

**WPI**

# **Device-centric or Environment-centric Function**

**DAVID C BROWN**

*Computer Science Department  
WPI, Worcester, MA 01609, USA  
dcb@cs.wpi.edu*

# Device-centric

A device is often viewed as having a function independent of the environment in which it might be used.

- This is “Device-centric”.

e.g., A pen produces ink at its tip.

- This caters to the *intended function*.
- Assumes an intended environment.
- “Environment-centric” definitions include aspects of the environment.

# Function as Desired Effects

Chandrasekaran and Josephson [2000] define function by viewing it as a set of effects that an entity has on its environment.

These effects must be *desired* by some agent in order for them to have meaning as a function

e.g., a clock's ticking doesn't help someone know the time.

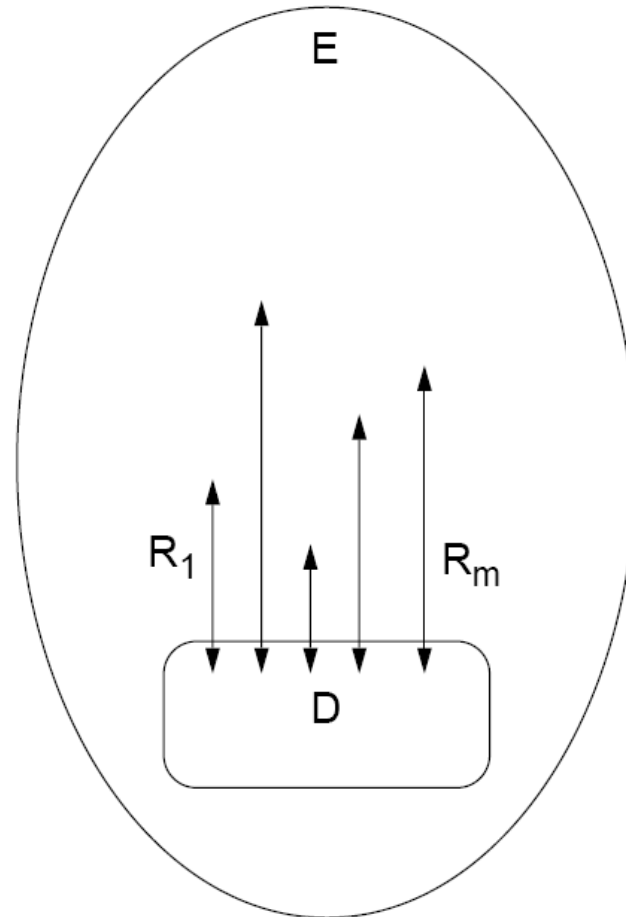
# D and E

- Device D
- Environment E
- Agents are Users or Devices in E
- Functions are usually utilized by agents in E to achieve **goals**.

# Mode of Deployment

- A set of physical relationships between D and E
  - Plugged in
  - Knife edge in contact with item
  - Start button pressed
  - Pen tip at appropriate angle to item
- Need not be constant

# Mode of Deployment



# Behavioral Constraints

- Conditions on the behavior of environment
  - e.g., required voltage being achieved.
  - e.g., situation producing some action.
- *If* a set of Bs is satisfied when D is deployed  
*Then* that entity plays a *role* in E.
- May be a pattern over time

