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Visually Representative Web History Browser

Workbook

by Gray Hodgkinson
http://www.designspace.co.nz/mdes.html

Part of a thesis submitted to the College of Creative Arts, Massey University, New Zealand, as fulfilment for the degree Master of Design.

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2D shapes/curves + 3D blocks

Planes, triangles, paths & wires

3-way directions with strong vertical
Transparency

circular (cones?) + wires & cube spots

Planar (circle) background

Faintly backgrounds act as "grounding" planes. Textures provide scale deliberately or accidentally.

Planar (not planar)
Blueprint / Diagrammatic / 2D
Intersecting 2-way axes
Both "Constructions"
- Right angle
- 2 x Directional, angled circle

3D Construction "Floating"
Predominantly square

Circular "prism?"
Globular? Why?

Another construction
- with mixed perspectives
- note curve
- strong line at 30°
3 layers plus a few floating objects simplify to a true cube. Many of Liszt's shapes are not parallelograms.

Essentially....

Ground plane with a 3D floating construction (with other vanishing points added for extra shapes)

On a ground plane may provide a stronger grounding, a la "grid."

Multi layered on XY using Z depth. Essentially 2.0 on a Z depth. Not very "virtual" - more like 2½ D. But, other shapes can be included to add to 2½ D, to provide recalcitrant navigation.
Sophisticated mix
Multi-angle, arcs, cubes, with wires & spots.

plus a "hole";
or perhaps a "target".

Mixed axes

Strong movement
Flow.

Key shapes/components
1. Angled axes
2. Spots & wires & points
3. Arcs
4. 3D constructions
5. Planes
6. Triangles & paths
7. Limited number of axes, 2 or 3 (x, y, z)
8. Backgrounds - painterly/textured,
   provide scale.

Functions of shapes
- To define area:
  - planes
  - tris
- To define direction:
  - axes, paths
  - wires
- To define points in space:
  - spots
  - points
  - constructions
- To connect points in space:
  - wires
  - paths

Most shapes are either 2D or 1D (wires).
Only the constructions are actually 3D.
Most shapes are 2D objects, fitted into 3D space.
Do they have thickness?

Deconstructing & reconstructing a Proun space
How design first design?
- choose style - planar, constructive
- choose function - landscape
- 2½D
- icons / storage
- thumbnails

Heirarchy storage

Intercept browser history?
- OR Add a “keep” button

[USE Random for BG’s, a la Mondrian makers]?

2½D overlay 3D?

Planar

Planar + arcs

Planes (tri's)

Floaters

spots
+ wires to points
**AFFECTIVE CP**

*Intro*

Norman - response - recognition

Jordan - characteristics
  - pleasures
  - 10 design principles
  - Formal / Experiential
  - Engagement
  - Direct Manipulation

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Early Axel test using hinges

---

*Group & store webpage thumbnails*

Distance = timeline?

Lissitzky - Objects in space
cg: ProCIE

- Construction's ProCIE Town

DOES USER CONTROL THE STARTING LOCATION? HOW?

Visions of whole space?

Distance = transparency?

Axel

Mouse → Position

Position → Transparency

---

*Relate custom - Axel*

- Select target:
  - spheres position
- Go to Relate, custom
- Operator [,,]

[sphere1, position.x, sphere1, position.y, cube1, position.x]

Means, cube's Z controls sphere's Z
Axel
S select
E Scale
R Rotate
T Translate
Z Zoom
X Pan
C Orbit
tc Orbit free
click, opt click = move group
h Snap Grid
B Preview
K keep offset (while setting constraint)

24 sides
All visible

24 sides
12 visible
12 hidden

Each block represents a site. Cubeness is built by multiple pages of any site

3D storage
2D display & access

colour? or letter
- colour faster - "Knosten" - Thumbnails strength
- colour
- layout
- dominant text

perhaps not cubes
why cubes?

could construction reflect nature of site?
Yes but very complex

Temporal or site structure?

sort out in step 5.
Folding out back plane

Two pivots

Objects cannot have two pivots

Constrain - orientation
- direct train - x-y-z movement

Constrain pose to lock to B - No orientation
- orient parameter to rotate

Axel - Cannot
Duplicate Interactions.

Orthographic?
Try in Axel

Try FLASH
- more modular,
tastier, easier to control aesthetic.

Items appear by alpha fade-up
Perhaps use some sort of random assembly?

But where's the 3D?

Remember - Buttons cannot receive action-script code!
Use movie clips!
AT SOME STAGE, WILL NEED TO: how integrate (or not) with browser
= consider page/history hierarchy.

(use random to generate objects?)

FG objects - spots, wires & constructions

MG objects - planes, paths, arcs

BG objects - planes, tris, arcs

Axonometric
- view plane not parallel to object
- projections generally orthographic
1. Isometric - equal angles
2. Dimetric - equal angles
3. Trimetric - unequal angles

Ideal scenario
- OK for prototype
- Difficult to implement

Page shrinks to thumbnail

3D background is revealed.

Need a system that "constructs" the visitable type space.

3 layers or ?

"Room Corner"

Begin with layers
- BG - can become room-like later if deemed necessary
Layers will provide simple model to initially explore with and establish visual language.
Axel Edge Screen Grabs

Controlling the various scripting functions

Button change out cheat

Pop up

Pop up text window

Double function button: uses micro change in built 1 + position sensor.

Link on object

Replace or New Window, no obvious way to open within Axel.

Constrain to path. Creates an animation timeline. If mixed with function, becomes unpredictable — perhaps have multiple timelines?

http://www.designspace.co.nz

Nice visually —库里

Spring constraints used for inertia

Permanent link - though spring can be relocated

Fade with distance — standard position translate, also transparent translate. One way trip — how to bring back?

Too basic — need scripting

Pin rotation — opening containers. Hidden faces that reveal contents.

— rather fussy to set up.

Camera zoom on click (easy)

Position relation script.

Easy.

Lights — link to depth, visual depth and illusion?

Ball1: transparency linked to zdepth, Ball2: colour linked to Ball1. Tricky.

Using Skin to create visible connections — very clever. Select target, shift click controllers, go Model, Apply Skin.

Imported tif image of website as texture — promising.

Colour linked — as objects depart, colours separate. Uses distance function linked to rgb or in script.
Axel Edge Custom Relations

Select the parameter to be affected.

- Box
  - Position = 1.00 1.00 1.00

Go to Relate, Add Custom Relation.

