CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 13:
Interface
Implementation

Tuesday / Thursday
12:00 to 1:20

James Fogarty
Kailey Chan
Dhruv Jain
Nigini Oliveira
Chris Seeds
Jihoon Suh

PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING

DESIGN
USE
BUILD

Project Status

Looking Forward

- 3e: Digital Mockup Due Thursday 11/16
- 3f: Report Due Monday 11/27
- 3g: Presentation Due Wednesday 11/29

- 4a: Initial Website Due Monday 11/27
- 4b: Video Prototype Due Monday 12/4

Other Assignments

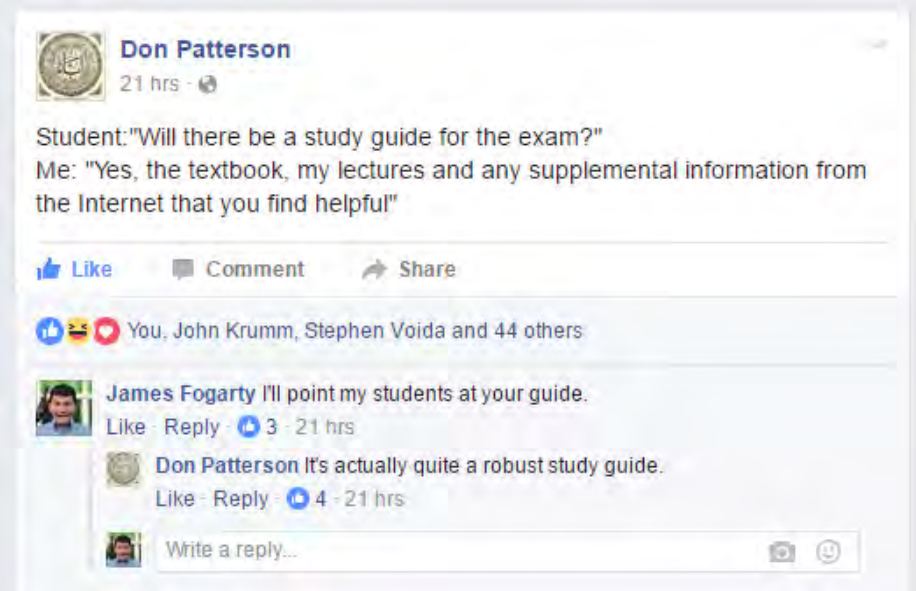
- Reading 5 Due Saturday 12/2, Sooner is Better

Exam

Next Tuesday 11/21, in Denny 303

Mostly short answer, some long answer

Content drawn from lecture and readings



Compilation of the lecture slides is posted

Q&A scheduled Monday at 3:00 in CSE 403

Tools and Interfaces

Why Interface Tools?

Case Study of Model-View-Controller

Case Study of Animation

Sapir-Whorf Hypothesis

Thoughtfulness in Tools

Case Study in Self-Tracking

Objectives

Be able to:

Describe benefits of tools in interface implementation, why we use them

Describe the Model/View/Controller approach to organizing interface implementation

Describe why tools eventually limit design thinking

Sequential Programs

Program takes control, prompts for input

Person waits
on the program

Program says when
it is ready for more
input, which the
person then provides

Sequential Programs

```
while true {
    print “Prompt for Input”
    input = read_line_of_text()
    output = do_work()
    print output
}
```

Person is literally modeled as a file

Event-Driven Programming

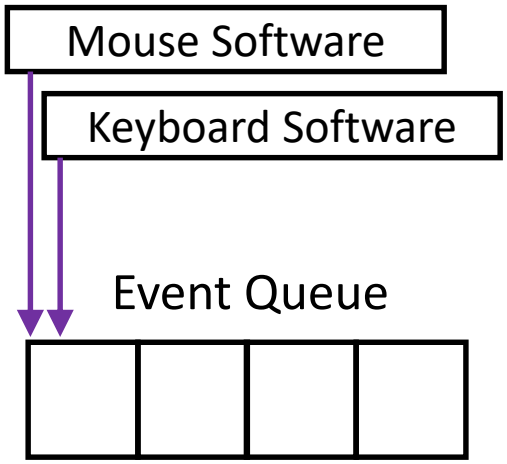
A program waits for a person to provide input

All communication done via events

- "mouse down", "item drag", "key up"

All events go to a queue

- Ensures events handled in order
- Hides specifics from applications



How many of these queues? How can you tell?

Basic Interactive Software Loop

```
do {
   e = read_event();
   dispatch_event(e);
   if (damage_exists())
      update_display();
} while (e.type != WM_QUIT);
```

} input
} processing
} output

All interactive software has this somewhere

Basic Interactive Software Loop

Have you ever written this loop?

Basic Interactive Software Loop

Have you ever written this loop?

Contrast with:

> “One of the most complex aspects of Xlib programming is designing the event loop, which must take into account all of the possible events that can occur in a window.”
>
> Nye & O'Reilly, X Toolkit Intrinsics Programming Manual, vol. 4, 1990, p. 241.

Understanding Tools

We use tools because they

- Identify common or important practices
- Package those practices in a framework
- Make it easy to follow those practices
- Make it easier to focus on our application

What are the benefits of this?

Understanding Tools

We use tools because they

- Identify common or important practices
- Package those practices in a framework
- Make it easy to follow those practices
- Make it easier to focus on our application

What are the benefits of this?

- Being faster allows more iterative design
- Implementation is generally better in the tool
- Consistency across applications using same tool

Understanding Tools

Why is designing tools difficult?

- Need to understand the core practices and problems
- Those are often evolving with technology and design

Example: Responsiveness in event-driven interface

- Event-driven interaction is asynchronous

- How to maintain responsiveness in the interface while executing some large computation?

Understanding Tools

Why is designing tools difficult?

- Need to understand the core practices and problems
- Those are often evolving with technology and design

Example: Responsiveness in event-driven interface

- Cursor:
  - WaitCursor vs. CWaitCursor vs. In Framework
- Progress Bar:
  - Data Races vs. Idle vs. Loop vs. Worker Objects

Fundamental Tools Terminology

- Threshold vs. Ceiling
  - Threshold: How hard to get started
  - Ceiling: How much can be achieved
  - These depend on what is being implemented
- Path of Least Resistance
  - Tools influence what interfaces are created
- Moving Targets
  - Changing needs make tools incomplete or obsolete

Myers et al, 2000
http://dx.doi.org/10.1145/344949.344959

Tools and Interfaces

Why Interface Tools?

Case Study of Model-View-Controller

Case Study of Animation

Sapir-Whorf Hypothesis

Thoughtfulness in Tools

Case Study in Self-Tracking

Model-View-Controller

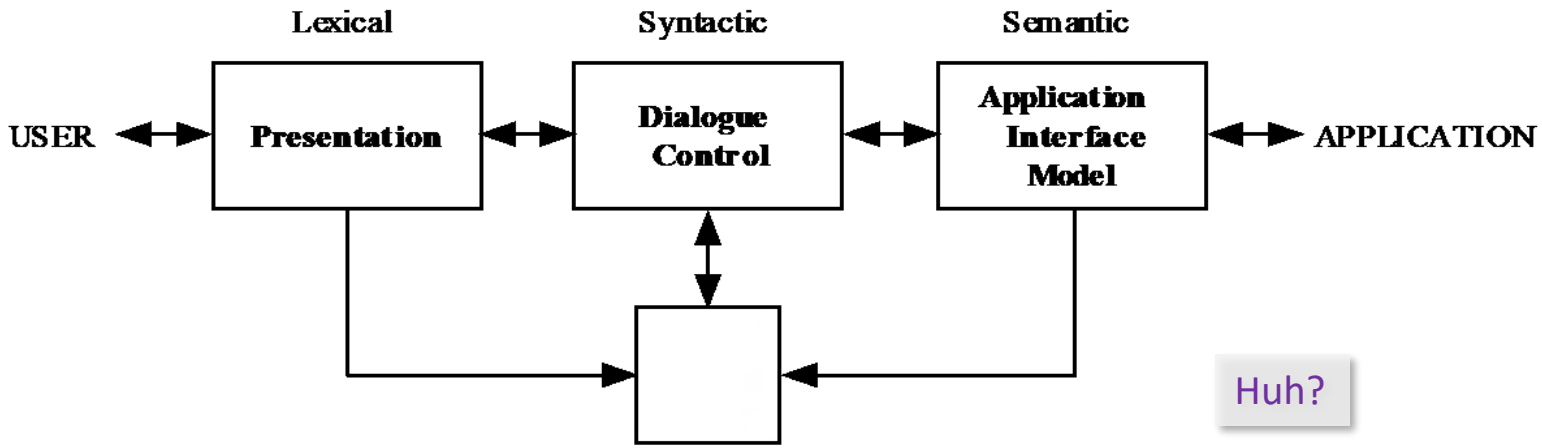
How to organize the code of an interface?

This is a surprisingly complicated question, with unstated assumptions requiring significant background to understand and resolve

Seeheim Model

Buxton, 1983
http://dx.doi.org/10.1145/988584.988586

Results from 1985 workshop on user interface management systems, driven by goals of portability and modifiability, based in separating the interface from application functionality



Seeheim Model

Lexical - Presentation

External presentation of interface — e.g., “add” vs. “append” vs. “^a” vs. 

Generates the display, receive input — e.g., how to make a “menu” or “button”

Syntactic - Dialog Control

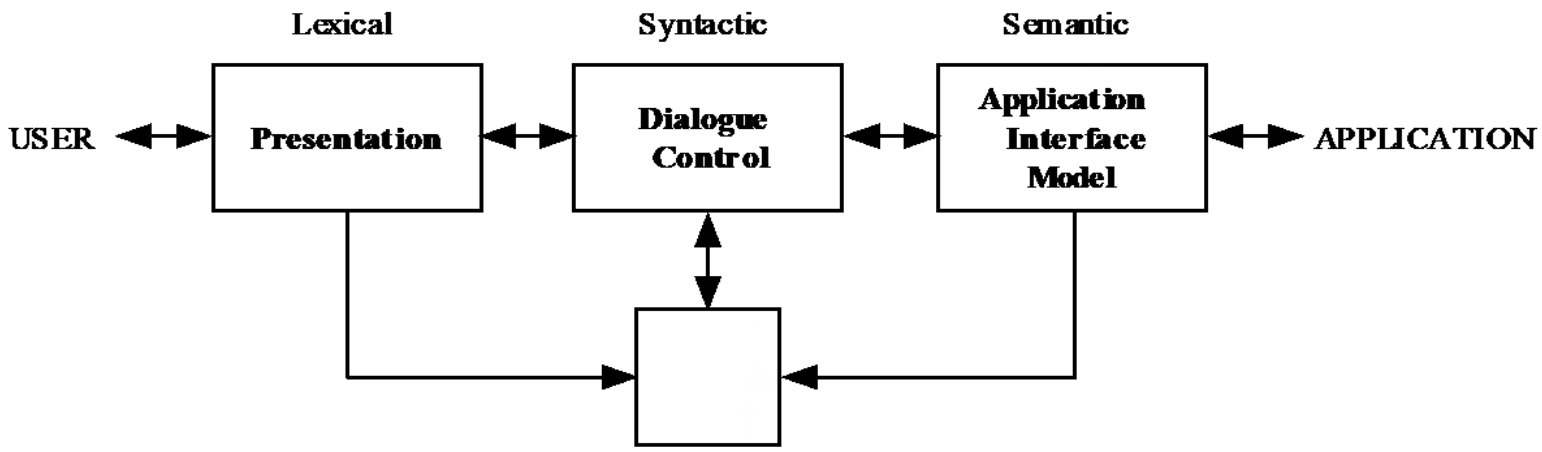
Parsing of tokens into syntax — e.g., three-state model, interface modes

Maintain state

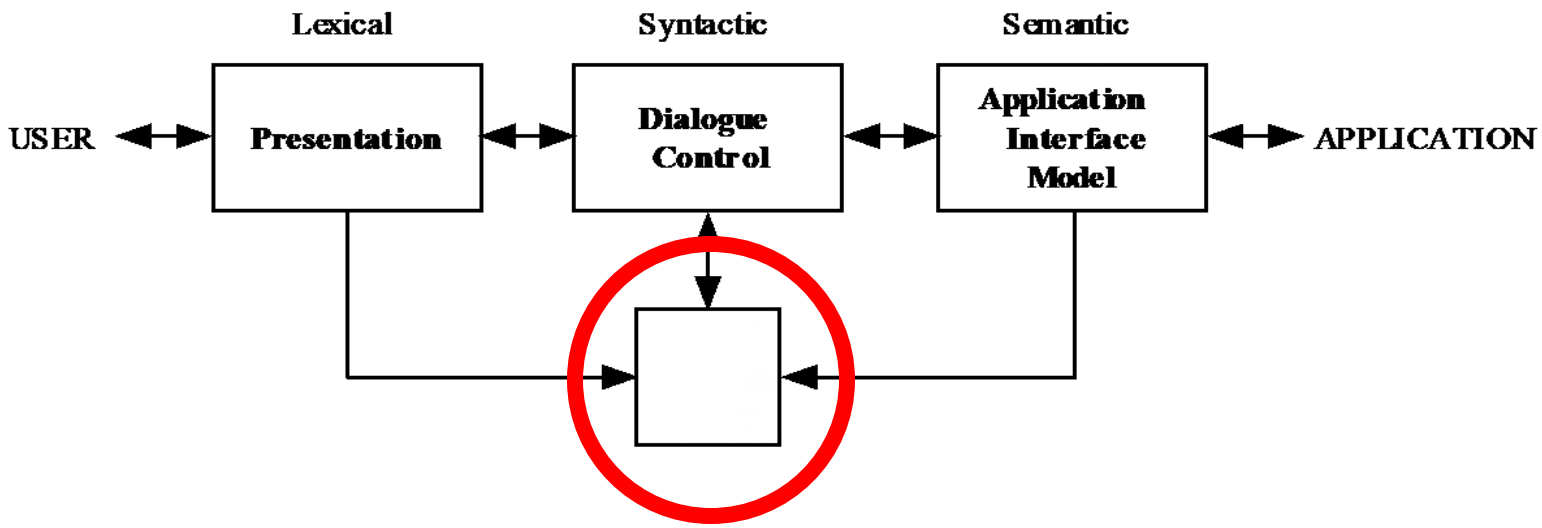
Semantic - Application Interface Model

Defines interaction between interface and rest of software — e.g., drag-and-drop target highlighting

Seeheim Model

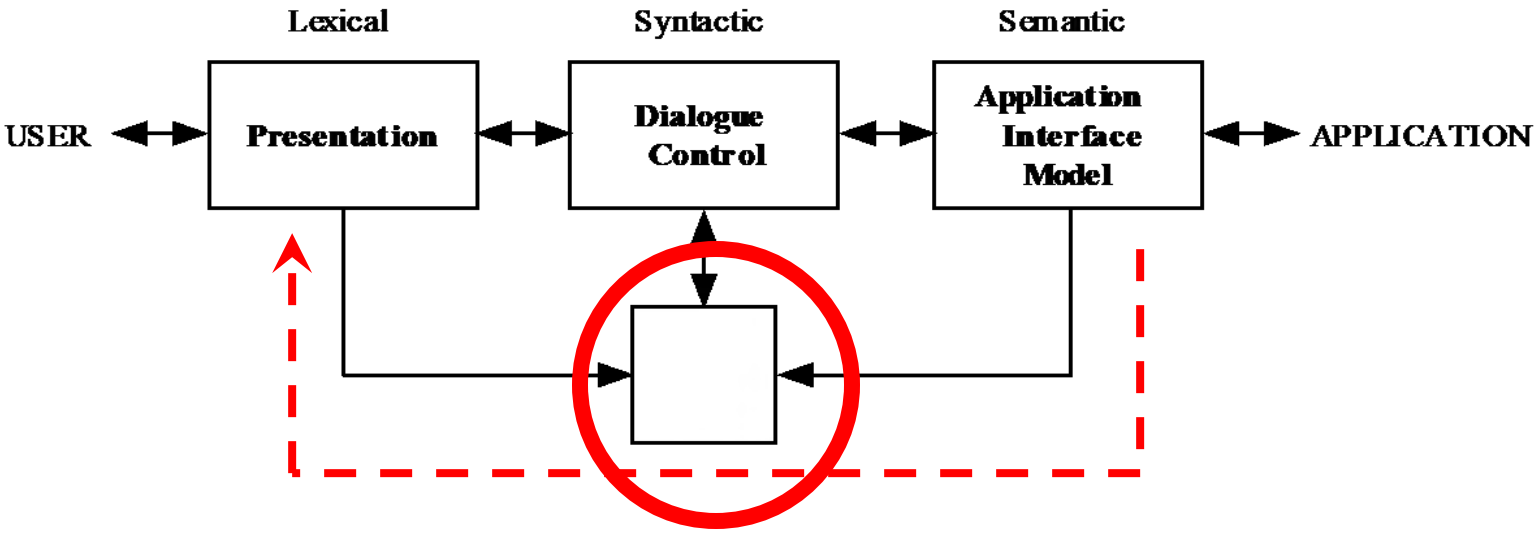


Seeheim Model



Huh?

Seeheim Model



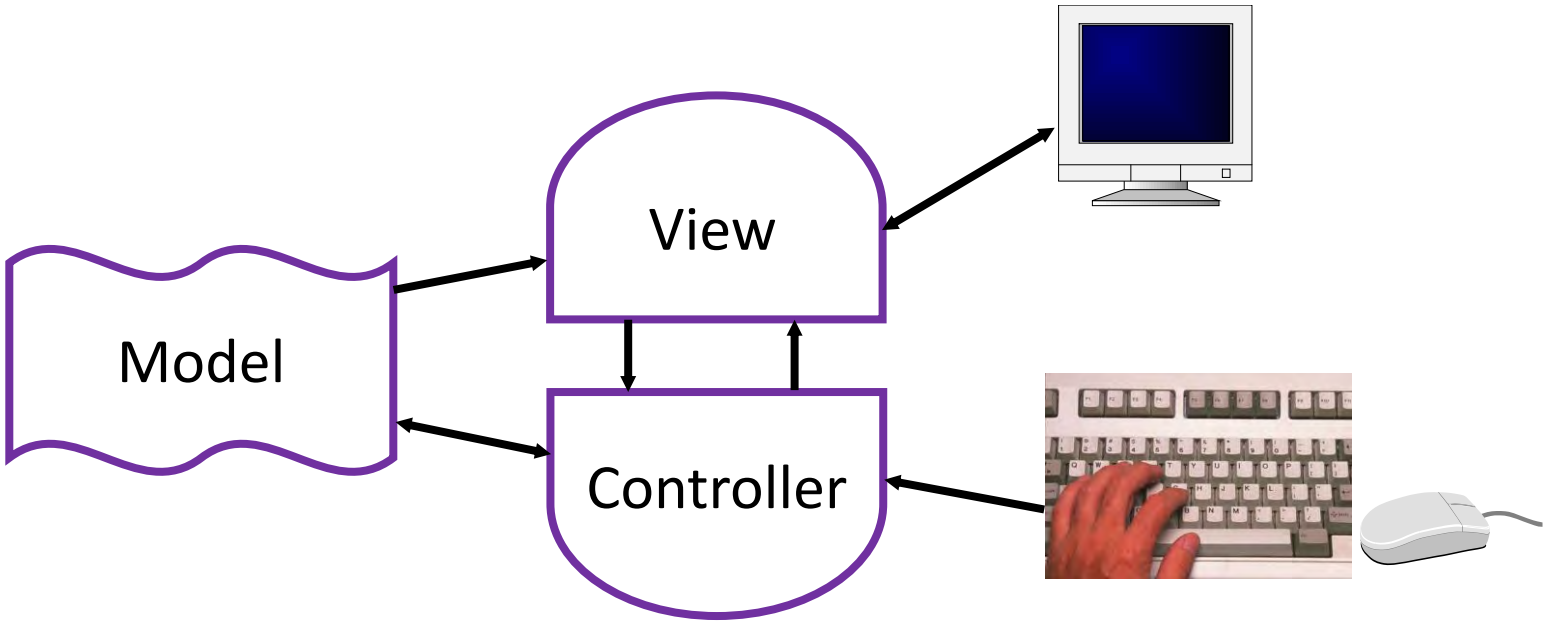
Rapid Semantic Feedback

In practice, all of the code goes in here

Model-View-Controller

Introduced by Smalltalk developers at PARC

Partitions application to be scalable, maintainable



View / Controller Relationship

In theory:

Pattern of behavior in response to input events (i.e., concerns of the controller) are independent of visual geometry (i.e., concerns of the view)

