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Faculty of Philosophy
General Linguistics

Syntax & Semantics WiSe 2021/2022

Lecture 23: Semantics Summary

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Overview

Q&As

Tutorial 9

In Exercise 1, why is "we" in "We are suprised about your absence" considered an anaphoric rather than deictic usage?

I admit that this is a tricky case since no further context (before the usage of "we" is given). So it would be acceptable to classify this as a deictic element. Note, however, that when a pronoun "we" is used, then the group that it refers back to has normally been established before (i.e. anaphoric). This contrasts with the usage of "I" or "you" (second person singular) whose reference is clear purely from the speech situation (the speaker and the addressee).

Tutorial 9

Regarding the Identity and the Contradiction test for the verb “carry”. Why in the Identity test we can consider “carried over the shoulder” and “with one hand” as two distinct interpretations even if we still have one sense of carrying and the verb passes this test, while in the contradiction test these to identities are not considered as distinct ones and the test fails? For example, a massive object can be carried both with a hand and over the shoulder (“She was carrying a map but she was not carrying.”). Is it required to have two distinct senses (like in “beat”) for the verb to pass the contradiction test?

The problem is that the answer to your last question is not predefined, but is supposed to emerge from using the tests. So for the identity test you have to ask: Would it be acceptable if someone says “John saw her carry sth., and so did Bill”, in a situation where John saw her carry sth. over the shoulder and Bill saw her carry sth. in one hand? I would say no (?), they should have both seen the same type of carrying. So the identity test passes. For the contradiction test the question is whether “She carried an egg, but did not carry it” feels like a contradiction. I would say it does. A hearer would probably not think about the different ways of carrying here to resolve the contradiction.

Predicate Logic Definitions

How exactly is n defined in predicate logic for n-ary predicates, i.e. does it include zero or not?

There is actually a contradiction in different accounts:

"In general, n-ary predicates may be introduced for any whole number *n* **larger than zero**." (Gamut, 1991, p. 67)

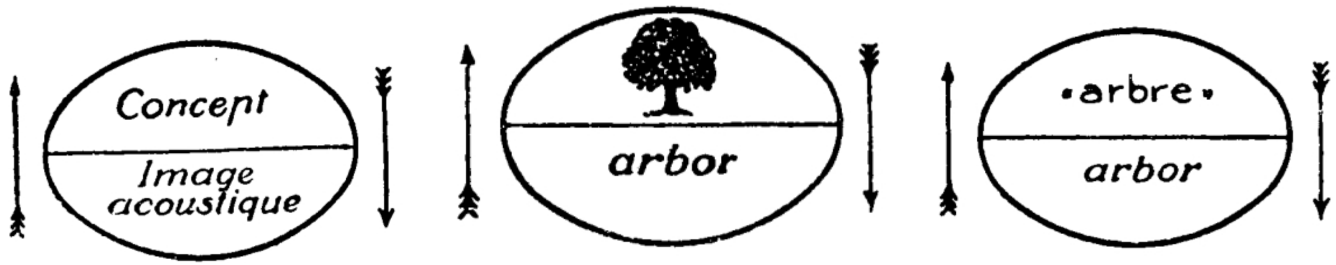
"For $n = 0$, PRED_n **contains the individual constants** of L; and if $n \geq 1$, the members of PRED_n are called n-place predicates." (Zimmermann & Sternefeld, p. 245).

I here follow Gamut (1991).

Semantics Introduction

The Roots

"Signifié et signifiant" at three levels:



Level 1: Abstract Relation
Level 2: Concrete Mapping (Denotation)
Level 3: Metalanguage (Translation)

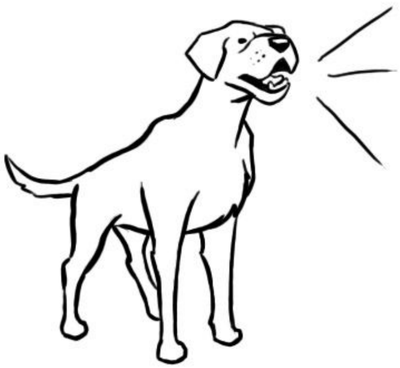
Saussure (1995). Cours de linguistique générale, p. 99.

Arbitrariness

"For most words, the relation between the form (i.e. phonetic shape) of the word and its meaning is **arbitrary**. This is not always the case. Onomatopoetic words are words whose forms are intended to be imitations of the sounds which they refer to."

Kroeger (2019). Analyzing meaning, p. 6.

Arbitrary:	Onomatopoetic:
dog (English)	bow-wow (English)
shun (Armenian)	haf-haf (Armenian)
cicing (Balinese)	kong-kong (Balinese)
gae (Korean)	mung-mung or wang-wang (Korean)
aso (Tagalog)	
etc.	etc.



However: Non-Arbitrariness (Iconicity)

Table 1. Some Iconic Associations Found in Ideophones across Languages [20,22]

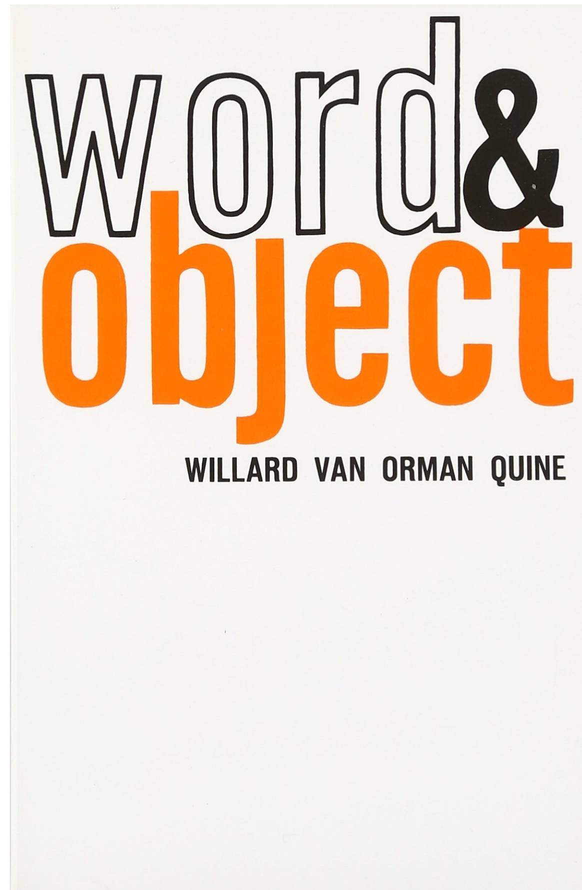
Form	Meaning	Examples
Reduplication	Repetition, distribution	*goro* : *gorogoro*, 'one : multiple heavy objects rolling' (Japanese) *wùrùfùù* : *wùrùfù-wùrùfù*, 'fluffy : fluffy here and there' (Siwu) *curuk-nu* : *curukcuruk-nu*, 'a sharp prick : many sharp pricks' (Tamil) *kpata* : *kpata kpata*, 'drop : scattered drops' (Ewe)
Vowel quality	Size, intensity	*katakata* : *kotokoto*, 'clattering : clattering (less noisy)' (Japanese) *pimbilii* : *pumbuluu*, 'small belly : enormous round belly' (Siwu) *giṇigiṇi* : *giṇugiṇu*, 'tinkling : bell ringing' (Tamil) *lɛgɛɛ* : *logoo*, 'slim : fat' (Ewe)
Vowel lengthening	Length, duration	*haQ* : *haaQ*, 'short : long breath' (Japanese) *piQ* : *piiQ*, 'tear short : long strip of cloth' (Japanese) *dzoro* : *dzoroo* 'long : very long' (Siwu)
Consonant voicing	Mass, weight	*koro* : *goro*, 'a light : heavy object rolling' (Japanese) *tsratsra* : *dzradzra*, 'a light : heavy person walking fast' (Siwu) *kputukpluu* : *gbudugbluu*, 'chunky : obese' (Ewe)

