Negation:
A case study in neurolinguistic development

“If we are by definition the animals that talk, we are ipso facto the animals that deny, for as Spinoza and Hegel argue, any linguistic determination directly or indirectly involves a negation.”
L. R. Horn
A Natural History of Negation
p. xiii

Overview
• Introduction
  – What is negation?
  – Why should we care about negation?
• 4 stages in the development of pre-propositional negation in humans and other animals
• What happens to humans at stage 5?
  – The role of the human prefrontal cortex
• Conclusion: Implications for language development & evolution

What is negation?
• It has been independently proposed many times (i.e. Plato [Sophist, §257B]; Spencer Brown, 1969; Bateson, 1973; Wilden, 1980) that negation is best defined not as enation (contrary) but as heteron (other)
  – That is: negation is a positive assertion of the existence of a relevant difference.

Symbols as rules for negation
[‘This is not the territory.’]

This is X

This is not(X)

This dividing line is how we discern the difference between X and NOT-X

Where is the negator?
• Hoffmeyer (1993) claimed that the boundary of negation “exists nowhere but in the mind of the one who has pictured it, the observer...Or, to put it another way: the boundary is not a part of the world unless ‘someone’ chooses to picture it”.

Symbols as rules for negation
[‘This is not the territory.’]
Why should we care about negation?

- Negation allows us to see a relation between:
  - ‘dimensioning’ of the world which increases/ allows behavioral flexibility
  - symbolic reference = reference without relations by resemblance [iconic reference] or contiguity [indexical reference]
- This makes it an ideal candidate for a 'case study' aimed at characterizing the development, evolution, and neurological substrate of abstract symbolic reference.

Negation as a case study for lexical reference

- Lexicalized negation is a form of early language use that:
  1.) Is well-defined;
  2.) Is extremely common;
  3.) Is continuous with behavioral analogies in both pre-linguistic humans and non-human animals
  4.) Is abstract
  5.) Admits of definable degrees of abstraction appearing in a well-specified order
  6.) Many have argued underlies symbolic reference

The roots of negation

- The 5 forms of negation appear in a temporal sequence of increasing complexity defined by selection from set of options that are increasingly:
  1.) Present versus temporally and/or spatially displaced (but concrete = perceptually salient)
  2.) Concrete versus abstract (non-perceptually salient)
  3.) Externally-driven versus Internally-driven

Stage 1: Rejection negation

- Negation as rejection/ emphasis of rejection of a salient and present external entity.
  - In 3D: Present; concrete; external
  - Example: ‘No’ as spinach is pushed away
  - 10-14 months
- Ubiquitous as an affective-volitional function among all living things
- Rejection negation is a degenerate case of ‘choice’
  - The only ‘choice’ here is a binary ‘choice’ to reject what is not wanted
  - ‘Doing nothing’ is equivalent to accepting the status quo, not an active alteration of circumstances

Stage 2: Refusal negation

- Negation as a refusal to stop or start ones own current behavior.
  - In 3D: Present; ~concrete; external
  - Example: ‘No’ when asked to sit up straight
  - Three requirements:
    1.) An ability to associate a command with a behavior or cessation of a behavior.
    2.) Means by which that command is issued in a regular manner.
    3.) Another entity to regularly recognize and enforce codes of behavior
   So social ‘scaffolding’ is required
### Stage 2: Refusal negation
- Language is not necessary for refusal negation
- Chimpanzee infants “are often restive when their mothers seize them in order to groom. They struggle to escape, or make vigorous attempts to change the nature of the activity from grooming to play” (Goodall, 1986, p. 391).
- This is a clear case of rejecting a ‘command’ (expressed, in this case, behaviorally by the mother) to ‘sit still’ or ‘let yourself be groomed’, in order to undertake an action that is more desirable.
- Adult chimpanzees also reject the actions of another using other forms of behavioral imperative: ignore a request to groom or have sex by presenting their rump, back, or bowed head.

