Fundamentals of Situated Interaction

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Human-Computer Partnerships

or

Co-Adaptive Instruments

Computer hardware
has changed dramatically over the past
40 years …

Key Challenge

How can we improve interactive systems, given today's ever-increasingly complex computational environment?

We have multiple relationships with computers

Computer as a ***tool***

I accomplish the task myself

Computer as a ***servant***

It accomplishes the task for me

Computer as a ***medium***

It lets me communicate with other people

Graphical User Interfaces

Designed for executive secretaries to process documents in a completely different technology environment

Dates back to the 1970s to:
copy hand-written notes
check for mistakes
format on letterhead

Problem:
Brilliant then,
out-moded today

GUIs are a vindication … and a challenge

Human-Computer Interaction research
    fought hard to make interfaces easier to use

Today, novices easily accomplish simple tasks

GUIs are a vindication … and a challenge

Human-Computer Interaction research
fought hard to make interfaces easier to use

Today, novices easily accomplish simple tasks

Yet …
advanced research in interaction techniques
is rarely adopted in commercial systems

Today, experts use inefficient techniques and are
constantly forced to change their behavior

Desktops, the web and apps …

Require constant relearning:

- each new version introduces arbitrary changes
- each system requires slightly different interaction

Require high visual attention

Do not scale

Depend on specific devices

We need to reassess human-computer interaction

Early assumptions about graphical user interfaces
no longer hold

Everyone, not just experts
manages increasing quantities of data
faces information overload
constantly relearns the details of interaction

Redefine what we mean by "computer literacy"

Human-Computer Relationships

Between people and physical tools:

- follow well-known physical principles
- users can learn them
- users can appropriate them

Human-Computer Relationships

Between people and physical tools:

- follow well-known physical principles
- users can learn them
- users can appropriate them

Between people and computer tools:

- follow arbitrary constantly changing rules
- users must learn, and relearn, and relearn them
- users break them when they try to appropriate them

Learning to play a musical instrument
—from novice to virtuoso—
the instrument becomes part of the body

Compare to learning software:
every 'upgrade' changes the interface
tools belong to the application, not the user

Co-adaptive Instruments

Worthwhile spending time and energy learning them

Complex tools become accessible
- can learn cognitive and sensori-motor skills
- can adapt to new situations

Move beyond
- graphical user interfaces
- to expert instruments

To do this:
- Extract widgets from applications
- to create personal instruments

Human-Computer Partnerships

What do we mean by 'partnership' ?

Take a taxi

Driver in control

What do we mean by ‘partnership’ ?

Take a taxi
  Driver in control

Drive a motorcycle
  User in control

What do we mean by ‘partnership’ ?

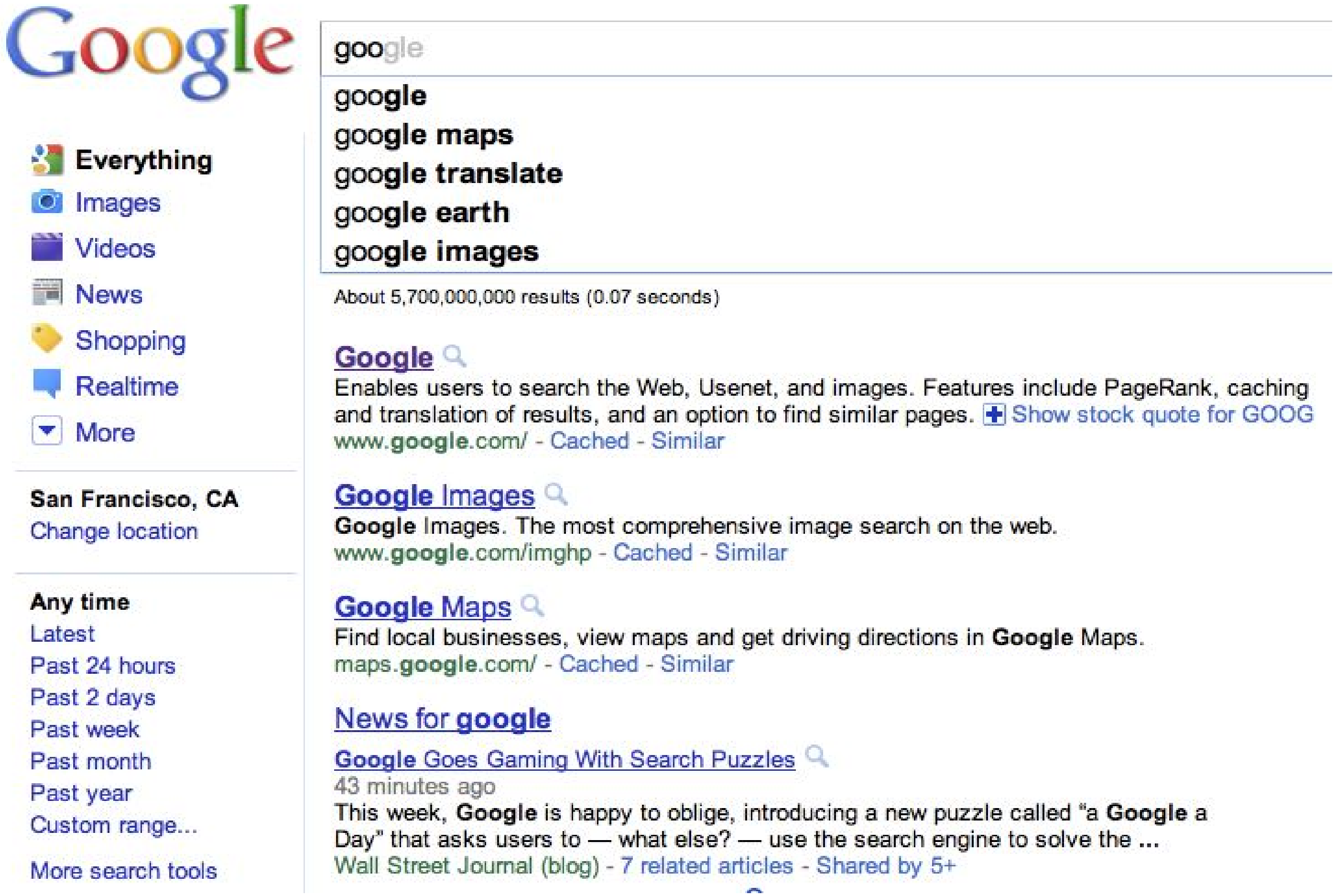
Take a taxi
  Driver in control

Drive a motorcycle
  User in control

Ride a horse
  Shared control

A ‘simple’ human-computer partnership

User types – Google suggests – User chooses



About 5,700,000,000 results (0.07 seconds)

Google
Enables users to search the Web, Usenet, and images. Features include PageRank, caching and translation of results, and an option to find similar pages. ➕ Show stock quote for GOOG
www.**google**.com/ - Cached - Similar

Google Images
Google Images. The most comprehensive image search on the web.
www.**google**.com/imghp - Cached - Similar

Google Maps
Find local businesses, view maps and get driving directions in **Google** Maps.
maps.**google**.com/ - Cached - Similar

News for **google**

Google Goes Gaming With Search Puzzles
43 minutes ago
This week, **Google** is happy to oblige, introducing a new puzzle called "a **Google** a Day" that asks users to — what else? — use the search engine to solve the **...**
Wall Street Journal (blog) - 7 related articles - Shared by 5+

Focus on interaction, not interfaces

How can we let users control interaction
in a flexible, reusable way?

How to develop expertise
without constantly relearning skills?

Co-adaptive Instruments

Separate *interaction* from data and functionality

Interaction becomes a first-class object

Key phenomenon: *Co-adaptation*

Users *adapt* to a new system

they learn to use it

Users *adapt* the new system to their own needs

they appropriate and change it

Co-adaption

Inspired by co-evolution in biology
  Organisms create their environment
  even as they adapt to it

Anaerobic bacteria change the atmosphere
  making it possible for aerobic bacteria to emerge

Users change spreadsheets from an addition tool
  to a tool for exploring 'what if' scenarios

Reciprocal Co-adaptation

People adapt their behavior to technology
… they learn it
People adapt the technology for their own purposes
… they appropriate it

Computers adapt their behavior to people
… machine learning
Computers adapt human behavior
… training

Our vision:

Software tools should be incrementally learnable

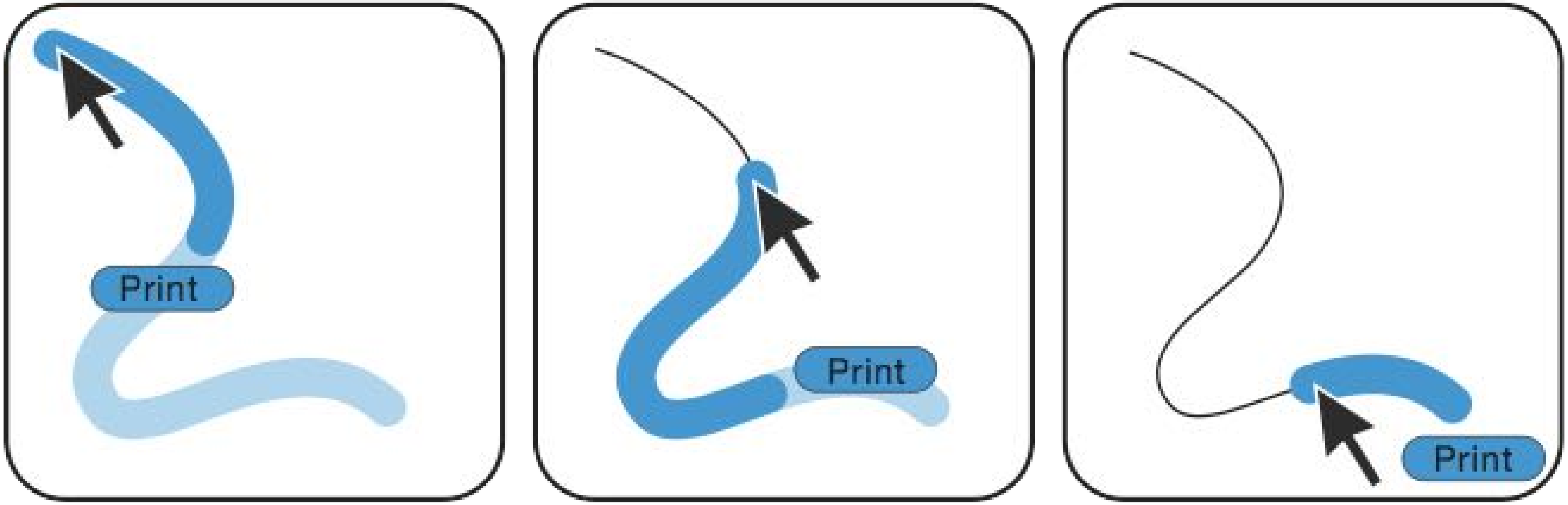
People should choose and control their own tools

Software tools should be easy to appropriate

Octopocus: Learning complex gestures

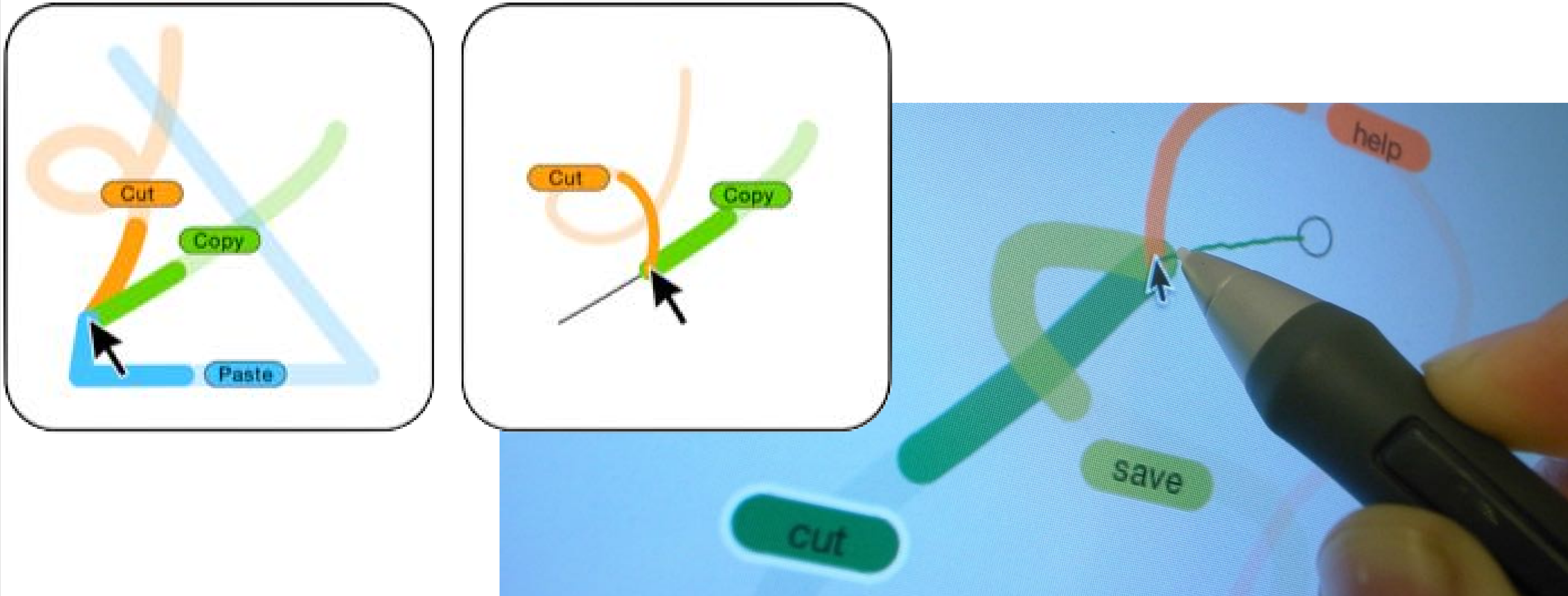
Dynamic partnership:

Progressive algorithms reveal intermediate recognition states



Octopocus: Learning complex gestures

Experts *just do it*

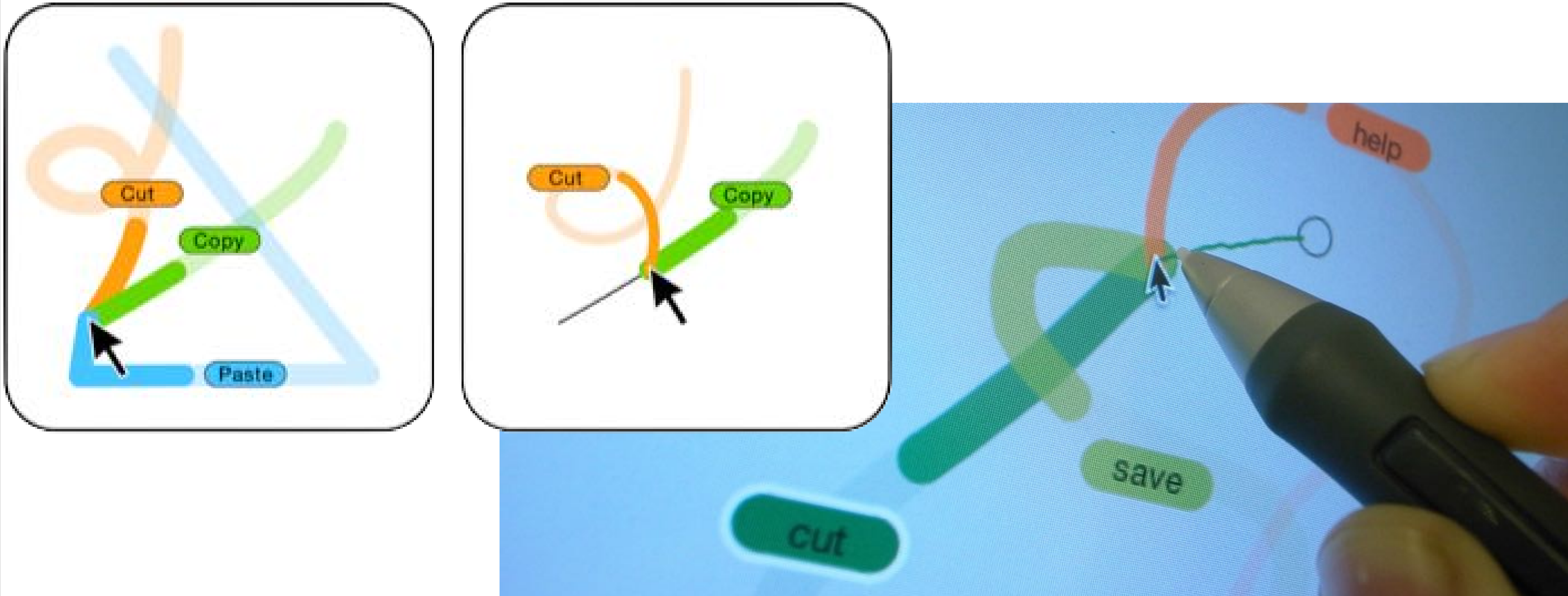


Octopocus: Learning complex gestures

Experts *just do it*

Novices *hesitate* … which activates:

feedforward shows current available gestures
feedback shows what the recognizer sees



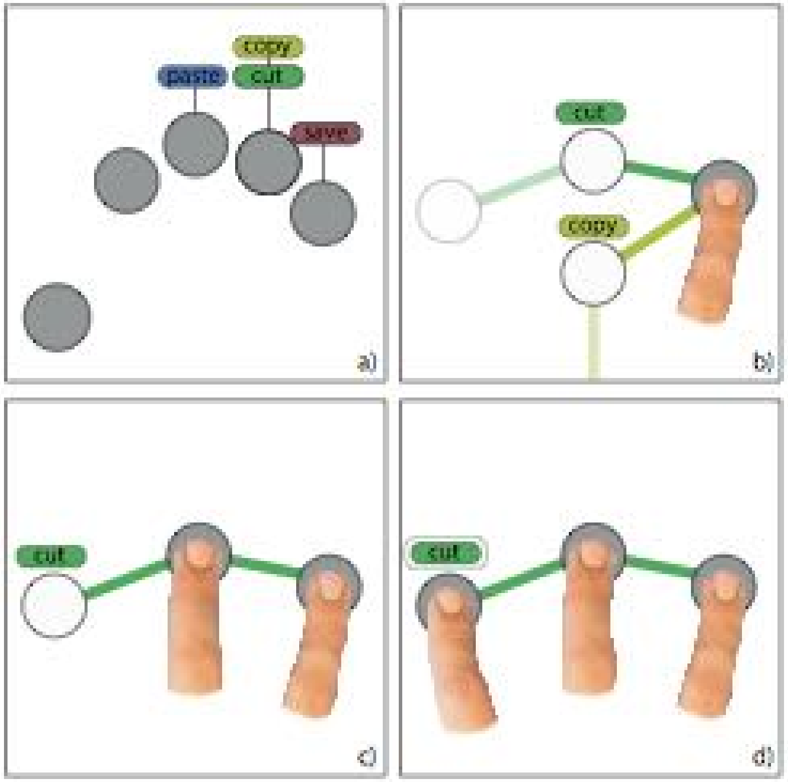
OctoPocus is a dynamic guide providing
continuous feedforward and feedback
that helps users to execute gesture-based commands

Physical tools are easy to appropriate — software tools are not

Arpege: Learning chords on a multi-touch surface

Beyond one- and two-finger gestures :

- novice to expert transition
- feedforward and feedback

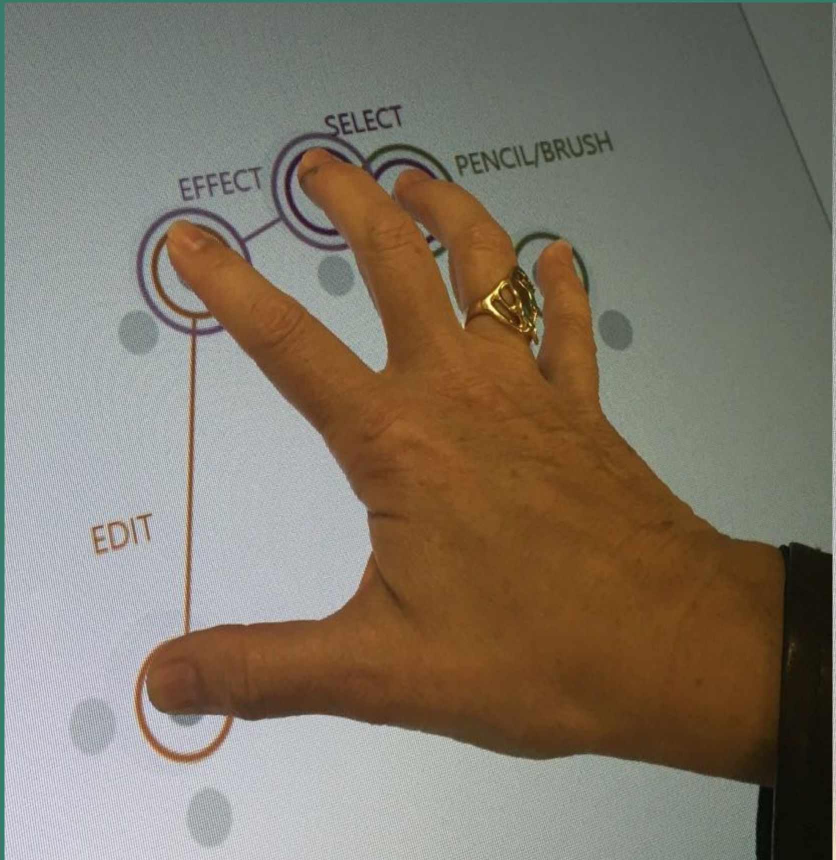


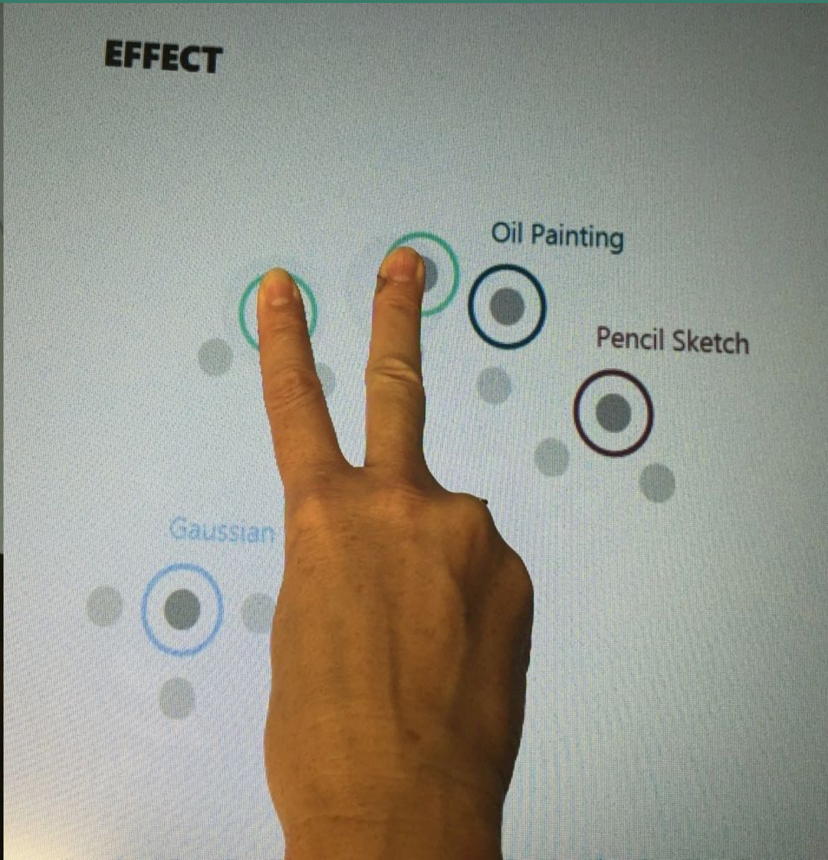
Arpege: Design and learning of multifinger chord gestures

Submitted for review
CHI 2010

Dynachord: Combining chords and gestures

Chord sequences for a larger chord vocabulary
Dynamic adjustment of parameters





Dynachord

Enter a chord with one hand to choose a color

Continuously adjust the color with the other hand

How can we help users choose and control their own tools ?