Dingemanse, Blasi, Lupyan, Christiansen, & Monaghan (2015). Arbitrariness, iconicity, and systematicity in language.

Meaning as Reference

"What is relevant rather to our purposes is *radical translation*, i.e., translation of the language of a hitherto untouched people [...] The utterances first and most surely translated in such a case are ones keyed to present events that are conspicuous to the linguist and his informant. A rabbit scurries by, the native says 'Gavagai', and the linguist notes down the sentence 'Rabbit' or 'Lo, a rabbit') as tentative translation, subject to testing in further cases."

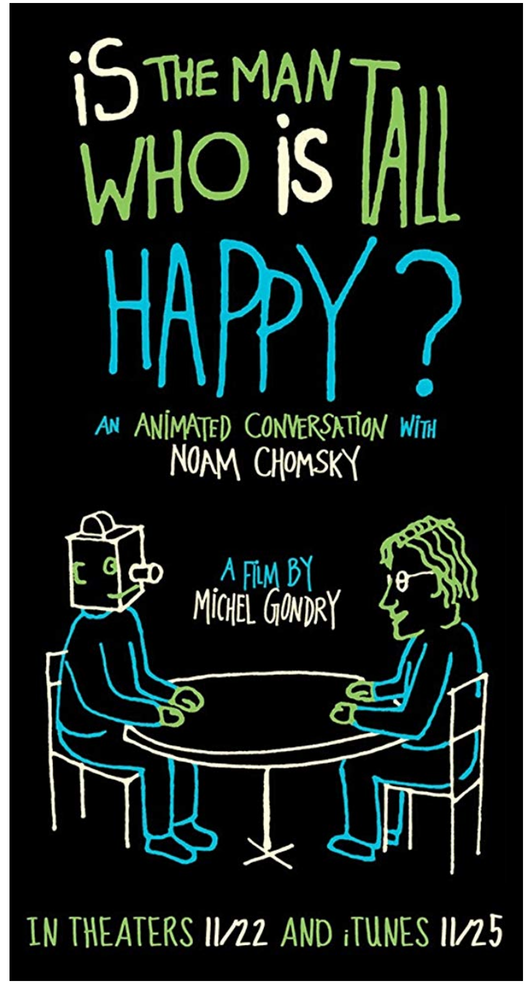
Quine (1960). Word and object, p. 28.



Against Reference: Words as Mental Representations

"It's just a classic error
that runs right through
philosophy and psychology
and linguistics
right up to the moment.
That's the idea that words...
say, meaning-bearing elements,
like, say, "tree" or "person"
or, you know, "John Smith"
or anything...
pick out something
in the extramental world,
something that a physicist
could identify
so that if I have a word...
say, "cow"...
it refers to something,
and a, you know, scientist
knowing nothing about my brain
could figure out
what counts as a cow.
That's just not true."

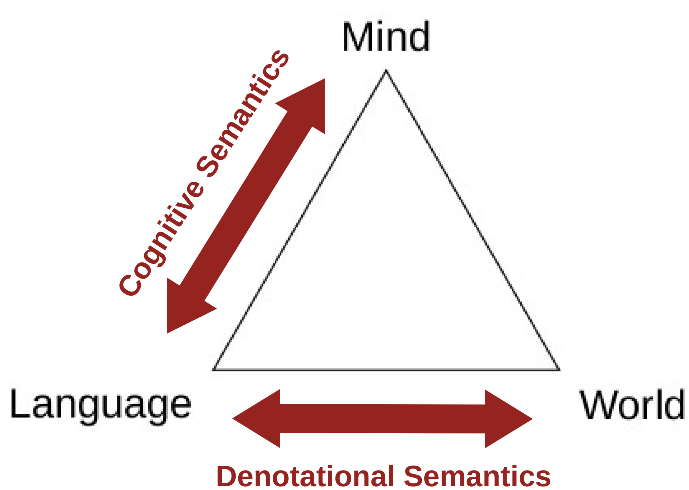
Noam Chomsky



Denotational vs. Cognitive Semantics

"The basic approach we adopt in this book focuses on the link between linguistic expressions and the world. This approach is often referred to as **denotational semantics** [...] An important alternative approach, **cognitive semantics**, focuses on the link between linguistic expressions and mental representations."

Kroeger (2019). Analyzing meaning, p. 17.



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Lexical Semantics (Word Meaning)

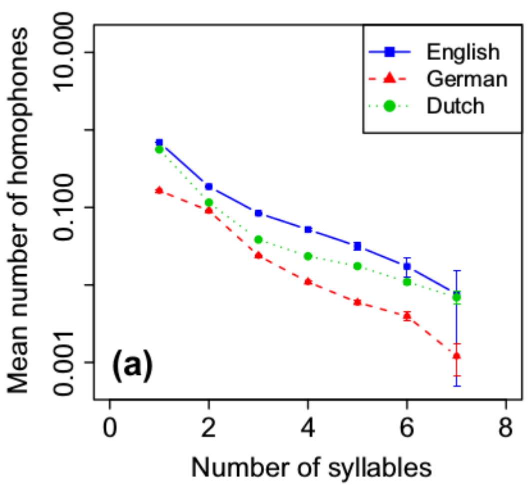
Variable Reference

Even if we assume that reference between forms and meanings is generally possible (i.e. denotational semantics), then there is still the problem of **variable reference**, i.e. *ambiguity*, *indeterminacy* and *vagueness*.

