Entailment

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Linguist 130a/230a: Introduction to semantics and pragmatics
The abstract idea

Entailment

Non-entailment

Contradiction

S $\Rightarrow$ not-S

′
The abstract idea

**Entailment**

\[ S \Rightarrow S' \]
The abstract idea

Entailment

\[ S \Rightarrow S' \]
The abstract idea

Entailment

\[ S \Rightarrow S' \]
The abstract idea

Entailment

\[ S \Rightarrow S' \]
The abstract idea

Entailment

$S \Rightarrow S'$
The abstract idea

Entailment

Sandy waltzed ⇒ Sandy danced
The abstract idea

Entailment

Sandy waltzed ⇒ Sandy danced

Sandy waltzed
The abstract idea

Entailment

Sandy waltzed $\Rightarrow$ Sandy danced

Sandy waltzed

Sandy danced
The abstract idea

Entailment

\[ S \Rightarrow S' \]

Non-entailment

\[ S \nRightarrow S' \]
The abstract idea

**Entailment**

\[ S \Rightarrow S' \]

**Non-entailment**

\[ S \nRightarrow S' \]

**Diagram:**

- Blue circle: \( S \)
- Green circle: \( S' \)

Intersection: \( S \cap S' \)
The abstract idea

Entailment

\[ S \implies S' \]

Non-entailment

\[ S \not\implies S' \]
The abstract idea

**Entailment**

Sandy waltzed ⇒ Sandy danced

**Non-entailment**

Sandy danced ⇒ Sandy waltzed
The abstract idea

Entailment

Sandy waltzed ⇒ Sandy danced

Non-entailment

Sandy danced ⇒ Sandy waltzed

Contradiction
The abstract idea

Entailment

Sandy waltzed $\Rightarrow$ Sandy danced

Non-entailment

Sandy danced $\not\Rightarrow$ Sandy waltzed

Sandy danced

Sandy waltzed
The abstract idea

**Entailment**

Sandy waltzed \(\Rightarrow\) Sandy danced

**Non-entailment**

Sandy danced \(\not\Rightarrow\) Sandy waltzed
The abstract idea

**Entailment**

\[ S \Rightarrow S' \]

**Non-entailment**

\[ S \nRightarrow S' \]

**Contradiction**

\[ S \Rightarrow not-S' \]
The abstract idea

Entailment

\[ S \implies S' \]

Non-entailment

\[ S \nimp S' \]

Contradiction

\[ S \implies \text{not-}S' \]
The abstract idea

**Entailment**

\[ S \Rightarrow S' \]

**Non-entailment**

\[ S \nRightarrow S' \]

**Contradiction**

\[ S \Rightarrow \text{not-}S' \]
Basic data

- Sandy danced
- Sandy waltzed
Basic data

Sandy danced

↑

Sandy waltzed
Basic data

Sandy danced

↑  ↓

Sandy waltzed
Basic data

A student danced

A Swedish student danced  A student waltzed
Basic data

A student danced

↑

A Swedish student danced  A student waltzed
Basic data

A student danced

\[ \downarrow \uparrow \]

A Swedish student danced A student waltzed
Basic data

A student danced

\[\downarrow \uparrow \uparrow\]

A Swedish student danced  A student waltzed
Basic data

A student danced  

A Swedish student danced  A student waltzed
Basic data

A student danced

$\uparrow$

A Swedish student danced

$\uparrow$

A student waltzed
Basic data

A student danced

A Swedish student danced

A student waltzed

S

NP

a student

VP

danced
Basic data

A student danced

A Swedish student danced

A student waltzed

S

NP

a

Swedish student

VP

danced
Basic data

A student danced

A Swedish student danced    A student waltzed

S

NP

a

Swedish student

VP

waltzed
Basic data

A student danced

A Swedish student danced  
A student waltzed

S

NP

a

Swedish student who likes linguistics and is afraid of skiing

VP

danced while juggling in the Quad
Basic data

No student danced

No Swedish student danced  No student waltzed
Basic data

No student danced

⇓

No Swedish student danced  No student waltzed
Basic data

No student danced  ☩  ☩  No Swedish student danced  No student waltzed
Basic data

Every student danced

Every Swedish student danced  Every student waltzed
Basic data

Every student danced

⇒

Every Swedish student danced   Every student waltzed
Basic data

Every student danced

\[\downarrow\quad \uparrow\]