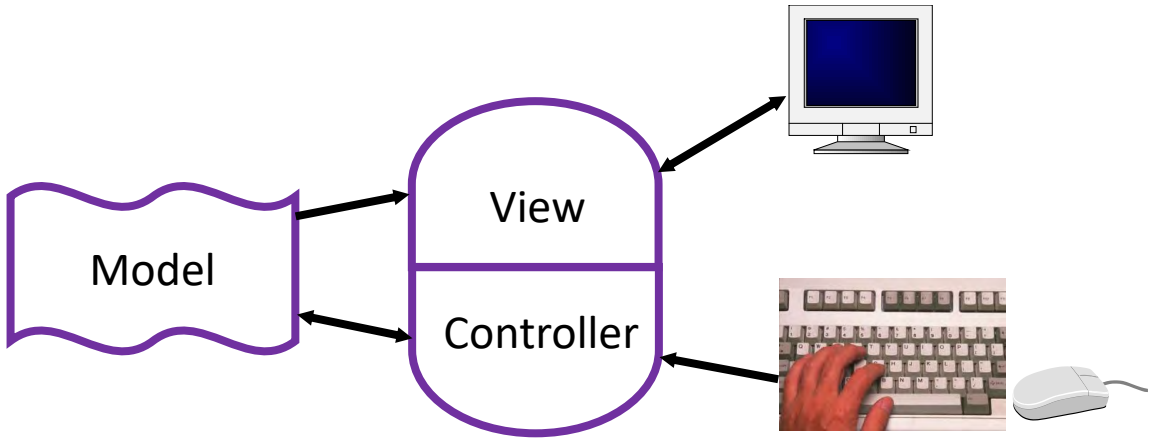
Controller contacts view to interpret what input events mean in context of a view (e.g., selection)

View / Controller Relationship

In practice:

View and controller often tightly intertwined, almost always occur in matched pairs

Many architectures combine into a single class



Model-View-Controller

MVC separates concerns and scales better than global variables or putting everything together

Separation eases maintenance

- Can add new fields to model,
  new views can leverage, old views will still work
- Can replace model without changing views

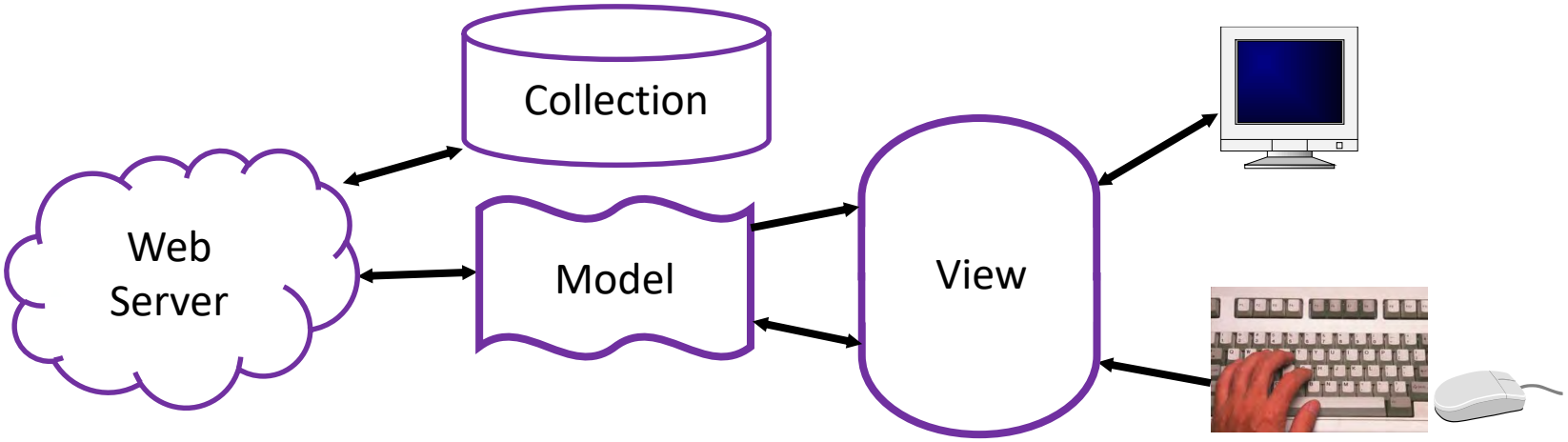
Separation of “business logic” can require care

- May help to think of model as the client model

Model-View-Collection on the Web

Core ideas manifest differently according to needs

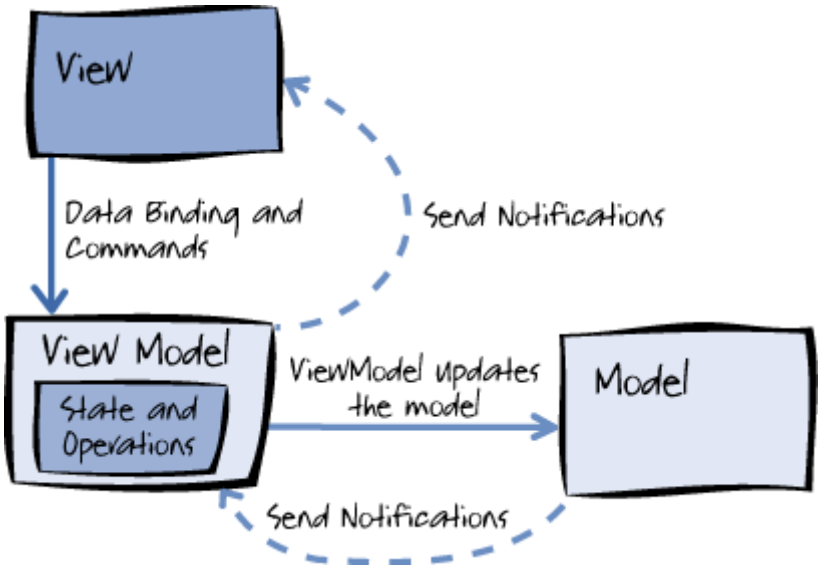
- For example, backbone.js implements client views of models, with REST API calls to web server
- Web tools often implement views as templates



Model View View-Model

Design to support data-binding
by minimizing functionality in view

Also allows greater separation of expertise



Tools and Interfaces

Why Interface Tools?

Case Study of Model-View-Controller

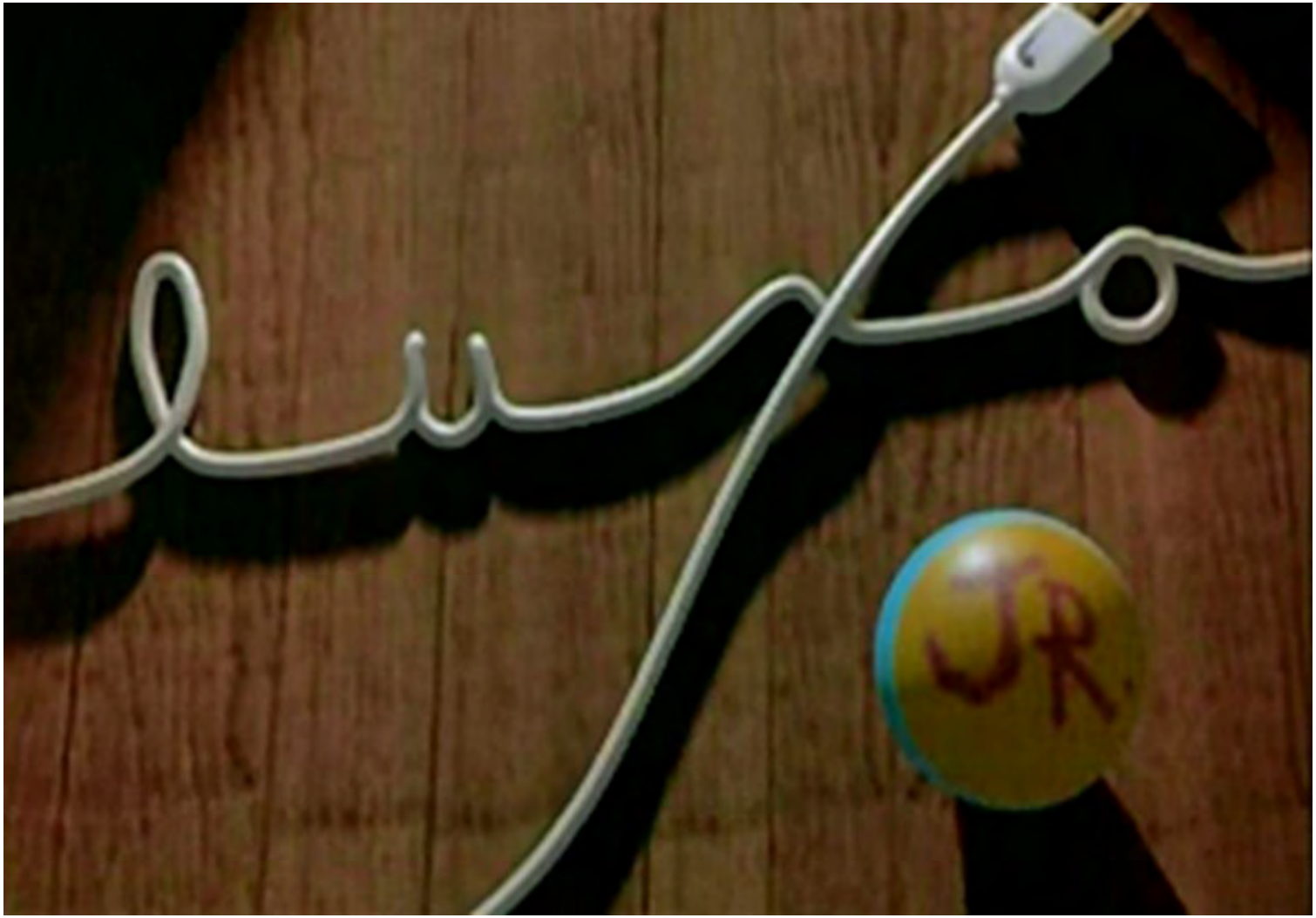
Case Study of Animation

Sapir-Whorf Hypothesis

Thoughtfulness in Tools

Case Study in Self-Tracking

Luxor Jr.



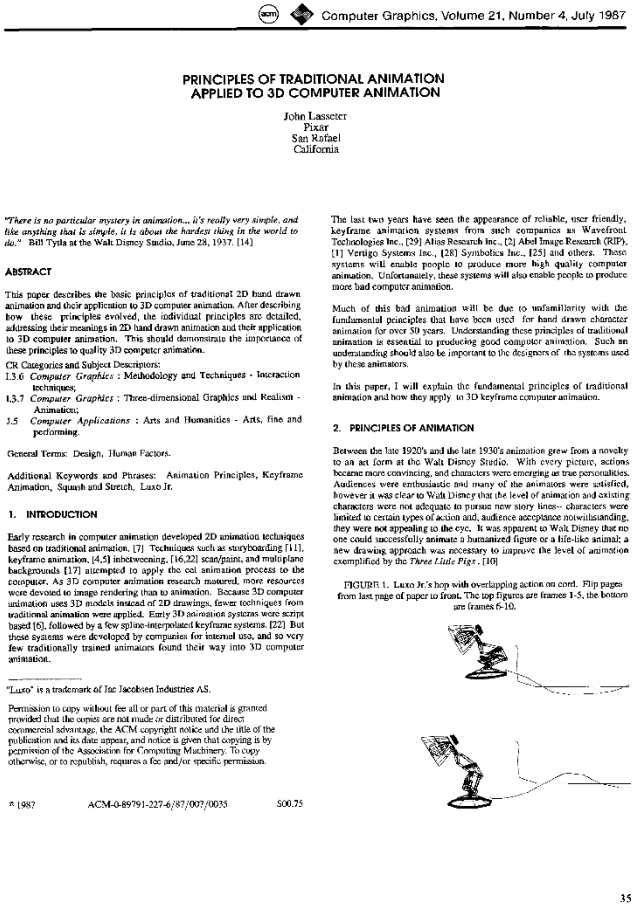
Luxor Jr.

Animation Case Study

Principles of Traditional Animation Applied to 3D Computer Animation

Lasseter, 1987

http://dx.doi.org/10.1145/37402.37407



Computer Graphics, Volume 21, Number 4, July 1987

PRINCIPLES OF TRADITIONAL ANIMATION APPLIED TO 3D COMPUTER ANIMATION

John Lasseter
Pixar
San Rafael
California

"There is no particular mystery in animation... it's really very simple, and like anything that is simple, it is about the hardest thing in the world to do." Bill Tytla at the Walt Disney Studio, June 28, 1937. [14]

ABSTRACT

This paper describes the basic principles of traditional 2D hand drawn animation and their application to 3D computer animation. After describing how these principles evolved, the individual principles are detailed, addressing their meanings in 2D hand drawn animation and their application to 3D computer animation. This should demonstrate the importance of these principles to quality 3D computer animation.

CR Categories and Subject Descriptors:
I.3.6 *Computer Graphics* : Methodology and Techniques - Interaction techniques;
I.3.7 *Computer Graphics* : Three-dimensional Graphics and Realism - Animation;
J.5 *Computer Applications* : Arts and Humanities - Arts, fine and performing.

General Terms: Design, Human Factors.

Additional Keywords and Phrases: Animation Principles, Keyframe Animation, Squash and Stretch, Luxo Jr.

1. INTRODUCTION

Early research in computer animation developed 2D animation techniques based on traditional animation. [7] Techniques such as storyboarding [11], keyframe animation, [4,5] inbetweening, [16,22] scanlines, and multiplane backgrounds [17] attempted to apply the cel animation process to the computer. As 3D computer animation research matured, more resources were devoted to image rendering than to animation. Because 3D computer animation uses 3D models instead of 2D drawings, fewer techniques from traditional animation were applied. Early 3D animation systems were script based [6], followed by a few spline-interpolated keyframe systems. [22] But these systems were developed by companies for internal use, and so very few traditionally trained animators found their way into 3D computer animation.

"Luxo" is a trademark of Jac Jacobsen Industries AS.

The last two years have seen the appearance of reliable, user friendly, keyframe animation systems from such companies as Wavefront Technologies Inc., [29] Alias Research Inc., [2] Abel Image Research (RIP), [1] Vertigo Systems Inc., [28] Symbolics Inc., [25] and others. These systems will enable people to produce more high quality computer animation. Unfortunately, these systems will also enable people to produce more bad computer animation.

Much of this bad animation will be due to unfamiliarity with the fundamental principles that have been used for hand drawn character animation for over 50 years. Understanding these principles of traditional animation is essential to producing good computer animation. Such an understanding should also be important to the designers of the systems used by these animators.

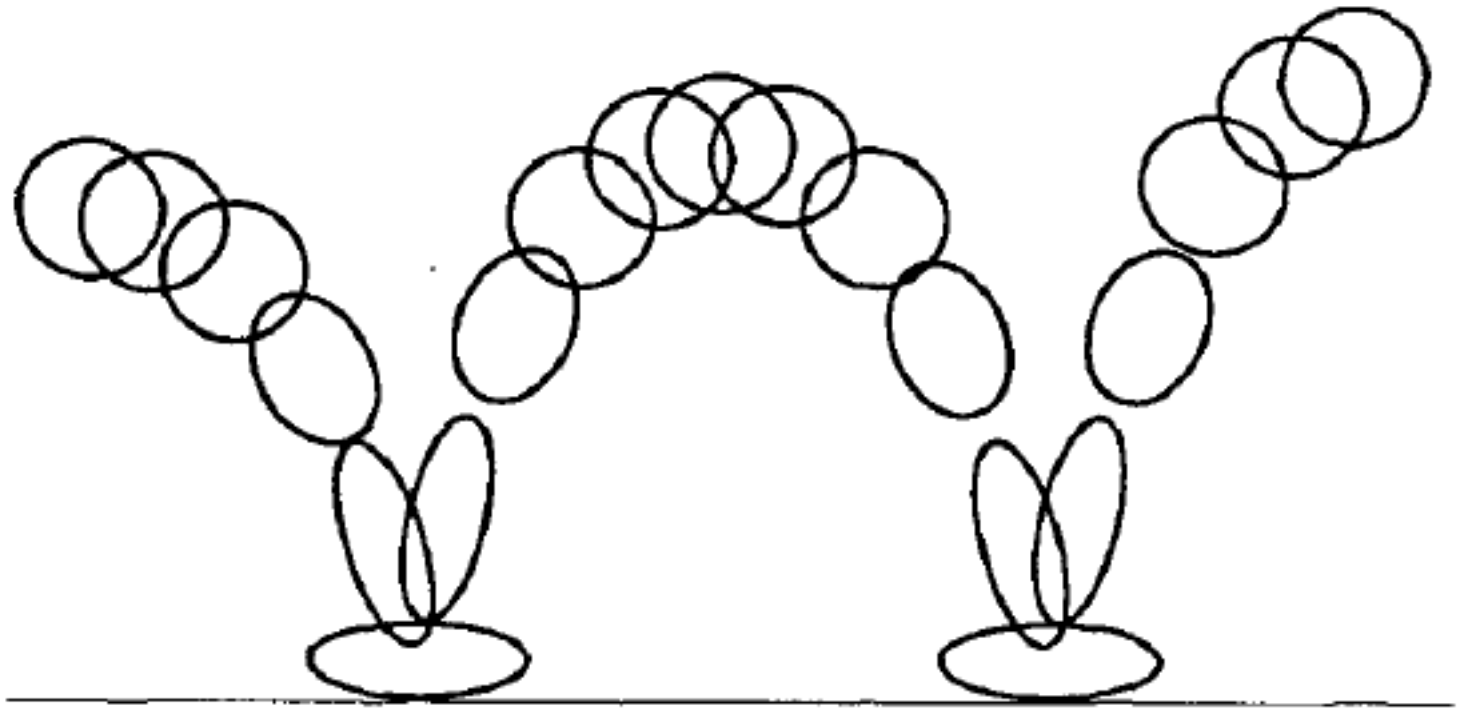
In this paper, I will explain the fundamental principles of traditional animation and how they apply to 3D keyframe computer animation.

2. PRINCIPLES OF ANIMATION

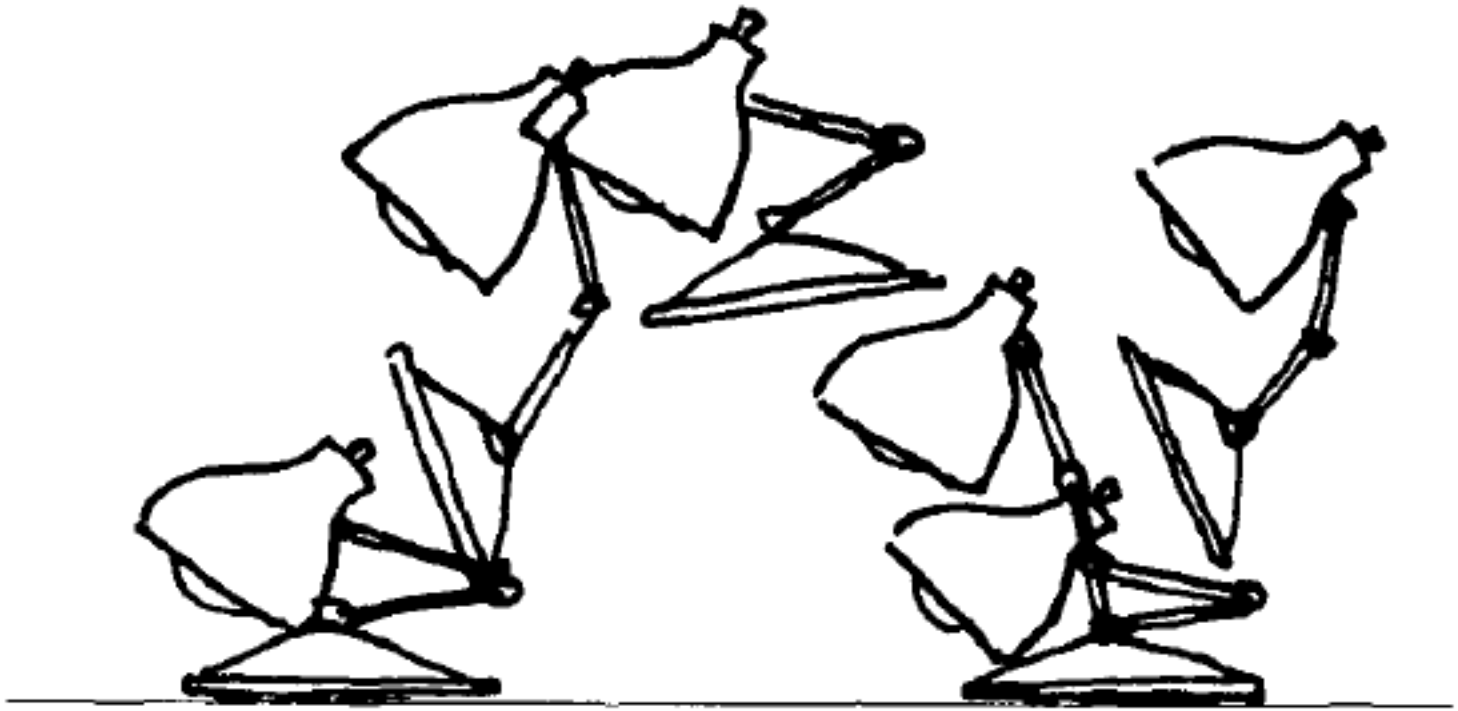
Between the late 1920's and the late 1930's animation grew from a novelty to an art form at the Walt Disney Studio. With every picture, actions became more convincing, and characters were emerging as true personalities. Audiences were enthusiastic and many of the animators were satisfied, however it was clear to Walt Disney that the level of animation and existing characters were not adequate to pursue new story lines-- characters were limited to certain types of action and, audience acceptance notwithstanding, they were not appealing to the eye. It was apparent to Walt Disney that no one could successfully animate a humanized figure or a life-like animal; a new drawing approach was necessary to improve the level of animation exemplified by the *Three Little Pigs*. [10]

FIGURE 1. Luxo Jr.'s hop with overlapping action on cord. Flip pages from last page of paper to front. The top figures are frames 1-5, the bottom are frames 6-10.