- Variable Reference
  - **Ambiguity**
    - Lexical Ambiguity
      - Polysemy
        - Systematic
        - Non-systematic
      - Homonymy
    - Structural Ambiguity
    - Referential Ambiguity
  - **Indeterminacy**
  - **Vagueness**

The Advantages of Ambiguity

"We present a general information-theoretic argument that **all efficient communication systems will be ambiguous**, assuming that context is informative about meaning. We also argue that ambiguity allows for greater ease of processing by permitting efficient linguistic units to be re-used. Our results and theoretical analysis suggest that ambiguity is a functional property of language that allows for greater communicative efficiency."



Piantadosi et al. (2012). The communicative function of ambiguity in language.

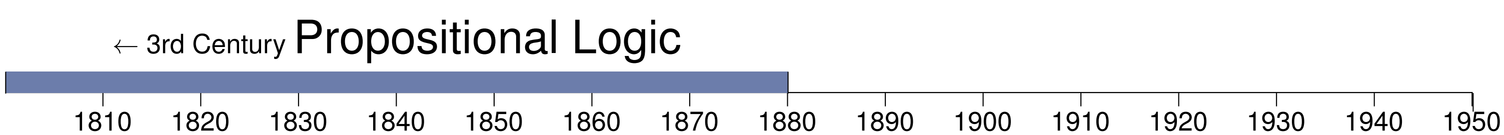
Propositional Logic

Historical Perspective

"In the Hellenistic period, and apparently independent of Aristotle's achievements, the logician Diodorus Cronus and his pupil Philo (see the entry Dialectical school) worked out the beginnings of a logic that took **propositions**, **rather than terms**,[1] as its basic elements. They influenced the second major theorist of logic in antiquity, the **Stoic Chrysippus (mid-3rd c.)**, whose main achievement is the **development of a propositional logic** [...]"

https://plato.stanford.edu/archives/spr2016/entries/logic-ancient/
(accessed 10/02/2021)

Q&As
Semantics Introduction
Lexical Semantics (Word Meaning)
Propositional Logic
Predicate Logic
Syntax & Semantics Interface
Summary
References



[1] A *term* here represents an object, a property, or an action like "Socrates" or "fall", which cannot by itself be true or false. A *proposition* is then a combination of terms which can be assigned a truth value, e.g. "Socrates falls".

Formal Definition: Extensions

"Let us denote the **extension** of an expression *A* by putting double brackets '$[\![\,]\!]$' around *A*, as is standard in semantics. The extension of an expression depends on the **situation *s*** talked about when uttering *A* ; so we add the index *s* to the closing bracket."

Zimmermann & Sternefeld (2013), p. 85.

$[\![\text{Paul}]\!]_s = \text{Paul McCartney}$[2]
$[\![\text{the biggest German city}]\!]_s = \text{Berlin}$
$[\![\text{table}]\!]_s = \{\text{table}_1, \text{table}_2, \text{table}_3, \ldots, \text{table}_n\}$[3]
$[\![\text{sleep}]\!]_s = \{\text{sleeper}_1, \text{sleeper}_2, \text{sleeper}_3, \ldots, \text{sleeper}_n\}$
$[\![\text{eat}]\!]_s = \{\langle\text{eater}_1, \text{eaten}_1\rangle, \langle\text{eater}_2, \text{eaten}_2\rangle, \ldots, \langle\text{eater}_n, \text{eaten}_n\rangle\}$

[2] Zimmermann & Sternefeld just put the full proper name in brackets here, Kroeger follows another convention and just put the first letter in lower case, e.g. $[\![\text{p}]\!]_s$.

[3] Kroeger (2019) uses upper case notation for both nouns and predicates, e.g. TABLE and SLEEP respectively.

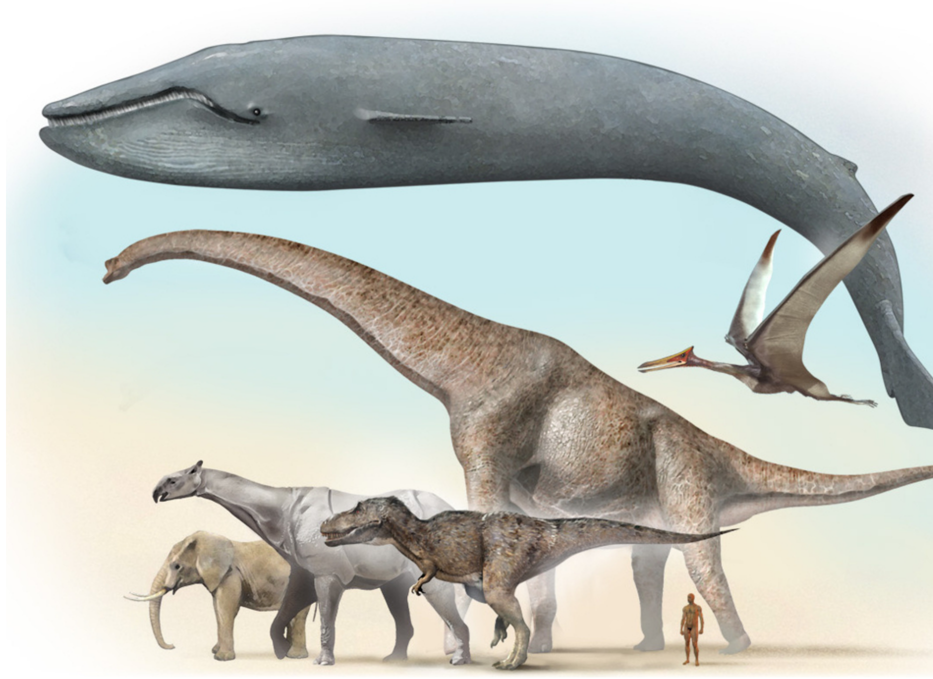
Formal Definition: Frege's Generalization

"The **extension of a sentence S** is its **truth value**, i.e., 1 if S is true and 0 if S is false."

Zimmermann & Sternefeld (2013), p. 74.

S_1: The African elephant is the biggest land mamal.
$[\![S_1]\!]_s = 1$, with s being 21st century planet earth.
$[\![S_1]\!]_s = 0$, with s being planet earth.

