

# Designing and Programming with Multiplicity

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# Overview

The tools I have used to develop design problems and propose interventions in the context of multiple computing

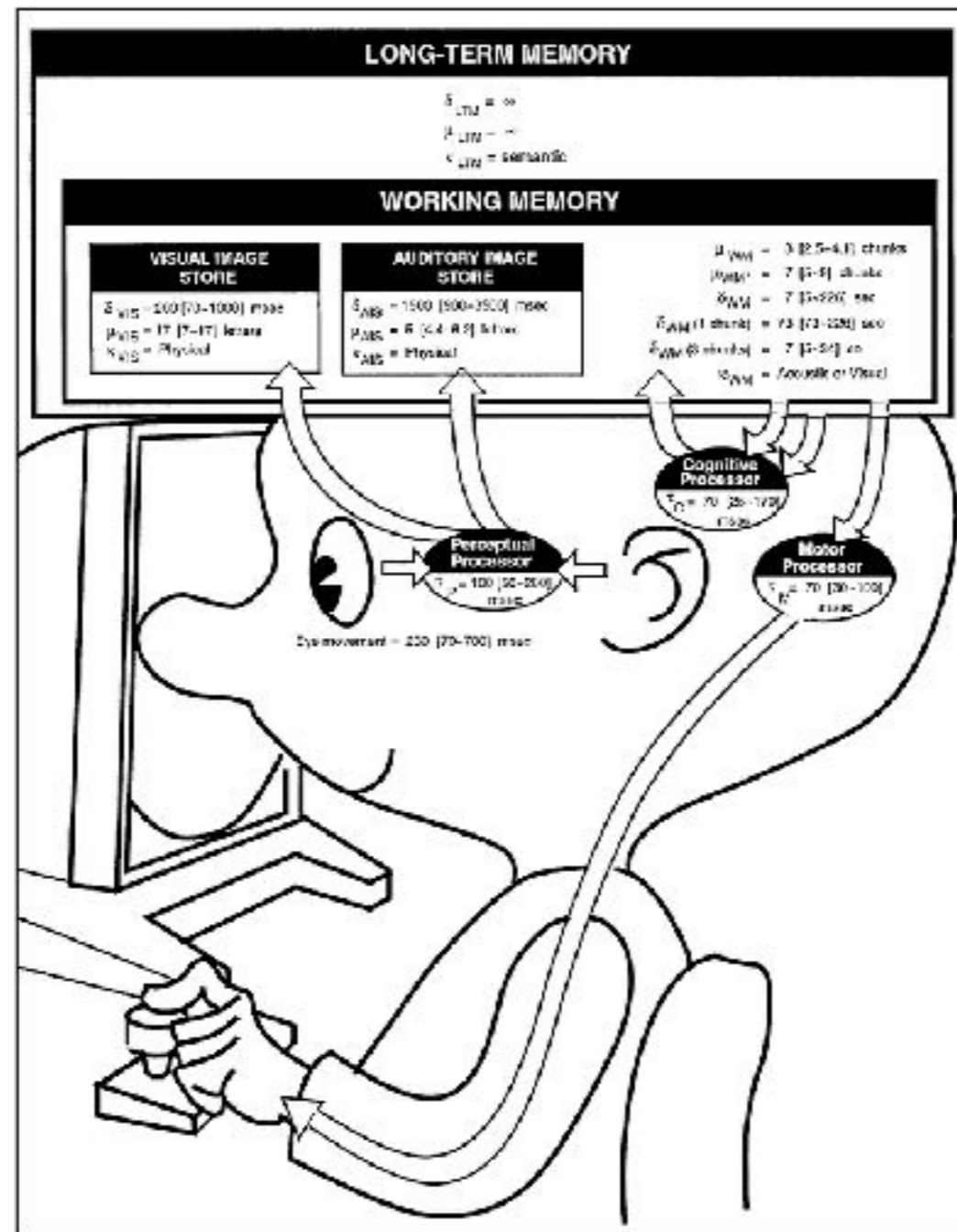
- I'm still developing and making sense of some
- Maybe some are useful to IDRC/the Fluid community
- I would love to hear about your theories and methods as well
- Please ask questions!