Appropriation

Interaction designers usually assume that users will focus on their system and use it as intended

Users often use systems in different ways

- They may have a different mental model of the system
- They may turn ‘mistakes’ into opportunities
- ‘Bugs’ become ‘features’

Anything that involves communication among people is usually adapted for new purposes

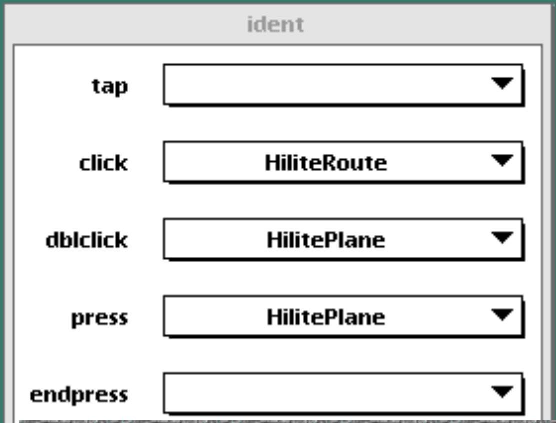
How can we help users appropriate technology ?

Creating a partnership in which
the user defines the **semantics** of the interaction
with the computer

Interaction Browser :	Linking marks to actions
Knotty Gestures :	Interacting while writing
Musink :	Creating a user-defined language
Façades :	User-reconfigurable interfaces

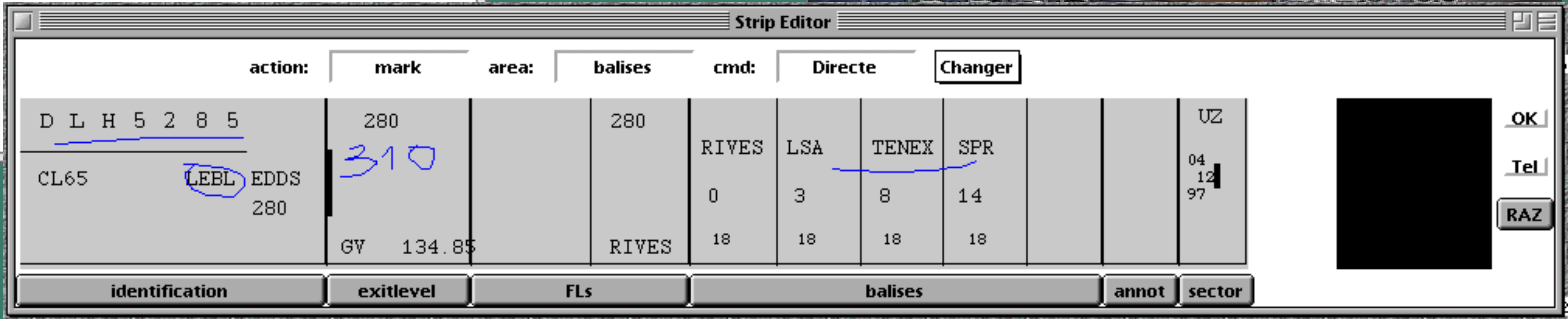
Interaction browser: User-defined commands

- Air traffic controllers annote flight strips
  - Marks can be linked to RADAR and other computer functions
  - Users define what marks mean



ident

tap	
click	HiliteRoute
dblclick	HilitePlane
press	HilitePlane
endpress	



Strip Editor

action: mark area: balises cmd: Directe

D L H 5 2 8 5
CL65 LEBL EDDS
280

280
310
GV 134.85

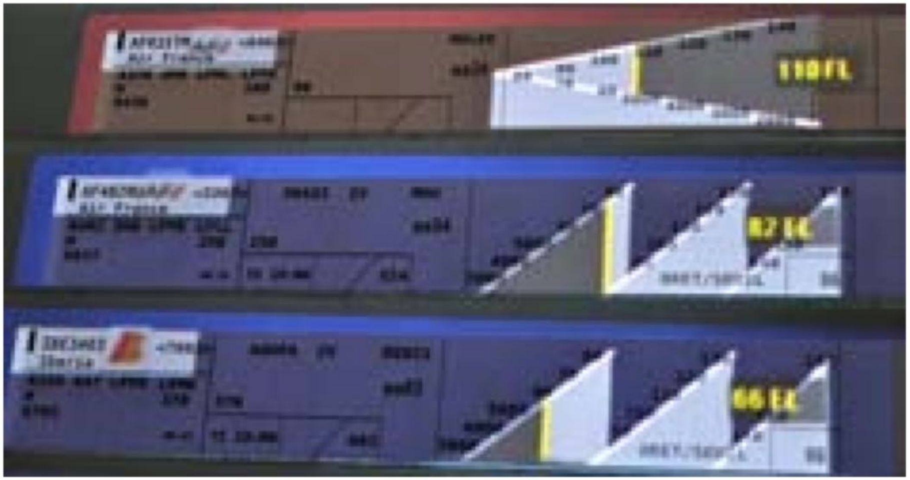
280
RIVES

RIVES	LSA	TENEX	SPR
0	3	8	14
18	18	18	18

UZ
04
12
97

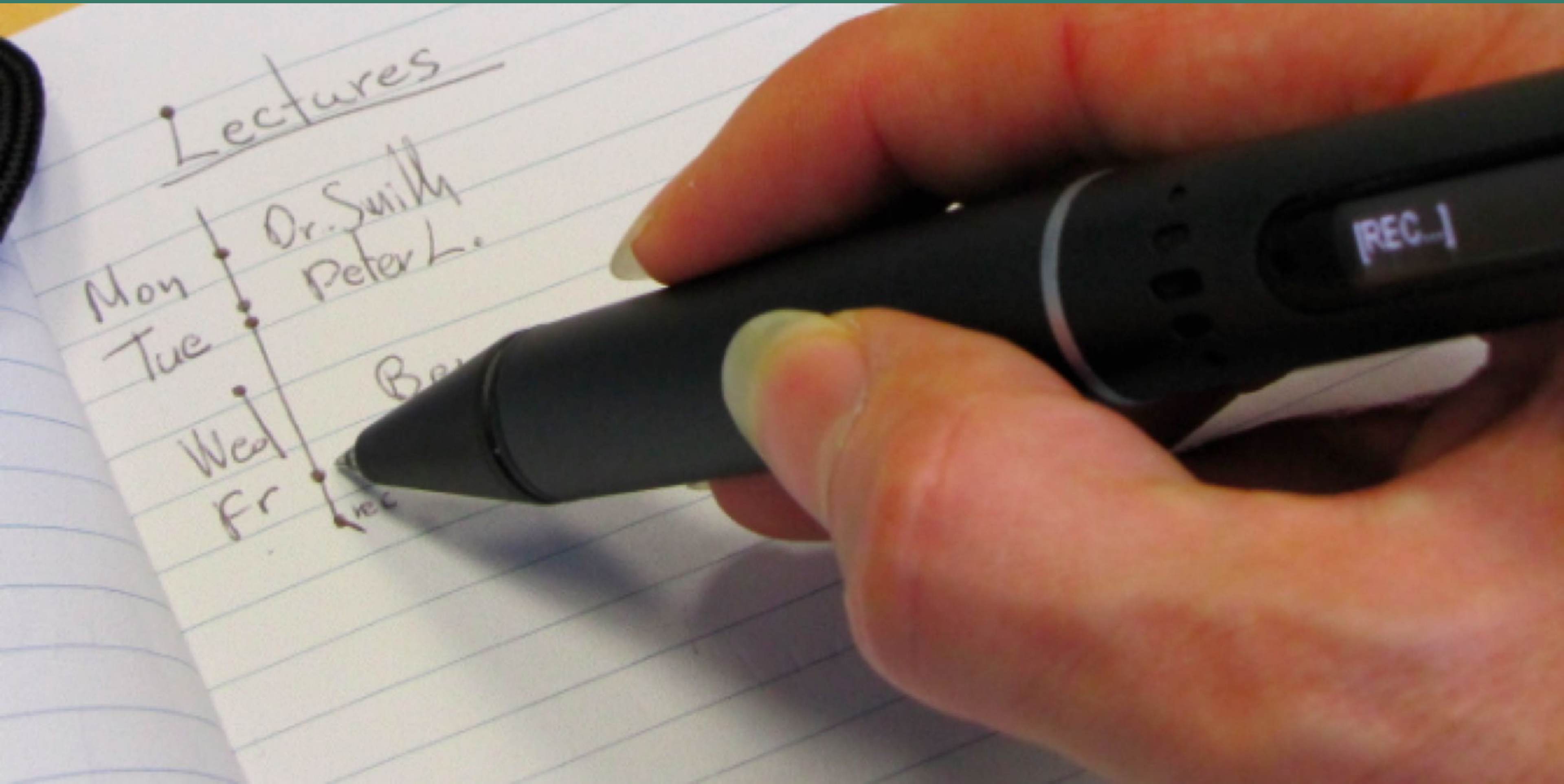
Striptic

Flights in my Hands: Coherence Concerns in Designing a Tangible Space for Air Traffic Controllers, (Letondal et al., CHI'14)



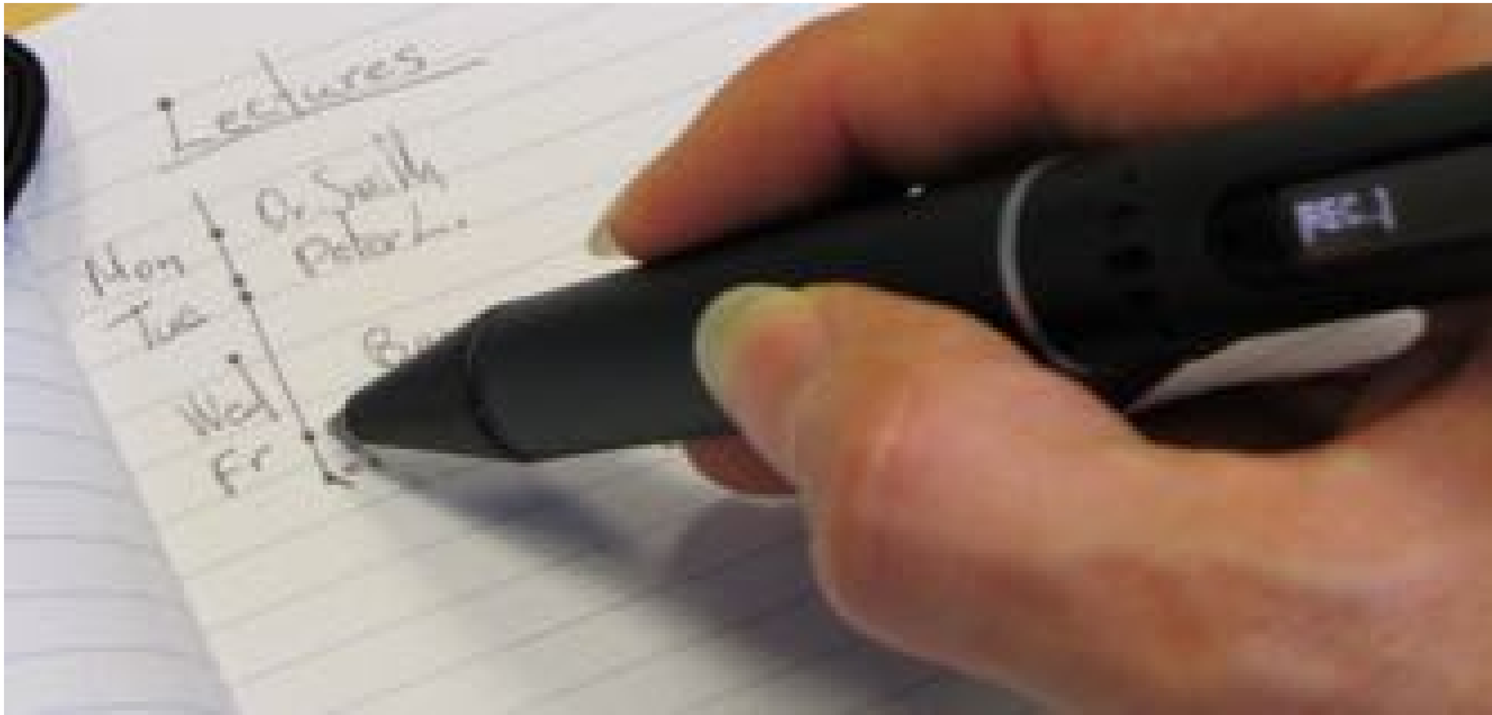
Knotty Gestures

Draw a dot, define a command
Interact while writing
Interact with command later



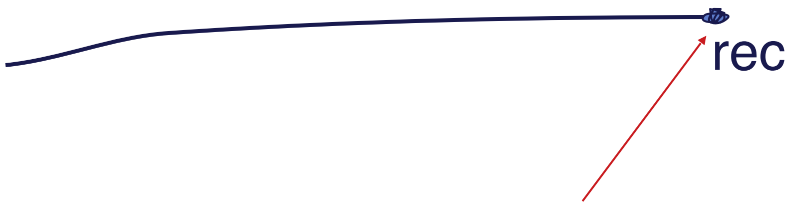
Knotty Gestures

- Interactive Paper
    - Users interact as they write
        - or define their own gestures
        - and interact with them later



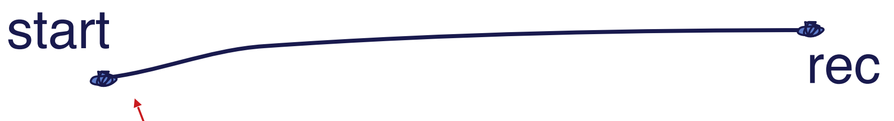
Knotty Gestures: Creating an interactive controller

Draw a line with a ‘knotty gesture’ at the end



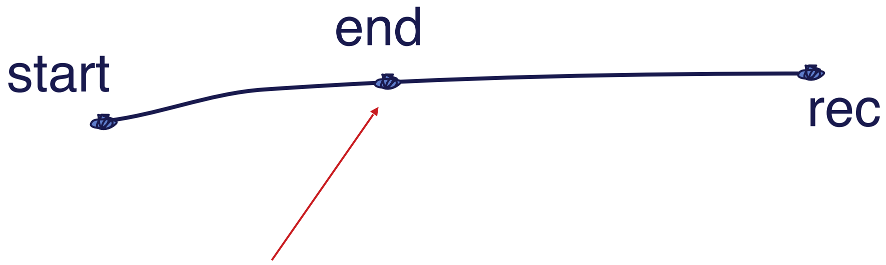
Choose “recording” to define the type of line