Squash and Stretch



Squash and Stretch



Squash and Stretch

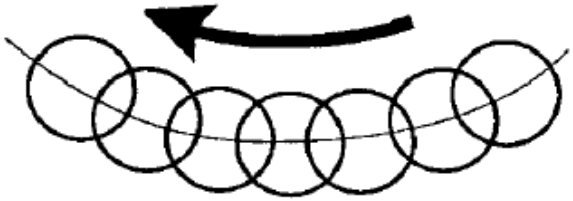


FIGURE 4a. In slow action, an object's position overlaps from frame to frame which gives the action a smooth appearance to the eye.

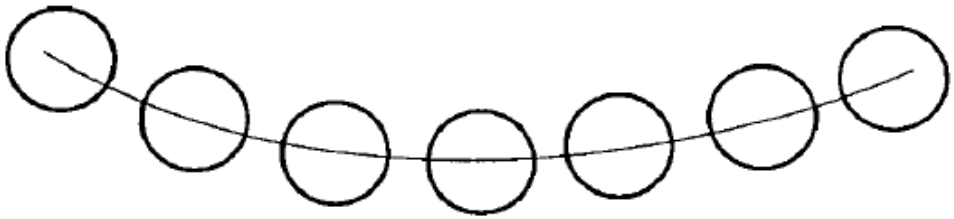


FIGURE 4b. Strobing occurs in a faster action when the object's positions do not overlap and the eye perceives seperate images.

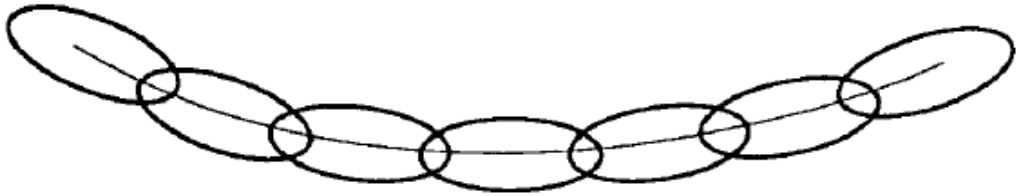


FIGURE 4c. Stretching the object so that it's positions overlap again will relieve the strobing effect.

Timing

Just two drawings of a head, the first showing it leaning toward the right shoulder and the second with it over on the left and its chin slightly raised, can be made to communicate a multitude of ideas, depending entirely on the Timing used. Each inbetween drawing added between these two "extremes" gives a new meaning to the action.

NO inbetweens..... The Character has been hit by a tremendous force. His head is nearly snapped off.

ONE inbetweens..... The Character has been hit by a brick, rolling pin, frying pan.

TWO inbetweens..... The Character has a nervous tic, a muscle spasm, an uncontrollable twitch.

THREE inbetweens..... The Character is dodging a brick, rolling pin, frying pan.

Timing

FOUR inbetweens..... The Character is giving a crisp order, "Get going!" "Move it!"

FIVE inbetweens..... The Character is more friendly, "Over here." "Come on-hurry!"

SIX inbetweens..... The Character sees a good looking girl, or the sports car he has always wanted.

SEVEN inbetweens..... The Character tries to get a better look at something.

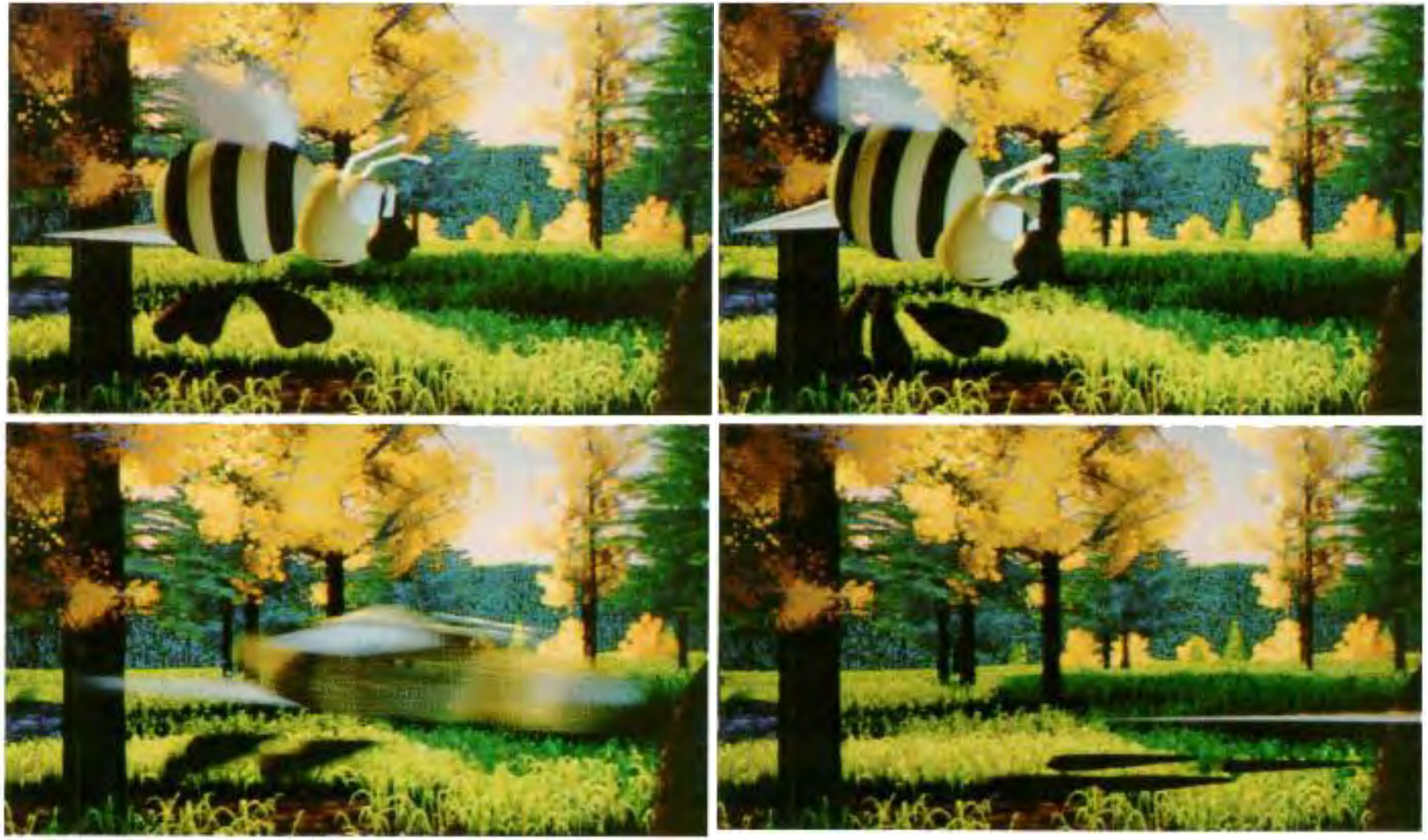
Timing

EIGHT inbetweens..... The Character searches for the peanut butter on the kitchen shelf.

NINE inbetweens.....The Character appraises, considering thoughtfully.

TEN inbetweens..... The Character streiches a sore muscle.

Anticipation



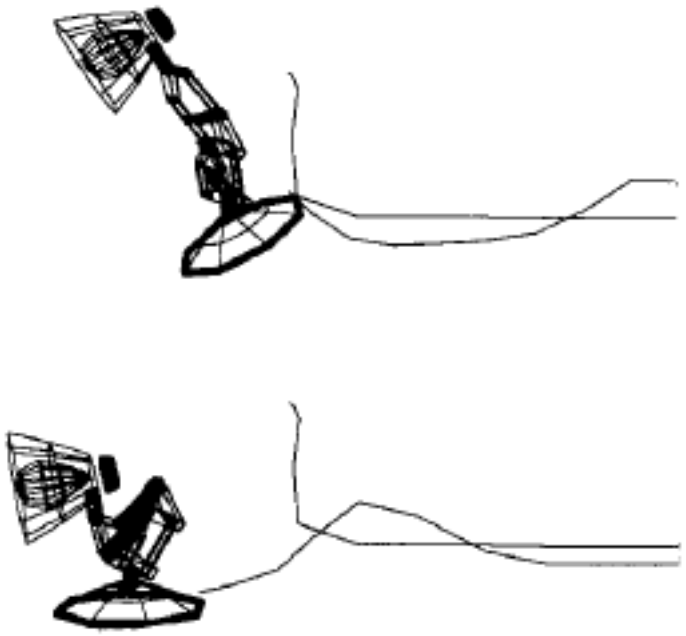
Staging

FIGURE 6. Andre's scratch was staged to the side (in "silhouette") for clarity and because that is where his itch was.

Staging

FIGURES 7-8. In *Luxo Jr.*, all action was staged to the side for clarity.

Follow Through, Overlap, Secondary



Pose-to-Pose, Slow In, Slow Out

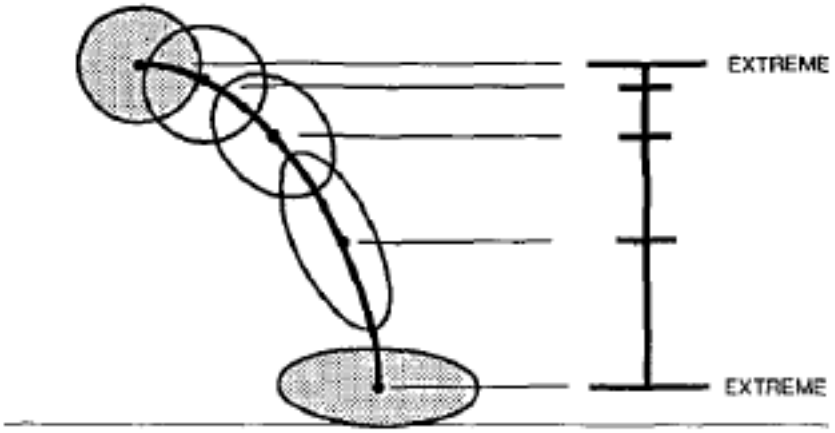
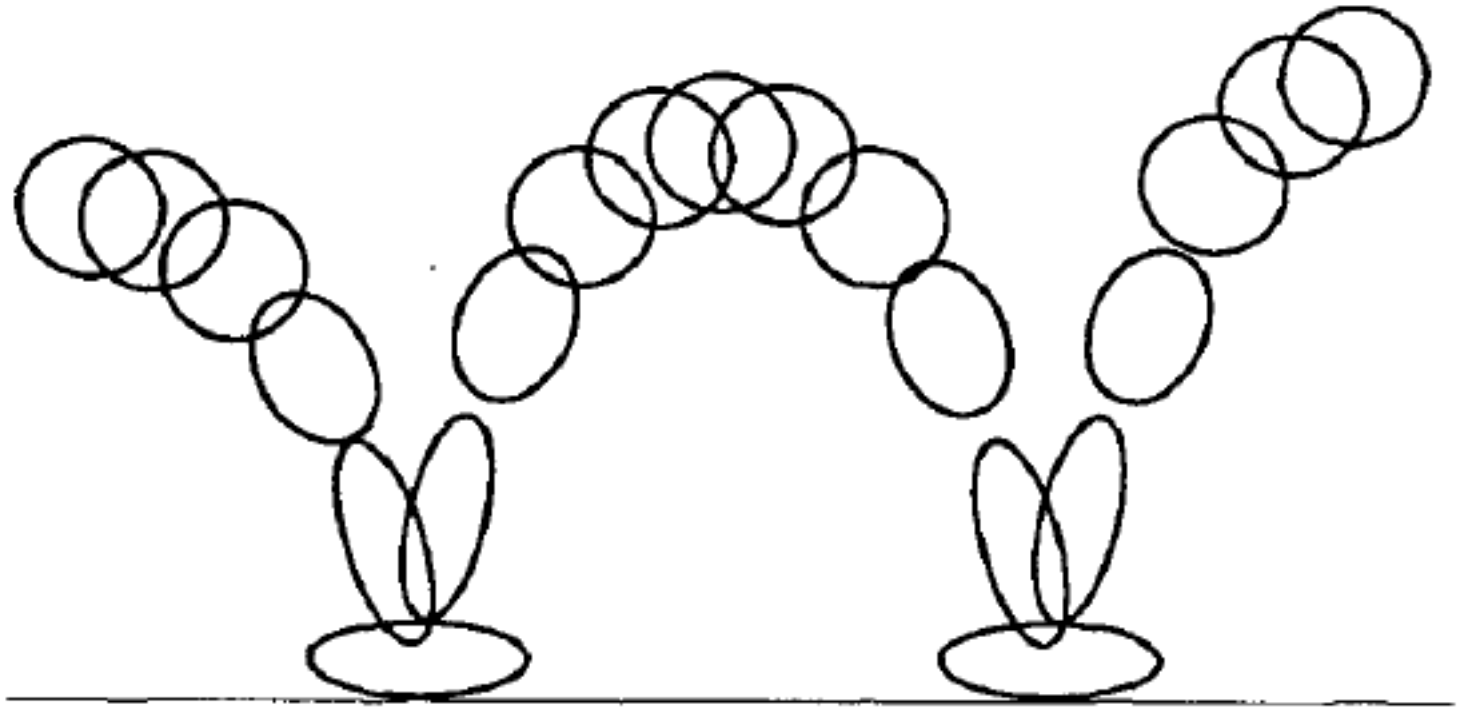


FIGURE 9. Timing chart for ball bounce.

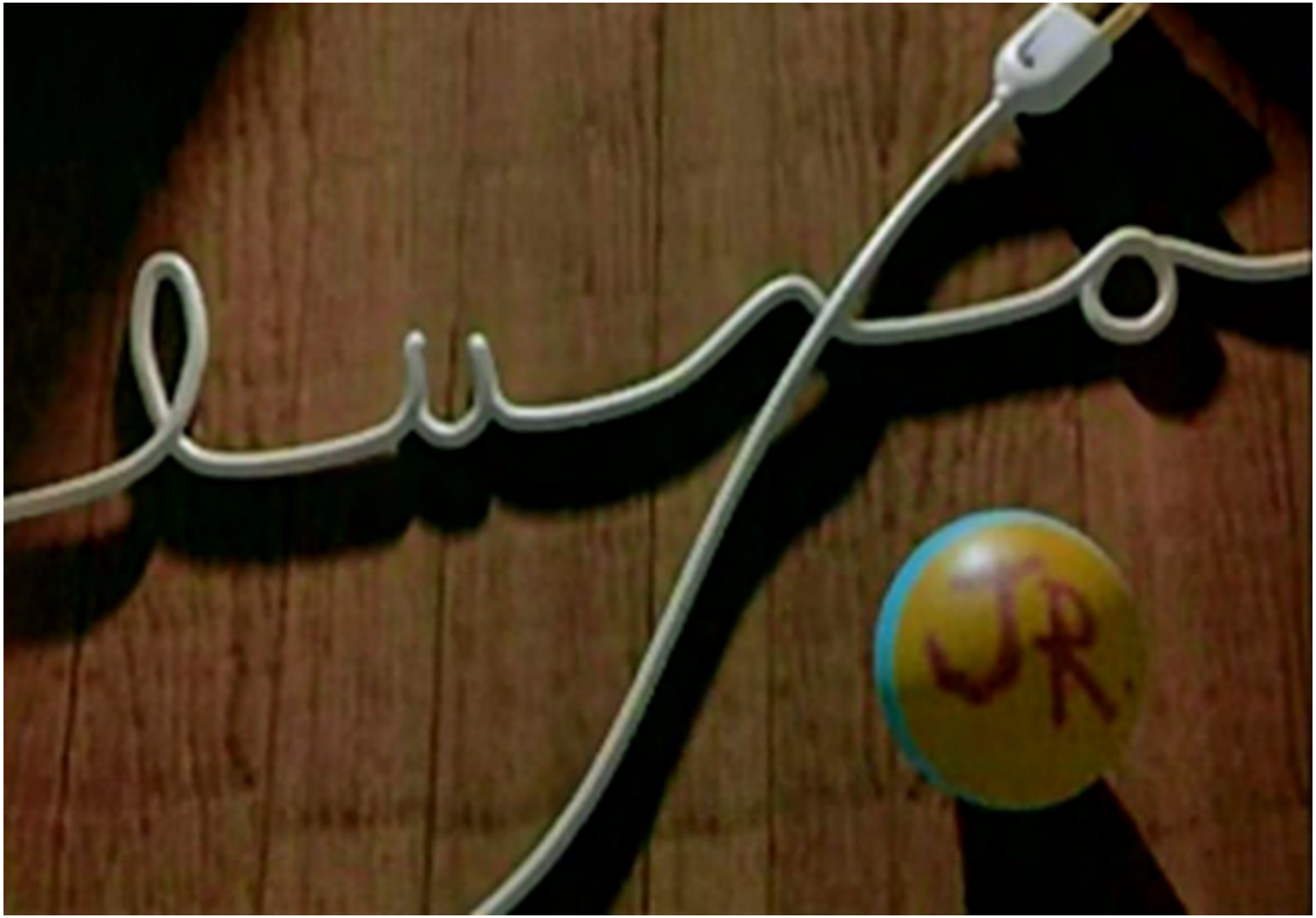
Objects with mass must accelerate and decelerate

Interesting frames are typically at ends,
tweaks perception to emphasize these poses

Arcs



Luxor Jr.



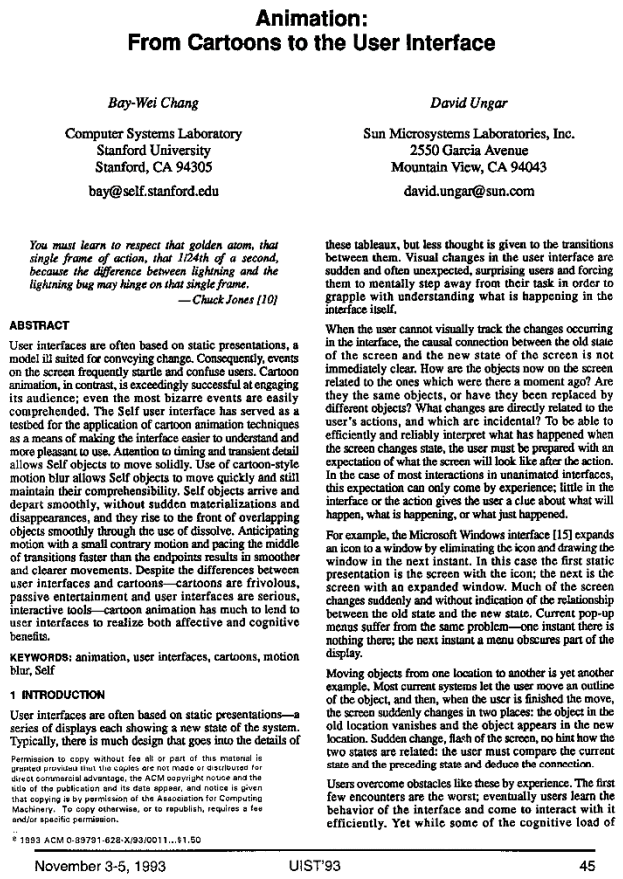
Luxor Jr.

Animation Case Study

Animation: From Cartoons to the User Interface

Chang and Ungar, 1993

http://dx.doi.org/10.1145/168642.168647



Animation:
From Cartoons to the User Interface

Bay-Wei Chang

Computer Systems Laboratory
Stanford University
Stanford, CA 94305

bay@self.stanford.edu

David Ungar

Sun Microsystems Laboratories, Inc.
2550 Garcia Avenue
Mountain View, CA 94043

david.ungar@sun.com

You must learn to respect that golden atom, that single frame of action, that 1/24th of a second, because the difference between lightning and the lightning bug may hinge on that single frame.
—Chuck Jones [10]

ABSTRACT

User interfaces are often based on static presentations, a model ill suited for conveying change. Consequently, events on the screen frequently startle and confuse users. Cartoon animation, in contrast, is exceedingly successful at engaging its audience; even the most bizarre events are easily comprehended. The Self user interface has served as a testbed for the application of cartoon animation techniques as a means of making the interface easier to understand and more pleasant to use. Attention to dimling and transient detail allows Self objects to move solidly. Use of cartoon-style motion blur allows Self objects to move quickly and still maintain their comprehensibility. Self objects arrive and depart smoothly, without sudden materializations and disappearances, and they rise to the front of overlapping objects smoothly through the use of dissolve. Anticipating motion with a small contrary motion and pacing the middle of transitions faster than the endpoints results in smoother and clearer movements. Despite the differences between user interfaces and cartoons—cartoons are frivolous, passive entertainment and user interfaces are serious, interactive tools—cartoon animation has much to lend to user interfaces to realize both affective and cognitive benefits.