# From human factors to human actors

Early Human-Computer Interaction (HCI) models described humans as components of computer systems, leading to

- Lab studies defining parameters of “human factors”
- Concept of users without history, context, or expertise

# From human factors to human actors



# From human factors to human actors

Second-wave HCI drew from methods and theories that aimed to describe practices and context more holistically, e.g. ethnography

# The Human-Artifact Model

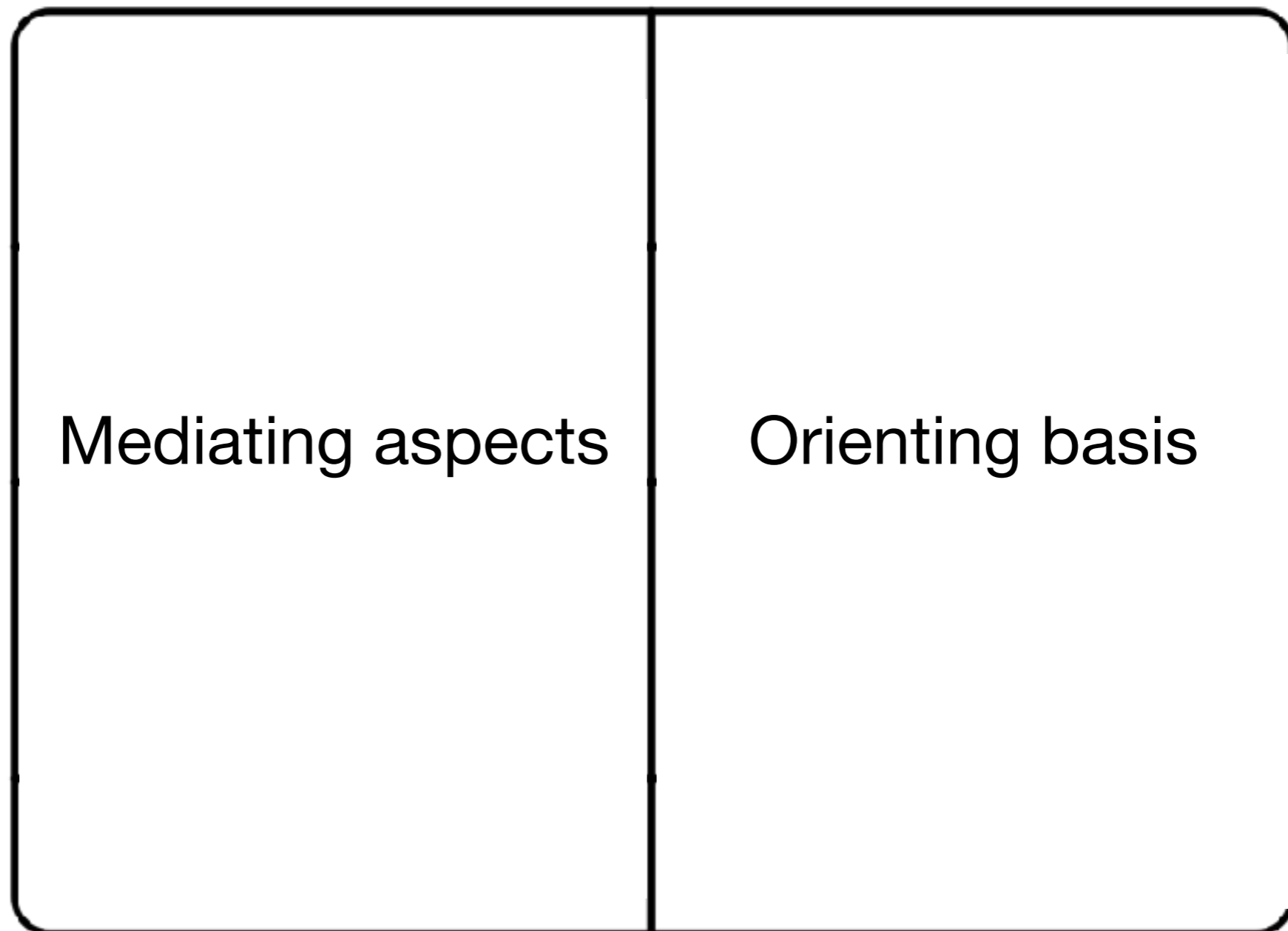
Tool for analysis and design developed by Bødker & Klokmoose

- Based on cultural-historical activity theory
- Describes human-artifact (mis-)match
- Views interaction as dialectical and developing, not causal and static
- Combines expertise, ability, and situational context

# The Human-Artifact Model

**Artifact**

**Human**



# The Human-Artifact Model

	Artifact	Human
What?	Instrumental aspects	Goal-orientation



# The Human-Artifact Model

	Artifact	Human
<b>What?</b>	Instrumental aspects	Goal-orientation
<b>How?</b>	Operational aspects - Handling aspects	Operational orientation - Learned handling
	- Adaptive aspects	- Adaptation