Knotty Gestures: Creating an interactive controller



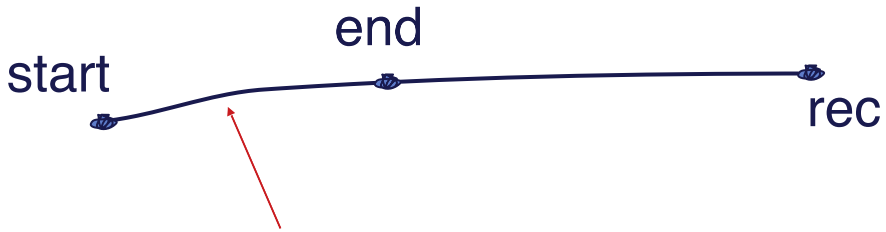
Define where the recording will start

Knotty Gestures: Creating an interactive controller



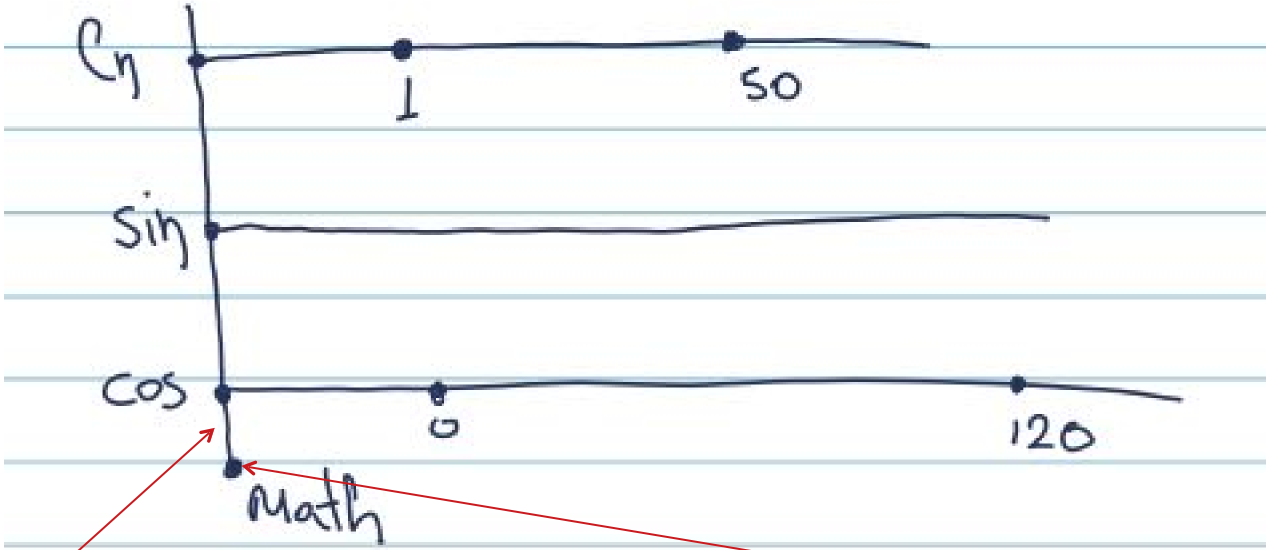
Define an end point for the recording

Knotty Gestures: Creating an interactive controller



Slide the pen along the line to move forward or backward on the recording

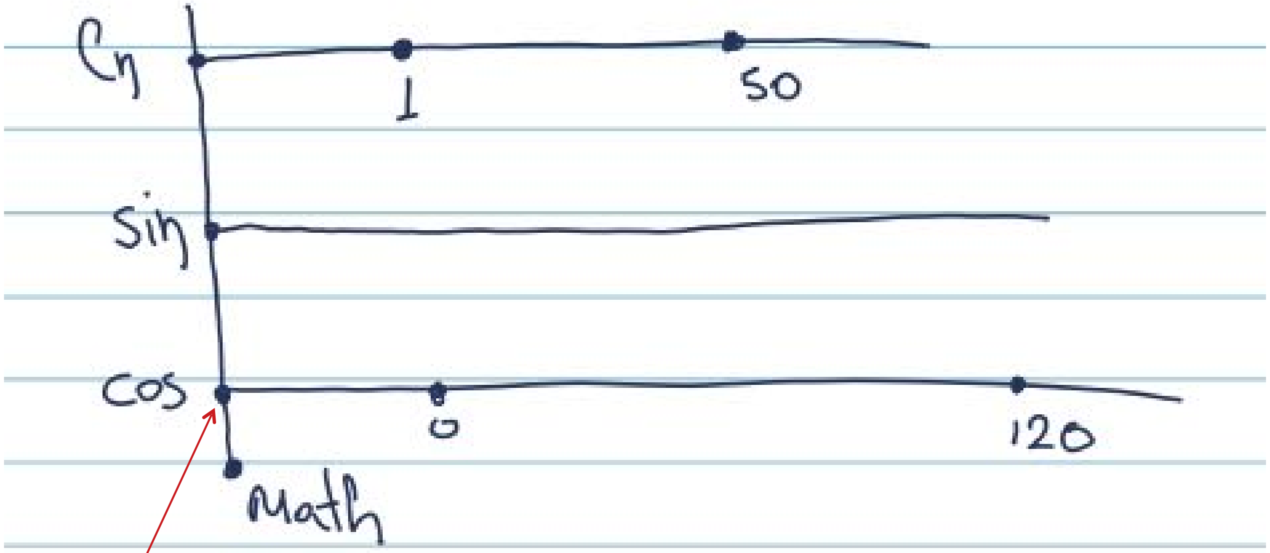
Drawing a Math Calculator



This line acts as a base for attaching mathematical value sliders

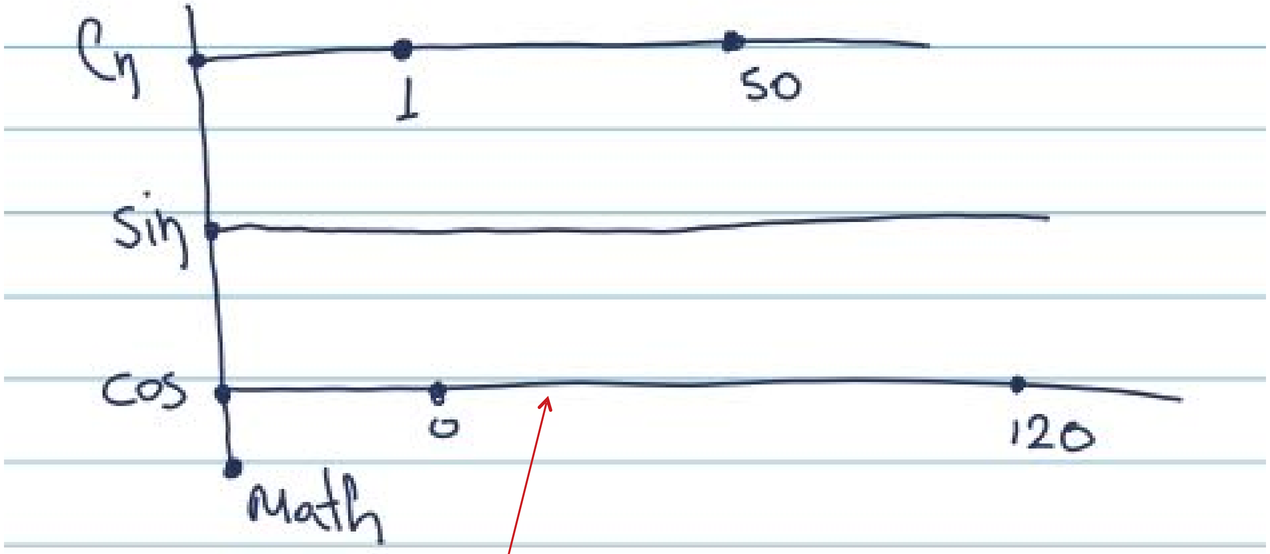
The knotty gesture at the end defines the type

Drawing a Math Calculator



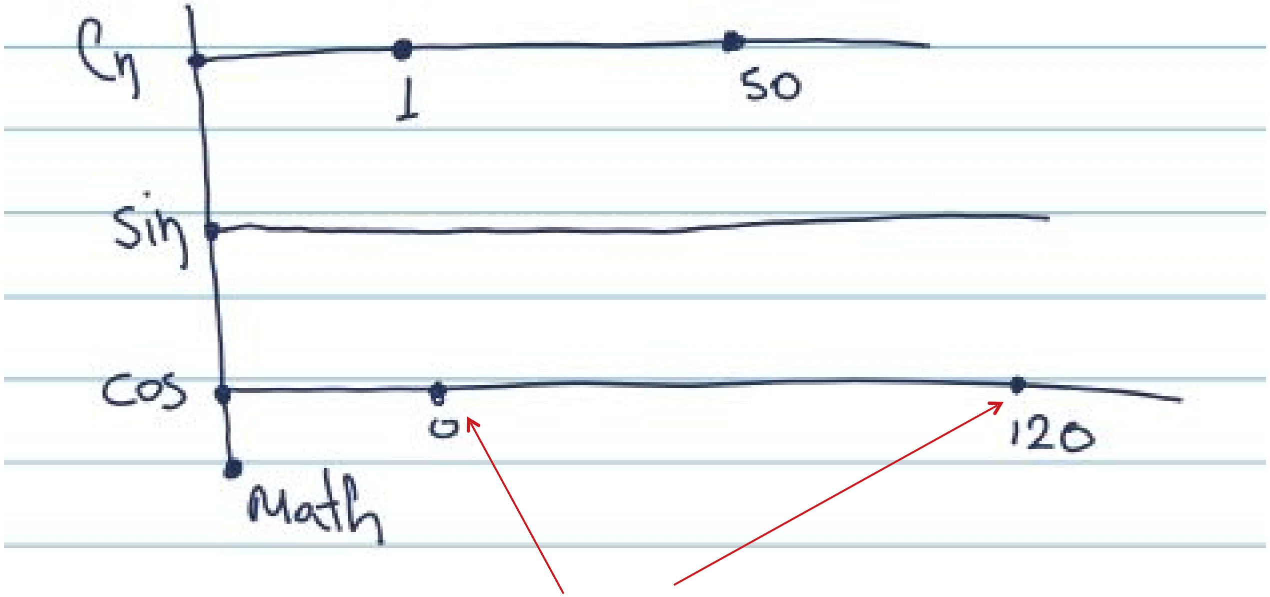
Any knot drawn on line lets the user select a mathematical function

Drawing a Math Calculator

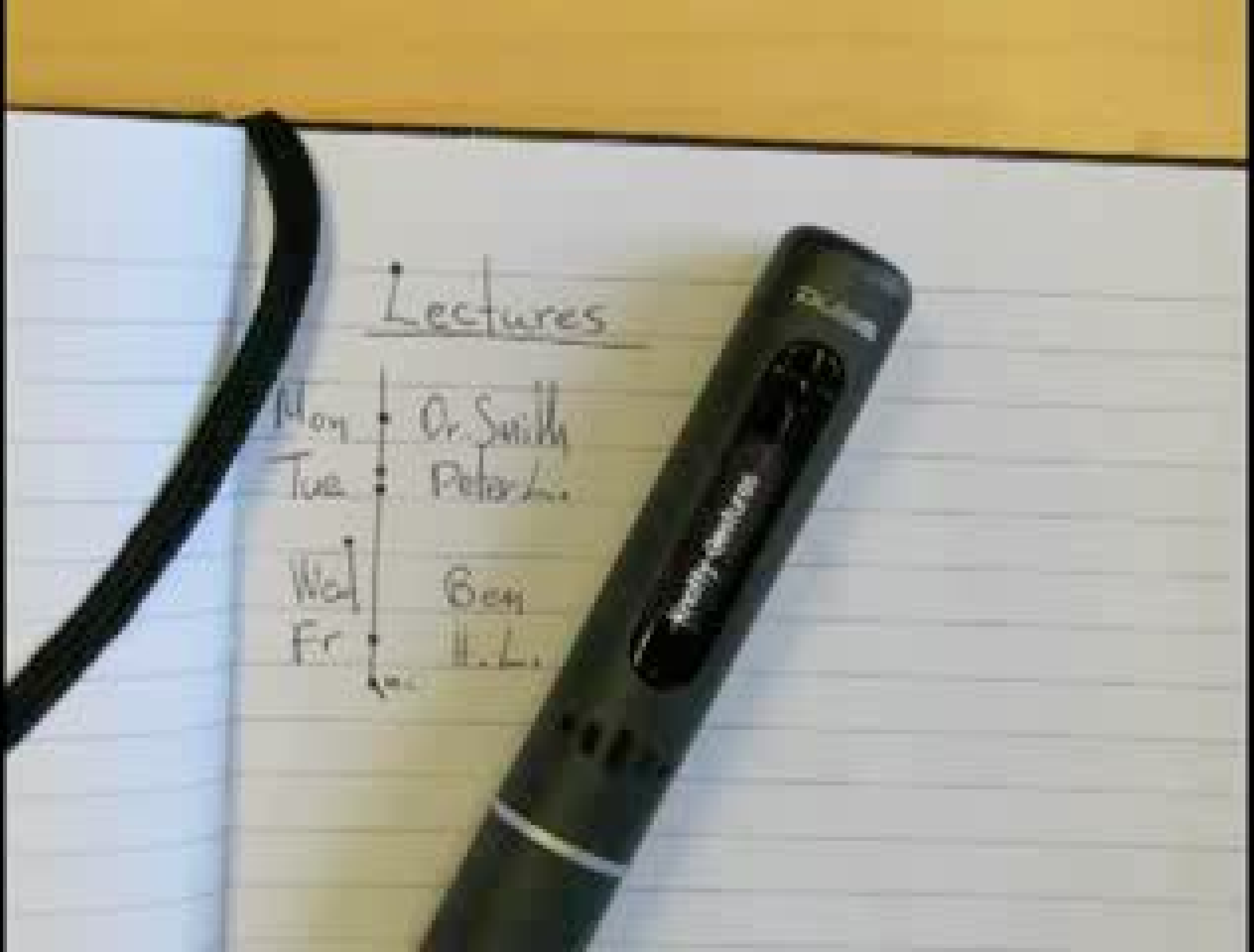


The extensions act as value controllers
Sliding the pen over the line moves through range of function values, shown on the pen display

Drawing a Math Calculator



Knots may define ranges or act as traces of past interactions with specific values



Lectures

Mon Dr Smith
Tue Peter L.
Wed Geog
Fri H.L.

But recognition is not the only problem …

Recognition must be *good enough*
- but users override and reinterpret
- no single ‘correct’ interpretation
- recognized and non-recognized gestures co-exist

Real question:
- Can Mus*ink* support the creative process?
- What are the design implications for Mus*ink* v2?

Semi-Structured Delayed Interpretation

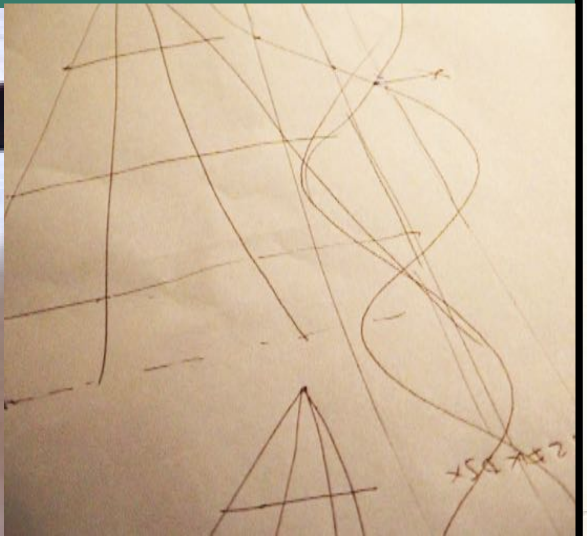
Key insights:

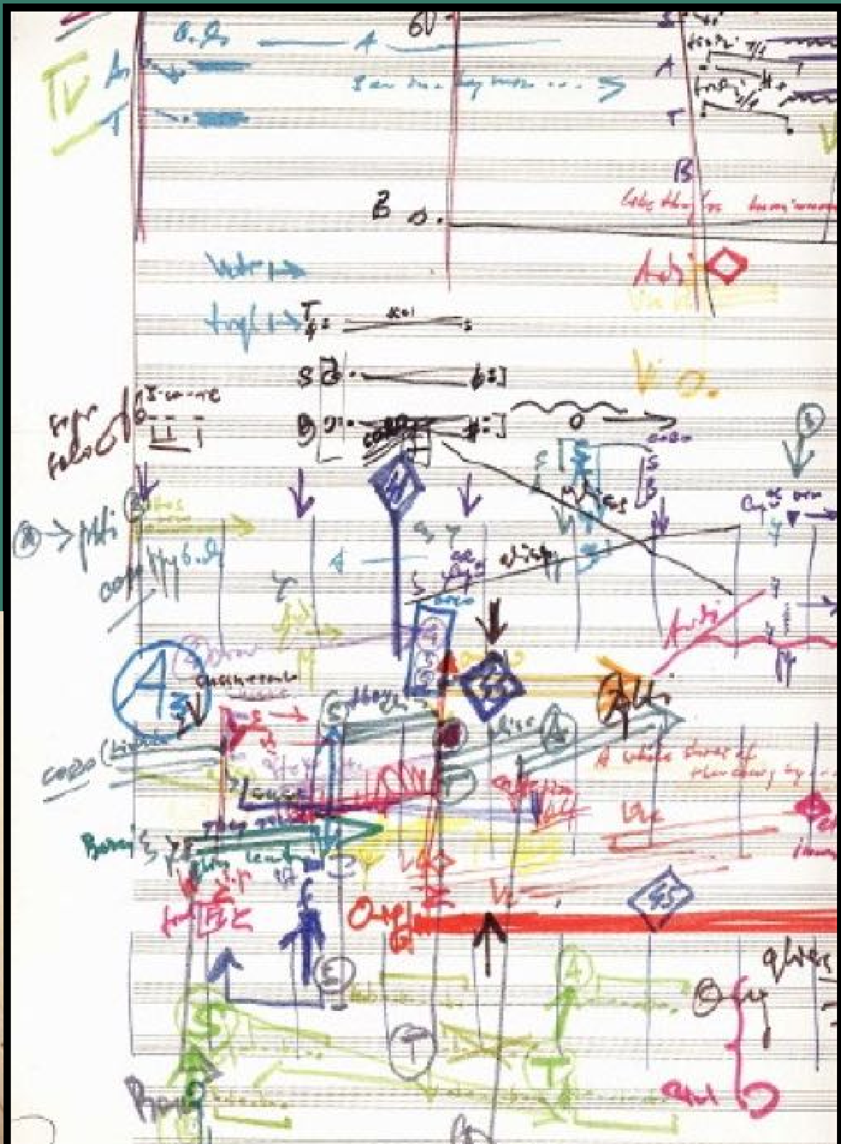
- Spatial structure on paper
  - improves recognition
  - under user's control
- Recognition need not be immediate
  - users decide *when* to intrepret
  - interpretation *changes over time*

Musink

Musicians create their own musical languages on paper

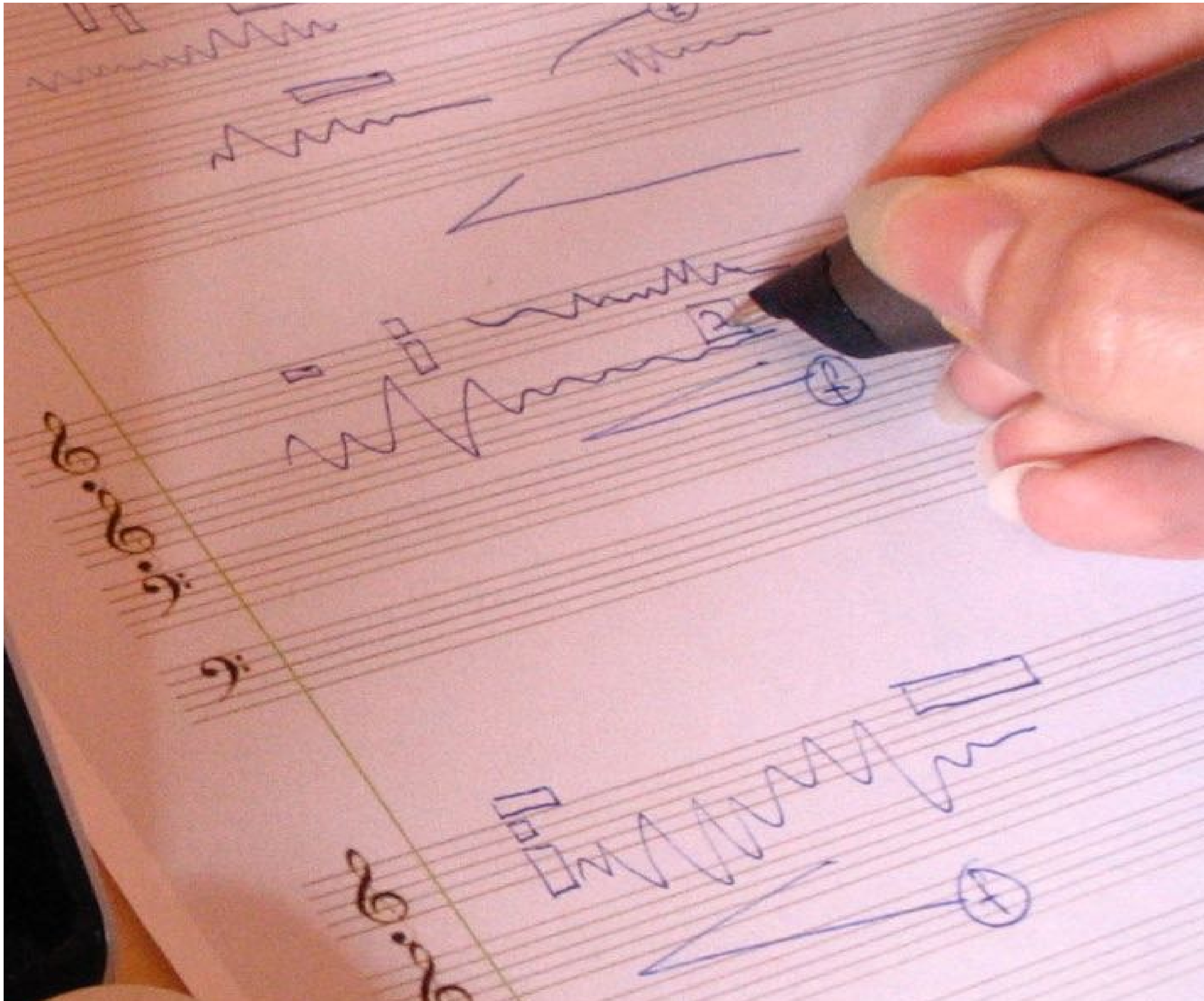
… and go back and forth between paper and computer



