12.1 Eventualities [Davidson, 1967, Bach, 1986]

We have reasons to treat eventualities (events and states) like entities.

1. First, we constrain them with modifiers like we constrain descriptions of entities:

   (1) a. *Etna erupted in 2021.*
       b. (entailed by $\lhd$:) *Etna erupted.*

2. Second, we describe them explicitly like entities in nominalizations:

   (2) a. *Etna erupted in 2021.*
       b. (entails and entailed by $\triangleright$:) *An eruption of Etna was in 2021.*

This similarity is modeled by adding an argument to verbs and other predicates – type $\langle e, (e, t) \rangle$:

$$\llbracket \text{Erupt} \rrbracket^M = \llbracket \lambda_{e_1} \lambda_{e_2} \text{Erupt } e_1 e_2 \rrbracket^M$$

Modifiers of these events can be composed using the schematized modifier rules:

```
(\lambda_{e_1} \text{Erupt Etna } e_1 \land \text{In 2021 } e_2) : \langle e_1, (e_1, t) \rangle
```

```
\text{Etna} : e
\text{Erupt} : \langle e, (e, t) \rangle
\text{In} : \langle e, (e, t) \rangle
\text{2021} : e
```

Practice 12.1: trees with rules

Label the tree for *Etna erupted in 2021* with rules.
Note that the variable $e$ above is not quantified.

We can quantify it with an adverb *Once*, translated as *Some*. For example:

\[
\text{(Some ($\lambda_{ee} \ Erupt \ Etna \ e \land \ In \ 2021 \ e$)) : } \langle (e, t), t \rangle
\]

\[
\text{Some} : \langle (e, t), \langle (e, t), t \rangle \rangle \quad \text{(Some ($\lambda_{ee} \ Erupt \ Etna \ e \land \ In \ 2021 \ e$)) : } \langle e, t \rangle
\]

\[
\text{Etna : } e \quad \text{(Some ($\lambda_{ee} \ Erupt \ x \ e \land \ In \ 2021 \ e$)) : } \langle e, (e, t) \rangle
\]

\[
\text{Erupt : } \langle e, (e, t) \rangle \quad \text{(In 2021) : } \langle e, t \rangle
\]

\[
\text{In : } \langle e, (e, t) \rangle \quad \text{2021 : } e
\]

This extends naturally to other cardinal quantifiers: *twice* as *Two*, *never* as *None*, etc.

If we don’t have an explicit quantifier, we can assume an implicit one:

\[
f : \langle e, t \rangle \Rightarrow (\text{Some } f) : \langle (e, \gamma_n), \gamma_n \rangle
\]

(Existential Closure)

This is sometimes called *existential closure*.

For isolated sentences we need an additional closure operation to get a truth value:

\[
g : \langle (e, t), t \rangle \Rightarrow (g (\lambda_{ee} \ True)) : t
\]

(Nuclear Scope Closure)

For example:

\[
(\text{Some ($\lambda_{ee} \ Erupt \ Etna \ e \land \ In \ 2021 \ e$) ($\lambda_{ee} \ True$)) : } t
\]

\[
(\text{Some ($\lambda_{ee} \ Erupt \ Etna \ e \land \ In \ 2021 \ e$)) : } \langle (e, t), t \rangle
\]

\[
(\lambda_{ee} \ Erupt \ Etna \ e \land \ In \ 2021 \ e) : \langle e, t \rangle
\]

\[
\text{Etna : } e \quad \text{(Some ($\lambda_{ee} \ Erupt \ x \ e \land \ In \ 2021 \ e$)) : } \langle e, (e, t) \rangle
\]

\[
\text{Erupt : } \langle e, (e, t) \rangle \quad \text{(In 2021) : } \langle e, t \rangle
\]

\[
\text{In : } \langle e, (e, t) \rangle \quad \text{2021 : } e
\]

This analysis treats quantified sentences like quantified noun phrases, for use as arguments.
Practice 12.2: trees with rules
Label the complete tree for \textit{Etna erupted in 2021} with rules.

12.2 Further decomposition (lexical semantics)

Many transitive predicates can be further decomposed into a cause and an intransitive predicate:

\( (3) \) a. \textit{The Constitution sank the Guerriere.} \\
b. (entailed by 3a:) \textit{The Guerriere sank.}

Here’s the translation:

\[
\begin{align*}
\text{(Some } & (\lambda_{e \in e} \text{ Cause } e \text{ Constitution } \land \text{ Sink Guerriere } e) (\lambda_{e \in e} \text{ True})) : t \text{) : t} \\
\quad \downarrow \\
\text{(Some } & (\lambda_{e \in e} \text{ Cause } e \text{ Constitution } \land \text{ Sink Guerriere } e)) : \langle \langle e, t \rangle, t \rangle \\
\quad \downarrow \\
(\lambda_{e \in e} \text{ Cause } e \text{ Constitution } \land \text{ Sink Guerriere } e) : \langle e, t \rangle
\end{align*}
\]