# The Human-Artifact Model

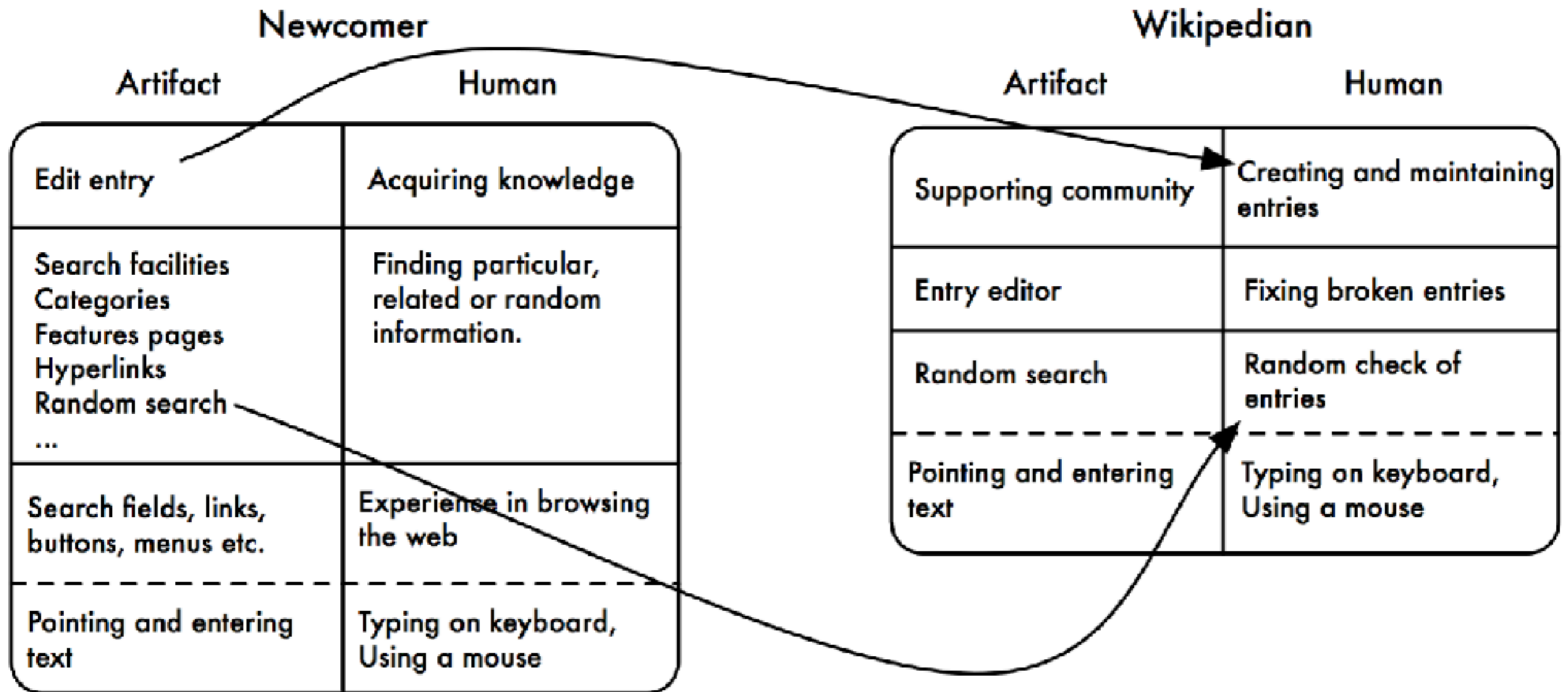
	Artifact	Human
Why?	Motivational aspects	Motivational orientation
What?	Instrumental aspects	Goal-orientation
How?	Operational aspects	Operational orientation
	- Handling aspects	- Learned handling
	- Adaptive aspects	- Adaptation

# HAM and Accessible Interfaces

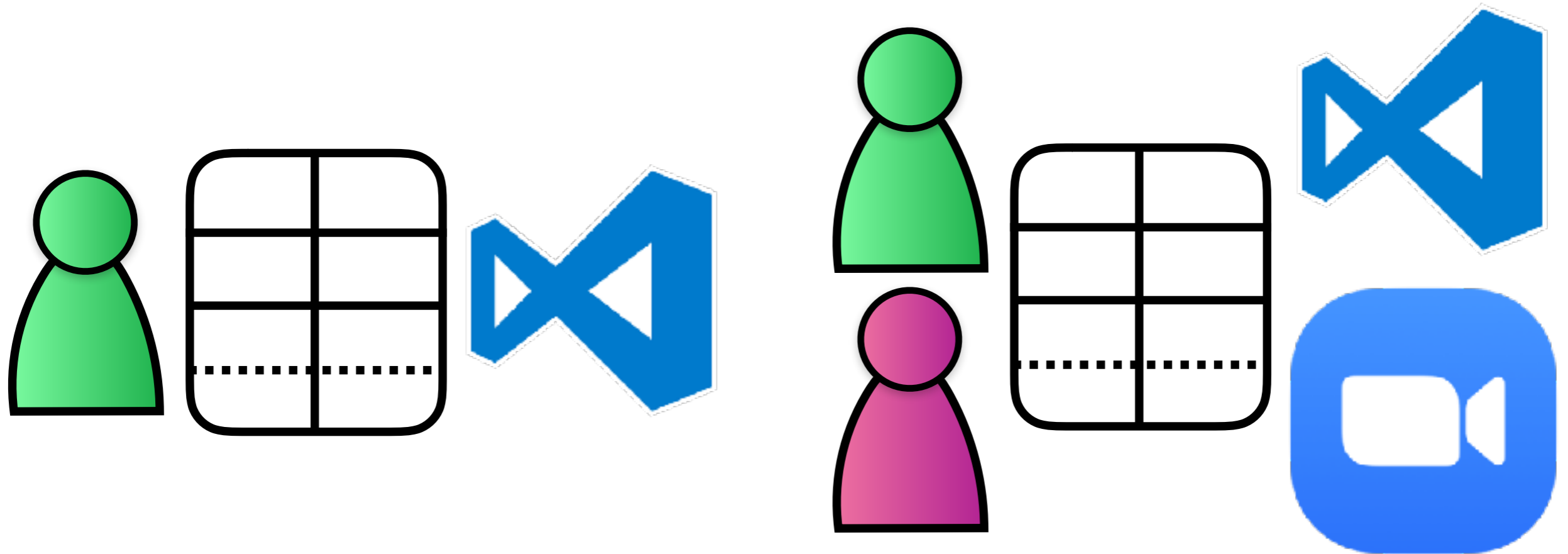
Accessibility adaptation often focuses on the operational level of artifacts