Type in the function, or d/click from the lists:

Object receives colour from another
Ball2Shader.Color =
[Ball1Shader.Color.r*2, Ball1Shader.Color.g,
Ball1Shader.Color.b*.5]

Object receives colour from another as it approaches, (the back, from -Z)
Box12Shader.Color =
[Ball1Shader.Color.r + (distance (Box1.Position.z,
Ball1.Position.x)*.1),
Ball1Shader.Color.g + (distance (Box1.Position.z,
Ball1.Position.x)*.1),
Ball1Shader.Color.b + (distance (Box1.Position.z,
Ball1.Position.x)*.1)]

Using Skin to create visible connections
Select target, shift click controllers, go Model, Apply Skin.

To alter only ONE value of xyz:
Set the non-changing values to themselves. Eg:
Box.Position =
[1,Box.Position.y, Box.Position.z]

Drive ONE value by another object
Set the non-changing values to themselves
Set the changing value to another object. Eg:
Box.Position =
[Box.Position.x, Box.Position.y, Ball.Position.x]

So Box’s Z position is controlled by Ball’s X position.

Distance between object controls transparency
Material7.Transparency =
distance (Cube4.Position.x*10,
Cube3.Position.x*10)

This means that the distance from Cube3 to Cube4 controls transparency. *10 is simply used increase the ratio.

Zdepth controls transparency.
Use “distance” to measure the distance from X to Z:
Ball1Shader.Transparency =
distance (Ball1.Position.x*10,
Ball1.Position.z*10)
browser window capturing & recall

Capture ➔ Jpeg ➔ Resize ➔ Save as incremental filename.

Axel can load images as textures

How does a new page load into Axel?

Tab change

IF screen change - cut is acceptable - browser & Axel could be in different tabs.

Quickkey could move between

Eg F1

window opens

screen grab ➔ save file

URL grab ➔ save as file

Call Javascript

change window

Axel loads file as iron

How

Axel can call Javascript - Interact, React... NEED TO TEST Potential of Javascript

Stay with prototype concept first, can investigate browser integration in later stages.

Screen Grab window under cursor

8f, Shift, 4, space, click.

This could be scripted...
There's one more intangible factor that deserves consideration: the pleasure/coolness factor. It's one thing for an operating system to allow you to be productive and get your job done. However, if that same OS can be as productive, and be cool at the same time, it can draw you in and make you enjoy doing what you set out to do. The more you enjoy using your computer, the longer you will be willing to sit in front of it and get your work done. If your computer is simply functional, you'll get your work done, but you'll burn out more quickly. And OS X surely gets my vote for the coolest OS.

An Appeal to the Soul:
A recent "It's just an OS" remark by a co-worker got me thinking. I spend more hours a day looking at and interacting with my OS than I do with my wife, more time looking at it than looking at trees, clouds, the ocean, or anything beautiful—combined! Millions of people log billions of hours in front of their OSes. For the sake of the soul, OSes at least need to be less aggravating, and at best to be things that are a pleasure to the eye and to the soul. I won't make any claims as to which OS I think does this better, but consider this next time you're pulling all nighter in front of your computer.

D Pouliot. OS Shootout
www.xvsxp.com

Petrus Van der Velden
"Romantic landscape" late 1870's

Distant haze = depth = greys

Depth Illusion of depth by "Haze". Often less than realism. Why? to enhance FX to aid rendering

Common in games since Myst I. Use of atmospheric haze to show depth—also serves to limit depth to limit refresh detail on screen. Possibility to use to reduce "clutter".

Does Axe have issues with high number of polys? Does fog help?

Haze = white (fog)
- black (night)
- coloured
Also consider changes in hue & saturation

Focused tonal range

Blue haze, blur of detail
Haze/white fog
Also - basic colour theory, warm colours advance, cool colours recede

How to: position wires - start, step; store icons
Need a visual storage mechanism; continue the "hanging" metaphor?

Space construction - Random element
No two spaces will be the same.
Everyone's space will be unique
**MONSTERS INC.**

- Redirection one to many.
- 6000 visual indication of stacking, filing system.
- Colours look good against dark background.

- Reduce colour, i.e. single hue.
- Increases perception of depth. Colours cannot make it through the "muck."

**DEFINE FOV**

- 28 - 50 - 70mm wide angle. Too wide causes distortion.
- Try 28°.
- In Axel 90° = 56 FOV

- 950
- 804
- 76
- 628

- 550
- 650
- 552
- Captured size ratio 4.5 x 3

**3 Methods:**

1. Present in Quicktime - standalone - all failed.
2. Present in standalone - All failed.
3. Present in Browser - change work area.
**Call JavaScript**

Axel call call javascript, that has already been defined in the host web page.

**Eg:**

1. Use Behaviours to create a pop up message. Note the Javascript that is created in the html head.

   ```javascript
   <script language="JavaScript" type="text/JavaScript">
   function MM_popupMsg(msg) {
       alert(msg);
   }
   </script>
   ``

2. Copy the code, inside the quotes, from the html body into Axel

   ```javascript
   onClick="MM_popupMsg("Java doody called")";
   ```

3. Paste into Call Javascript in Axel

   ```javascript
   MM_popupMsg("Java doody called")
   ```

   This pops up in window

---

**Open in Frame from Axel**

Use Behaviour "Open URL" to create Javascript to open in another frame. Copy and paste this into Axel - wallah!! 5 August 2004

The function:

```javascript
function MM_goToURL() { //Get argsMM_goToURL.arguments; document.MM_returnValue = false;
    for (i=0; i<args.length-3; i++) eval(args[i] + "=" + args[i+1] + "=" + args[i+2]);
}
```

**The code** - this bit goes into Axel

