretation of \( \alpha \).

Question: Which expression in (27) carries the interpretable \( \theta \)-feature?
Answer: It depends on how you do composition!

**Analysis 1:** \( \theta \)-relations are folded into the lexical semantics of V. Names denote individuals (Parsons 1991).

(29) a. vP

\[ \text{Mary} \rightarrow v \text{ John} \rightarrow v' \text{ Fido} \rightarrow f \]

\[ \lambda x \lambda y \lambda z \lambda e[\text{give}(e) & \text{Ag}(e,x) & \text{Gl}(e,y) & \text{Th}(e,z)] \]

\[ \lambda y \lambda x \lambda e[\text{give}(e) & \text{Ag}(e,x) & \text{Gl}(e,y) & \text{Th}(e,z)] \]

**Analysis 2:** \( \theta \)-relations come with the argument nominals. V contributes only the event sortal (Krilka 1993).

(30) a. vP

\[ \text{Mary} \rightarrow v \text{ John} \rightarrow v' \text{ Fido} \rightarrow v' \]

\[ \lambda e[\text{Ag}(e,m)] \]

\[ \lambda e[\text{Gl}(e,j)] \]

\[ \lambda e[\text{Th}(e,f)] \]

\[ \lambda e[\text{Gl}(e,j)] \]

\[ \lambda e[\text{Th}(e,f)] \]

\[ J \rightarrow \lambda e[\text{Ag}(e,m)] \]

\[ \lambda e[\text{Gl}(e,j)] \]

\[ \lambda e[\text{Th}(e,f)] \]
On ANALYSIS 1, Th(e,y) is part of the interpretation of give; hence [tn] is interpretable on give. Presumably [tn] is valued on Fido (31a). On ANALYSIS 2, Th(e,y) is part of the interpretation of Fido. Hence [tn] as interpretable on Fido. [tn] is valued on give (31b).

(31) a. give [tn] VP give [tn] VP

Larson (2014) works out ANALYSIS 2 in detail using the full matrix of feature possibilities proposed by P&T:

(32)

Mary [a[2]] vP v'

v [a[2]] [a[2]]  

kiss [a[2]] [a[2]]

v [a[2]] [a[2]]  

kiss [a[2]] [a[2]]

John [m[1]]

(33)

Mary [a[3]] vP v'

v [a[2]] [a[2]]  

give [tn] [a[2]]

give [tn] [a[2]]

John [m[1]]

Thematic Hierarchy: [a] > [tn] > [a] > [loc] > ...

Constraint: A feature in a θ-set can undergo agreement only if there are no lower-ranked, unagreed features in that set.

Neo-Davidsonian arg-separation with Vs thus:

- allows GB “θ-roles” and “θ-role assignment” to be coherently recast as formal features subject to formal feature agreement
- provides a transparent understanding of “interpretable θ-feature”
- supports a theory of projection and External Merge based on θ-features

This picture seems extensible to A, P, N (2)-(4). Can it go further?

2.2 θ-Roles & Selection with D

Relational View of Determiners: Ds express relations among predicate meanings.

(34) a. ALL(X,Y) iff |Y - X| = 0  

b. SOME(X,Y) iff |Y ∩ X| = 0  

c. NO(X,Y) iff |Y ∩ X| = 0  

d. MOST(X,Y) iff |Y \ X| > |Y - X|  

e. TWO(X,Y) iff |Y ∩ X| = 2  

(35) HEi(X) iff g(n) ∈ X  

(36) a. EVERY-EXCEPT(X,Y,Z) iff |(Y - Z) \ X| = 0 \ |X \ Z| = 0  

b. Every man except Bill and James smokes

Set arguments play different parts in quantification (cf. 37a,b). Y gives the domain or restriction. X gives the ‘test’ set or scope. 1st order formulae (37c) fail to capture this difference with some, representing X and Y contributions symmetrically (cf. 38):

(37) a. Some [man] [runs].

b. Some [runner] [is a man].

c. 3x[man(x) \ runs(x)] = 3x[runs(x) \ man(x)]

(38) a. Some [men] [are bachelors].

b. Some [bachelors] [are men].

Larson (1991): Restriction and scope might be thought of as θ-roles assigned by D (and other quantifiers) (39a). Pronouns would assign only θSCOPE Every-except, would assign a third role (θEXCP) (39b).

(39) a. θSCOPE θRESTR  

b. θSCOPE θAGENT  

c. θSCOPE θRESTR θEXCP

These ideas can be recast in terms of θ-features and θ-feature agreement in parallel with vP/VP. Compare (32/33) and (40)/(41):
3.0 Motivating Argument Separation II

We noted earlier that arg-separation seems inappropriate for O-relations. E.g., every directly compares membership of sets Y and X (43a). Arg-separation appears to sever this connection (43b).