- How does accessibility and inclusiveness address instrumental and motivational aspects?
- How do accessible interfaces support routinizing and abbreviating common interactions?

# Analyzing Development



# Analyzing Multistability



# Artifact Ecologies

VSCode, Wikipedia, etc. are not used alone, but alongside other tools, digital and not

- *An artifact ecology* consists of the artifacts that an individual (or community) owns, uses, and has access to
- Overlapping, historical, current, and potential ecologies
  - e.g. the mass of collaboration tools we enumerated last week

# How Ecologies Develop

- Happenstance: unpredictable resources, changes, and breakdowns
- Strategies: possibly formalized activities to develop and maintain support for individual or group practice
- Tactics: situated reactions to replace, hack, or reconfigure artifacts in response to happenstance

# Appropriation and Design

Happenstance, strategies, and tactics are examples of *intrinsic design*, as opposed to *extrinsic design*



# Appropriation and Design

Intrinsic and extrinsic design are entangled

- Adopting commercial and public tools and resources is socially and economically necessary
- Tools “from outside” only become artifacts through *articulation work* that weaves them into a concrete practice

# The Limits of Appropriation

- We have theories that describe how people deal with the mess of variously compatible technologies
- But we're missing theories that describe why certain kinds of appropriation happen and others don't
- The tendency towards centralization and enclosure

# Qualitative Methods

These theoretical models motivate multiple data gathering methods

- What: critical incident interviews, contextual inquiry
- How: in-situ observations, video analysis
- Why: in-depth interviews, diary studies
- Dynamics and ecologies: **artifact maps** and histories

# Artifact Ecology Mapping

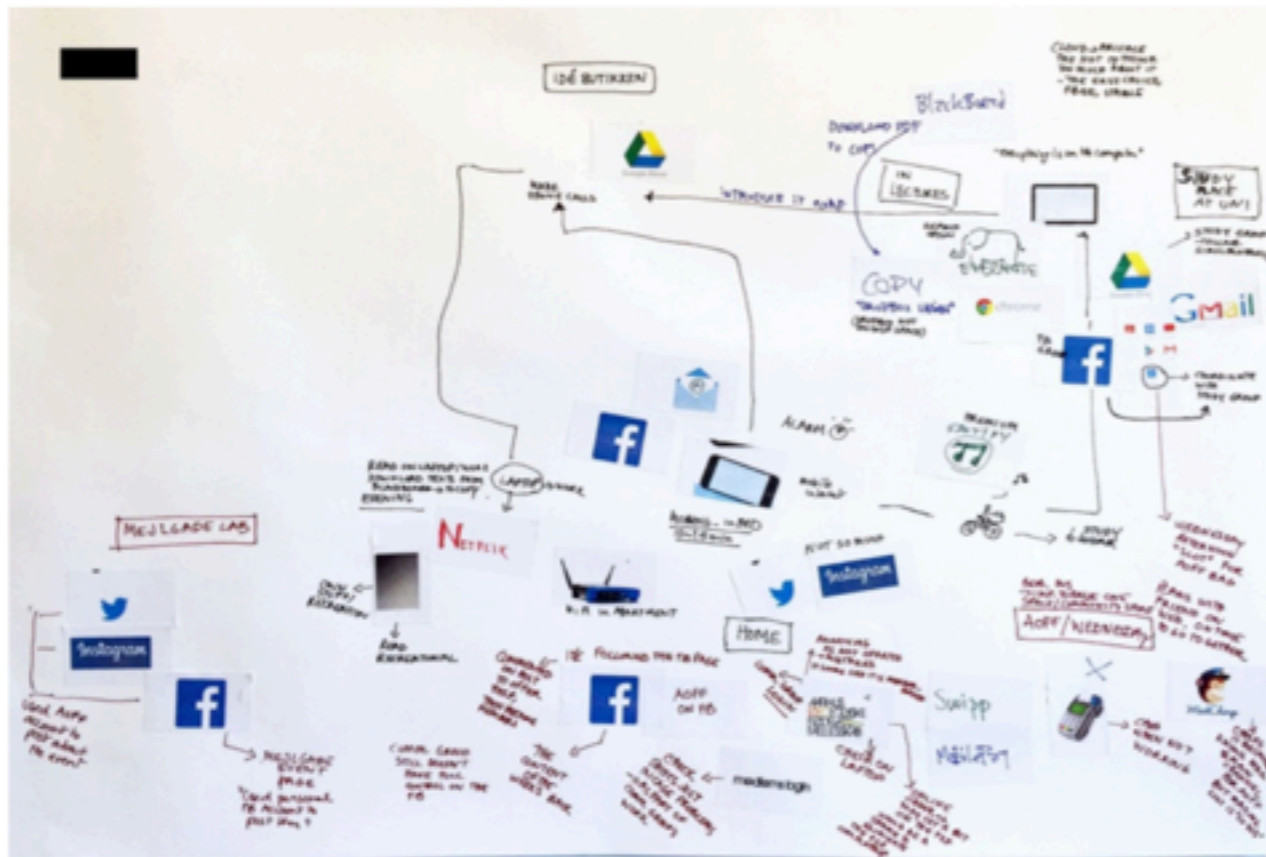
Bødker et al. create maps of artifact ecologies to focus on different ecology-level patterns