S_2: The African elephant is the biggest mamal.
$[\![S_2]\!]_s = 0$, with s being 21st century planet earth.
$[\![S_2]\!]_s = 0$, with s being planet earth.



Formal Definition: Proposition

"The **proposition expressed by a sentence** is the **set of possible cases [situations]** of which that sentence is true."
Zimmermann & Sternefeld (2013), p. 141.

Coin-flip example:

situation	flip1	flip2
1	heads	heads
2	tails	tails
3	heads	tails
4	tails	heads

Sentence	**Proposition**
S_1: only one flip landed heads up	$[\![S_1]\!] = \{3, 4\}$
S_2: all flips landed heads up	$[\![S_2]\!] = \{1\}$
S_3: flips landed at least once tails up	$[\![S_3]\!] = \{2, 3, 4\}$
etc.	etc.

Logical Word Inference

If inferences are drawn based purely on the **meaning of logical words** (operators), then the inference is generalizable to a potentially infinite number of premisses and conclusions. Note that we can replace the propositions by placeholders. Here, we are in the domain of **propositional logic**.

(1) Premise 1: ***Either*** *Joe is crazy* ***or*** *he is lying.*
Premise 2: *Joe is* ***not*** *crazy.*

Conclusion: ***Therefore***, *Joe is lying*.

(2) Premise 1: ***Either*** *x* ***or*** *y.*
Premise 2: ***not*** *x.*

Conclusion: ***Therefore***, *y*.

Propositional Operators

We will here use the following operators:

Operator	Alternative Symbols	Name	English Translation
$\neg$	$\sim$, !	negation	*not*
$\wedge$	., &	conjunction	*and*
$\vee$	+, $\|\|$	disjunction (inclusive *or*)	*or*
XOR	EOR, EXOR, $\oplus$, $\veebar$	exclusive *or*	*either ... or*
$\rightarrow$	$\Rightarrow$, $\supset$	material implication[4]	*if ..., then*
$\leftrightarrow$	$\Leftrightarrow$, $\equiv$	material equivalence[5]	*if, and only if ..., then*

Note: We will here assume that the English translations and the operators themselves are indeed equivalent in their meanings. However, in language usage, this might not actually be the case.

[4]aka *conditional*
[5]aka *biconditional*

Truth Tables

In a **truth table** we identify the extensions of (declarative) sentences as truth values. In the notation typically used, the variables *p* and *q* represent such **truth values of sentences**.[6] The left table below gives the notation according to Zimmermann & Sternefeld, the right table according to Kroeger. We will use the latter for simplicity.

$[\![S_1]\!]_s$	$[\![S_2]\!]_s$	$[\![S_1]\!]_s \wedge [\![S_2]\!]_s$
1	1	1
1	0	0
0	1	0
0	0	0

p	q	p∧q
T	T	T
T	F	F
F	T	F
F	F	F

[6]Kroeger (2019), p. 58 writes that *p* and *q* are variables that represent propositions. However, according to the definitions we have given above this is strictly speaking not correct.

Building Truth Tables for Complex Sentences

We will follow the following four steps to analyze the sentence below:

1. Identify the **logical words** and translate them into **logical operators**
2. **Decompose the sentence** into its component declarative parts and assign **variables** to them (i.e. p and q).
3. Translate the whole sentence into **propositional logic notation**
4. Start the truth table with the variables (i.e. p and q) **to the left**, and then add operators step by step (from the most embedded to the outer layers).

Example Sentence: *If the president is either crazy or he is lying, and it turns out he is lying, then he is not crazy.*

Beyond Propositional Logic

"The propositional logic outlined in this section is an important part of the logical metalanguage for semantic analysis, but it is not sufficient on its own because it is concerned only with **truth values** [of whole sentences]. We need a way to go beyond p and q, to represent the actual meanings of **the basic propositions** we are dealing with."

Kroeger (2019). Analyzing meaning, p. 66.

Example Sentences (Set 1):

p: John is hungry.
q: John is smart.
r: John is my brother.

Example Sentences (Set 2):

p: John snores.
q: Mary sees John.
r: Mary gives George a cake.

Note: Propositional logic assigns variables (p, q, r) to whole declarative sentences, and hence is "blind" to the fact that the first set of sentences shares both the same subject, and the copula construction, whereas the second set of sentences uses predicates of different valencies and different subjects and objects.

Beyond Propositional Logic

A second major limitation of propositional logic is that it cannot take into account **quantifications**, and hence cannot decide on the truth values of the classical syllogisms below.

(3) Premise 1: ***All*** *men are mortal.*
Premise 2: *Socrates is a man.*

Conclusion: *Therefore, Socrates is mortal*.

(4) Premise 1: *Arthur is a lawyer.*
Premise 2: *Arthur is honest.*

Conclusion: *Therefore,* ***some (= at least one)*** *lawyer is honest*.

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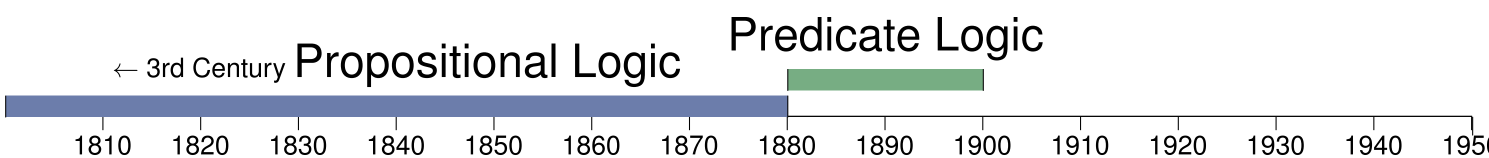
Predicate Logic

Historical Perspective

"The first formulation of **predicate logic** can be found in Frege (1879); a similar system was developed independently by Peirce (1885). Modern versions radically differ from these ancestors in notation but not in their expressive means."

Zimmermann & Sternefeld (2013), p. 244.



Logical Symbols

The following types of logical symbols are relevant for our analyses:

- **Logical operators (connectives)** equivalent to the ones defined in propositional logic: $\neg$, $\wedge$, $\vee$, $\rightarrow$, $\leftrightarrow$
- The **quantifier** symbols: $\forall$ (universal quantifier), $\exists$ (existential quantifier)
- An infinite set of variables: x, y, z, etc.[7]
- Parentheses '()'.[8]

[7] This set is called *Var* in Zimmermann & Sternefeld (2013), p. 244.

