Introducing and motivating the event argument of the verb
(Landman 2000)

1. Introduction.

(1) a. Jones buttered the toast.
b. Jones buttered the toast slowly in the bathroom with a knife.

■ Representation in the CLASSICAL Montagovian THEORY: adverbials as verb modifiers, that is, as functions from verbs to verbs.

(2) a. BUTTER(j,t)
b. WITH(k)(IN(b)(SLOWLY(BUTTER))) (j,t)

■ DAVIDSONEAN THEORY (Davidson 1967):
(i) (action/non-stative) verbs have an implicit event argument *e*;
(ii) adverbials are predicates of this event argument, added conjunctively;
(iii) the event argument is existentially quantified over at the top of the clause.

(3) a. $\exists$e [BUTTER(e,j,t)]
b. $\exists$e [BUTTER(e,j,t) $\wedge$ SLOWLY(e) $\wedge$ IN(e,b) $\wedge$ WITH(e,k)]

■ NEO-DAVIDSONEAN THEORY (Higginbotham 1983. Parsons 1990, etc.): (ii) and (iii) as in the Davidsonean Theory, plus:
(i') both action and stative verbs have an implicit event variable;
(iv) not only adverbials, but also arguments (e.g. agents, themes) are added conjunctively.

(4) a. $\exists$e [BUTTER(e) $\wedge$ AGENT(e)=j $\wedge$ THEME(e)=t]
b. $\exists$e [BUTTER(e) $\wedge$ AGENT(e)=j $\wedge$ THEME(e)=t $\wedge$
SLOWLY(e) $\wedge$ IN(e,b) $\wedge$ WITH(e,k)]

■ Three main reasons or arguments for the (neo)-Davidsonian Theory (Parsons 1990):
1. Event modification.
2. Explicit reference to events.
3. Perception verbs.

2. Event modification.

2.1. Adjectives modifying nouns (Kamp 1975)

■ A potential semantic representation:

(5) $[\![$ *blond* $]\!]$ = $\lambda P_{<e,t>}$. BLOND(P)

(6) John is a blue-eyed, blond, fourty year old American with a beard.

(7) WITH(b) (BLUE-EYED (BLOND(40-YR-OLD(AMERICAN)))) (j)

■ Some semantic properties of adjectival modification:

A. **Permutation**: leaving aside certain syntactic constraints, permuting the modifiers does not change truth conditions. Here, (6) and (8) are truth-conditionally equivalent.

(8) John is a fourty year old, blond, blue-eyed American with a beard.

B. **Drop**: If we take a sentence ϕ with modifiers and drop any number of those modifiers, the resulting sentence ϕ' will be entailed by ϕ. Here, (6) entails (9).

(9) John is a blue-eyed, fourty year old American.

⇨ How to make these properties follow from our semantic representation?

QUESTION 1: Do Permutation and Drop hold for all kinds of adjectives? Try *former* and *small* in the sentences below.

(10) John is a former world-class ballet dancer.

(11) Jumbo is a small pink elephant.

■ CLASSICAL theory for intersective adjectives:

(12) $[\![\textit{blond}]\!] \quad = \quad \lambda P_{<e,t>}.\ \lambda x_e.\ [\ P(x) \wedge \text{BLOND}(x)\ ]$

(13) John is a blue-eyed, blond, fourty year old American with a beard.

(14) $\lambda x_e.\ [\ \text{AMERICAN}(x) \wedge \text{40-YR-OLD}(x) \wedge \text{BLOND}(x) \wedge \text{BL-EYED}(x) \wedge \text{WITH}(b)(x)\ ] \quad (j)$

(15) $\text{AMERICAN}(j) \wedge \text{40-YR-OLD}(j) \wedge \text{BLOND}(j) \wedge \text{BL-EYED}(j) \wedge \text{WITH}(b)(j)$

⇨ Permutability and Drop follow from Propositional Logic (PL) (See appendix)

■ Some more properties of adjectival modification:

C. **Monotonicity**: The inference below is valid.

(16) Every yankee is an American.
John is a fourty year old yankee.
Hence, John is a fourty year old American.