# Artifact Ecology Mapping



Drawing with participants, using prepared stickers

# Artifact Ecology Mapping



Remapping with co-investigators and annotating

# From systems to ecosystems

Our models for the architecture and interfaces of interactive software were also developed in an era of relatively few, relatively stable devices and applications.

# From systems to ecosystems





# From systems to ecosystems

In the last three decades, the use and production of software has changed substantially

- From the workplace to work and leisure intermixed
- From a single, static system to many heterogeneous devices, apps, and documents

Production tools have been transformed in response, but the user-facing model of applications lags behind

# Programming for multiplicity

Tools for customizing and integrating interfaces help people manage a changing and distributed computing environment

- Appropriation work + computation = abbreviation
- Customization supports both diversification and standardization

# A customization network

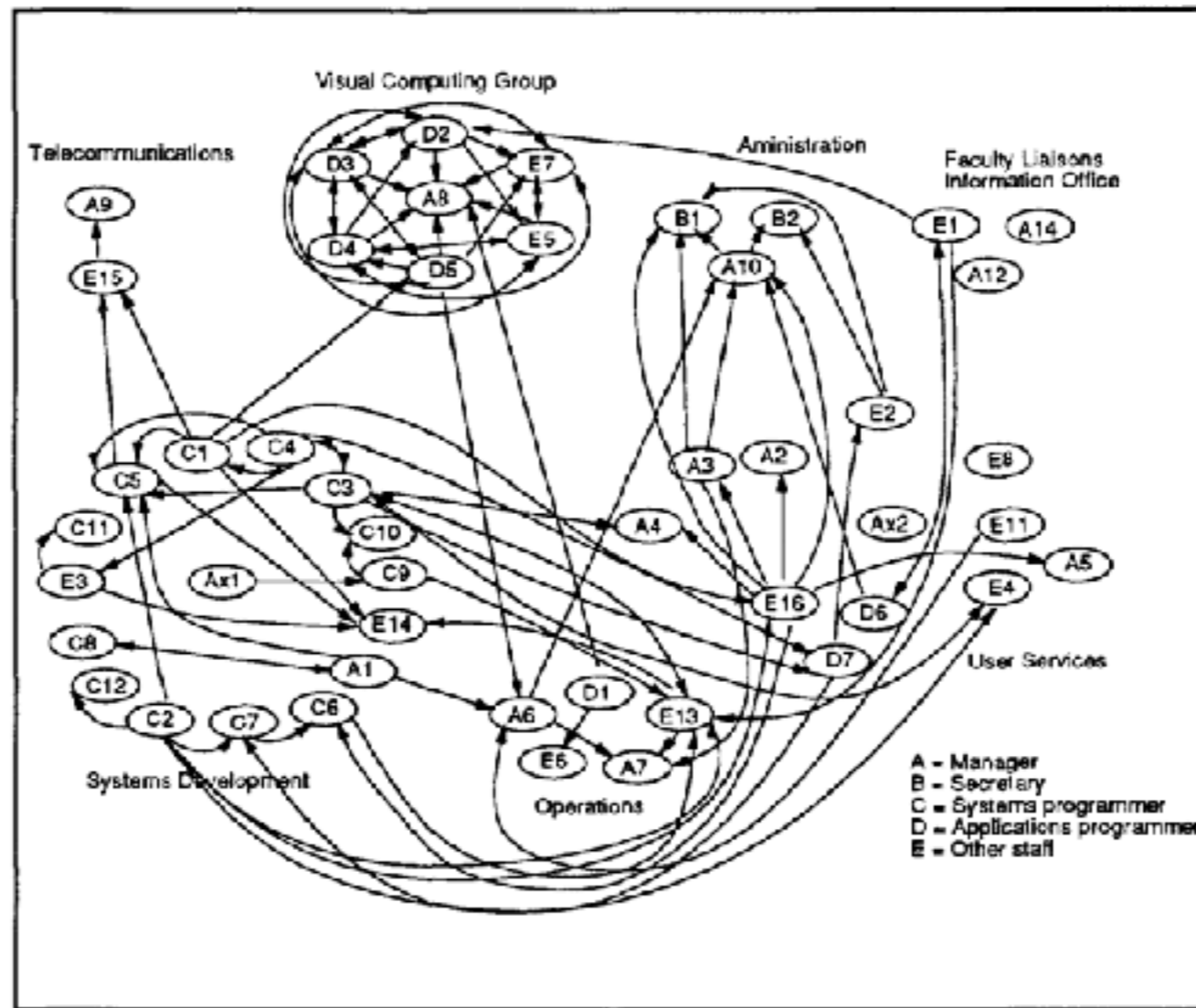
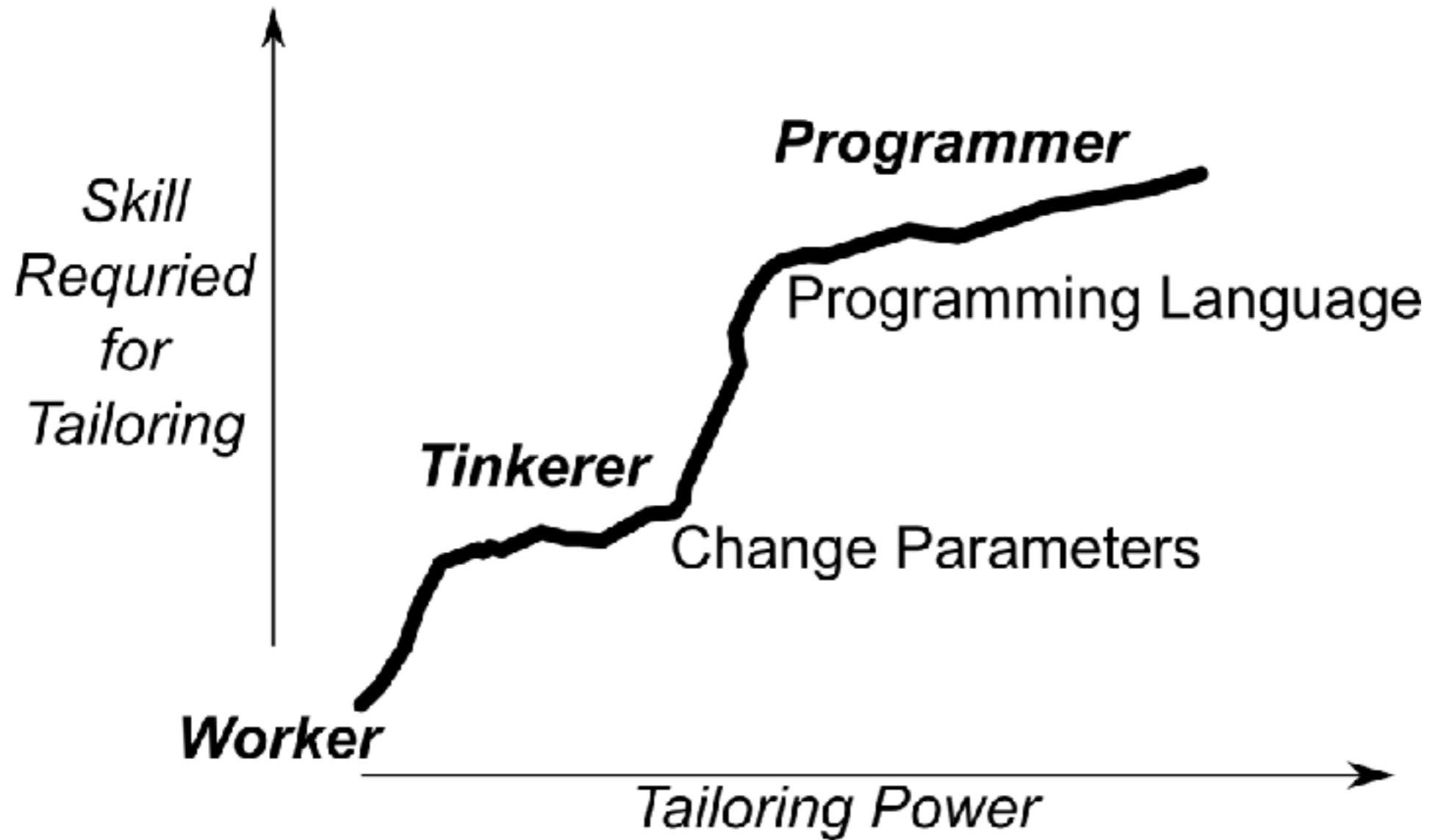