KEYWORDS: animation, user interfaces, cartoons, motion blur, Self

1 INTRODUCTION

User interfaces are often based on static presentations—a series of displays each showing a new state of the system. Typically, there is much design that goes into the details of these tableaux, but less thought is given to the transitions between them. Visual changes in the user interface are sudden and often unexpected, surprising users and forcing them to mentally step away from their task in order to grapple with understanding what is happening in the interface itself.

When the user cannot visually track the changes occurring in the interface, the causal connection between the old state of the screen and the new state of the screen is not immediately clear. How are the objects now on the screen related to the ones which were there a moment ago? Are they the same objects, or have they been replaced by different objects? What changes are directly related to the user's actions, and which are incidental? To be able to efficiently and reliably interpret what has happened when the screen changes state, the user must be prepared with an expectation of what the screen will look like after the action. In the case of most interactions in unanimated interfaces, this expectation can only come by experience; little in the interface or the action gives the user a clue about what will happen, what is happening, or what just happened.

For example, the Microsoft Windows interface [15] expands an icon to a window by eliminating the icon and drawing the window in the next instant. In this case the first static presentation is the screen with the icon; the next is the screen with an expanded window. Much of the screen changes suddenly and without indication of the relationship between the old state and the new state. Current pop-up menus suffer from the same problem—one instant there is nothing there; the next instant a menu obscures part of the display.

Moving objects from one location to another is yet another example. Most current systems let the user move an outline of the object, and then, when the user is finished the move, the screen suddenly changes in two places: the object in the old location vanishes and the object appears in the new location. Sudden change, flash of the screen, no hint how the two states are related: the user must compare the current state and the preceding state and deduce the connection.

Users overcome obstacles like these by experience. The first few encounters are the worst; eventually users learn the behavior of the interface and come to interact with it efficiently. Yet while some of the cognitive load of

Frames Three Principles

Solidity

- Desktop objects should appear to be solid objects

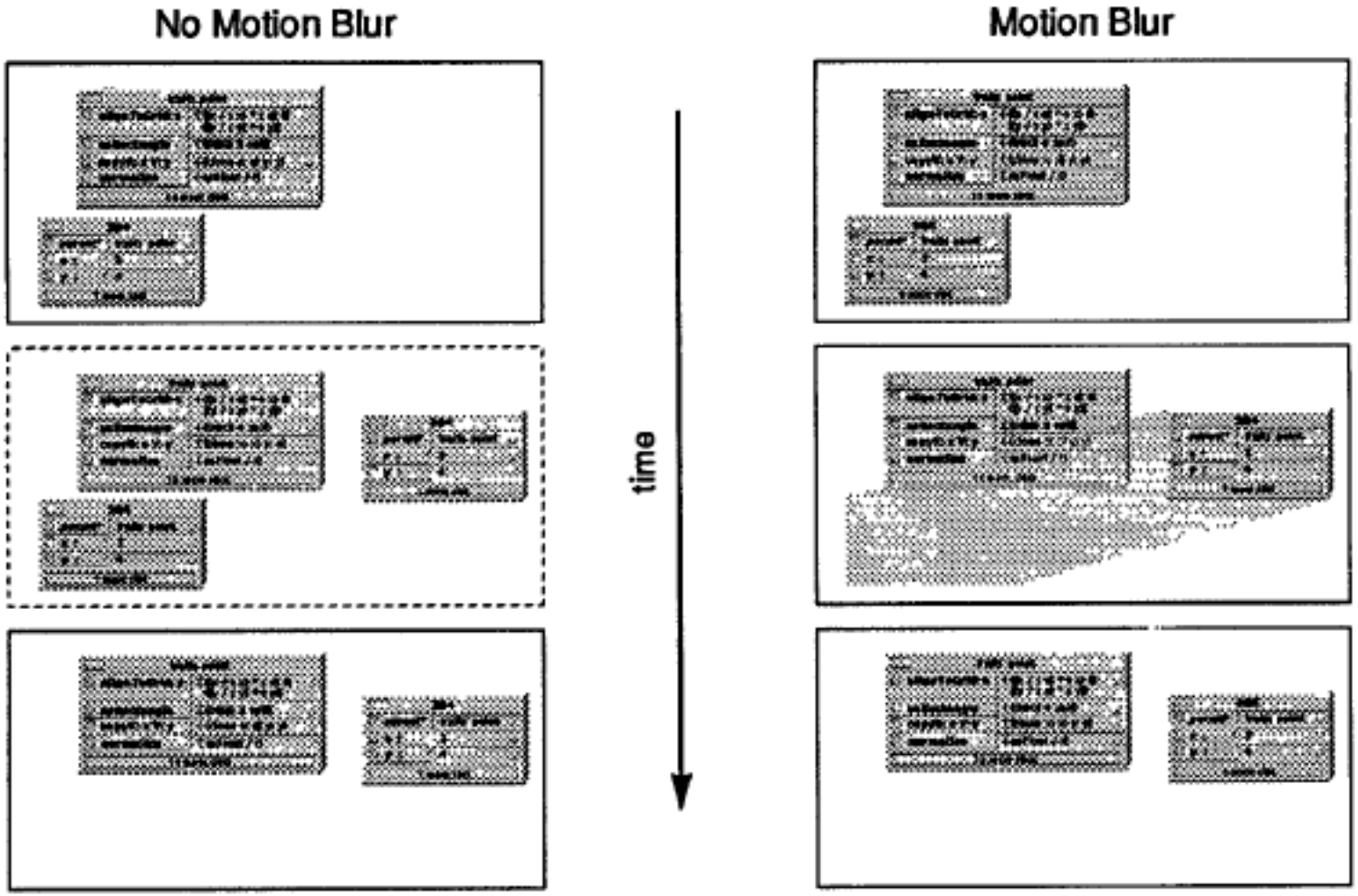
Exaggeration

- Exaggerate physical actions to enhance perception

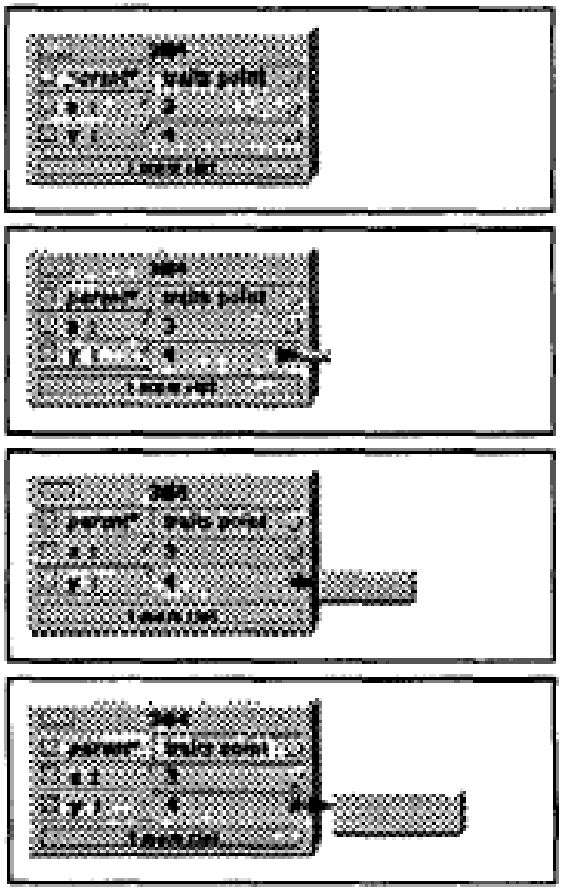
Reinforcement

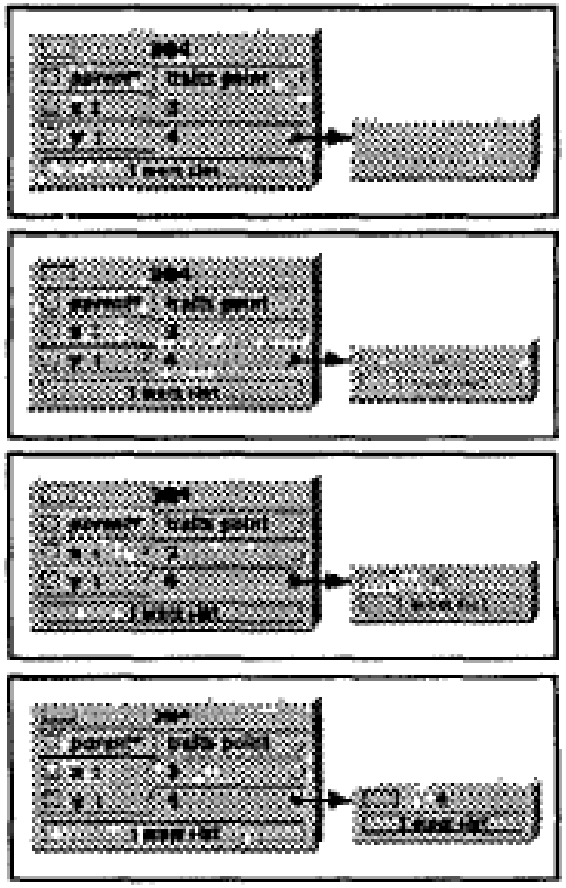
- Use effects to drive home feeling of reality

Solidity: Motion Blur

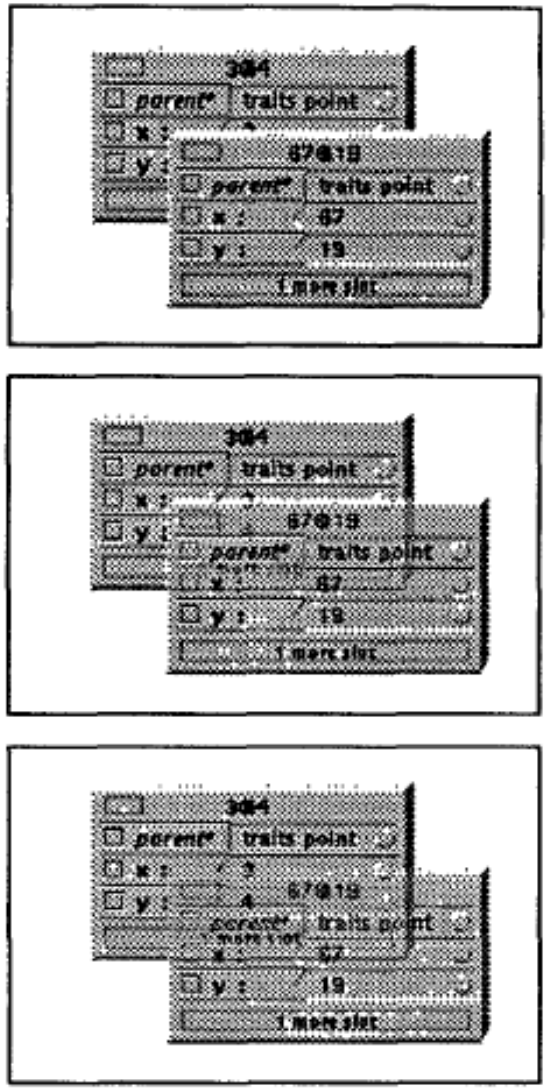


Solidity: Arrival and Departure





Solidity: Arrival and Departure



Exaggeration: Anticipation

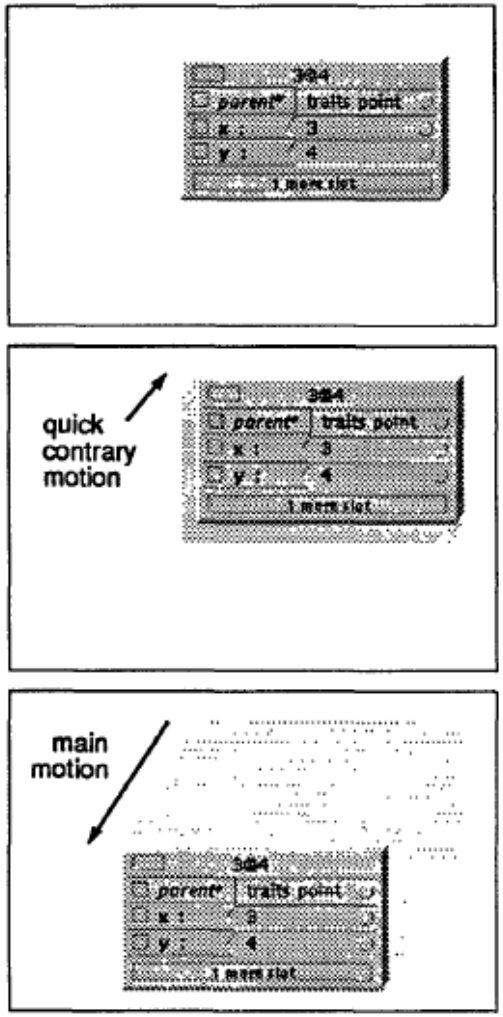


Figure 7. Objects anticipate major actions with a quick contrary motion that draws the user eye to the object in preparation for the main motion to come.

Reinforcement: Slow In Slow Out

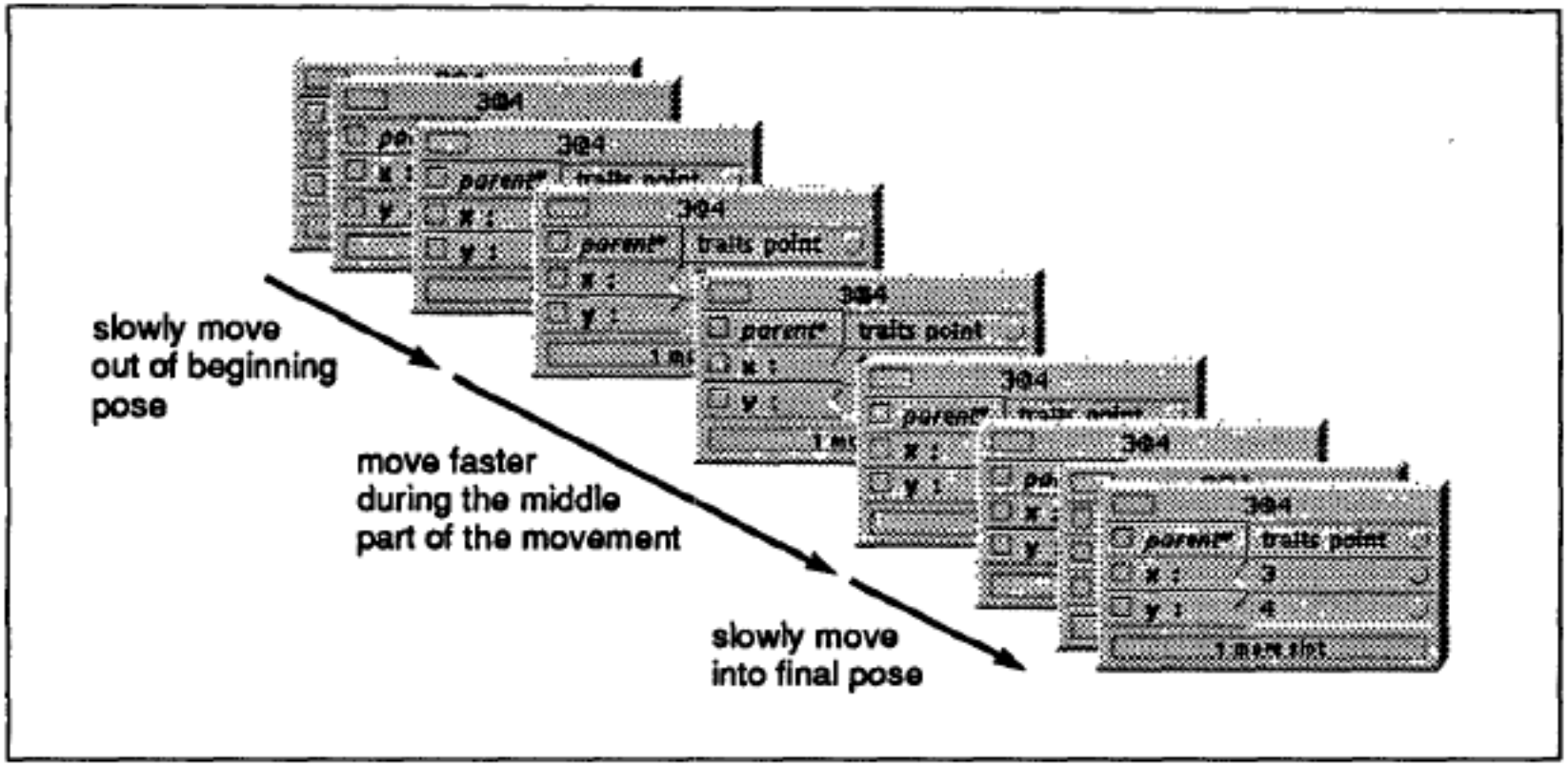


Figure 8. Objects ease out of their beginning poses and ease into their final poses. Although these motions are slower than that during the main portion of the movement, they are still quite fast.

Reinforcement: Arcs

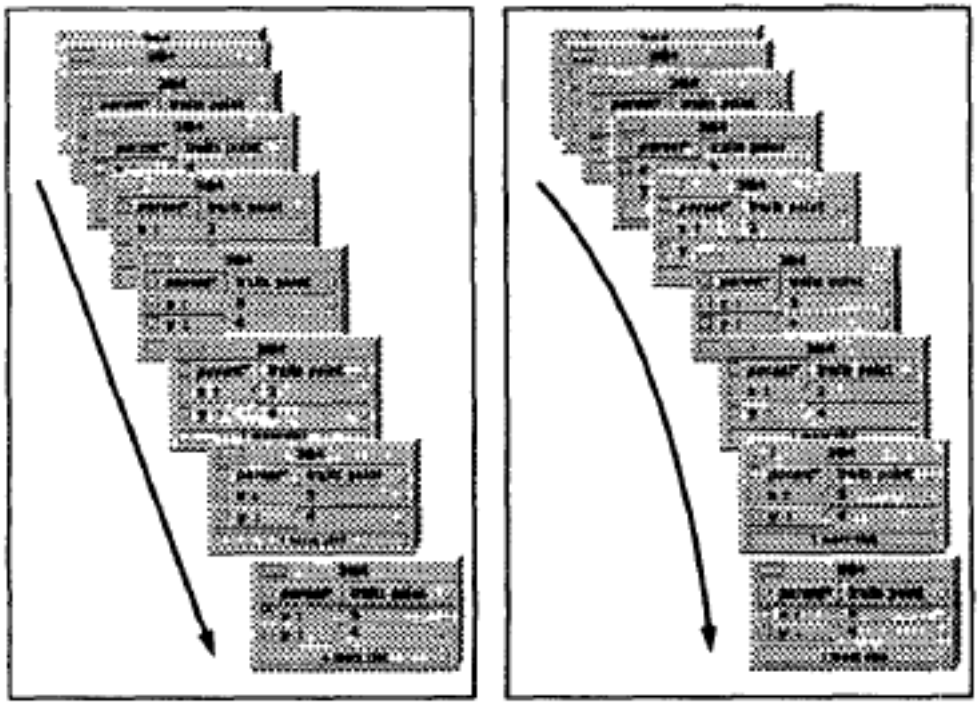


Figure 9. When objects travel under their own power (non-interactively), they move in arcs rather than straight lines.

Reinforcement: Follow Through

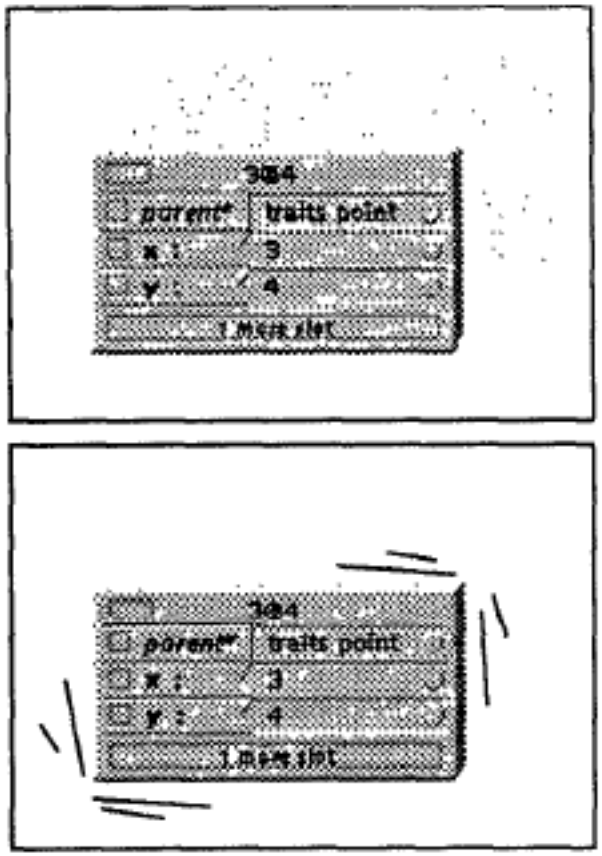


Figure 10. When objects come to a stop after moving on their own, they exhibit follow through in the form of wiggling back and forth quickly. This is just suggested by the "wiggle lines" in the figure—in actuality, the object moves back and forth, with motion blur.

