On *In* and *On*

CAMILLE LEWANDOWSKI

UNIVERSITY OF UTAH

Semantics of *In* and *On*

How can one define prepositions like *in* and *on*?

These can be used for a variety of spatial, temporal, and idiosyncratic/idiomatic uses.

- *in the bowl, in the field, in the air* — **Spatial**
- *On the table, on the field, on earth*

- *in two hours, in December* — **Temporal**
- *on Monday*

- *in essence, in theory* — **Other**
- *on topic, on accident*

A Central Definition

This research deals with defining a central meaning of *in* and *on*.

Is there one main idea that can encompass each of these different uses?

Proposal: Spatial Central Definitions

In: Containment.

- This could be something along the lines of Herskovits (1986)
  - *in*: inclusion of a geometric construct in a one-, two-, or three- dimensional geometric construct.

On: contiguity

- Essentially, two objects *in contact*. Alternatively, the notion of *connectedness* (Coventry & Garrod 2004)

Some definitions:	Figure—the oriented object Ground—what the object is oriented to Example: *the apple in the bowl* (apple = Figure, bowl = Ground)

Is Spatial Enough?

Some contexts are problematic for spatial definitions alone:

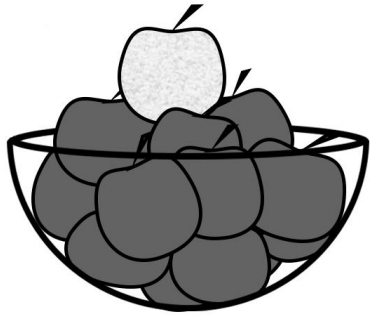


Figure 1: The apple is in the bowl.
The apple is in the bowl, but it is not spatially contained by the bowl.

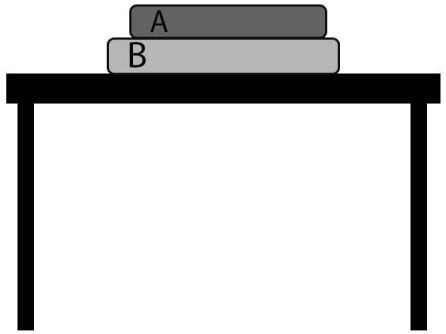


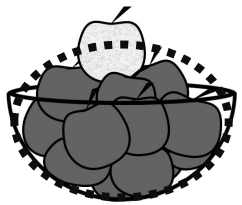
Figure 2: Book A is on the table.
Book A is on the table, but it is not in contact with the table.

In: Previous Spatial Accounts

A geometric (spatial) account: Herskovits (1986)

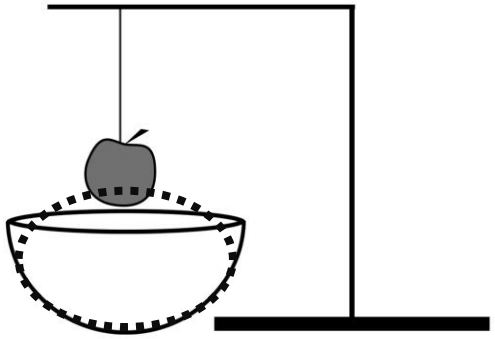
- inclusion

Apple in bowl by *tolerance*.



Problems:

Tolerance does not apply when the bowl is not filled. How can this be defined?

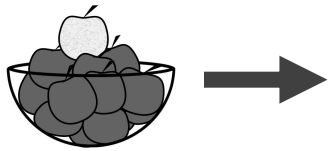


In: Force-Dynamic Accounts

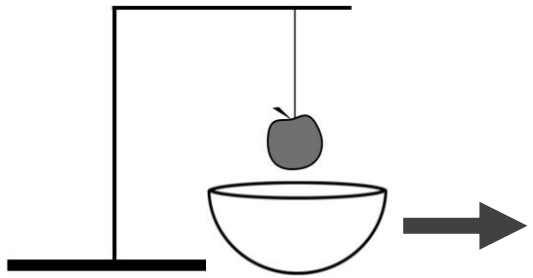
Alternatives to spatial accounts consider the forces between objects.

Gardenfors (2014): Defines *in* in the force domain.

- Containment defined by relation of forces.
- "If the Ground moves the Figure moves."



containment



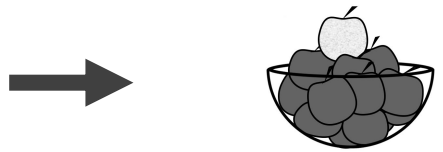
no containment

In: Force-Dynamic Accounts

Alternatives to spatial accounts consider the forces between objects.

Gardenfors (2014): Defines *in* in the force domain.