# Function as Potential

*If* D plays a role in E

*and* role is *desired* by some agent in E

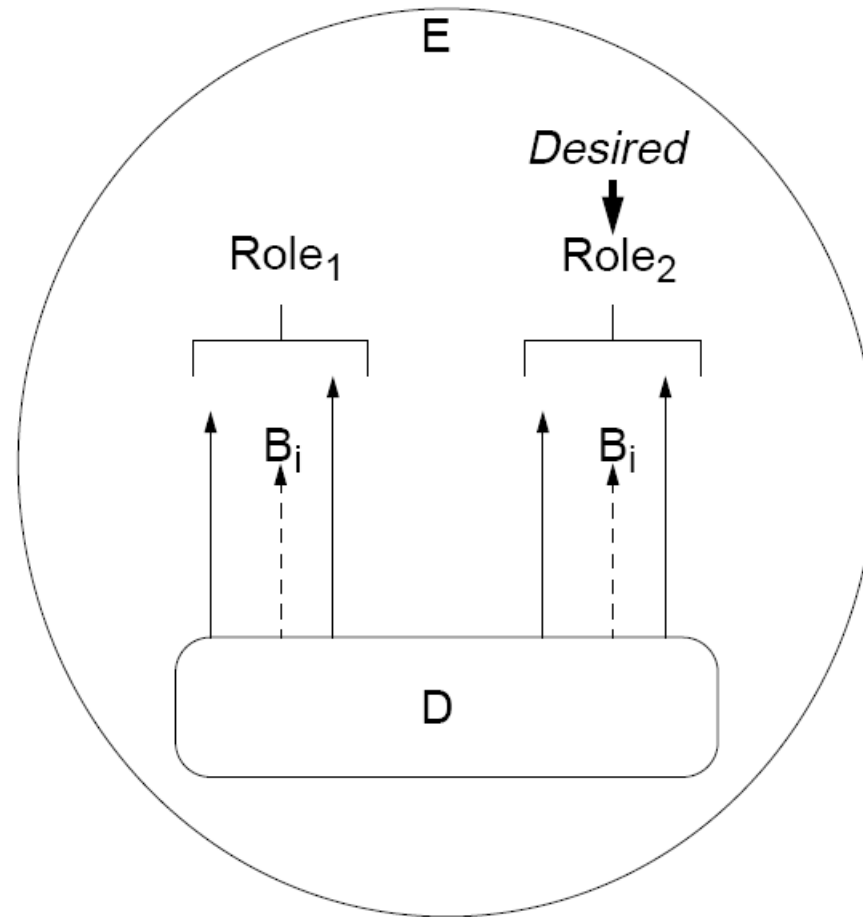
*Then* the entity has/performs a **function**.

The actual function is defined by the Bs satisfied.

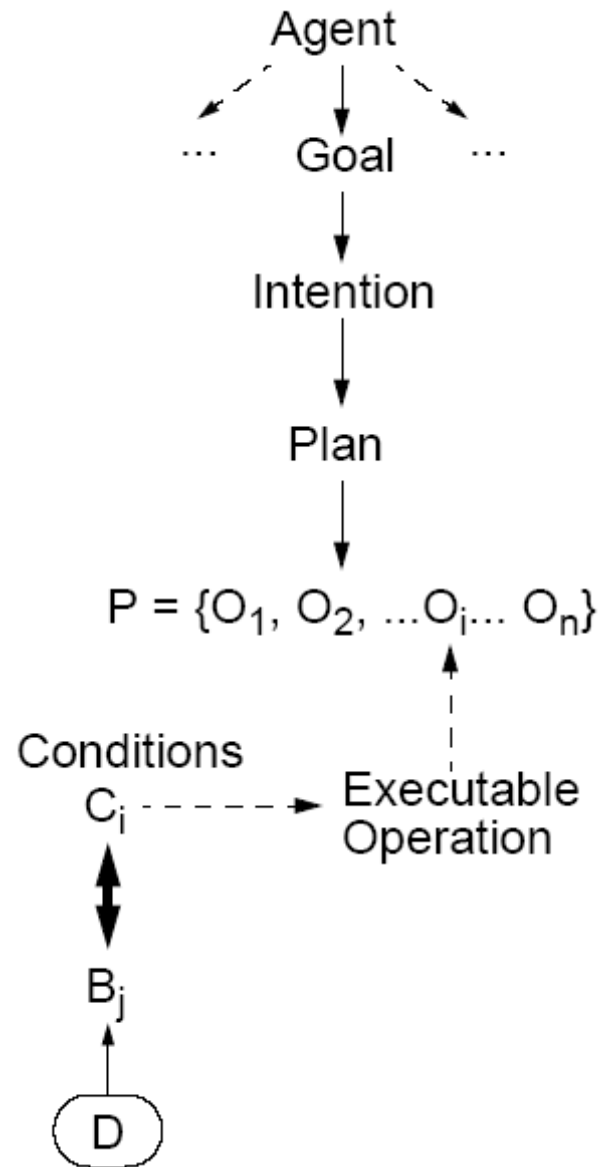
And by what role is desired.