Animation Case Study

Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions

Hudson and Stasko, 1993

http://dx.doi.org/10.1145/168642.168648

Animation Support in a User Interface Toolkit: Flexible, Robust, and Reusable Abstractions

Scott E. Hudson
John T. Stasko

Graphics Visualization and Usability Center
College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280
E-mail: hudson@cc.gatech.edu, stasko@cc.gatech.edu

ABSTRACT

Animation can be a very effective mechanism to convey information in visualization and user interface settings. However, integrating animated presentations into user interfaces has typically been a difficult task since, to date, there has been little or no explicit support for animation in window systems or user interface toolkits. This paper describes how the Artkit user interface toolkit has been extended with new animation support abstractions designed to overcome this problem. These abstractions provide a powerful but convenient base for building a range of animations, supporting techniques such as simple motion-blur, "squash and stretch", use of arcing trajectories, anticipation and follow through, and "slow-in / slow-out" transitions. Because these abstractions are provided by the toolkit they are reusable and may be freely mixed with more conventional user interface techniques. In addition, the Artkit implementation of these abstractions is robust in the face of systems (such as the X Window System and Unix) which can be ill-behaved with respect to timing considerations.

Keywords: object-oriented user interface toolkits, window systems, animation techniques, dynamic interfaces, motion blur, real-time scheduling.

This work was supported in part by the National Science Foundation under grants IRI-9015407, DCA-9214947, CCR-9121607 and CCR-9109399.

1 INTRODUCTION

Human perceptual capabilities provide a substantial ability to quickly form and understand models of the world from moving images. As a result, in a well designed display, information can often be much more easily comprehended in a moving scene than in a single static image or even a sequence of static images. For example, the "cone tree" display described in [Robe93] provides a clear illustration that the use of continuous motion can allow much more information to be presented and understood more easily.

However, even though the potential benefits of animation in user interfaces have been recognized for some time ([Baec90] for example, surveys a number of uses for animation in the interface and cites their benefits and [Stask93] reviews principles for using animation in interfaces and describes a number of systems that make extensive use of animation in an interface), explicit support for animation is rarely, if ever, found in user interface support environments. The work described in this paper is designed to overcome this problem by showing how flexible, robust, and reusable support for animation can be incorporated into a full scale object-oriented user interface toolkit. Specifically, this paper describes how the extension mechanisms of Artkit — the Advanced Reusable Toolkit (supporting interfaces in C++) [Henr90] — have been employed to smoothly integrate animation support with other user interface capabilities.

The animation abstractions provided by the Artkit system are designed to be powerful and flexible — providing basic support that can be used to build a range of sophisticated techniques such as: simple motion-blur, "squash and stretch", use of arcing

Events and Animation

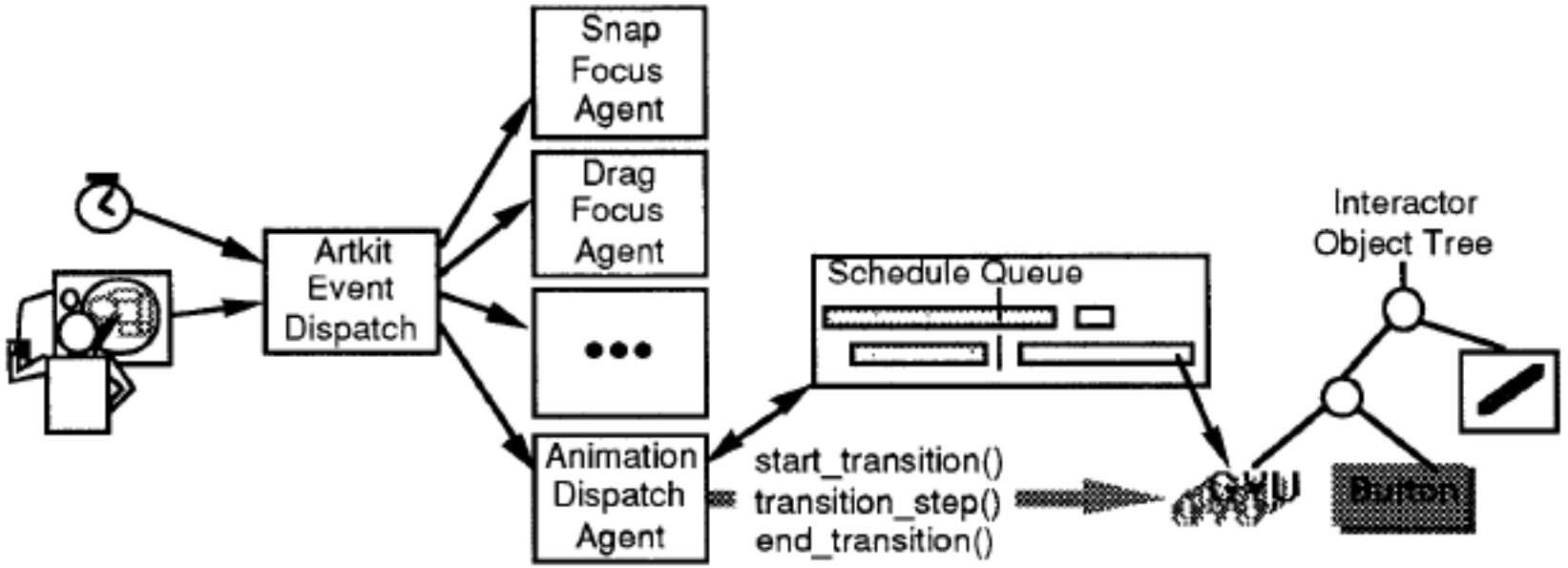


Figure 5. Animation Event Translation and Dispatch

Not Just an Implementation

Provides tool abstractions for implementing previously presented styles of animation

Overcomes a fundamental clash of approaches

- Event loop receives input, processes, repaints
- Animations expect careful control of frames, but the event loop has variable timing

Events and Animation

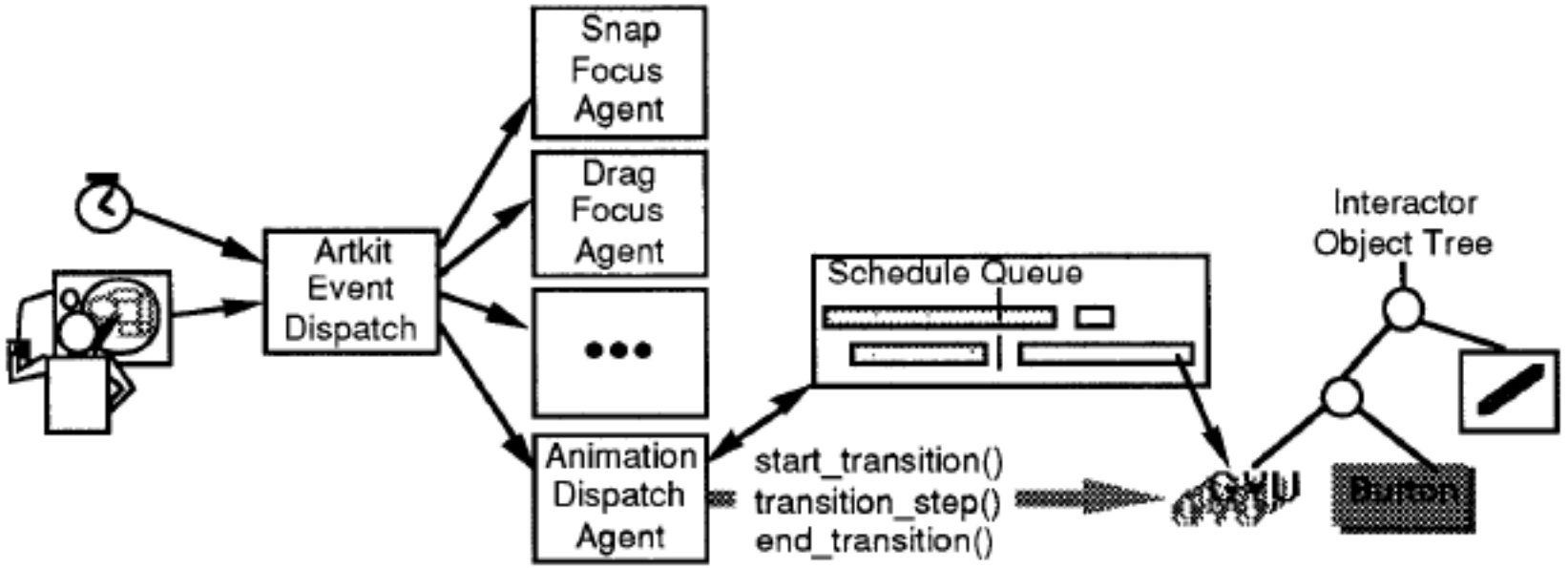


Figure 5. Animation Event Translation and Dispatch

Transition Object

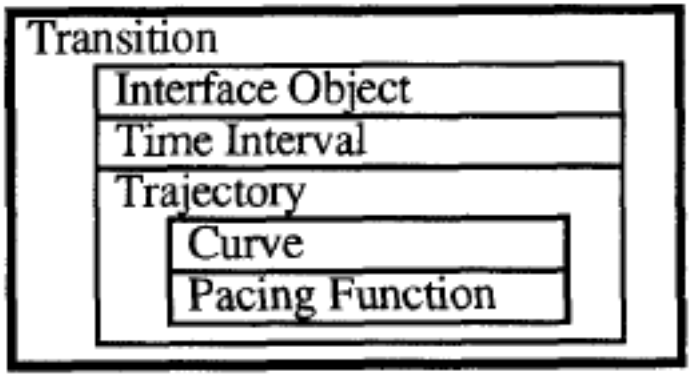


Figure 3. Parts of a Transition Object

Pacing Function

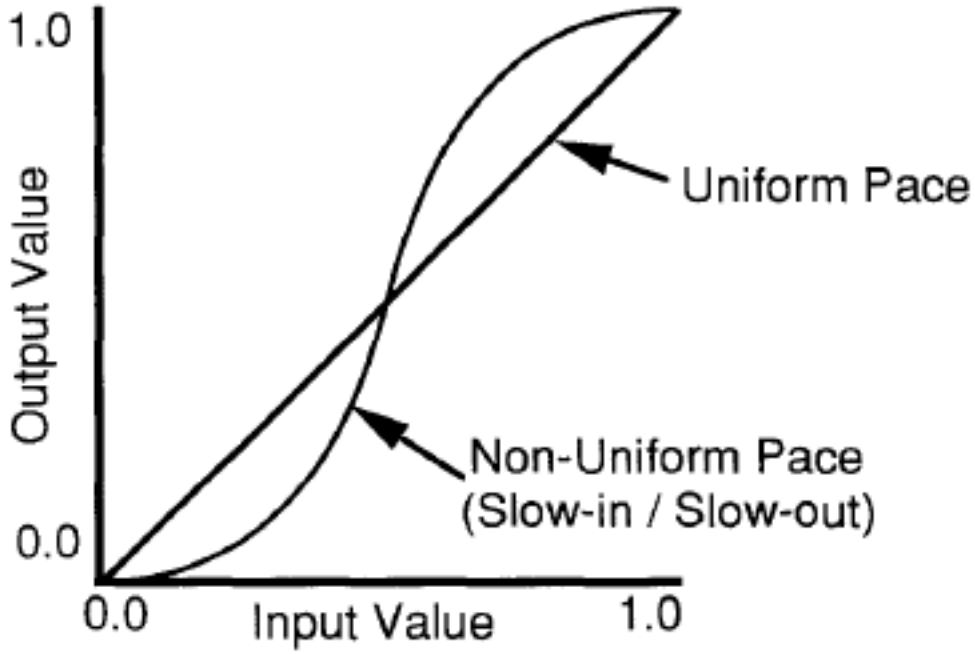


Figure 4. Two Example Pacing Functions

Computing a Frame

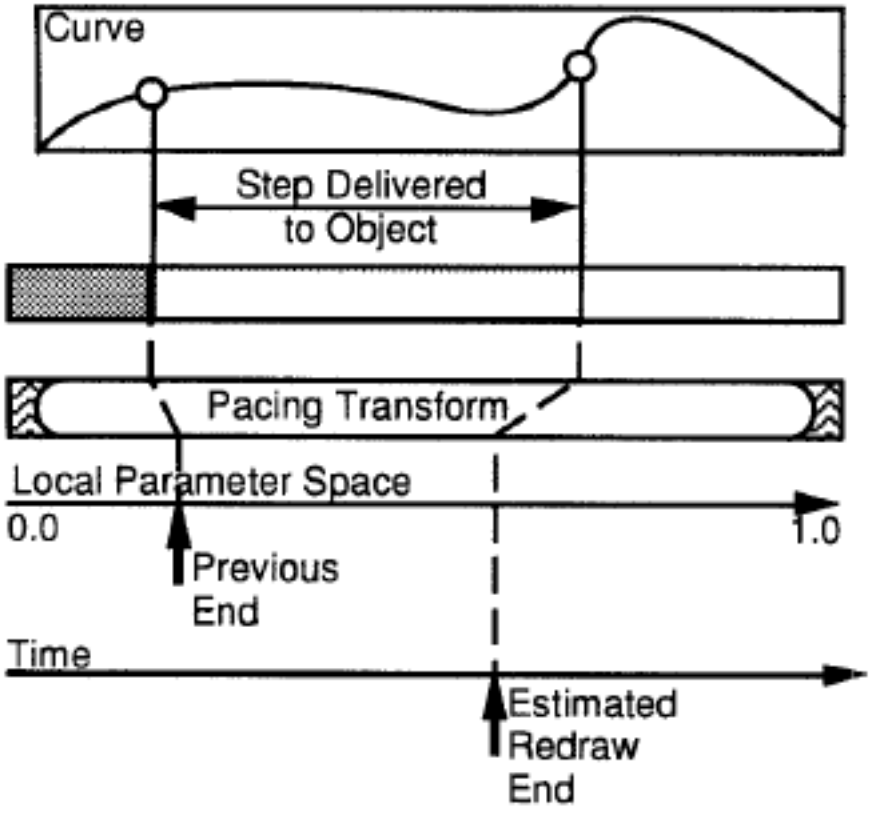


Figure 8. Translation from Time to Space

Animation Case Study

Based on increased understanding of how animation should be done in the interface, increasingly mature tools develop

Now built into major commercial toolkits (e.g., Microsoft's WPF, JavaFX, jQuery)

Once mature, begins to be used as a building block in even more complex behaviors

Animation Case Study

The Kinetic Typography Engine: An Extensible System for Animating Expressive Text

Lee et al, 2002

http://dx.doi.org/10.1145/571985.571997

The Kinetic Typography Engine:
An Extensible System for Animating Expressive Text

Johnny C. Lee*, Jodi Forlizzi*†, Scott E. Hudson*
*Human Computer Interaction Institute and †School of Design
Carnegie Mellon University,
Pittsburgh, PA 15213 USA
{ johnny, forlizzi, scott.hudson }@cs.cmu.edu

ABSTRACT
Kinetic typography – text that uses movement or other temporal change – has recently emerged as a new form of communication. As we hope to illustrate in this paper, kinetic typography can be seen as bringing some of the expressive power of film – such as its ability to convey emotion, portray compelling characters, and visually direct attention – to the strong communicative properties of text. Although kinetic typography offers substantial promise for expressive communications, it has not been widely exploited outside a few limited application areas (most notably in TV advertising). One of the reasons for this has been the lack of tools directly supporting it, and the accompanying difficulty in creating dynamic text. This paper presents a first step in remedying this situation – an extensible and robust system for animating text in a wide variety of forms. By supporting an appropriate set of carefully factored abstractions, this *engine* provides a relatively small set of components that can be plugged together to create a wide range of different expressions. It provides new techniques for automating effects used in traditional cartoon animation, and provides specific support for typographic manipulations.

KEYWORDS: kinetic typography, dynamic text, time-based presentation, automating animation effects

INTRODUCTION
The written word is one of humanity's most powerful and significant inventions. For over 4000 years, its basic communicative purpose has not changed. However, the method in which written communication is authored and presented has never stopped evolving. From cuneiform markings on clay tablets, to pen and parchment, to the Gutenberg press, to computers and the internet, technology has always provided text with new mediums to express itself. The explosion of available computing power has added a new possibility: *kinetic typography* – text that moves or otherwise changes over time.

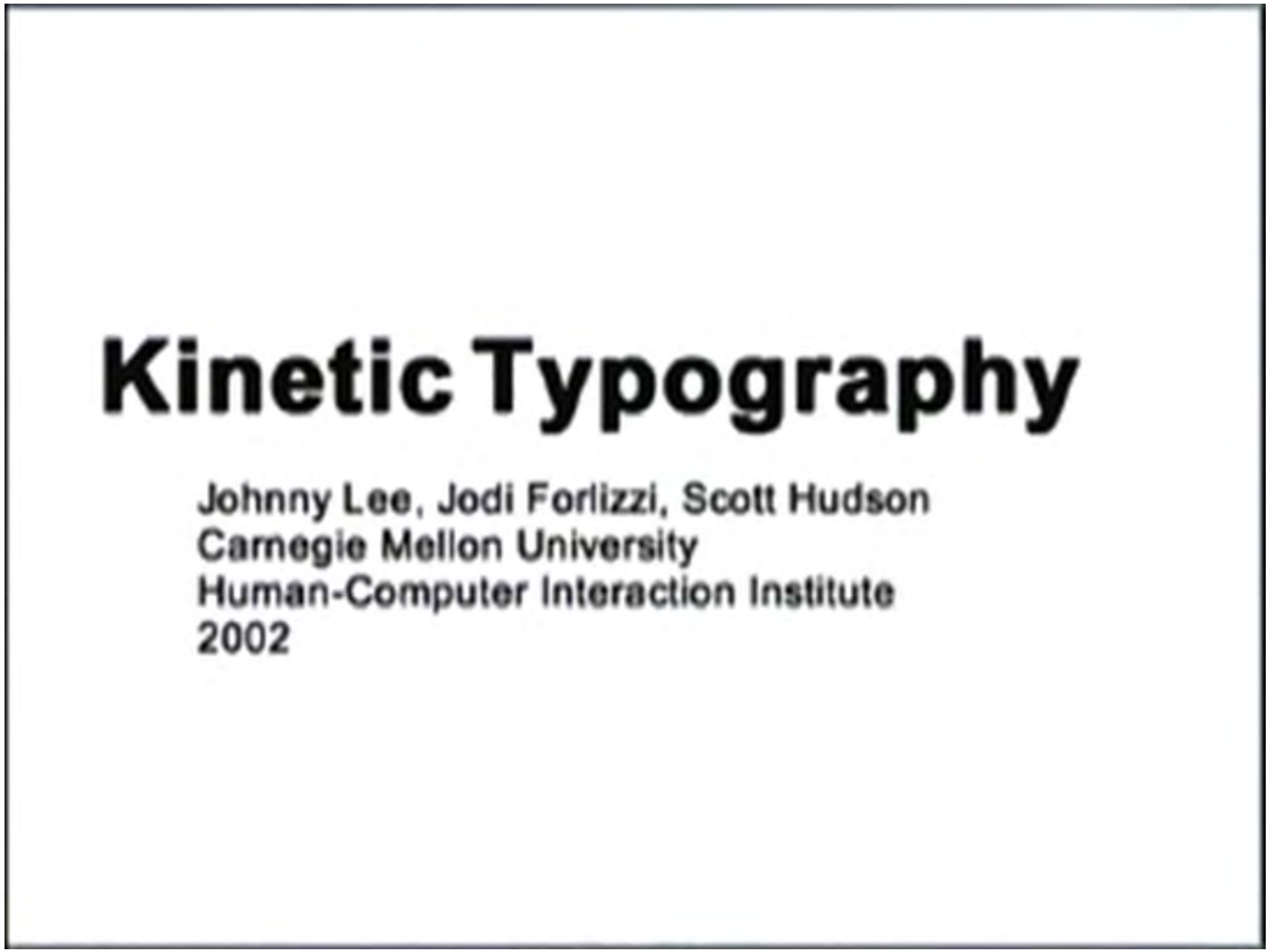
Kinetic typography can be seen as a vehicle for adding some of the properties of film to that of text. For example, kinetic typography can be effective in conveying a speaker's tone of voice, qualities of character, and affective (emotional) qualities of text [Ford97]. It may also allow for a different kind of engagement with the viewer than static text, and in some cases, may explicitly direct or manipulate the attention of the viewer.

In fact, the first known use of kinetic typography appeared in film – specifically, Saul Bass' opening credit sequence for Hitchcock's *North by Northwest* [Bass59] and later *Psycho* [Bass60]. This work stemmed in part from a desire to have the opening credits set the stage for the film by establishing a mood, rather than simply conveying the information of the credits. Use of kinetic typography is now commonplace for this purpose, and is also very heavily used in TV advertising where its ability to convey emotive content and direct the user's attention is generally a good match to the goals of advertising. We believe that if it can be made accessible via good tools, the power of kinetic typography can also be applied to benefit other areas of digital communications.