Figure 1: Exchange of Customization Files at Project Athena

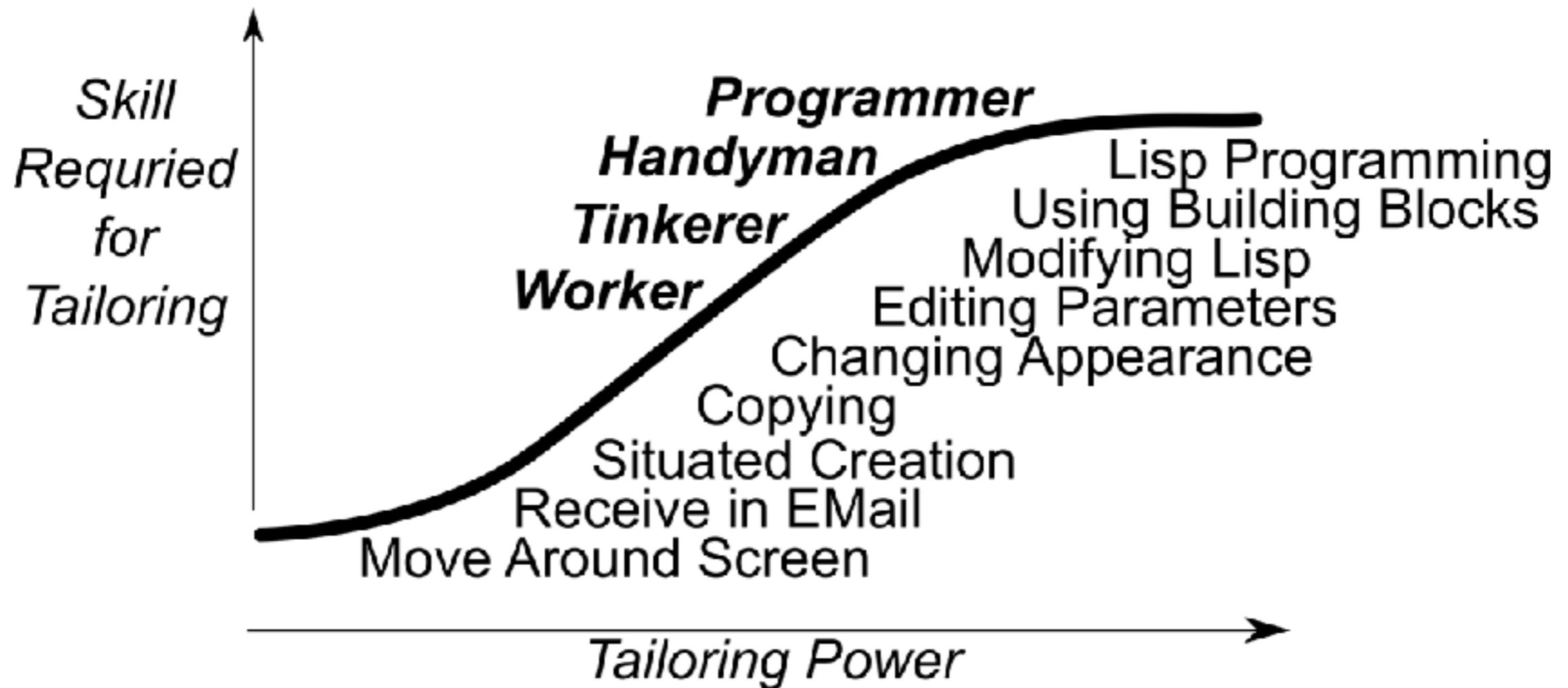
(Mackay, 1990)

# The Tailorability Mountain and its Inhabitants



(MacLean et al., 1990)

## Buttons - The Gentle Slope to Tailorability and the Folk Who Live on the Hill



(MacLean et al., 1990)

1PT CUSTOM EUROPARC RX 12 on Gutenberg -- InProgress  
 1PT CUSTOM EUROPARC RX 12 on Custom -- Completed  
 1PT CUSTOMERS EUROPARC RX 12 on Gutenberg -- Completed

entering--0 Executive  
 UNWILLING WRITER) (HARDY-BU-MENU-TO DU-REL  
 U-TEBIT (OK) LAPITE.ABBREVS TEBIT.ABBREV  
 E1)  
 ED- EDIT(SETUP-LAFITE)  
 SETUP-LAFITE  
 ED-  
 ED-



