
The Relationship between Function and Affordance

David Brown

WPI

Lucienne Blessing

Technical University Berlin

Objectives

- present a model of function
- clarify the concept of affordances
- relate affordances to function
- discuss reasoning with affordances

Not an Objective

- ❑ To attack existing work on Affordances.

However, we feel that evaluation, critiquing and discussion are valuable.

Sources & Influences

Chandrasekaran & Josephson (2000)
Function in Device Representation

Maier & Fadel (2003)
Affordance-Based Methods for Design

Rosenman & Gero (1998)
Purpose and function in design: from
the socio-cultural to the techno-physical

Norman (1988)
The Psychology of Everyday Things

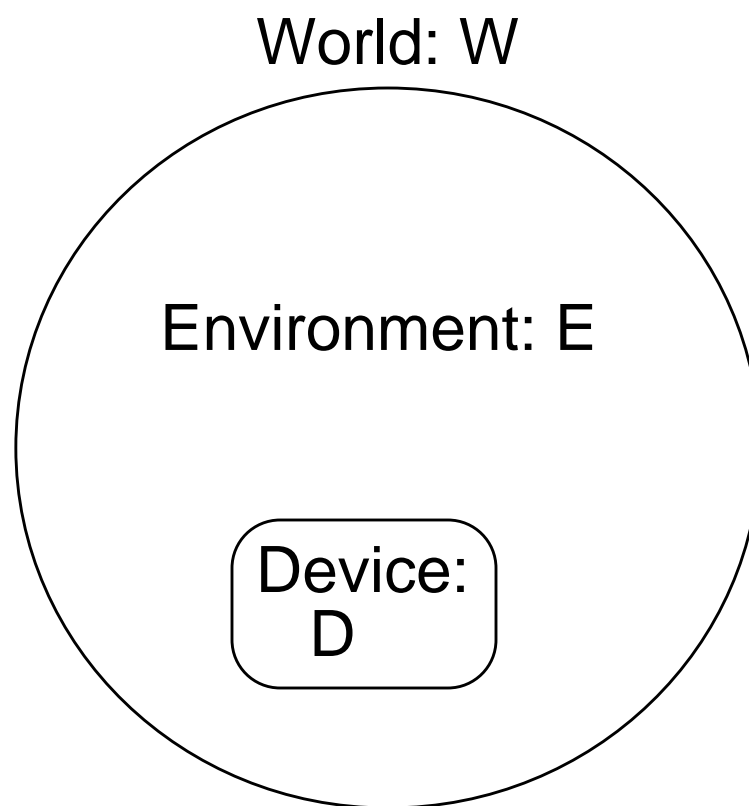
Hartson (2003)
Cognitive, physical, sensory, and
functional affordances in interaction
design

Motivation

- ❑ use of functions and functional decomposition in design is common
- ❑ Maier and Fadel (M&F) proposed an alternative approach to designing that uses affordances
- ❑ There's a lot of ambiguity in the terms "function" and "affordance"