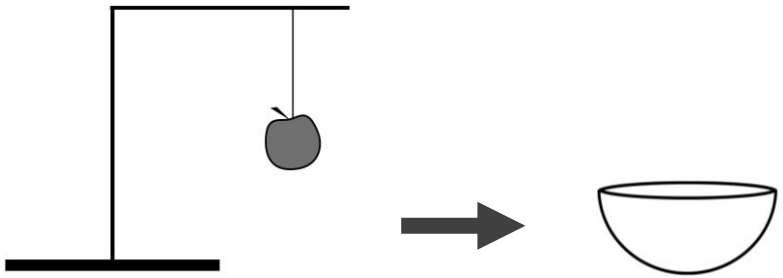
- Containment defined by relation of forces.
- "If the Ground moves the Figure moves."



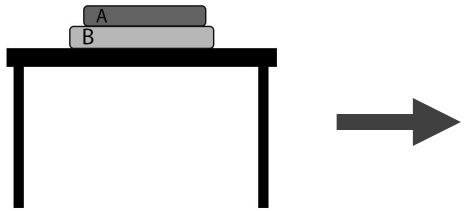
containment

Problem: How to distinguish this from *on*?

- Appeal to convexity, but this is vague



no containment



containment?

In: Functional Accounts

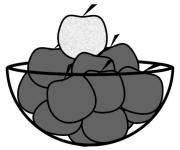
Garrod et al. (1999): Functional Geometric Account

- Combination of geometric element and functional element.
- *Fcontainment*: the Ground controls the location of the Figure by "*some degree* of spatial enclosure" of the Figure by the Ground.

In: Functional Accounts

Garrod et al. (1999): Functional Geometric Account

- Combination of geometric element and functional element.
- *Fcontainment*: the Ground controls the location of the Figure by "*some degree* of spatial enclosure" of the Figure by the Ground.



fcontainment

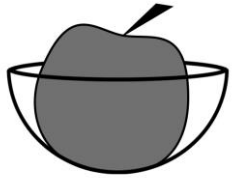
Problems:

- *Fcontainment* requires "some degree of spatial enclosure."
  - *Apple in bowl* by transitivity.
    - *light apple in pile apples → apples in bowl → light apple in bowl (to some degree)*
- Is this use of transitivity valid?
  - *A partially in B → B partially in C → C is* ***not*** *partially in A*
- Is the apple is in the bowl *by some degree of spatial enclosure*, is this not enough to define *in*?
  - Are functional relations even necessary?

In: Proposal

In defined in spatial terms, e.g. containment

- *X* in *Y* means that the space of *X* is at least partially contained in the space of *Y*.



For some problematic examples:

- For Figure 1
- The Ground is extended to include the top apple
  - *tolerance*, e.g. Herskovits (1986)
  - *The top apple is in the bowl because the space of the bowl is extended*
- In what contexts does the Ground extend?

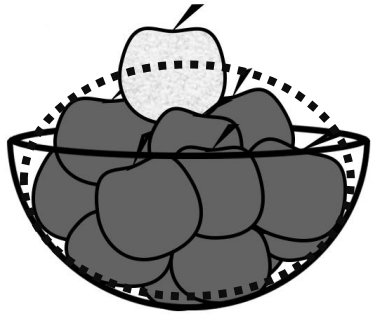


Figure 1: The apple is in the bowl.
The Ground is extended to include the top apple.

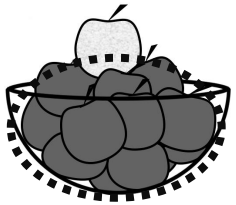
In: Proposal

The Ground only extends when the bowl is filled (See pictures).

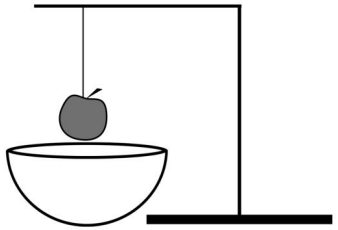
Proposal: When there is location control of the Figure, the Ground extends to include that Figure.

I define *location control* as below. (e.g. Coventry & Garrod 2004)

Location Control: Y controls the location of X if there is some relation between Y and X such that if Y moves, X moves.



The apple is in the bowl.
Extension of Ground.
Location Control



The apple is not in the bowl.
No extension of Ground.
No location control

On: Previous Accounts

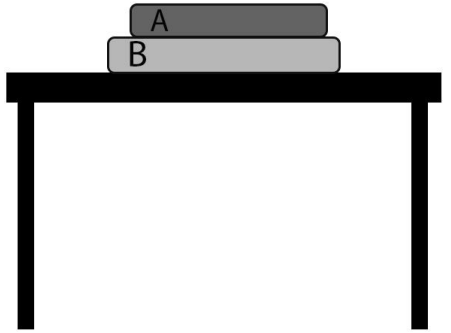
Like *in*, *on* has been defined in both spatial and force-related terms.