(43) a. EVERY(X, Y)
   b. X Y
c. EVERY(a, X) & \theta_1(e, X) & \theta_2(e, Y)
   d. X Y

But compare nominal and adverbial quantification:

(44) a. Everyone who sneezed left.
   b. Always if John sneezes, Mary leaves.
(45) a. \{y: sneezes (y) \supset (x: left(x))
   b. \{e: leaving(e) & Ag(e,m) \supset (e: sneezing(e) & Ag(e,j))

Davidsonian events are **thematicall**y unique: a given event can have at most one agent, one theme, one goal, etc. This means no event of Mary leaving can also be an event of John’s sneezing. The first set **cannot** contain the second.

This result is general for adverbial Qs understood as quantifying over events.

(46) a. If it snows, I usually stay inside.
   b. MOST(X,Y) \iff ) Y \cap X \supset (Y - X \cap
   c. \{e': Snowing(e')\} \cap \{e: Stay-inside(e') \& Th(e,i)\} \supset
   \{e': Snowing(e')\} – \{e: Stay-inside(e') \& Th(e,i)\}

How is this point accommodated? Consider Herburger (2000):

(47) a. \{most e: C(e) \& \{ye: C(e') \& **One-to-one** e,e'\} Snowing(e')\}  
   \{e: Stay-inside(e') \& Theme(e,i)\}
   b. ‘Most events where every one-to-one related event is a sneeving such that I stay inside’
   c. \{e': Snowing(e')\} \cap \{e: Stay-inside(e') \& Th(e,i)\} \supset
   \{e': Snowing(e')\} – \{e: Stay-inside(e') \& Th(e,i)\}

(48) a. **ALWAYS**(X, Y)
   b. X Y
c. X f(Y) Y

Adverbial Qs thus present a situation **opposite** to nominal Qs: we precisely can’t compare sets Y and X directly. Comparison of X must be to a subset f(Y) that is the one-to-one image of Y.
4.0 Executing Argument Separation

4.1 A Temptation

It’s tempting to look to verbal constructions like (49a) in attempting to “neo-Davidsonianize” quantification:

(49) a. This set of choices exhausts/subsumes/includes our range of options.
b. \( x: \text{option}(x) \subseteq \{ x: \text{choice}(x) \} \)
c. EVERY(\( X, Y \)) if \( Y \subseteq X \) (i.e., if \( Y \cap X = \emptyset \))

(50) \( \exists e \{ \text{exhaust/subsume/include}(e) \land \theta_1(e, X) \land \theta_2(e, Y) \} \)

This would appeal to a primitive, verbalized counterpart of the subset relation to explicate universal quantification. But:

(51) \( A \subseteq B \iff \forall x (x \in A \rightarrow x \in B) \)

How can the subset relation explicate universal quantification when subset is itself defined in terms of universal quantification?

4.2 Quantizing e

Neo-Davidsonian representation (52c) separates the individuals (\( X, Y \)) involved in quantification, relating them to e but not to each other. How can we capture the equivalent of (52) – how can we relate the two in the way quantification requires?

(52) a. EVERY(\( X, Y \))
b. \( \theta_1(e, X) \land \theta_2(e, Y) \)
c. EVERY(e) & \( \theta_1(e, X) \land \theta_2(e, Y) \)
d. \( e \subseteq Y \land \theta_1(e, X) \land \theta_2(e, Y) \)

\[ \begin{array}{c|c|c}
| a | b | c | d | e | f |
\hline
| a | b | c | d | & |
\hline
| a | b | c | d | \rightarrow \theta_1 | \rightarrow \theta_2 |
\hline
\end{array} \]

Idea: Take the adverbial situation as basic and attempt to generalize from that.

Tentative proposal: X and Y are related via the structure of e.

(53) a. Assume e has mereological structure.
b. \( \theta_{\text{RESTR}}(e, Y) \iff \exists f \) a bijection from \( Y \rightarrow e \).

(54) a. \( e \subseteq Y \)

(55) a. \( e \subseteq Y \)

Injections \( \sigma \) from \( e \) to \( X \) (i.e., functions from \( e \) onto \( X \))

Note that \( \text{iff } Y \subseteq X \), there will be an injection \( \sigma \) from \( e \) to \( X \) that, when composed with \( f \), is an insertion:

(56) a. \( e \subseteq Y \)

Under this picture:

- \( \theta_{\text{RESTR}} \) “injects” the structure of [NP] into e, the Q-state.
  (i.e., the Q-state = the states of those individuals)
- Individual quantifiers represent \( \theta \)-relations of e to [Pro].
- D spells out the “subject” \( \theta \)-role for DP

(57) a. \( \theta_{\text{RESTR}}(e, X) \iff \exists \sigma \) an injection from \( e \) to \( X \).
b. \( \theta_{\text{RESTR}}(e, X) \iff \exists \sigma \) an injection from \( e \) to \( X \) such that \( \sigma \circ f \) is an insertion.