```javascript
MM_goToURL('parent.frames[\"mainFrame\"]\', 'two.html'); return document.MM_returnValue
```

---

*Could also use layers to open & close windows/talk to windows*

To be INNOVATIVE - do not feel obliged to conform to existing web surfing paradigm. Do not fit into a browser, make the browser fit into my concept.

Go with - AxelPlayer - full screen or window, with Browser windows opening & going!

*BREAKTHROUGH!*
Browser should forego the banner-replace with banner that has new function-drag, hanging etc.

Perhaps browser banner remains of "browser hanger"

Maximise metaphor

"Presently we control and limit our future by designing what is already known"

Born 1940, in Lansing, Michigan. Woods worked for Eero Saarinen and Associates and has been creating experimental projects since 1976. His visionary architecture is concerned with the cultural regeneration of society, directly confronting urban landscapes and social and political conditions presently undergoing radical transformations. His projects propose architecture as an instrument of social transformation. He is a co-founder of the New York-based Research Institute for Experimental Architecture. Currently, he is a Visiting Professor at Cooper Union in New York.
Banner 1 "B1" Why separate banners?

View 1

Mid distance "shuffle" zone

NEED TO SIMPLIFY X IDENTIFY:
As history builds:
1. Where do the files stack?
2. What right does the user have?

Ctrl - click zoom to back & auto arrange

X = Script
CX = Custom relation
To make draggable, another custom relation?
How activate? Hot spot?

Better much!

DragMouse
OnLeftClick

ProximitySensor

Drag box
ToggleXYZ Driver

Note trigger modes:
Proximity is always start
Click is always stop—that way, whenever user initially selects object, they can move it.
See 21-Attach_Drag_Detach file.

* SEE ALSO
CUSTOM SENSOR
IF/ELSE - 2 pages

Web Cam Position
Pos: 0 0 2.0
Or: 0 0 0
Scale: 1 1 1

No good!
needs a
Release button
Simple button
that toggles
XYZ script.

Need to develop a code language for interaction
Edition.
How to deal with sheer amount of history filenames?

1. The list is generated anyway, automatically as history.

2. At what stage should the user select those to be filed & kept.
   - at browsing? — no user is concentrating on searching, not storing
   - following a browsing session? — yes — searching is over, users can now spend some time organising.

3. Can history lists be organised automatically?

4. Can the history list be accessed, sorted, & stored at any time.

   In which case, how is the information catalogued?

   ⇒ If we ask for user intervention, are we not at point 2 again.

Instancing
- Lighter files
- Quicker to download
- Display speed the same as duplicating: since the computer still must calculate all objects on screen.

Manipulations (position, rotation and scaling) of the objects — when you are in Object mode ( ) — are independent.

An instance appears in the Project Manager and in the viewports, where it is offset from the original. You can adjust the instance's offset in the Edit settings in the Project Manager.

Unique Materials:
When you instance an object, the instances share the same material, however, you can then add a new material to any instance and it's added to just that instance. This single instance would then have an independent material, although geometries remain connected.

Duplicate — Offset and Array (?)
A duplicate appears in the Project Manager and in the viewports, where it is offset from the original. You can adjust how much a duplicate is offset by expanding Author Settings / Edit in the Project Manager, then typing a new value for Duplicate offset in the Parameter Editor.
**Scroller**

1. Give button *Mouse Sensor*
2. Select object or group's translate channel
3. Select *Custom Relation* (not reaction).
   Write script.
4. Select *Script channel, Active*, select Reaction, *Toggle Parameter*.
5. Change Mouse link to *Hold*, and *Toggle Start/Stop*.

---

**Parameter Editor**

- **Link to ToggleParam1**
  - **Trigger on**: Hold
  - **Modifier key**: None
  - **Expiry count**: 100000
  - **Time delay**: 0.00
  - **Repeat delay**: 0.00
  - **Trigger mode**: Toggle Start/Stop

**Custom Relation** (Not reaction - which will not allow mouse hold)

```plaintext
```
Works ok, but greatest sense of 3D comes from camera zoom-in - very cool wires may need to be longer (deeper) to give greater sense of scale.

⚠️ Not sure about scrollbars. It's adding another interface metaphor - also is limited to 4x6 views at a time.

Perhaps files should just collect on "back wall"

Vertical stacks = days / sessions / groups of 10...

Link colours:
- Select material of Z
- Select other object
- Material link
- If other object is then instance, central is retained
If/Else

Use Custom Sensor to set up If/Else. Eg: If Sphere1's x position is greater than 2, then... link to normal reaction.

This last button allows access to Script window, which is otherwise in resources, etc etc

Best Snap Method!
1. Use the Snap Constraint in the Relate menu
2. Multi select the snap targets - these will stack up in the Parameter Editor - Nice and tidy, all in one place!
3. Use Toggle Reaction to turn the snap on and off while dragging (if you want to).
4. Clean layout in interaction editor too

Using Snap Constraint under Relate menu
Drag toggles active

Perhaps ALL movement can be controlled by snap - using proximity sensors to toggle snap actives often.

Basically - all objects "snap" from place to place.
Banner is pose constrained to View panel.
- V is snapped to both S2 & S2
- Drag Translate V
- HOLO: Start/Stop
- Toggle snap ons
- Banner
- Move V to near S2

How this works:
When banner is clicked - V is moved to near S2:
- Snap is briefly turned off then on again - by using the "hold" time of the click.
- The delay lets the move "break free" of the snap.
- After 0.3 secs, the snap is re-enabled, and now snaps to the newer, closer S2.

VERSION 2 - Using position triggers to allow free drag at front.
Both Stop and Deactivate are required.