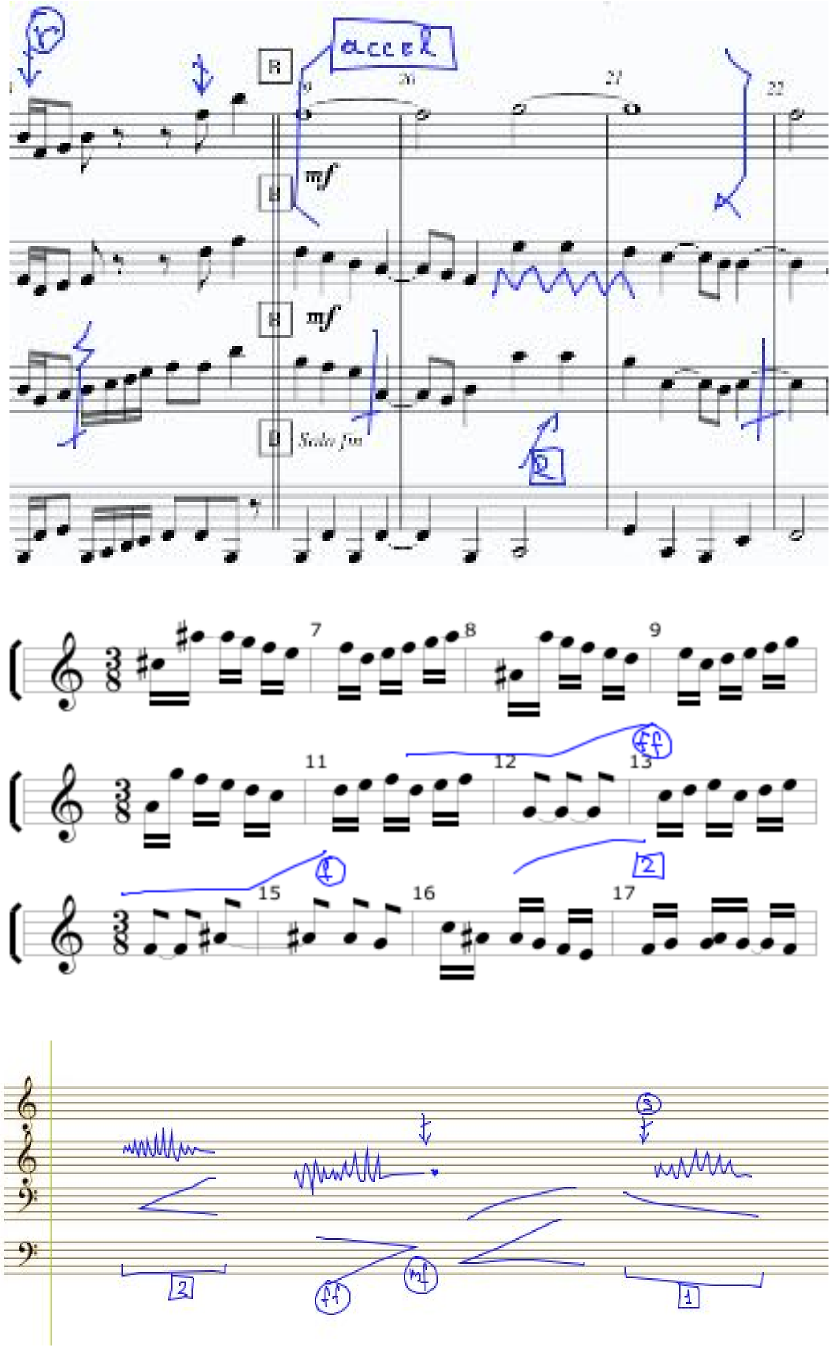


Mus*Ink* Define meaning of gestures over time

User decides if and when to interpret each gesture

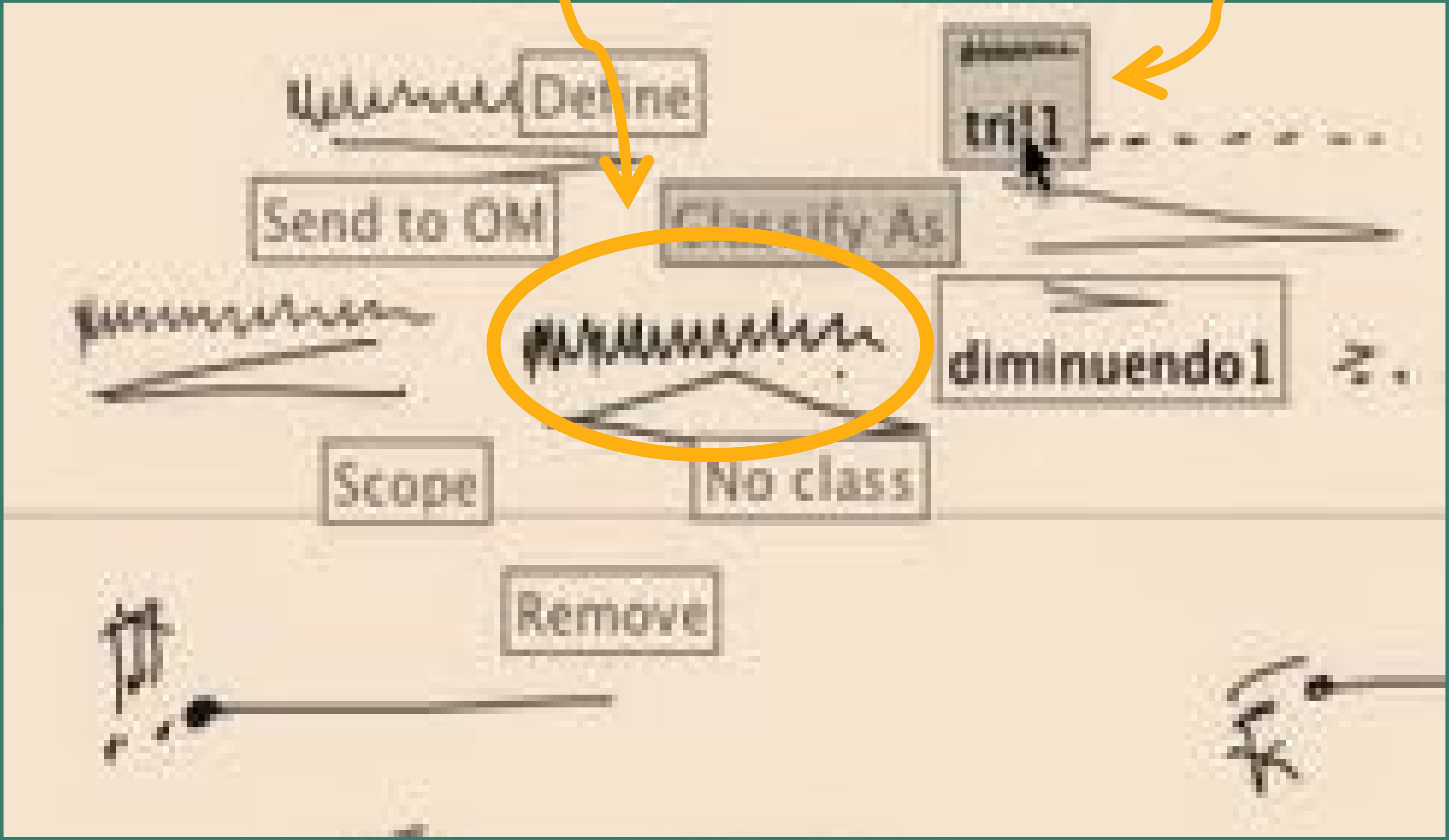


Create interactive annotations

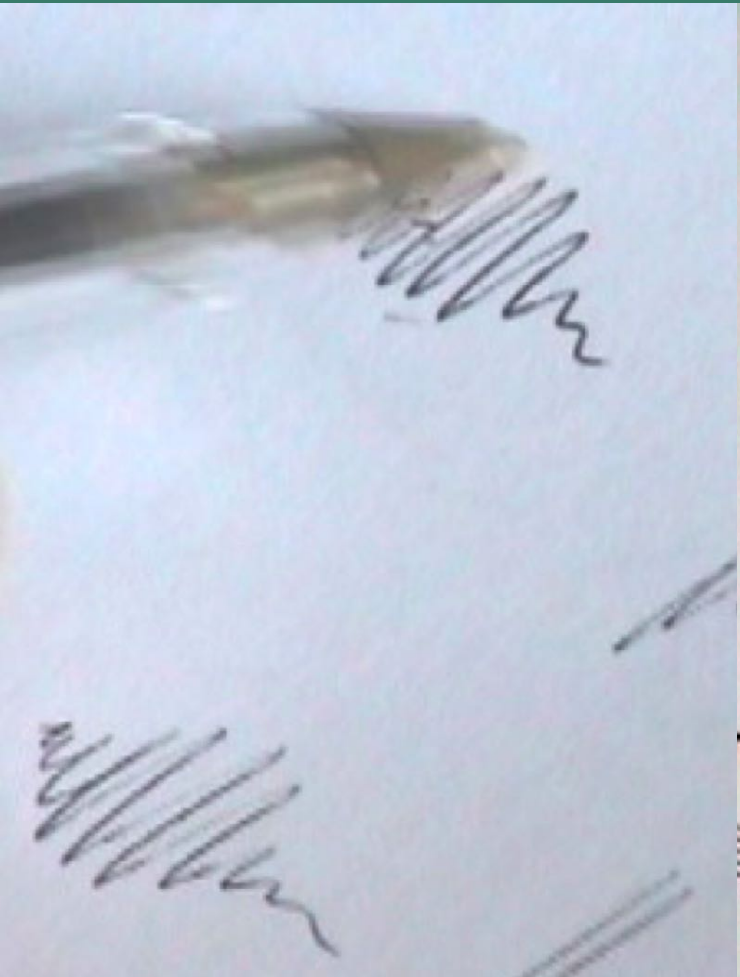


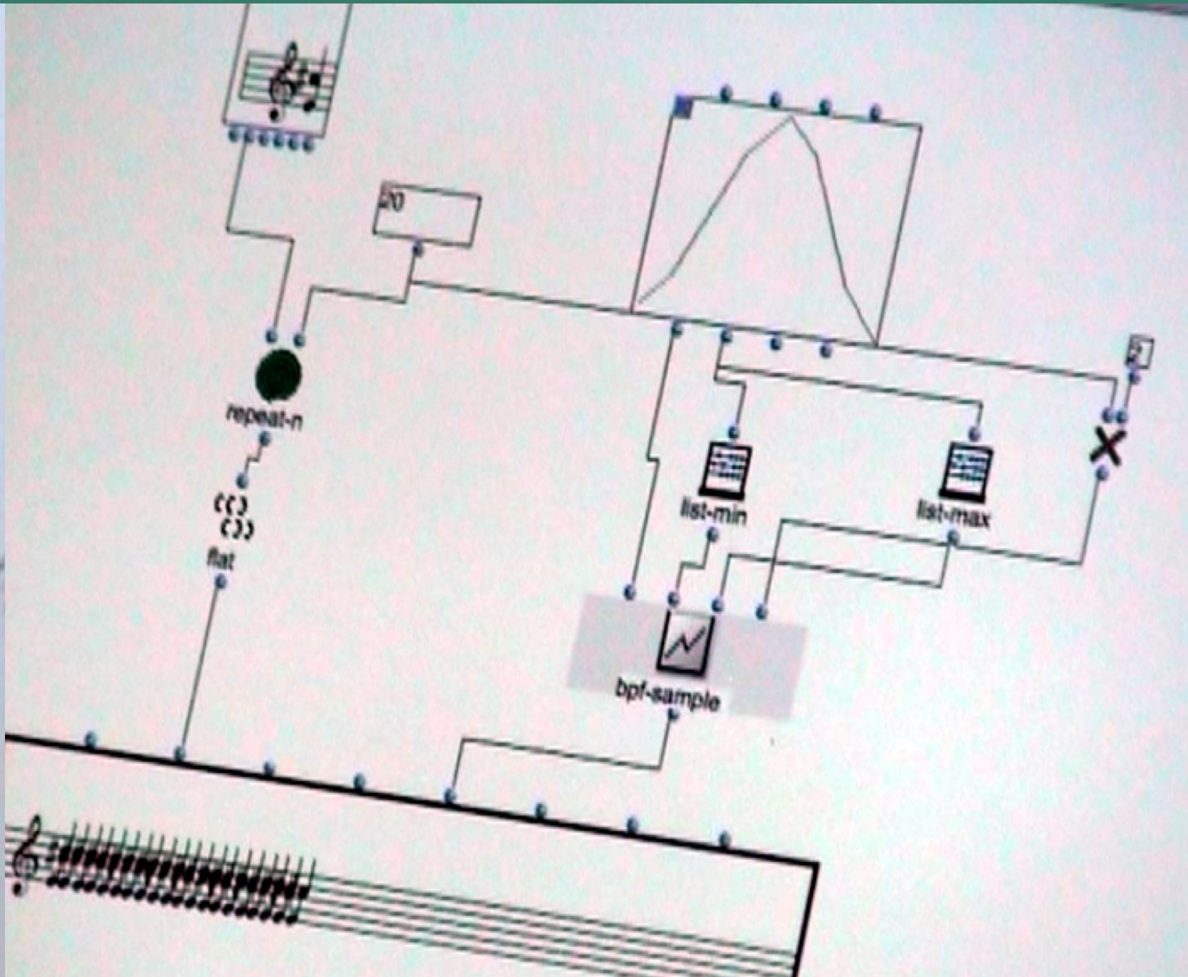
Reclassify a 'squiggle'

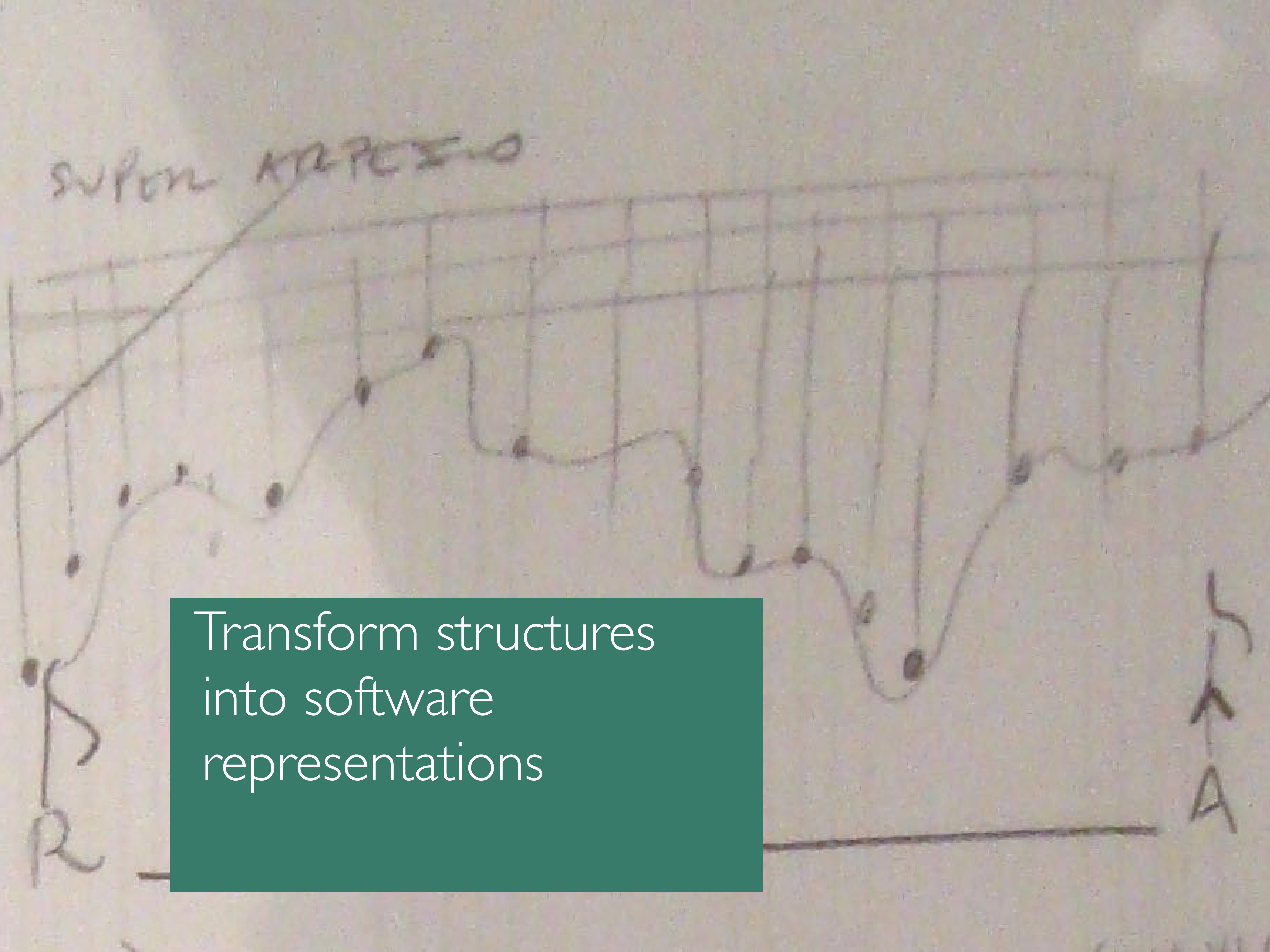
and turn it into a trill



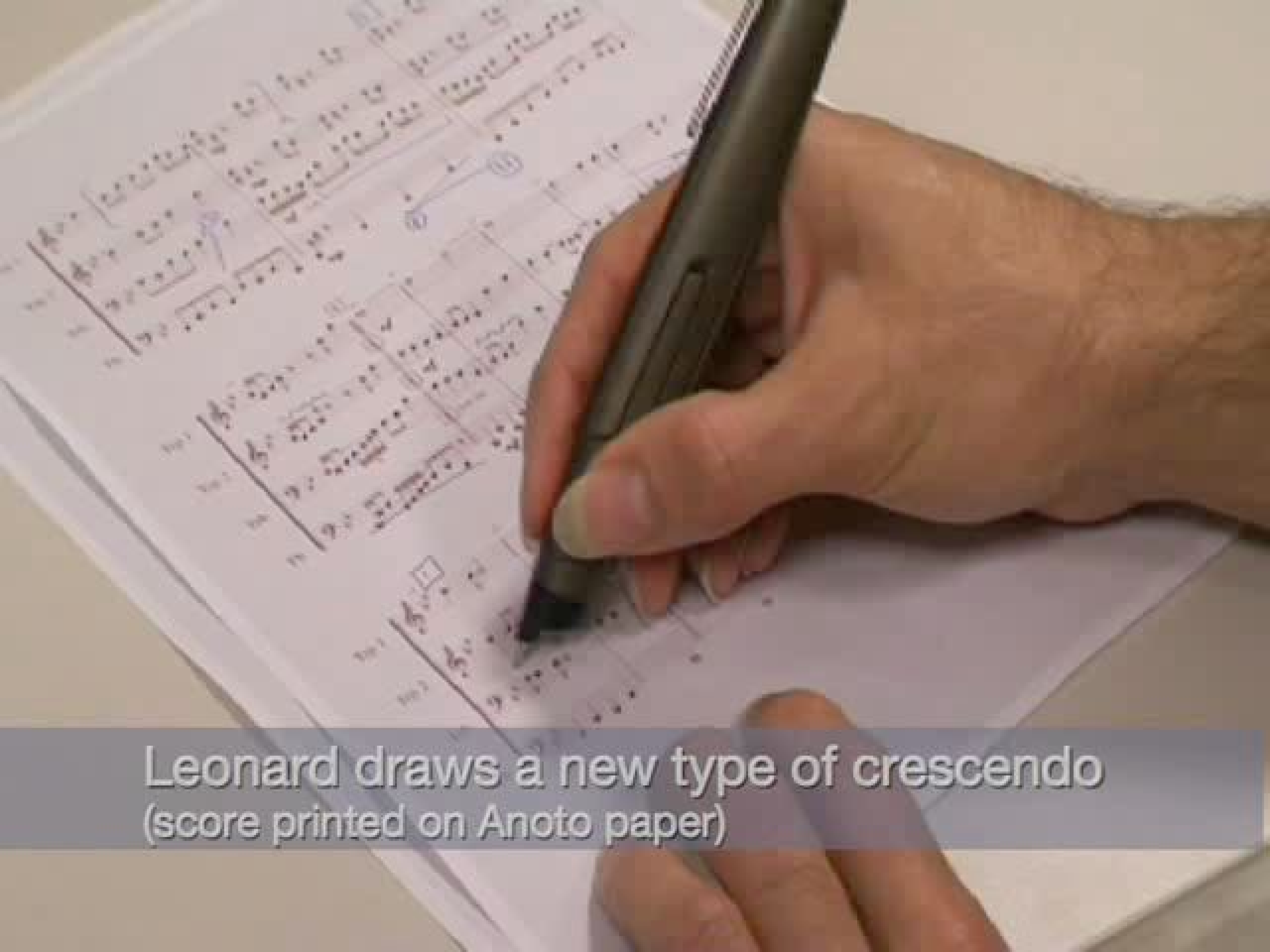
From symbols to wave forms: Interpret a tremolo gesture as a waveform by *OpenMusic*







Transform structures into software representations

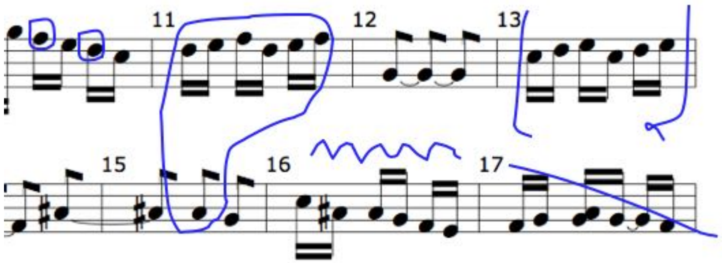


Leonard draws a new type of crescendo
(score printed on Anoto paper)

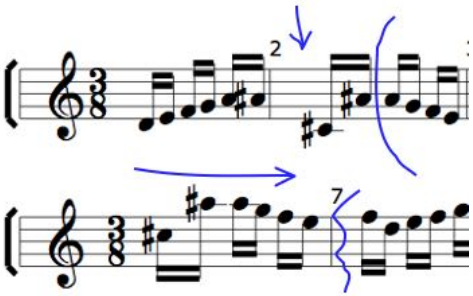
Musink: Semi-structured, delayed interpretation