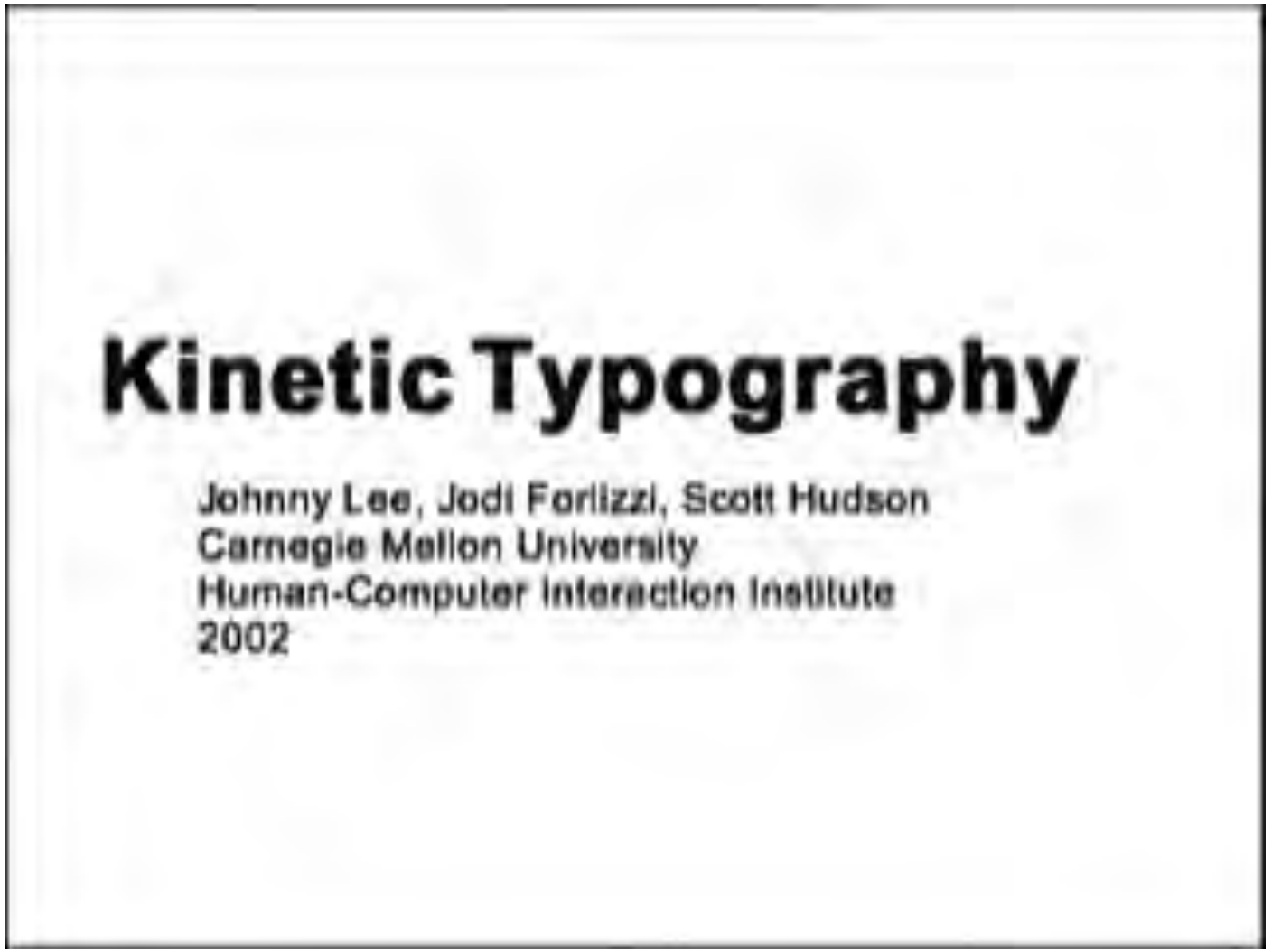
A second origin for time-based presentation of text comes independently from psychological studies of perception and reading. For example, [Mill87] studies perceptual effects of a number of text presentations, such as scrolling text. One of the most fruitful of these is a method known as *Rapid Serial Visual Presentation* (RSVP), where text is displayed one word at a time in a fixed position [Pott84]. Studies have shown that, because scanning eye movements are unnecessary when using RSVP, it can result in rapid reading without a need for special training. In addition, RSVP techniques provide advantages for designers because they allow words to be treated independently without regard to effects on adjacent text elements. Finally, RSVP can be seen as a means for trading time for space, potentially allowing large bodies of text to be shown at readable sizes on small displays.

Figures 1-3 illustrate some of the things that kinetic typography can do. (Please refer to the video proceedings for dynamic renditions of these figures.) Figure 1 shows two different renditions of the same words expressing a different emotional tone. As described by Ishizaki [Ishi97]:

Kinetic Typography Engine



Kinetic Typography Engine



Kinetic Typography Engine

Goals of Kinetic Type

- Emotional content
- Creation of characters
- Direction of attention

Animation Composition

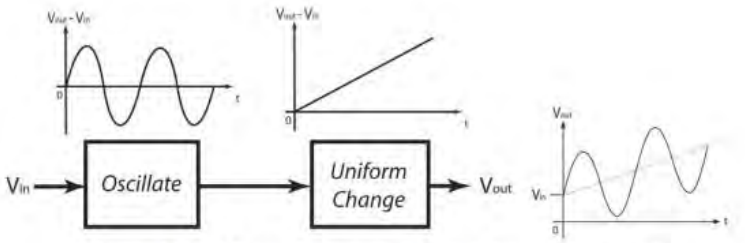


Figure 6. Waveform addition by chaining"

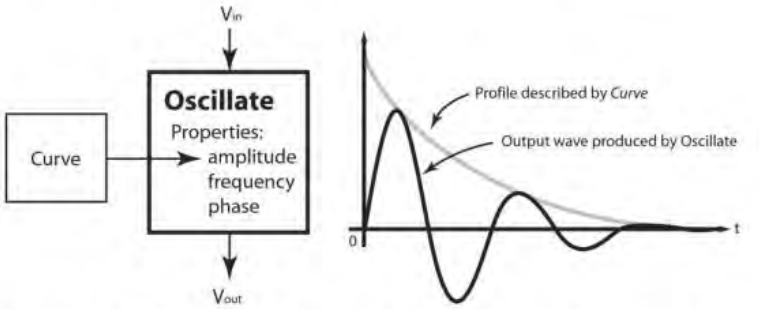


Figure 7. Waveform scaling by functional composition with amplitude

Tools and Interfaces

Why Interface Tools?

Case Study of Model-View-Controller

Case Study of Animation

Sapir-Whorf Hypothesis

Thoughtfulness in Tools

Case Study in Self-Tracking

Sapir-Whorf Hypothesis

Roughly, some thoughts in one language cannot be stated or understood in another language

Our tools define the language of interaction

- Beyond the simple matter of code
- Frame how we think about possibilities

Myers, Hudson, Pausch. Past, Present, and Future of User Interface Software Tools. *TOCHI 2000.*

Sapir-Whorf Hypothesis

Roughly, some thoughts in one language cannot be stated or understood in another language

- Language is not simply a way of voicing ideas, but is the very thing which shapes those ideas

Our tools define the language of interaction

- Beyond the simple matter of code
- Frame how we think about possibilities

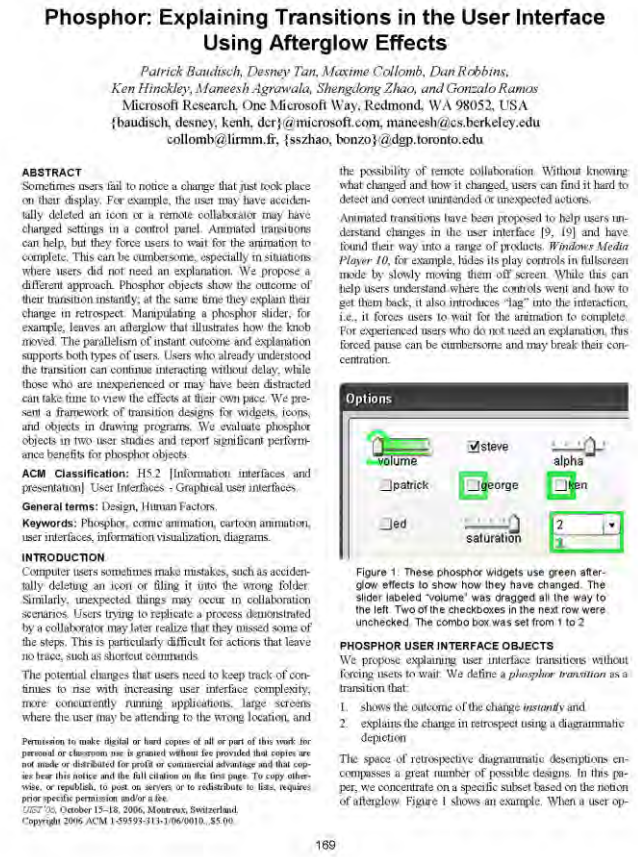
You must be aware of this when choosing tools, designing applications, and creating new tools

Animation Case Study

Phosphor:
Explaining Transitions
in the User Interface
Using Afterglow Effects

Baudisch et al, 2006

http://dx.doi.org/10.1145/1166253.1166280



Phosphor: Explaining Transitions in the User Interface Using Afterglow Effects

Patrick Baudisch, Desney Tan, Maxime Collomb, Dan Robbins, Ken Hinckley, Maneesh Agrawala, Shengdong Zhao, and Gonzalo Ramos
Microsoft Research, One Microsoft Way, Redmond, WA 98052, USA
{baudisch, desney, kenh, dcr}@microsoft.com, maneesh@cs.berkeley.edu
collomb@lirmm.fr, {sszhao, bonzo}@dgp.toronto.edu

ABSTRACT
Sometimes users fail to notice a change that just took place on their display. For example, the user may have accidentally deleted an icon or a remote collaborator may have changed settings in a control panel. Animated transitions can help, but they force users to wait for the animation to complete. This can be cumbersome, especially in situations where users did not need an explanation. We propose a different approach. Phosphor objects show the outcome of their transition instantly; at the same time they explain their change in retrospect. Manipulating a phosphor slider, for example, leaves an afterglow that illustrates how the knob moved. The parallelism of instant outcome and explanation supports both types of users. Users who already understood the transition can continue interacting without delay, while those who are inexperienced or may have been distracted can take time to view the effects at their own pace. We present a framework of transition designs for widgets, icons, and objects in drawing programs. We evaluate phosphor objects in two user studies and report significant performance benefits for phosphor objects.

ACM Classification: H5.2 [Information interfaces and presentation] User Interfaces - Graphical user interfaces.

General terms: Design, Human Factors.

Keywords: Phosphor, comic animation, cartoon animation, user interfaces, information visualization, diagrams.

INTRODUCTION
Computer users sometimes make mistakes, such as accidentally deleting an icon or filing it into the wrong folder. Similarly, unexpected things may occur in collaboration scenarios. Users trying to replicate a process demonstrated by a collaborator may later realize that they missed some of the steps. This is particularly difficult for actions that leave no trace, such as shortcut commands.

The potential changes that users need to keep track of continues to rise with increasing user interface complexity, more concurrently running applications, large screens where the user may be attending to the wrong location, and the possibility of remote collaboration. Without knowing what changed and how it changed, users can find it hard to detect and correct unintended or unexpected actions.

Animated transitions have been proposed to help users understand changes in the user interface [9, 19] and have found their way into a range of products. *Windows Media Player 10*, for example, hides its play controls in fullscreen mode by slowly moving them off screen. While this can help users understand where the controls went and how to get them back, it also introduces "lag" into the interaction, i.e., it forces users to wait for the animation to complete. For experienced users who do not need an explanation, this forced pause can be cumbersome and may break their concentration.

UIST'06, October 15–18, 2006, Montreux, Switzerland.

Figure 1: These phosphor widgets use green afterglow effects to show how they have changed. The slider labeled "volume" was dragged all the way to the left. Two of the checkboxes in the next row were unchecked. The combo box was set from 1 to 2.

PHOSPHOR USER INTERFACE OBJECTS
We propose explaining user interface transitions without forcing users to wait. We define a *phosphor transition* as a transition that:

1. shows the outcome of the change *instantly* and
2. explains the change in retrospect using a diagrammatic depiction.

The space of retrospective diagrammatic descriptions encompasses a great number of possible designs. In this paper, we concentrate on a specific subset based on the notion of afterglow. Figure 1 shows an example. When a user op-

Phosphor

Animation can help people follow interface transitions

But the right speed is crucial

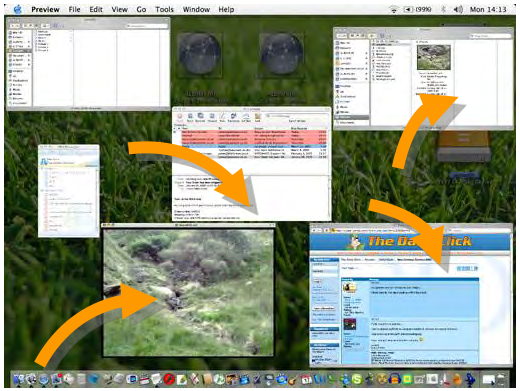
- Too fast increases error rate
- Too slow increases task time

The right speed depends on familiarity, distraction, etc.

- It cannot be determined

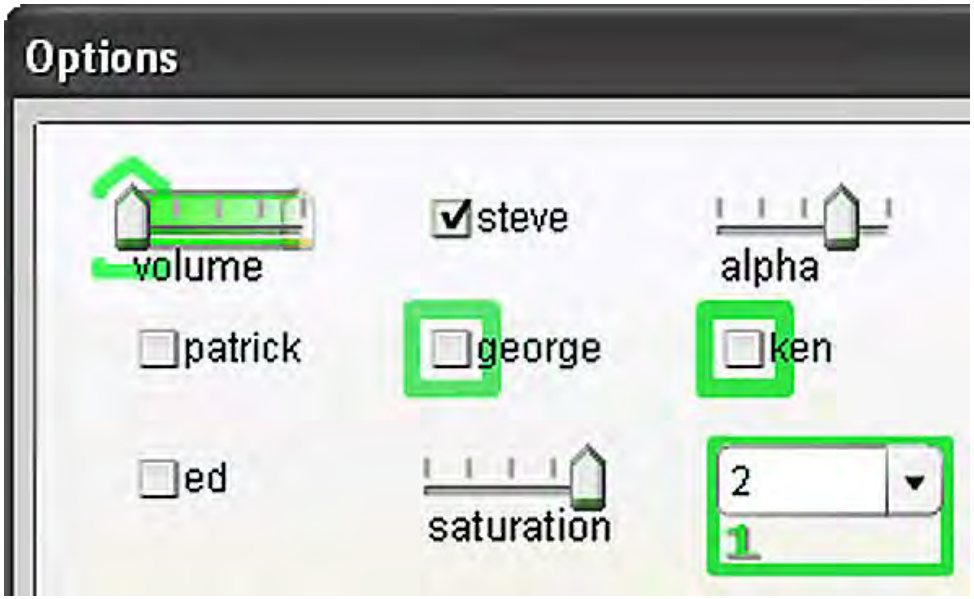
Windows Media Player

Apple Expose

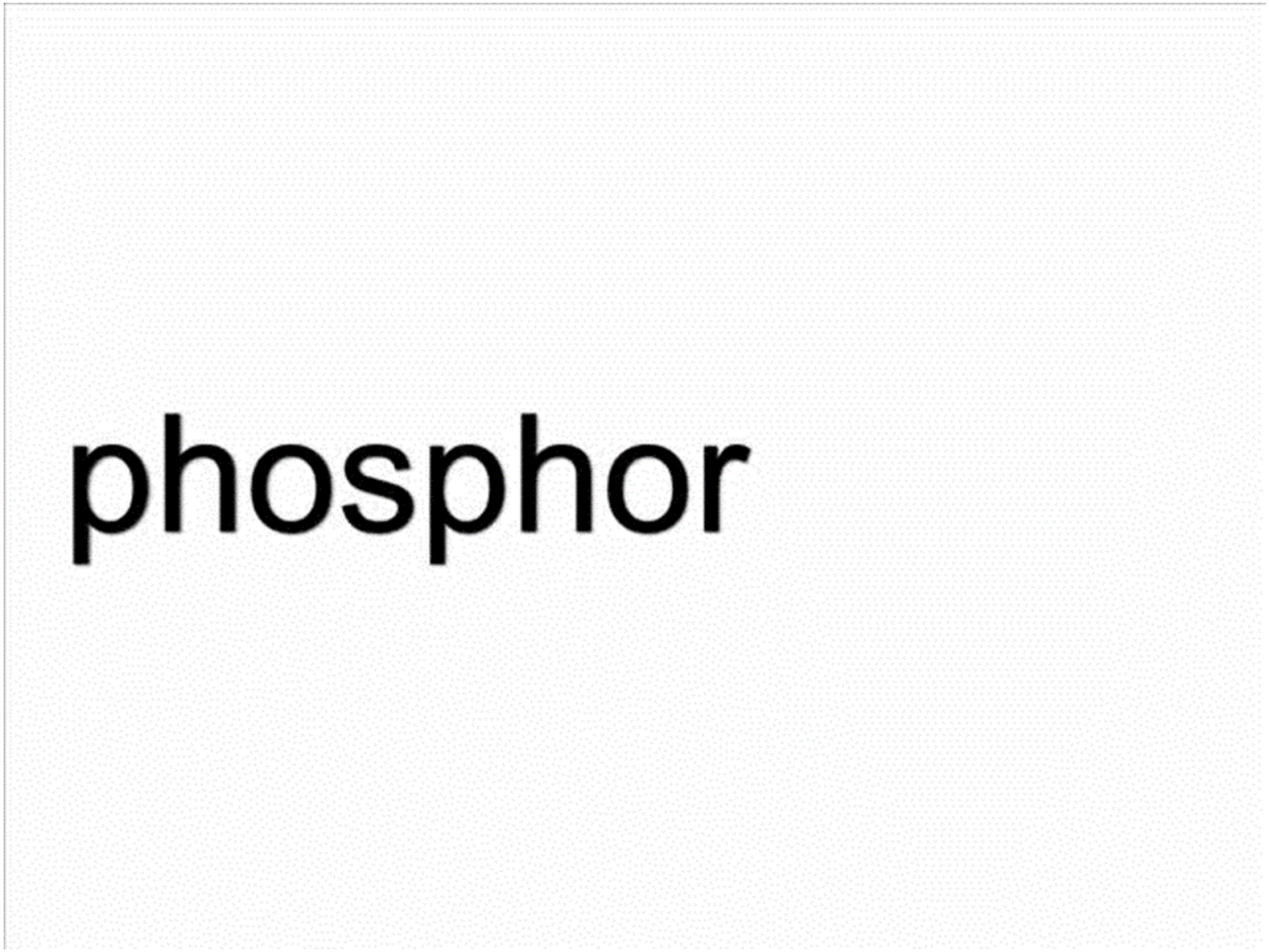


Phosphor

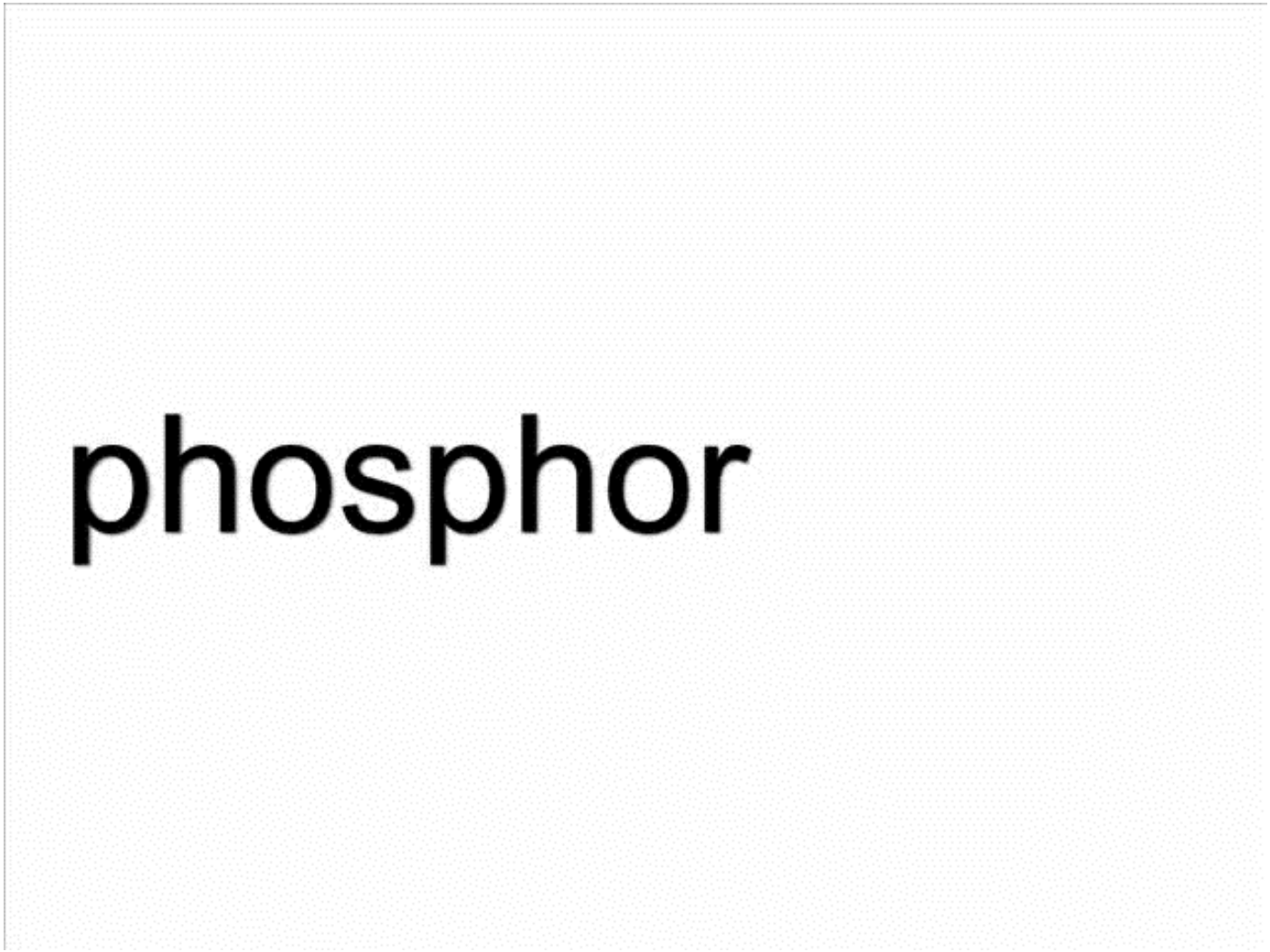
Phosphor shows the outcome immediately, then explains change in retrospect using a diagrammatic depiction