```
IF Cube.Z > 1
  stop
  8: Snap Cns
```

Use Proximity
onEnter
onExit

This allows free dragging at Z > 2 without re-activating the snap constraint.

Now - How do we (simply) reverse this procedure?

**ACTIVATE command are SWITCHES - they make reactions work,
not work.**

**E6**

- **SPIN ME** START SPIN 2
- **BUTT 1** Deactivate
- **BUTT 2** Activate

Deactivate stops SPIN2 from receive any commands.
Activate do NOT turn a reaction off, it the condition is not met. It simply does nothing.

**USING LOCATION TO TRIGGER**

- **Proximity Sensor**
  - **On Enter**
  - **On Exit**

- **Reaction "switch"**
  - **Active ON**
  - **Active OFF**

- **Relational**
  - **Custom Relation**

- **Consider:** Use a script to provide movement, rather than Position Reaction, e.g. $x+1$ etc.

- **Custom are best!**

- **Grouped Reactions!**
  - **MAJOR REVELATION!!**

---

**Interaction Editor**

- **TimeSensor**
- **MouseSensor1** (Cont. ClickOn)
- **PositionSensor1** (Sphere.Keeping...)
- **BrowserSensor**

**Parameter Editor**

- **GroupReaction1**
  - **Name:** GroupReaction1
  - **Reaction order:** Solo: in order
  - **Link to PlaySound2**
  - **Link to PlaySound1**
  - **Link to PlaySound4**

---

**Events played Separately**

Sensor ➔ Reaction ➔ Event 1 ➔ Event 2 ➔ Event 3 ➔ etc

This changes everything!

Can be "stacked" etc etc!
THIS WORKS VERY WELL. Nicely modular (mostly)

Don't need to deactivate snaps when on hold. Use override option when dragging instead.

Only need to shuffle downward, as long as we stack from top down, i.e., HANG.

Use override (?) to force top pc to jump down.

Maybe use HOLD to deactivate snaps to allow top to move down.

**Buggy Tip**

If you want to toggle a parameter ON/OFF, make the reaction with the parameter OFF.

\[
\text{distance} \left( \text{Pink, Position}, \text{Blue, Position} \right) \leq 1 \quad \text{use || to mean "or"}
\]

Trouble is, does not distinguish between the two, therefore, which one moves?
Mouse down = drag
Mouse up = then play snap for 3s

Snap on \( \Rightarrow \) OK \( \Rightarrow \) Snap off

Snap active, wait 2s, deactivate

Need to try to keep all behaviours on the object, so as to keep assembly as modular as possible. Modular = Flexibility

**STOP!**

Cool, but no cookie.

- **Pink Drag & Snap**
  - TimeSensor
  - Pink_Mouse
  - Pink_drag
  - Pink_snap on
  - Pink_snap off

- **Blue Drag & Snap**
  - TimeSensor
  - Blue_Mouse
  - Blue_drag
  - Blue_snap on
  - Blue_snap off

On proximity move down custom reactions (MUST BE CUSTOM)

Just add as required. CAN BE GROUPED!

Core - might work - but not very "Ulitely!". Ulitely's ideas have been reduced to a backdrop. Not really the initial plan!

Also, technical prob of pages getting confused with snap zones, & confusing selection.
Lissitzky talks of exploring the space. VR talks of virtual landscapes. Why not have the environment "contain" the web pages. Pages do not need to jump to the front... instead, the user can jump to the web pages.

2 ISSUES TO ASCERTAIN: 1. Model up a complete space. Perhaps model in Maya first, use as template in Axel?

2. Need to establish a fluid user/camera motion all in Axel.

Click on yellow - camera moves to position by yellow. However, camera orientation is controlled by constraints to both yellow and green. VERY interesting. NICE movement, FLUID!

Need to control transition - look at weighting the constraints, and deactivating those not relevant. These options potentially could be controlled by the user.

Constraints could be used to control orientation - setup on triangle: keep two elements in site:

1. Aids user orientation
2. Aids web cam orientation

We could script: on click, cam XYZ = box XYZ
That's elegant! Constraints take care of everything else.
Spring constraint parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Toggles the constraint on and off.</td>
</tr>
<tr>
<td>Rest length</td>
<td>Determines the distance in units at which the object comes to rest vis-a-vis the leader. For example, if the rest length is 0, it comes to rest on upon the leader object. If the rest length is 2, it comes to rest 2 units from the leader.</td>
</tr>
<tr>
<td>Springiness</td>
<td>Determines the strength of the spring. A low value makes the object slowly spring back to its original position, whereas a higher value tightens the spring making the object bounce quickly into place.</td>
</tr>
<tr>
<td>Resistance</td>
<td>Attenuates the strength of the bouncing. A higher value makes the constrained object or group seem to be moving through molasses!</td>
</tr>
</tbody>
</table>

**CAMERA**

**ZOOM TO DRAGGABLE TARGET**

**Shift-click to Zoom**

Springs - very cool! Also grouped custom ON/OFF switches. Better than supplied!
Don't worry about alignment to objects, could offset pivots, or target dummies.
Note that we can drag the object, and the camera stays pointed! Very cool indeed.
PERFECT DRAG AND SNAP!

VERY Modular
Behaves as it should!

Gets close
And, user can drag off easily

ON DRAG
Proximity, limit 1
onEnter
onExit

DRAG override other

Toggle Param Snap Weight

Snap Constraint
Active
Weight 0.00
Transition 0.3

Megalith?

Create construct "units"
-these can be randomised
in Axel easily-no need to
do this in Maya

NEXT TASK!
Design the form---

Games orientation
(colour coding?)

How do we construct more
constructs? Set up read to
create, following principles?

"Rock!"
VR conceptual anchor.

small  LARGE
240 x 150  400 x 250

45°
**Construct Builder:** How to create forms within a style, with a certain amount of originality and "randomness", without being too contrived. By using the `rand` function (random) in Maya, we can create new compositions in space, that fit within certain parameters, but still retain freshness. Unlimited variety. Question for later: should this be offered to the user as part of the interface?

**Using frames to trigger event:**
The `rand` function cannot be triggered directly from a window button, so I use the button to trigger frame changes, which triggers the `Expression` I wrote : Random. This turned out to be very handy, as the different frames can be linked to different actions.

![Diagram of frame changes](image)

### Expressions code:
```cpp
if (frame == 1) {
    b1.translateX = rand (2, 8);
    b1.translateY = rand (2, 8);
    b1.translateZ = rand (2, 8);
}
if (frame == 2) {
    b2.translateX = rand (2, 8);
    b2.translateY = rand (2, 8);
    b2.translateZ = rand (2, 8);
}
if (frame == 3) {
    b3.translateX = rand (2, 8);
    b3.translateY = rand (2, 8);
    b3.translateZ = rand (2, 8);
}
if (frame == 4) {
    b4.translateX = rand (2, 8);
    b4.translateY = rand (2, 8);
    b4.translateZ = rand (2, 8);
}
if (frame == 5) {
    b5.translateX = rand (2, 8);
    b5.translateY = rand (2, 8);
    b5.translateZ = rand (2, 8);
}
if (frame == 6) {
    b6.translateX = rand (2, 8);
    b6.translateY = rand (2, 8);
    b6.translateZ = rand (2, 8);
}
if (frame == 7) {
    b1.translateX = rand (2, 8);
    b1.translateY = rand (2, 8);
    b1.translateZ = rand (2, 8);
    b2.translateX = rand (2, 8);
    b2.translateY = rand (2, 8);
    b2.translateZ = rand (2, 8);
    b3.translateX = rand (2, 8);
    b3.translateY = rand (2, 8);
    b3.translateZ = rand (2, 8);
    b4.translateX = rand (2, 8);
    b4.translateY = rand (2, 8);
    b4.translateZ = rand (2, 8);
    b5.translateX = rand (2, 8);
    b5.translateY = rand (2, 8);
    b5.translateZ = rand (2, 8);
    b6.translateX = rand (2, 8);
    b6.translateY = rand (2, 8);
    b6.translateZ = rand (2, 8);
}
```

---

**Maya Window GUI Mel script:**
```cpp
window -title "Grays GUI" -widthHeight 200 400;
setUITemplate -pushTemplate DefaultTemplate;
tabLayout -scr true -tv false;
string $parent = `columnLayout -adjustableColumn 1`;
columnLayout;