[8] Beware: In the propositional logic notation, we used parentheses '()' for disambiguating the reading of a propositional logic expression as in $(p \rightarrow q) \wedge q$. However, in the predicate logic notation, parentheses can also have a different function (see below).

Non-Logical Symbols: Predicates

Predicate symbols: these are typically given as upper case letters, and reflect relations between n elements, where $n \geq 1$, and $n \in \mathbb{N}$ (i.e. natural numbers). These are also called **n-ary** or **n-place predicate symbols**: $P(x)$, $P(x, y)$, $Q(x, y)$, etc.

Examples:	Predicate notation:
x snores	P(x)$\equiv$ SNORE(x)
x is honest	Q(x)$\equiv$ HONEST(x)
x sees y	R(x,y)$\equiv$ SEE(x,y)
x gives y z	S(x,y,z)$\equiv$ GIVE(x,y,z)

The single upper case letter notation is used by Zimmermann & Sternefeld (2013), the all capital notation is used by Kroeger (2019). Yet another notation involving primes (e.g. snore′was used earlier in the lecture following Müller (2019). In the following we will use the notation by Kroeger.

Scope Ambiguities

"When a quantifier combines with another quantifier, with negation, or with various other elements [...], it can give rise to **ambiguities of scope**."

Kroeger (2019). Analyzing meaning, p. 72.

(5) *Some man loves every woman.*

i. $\exists x(\text{MAN}(x) \land (\forall y(\text{WOMAN}(y) \rightarrow \text{LOVE}(x,y))))$
lit. "Fore some x it is the case that x is a man and (for all y it is the case that if y is a woman then x loves y)."

ii. $\forall y(\text{WOMAN}(y) \rightarrow (\exists x(\text{MAN}(x) \land \text{LOVE}(x,y))))$
lit. "For all y it is the case that if y is a woman then there is an x which is a man and loves y."

(6) *All that glitters is not gold.*

i. $\forall x(\text{GLITTER}(x) \rightarrow \neg\text{GOLD}(x))$
lit. "For all x it is the case that if x glitters then x is not gold."

ii. $\neg\forall x(\text{GLITTER}(x) \rightarrow \text{GOLD}(x))$
lit. "It is not the case for all x that if x glitters then x is gold."

Note: In the first case the ambiguity is between whether the existential quantifier scopes over the universal quantifier, or the other way around. In the second example the ambiguity is whether the negation scopes over the universal quantifier or the other way around.

Universal Instantiation

We can now translate the classical types of inferences (which are not covered by prepositopnal logic) into predicate logic notation. Below is a classic inference called **universal instantiation**. By using a variable x bound by the universal quantifier (Premise 1), and then specifiyng this variable as a constant symbol (Premise 2), we adhere to a valid pattern of inference.

(7)

Premise 1: ***All*** *men are mortal.*	$\forall x[\text{MAN}(x) \rightarrow \text{MORTAL}(x)]$
Premise 2: *Socrates is a man.*	MAN(s)
Conclusion: *Therefore, Socrates is mortal*.	MORTAL(s)

Existential Generalization

Another classic example is the so-called **existential generalization**. By asserting that two predicates are true for the same constant symbol (premise 1 and premise 2), we can generalize that there has to be a variable x for which both predicates hold.

(8) Premise 1: *Arthur is a lawyer.* LAWYER(a)
Premise 2: *Arthur is honest.* HONEST(a)

Conclusion: *Therefore, **some (= at least one)** lawyer is honest*.
∃x[LAWYER(x)∧HONEST(x)]

Example Model Evaluation

Based on our **example model**, consisting of the example domain and the example universal set, we can now evaluate the truth values of predicate logic expressions. One-place predicates are evaluated by whether the constant symbol is a member of the denotation set of the predicate. Logical operators are evaluated the same way as in propositional logic. Quantifiers are evaluated according to subset relations.

See Kroeger (2019). Analyzing meaning, p. 241.

English sentence	logical form	interpretation	truth value
a. *Thomas More is a man.*	MAN(t)	Thomas More $\in [\![MAN]\!]$	T
b. *Anne Boleyn is a man or a woman.*	MAN(a) $\vee$ WOMAN(a)	Anne Boleyn $\in ([\![MAN]\!] \cup [\![WOMAN]\!])$	T
c. *Henry VIII is a man who snores.*	MAN(h) $\wedge$ SNORE(h)	Henry VIII $\in ([\![MAN]\!] \cap [\![SNORE]\!])$	T
d. *All men snore.*	$\forall$x[MAN(x) $\longrightarrow$ SNORE(x)]	$[\![MAN]\!] \subseteq [\![SNORE]\!]$	F
e. *No women snore.*	$\neg\exists$x[WOMAN(x) $\wedge$ SNORE(x)]	$[\![WOMAN]\!] \cap [\![SNORE]\!] = \emptyset$	T

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Syntax & Semantics Interface

Valency in Semantics

"[...] one may detect an increasing complexity concerning the so-called **valency of verbs** [...] Corresponding to these types of predicates there are **three-place tuples (triples)**, **two-place tuples (pairs)** and **one-place tuples (individuals)**."

Parallelism between valency and type of extension:
The extension of an *n*-place verb is always a set of *n*-tuples.
Zimmermann & Sternefeld (2013). Introduction to semantics, p. 72.

Verb	**Valency**	**Extension**
sleep	monovalent	$[\![\text{SLEEP}]\!]_s = \{\text{sleeper}_1, \text{sleeper}_2, \ldots, \text{sleeper}_m\}$
see	bivalent	$[\![\text{SEE}]\!]_s = \{\langle \text{seer}_1, \text{seen}_1\rangle, \ldots, \langle \text{seer}_m, \text{seen}_m\rangle\}$
give	trivalent	$[\![\text{GIVE}]\!]_s =$ $\{\langle \text{giver}_1, \text{receiver}_1, \text{given}_1\rangle, \ldots, \langle \text{giver}_m, \text{receiver}_m, \text{given}_m\rangle\}$

Note: We use *m* instead of *n* here as an index, in order to not confuse it with the *n* representing the valency.

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Filling of Arguments/Gaps

As the arguments of an *n*-place verb are “filled in”, the extensions change according to how many *components*[9] are in the tuples.[10]

Zimmermann & Sternefeld (2013). Introduction to semantics, p. 72.