Users decide when and how each annotation should be interpreted by the computer

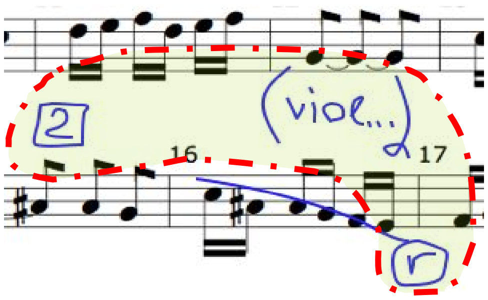
scoping gestures



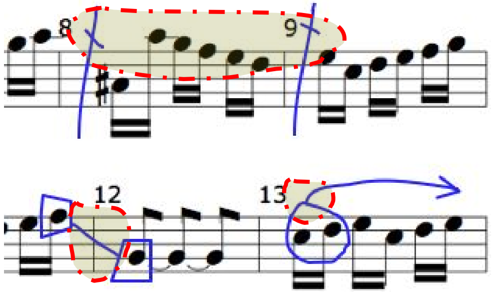
score pointers



textual elements



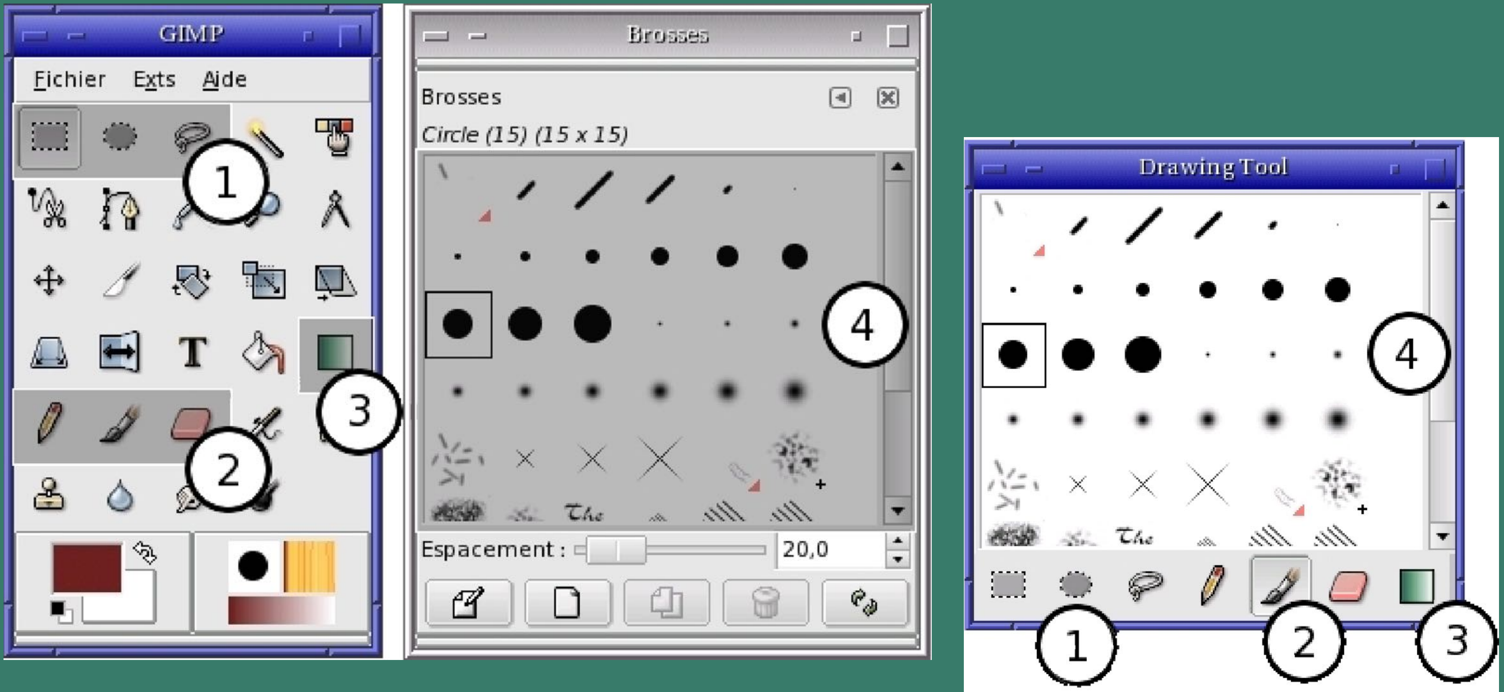
connectors



Façades: Reconfiguring interfaces

Users can adopt parts of **any** Linux interface
 and reconfigure it for specific needs

Grab three selections from GIMP and choose a brush
 and create a new, custom-made palette



Circle (15) (15 x 15)

Espacement : 20,0

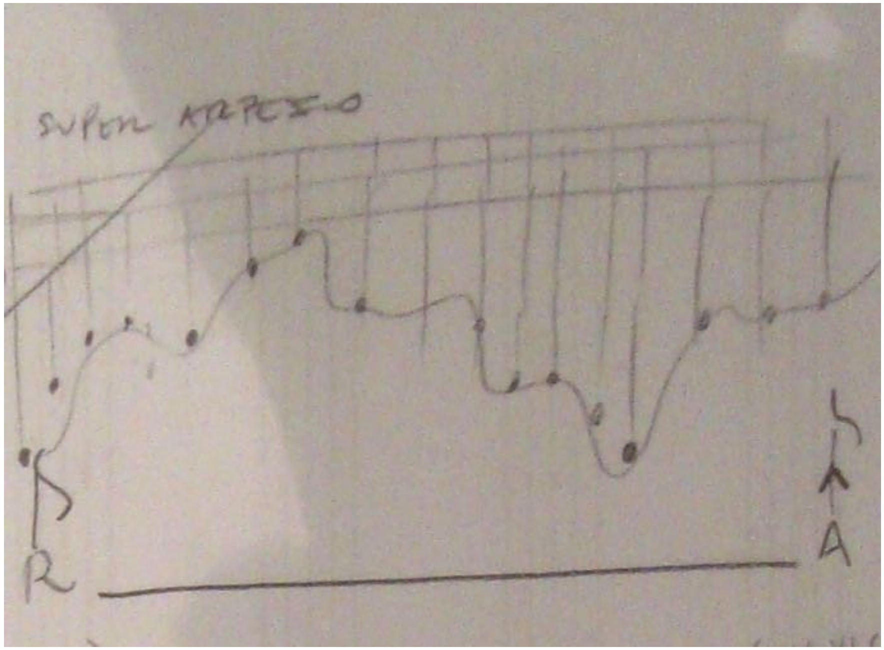
Substrates

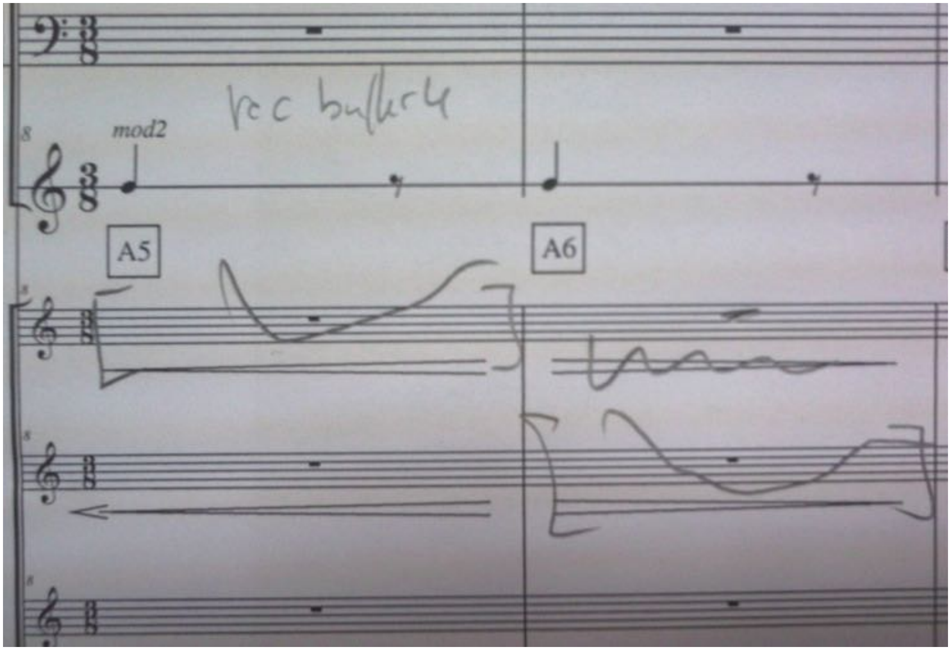
Define the structures and rules

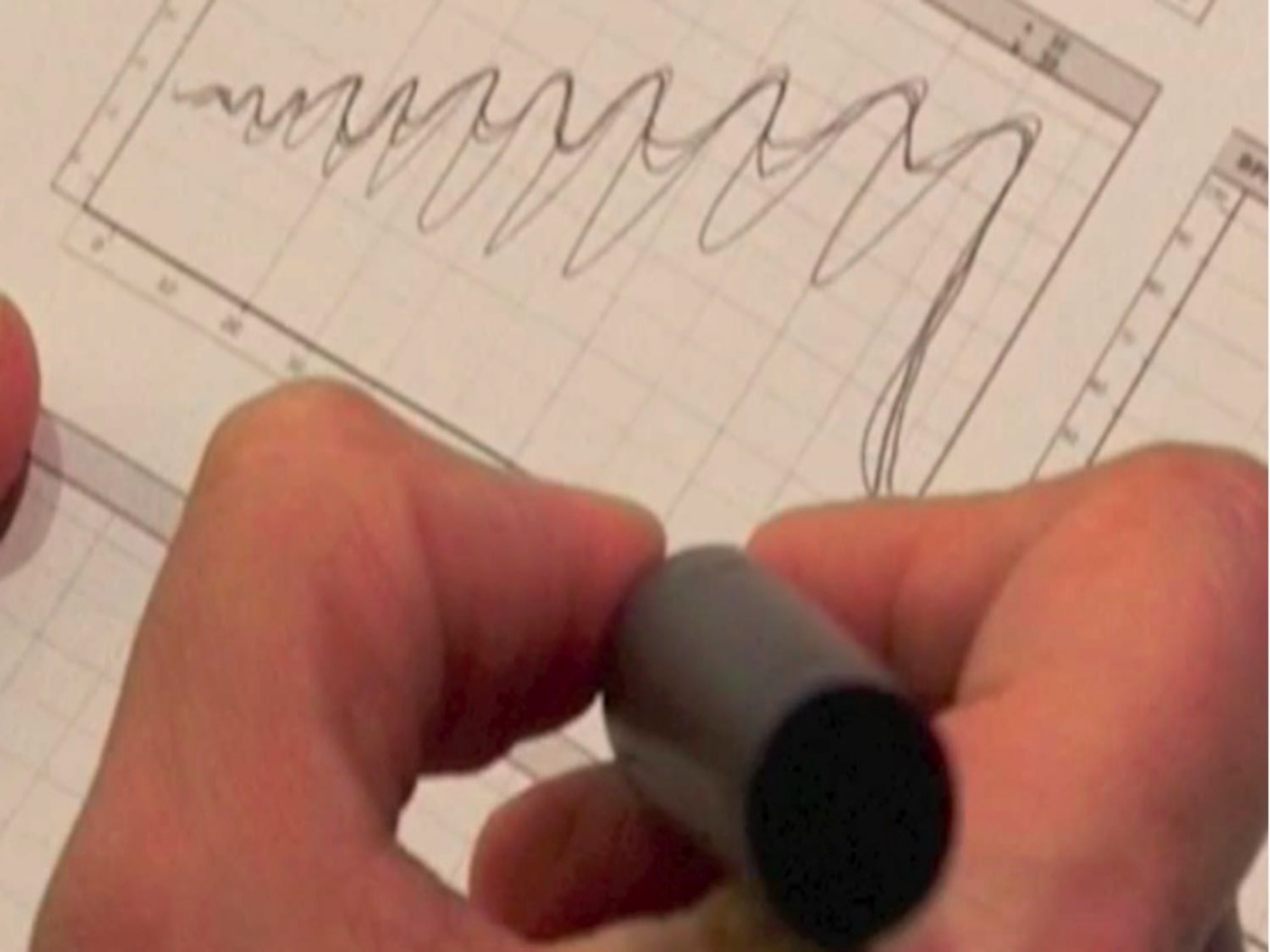
Ways to interpret the data

Different structures

to facilitate
interpretation

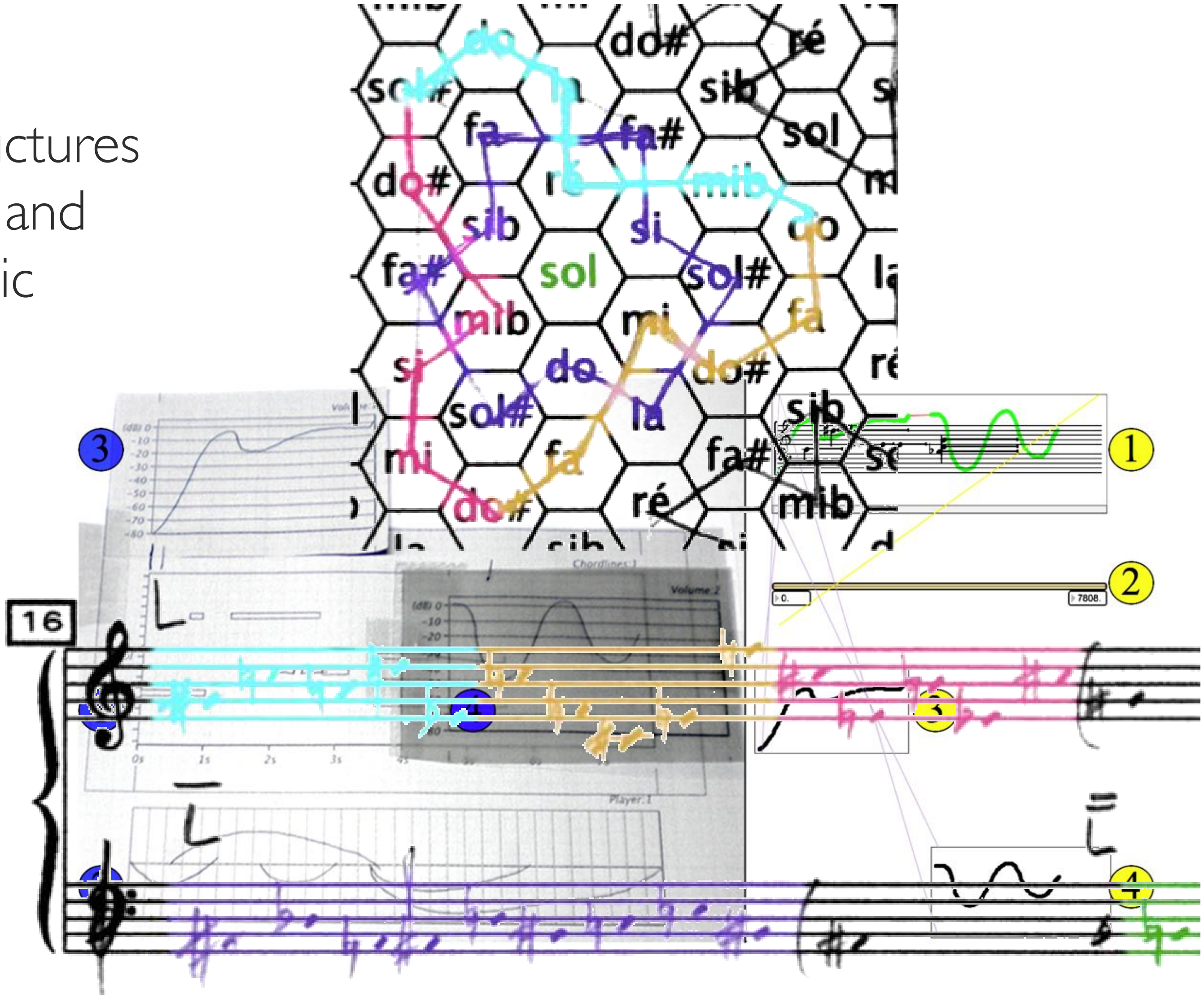


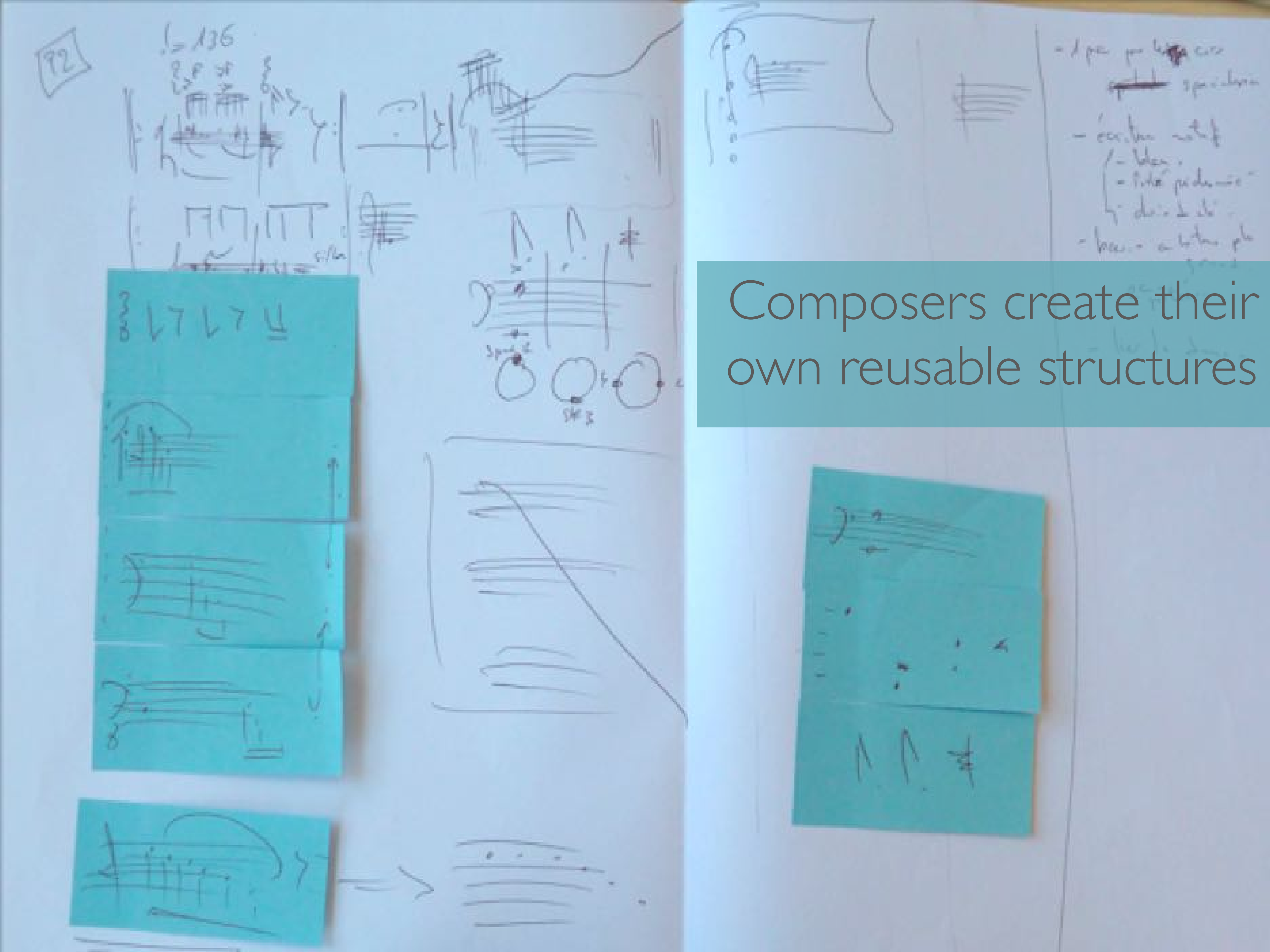




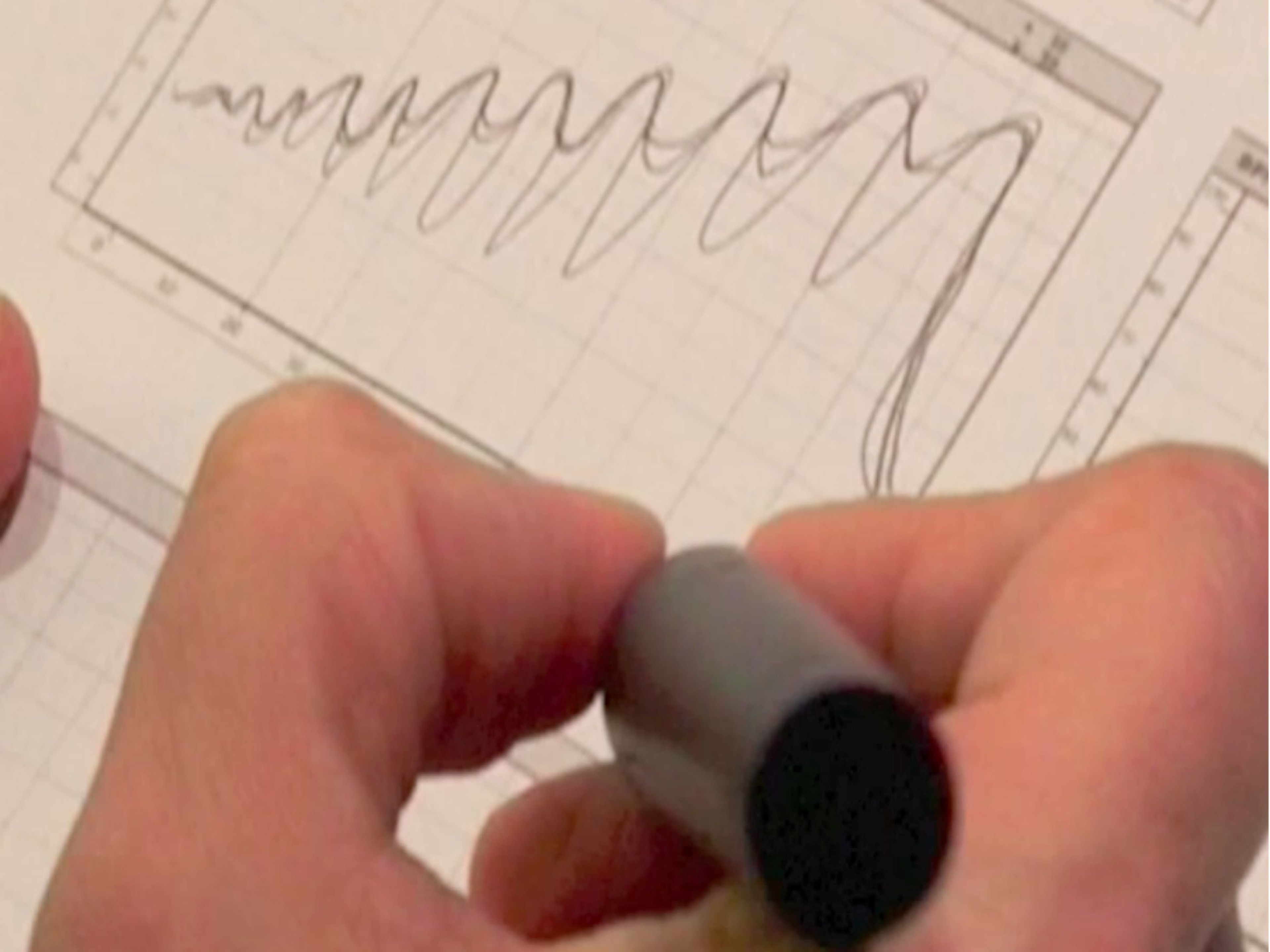
Paper Substrates: create own language & structure