// Create the button.
string $button1 = `button -label "Reset to Frame 1"`;
string $button2 = `button -label "Reset to Frame 2"`;
string $button3 = `button -label "Reset to Frame 3"`;
string $button4 = `button -label "Reset to Frame 4"`;
string $button5 = `button -label "Reset to Frame 5"`;
string $button6 = `button -label "Reset to Frame 6"`;
string $button7 = `button -label "Reset to Frame 7"`;

// Add the command.
string $buttonCmd;
$buttonCmd = `CurrentTime 1;
button -edit -command $buttonCmd $button1;
$buttonCmd = `CurrentTime 2;
button -edit -command $buttonCmd $button2;
$buttonCmd = `CurrentTime 3;
button -edit -command $buttonCmd $button3;
$buttonCmd = `CurrentTime 4;
button -edit -command $buttonCmd $button4;
$buttonCmd = `CurrentTime 5;
button -edit -command $buttonCmd $button5;
$buttonCmd = `CurrentTime 6;
button -edit -command $buttonCmd $button6;
$buttonCmd = `CurrentTime 7;
button -edit -command $buttonCmd $button7;

setParent ...
setParent ...
setUITemplate -popTemplate;
showWindow;
```

---

This method may seem odd, but is MUCH easier than putting into one Mel script!

**IT WORKS**

Don't waste time trying to be more "efficient"
Attempt at envisioning construction, combining "constructs" and larger layout devices.

- Multiple floating constructs don't assist layout.
- The large elements work well.
- Still have issues with composing the space.
- Need to look further at letting software create unique compositions—within defined parameters.

Also—what is the role of the floating constructs? As 3D space locators, they seem to work much better at distance. Very unsure about usefulness up close.

**COMPOSITION**: Note that the few main shapes dictate the composition. This is as it should be, and is true to Lissitzky space. The other elements are "feeder" objects, dots, wires, etc. Need to construct central compositions FIRST!

**WHAT IS THE FUNDAMENTAL STARTING SHAPE?**

- Box?
- Roadway?
- Grid? - Flat? - Wall?
- End?
- Side?

Loos— but again, it's just a wall. Contrived!

Lissitzky's objects generally

Float in space,

which removes such devices as rooms, & roadmaps.

So—think of cityscapes that can be entered perhaps?

Not several "floating" constructs, why not one construct?
Getting JavaScript working

1. The JavaScript function in Dreamweaver:

```javascript
function helloworld()
{
    alert("Yah Har");
}
```

2. The bit that goes in Axel

Changing frames and open new windows

1. First, use a temporary button in Dreamweaver in order to create the header script function.
2. Copy the code from the button into Axel. Do not include the speach marks.

Both of these worked in Safari, pop-up worked in IE, and neither worked in Firefox!

Change frame

```html
<p><a href="#" onClick="MM_goToURL('parent.frames['mainFrame'].');one.html');return document.MM_returnValue">One</a></p>
```

Open a new window.

```html
<p><a href="javascript:;" onClick="MM_openBrWindow('one.html','metoo',toolbar=yes,location=yes,resizable=yes,width=555,height=333);">Image1.jpg width="47" height="42" border="0"</a></p>
```

NEW APPROACH ⇒ How about utilising Levitzky’s space to “label” groupings of pages/files. Use 3D “tags”, and users can arrange into 3D space?

Perhaps have “snap into perspective” function.

The User “creates” the 3D structure!
OR Tumble——

Revisit rotating object:
Main issue is hidden faces.
However: - All other methods have their own versions of hidden faces.
- List: scrolling off screen — icons become so small they lose recognition

Don't think of it as hidden faces, consider it as 'putting away'.
The interface metaphor should enhance this — the "hidden" aspect

Page groups stack into unique shapes.

Why 3D? This technique does not need 3D!

THE ESSENTIAL CONSTRUCTIVIST
VISUAL "STYLE" IS:

- use of geometric shapes — the universal building blocks
- planar composition — angles, intersections, overlaps, perspective
- colour & texture — though perhaps influenced by the tools of the time
VARIATIONS:
- Less "constructed 3D"
- More planar - more about flat planes, turning & twisting in a 3D space
- Note use of circle!

NOTE - Axonometric, not true perspective. As the groups of folds approach the camera, their contents will be partially visible. The user will be able to partially scan before files "in fold."

Axonometric
"Parallel Perspective"
- Isometric
- Dimetric
- Trimetric
Using perspective to simply fit more stuff into a window.

Axonometric - 3D confusing

Function to allow browsing of clusters. Should add scale function too.

Clustering of pages zooms up to view & partially unfolds - only partially so as to obscure the space a little as possible.

The clusters themselves will have shadows & randomly generated stack positions.

Random is good, re-surprise rewarding guaranteed (!)

R-back shape has a stronger "window" feel.

Recognition value: Better-than stacking.

Attached to a "hanger"? of varying colour & possibly shape.
Custom reaction to ascertain position

Custom relation to maintain snap,
but this will reposition the centrepoint!

Basic geometric shapes as handles.
Variation in colour.

Users simply select the handle of choice, collects pages.

---

Use Import
- Import an Axe file & all constraints, scripts etc are imported.
- Objects are auto named.

Code schematic for only 5 separate objects:
- retreats
- Each relation = 3 nodes
- Each object = 1 node (drag).
- So far 5 base objects & 10 pages:
- 150 relationships
- 15 drags
- 165 nodes

WASTEFUL CODING! SO, REDUCE OBJECT NUMBERS?
Parallel Projections

- Orthographic
  - Multiview
    - Axonometric
      - Isometric
      - Dimetric
      - Trimetric
    - Oblique
      - Cavalier (true length of sides)
      - Cabinet (1/2 length of sides)

The handles could be "solid" - have depth, whereas the pages are planes - transient, changing.

Lock mouse to move YZ
But how to move X - in/out
- shift?
- Another hot spot?

\[
\begin{align*}
\text{Position of } X = & \ (x_1 + x_2) + (C/10) \\
& \text{1st time is } 12 \\
& \text{2nd } = \ \\
x_1 + (C \times 0.5) \ 15
\end{align*}
\]

Zoom in/out to cam.

Distance Constraint
- Go away
- Come back

Custom rels,
- + style eg.
- Distance = Distance + 1

Works better than supplied Toggle Param.

Sure - works, but really requires too much drawing from the user.
Need a "snap to selected" function.
**Isometric**

**KEY ASPECTS**
- Cannot use perspective to reduce size of objects
- All objects are the same size:
  - equally selectable
  - does not have complexities of depth perception
- Users will have some experience of isometric:
  - diagrams & instructions
  - computer games
  - existing icons

**SO why use isometric over 2D?**
- Isometric is 3D and offers functionality of depth - even if it is diagrammatic.
- Is more indicative of an object, rather than an environment, that requires 3D travel (problematic).

< Reduce to isometric grid, for "storage"

<< Click & zoom up to this size

This can be done in Flash! - which also has stacking order (!), plus target instances, random, all scriptable, in a better interface than Axel.
Still retains several perceptual concepts of 3D; 3D scroll, zoom in/out (storage), virtual environment is 3D.

**FLASH NOTES**
- Consider _level_ to control loading etc.

**Goodbye to Axel**
**Hello to Flash.**
- Mainly due to scripting control

**VERY Modular! Much easier environment than Axel! Better script - more extensive, better info & tools available.**