Verb or VP	Valency	Extension
_ shows _ _	3	set of all triples $\langle a, b, c\rangle$ where a shows b c
_ shows the president _	2	set of all pairs $\langle a, c\rangle$ where a shows the president c
_ shows the president the Vatican Palace	1	set of all individuals (1-tuples) $\langle a\rangle$ where a shows the president the Vatican Palace
The Pope shows the president the Vatican Palace	0	set of all 0-tuples $\langle\rangle$ where the Pope shows the president the Vatican Palace

[9]Zimmermann & Sternefeld (2013), p. 67 point out that we speak of *components* of tuples (ordered lists), but *elements* of sets.

[10]Note: the individuals (constant symbols) are here given as *a*, *b*, and *c*. In the Kroeger (2019) notation, we would use p_1, p_2, v (the first letter of the respective name).

The Truth is an Emtpy Set

We thus conclude that (18) has one of two possible extensions depending on whether or not it is true: if it is, we get $\{\emptyset\}$; if not, we have $\emptyset$. Our next step is to note that this not only works for the particular sentence under discussion. It works for all sentences the same way! That is, if a sentence is true, its extension is $\{\emptyset\}$, and this holds for all true sentences. This means that all true sentences have the same extension, namely $\{\emptyset\}$. Likewise, all false sentences have the same extension, namely the empty set $\emptyset$. These two sets are also called **truth values**. In logic and semantics, they are also represented by the letters "T" and "F" or by the numbers "1" and "0":[8]

(22) *Frege's Generalization* [9]
The extension of a sentence S is its truth value, i.e., 1 if S is true and 0 if S is false.

8 Incidentally, the identification of 0 and 1 with $\emptyset$ and $\{\emptyset\}$, respectively, is in line with the standard set-theoretic construction of the natural numbers, the *von Neumann ordinals*, named after the Hungarian mathematician John von Neumann [1903–57].

9 The generalization, and the very term *truth value* (*Wahrheitswert*)—though not the identification of truth values with numbers—go back to Frege (1892). The set-theoretic argument used in this section is from Carnap (1947).

Zimmermann & Sternefeld (2013), p. 74.

Semantic Types

"Linguistic expressions are classified into their **semantic types** according to the kind of denotation they have. The two most basic denotation types are **type e**, the type of **entities**, and **type t**, the type of **truth values**."

Kearns (2011). Semantics, p. 57.

Type of expression	Type of extension	Semantic type	Example
proper name	individual (entity)	**e**	$[\![\text{Paul}]\!]_s$=Paul McCartney
...	...	...	...
sentence	truth value	**t**	$[\![\text{Paul is happy}]\!]_s \in \{0, 1\}$

Functional Application

"[...] a function binds arguments together into a statement. From this insight, Frege proposed that all semantic composition is **functional application**. Functional application is just the combination of a function with an argument."

Kearns (2011), p. 58.

Formal Definition

"We can define the following **combinatorial rule** for [...] typed expressions:

If α is of type $\langle b, a \rangle$ and β of type b, then $\alpha(\beta)$ is of type a.

This type of combination is called **functional application**."

Müller (2019), p. 188.

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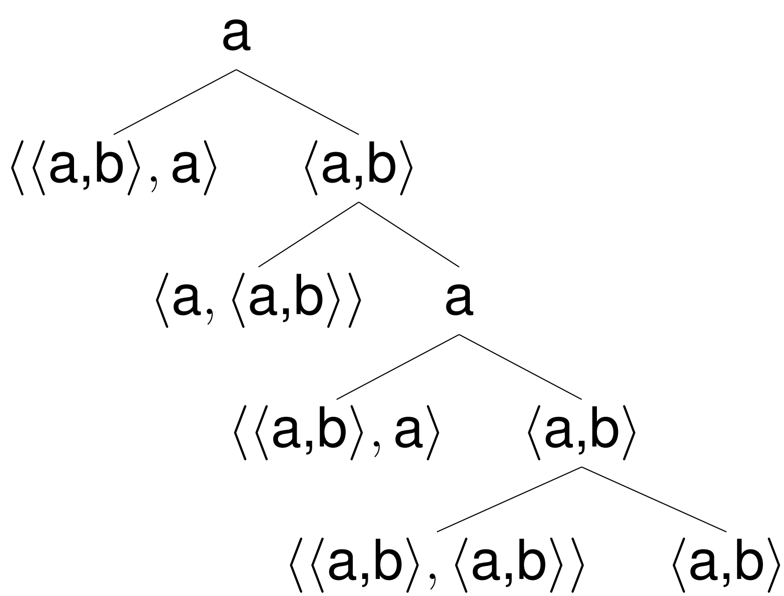
Example: Recursive Application

$$\alpha(\beta) = \text{a}$$

$$\alpha = \langle \text{b,a} \rangle \qquad \beta = \text{b}$$

Note: The **functional application** of the component *b* to the tuple $\langle b, a \rangle$ is a mapping from *b* to *a* (this is how mathematical functions are defined, see also Kroeger (2019), p. 235 on relations and functions). For illustration, this might be thought of as an inference: the tuple expresses *if b then a*. b expresses *b is the case*, hence we get *a*. Importantly, it is always the *left component* in a tuple that is the argument, and the *right component* is the outcome *value*.