Phosphor

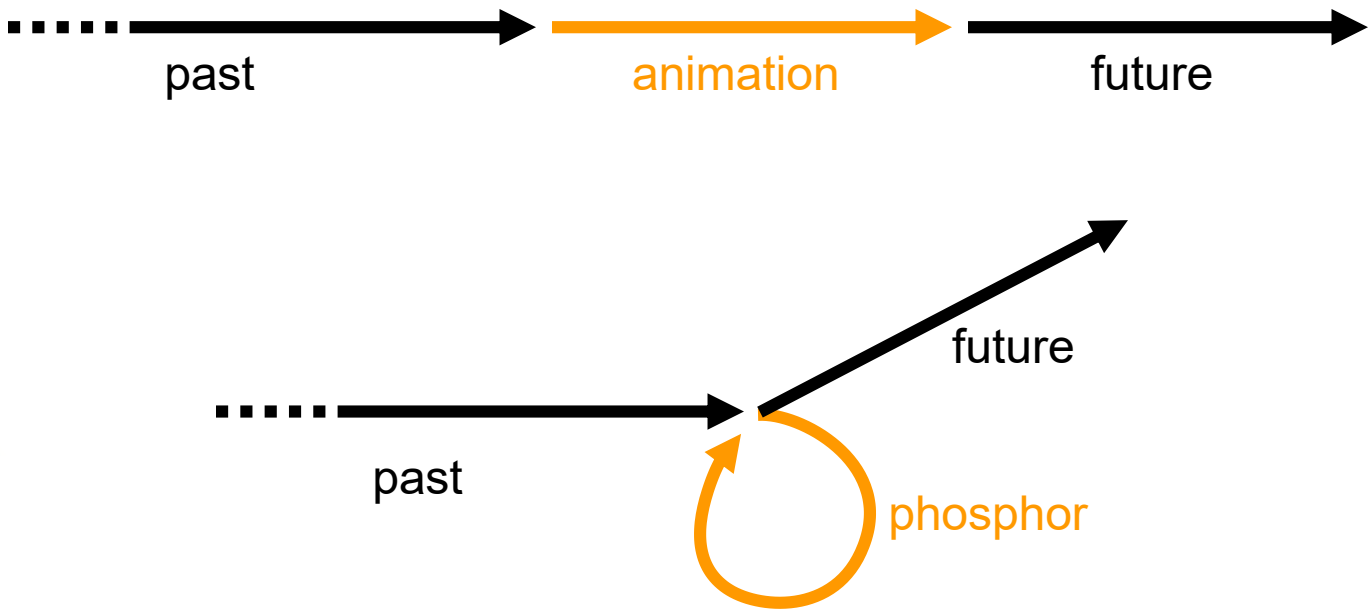


Phosphor



Challenging Assumptions of Tools

Phosphor breaks from the assumptions that have evolved into current transition tools



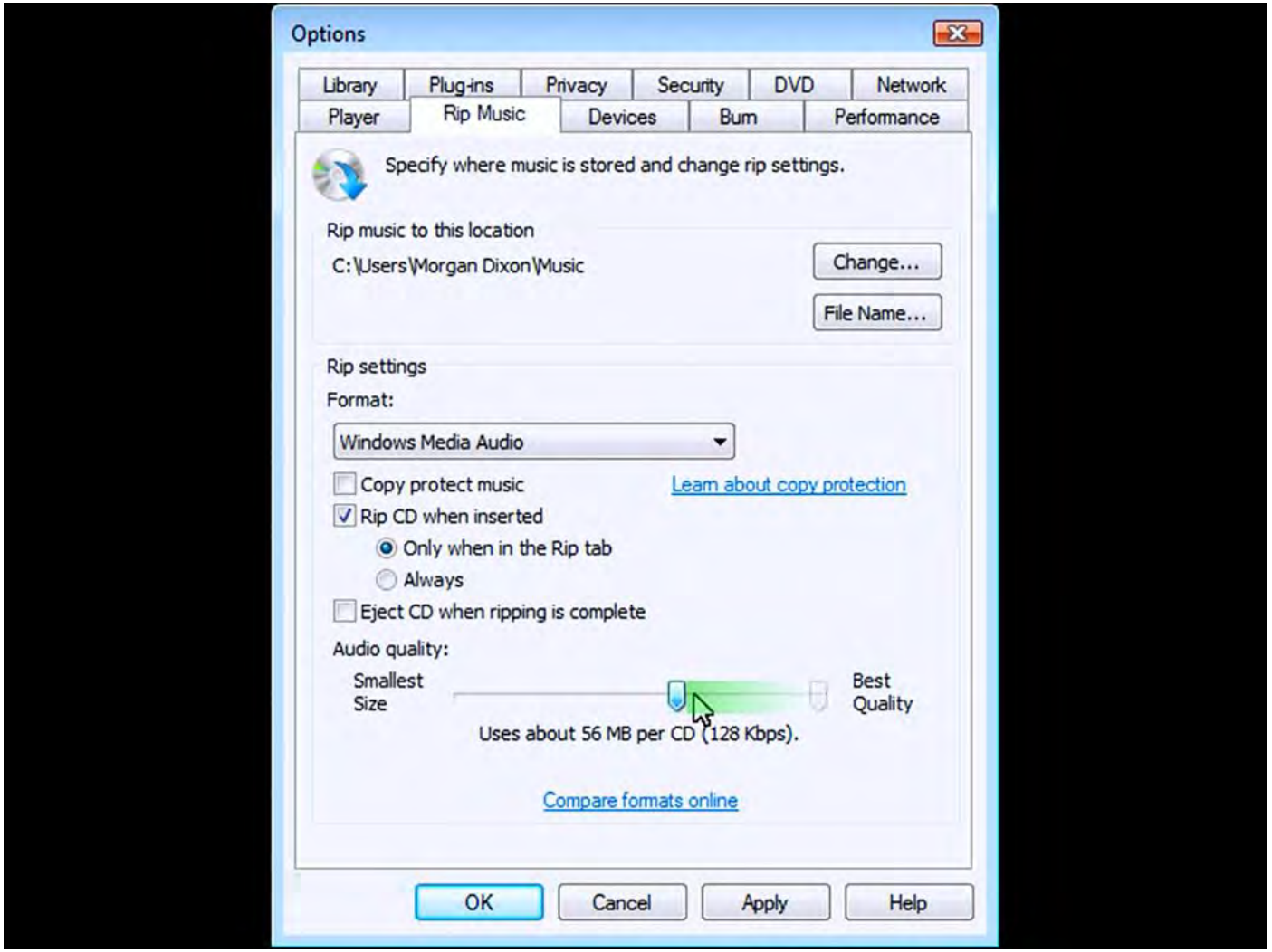
Prefab

Prefab uses pixel analysis to modify existing applications from the outside, using only pixels

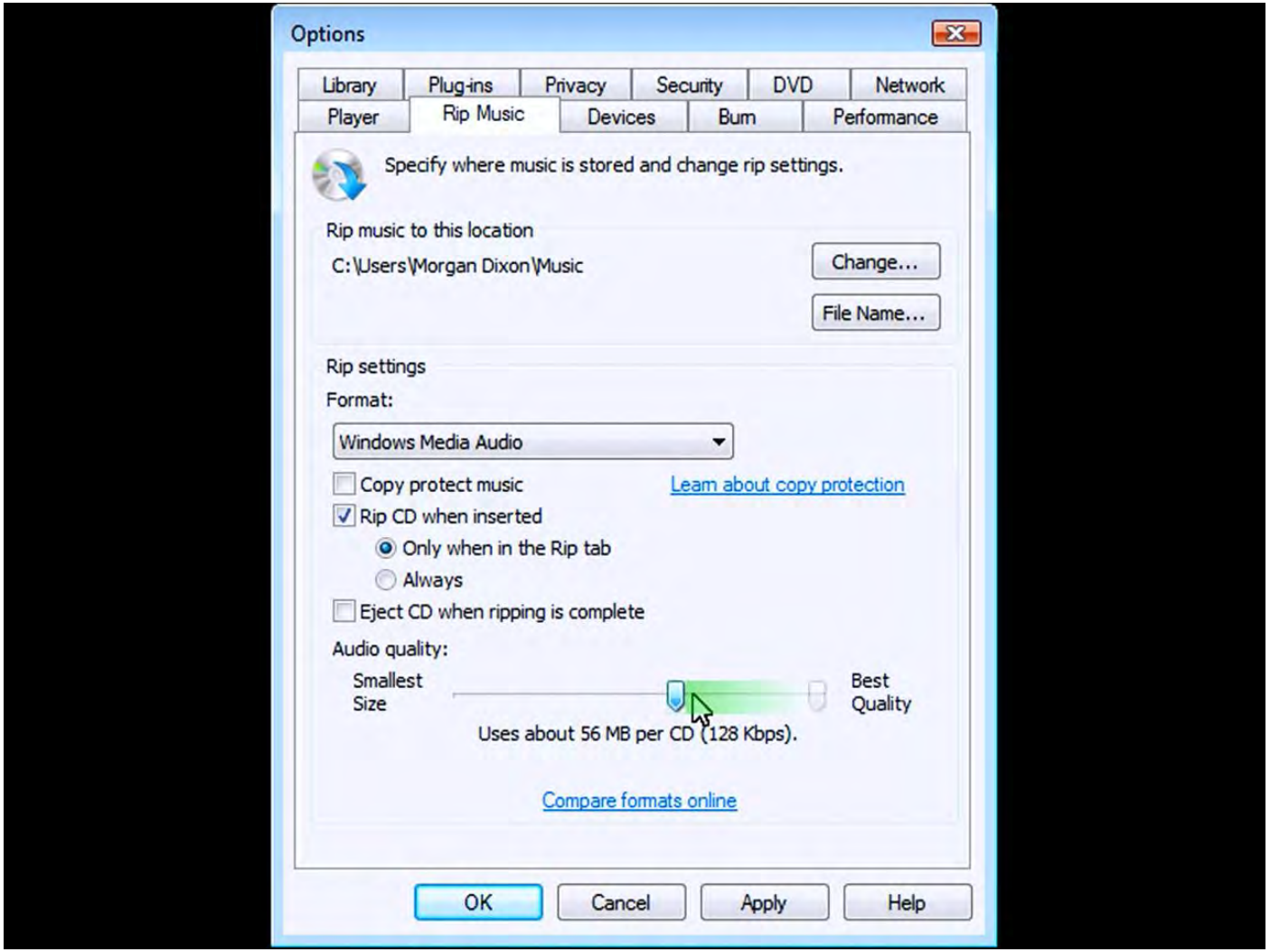
Prefab is informed by how toolkits work, but not linked to any particular toolkit implementation

Allows trying and fielding new ideas that are not supported by existing applications or toolkits

Prefab


Options
Library
Plug-ins
Privacy
Security
DVD
Network
Player
Rip Music
Devices
Burn
Performance
Specify where music is stored and change rip settings.
Rip music to this location
C:\Users\Morgan Dixon\Music
Change...
File Name...
Rip settings
Format:
Windows Media Audio
Copy protect music
Learn about copy protection
Rip CD when inserted
Only when in the Rip tab
Always
Eject CD when ripping is complete
Audio quality:
Smallest Size
Best Quality
Uses about 56 MB per CD (128 Kbps).
Compare formats online
OK
Cancel
Apply
Help

Prefab


Options
Library
Plug-ins
Privacy
Security
DVD
Network
Player
Rip Music
Devices
Burn
Performance
Specify where music is stored and change rip settings.
Rip music to this location
C:\Users\Morgan Dixon\Music
Change...
File Name...
Rip settings
Format:
Windows Media Audio
Copy protect music
Learn about copy protection
Rip CD when inserted
Only when in the Rip tab
Always
Eject CD when ripping is complete
Audio quality:
Smallest Size
Best Quality
Uses about 56 MB per CD (128 Kbps).
Compare formats online
OK
Cancel
Apply
Help

Understanding Tools

Tools promote and encapsulate proven practices

- Reduce expertise barriers
- Enable more rapid and iterative implementation

Codification eventually constrains design

- Inevitable consequence of codification versus evolving understanding of emerging technologies

Codification goes deeper than the code

- Frames how we think about our applications

Myers, Hudson, Pausch. Past, Present, and Future of User Interface Software Tools. *TOCHI 2000.*

Rebuilding the Language

We regularly rebuild the entire system

- Command Line, Text Screens
- Multiple Generations of Desktop
- Multiple Generations of Web
- Mobile Apps

We will do it again

- Several near-term challenges require it
- e.g., Touch, Cloud, Distributed Interfaces

Backward compatibility helps, but is not required

Olsen. Evaluating User Interface Systems Research. *UIST 2007.*

Informing the Next Language

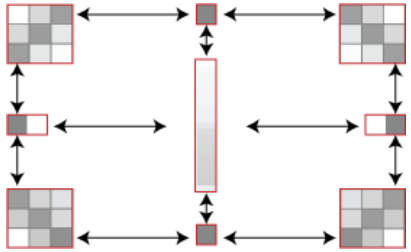
Research explores the next generation of language, while being limited by the current

We therefore conflate:

- Ideas
- Proof of Concept
- Engineering
- Implementation
- Broken Metaphors
- Unspeakably Dirty Hacks

Informing the Next Language

Research explores the next generation of language, while being limited by the current



We therefore conflate:

- Ideas
- Proof of Concept
- Engineering
- Implementation
- Broken Metaphors
- Unspeakably Dirty Hacks

Prefab is not just about ‘do everything with pixels’, but about exploring new possibilities in the current ecosystem of interface tools

Mobile Phones as Pagers

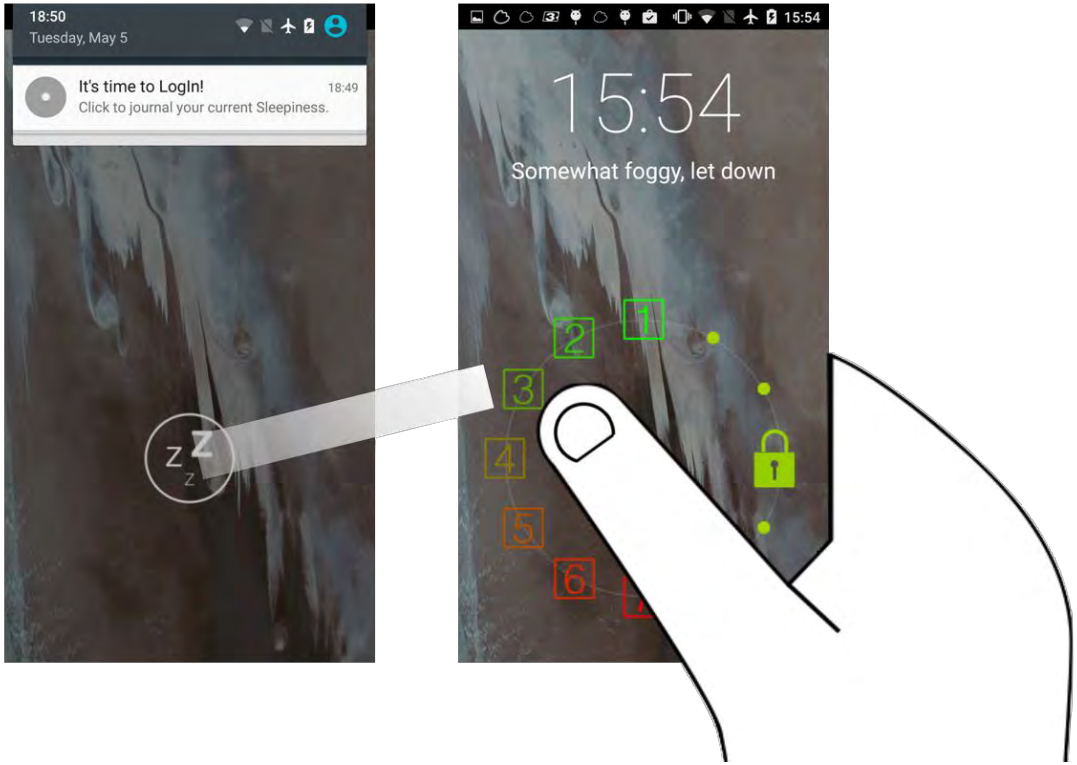
Our notion of technology design for journals / ESM / EMA has been anchored by papers journals and pager-based reminders

Csikszentmihalyi, Larson. Validity and Reliability of the Experience-Sampling Method. *J Nerv Ment Dis 1987*.

Feldman Barrett, Barrett. An Introduction to Computerized Experience Sampling in Psychology. *Soc Sci Comput Rev 2001*.

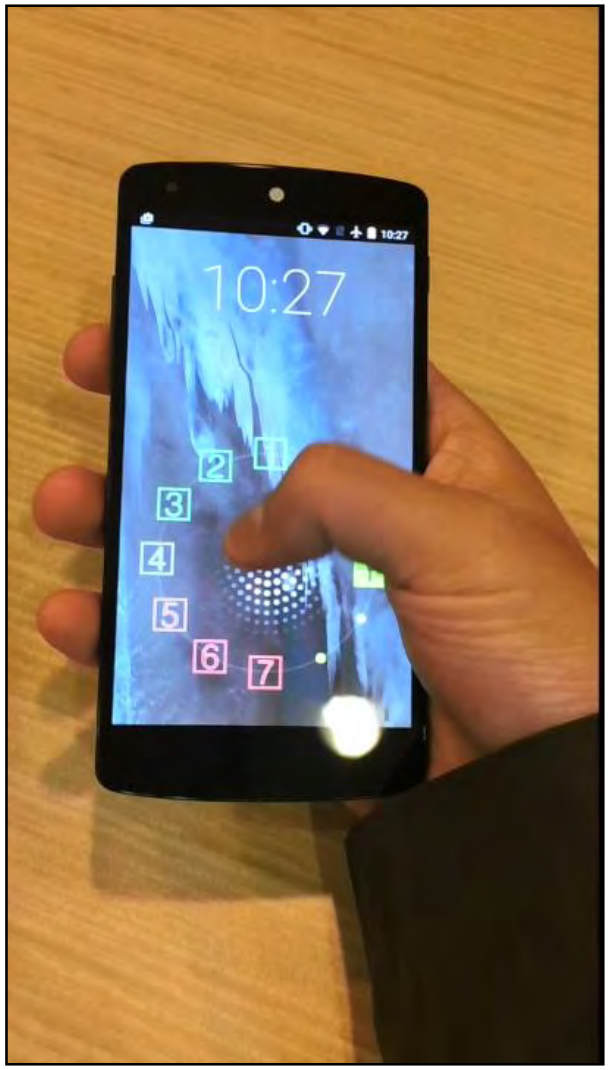
Froehlich, Chen, Consolvo, Harrison, Landay. MyExperience … *MobiSys 2007*.