```javascript
on (press) {
    startDrag(this);
}
on (release) {
    stopDrag();
    if (eval(this._droptarget) == _root.t1) {
        this.x = _root.t1.x;
        this.y = _root.t1.y;
    }
}
```

**ON Button**

```javascript
function zoom(me) {
    _root.onEnterFrame = function() {
        me_x = t1.x;
        me_y = t1.y;
    }
}
```

**Frame action with variable function**

```javascript
on (release) {
    delete t1.onEnterFrame;
    zoom(d1);
    snap;
    on (press) {
        startDrag(this);
    }
    on (release) {
        stopDrag();
    }
    draggable
    ALL WORKS!
```

**Constraint function on/off.**
- Now need to attach do dragging object

Canvas scrolls in XY isometric. (if need be).
Frame Script

```javascript
function zoom(me) {
  t1.onEnterFrame = function() {
    me._x = t1._x;
    me._y = t1._y;
    lock = true;
    trace("Lock is working");
  };
}

need to do:
1. Sort out what bits of code are
   attached to objects, and what bits can
   stay as frame actions.
2. Stop lock-off turning off other mc
   locks.
```

Button Script

```javascript
on (press) {
  this.swapDepths(100);
  startDrag(this);
  if (lock=true) {
    delete _root.t1.onEnterFrame;
    trace("unlocked");
  }
}

on (release) {
  stopDrag();
  if (ovl(this._droptarget) ==
      _root.t1) {
    this._x = t1._x;
    this._y = t1._y
    _root.zoom1(_root.p1);
  }
}
```

Whoops-the unlock script unlocks both objects

By problem with _droptarget-it doesn't seem
to be able to cope with two objects?

mouseDown = release snap

mouseUp = if near snap

Can't nest clipcaptrenets!

Try dropping onto a fake target, then release to +1

- Use hitTest instead. hit Test will use entire
  shape of object (?)

Why not use hit test? When select yellow, hitTest if.

true

Switches are general eg set a variable scooby = true;
Then test for it if scooby = true

P1 Lock function

```javascript
function p1_lock_t1(me) {
  p1.onEnterFrame = function() {
    me._x = t1._x+5;
    me._y = t1._y+5;
    readout1 = "lock1";
  };
}
```

P2 Lock function

```javascript
function p2_lock_t1(me2) {
  p2.onEnterFrame = function() {
    me2._x = t1._x+10;
    me2._y = t1._y+10;
    readout2 = "lock2";
  };
}
```

P1 drag

```javascript
p1.onPress = function() {
  startDrag(this);
  this.swapDepths(100);
  delete this.onEnterFrame;
  readout1 = "Unlocked";
};
```

P1 Release, Snap if over T1

```javascript
p1.onRelease = function() {
  stopDrag();
  readout1 = "Released";
  if (p1.hitTest(t1)) { p1_lock_t1(p1);
```

etc.

---

Snap function required for each possibility. Will get much

```
[This much code for one object & one target.
Lock function for each possibility. Exponential increase.
For 4 objects & 2 targets that's 16 blocks of code.

How about deriving the lock from the target. IF, Whomever is in my
zone, is under my control.

This works very well.

---
```

etc.
recreate FH mockup in Flash MX 2004

- Decide example sites — Apple, OM Exposure, ED-Media, Nat Bank page.
- Ascertain skew, squash & scale ratios
- Create variable-based hierarchy
  - Simple dragging
  - Button clicking parenting (at first)
  - Connector lines

MUCH TIDIER!
This will do!

Once only target hit test code, for every object, simple list.

Drag & depth for each object.

- Now make it isometric
- Add Thumbs
- Add Connectors

---
Flash skew iso 1
Works O.K.

- What sort of zoom?
  - Entire page?
  - Per object?
  - By key?
  - By button?
Drag all page

on press() {
  drag(all);
}

All objects zoom
Main BG can drag
Individuals objects can drag.

NESTED clips works WELL!

224 x 200

Swapdepths problem

Swapdepth (100) – if go to 100, but if another
object has 100 will go the
absolute bottom, -16384

If we use common numbers eg 100, to
force swap, the pages simply zoom 100

behind the Target.

This is NOT
caused by the
Target, but
conflicting depths.

SOLUTION

Each click adds to a number
in a dynamic text box/variable
This number is then re-read
as the new level.

Global number for
ALL pages

The Target objects have the same,
but with -1000 included!

As soon as any 2
pages share the same
depth - zoom - 056
to -16384.

Run an onEnterFrame,
if blah = -16384,
make eg 50
No, it'll loop as all
pages hit 50!
Zooming has a basic problem

The object zooms, not the view. Therefore, the view object (item) will likely move off screen.

Thur 16 - GOT ZOOMING TO WORK.

Alternative

Simply scale up the objects

* Bitmap images are likely to not scale smoothly. Two options:
  1. Use blenders for the scaling stage. (weird, disruptive)
  2. Zoom up in stages.

EQ: slides = U/D = 1 x
    slides = 200 = 2 x etc.

Single action partner to onEnterFrame:

