Why is computationalism relevant to language acquisition?

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Computationalism in psychology: treating symbols as relating to the nature of representations, that is, to their encoding in the mind (see Bickhard 1996 for overview)

Computationalism in the rest of CogSci: computational aspects that make a problem easy or difficult.

Computer scientist's view of computation

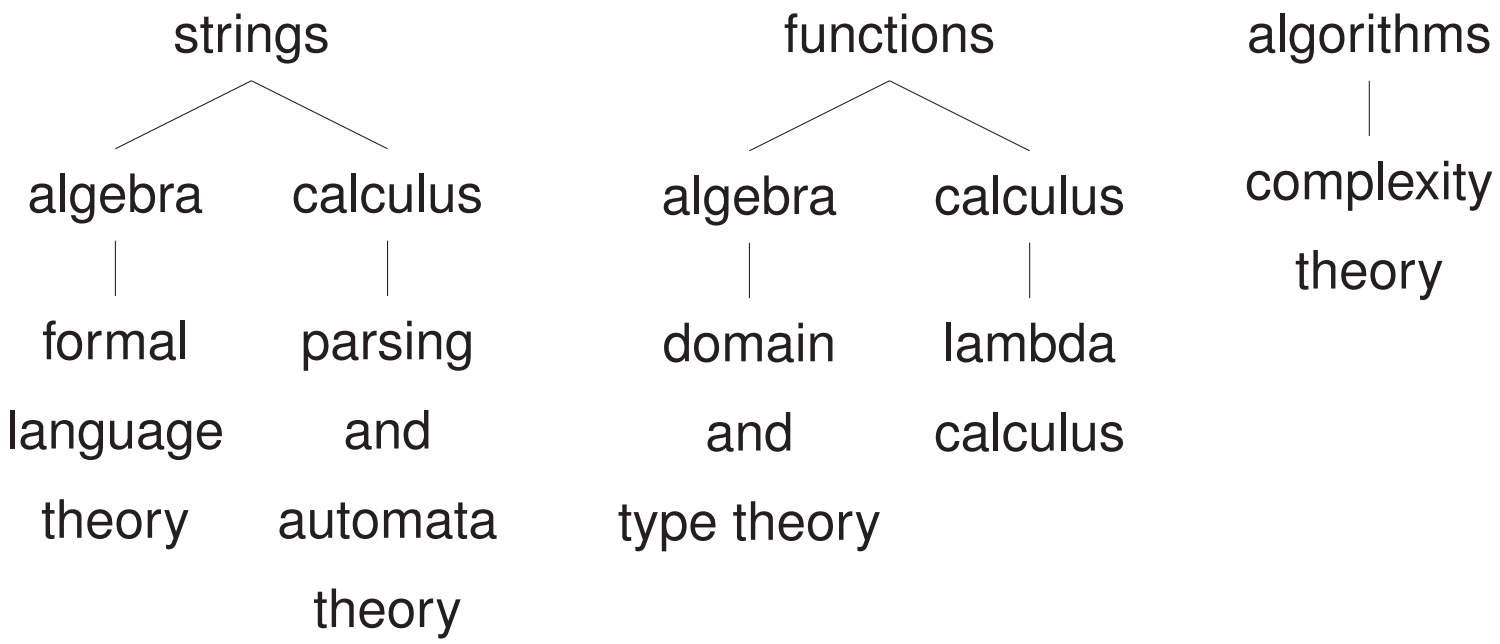
Formal language theory (theory of descriptions)

Automata theory (theory of computing with descriptions)

Complexity theory (theory of algorithms and their effective computability)

- Space and time complexity

Objects of computing



What makes a problem computationally easy or difficult?

Ambiguity

Non-determinism (not always the same thing as amb.)

Completeness and decidability

Memory kind, and its management

Frequency

Algorithms vs. heuristics

Radical lexicalization

First step towards getting a grip on computational properties.

Rationalists do it by the rules. (Shimon Edelman)

Empiricists do it **to** the rules.

(1)	S	$\rightarrow$	NP VP	Det	$\rightarrow$	every
	NP	$\rightarrow$	Name	N	$\rightarrow$	chemist
	NP	$\rightarrow$	Det N	Name	$\rightarrow$	Kafka
	VP	$\rightarrow$	V_{iv}	V_{iv}	$\rightarrow$	arrived
	VP	$\rightarrow$	V_{tv} NP	V_{tv}	$\rightarrow$	adored

NP=S$/$VP and **VP=S$\backslash$NP**. Hence **NP=S$/$(S$\backslash$NP)**

(2)