Every Swedish student danced  Every student waltzed
The abstract idea
Basic data
Negation reverses entailments
An intuitive but precise argument
More data, deeper insights

The patterns
The patterns

A student danced

A Swedish student danced  A student waltzed
The patterns

A student danced

\[
\uparrow \quad \uparrow
\]

A Swedish student danced   A student waltzed
The patterns

A student danced

Ａ Swedish student danced Ａ student waltzed

No student danced

No Swedish student danced Ｎo student waltzed
The patterns

<table>
<thead>
<tr>
<th>A student danced</th>
<th>A Swedish student danced</th>
<th>A student waltzed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>No student danced</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>No Swedish student danced</td>
<td>No student waltzed</td>
<td></td>
</tr>
</tbody>
</table>
The patterns

A student danced

↑  ↑

A Swedish student danced  A student waltzed

No student danced

↓  ↓

No Swedish student danced  No student waltzed

Every student danced

Every Swedish student danced  Every student waltzed
The patterns

A student danced

A Swedish student danced  A student waltzed

No student danced

No Swedish student danced  No student waltzed

Every student danced

Every Swedish student danced  Every student waltzed
Negation reverses entailments

A student danced

A Swedish student danced  A student waltzed

No student danced

No Swedish student danced  No student waltzed
Negation reverses entailments

A student danced

\[ \uparrow \quad \uparrow \]

A Swedish student danced  A student waltzed

No student danced

\[ \downarrow \quad \downarrow \]

No Swedish student danced  No student waltzed

Sandy danced

\[ \uparrow \]

Sandy waltzed

Sandy didn’t dance

Sandy didn’t waltz
Negation reverses entailments

A student danced

A Swedish student danced  A student waltzed

No student danced

No Swedish student danced  No student waltzed

Sandy danced

Sandy waltzed

Sandy didn’t dance

Sandy didn’t waltz
Negation reverses entailments

A student danced

A Swedish student danced    A student waltzed

No student danced

No Swedish student danced    No student waltzed

Sandy danced

Sandy waltzed

Sandy didn’t dance

Sandy didn’t waltz
Negation reverses entailments

A student danced

\[\uparrow\quad \uparrow\]

A Swedish student danced \quad A student waltzed

No student danced

\[\downarrow\quad \downarrow\]

No Swedish student danced \quad No student waltzed

Sandy danced

\[\uparrow\]

Sandy waltzed

Sandy didn’t dance

\[\downarrow\]

Sandy didn’t waltz
Negation reverses entailments

A student danced

A Swedish student danced    A student waltzed

No student danced

No Swedish student danced    No student waltzed

Sandy danced

Sandy waltzed

Sandy didn’t dance

Sandy didn’t waltz
Negation reverses entailments

A student danced

A Swedish student danced  A student waltzed

No student danced

No Swedish student danced  No student waltzed

Sandy danced

Sandy waltzed

Sandy didn’t dance

Sandy didn’t waltz

dance

waltz

dance

waltz
An intuitive but precise argument

Every student danced

\[\downarrow \quad \uparrow\]

Every Swedish student danced  Every student waltzed
An intuitive but precise argument

Every student danced

Every Swedish student danced  Every student waltzed
An intuitive but precise argument

Every student danced
\[ \downarrow \quad \uparrow \]
Every Swedish student danced    Every student waltzed
An intuitive but precise argument

Every student danced

\[\downarrow \quad \uparrow\]

Every Swedish student danced  Every student waltzed
An intuitive but precise argument

Every student danced
\[\downarrow \uparrow\]
Every Swedish student danced  Every student waltzed
An intuitive but precise argument

Every student danced

Every Swedish student danced

Every student waltzed
An intuitive but precise argument

Every student danced

\[ \downarrow \quad \uparrow \]

Every Swedish student danced  Every student waltzed
An intuitive but precise argument

Every student danced

Every Swedish student danced

Every student waltzed
An intuitive but precise argument

Every student danced

\[ \Downarrow \quad \Uparrow \]

Every Swedish student danced

Every student waltzed
An intuitive but precise argument

Every student danced

\[ \Downarrow \quad \Uparrow \]

Every Swedish student danced   Every student waltzed
More data, deeper insights

1. some (↑)(↑)
2. no (↓)(↓)
3. every (↓)(↑)
4. exactly three (−)(−)
5. few ( )
6. most ( )
7. a minority of ( )
8. not every ( )
9. only ( )