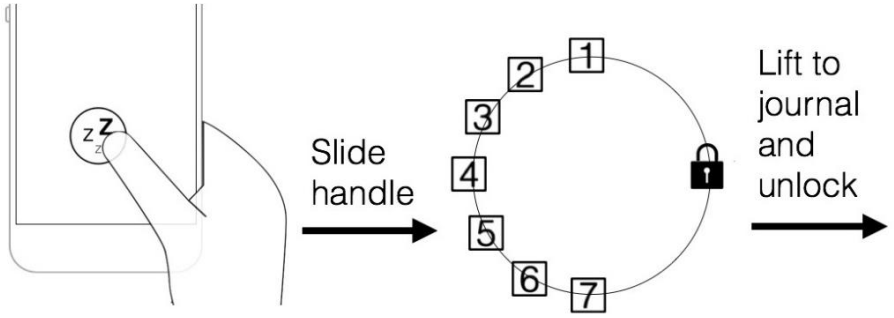
Unlock Journaling for Self-Report



Truong, Shihipar, Wigdor. Slide to X: Unlocking the Potential of Smartphone Unlocking. *CHI 2014*.
Zhang, Pina, Fogarty. Examining Unlock Journaling with Diaries and Reminders ... *CHI 2016.*

Unlock Journaling for Self-Report

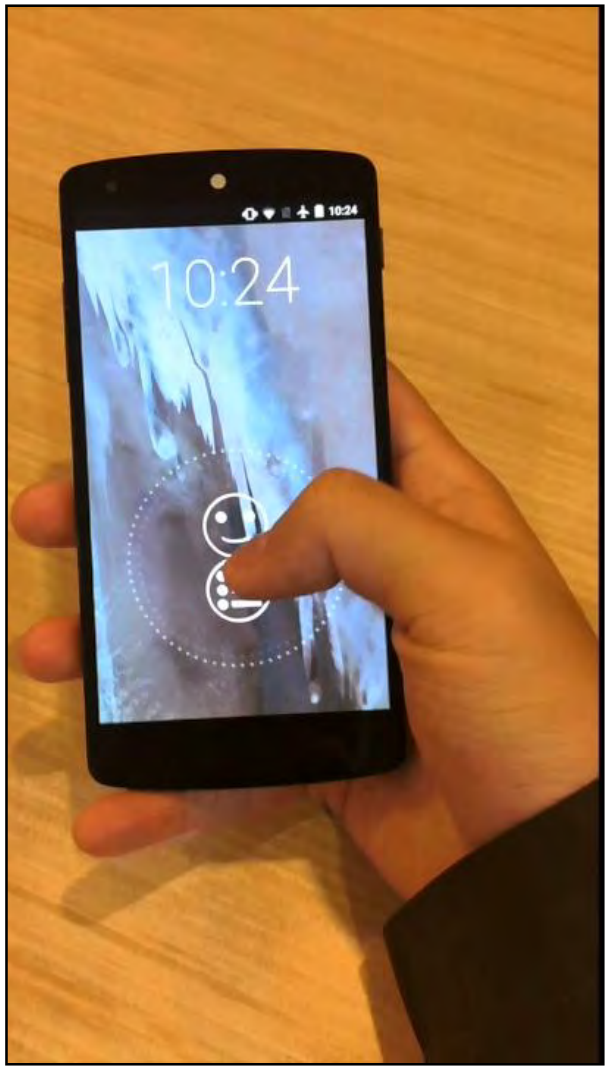


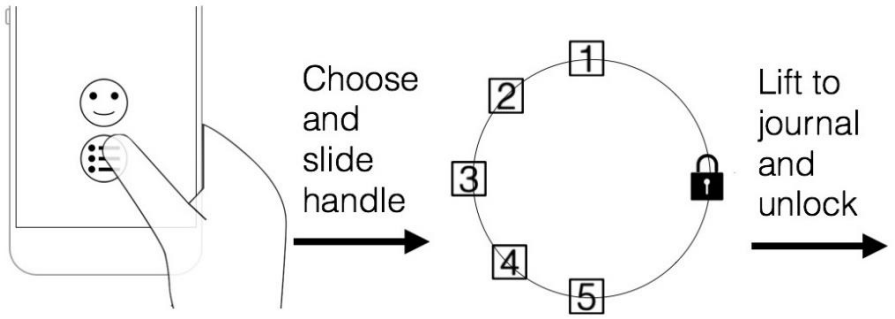


Stanford Sleepiness Scale

Hoddes, Zarcone, Dement. Development and Use of Stanford Sleepiness Scale. *Pyschophysiology 1972*.

Unlock Journaling for Self-Report

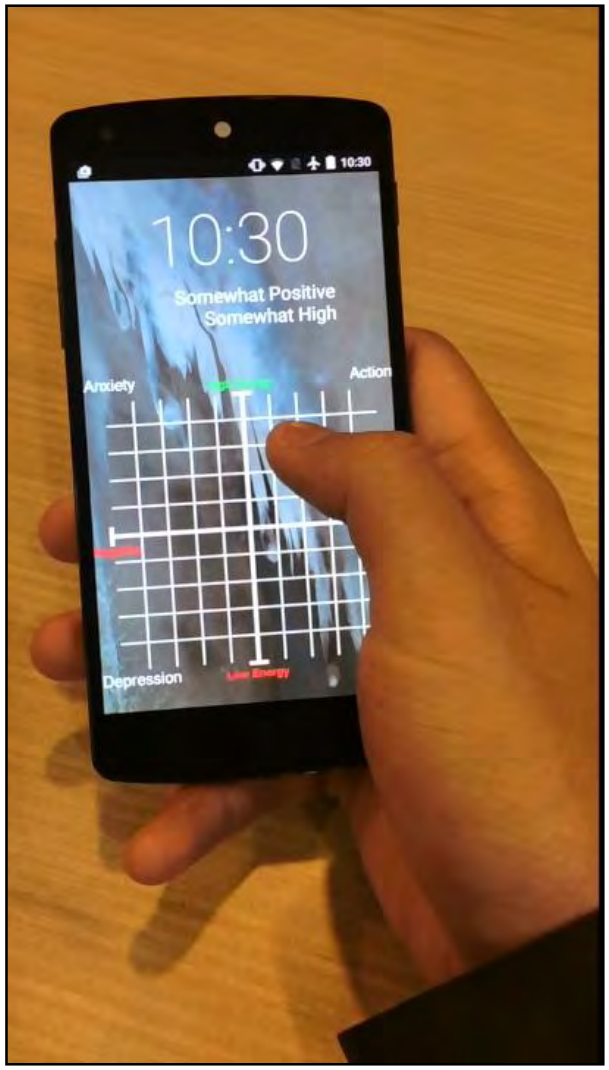


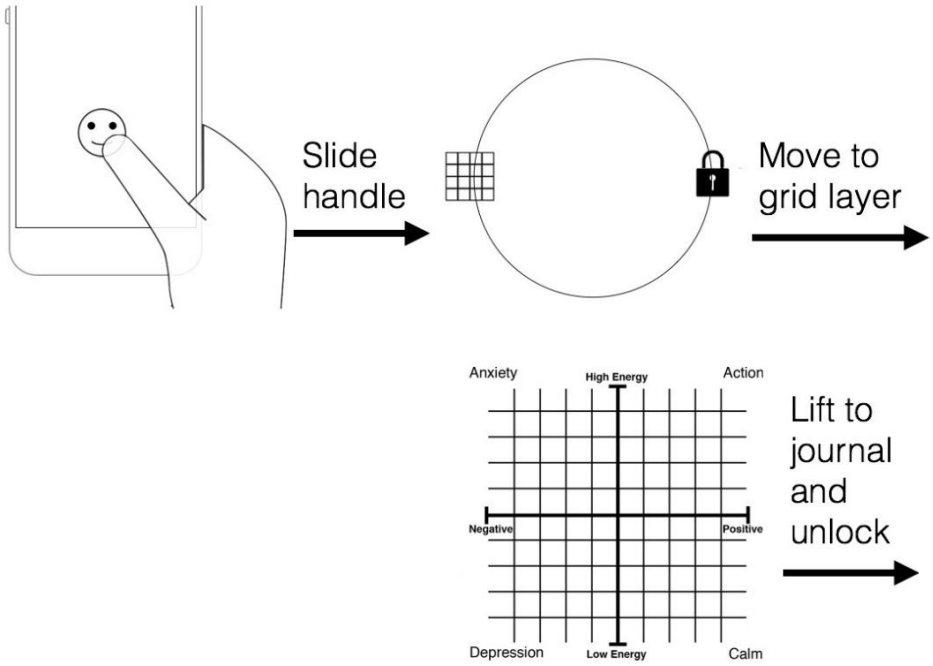


Pleasure and Accomplishment
(e.g., self-monitoring depressive symptoms)

Lejuez, Hopko, Acierno, Daughters, Pagoto. ... Behavioral Activation Treatment for Depression … *Behav Modif 2011*.

Unlock Journaling for Self-Report





Russell's Affect Grid

Russell, Weiss, Mendelsohn. Affect Grid: A Single-Item Scale of Pleasure and Arousal. *J Pers Soc Psychol 1989*.

Unlock Journaling vs. Notifications

Unlock journaling is:

rated less intrusive

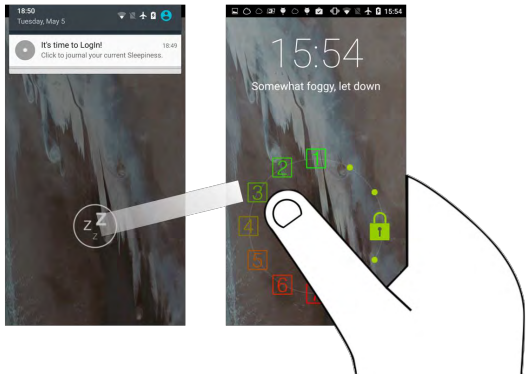
(1.77 vs. 2.22 on a 5-point scale)

yields greater frequency

(15.0 vs. 9.8 per 12-hour day)

comparable timeliness

(8.6 vs. 9.3 minutes)



Instead of reminders to journal, unlock journaling makes the opportunity visible, easy, and optional

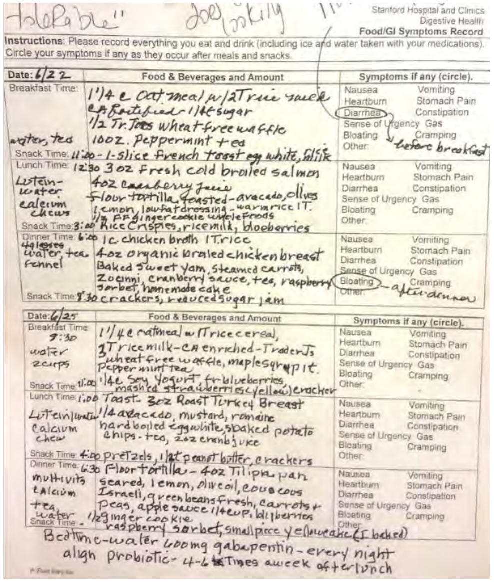
It should not have taken 10 years to get here

Mobile Food Journals

Origins in daily recall

Self-monitoring of food can support many goals

- Weight Loss
- Diabetes Management
- Trigger Identification



High burdens detract from potential benefit, data is often wrong

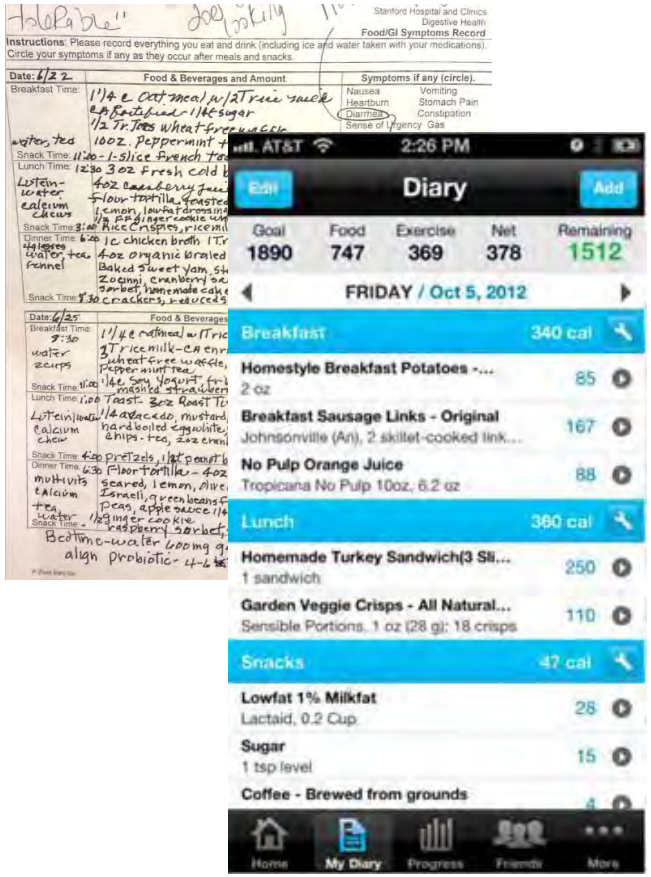
Burke. The Dietary History as a Tool in Research. *J Am Diet Assoc 1947*.
Craig, Kristal, Cheney, Shattuck. The Prevalence and Impact of 'Atypical' Days in 4-Day Food Records. *J Am Diet Assoc 2000*.

Mobile Food Journals

Mobile devices provide real-time feedback

- Search for each food in a large database, often breaking into components
- Typically provide calorie-based feedback

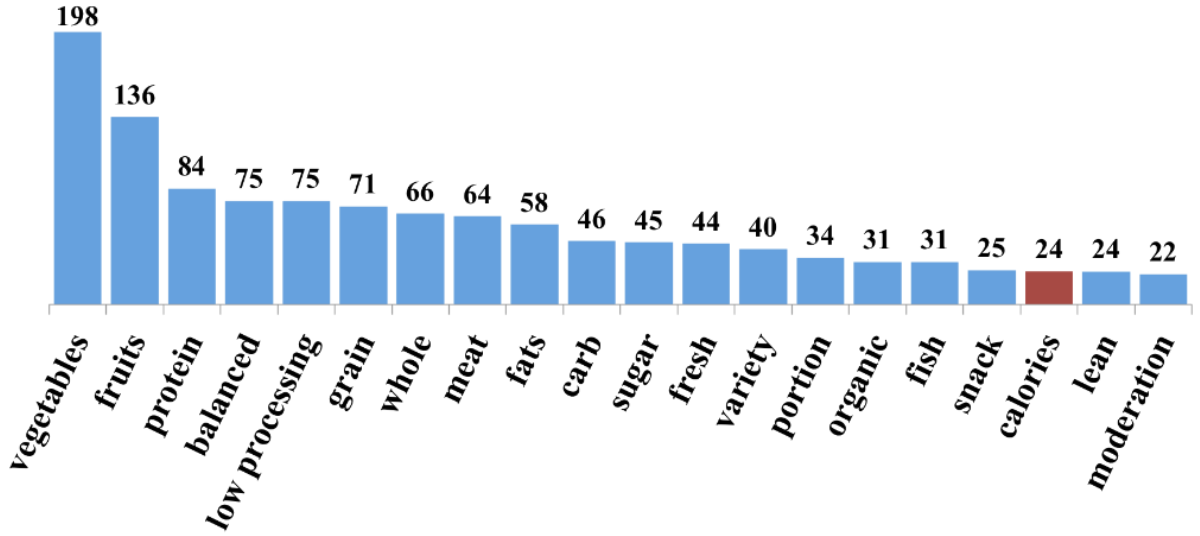
High burdens detract from potential benefit, data is often wrong



Tsai, Lee, Raab, Norman, Sohn, Griswold, Patrick, K. Usability and Feasibility of PmEB … *Mobile Netw Appl 2007*.

Perceptions of Healthy Eating

"What does healthy eating look like to you?"



Food types:	Food qualities:	Diet qualities:
"vegetables"	"low processed"	"balanced"
"fruits"	"organic"	"variety"
"protein"	"fresh"	"portion"

Cordeiro, Bales, Cherry, Fogarty. Rethinking the Mobile Food Journal … *CHI 2015*.

Difficulty as a Negative Nudge

"I just avoided eating things that were hard to log" – SP132

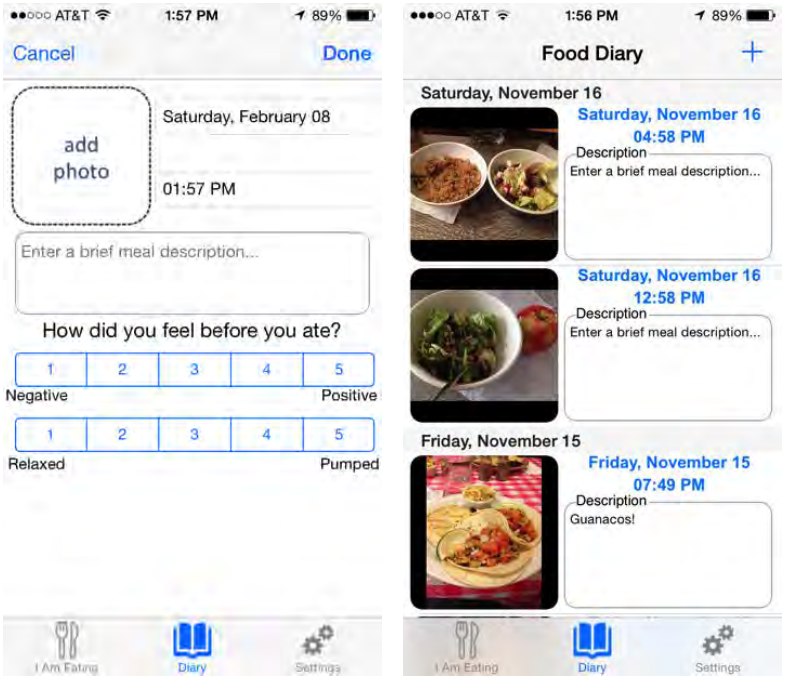
"Prepackaged meals were the easiest because of bar codes but those aren't healthy" – SP123

"I could make life easier by eating the same things regularly" – SP97

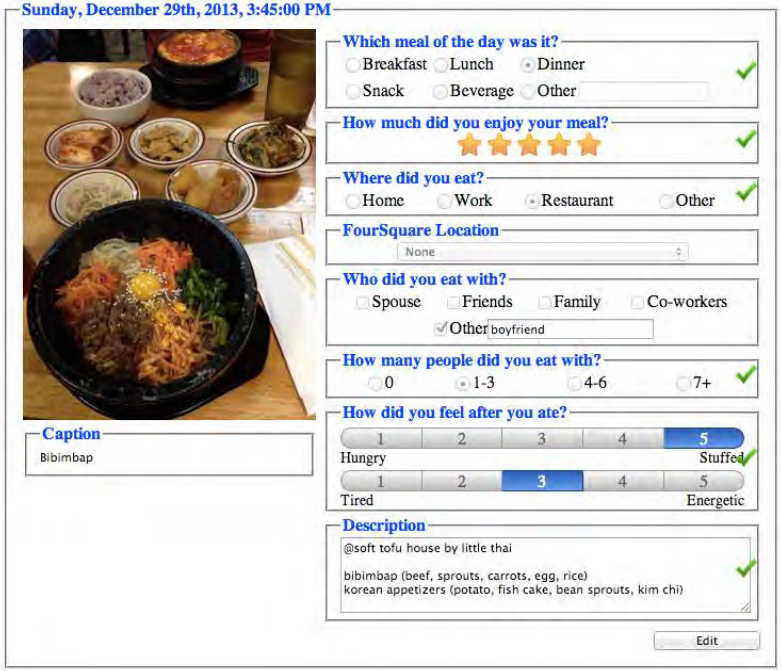
"It discourages you from eating out or at a friend's, even if it is healthy" – SP42

Cordeiro, Epstein, Thomaz, Bales, Jagannathan, Abowd, Fogarty. Barriers and Negative Nudges ... *CHI 2015*.
Cordeiro, Bales, Cherry, Fogarty. Rethinking the Mobile Food Journal … *CHI 2015*.

Deploying a Photo-Based Journal



Mobile capture and review



Web review and annotation

Cordeiro, Bales, Cherry, Fogarty. Rethinking the Mobile Food Journal … *CHI 2015*.

Leveling the Difficulty of Journaling

With prior techniques:

- 60% report not journaling because it was too difficult
- 65% report not journaling because they did not know

With photo-based capture:

- 22% report not journaling because it was too difficult
- None report not journaling due to food knowledge

“For some meals, it’s just really easy to take a picture … than sit there and type in every ingredient” – FP20

Journaling without Judgment

With prior journals, participants report choosing not to journal because they would exceed a calorie budget or because a food was unhealthy

- 13% of survey participants
- 45% of field participants

Photos enable mindfulness while avoiding judgment

- "[it was] easier because there were no calorie counts, no judgments, but still makes you aware" – FP14
- "Do I really want to eat this? I'm capturing this" – FP17

Triggers and Trends

"I eat too much pizza" – FP10

"I'm surprised at how many times I'm seeing things that I consider an exception to my diet!" – FP4

"I don't branch out as much as I thought I did, even when I go somewhere new, I kind of get what I always get somewhere else" – FP10

Food Journals as Daily Recall

"it should be noted that much of the use of food journaling is in a more clinical setting with the purpose being sharing and evaluating the journal with nutritionists and care providers …

it's not relevant if photos are more or less easily understood by the user if a nutritionist is the eventual consumer of the data"

– Actual Anonymous Grumpy R3

Tools and Interfaces

Tools embody expertise and assumptions

Tools evolve based on emerging understanding of how to address categories of problems

Be conscious of your tool decisions

- Try to think about designs before tying to a tool
- Choose good and appropriate tools
- Understand what you are getting in a tool
- Push yourself to think outside the tool

CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 13:
Interface
Implementation

Tuesday / Thursday
12:00 to 1:20

James Fogarty
Kailey Chan
Dhruv Jain
Nigini Oliveira
Chris Seeds
Jihoon Suh

PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING

DESIGN
USE
BUILD