

# 언어(특히 의미)와 인지과학

## Language (Meaning) and Cognitive Science

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### 요 약

언어 특히 의미에 대한 연구와 마음의 구조를 연구하는 인지과학이 어떻게 중요한 관계를 가지고 발전하는가를 살펴보기로 한다. 언어의 구조는 마음의 구조의 일부라고 본 촘스키의 입장에 동조하면서도 의미의 구조에 대해서 소극적인 입장에 서는 그의 입장에서 자유롭게 벗어나 발전하고 있는 의미에 대한 연구를 조명하고 전망하기로 한다. 언어의 의미는 내면적(internal)인 것인가 외부적(external)인 것인가 의미 내용(content)과 맥락(context)의 관계는 어떠한가, 왜 정보구조가 중요한가 등을 점검한다.

#### 1. 들어가며

##### 1.1. 인지과학의 성립 배경

###### 1.1.1. (1) Computer metaphor

machine thinking---Turing (1950) 'Computing Machinery and Intelligence', Artificial intelligence, Turing test  
 information processing revolution: thinking as a symbol-manipulating process (computer simulation)(Simon 1979)

###### (2) Brain metaphor

electric circuit, neural net  
 McClelland, J. L. and D. E. Rumelhart, PDP Research Group *Parallel Distributed Processing: Explorations of Microstructure of Cognition*, I and II, MIT Press, 1986.

(3) Study of **language** as part of the study of **mind**, attack on behaviorist psychology (Chomsky 1959), *Language and Mind* (Berkeley lectures): Formal properties of natural language (Chomsky 1955 *The Logical Structure of Linguistic Theory*, published in 1975, Chomsky 1963 'Formal Properties of Grammars' in Luce et al *Handbook of Mathematical Psychology II*)

###### 1.1.2. (고전적) 인지과학의 과제: 표상(representation)과 계산(computation)

1.1.2.1. 인간의 mind: 복잡한 정보 처리 기계[받이들이고, 저장하고, 검색하고, 변형시키고, 전수시킴]  
 형식적(formal) 정보 (처리) 과정 (pattern, pattern 조작)

예: 곱하기 문제  
 45 숫자(numeral) -- 수(number)

x 32

90

135

1440 숫자[기호]가 물리적 실체(세계  
 자리 일부를 가리킴(stands for))

1.1.2.2. 앨거리듬(algorithm): 일단의 유한한 수의 규칙 체계(의미보다 형식  
 기계적 절차)

표상

(1) 표상 속의 기호들은 그것이 나타내는 세계의 대상물과 잘 정의된 사상관계를 가져야  
 (2) 형식적 정보 과정은 그것이 표상하는 세계의 과정과 같은 방식으로 작용해야.

신호등 (꺼지고 켜지고)

```

- - - - 0
  - - - * 1
    - - * - 2
      - - * * 3
        - * - - 4
          :
            * * * * 15
    
```

신호등 2개:  $2^2=4$ 가지 신호  
 3개:  $2^3$   
 4개:  $2^4=16$ 가지 신호 (binary=꺼지고 켜지고 digit=자리수, - bit)  
 신호등 8개  $2^8=256$ 가지 신호(문자/숫자) - 8bit

1.1.3. 지향성(intentionality)

인지자는 어떤 심적(정신적) 상태에 있다.  
 비가 오는 것을 **알면** 세계에서 비가 오고 있는 것이 사실  
 비가 오는 것을 **믿으면** 세계에서 비가 오고 있는지 여부에 따라 참-거짓  
 비가 오기를 **바라면** 세계에서 실제로 비가 오게 되면 바람 성취  
 우산을 가지고 나가기로 **의도하면** 세계에서 실제로 가지고 나가야 의도가 실행됨  
 각 경우 관련된 심적 상태는 외부적 의미를 갖는다. 즉 그 심적 상태가 무엇에 관한(about) 것이냐에 따라 세계와 연결된다. 이러한 관해서성(aboutness)이 지향성.

1.1.4. 합리론적 표상 가설

17C Descartes부터: 사고는 정신 속의 표상 구조의 조종에 있다. 언어적이 아니더라도 '내면언어' (internal lg, 속말)의 문장들로 취급되며, 이는 (지향성에 의해) 세상과 연결된다  
 인지는 세계의 대상과 속성(관계)을 가리키는 것으로 이해될 수 있는 기호적 표상(symbolic representation)의 조종에 있다.

심리학적(Kosslyn) mental representation

memory pictorial - propositional

논리학적 Barwise, Perry, Devlin 기본 단위 정보소(infon), 상황 - 실재의 일부S|-> sigma

인지: 지각 -- 무한한, 연속적 analog적

인지 - 이산적 digital

계산(Computation): 표상 상태에서 표상 상태로의 규칙(=기호적 과정)에 의한 변화 [명시적 형식규칙]  
 input-output behavior (PLUS 2 3) 입력 출력 "5" (=함수의 값을 나타 내는 상태)

입력 -----음운/통사규칙- 출력

1.2. 연결론(Connectionism)

a set of processing units;

a state of activation defined over the processing units;

an output function for each unit that maps its state of activation into an output;

a pattern of connectivity among units

an activation rule for combining the inputs impinging on a unit with its current state to produce a new level of activation for the unit;

a learning rule whereby patterns of connectivity are modified by experience;

an environment within which the system must operate (Rumelhart 1989)

1.3. 마음은 기계인가?