Thus a pen may write, may act as a pointer, or act as a paperweight.

# Desired Role



# Desired



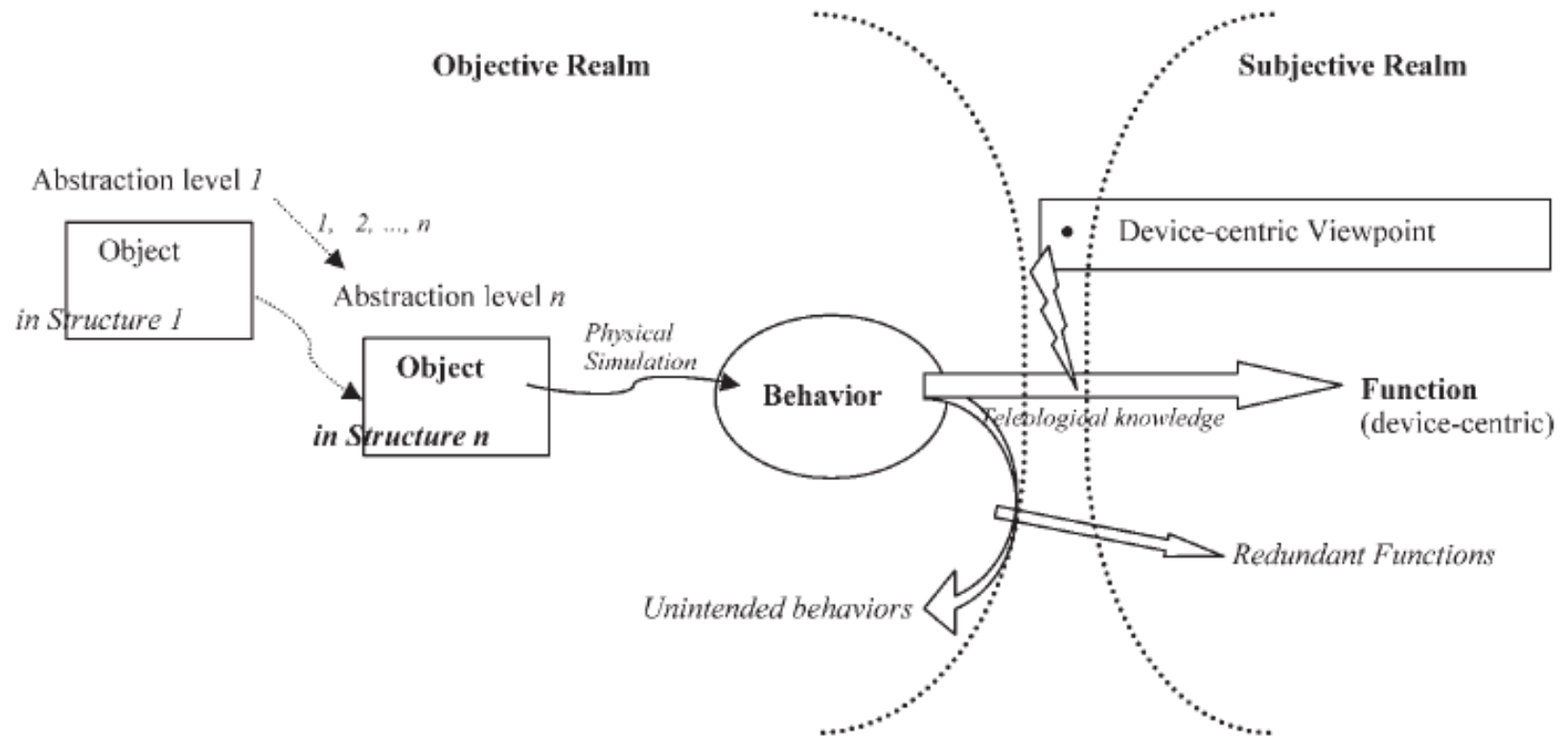
# Erden et al.