No New Mail at 10:08am  
 1 of 1 in (MS)  
 Browse Send Mail Out  
 Delivered Messages:  
 14:58 Crosslink video  
 15:30 Call for papers

Update from Tom

Diary FB

04-Fax

04-Fun

copy floppy to (OK)

FB (OK) (Logfile/floppy?\*,\*)

FB Message Mail

Mid Year

Year End

02/20/02

FB PERSONNEL

FB LISTING CANDIDATES

FB PERSONNEL CHANGES

FB AGO

CONFIDENTIALITY

FB ADMIN

Publication of News and Messages

Publication of News and Messages

Message 725 from (OK) OLDFRESHACTIVE MAIL 1 (OK)

Subject: A/V Buttons  
 To: King

Here are the buttons I promised you open video connections with us.

[Meet Kenneth](#)   [Meet Kathy](#)  
[Meet Alan](#)   [Meet David](#)

and here are a couple of others you may find useful

[See Video](#)   [Marcelle](#)

EuroPARC Letterhead

News edit

Fax Message

admin agenda master button

Calendar

Founder Agenda

88-87-EuroPARC People

EuroPARC Log-88

LIBRARY Information

JOURNALS - LIST

LIBRARY - LIST

BOOKS - LIST

FB VIDEO - LIST

PAPER

Learn format

File stamp   Insert page break

Proceedings List Format

Capture Para Links

test button

Capture Char Links

Print User's guide

Change my TEdit Address

Print Full documentation

empty collector

start button cover

make FB   No-button

Print Buttons User's Guide

Show all TEdit Address

Print from TEdit button

Empty Filebrowser

Print User's guide

FB-UP BUTTON

Print user's guide

make LAFITE

Edit   Select All

Update LAFITE Fonts



Reply	Time	Link	Answer	Forward	Reply	Move to	Update	Get Mail
710	20 Sep	4174662.pa						
717	20 Sep	Ottoline Lavesdel.parc	Re: Stanford Blood Drive - Monday - 1					
718	20 Sep	Subhana.pa	(string too long) (2043 chars)					
719	20 Sep	hayes.pa	Stanford Blood Drive - Monday - Sept					
720	20 Sep	Boettcher.pa	NOTE TIME CHANGE - Talk on Aed					
721	20 Sep	Fred Duvitch	Re: Stanford Blood Drive - Monday - 1					
722	20 Sep	David Hoch.parc	EIL Seminar September 25 - R. Bruce					
723	20 Sep	hayes.pa	Stanford Blood Drive - Monday - Sept					
724	21 Sep	Ely	Bill Gaver and 10 years (9k) chars)					
725	21 Sep	Allan MacLean	A/V Buttons (5887 chars)					

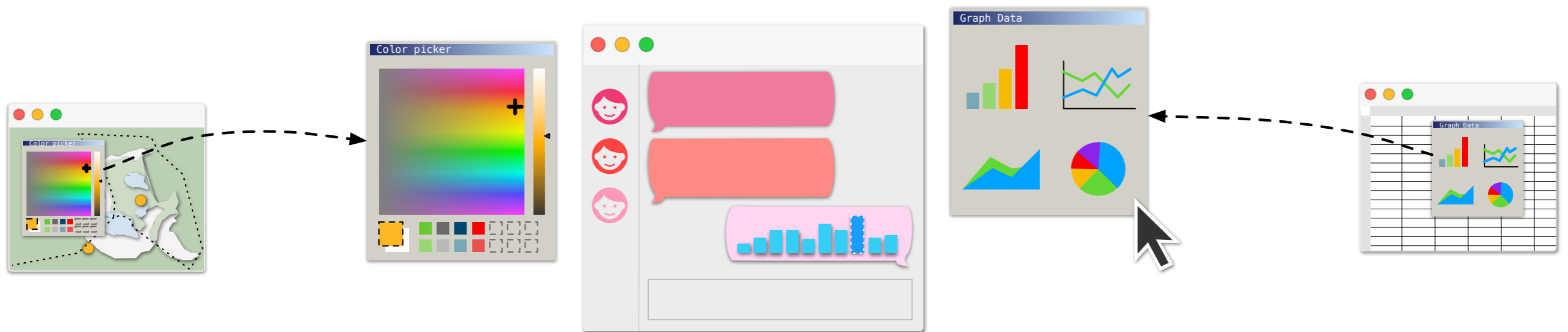
Original

# Malleable Software

Tools such as *If This Then That* enable some ability to integrate applications, but they can't email a button

To enable inclusive networks of customization today, we have to erase the boundaries of applications

# Malleable Software





# Malleable Software

Malleability could support inclusive design

- Interoperability and customizability support maintenance
- Assembling systems piecemeal means more people can have a say

# Conclusion

How do we improve interfaces when problems can't be localized to a single user in front of a single system at a single point in time?

We need to be able to describe and design for technological practices that are distributed, multi-stable, and developing