### Stage 3: Imperative negation
- Negation as a command to stop another’s current behavior.
  - In 3D: Present; –concrete; –internal
  - Example: ‘No’ to reject kiss
  - 1:3 years of age
  - Continuous with but more cognitively complex than Stages 1 and 2, because the degeneracy is not so clear: the alternatives are more complex due to
    i.) the absence of ‘nothing’ as a choice and
    ii.) the complex consequences of rejecting animate agents

### Stage 4: Failure negation
- Negation of a self-generated or planned action.
  - In 3D: Displaced; –concrete; internal
  - Example: ‘No’ in response to dropping bead during stringing game
  - ~1.5 years
- Failure negation is the earliest form:
  i.) Elicited without concrete, present external coercion (= not forced choice)
  ii.) That allows its user to reject an entity that he has himself generated- and therefore
  iii.) That can (often must) operate on a non-existent entity.

### Stage 4: Failure negation
- Many researchers have documented early uses of negation as self-prohibition, uttered by the child when he or she is about to do something or is doing something that is prohibited.
  - The use of negation in this manner is typically of brief duration (Pea, 1980b, p. 181)
  - This is interesting as a sign of language as a system for self-control

### Stage 4: Failure negation
- Language is not necessary for this kind of self-control
- De Waal (1982) gives an example of a behavioral analogue of failure negation.
- He observed a chimpanzee who, upon being challenged by another, “bared his teeth [a display of fear] but immediately put his hand to his mouth and pressed his lips together...the nervous grin appeared on his face again, and once more he used his fingers to press his lips together. The third time [the chimpanzee] finally succeeded in wiping the grin off his face; only then did he turn around” (p. 133).

### Stage 5: Scalar negation
- Negation as rejection of an absent entity
  - In 3D: Displaced; –concrete; internal
  - Example: Saying “No car” in absence of any car
  - Appears in the two-word stage: 1:6 - 2:0 years
- The first form of negation that must necessarily be detached: i.e. used against an absent entity
- It is therefore the first form that requires a stated predicate
- It therefore requires a separate negator symbol + a symbol for the negated object
- Without predication, there can be no scalar negation- and there is none in non-human animals
Stage 5: Scalar negation

- Negation as rejection of an absent entity
  - In 3D: Displaced; ¬concrete; internal
  - Example: Saying “No car” in absence of any car
- Scalar negation is dependent upon an ability to make internally-controlled shifts of behavioral significance
- This behavior is primarily reliant on two closely interconnected cortical regions, the dorsolateral and orbital prefrontal cortex

Stage 5: Scalar negation

- Negation as rejection of an absent entity
  - In 3D: Displaced; ¬concrete; internal
  - Example: Saying “No car” in absence of any car
- The linguistic use of negation for scalar predication can only be properly used as an expression of a departure from an expected state of affairs: the value expressed thereby is or could be unexpected.
- To negate a proposition to imply that some (imagined or real) interlocutor (perhaps oneself) believes, or might reasonably be expected to believe, the non-negated proposition

Stage 5: Scalar negation

- What is new is neither the semantics involved in expressions of a lack of fulfillment (failure negation), nor the syntax (rejection negation)
- It is the particular combination—the specific use of negation to express a lack of fulfillment.

Stage 5: Scalar negation

- Such a combination allows the use of expressions of scalar negation to accomplish a radical linguistic effect: the ‘neutering’ of the affective valence of the negation operator.
- When the infant uses ‘no’ to reject or comment upon a non-existent state of affairs, the negation operator that had been reserved only for active rejection of undesirable entities becomes available for use in expressions of positive desire and neutral comments
- The word is liberated from affective valence

Stage 5: Scalar negation

- Displaced reference is seen in human beings who have been reared in isolation from any conventional language model, though it appears much later
- Morford & Goldin-Meadow (1997) present evidence that displaced reference first makes its appearance at about 2;7 in deaf children who are reared without being exposed to formal sign language.
- This finding suggests that the development of displaced reference is independent of formal language training, and may reflect neurological maturation.

Words as clay

- “Since Words are only names for Things, it would be more convenient for all Men to carry about them, such Things as were necessary to express the particular business they are to discourse on.” (Gulliver’s Travels: Swift, 1735).
- The cognitive clay that we use to construct dimensions is negation as heteron: the ability to formulate and follow rules about how to make either/or distinctions.
Developmental immaturity at birth

Bi-manual manipulation

Tool development

Childcare practices

Selection for Pre-frontal cortex

Spoken language

Predication

Dangerous environment

Not X X