```
_root.onLoad = function() {
    with (_root.all.p1) {
        _inner_rotation = 40;
        _height = 43.25;
        _rotation = -55.75;
    }
    with (_root.all.p2) {
        _inner_rotation = 40;
        _height = 43.25;
        _rotation = -55.75;
    }
    with (_root.all.p3) {
        _inner_rotation = 40;
        _height = 43.25;
        _rotation = -55.75;
    }
    with (_root.all.p4) {
        _inner_rotation = 40;
        _height = 43.25;
        _rotation = -55.75;
    }
    with (_root.all.p5) {
        _inner_rotation = 40;
        _height = 43.25;
        _rotation = -55.75;
    }
}
```

```
FRAME SCRIPT

_root.onLoad = function() {
    function skewer(skew_me) {
        with (skew_me) {
            _inner_rotation = 40;
            _height = 43.25;
            _rotation = -55.75;
        }
    }
    skewer(_root.all.p1);
    skewer(_root.all.p2);
    skewer(_root.all.p3);
    skewer(_root.all.p4);
    skewer(_root.all.p5);
}
```

Curves

How to turn on & off:

* Can easily hide permanently
* Need on/off
* Create in simple scenario first!
```javascript
b1.onPress = function() {
    delete b2.onEnterFrame;  // delete any function
    dragline();
};

b2.onPress = function() {
    startDrag(this);
};

b2.onRollOver = function() {
    // use RollOver to detect second line
    stopDrag();
    trace("Stop Drag Working");
    delete base.onEnterFrame;
    joinline();
};

// Line drawing function dragged out by b1
function dragline() {
    base.onEnterFrame = function() {
        _root.createEmptyMovieClip("dragger", -7000);
        with (dragger) {
            lineStyle(0, 0x666666, 100);
            moveTo(_root.base_x, _root.base_y);  // add _root to parameter
            curveTo(_xmouse+20, _ymouse-40, _xmouse, _ymouse);
        }
    }

    // Line drawing function b1 to b3
    function joinline() {
        b2.onEnterFrame = function() {
            _root.createEmptyMovieClip("linejoin", -7000);
            with (linejoin1) {
                lineStyle(6, 0x666666, 100);
                moveTo(base_x, base_y);
                curveTo(150, 100, b2_x, b2_y);
            }
        }
    }

    // Base Drag
    base.onPress = function() {
        startDrag(this);
    }

    base.onRelease = function() {
        stopDrag();
    }
};
```

---

**Fully working!**

All objects draggable, line stays connected as objects move.

Need more pages.
IDEA re lines

- lines appear - Have lines already connected - use circle to make visible.

Advantages - lines can be pre-connected
- lines can be pre-named

- circle on single lines to make invisible

BRILLIANT!

- on roller - readout 2 = 3 (e.g. a number specifies to track thumbnail)

- on spacebar down
  - if readout 2 = 3
    - make big

The SPACEBAR command is a problem - it is GLOBAL like OnEnterFrame. Even if followed by if statements, it really doesn't behave normally.

Because it loops, you can't use if/else, as it continually repeats the loop e.g. if green make blue, if blue make green, if green make blue etc NOT helpful.

Also harder to script as keystrokes are not attached to movie clips. Most certainly more hassle than they are worth at this point in time.
SO... What needs to be refined, debugged & TESTED?

- Main interface features are:
  - Entire stage is draggable
  - Thumbnails zoom
  - Thumbnails have spatial positioning
  - Thumbnails can be grouped onto target objects
    - Target objects can also "sweep" up thumbnails
  - Lines can be drawn between targets

USER FUNCTIONALITY that could be desired...
- User controls colour of targets & lines
- User controls thickness of lines
- Greater control over size of all objects - bigger AND smaller!

KEY UNIQUE ISSUES THAT SHOULD BE TESTED

1. Grouping concept using target objects
2. Lines joining groups/ideas
3. Perhaps zoom/drag
   Stage view should be a separate study?

Could test the difference between:
1. Icon zoom
2. View zoom

But - what would be achieved?
This is not as valuable as the first two points! Do 2 & 2 FIRST!

Leave stage - drag out of 1st test.
- So incorporate icon zoom.
  - ALL icons?
  - JUST ON ROLLOVER?

WHAT am I trying to ascertain?

- Need key questions
  - Do target objects assist with grouping files, cognitive associations & recall
  - Do lines...
User browses pages

Then presented with normal history list:

Q1 - present with questions that require accessing history in a specific order.

Q2 - Asked to re-order pages in accordance to differing criteria e.g. by model, date, colour, price.

Then, presented with interface and asked same tasks.

How many pages? (more than prototype 1)

TESTING

Qualitative Methods (Tochrin)
- Direct Observation
- Followed by Unstructured Interview

My Method chapter says:
- Expert Appraisal
- Followed by interview
to next design iteration if deemed appropriate

No Likert scales!
Need to encourage participation at interview - Likert does the opposite.

My Notes NUN-AUG'05

- OR Direct Observation? Both?

- Two Tier - Fixed response
  - Open response.

Whether to go expert or observation may depend on final nature of prototype, e.g., an expert will be easier to brief than a less skilled user.

Would be interesting to do both.
How assemble?

Stages

Web browsing

Standard browsing

* Individually resize
  AND all resize, + reset
  * How about labels?
    NOT rollovers (require mousing)

Reversing

* Size of page
  screen cap doesn't really matter, as scroll bars will accommodate.

PAGES

* If user resizes, image stays centered
* Design for 1024 x 768

Want to buy
a 20Gb colour iPod

Apple.com
Pod lab
20 20Gb iPod pic
Pod mini ion at top
Tech specs
Goback

iPod Tech specs

1. iPod Nano
2. iPod Tech specs
3. iPod normal
4. Tech specs

Music and More
Pod camera connector

Then store

1P00l
From $49
Users to arrange:
1. By Price
2. By Product - iPod or nano (?)
3. By Source - Apple
   - Mac Warehouse
   - Magnum Mac
   - Trade Me

Then, by using the interface,
Find - Best Price
   Tech into ext...

Create a faked Google page with
   - Magnum Mac
   - Mac Warehouse
   - OSE
   - Trade Me
   - all included

Use "Buy iPod NZ"?

History menu test:
Used pop-up instructions box - how to keep on top?
Frame?

This page changes out.
- But the history list will replace entire "page".
- History remembers dance sets - which is unhelpful.
- Google example - Try

Make all on-screen instructions use an appealing skin - ey Ruler - the whole feel needs to be assuring & usually professional.
Consider floating interface over background.

Also consider:
- Omnibox web icons
- Opera history

History created by test sequence.

Do I need the user to complete tasks using this list to provide comparison? Why? To achieve what?
Good idea. Let's this space become a "working area". Can deal with more of large numbers later - once key principles have been tested.

URL's & page titles can get very long - how to deal with this? VERY MEANINGLESS!

Go for file.

Need a mechanism where individual pages can be kept large - eg while certain pages are being looked for.

Use a zone, where pages are still affected until they are pulled off. Ideally use drag - but how do you drag on a diagonal?

Object = mouseX + 3.45

object = mouseY + 2

Drop the diagonal

No keep ISO

Watch out for hot-spots - always square.

USE

if( (_root.object.hitTest (this.y, this.x, true)))

Target object

moving object

or current object

function zoom (me) {

me._width = 100;

} on (release) {

zoom(object);

}

Small items should have a zoom preview - ideally using simple keystroke, ie spacebar.

- refer, same sort of mouse "hot-spot"
Would it help to PRE ANGLE the rims?

Then remove all That skewing code!

Re Testing - if the page browser sequence is too slow, provide "instant button" button.

E.g. Go to end - all pages browsed.

Note: IF we have a MC with two MC's inside, DO NOT target the outer MC or the inside ones WILL NOT WORK.

Dragging out a line has problems:

- Very technically difficult
- Has high load on framerate
- Is possibly unnecessary - when a "click" may do just as well.

How about:

- Click once on block A
- Click once on block B
- Line then appears

Code: on release T1.line = 1
      on release T2.line = 1

Then a bunch of functions:

OnEndFrame = function ( ) {
    if T1.line = 1 and T2.line = 1
    T1.T2Line._visible = 1
}
Each click needs to set a variable.