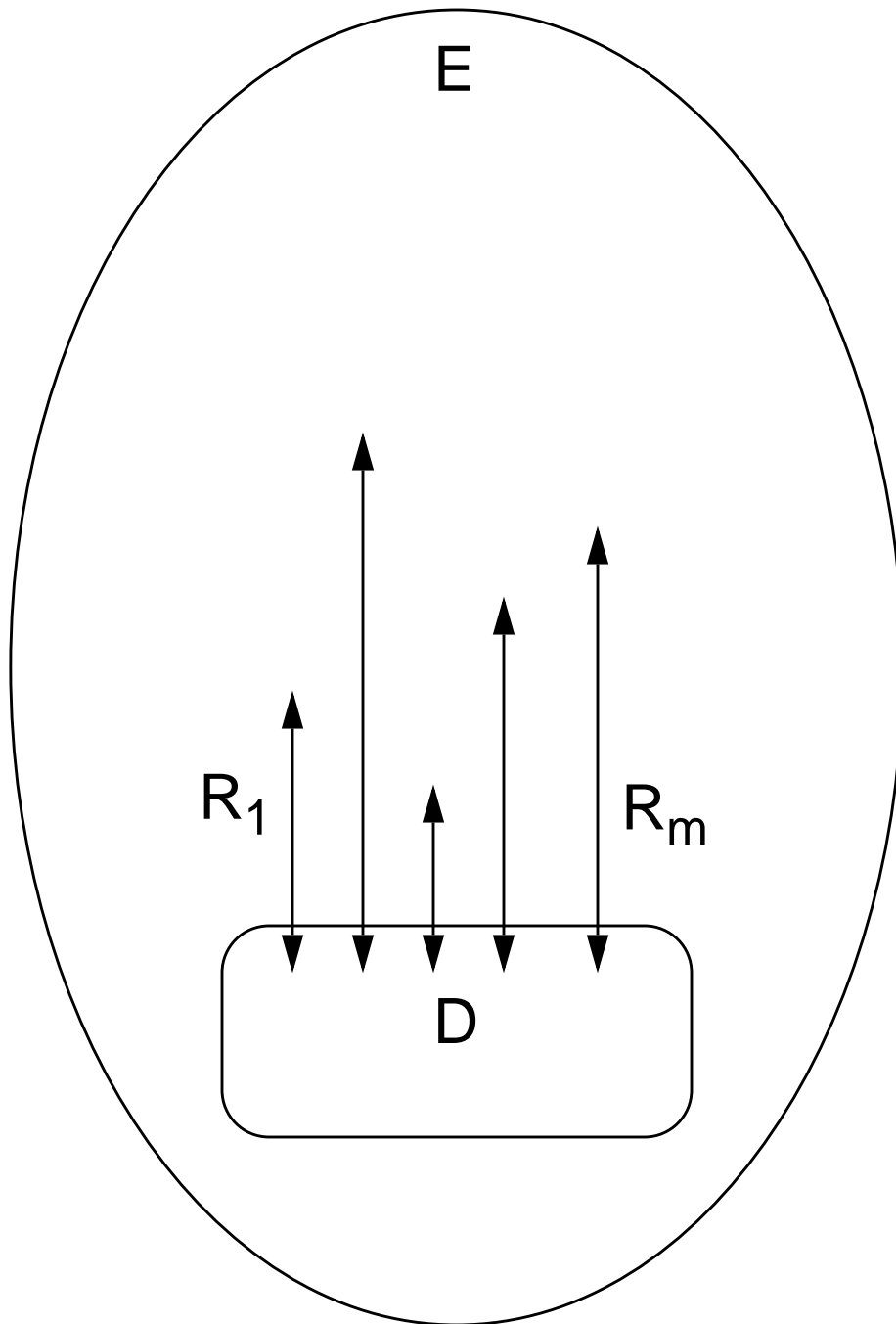
A Model of Function

Place D in an Environment.



Mode of Deployment

$M(D, E_i)$ for all R_i at time t .