M.S. Erden, H. Komoto, T.J. van Beek, V. D'Amelio, E. Echavarria and  
T. Tomiyama,

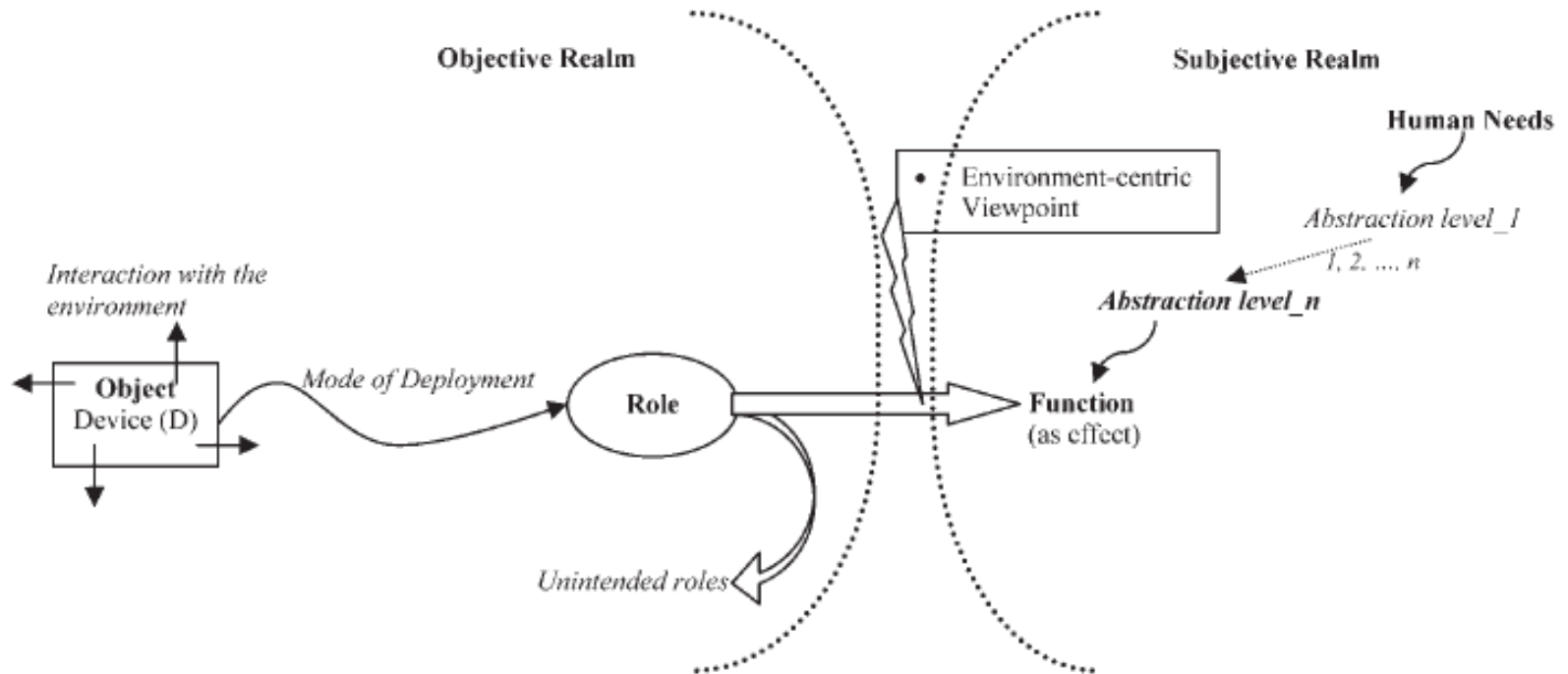
“A review of function modeling: Approaches and applications”,

*AI EDAM*, 22(2), March 2008, pp 147-169.

# Erden: Device-centric



# Erden: Environment-centric



# Function unchanged?



Given Right Handed Scissors

Design Left Handed Scissors.

i.e., change structure

Affects Mode of Deployment.

Affects function?

Needs environment-centric definition.

# Pen Example

- *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.
- *Behav:* ink flows from tip; ink coats the paper; the tip is moving.
- *Mode of D:* human grips pen; pen tip is down; tip in contact with paper; tip presses on 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 a message on it.