```javascript
on click
b1.readout1 = b1
b2.readout2 = b2

if readout1 = b1 + readout2 = b2
  line draw 1-2.

Can have one function with all possibilities
```

Use a variable

```javascript
use variable "bl"
```

Delete?

```javascript
use double click
  - click once to set var
  - if var is "this"
  - delete.
```

Then:

```javascript
if var1 = 1 & var2 = 1
  then show line 1

if var2 = 1 & var3 = 1
  then show line 2
```

Nodes from AMM AM - 16:06:06

- Focus on Lessizing "SPACE"
- Abstract shape thing
- Allow naming groups
- Action research
- "Names from Websites - select me"
- Include icons - eg iphone
- Q's on concept - drag/drop/group/more
- Thumbnails live update?
**KEY STROKE LISTENING**

```javascript
var myListener = new Object();
myListener.onKeyDown = myOnKeyDown;
Key.addListener(myListener);

function myOnKeyDown() {
  if (Key.isDown(Key.CONTROL)) {
    pop_up_panel._width = 200;
  }
}
```

**BLOCKS - Drag off toolbar or pop-up toolbar?**

- Go for drag-off as this continues the drag-n-drop approach. Also shapes are visible to select from.
- A pop-up introduces a new "mode", and is invisible and unknown unless informed. Not ideal.

**USE ICONS?** (Drawn in Freehand)

Using literal icons creates problems -
- Where do they come from - a huge database somewhere?
- The more literal you get, the harder it is to find "just" the right icon.
- This replicates current issues with literal icons, and achieves little that is new.
- One of my main issues is the generic usefulness of abstract objects - STICK WITH SHAPES!
So *Generic geometric shapes
  - colour coded

How select colour?

- Click, set var to x
- Click if var = x
  - Make yellow

R, 0, 1, 6, 0, Purple, Grey

TWO METHODS
- Change Object - requires making up more objects
- Change colour - requires rebuilding objects

and using RGB values

But once setup, endless colour range

/** Swapping MovieClips
Use, my_mc.attachMovie(idName, newName, depth [, initObject])
EG

on (release) {
  thing attachesMovie( "circle", "circle1", 2 );
}
Use MovieClip.removeMovieClip() to remove
*/
_root.b1_change_button.onPress = function() {
  tagbar1_width = 200;
  _root.b2.attachMovie("ipod_icon", "ipod_icon", 2);
  _root.b2.blue_box_gpx._alpha=0;
};

MW AM July 7
- Add text labels to "groups"
  - Can pull from web page?
- Isoview can open in-page is ok
- Video can be - can record initial reactions

THIS DIDN'T WORK!!
Too many actions failed, set ups, voltages etc go back to adding a web page into the background to "fake" a float-over panel

Floating overlay could be semi-transparent

Isoview is load movieclip into SWF
Many by transparent

Draggable?

80 x 68
680 x 760
800 x 800
80 x 936
80
Need a "undo double click" go to URL.
Keys - eg Ctrl+space, don't work inside the browser only as lone SWF.
We already have Press & Release on the P's - so need to watch context.

On Press = Start Drag = function (times function
On Release = Stop Drag
IF timer within range
-> go to URL.

VERY CLEVER Double Click
script - totally original - works well!

_root.PIzone.onPress = function() {
    bar.width += 50;
    if (bar.width >= 100) {
        getURL("pl.html", "_self");
    }
    bar.onEnterFrame = function() {
        bar.width -= 1;
    }
}

Each click add 50 pixels to bar length.
And if bar gets to 100 (two clicks)... go to URL.

however, be quick, because
the bar will soon shrink back
to original size
(add delete this)

IF new windows opens _self, then when
returning to source, it does not retain state!

This means we have to open a new window
a new tab
NEW tab is not controllable by html/flash!
JUST HAVE TO LIVE WITH THAT!!

GRAYS "SYMBOLIC SCALE"

Named SYMBOLS eg Web visualisers
content representation
Named content only
Symbolic environment representation.

DDS XP Mac

Full page views, accurate icons
"desktop"
A study of user-behavior when confronted with an interface that conveys functionality, has an integrated visual style, but also uses non-specific visual forms.

- reaction (based on experience) in response to visual statement
- ability to recognise and use symbolic functionality
- ability to apply meaning to non-specific elements