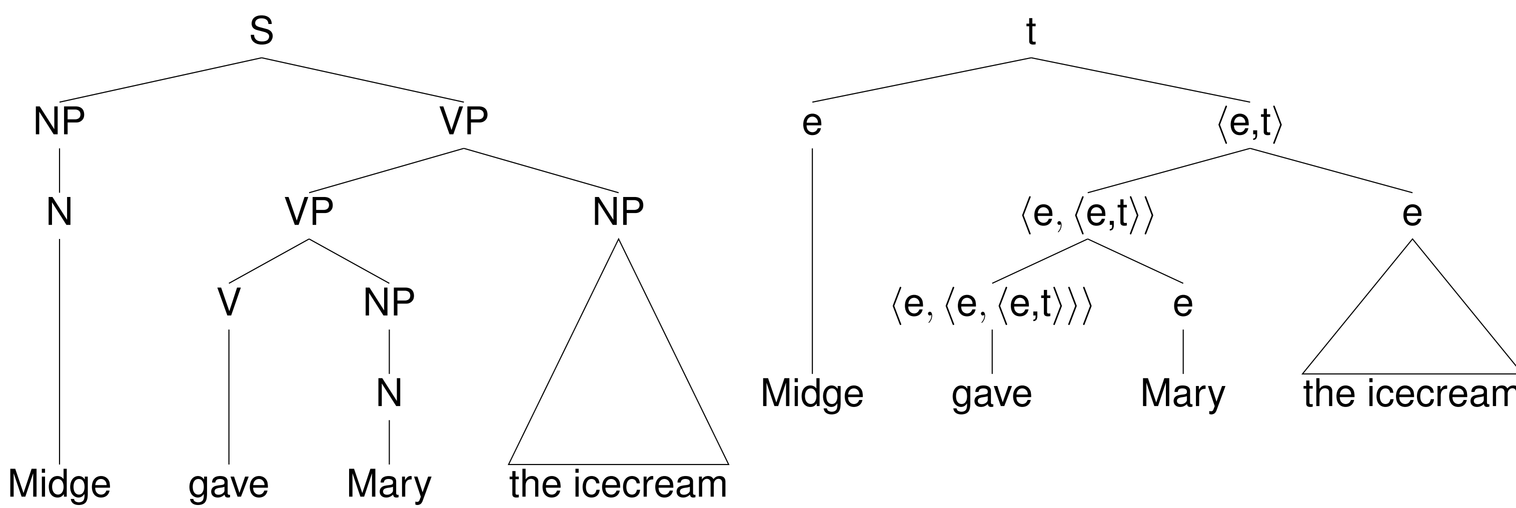
Example: Recursive Application



Note: Binarization does **not** mean that there are only a maximum of two components in each overall tuple. Instead there can be infinitely many 2-tuple embeddings. But each individual tuple can only have two components. Hence, we can built more complex semantic types out of the two basic types *e* and *t*.

Semantic Types: Three-Place Predicates

A **ditransitive verb** requires **three arguments** to be filled in order to form a full sentence, hence it is of the **type** $\langle \mathbf{e}, \langle \mathbf{e}, \langle \mathbf{e,t} \rangle\rangle\rangle$.



Summary: Semantic Types

Type of Expression	**Semantic Type**
Proper names	e
Sentences	t
Nouns	$\langle e,t \rangle$
Adjectives	$\langle e,t \rangle$
One-Place Predicates	$\langle e,t \rangle$
Two-Place Predicates	$\langle e, \langle e,t \rangle \rangle$
Three-Place Predicates	$\langle e, \langle e, \langle e,t \rangle \rangle \rangle$
Determiners	$\langle \langle e,t \rangle, e \rangle$
Adverbs	$\langle \langle e,t \rangle, \langle e,t \rangle \rangle$

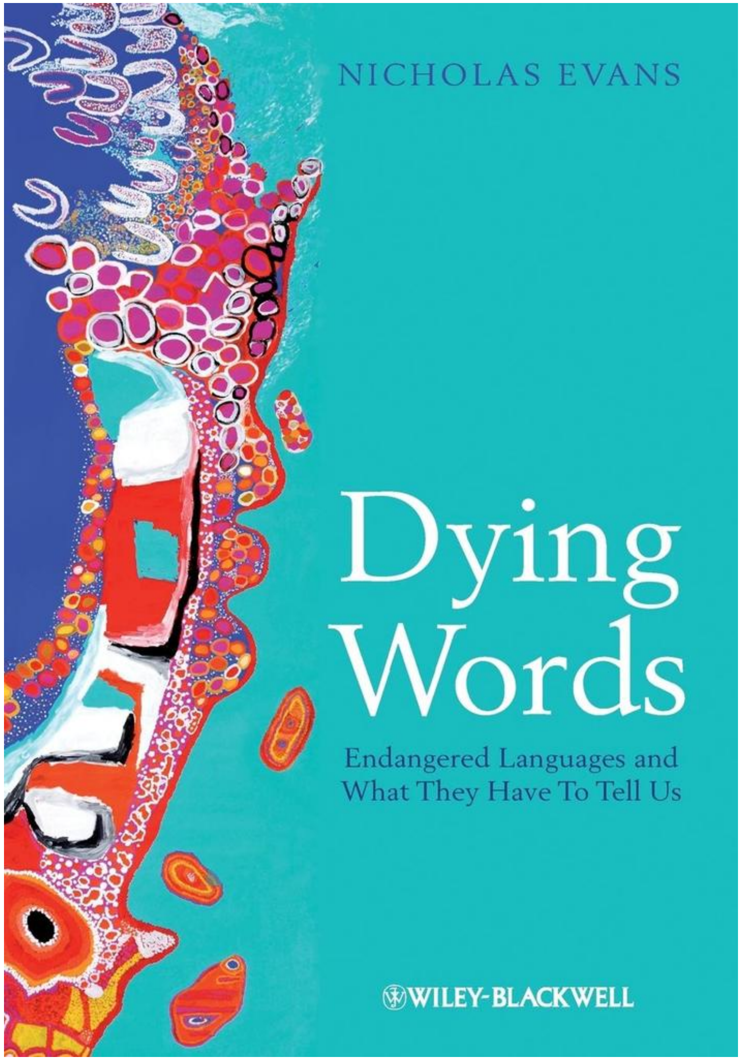
Summary

Summary

- The mapping between form and meaning is typically seen as **arbitrary**. However, recently, systematic examples of *non-arbitrariness* have been uncovered, e.g. *iconicity*.
- It is controversial whether meaning can be construed as reference, or rather as a purely mental phenomenon. This gives rise to the difference between **denotational** and **cognitive semantics**.
- The mapping from form to meaning is complicated by different types of **referential variability**, e.g. *ambiguity*, *indeterminacy*, *vagueness*.
- To provide a solid footing for the mapping from form to meaning, **formal semantic frameworks** have been proposed. One of the earliest is **propositional logic**.
- To overcome limitations of propositional logic (e.g. lack of quantification), **predicate logic** was introduced in the late 19th century.