D. **Upward conjunction**: The inference below is valid.

(17) John is a blond American and John is a blue-eyed American.
Hence, John is a blond, blue-eyed American.

2.2. Back to adverbials modifying verbs (or Verb Phrases, VPs)

■ Semantic properties of adverbial modification:

A. **Permutation**: Yes! (18) and (19) have the same truth conditions:

(18) Brutus stabbed Caesar in the back through his toga with a knife.

(19) Brutus stabbed Caesar with a knife through his toga in the back.

B. **Drop**: Yes! (18) entails (20):

(20) Brutus stabbed Caesar in the back with a knife.

C. **Monotonicity**: No! The inference in (21) is not valid.

(21) If you talk to a crowd, you move your thorax.
John talks to a crowd through a megaphone.
~~Hence~~, John moves this thorax though a megaphone.

D. **Upward Conjunction**: No!

QUESTION 2: Show with your own examples that Upward Conjunction does not hold for adverbial modification.

■ To account for the similarities between adjectival and adverbial quantification wrt A and B, it seems appropriate to have parallel lexical entries for adjs and advs, as in (22). But keep in mind that we also need to account for their differences wrt properties C and D.

(22) a. $[\![$ *blond* $]\!]$ = $\lambda P_{<e,t>}.\ \lambda x_e.\ [\ P(x) \wedge \text{BLOND}(x)\ ]$
b. $[\![$ *slowly* $]\!]$ = $\lambda P_{<\sigma,t>}.\ \lambda x_\sigma.\ [\ P(x) \wedge \text{SLOW}(x)\ ]$

⇨ The question is: What type of argument will this x_σ be?

■ TRY 1: This x_σ is the subject.

(23) a. $[\![$ *slowly* $]\!]$ = $\lambda P_{<e,t>}.\ \lambda x_e.\ [\ P(x) \wedge \text{SLOW}(x)\ ]$
b. $[\![$ *through a megaphone* $]\!]$ = $\lambda P_{<e,t>}.\ \lambda x_e.\ [\ P(x) \wedge \text{THROUGH}(x,m)\ ]$

(24) $[\![$*talk to a crowd through a megaphone*$]\!]$ = $\lambda x_e.[\text{TALK}(x,c) \wedge \text{THROUGH}(x,m)]$

⇨ But we wrongly predict that Monotonicity and Upward Conjunction holds for advs.

QUESTION 3: Show why Try 1 makes this wrong prediction.

■ TRY 2: This x_σ is an implicit event argument.

- Introducing the event argument:

(25) ⟦ *slowly* ⟧ = $\lambda P_{<v,t>}.\ \lambda e_v.\ [\ P(e) \wedge SLOW(e)\ ]$
$(\ OR: \lambda V_{<e,<e,vt>>}.\ \lambda x_e.\lambda y_e.\lambda e_v.\ [\ P(x)(y)(e) \wedge SLOW(e)\ ]\ )$

(26) Brutus stabbed Caesar in the back with a knife.
$\lambda e\ [\ STAB(e,b,c) \wedge LOC(e,back) \wedge INSTR(e,k)\ ]$

⇨ The intersective treatment of event modification guarantees Permutation and Drop.

- Furthermore, the event variable of each verb is existentially quantified at the top of clause:

(27) Brutus stabbed Caesar in the back with a knife.
$\exists e\ [\ STAB(e,b,c) \wedge LOC(e,back) \wedge INSTR(e,k)\ ]$

⇨ ∃-quantification prevents Upward Conjunction:

(28) a. John is a blond, blue-eyed American.
b. John is a blond American and John is a blue-eyed American.

(29) a. Someone is a blond, blue-eyed American.
b. Someone is a blond American and someone is a blue-eyed American.

(30) a. Brutus stabbed Caesar in the back with a knife.
$\exists e\ [\ STAB(e,b,c) \wedge LOC(e,back) \wedge INSTR(e,k)\ ]$
b. Brutus stabbed Caesar with a knife and Brutus stabbed Caesar in the back.
$\exists e\ [\ STAB(e,b,c) \wedge LOC(e,back)\ ] \wedge \exists e\ [\ STAB(e,b,c) \wedge INSTR(e,k)\ ]$

QUESTION 4: What entailment relations are there between the (a) and (b) sentences in each of the above examples?