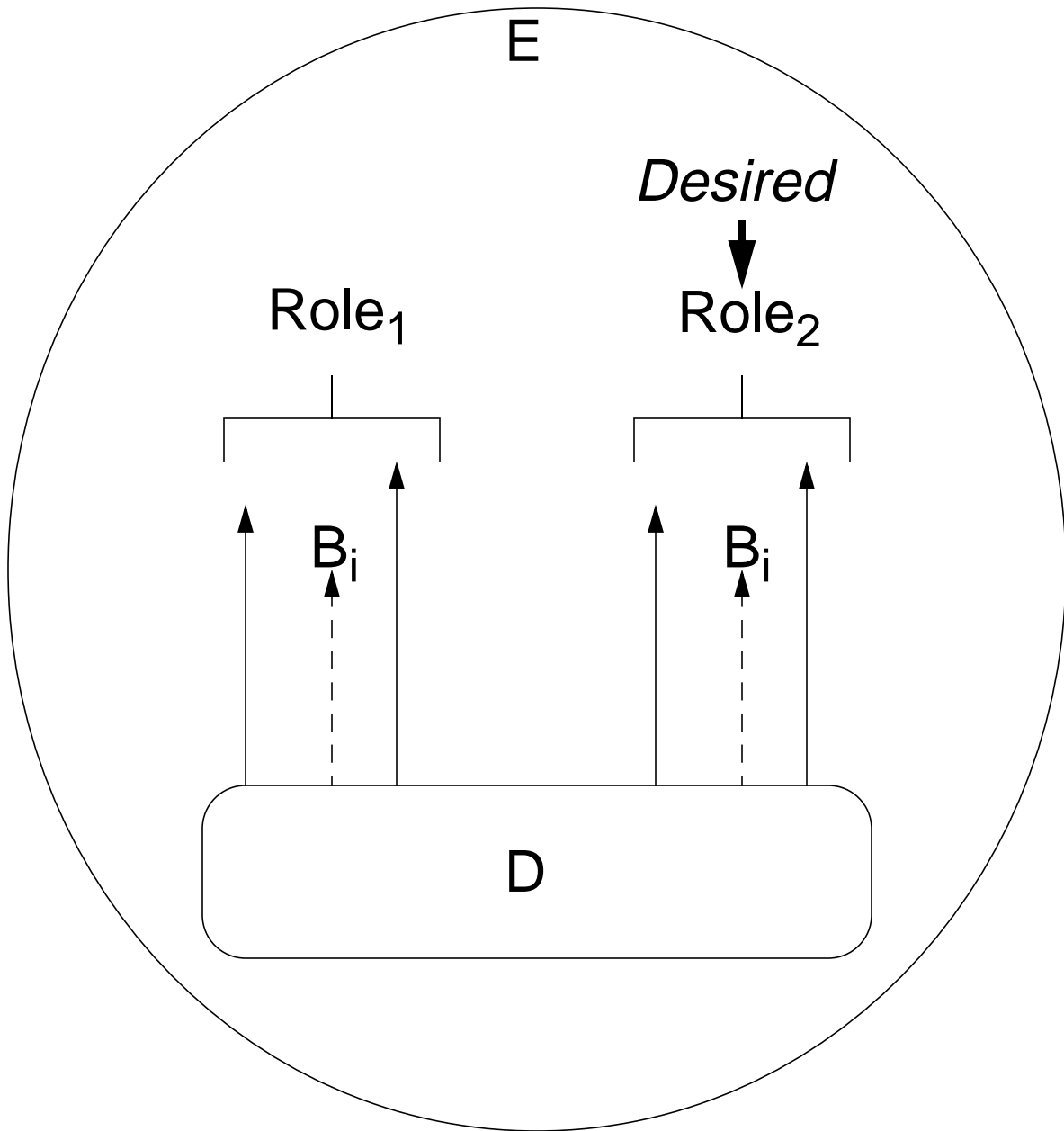


Behaviors

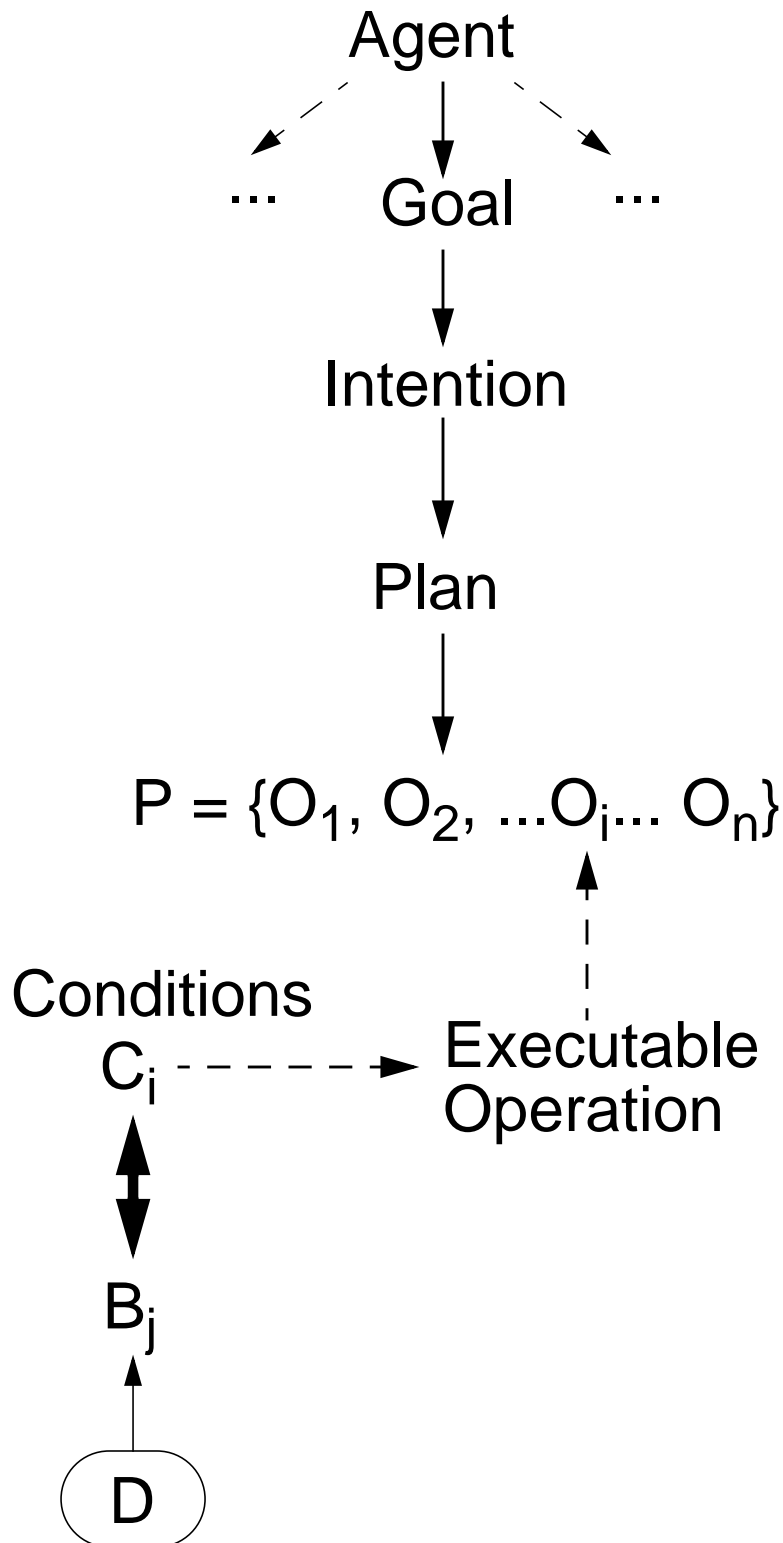
- ❑ $M(D, E_i)$ enables interactions between D and E_i
- ❑ Interactions are interpreted as “Behaviors”
- ❑ Behaviors can be at an instant or over time.
- ❑ Behavioral Constraints B_i are:
 - ➔ Patterns of interactions involving the state of D and the state of E

Roles and Function

If a role is *desired* by an agent/entity then the set of B_i provides a **function** for D in E



Desired



Example (D = Pen)

Goal: to have another human know the information that you desire to tell them.

Intention: get paper, get pen, write message, transfer paper to other human.

Plan: grip pen, orient pen, put pen tip to paper, apply pressure, move pen.

B: ink flows from tip; ink coats the paper; the tip is moving.

Mode of Deployment: human grips pen; pen tip is down; tip in contact with paper; tip exerts pressure on the paper.

Device-centric function: to cause ink to flow out of its ink container onto the tip.

Environment-centric function: to cause a piece of paper to have ink on it.

Affordances

Affordances are context-dependent action or manipulation possibilities from the point of view of a particular actor.

- The actor is considered to be the entity, human or otherwise, capable of taking action.