The intransitive predicate can then occur by itself as an \textbf{unaccusative} verb:

\[
\begin{align*}
\text{(Some } & (\lambda_{e \in e} \text{ Sink Guerriere } e) (\lambda_{e \in e} \text{ True})) : t \text{) : t} \\
\quad \downarrow \\
\text{(Some } & (\lambda_{e \in e} \text{ Sink Guerriere } e)) : \langle \langle e, t \rangle, t \rangle \\
\quad \downarrow \\
(\lambda_{e \in e} \text{ Sink Guerriere } e) : \langle e, t \rangle
\end{align*}
\]

The transitive and intransitive need not be the same verb:

\[
\begin{align*}
\text{kill } \Rightarrow (\lambda_{e \in e} \lambda_{x \in e} \lambda_{e \in e} \text{ Cause } e \land \text{ Die } y e) : \langle e, \langle e, \langle e, t \rangle \rangle \rangle \\
\text{give } \Rightarrow (\lambda_{e \in e} \lambda_{y \in e} \lambda_{x \in e} \lambda_{e \in e} \text{ Cause } e \land \text{ Have } z y e) : \langle e, \langle e, \langle e, \langle e, t \rangle \rangle \rangle \rangle
\end{align*}
\]
12.3 Quantified sentences as arguments

This treatment provides a simple analysis for sentential arguments analogous to noun phrases:

\[
(\text{Some } (\lambda_{e,e} \text{ Erupt Etna } e \land \text{Erupt Wolf} \text{ After) } e) \ (\lambda_{e,e} \text{ True})) : t
\]

\[
(\text{Some } (\lambda_{e,e} \text{ Erupt Etna } e \land (\text{Erupt Wolf) After) } e)) : \langle (e, t), t \rangle
\]

\[
(\lambda_{e,e} \text{ Erupt Etna } e \land (\text{Erupt Wolf) After) } e) : \langle e, t \rangle
\]

\[
\text{Erupt Etna} : \langle e, t \rangle \quad \text{Erupt} : \langle e, (e, t) \rangle \quad \text{After} : \langle e, (e, t) \rangle \quad (\text{Some}_{e,t} \text{ (Erupt Wolf) After) } e) : \langle e, t \rangle
\]

\[
(\lambda_{e,e} \text{ Erupt Etna } e \land (\text{Erupt Wolf) After) } e) : \langle e, t \rangle
\]

\[
\text{Erupt Etna} : \langle e, t \rangle \quad \text{Erupted} : \langle e, (e, t) \rangle
\]

Practice 12.3: trees with rules

Label the tree for *Etna erupted after Wolf erupted* with rules.

12.4 Tense

We can use eventualities to carry tense, assuming an entity *Now* for the beginning of the speech. For example, here’s a present tense function (schematized for use with an intransitive verb):

\[
\llbracket \text{Present}_{(e,t)} \rrbracket^M = \llbracket \lambda_{f,(e,(e,t))} \lambda_{x,e} f \ x \ e \land \text{In } e \ \text{Now} \rrbracket^M
\]

And here’s one for past tense, assuming *Precede* with its usual meaning:

\[
\llbracket \text{Past}_{(e,t)} \rrbracket^M = \llbracket \lambda_{f,(e,(e,t))} \lambda_{x,e} f \ x \ e \land \text{Some } (\text{In } e) \ (\text{Precede Now}) \rrbracket^M
\]

So here’s what the translation looks like:

\[
(\text{Past}_{(e,t)} \text{ Erupt Etna) : } \langle e, t \rangle
\]

\[
\text{Etna} : e \quad (\text{Past}_{(e,t)} \text{ Erupt) : } \langle e, (e, t) \rangle
\]

\[
\text{Etna} \quad \text{erupted}
\]
12.5 Non-intersective modifiers

Remember our trouble with new capital:

(4) a. *Beijing is a new capital.*
    b. (entailed by 4a:) *Beijing is a capital.*
    c. (not entailed by 4a:) *Beijing is new.*

as opposed to coastal capital:

(5) a. *Beijing is a coastal capital.*
    b. (entailed by 5a:) *Beijing is a capital.*
    c. (entailed by 5a:) *Beijing is coastal.*

Here’s an analysis using eventualities:

\[
\begin{array}{c}
\lambda e \text{ Some } (\lambda e \text{ Capital } x e \land \text{New } e) (\lambda e \text{ True}) : \langle e, t \rangle \\
\lambda f (e, \langle e, t \rangle) \lambda e \text{ Some } (\lambda e f x e \land \text{New } e) (\lambda e \text{ True}) : \langle \langle e, \langle e, t \rangle \rangle, \langle e, t \rangle \rangle \\
\lambda e \lambda e \text{ Capital } x e : \langle e, \langle e, t \rangle \rangle \\
\end{array}
\]

In English, adjectives like *old* are polysemous between intersective and non-intersective:

(6) a. *Kim is an old friend of mine.*
    b. (entailed by 6a:) *Kim is old.*
    c. (entailed by 6a:) *My friendship with Kim is old.*

These meanings are distinguished using pre- or post-modifiers in Spanish and Portuguese:

(7) a. *Kim é um velho amigo.*
    b. (entailed by 7a:) *Kim is old.*
    c. *Kim é um amigo velho.*
    d. (entailed by 7c:) *My friendship with Kim is old.*

References