(58) a. Everyone who sneezed left.
b. \( \exists e(\theta_{\text{RESTR}}(e, \text{[left]}) \land \theta_{\text{RESTR}}(e, \text{[sneezed]}) \] )

(59) a. Always if John sneezes, Mary leaves.
b. \( \exists e(\theta_{\text{RESTR}}(e, \text{[Mary leaves]}) \land \theta_{\text{RESTR}}(e, \text{[John sneezes]}) \)
Similar proposals will work for other Qs:

\[(57) \ a. \ \theta_X(e, X) \iff \exists \alpha \text{ an injection from } e \text{ to } X \text{ such that for some } x, \alpha(x) = x.
\]

\[b. \ \theta_0(e, X) \iff \exists \alpha \text{ an injection from } e \text{ to } X \text{ such that for some } x, \alpha \circ f(x) = x.\]

\[(58) \ \theta_0(e, X) \iff \text{for no } \alpha \text{ injection from } e \text{ to } X, \alpha \circ f(x) = x, \text{ for some } x.\]

4.3 Wider Perspectives

- Krifka (1989;1999) offers an analysis of telicity in which the theme of a telic predicate is homomorphically injected into the verbal event. Boundness/unboundedness in the former yields boundness/unboundedness in the latter. \(\theta_{\text{PRESTR}}\) appears suspiciously similar to Krifka’s incremental theme relation (although making no use of mereological structure for sortal Ns).

- Davidson (1967a) argues that a great many sentences are underlying event quantifications. It would thus not be surprising to find that the event analysis of quantifiers underlies the event analysis of familiar, verbal predication.

5.0 Summary

- Neo-Davidsonian analysis of relational Vs appears extensible to lexical As, Ps and Ns without major complications.
- What about non-lexical cats – specifically, to relational Ds?
- Q1: Is there motivation for positing quantificational states?
- Q2: Is there motivation for arg-separation?
- Q3: How could arg-separation be executed semantically?
- If causation & perception involve relations to eventualities, and if adverbial Qs quantify over eventualities, quantificational states seem to be motivated (Q1).
- If we wish to implement \(\theta\)-roles as \(\theta\)-features and appeal to these in the projection of non-lexical cats (D, Q), then arg-separation seems required to give semantic substance to the notion “interpretable \(\theta\)-feature for D/O” (Q2).
- Adverbial quantification already suggests a semantics in which the set arguments are related through an intermediate set of events (Q2)
- We explored (briefly and tentatively) potential semantics for quantifier \(\theta\)-roles that involve mapping through an intermediate event domain (Q3)
- Although history proceeded the other way, the resulting picture suggests the tantalizing possibility that quantificational \(\theta\)-relations are actually more basic than verbal ones - that V is analogous to D, rather than the contrary.

References


Appendix: The K/P Analysis (“K/P” for “Kratzer/Pylkkänen”)

\[(A1) \ a. \ \text{give } \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Th}(e,x) \right] \quad \text{Mary } \rightarrow \ m
\]

\[\nu \rightarrow \lambda x \lambda e \left[ \text{Ag}(e,x) \right] \quad \text{John } \rightarrow j
\]

\[\text{App} \rightarrow \lambda x \lambda e \left[ \text{Gl}(e,x) \right] \quad \text{Fido } \rightarrow f
\]

\[b. \ \exists! \text{[give}'(e) & \text{Ag}(e,m) & \text{Gl}(e,j) & \text{Th}(e,f) \right]
\]

\[\nu \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Ag}(e,m) & \text{Gl}(e,j) & \text{Th}(e,f) \right]
\]

\[\text{John } \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Ag}(e,m) & \text{Gl}(e,j) & \text{Th}(e,f) \right] \quad m
\]

\[\nu \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Ag}(e,m) & \text{Gl}(e,j) & \text{Th}(e,f) \right] \quad j
\]

\[\text{App} \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Ag}(e,m) & \text{Gl}(e,j) & \text{Th}(e,f) \right] \quad \text{EI}
\]

\[\text{Mary } \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Gl}(e,x) & \text{Th}(e,f) \right] \quad \text{EI}
\]

\[\text{App} \rightarrow \lambda x \lambda e \left[ \text{give}'(e) & \text{Th}(e,f) \right] \quad \text{EI}
\]

\[\lambda x \lambda e \left[ \text{give}'(e) & \text{Th}(e,x) \right] \quad \text{EI}
\]

K/P requires a stipulative operation of “Event Identification” (EI) to allow the interpretations of App and \(\nu\) to combine properly.

K/P is thus dispreferred in comparison to K and P (Larson 2014).