Searle's Chinese room thought experiment "인지과학=인문학+연구비"

Roger Penrose (1989) *The Emperor's New Mind*, OUP: the most powerful attack yet written on strong AI (=electronic computers can do everything a human mind can do).

Mysteries? Categorical Perception, Binding Problem.

Genetic endowment? 복제 기술로?

2. 언어는 Mathematical or Psychological Structure? --- (B. Partee)

Mathematical (algebraic) --- R. Montague

every  $\alpha \Rightarrow \lambda P \forall x [\alpha' (x) \rightarrow P(x)]$  (P는 <e, t> type의 변항)

Mary  $\Rightarrow \lambda P [P(m)]$  [GQ] (<<e,t>, t> =set of properties)

Mary dances<sub>t</sub>  $\Rightarrow \lambda P [P(m)](\text{dance}' )$

$\Rightarrow \text{dance}' (m)$  (by  $\lambda$ -conversion)

(input to model-theoretic interpretation) {1, 0}

GQ theory --- monotonicity (of Determiners), lattice structure  
negative polarity items like 아무도, 'any'

Ladusaw - beauty of model-theoretic semantics

Barwise and Etchemendy 'both' --- *Foundations of Cog Sci* -Hoeksema, Partee  
(이정민 '일반 양화사 이론,' in 강범모 외 *형식의미론과 한국어의 기술*)

Monotone-decreasing and NPIs, nonveridicality (이정민, 남승호 논문들) NPI는  
자연언어에만(not in formal lg)

**Psychological** --- Generative Grammar (Chomsky, Partee; Jackendoff-Katz&Fodor ---Semantic  
representation or "logical/conceptual" structure)

## 2 1. Externalism vs. Internalism

*New Essays on Semantic Externalism and Self-Knowledge*, MIT Press (Bradford Book) Anne Reboul  
(2003), Institute for Cognitive Sciences, CNRS, Lyon, France

*Semantics*, Davis and Gillon (eds) (2004), OUP. I-1g, I-Semantics (study of internalized semantic  
ability)

Putnam (1975): meanings are at least in part determined by states of affairs in the world and thus  
are not purely mental and private. A subject can not have a privileged access to his/her own  
thought, which contradicts a central tenet in philosophy of mind? ---Semantic externalism

This question has repercussion in linguistics, notably in Gricean type pragmatics, particularly  
Relevance Theory, where meaning is defined in psychological terms. The discussion is thus of quite  
real importance for all linguists who adopt a mentalistic view of language use and meaning.

## 2.2. Intentionality mental - standing for things and events in the world

*The Ontology of Mind* the ontology of 'facts' ---H. Steward (1987)

**Psychological** reality of event structure --- experiments

## 3. Compositionality --- (*Hnbk of Logic and Lg* vol p.239)

"**compositionality**" (Frege) 'p and q' cf. ( 'p or q' ); 'Mary kissed Sam'

The meaning of an expression is determined by the meanings of its parts and the way of combining them  
Fodor -- Pustejovsky controversy over **decomposition** (LI, vols and Fodor and Lepore' s (2002) *the  
compositionality papers*, OxfordUP.)

(1) ?Mary began the rock (Pustejovsky 1995 *The Generative Lexicon*, MIT Press;  
qualia structure --- artifacts)

(2) God began the rocks, having finished the oceans (Fodor)

Partee --- against Montague' s strong version of compositionality: meanings can be anything  
you like, as long as they form an algebra homomorphic to the syntactic algebra,  
Context-dependence, ambiguity

(3) The horse is widespread (generic)

(4) The horse is in the barn (non-generic)

(5) The horse is growing stronger (ambiguous) --- against bottom-up compositionality "meaning  
determined by other parts" local ambiguity

(6) 아무/누구-라-도 그 문제를 풀 수 있어 (자유선택)

(7) 아무/누구-라-도/누가 그 문제를 풀 수 있다면 유미도/유미가 풀 수 있겠지 (중의적 ambiguous;  
자유선택과 약 부정극어)

(8) #아무-라-도 그 답을 맞췄어

(9) 아무-라-도그 답을 맞췄다면 유미가 그랬겠지(약 부정극어)

Chomsky --- skeptical (the 'autonomy of syntax' thesis); independent levels

## 4. Non-monotonic reasoning 총칭성(genericity) '새는 난다'

Generic ---Gn x [Bird (x)] [Fly (x)] legitimate exceptions human

Cf.  $\forall x [Bird (x) \rightarrow [Fly (x)]$  (Bird  $\subseteq$  Fly) no exceptions

Application to AI --- not successful, two decades' investment

## 5 Semantics and Cog Sci

### 5 1 Situation Semantics (*Situations and Attitudes* by J Barwise and J. Perry)

Partial function, partial world --- context with sits, Austin' s pragmatics

Definite descriptions attributive/referential (Donnellan)

(6) 'The man who is drinking martini stands over there.'