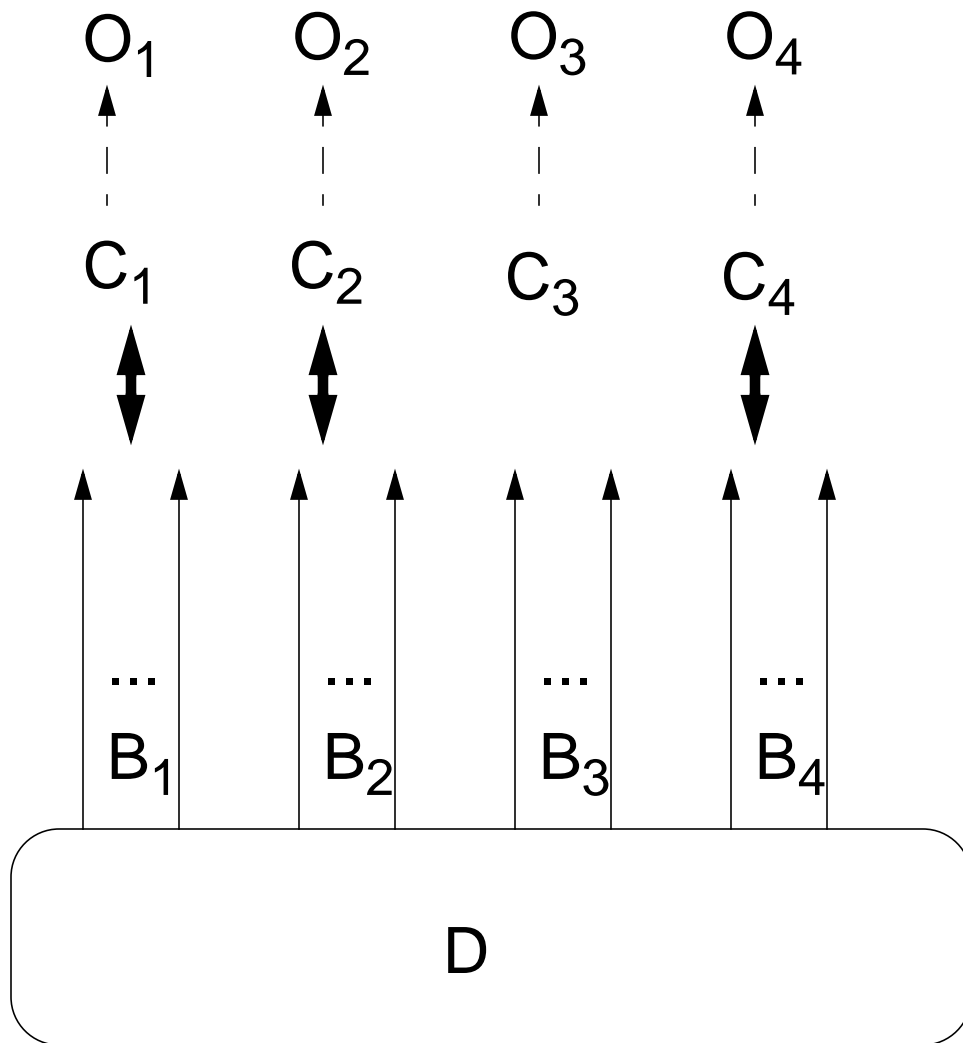
- The set of affordances of a device is a *very large set!*
 - i.e., the set of all potential agent behaviors that the device might allow.

 - i.e., all the Operations O_i , Plans P_i , or Intentions I_i that the device might allow.

 - e.g., Cell phones afford throwing.

Affordances

For all $M(D, E_i)$:



Reasoning

Design —→ Affordances

- ↳ Hard to do without guidance.
- ↳ Very useful for design evaluation.

Design —→ Function

- ↳ Usually provided (Intended Function).
- ↳ Hard to reason out without $M(D, E_i)$.

Function —→ Design

- ↳ Using functional decomposition.
- ↳ Existing designs may be indexed.

Affordances —→ Design

- ↳ Not normally indexed.
- ↳ May be able to map to function.

Conclusions

- ❑ Affordances very useful for design evaluation.
- ❑ Hard to determine all relevant affordances.

- ❑ Explicit models of function and affordance useful in the development new techniques and tools.
 - ➔ explicit representations needed to allow explicit reasoning.
 - ➔ e.g., functional basis.
 - ➔ e.g., matching (and therefore analogy) by Goal, Operations, Behavioral Constraints, and Mode of Deployment, in addition to device structure and device behavior.

Note: AIEDAM Vol.19, No. 2 & 3, 2005,
Special Issue: *Engineering Applications of Representations of Function.*