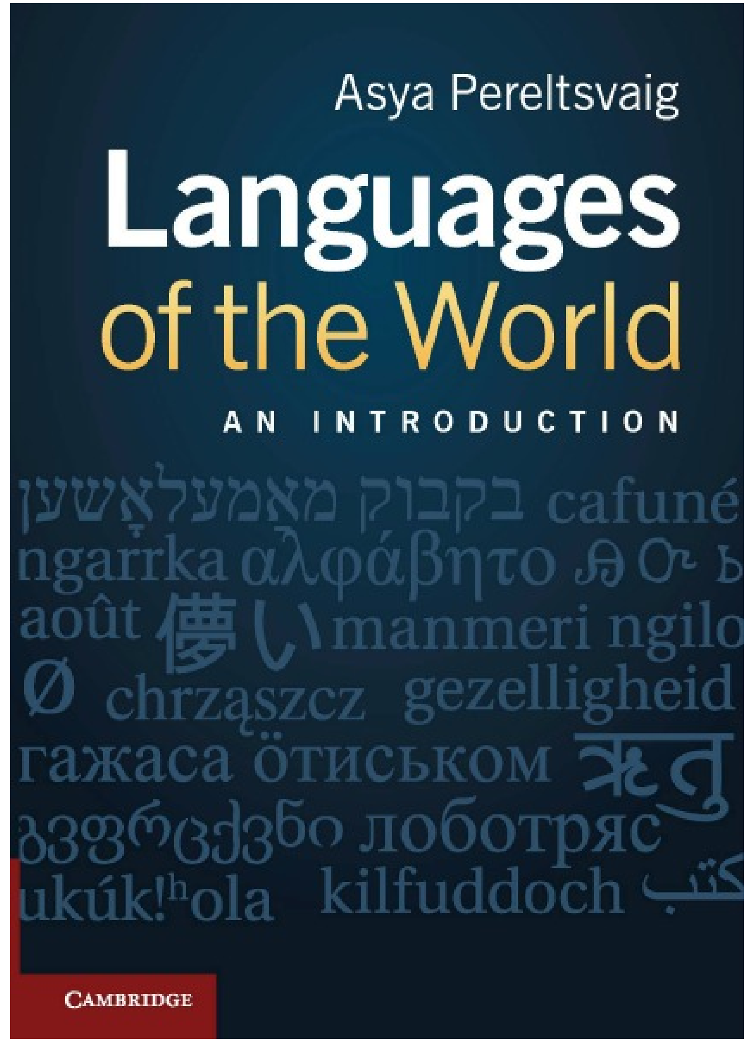
Good-Reads

Good-Reads
Language Diversity and Endangerement

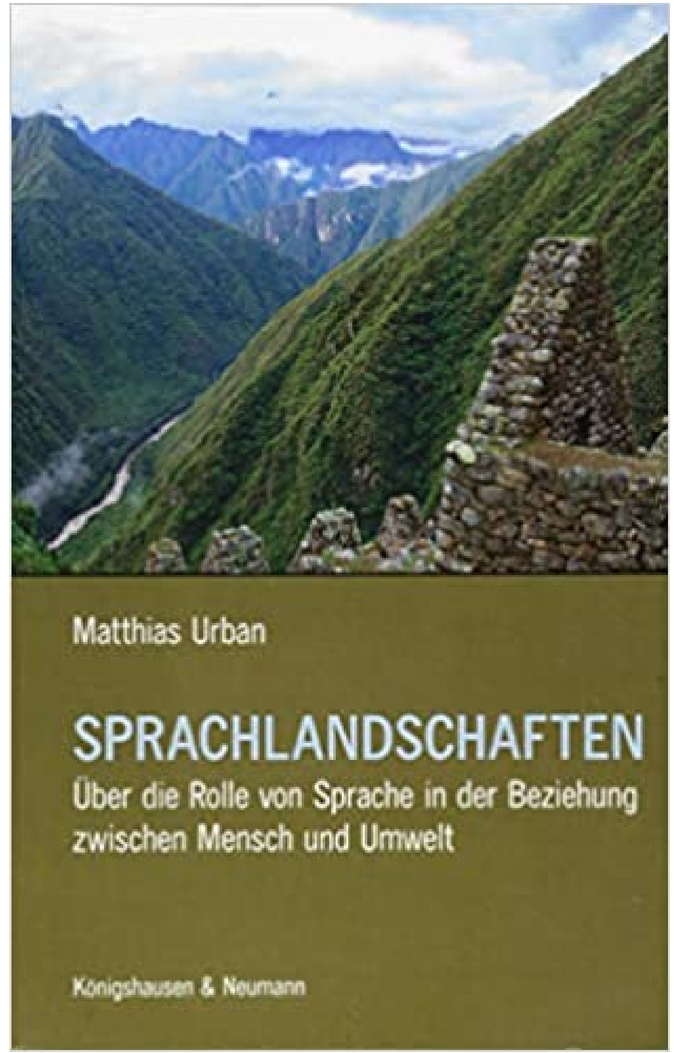


Good-Reads

Language Diversity and Typology

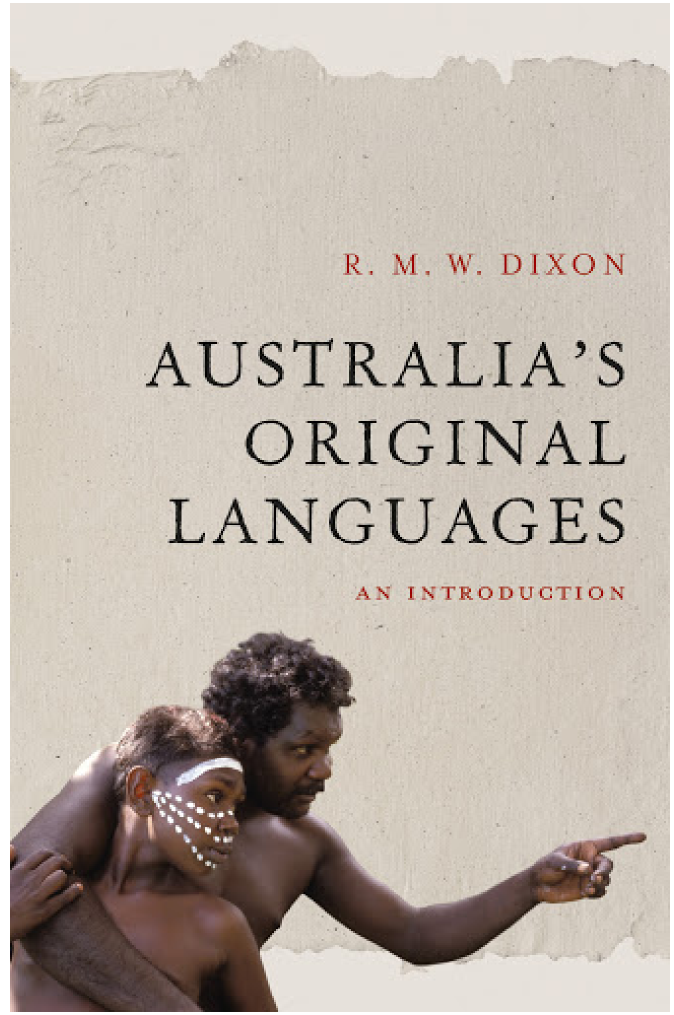


Good-Reads
Language and Environment



Good-Reads

Australian Languages and Language Politics



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Thank You.

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