Perception predicate 'see'

Conditional / Cooper etc

Keith Devlin's *Logic and Information* infon --- a primitive

Perception - analog and cognition - digital

Cognitive agent-온도조절기(thermostat)

but not 한란계(thermometer/mercury)

R. Breheny: indefinites and anaphora uses sit theory infon pdf in binding

Contribution to information channel theory

5.2 Hans Kamp's Discourse Representation Theory: incremental across Ss

5.3 Johnson-Laird: mental representation, mental model (logical --- "1<sup>st</sup>-order logic")

Atlas and Levinson *Radical Pragmatics* p. 8 logical form

Typically we think of a logical form as a formula in first-order quantificational theory

first-order logic --- individual variables only

5.4 Information Structure Theory:

Topic and Focus: Kuroda -categorical vs.thetic judgment 자동화?

Contrastive Topic & Contrastive Focus--- C. Lee -implicature part, predicates, Steedman,

contrast; Buring 'set of sets of propositions involved in CT' (See

<http://plaza.snu.ac.kr/~clee>)

Sentential negation Horn 470 external neg Atlas and L p.2

Constituent negation --- information str-sensitive

Questions --- Gronondijk and Stokof Properties, Types --- p. 21 type-shifting

flexibility; Partitions- Extensional (intensional objects -) in conclusion

5.5 Multi-propositional theory S. Neele, D. Kaplan, K. Bach

"Conventional Implicatures" ---propositions.

5.6 Geometry?

Fenstad --- why Grammar needs Geometry, 'Situations and PPs'

perceptual spaces and mental models subsumed under conceptual spaces (by P. Gardenfors 1991,

1996) -metric or topological str --- transcend the formula *mind* = *database* the property RED

relative to the color circle has a definite geometric str -- a convex subsets of suitable conceptual

spaces Gardenfors (1991) identifies *natural properties* with convex subsets of suitable conceptual

spaces---application to Prototypes (Loebner Understanding Semantics) an alternative to the

standard logical approach based on lists of necessary and sufficient conditions. Rosch 1978

Geometry vs. Algebra ---Descartes: 기하학의 연산에 대수학의 연산을 1대 1로 대응시킴.

*Hnbk of Logic and Lg* p. 649 partiality -sit theory-see---geometry of models

Diagrammatic reasoning: Sun-Joo Shin

Kosslyn [1980, 1994] and other pictorialists [Shepard & Metzler 1971] present experimental data to support their position that some of our mental images are more like pictures than a linear form of language (for example, natural languages or artificial symbolic languages) in some important aspects, even though not all visual mental images and pictures are of exactly the same kind. By contrast, Pylyshyn [1981] and other descriptionalists [Dennett 1981] raise questions about the picture-like status of mental images and argue that mental images are formed out of structured descriptions. To them, mental images represent in the manner of language rather than pictures and, hence, there are no picture-like visual mental images.

5.7 Combination needed?

GQ Theory and the Sem of Focus by Sjaark de Mey in

J. Gutierrez-Rexach (ed) (2003) *Semantics: Critical Concepts*

Logical structure: "p and q"와 "p but q" -- identical truth conditions

PA(*aber*), SN(*sonern*) conjunctions *but*, *mais* '-지만' 대 '아니라'

Information Structure and Argumentation Structure (rather inferential) combined

'aval' Ss involving non-attributive uses of definite descriptions of the type described by

Donnellan (1966):

(10) A: The man who is drinking martini stole the car

B: Yes, but he is not drinking martini.

\*C. Yes, but he did not steal the car. P. 167 M. Dascal and T. Katriel

'Between Semantics and Pragmatics: Two Types of 'BUT' ---Hebrew 'aval' and 'ela'

- (11) 황홀하지는 않아/않지만 행복해 (척도성-scalarity)
- (12) 행복한 게 아니라 황홀해 (SN -metalinguistic negation)

Appendix: Even Str --- Psych experiments

Barbara Tversky (Stanford)  
Segmentation of *even*' paths

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**Abstract**

Humans perceptually segment events, but models that predict where events will be segmented are limited. Developing a detailed model may be hard because of the overlapping quality of events (i.e., one can smile and walk at the same time, but the endpoint of each event can be different). However, some aspects of events appear to be universally represented in the world's languages. For example, path, the trajectory of an object's movement, is one of the most universally encoded event features. Although it is generally encoded in the prepositions of English (e.g., up), in other languages it is encoded in the verbs (e.g., descendere). Linguistic universals may represent basic levels of event perception. Here we consider how one of these, path, might be parsed. Because the spatiotemporal projection of paths to an observation point is similar to the spatial projection of objects, we tested the hypothesis that path segmentation and object segmentation would be based on similar image properties, such as discontinuities in orientation.