Most definitions of on require some notion of support.

Herskovits (1986): Contiguity and support

Gardenfors (2014): force relations

Garrod et al. (1999): *fsupport*



Book A is on the table.
Book A is on the table, but it is not in contact with the table.

This is usually dealt with by support.
Book A is on the table because it is supported by the table.

On: Previous Accounts

Herskovits (1986):

- Ground is a line or surface: contiguity
- Ground is the surface of an object: support

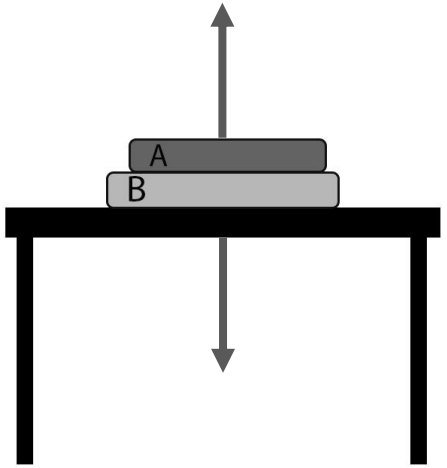
Problems:

- Two definitions, unclear how these relate.
- When is the Ground a surface, and when is the Ground the surface of an object?

On: Previous Accounts

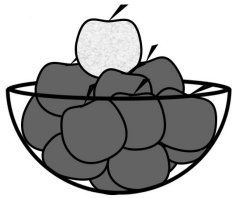
Gardenfors (2014):

- Balanced force relation between the Figure and Ground s.t. the Figure remains in contact with the Ground.
- Allows transitivity
  - Book A on book B → Book B on table → Book A on table



Problem: How it distinguish this from *in*?

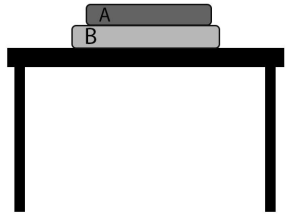
- Above definition holds in picture below.



On: Previous Accounts

Garrod et al. (1999):

- Combination of geometric element and functional (*locational* control) element.
- *Fsupport*: the Ground controls the location of the Figure "with respect to a unidirectional force by *some degree* of contact" between the Figure by the Ground.



Problems:

- Similarly to *in*, what is meant by *to some degree of contact*?
- If there is some degree of contact between Book A and the table, why is this not sufficient?

On: Proposal

On defined in spatial terms, e.g. contiguity/contact

- *X* on *Y* means that X is contiguous with the surface of Y.
- *X* on *Y* means that X is in contact with Y

For some problematic examples:

- For Figure 2
- The Ground is extended to meet Book A.
- In what contexts does the Ground extend?
  - Like *in*, Ground extends with *location control*.

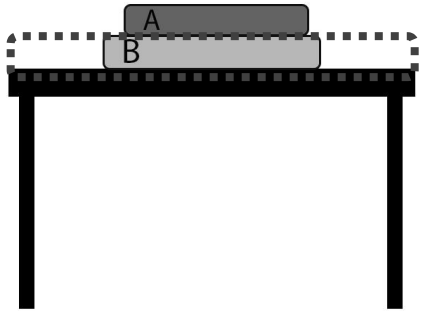


Figure 2: Book A is on the table
The Ground is extended to be in contact with Book B

Advantages of Proposal

What situations does this deal with that the other theories don't?

- Unifies Figure and Ground
- Coventry and Garrod (2004) also does this. Why is this proposal better?
  - Maintains distinction between *in* and *on*.
  - If Ground extends to include *convex hull*, this maintains relations of containment, contiguity
- Central meaning of space is a more natural relation to other uses of the prepositions
  - E.g. compare Gardenfors (2014)
- Garrod et al. (1999) already imply extension of Ground to some extent.
  - Remember: what does it mean to say "some degree of spatial containment"? "some degree of contact"?
  - My proposal states these intuitions in more specific terms. There is "some degree of spatial containment" via extension of the Ground.
- *Location control,* which has been shown in literature, is preserved to some extent.

References

- Coventry, K., & Garrod, S. C. 2004. *Saying, seeing, and acting : The psychological semantics of spatial prepositions* (Essays in cognitive psychology). Hove, East Sussex ; New York: Psychology Press.

- Gärdenfors, P. 2014. *Geometry of meaning : Semantics based on conceptual spaces*, The MIT Press: Cambridge.

- Garrod, Simon, Ferrier, Gillian & Siobhan Campbell. 1999. In and on: investigating the function geometry of spatial prepositions. Cognition 72, 167-189.

- Herskovits, A. 1986. *Language and spatial cognition : An interdisciplinary study of the prepositions in English* (Studies in natural language processing) Cambridge University Press: New York.