⇨ ∃-quantification is also responsible for the lack of Monotonicity:

(31) If you talk to a crowd, you move your thorax.
<u>John talks to a crowd through a megaphone.</u>
~~Hence~~, John moves this thorax though a megaphone.

(32) $\forall e \forall x\ [\ TALK(e,x,c) \rightarrow \exists e'[MOVE(e',x,t(x)) \wedge INVOLVE(e,e']\ ]$
$\underline{\exists e\ [\ TALK(e,j,c) \wedge THROUGH(e,m)]}$
$\not\therefore\ \exists e'\ [MOVE(e',j,t(j)) \wedge THROUGH(e,m)\ ]$

■ In sum:
Given its strong parallelism between adj and adv modification, the two phenomena should receive a parallel treatment: the modifier is a co-predicate of an argument of the modifiee. In verbs, this argument is an **event argument**, ∃-closed at the clause level.
Note that the argumentation just made for action verbs can also be made for stative verbs like *be available* or *stink* (stage-level) and like *know* (individual level): (33).
This means that all verbs have an eventuality argument (an event or a state argument).

(33) a. I know John by face from TV.
b. I know John from TV by face.
c. I know John from TV.

■ Other considerations: situations instead of events; events not as primitives but constructed; ι-closure instead of ∃-closure.

3. Explicit reference to events.

■ Naïve argument: discourse anaphora to events.
This /it in (34) seems to refer back to the previous event. But we know that discourse anaphora can rely on accommodation: e.g. kind reading in (35).

(34) John arrived late. This / It bothered Mary.

(35) This dike was built by three dutchmen. As we all know, they're good at building dikes.

■ Mittwoch's argument:
Contrast in (36): discourse anaphora in (36a) can rely on inferencing or accommodation, but modification in (36b) cannot (at least not as easily) and thus it is #.
No contrast in (37). That is, the modification in (37b) is successfull without inferencing or accommodation.

(36) a. This dike was built by three dutchmen. As we all know, they're good at building dikes.
b. This dike was built by three dutchmen, who -as we all know- are good at building dikes.

(37) a. Car A collided with car B. It killed both drivers.
b. Car A collided with car B, killing both drivers.

■ Parsons' argument: The first NP in (38a) quantifies over events explicitly. If we assume that the verbs in (38b) and (38c) ∃-quantify over events, then we can explain why the argument is valid.

(38) a. In every burning, oxygen is consumed.
b. John burned wood yesterday.
c. Hence, oxigen was consumed.

■ Landman's counterargument to Parsons':
Let us accept that the NP *every burning* does quantify over events. Still, we do not need to assume that the verb *burn* introduces an ∃-quantified event variable. We only need to assume a meaning postulate relating the noun *burning* to the verb *burn*:

(39) BURN(x,y) iff $\exists e\,[\mathrm{BURNING}(e) \wedge \mathrm{AG}(e)=x \wedge \mathrm{THEME}(e)=y]$

4. Perception reports.

■ A first analysis:

(40) Poppaea saw Brutus leave.
$\exists e\,[\mathrm{SEE}(e) \wedge \mathrm{AG}(e)=p \wedge \exists e'\,[\mathrm{THEME}(e)=e' \wedge \mathrm{AG}(e')=b]\,]$

■ Difference between events and event types:

(41) a. # In 1912, Whitehead saw Russell wink. In 1914, McTaggart saw <u>it</u> too.
b. In 1912, Whitehead saw Russell wink. In 1914, McTaggart saw <u>the same</u>.

■ Inference:
(42) is intuitively not valid. However, the event analysis in (40) predicts it to be valid.

(42) a. Poppaea saw Brutus leave the house.
b. Brutus left the house with a knife hidden under his coat.
c. Brutus left the house only once.
d. ~~Hence~~, Poppaea saw Brutus leave the house with a knife hidden under his coat.

QUESTION 5: Is the invalidity of this inference due to intensionality? Why / why not?