Composers
create new structures
for interpreting and
composing music



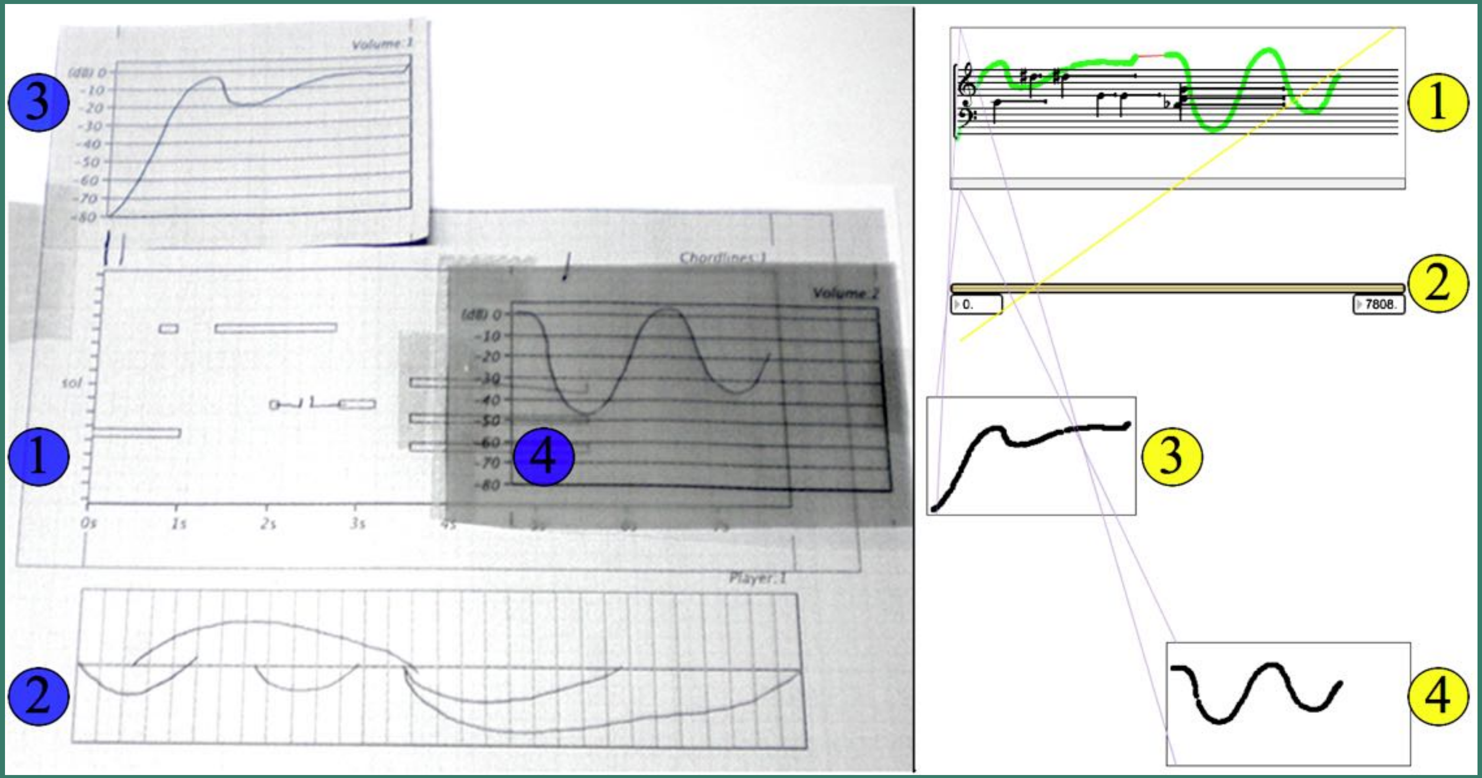


Composers create their own reusable structures

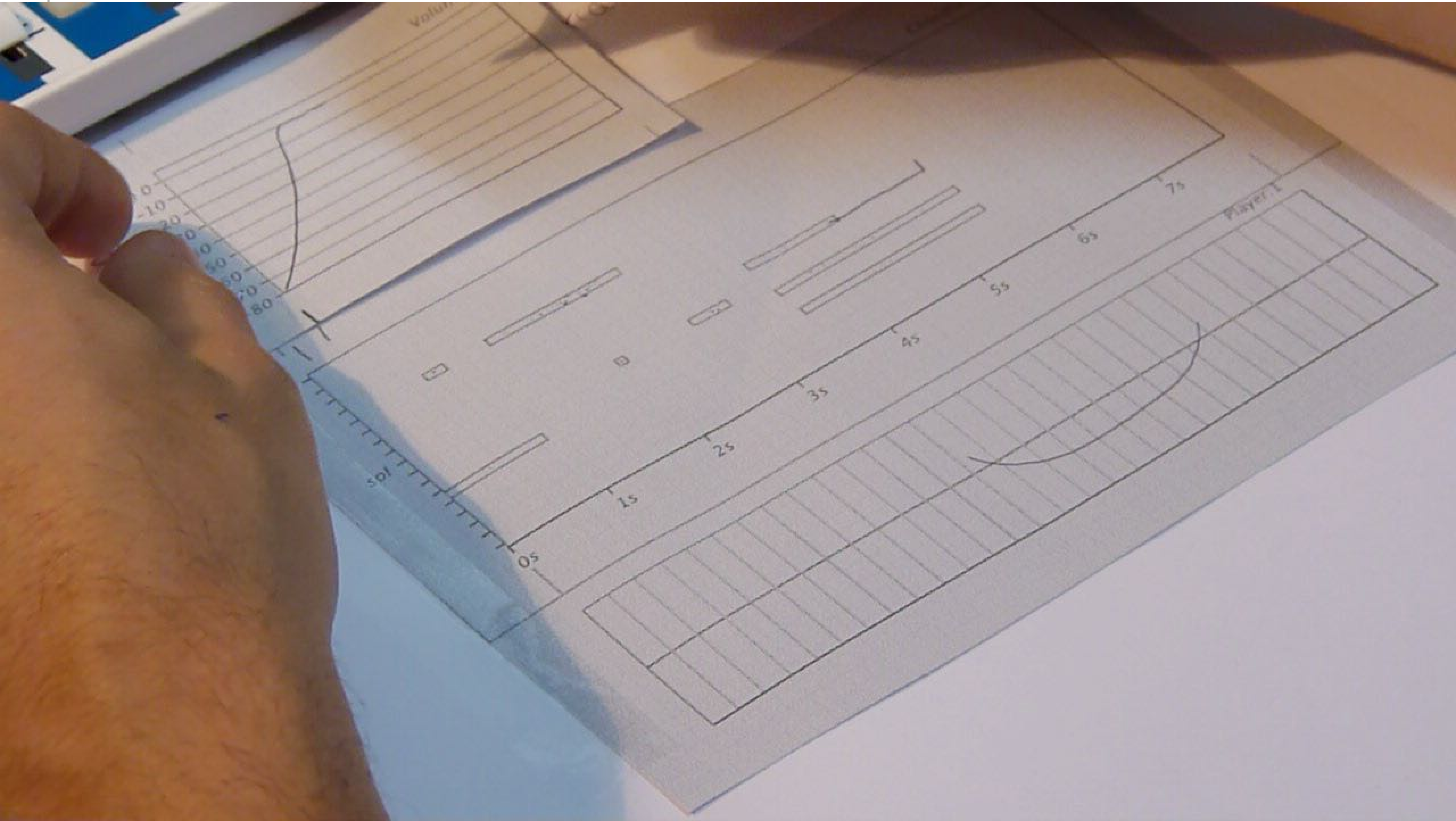


Paper Substrates

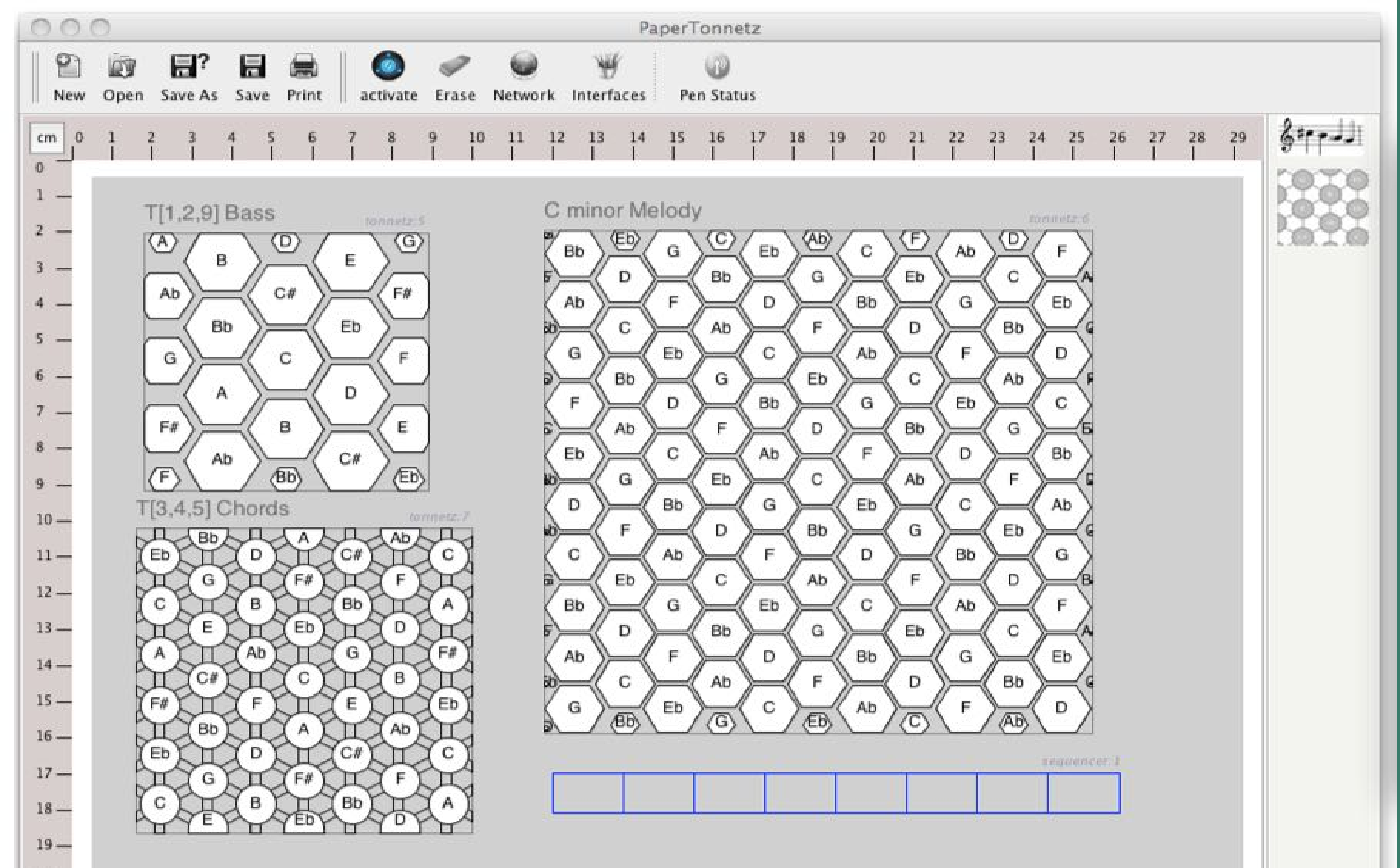
A substrate is both an instrument
for interpreting a personalized language
and an object in its own right