	$\mathbf{V_{tv}=VP/NP}$	$\mathbf{V_{iv}=VP}$	$\mathbf{NP=VP\backslash V_{tv}}$
	$\mathbf{NP=S/VP}$	$\mathbf{VP=S\backslash NP}$	Det=$\mathbf{NP/N}$
	Name=**NP**	$\mathbf{N=NP\backslash}$Det	
Hence	$\mathbf{V_{tv}=(S\backslash NP)/NP}$	$\mathbf{V_{iv}=S\backslash NP}$	
	$\mathbf{NP=(S\backslash NP)\backslash((S\backslash NP)/NP)}$		
	$\mathbf{NP=S/(S\backslash NP)}$		

(3)

	every	:=	Det = **NP**$/$**N** = **(S**$/$**(S**$\backslash$**NP))**$/$**N**
	chemist	:=	N = **NP**$\backslash$Det = **NP**$\backslash$**(NP**$/$**N)**
	Kafka	:=	Name = **NP** = **S**$/$**VP**=**S**$/$**(S**$\backslash$**NP)** and **(S**$\backslash$**NP)**$\backslash$**((S**$\backslash$**NP)**$/$**NP)**
	arrived	:=	**VP = S**$\backslash$**NP**
	adored	:=	**VP**$/$**NP = (S**$\backslash$**NP)**$/$**NP**

Cognitivism in CogSci: Qualitatively different problems

Computationalism in CogSci: Quantitatively different tasks
(i.e., *same* problem, with some task-specific knowledge)

Empiricist in heart, interactionist at work

Some examples

Nouns-first acquisition

Syntactic acquisition

Innate knowledge of morphemehood

Parameters versus statistics

Emergence of grammatical relations

Some Piagetian stages

Period of Sensorimotor activity

- Stage of reflexes
- Stage of primary circular reactions
- Stage of coordination of secondary circular reactions

Period of Operational thought

Period of Formal operations

Keren's first words (Dromi, 1987) Hebrew (Israel)

Age m(d)	Child's word	conven. form					
10(12)	haw	(?)	a dog's bark	12(16)	hita	(?)	going out for a walk
11(16)	?aba	(aba)	Father	12(18)	tiktak	(?)	sound of clock
11(17)	?imaima	(?)		12(19)	cifcif	(?)	bird's tweet
11(18)	ham	(?)	said while eating	12(20)	hupa	(?)	accom. making sudden contact w/ground
12(3)	mu	(?)	a cow's moo	12(23)	dio	(dio)	giddi up
12(3)	?ia	(?)	a donkey's bray	12(25)	hine	(hine)	here
12(8)	pil	(pil)	an elephant	12(25)	?ein	(?ein)	all gone
12(11)	buba	(buba)	a doll	12(25)	na?al	(na?al)	a shoe
12(13)	pipi	(pipi)	urine	12(25)	myau	(?)	a cat's meow

Tad's first words (Gentner, 1982) AmE

Age (m.)					
11	dog	16	eye	19	down
12	duck	18	cow		boo
13	daddy		bath		bottle
	yuk		hot		up
	mama		cup		hi
	teh (teddy bear)		truck		spoon
	car	19	kitty		bye
14	dipe (diaper)		pee pee		bowl
	toot toot (horn)		happy		uh oh
	owl		oops		towel
15	keys		juice		apple
	cheese		TV		teeth

Eat veggies

eat := **NP**:eat' *eat:=**S****NP**:$veggies'$ *eat:=**S****NP**:eat'

eat:= **S**/**NP**:eat' eat:= **S**:eat' eat:= **S**/**NP**:$veggies'$

veggies := **S****NP**:$veggies'$ eat:= **NP**:dog' *veggies := **S**/**NP**

Look, veggies! belief update on lexical categories.

Computational considerations

Ambiguity

Frequency

Algorithmic complexity (power set construction)

short strings first; contiguity assumption

Needed for completeness

More examples

Syntactic acquisition

Innate knowledge of morphemehood

Parameters versus statistics

Emergence of grammatical relations

There are computational alternatives to innateness

Conclusion

Computationalism cannot be confined to some naive representationalism.

We care about **what** representations stand for, not **how** they are represented.

Weak computationalism is essentially functional, because we are not in the business of constructing minds (yet),

only understanding how it works.

It is not behaviorist. We aim to understand **interaction** of internal processes and the external world, and task-specificity of knowledge

with as few auxiliary assumptions as possible.

*References

Bickhard, Mark H. 1996. "Troubles with computationalism." In W. O'Donohue and R. Kitchener, eds., *Philosophy of psychology*, 173–183. London: Sage.

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Gentner, Dedre. 1982. "Why nouns are learned before verbs: Linguistic Relativity versus Natural Partitioning." In Stan A. Kuczaj II, ed., *Language Development, vol.2: Language, Thought and Culture*, 301–334. Hillsdale, New Jersey: Lawrence Erlbaum.