■ Wyner 1994: perception reports involve visual scenes (=visual input) supporting partial events or event types. For a scene to support an event type, it should not just contain an event that instantiates that event type; it should also contain all the parts of the event that instantiate any part of the event type.

APPENDIX

Some logical concepts

(1) a. A formula is a *tautology* iff it is true under any $[\![\ ]\!]^w$. $\top$
b. A formula is a *contradiction* iff it is false under any $[\![\ ]\!]^w$. $\bot$
c. A formula is *contingent* iff it is true under some $[\![\ ]\!]^w$ and false under other $[\![\ ]\!]^{w'}$.

(2) ϕ and ψ are *logically equivalent* (i.e., $\phi \Leftrightarrow \psi$) iff, for every w, $[\![\phi]\!]^w = [\![\psi]\!]^w$.

(3) ψ is a *logical consequence* of ϕ (i.e., $\phi \Rightarrow \psi$)
iff, for every world w such that $[\![\phi]\!]^w = 1$, $[\![\psi]\!]^w = 1$.

Laws of Propositional Logic (PL)

1. Idempotent Laws:	$(\phi \vee \phi)$	$\Leftrightarrow$	ϕ
	$(\phi \wedge \phi)$	$\Leftrightarrow$	ϕ
2. Commutative Laws:	$(\phi \vee \psi)$	$\Leftrightarrow$	$(\psi \vee \phi)$
	$(\phi \wedge \psi)$	$\Leftrightarrow$	$(\psi \wedge \phi)$
3. Associate Laws:	$((\phi \vee \psi) \vee \pi)$	$\Leftrightarrow$	$(\phi \vee (\psi \vee \pi))$
	$((\phi \wedge \psi) \wedge \pi)$	$\Leftrightarrow$	$(\phi \wedge (\psi \wedge \pi))$
4. Distributive Laws:	$(\phi \vee (\psi \wedge \pi))$	$\Leftrightarrow$	$((\phi \vee \psi) \wedge (\phi \vee \pi))$
	$(\phi \wedge (\psi \vee \pi))$	$\Leftrightarrow$	$((\phi \wedge \psi) \vee (\phi \wedge \pi))$
5. Identity Laws:	$(\phi \vee \bot)$	$\Leftrightarrow$	ϕ
	$(\phi \vee \top)$	$\Leftrightarrow$	$\top$
	$(\phi \wedge \bot)$	$\Leftrightarrow$	$\bot$
	$(\phi \wedge \top)$	$\Leftrightarrow$	ϕ
6. Complement Laws:	$(\phi \vee \neg\phi)$	$\Leftrightarrow$	$\top$
	$(\phi \wedge \neg\phi)$	$\Leftrightarrow$	$\bot$
	$\neg\neg\phi$	$\Leftrightarrow$	ϕ
7. DeMorgan's Laws:	$\neg(\phi \vee \psi)$	$\Leftrightarrow$	$(\neg\phi \wedge \neg\psi)$
	$\neg(\phi \wedge \psi)$	$\Leftrightarrow$	$(\neg\phi \vee \neg\psi)$
8. Conditional Laws:	$(\phi \rightarrow \psi)$	$\Leftrightarrow$	$(\neg\phi \vee \psi)$
	$(\phi \rightarrow \psi)$	$\Leftrightarrow$	$(\neg\psi \rightarrow \neg\phi)$
9. Biconditional Laws:	$(\phi \leftrightarrow \psi)$	$\Leftrightarrow$	$(\phi \rightarrow \psi) \wedge (\psi \rightarrow \phi)$
	$(\phi \leftrightarrow \psi)$	$\Leftrightarrow$	$(\neg\phi \wedge \neg\psi) \vee (\phi \wedge \psi)$

Some valid inferences in Propositional Logic

10. Simplification of $\wedge$: $(\phi \wedge \psi) \Rightarrow \phi$

11. Addition of $\wedge$:

$$\frac{\phi \qquad \psi}{(\phi \wedge \psi)}$$

12. Simplification of $\vee$:

$$\frac{(\phi \vee \psi) \qquad \neg\phi}{\psi}$$

13. Addition of $\vee$: $\phi \Rightarrow (\phi \vee \psi)$