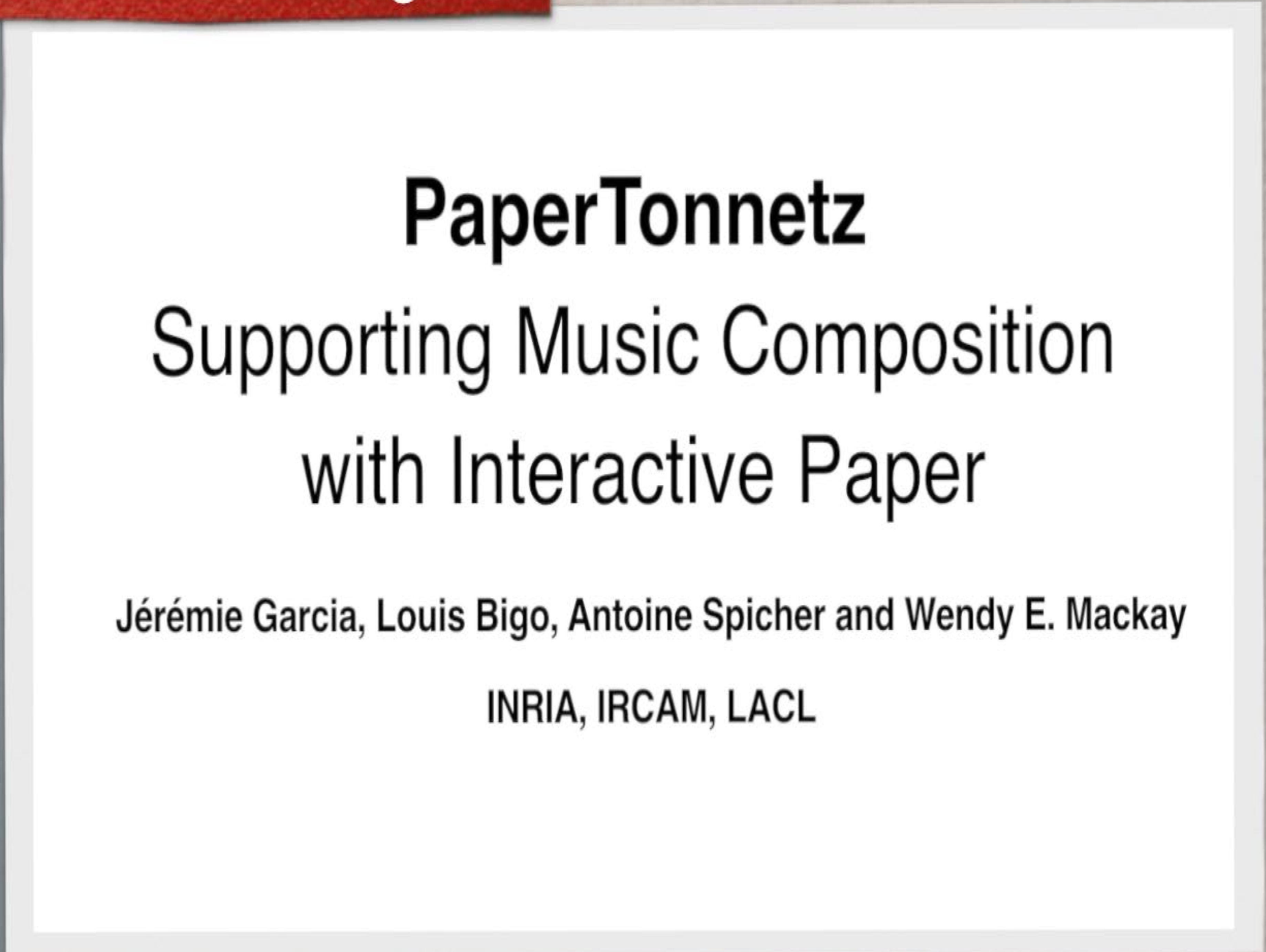


Interactive Paper Substrates for music composers



Paper Tonnetz
Draw music based on musicalrelationships among pitches



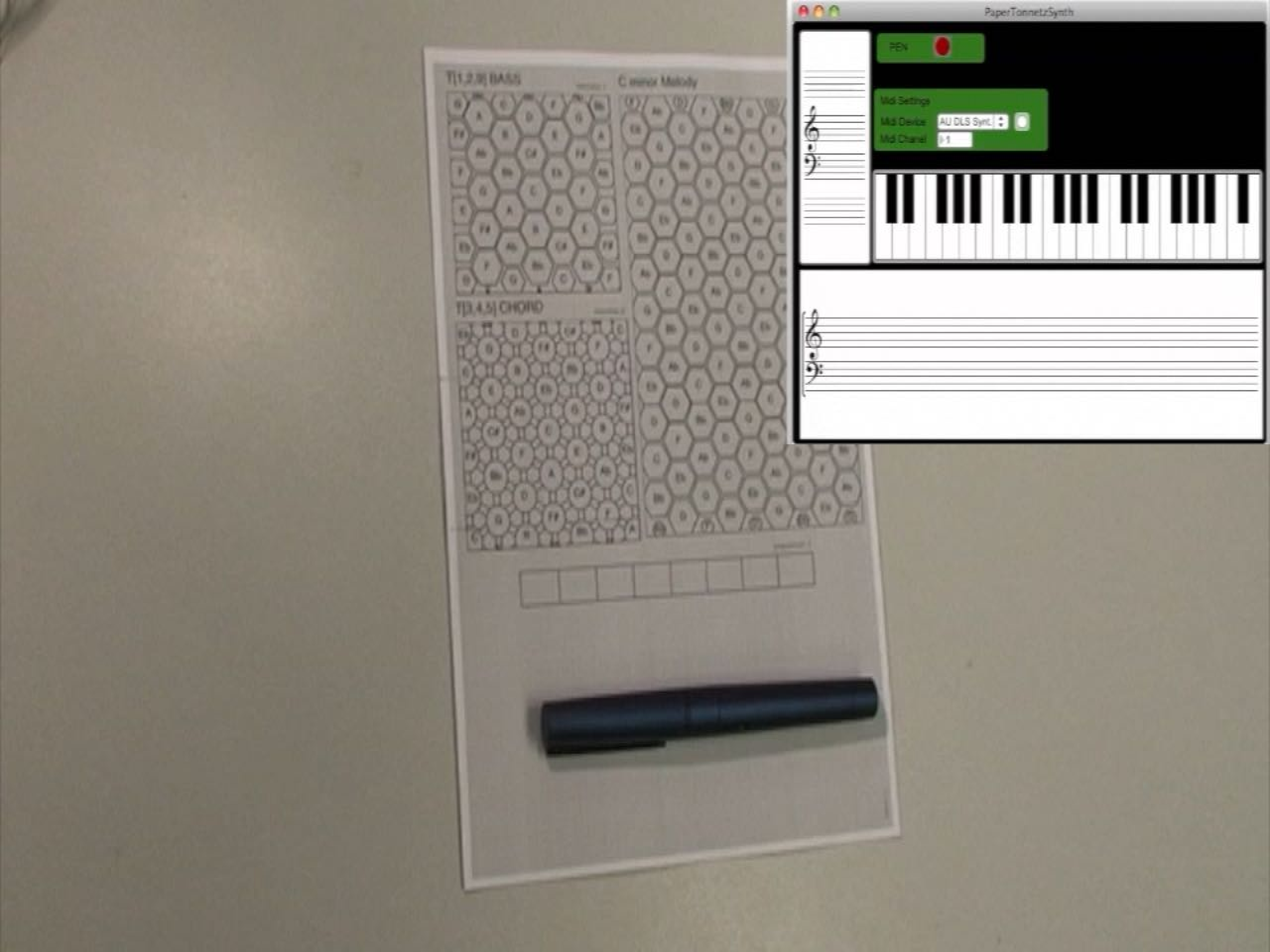


PaperTonnetz

Supporting Music Composition with Interactive Paper

Jérémie Garcia, Louis Bigo, Antoine Spicher and Wendy E. Mackay

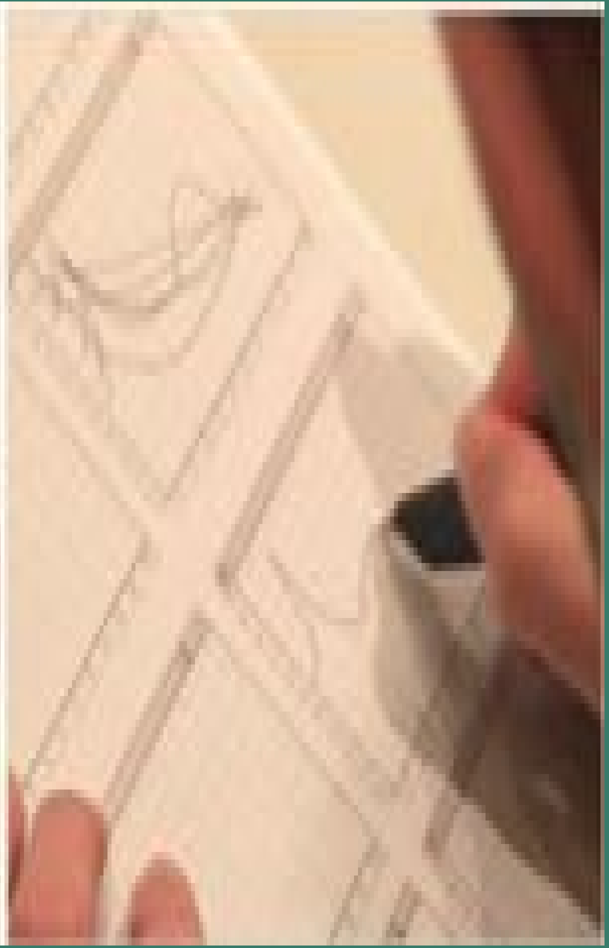
INRIA, IRCAM, LACL

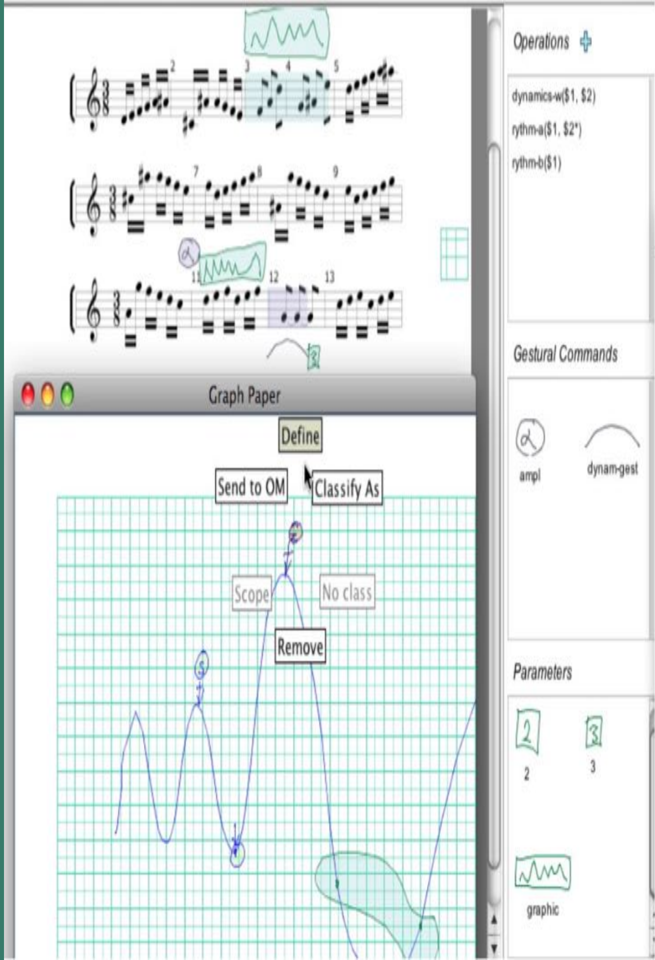


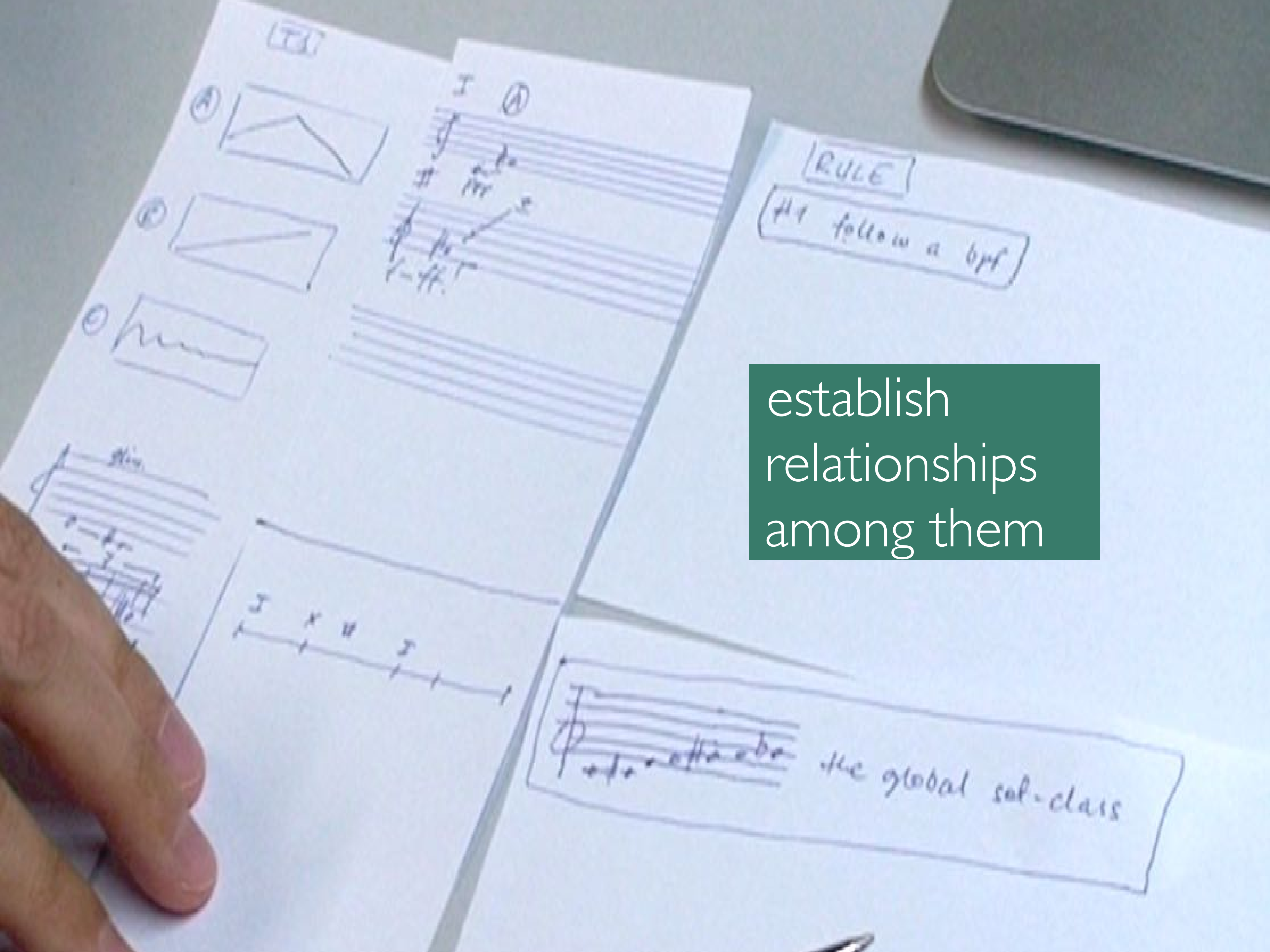
Midi Device: AU DLS Synt

Midi Chanel: 1

Paper Substrates
Composer create their own reusable musical structures

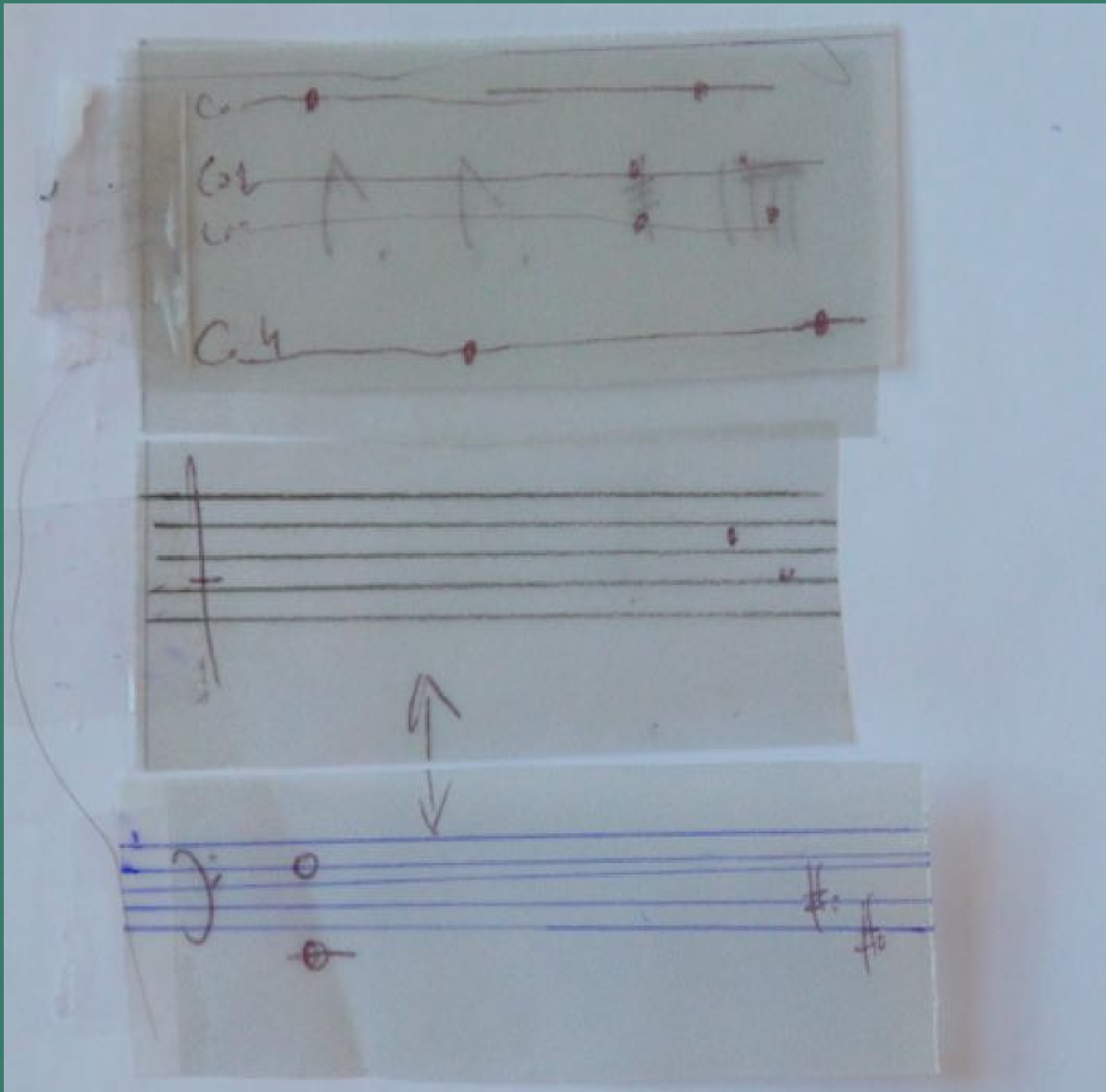






establish relationships among them

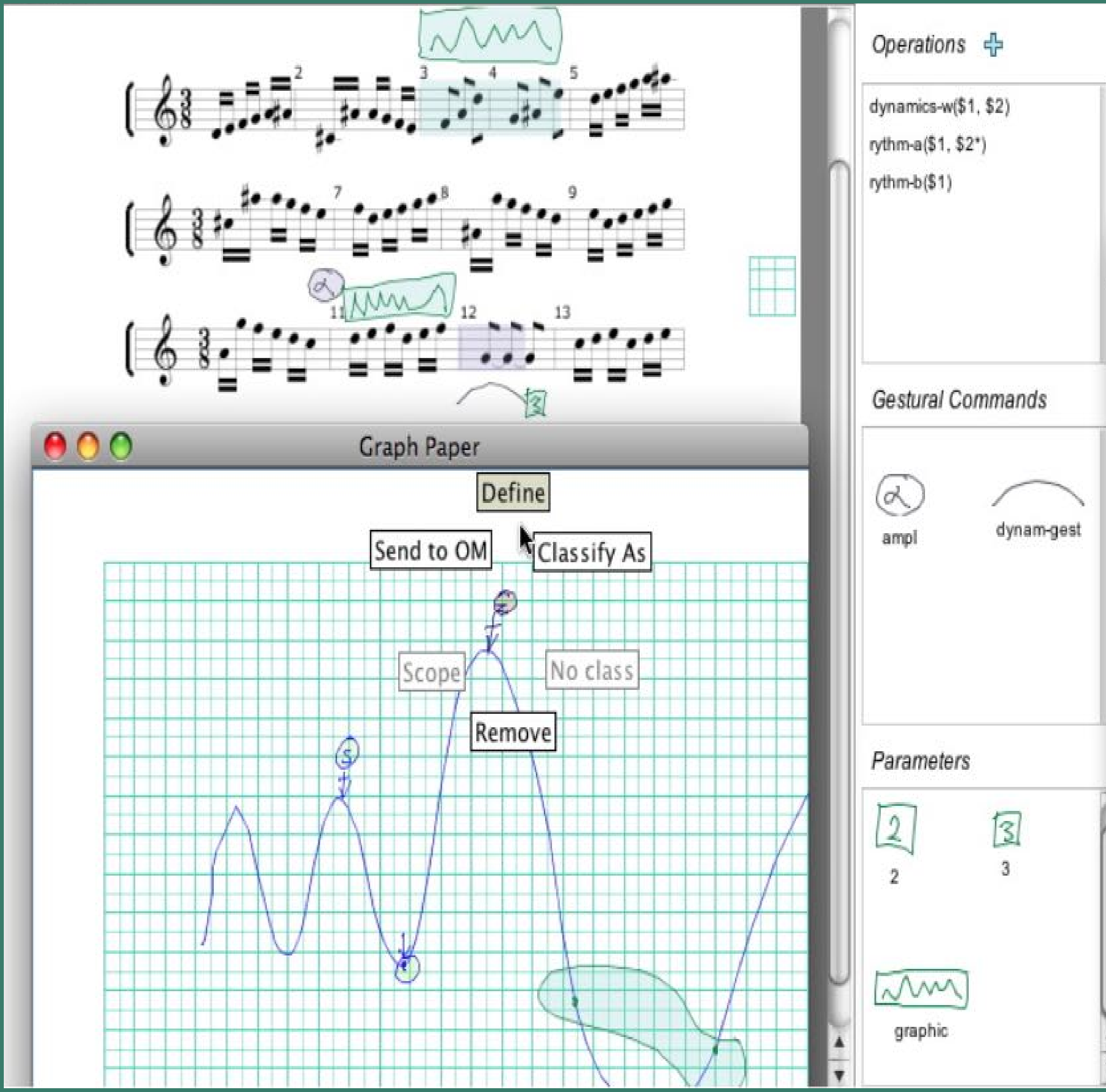
Arrange and Link substrates



Arrange
and
Link
substrates

to

composition
software



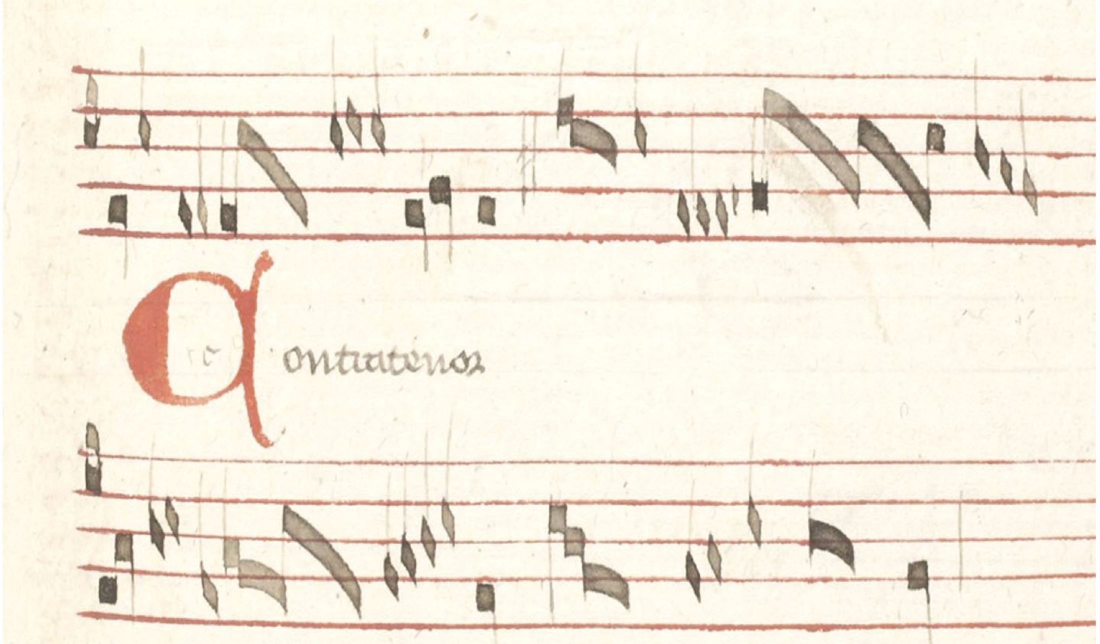
Interactive Paper Substrates
to Support Musical Creation

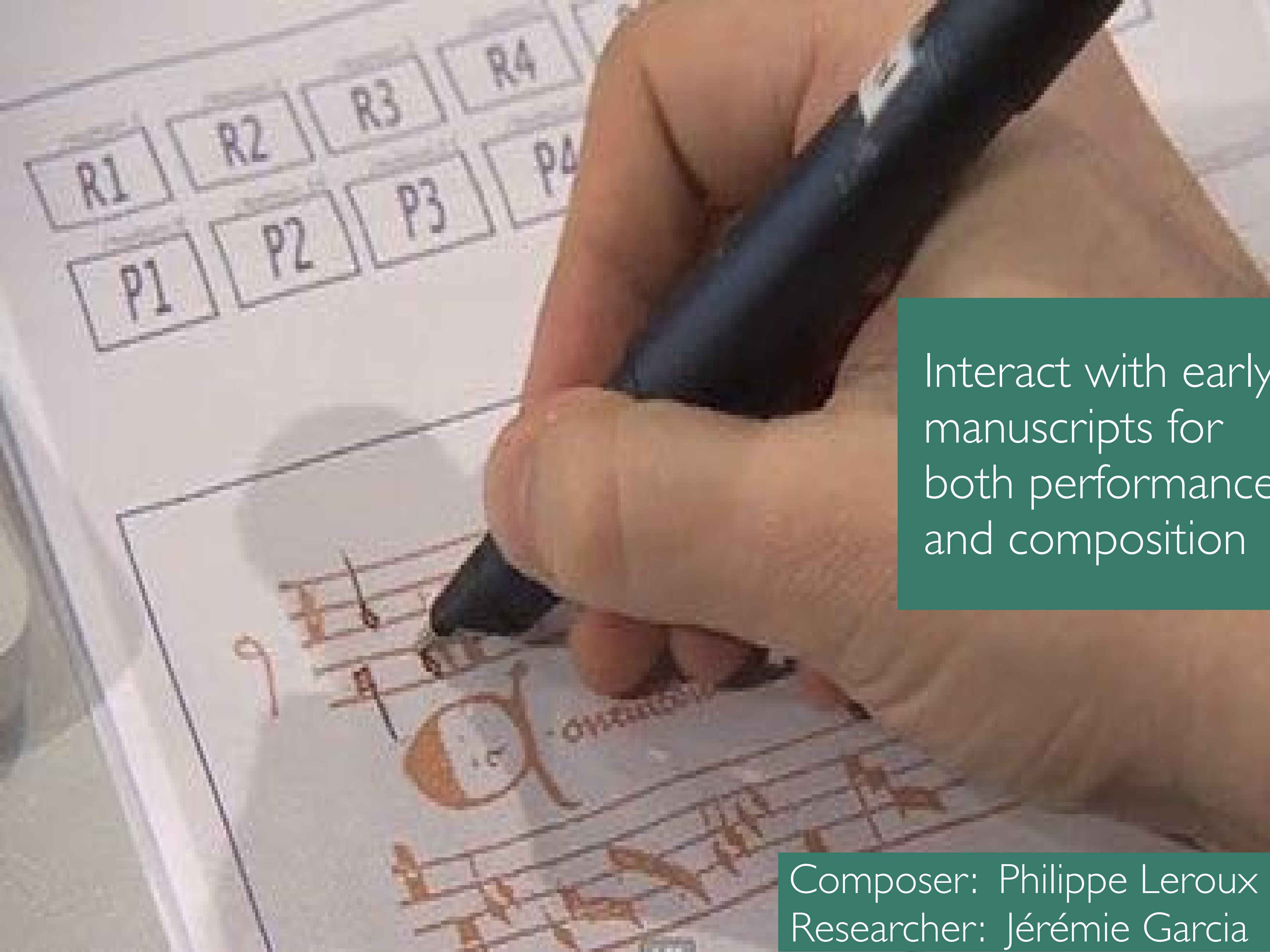
Jérémie Garcia, Theophanis Tsandilas, Carlos Agon & Wendy E. Mackay

INRIA, Université Paris-Sud, CNRS, IRCAM & Stanford University

Quid Sit Musicus
Philippe Leroux

13th century musical scores
Each note indicates expression

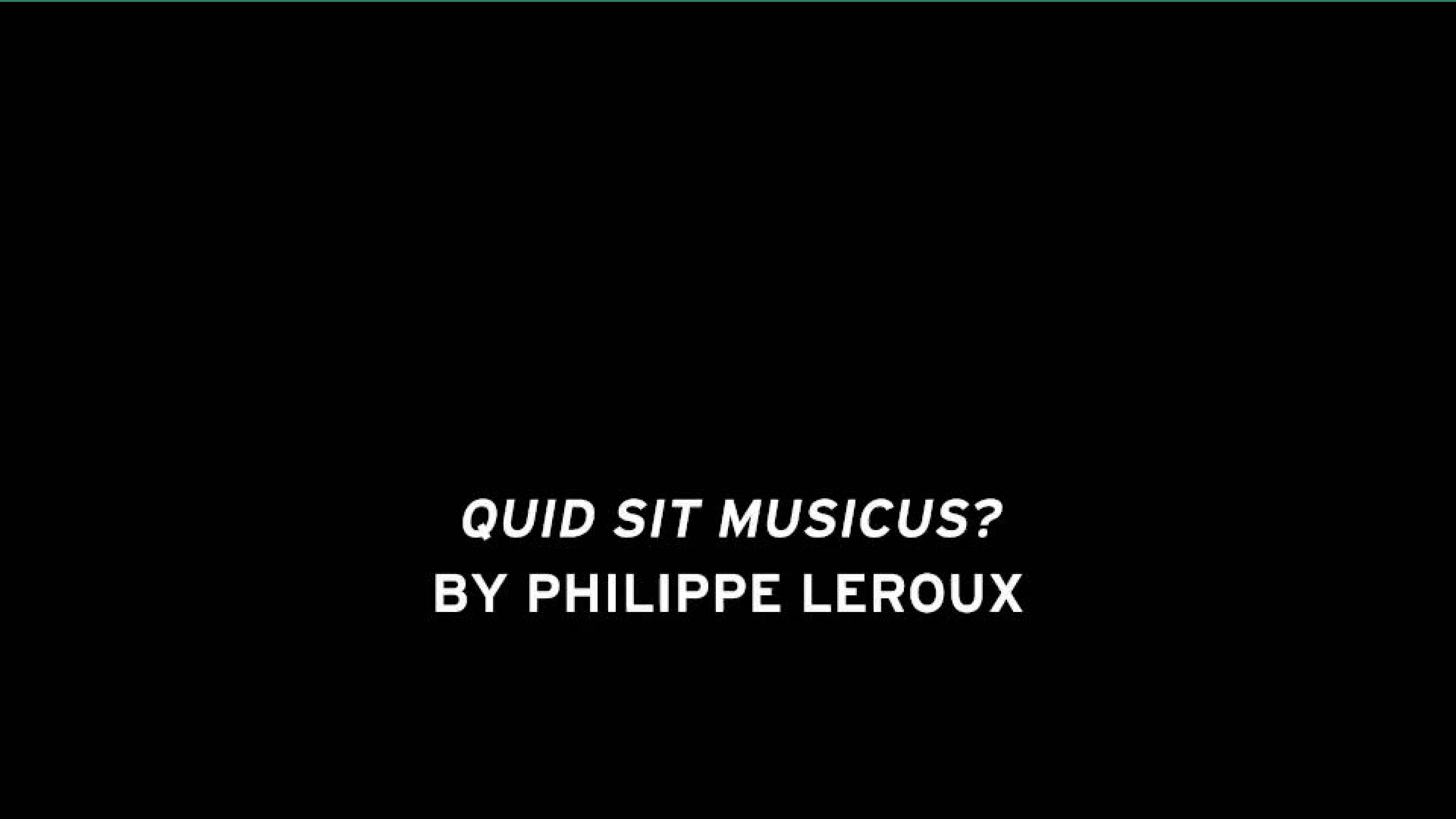




Interact with early manuscripts for both performance and composition

Composer: Philippe Leroux
Researcher: Jérémie Garcia

Quid Sit Musicus
(composer: Philippe Leroux)



QUID SIT MUSICUS?
BY PHILIPPE LEROUX

How do we create human-computer partnerships with mobile devices?

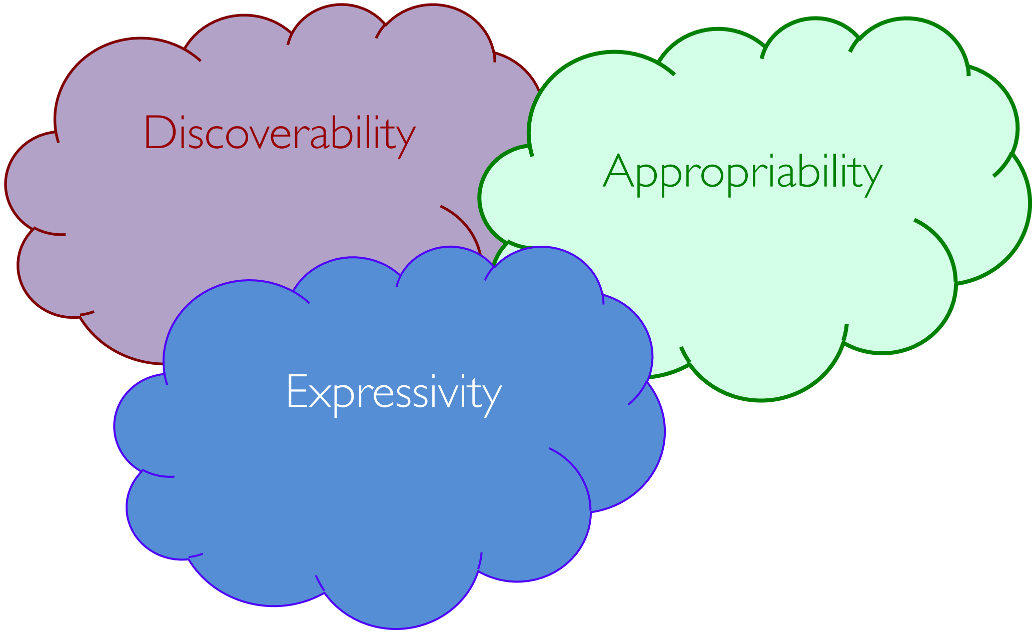
- Expressive Keyboard
- Fieldward
- CommandBoard

Co-Adaptation

People can

adapt to technology — they learn it

adapt the technology — they appropriate it

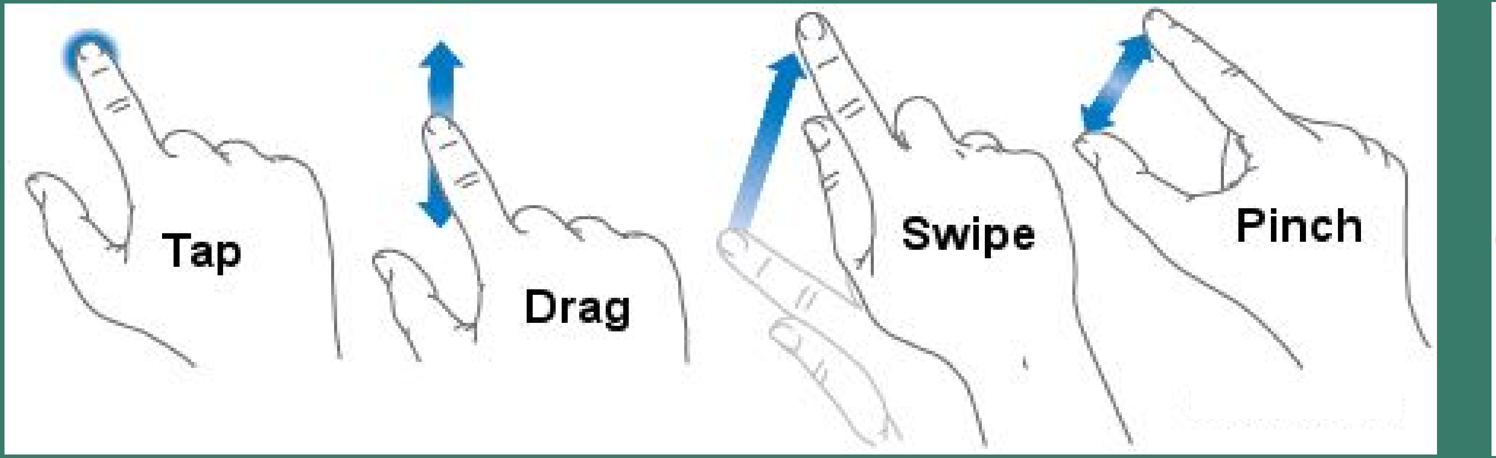


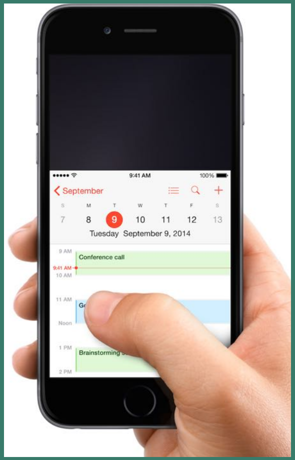
People have rich cognitive and
sensory motor capabilities

increasingly,
so do computers

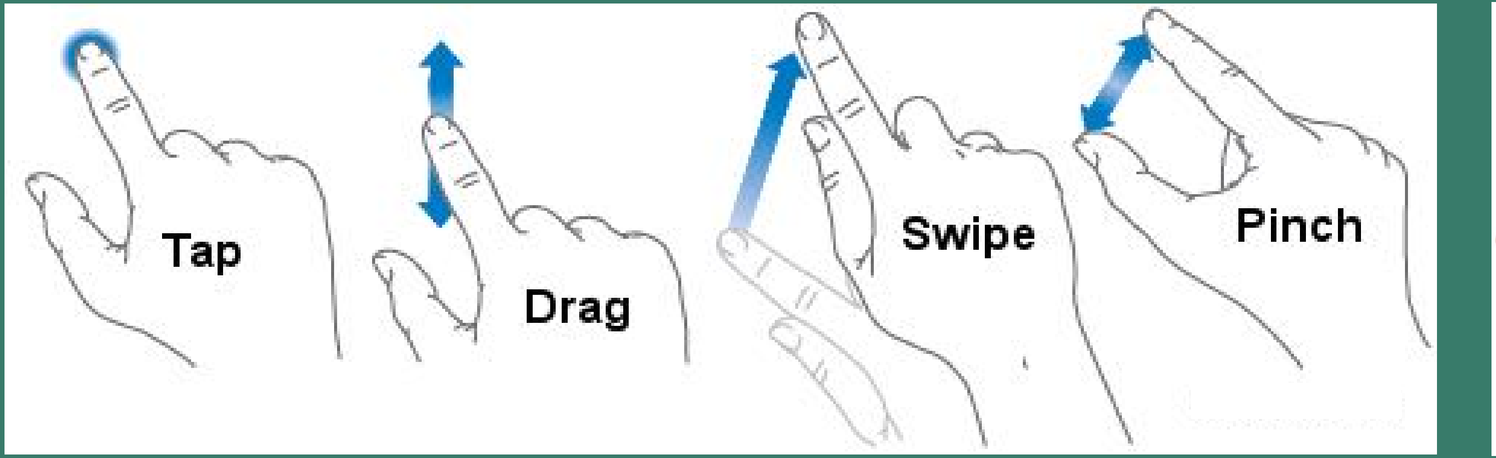
Why is the interface so limited?

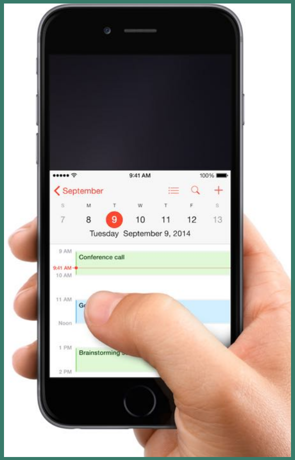
Smartphones are easy … but not powerful





Smartphones are easy … but not powerful

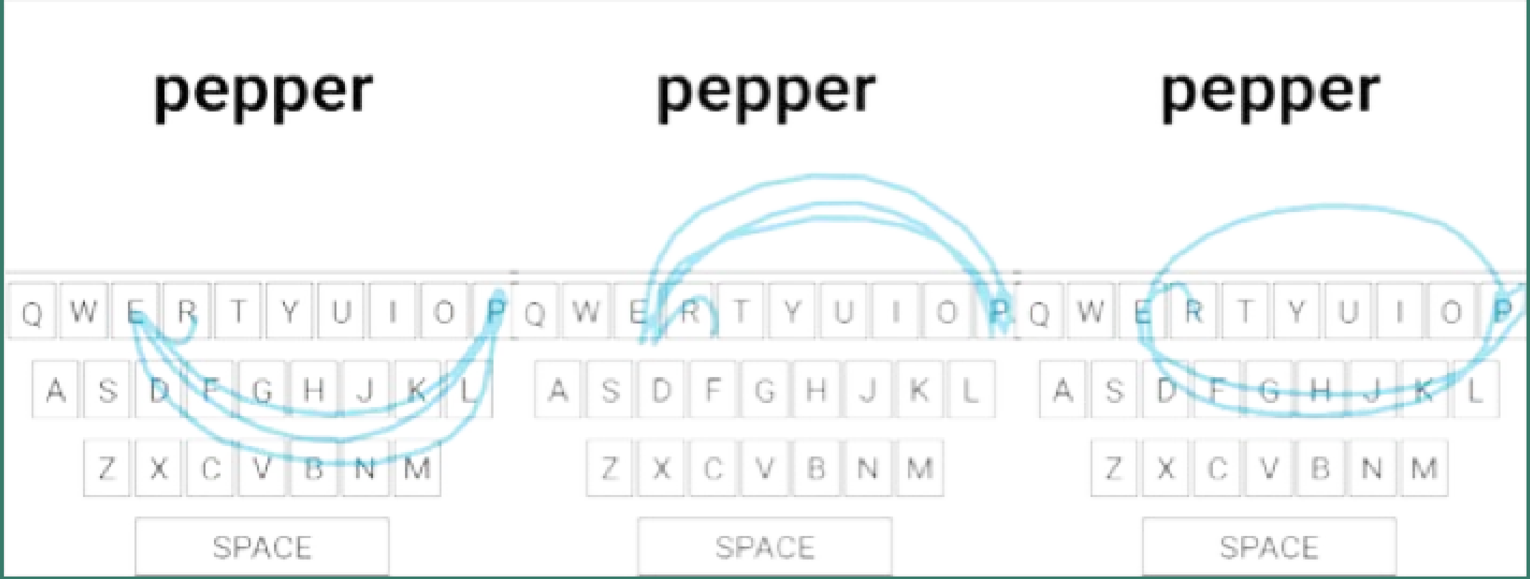




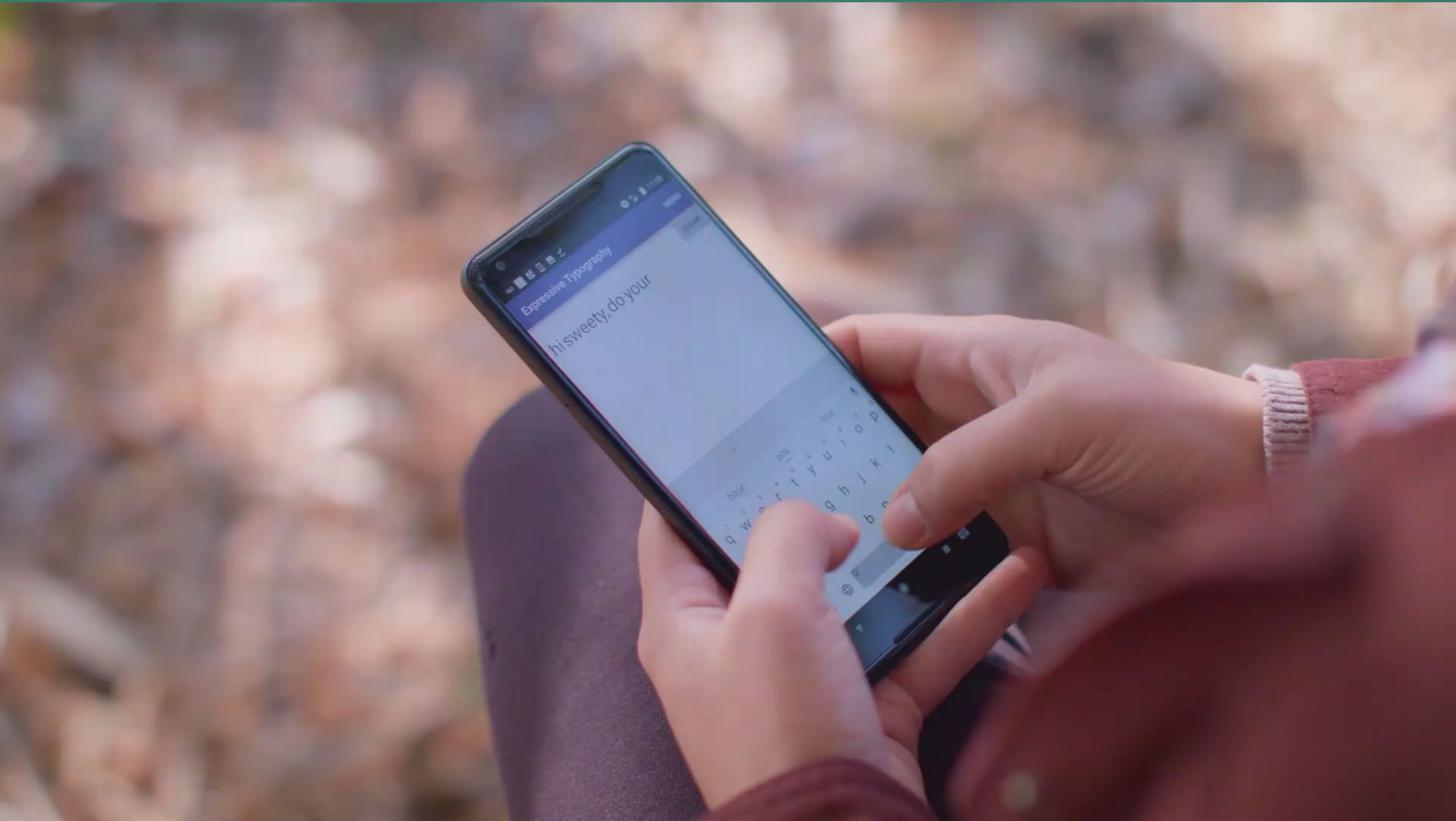
What about creativity and expression?

Expressive keyboard

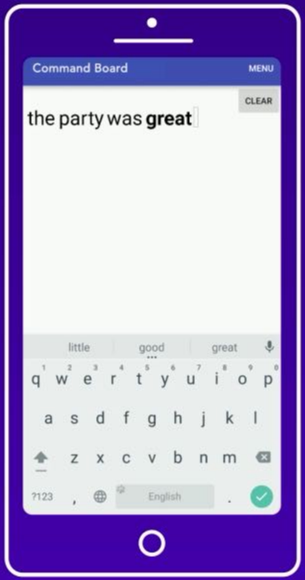
Gesture typing uses gestures to input text but focuses on finding *one* correct word



Expressive Keyboard

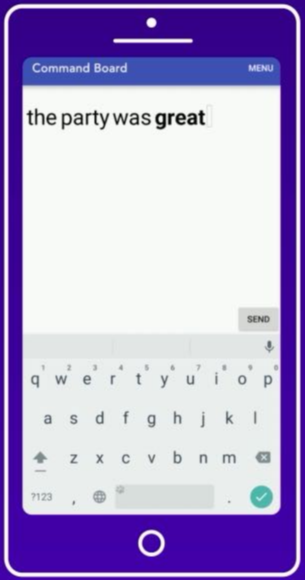


CommandBoard



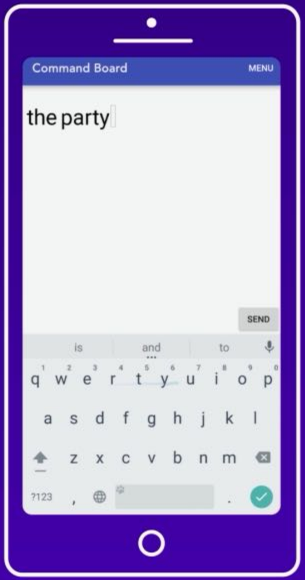
the party was **great**

Type and execute



the party was **great**

Gesture shortcuts



the party

Octopocus

Fieldward

Unified principles of interaction

Two complementary perspectives:

System: How to build it ?

Instrumental Interaction

and Substrates

Unified principles of interaction

Two complementary perspectives:

System: How to build it ?

Instrumental Interaction

and Substrates

Human: How to interact with it ?

Co-adaptive Systems

Human-computer partnerships