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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20 shapes/curves + 30 blocks

Planes, Triangles, parts & 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.

Plan (not planar)
Blueprint / Diagrammatic / 2D
Intersecting 2-way axes
Both "Constructions"

Right angle

2x Directional angled circle

3D Construction "Floating"
Predominantly square

Circular "prism?"
Globular? Why?

Another construction
- with mixed perspectives
- note arc
- strong line of 30°
3 layers plus a few floating objects

Simplified to a true cube. Many of Leibniz's shapes are not parallelograms.

Essentially...

Ground plane with a 3D floating construction

(with other vanishing points added for extra shapes)

Multi-layered on XY using Z depth. Essentially 2D on a Z depth. Not very "virtual"—more like 2½ D. But other shapes can be included to add to 2½ D to provide recyclable navigation

Base on a ground plane may provide a stronger grounding, a la "Grid."

Formal Drawing
- Isometric Projection
- Planometric Projection
- Orthographic Projection
- Perspective Projection
strong movement

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)
   3/4 view of "cubic" shapes?
8. Backgrounds - paintedly/textured, provide scale.

Not 3D - depth through texture, not perspective.

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, tilted into 3D space.
Do they have thickness?

Sophisticated mix
Multi-angle, arcs, cubes, with wires & spots.
plus a "hole", or perhaps a "target".

mixed axes
How design first design? - choose style - planar, construction, etc
- choose function - landscape
- 2½D
- icons / storage
- Thumbnails

Heirarchy storage

Intercept browser history?
[ OR Add a "Keep" button ]?

[ USE Random for BG's, ]?
ala Mondrian maker

2½D overlay 3D?

Planar

Planar + arcs

Planes (tris)

floaters
spots
+ wires to points
AFFECTIVE CP
Intro

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

Early Axel test using hinges

Group & store web page thumbnails

Lissitzky - Objects in space
cg Procm12E
- Construction's
  Procm1E Town

Does user control the starting location? How?

Distance = transparency?

Axel
Mouse - Position
Position - transparency
set param

Distance = transparancy?

Select target:
  spheres position
Go to Relative, custom
Operator [,,]
Axel
S select
E Scale
R rotate
T translate
Z zoom
X pan
C orbit
O orbit free
C click, opt click
M move group
H snap grid
P preview
K keep offset
W white setting
A measure

24 sides
12 visible
12 hidden

24 sides
ALL visible

16 x 6
213 sides!
16 visible
32 partially visible

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

3D storage
2D display & access

Colour? or letter
- Colour faster - "Krauten" - 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

Pose constrain holds pose with object.

Objects cannot have two pivots

Constrain - Orientation
- Directraing - xy z movement

Constrain pose to lock to B - No orientation
- Orient parameter to rotate.

Axel - Cannot
Duplicate Interactions.

3D box unfolding
Not so "revealing"
Many hinge variable
Less repeatable code.

Not as "cool" as expected - no strong interface
Feel - perhaps not suited?

Orthographic?
Try in Axel

Ugly obstruction probs

Try Flash
More modular, faster, easier to control aesthetic

Remember - Buttons cannot receive action-script code!
Use movie clips!

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

Is but where's the 3D?
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, tri, arcs

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

Page shrinks to thumbnail

3D Background is revealed

Need a system that "constructs" the least bulky 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

http://www.designspace.co.nz

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?

Nice visually - "Curvey"

Imported tif image of website as texture - promising.

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

Camera zoom on click (easy)

Lights - link to depth, visual depth and illusion?

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

Colour linked - as objects depart, colours separate. Uses distance function linked to rob 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:

```plaintext
&
?:
[1,1,1]
```

**Box.Position** = 

[1,1,1]

Add values. In this case, [1,1,1] = places the object in xyz space.

**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.

**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**


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 )

**Grouping - watch out, objects behave differently - more wrong etc**
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 changeout is acceptable - browser & Axel could be in different tabs.

Quickkey could move between Eg F1

F1 ➔ ScreenGrab ➔ save file ➔ URLGrab ➔ save as file ➔ Call Javascript ➔ Change window ➔ Axel loads file as iron ➔ click on thumbnail

Window open's

How

Axel can call JavaScript - Interact, React, Interact...

NEED TO TEST Potential of JavaScript

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

ScreenGrab Window under cursor

Ctrl + Shift + 4, Space, Click

This could be scripted.

OR

Work in a
Frame Window
too small?
Use JavaScript to adjust size?

Fade to white
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 an all nighter in front of your computer.

D Pouliot. OS Shootout
www.xv5xp.com

Petrus Van der Velde
"Romantic landscape" late 1890's

Haze = depth - greys

Haze = white (fog)
- black (night)
- coloured
Also consider changes in hue &
Saturation
Haze/white fog
Also - basic colour theory,
warm colours advance
cool colours recede

How to: position wires - start, stop
store icons
Need a visual storage mechanism continues the "hang" metaphor?

Space construction - Random element
No TWO spaces will be the same.
Everyone's space will be unique
How much real world physics?

The Data Bank:
- Library Shelves
- Shelves, Piles, Rows, Columns

MONSTERS INC

re-direction one to many

600 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."

Axel Standalone includes a top menu bar - could also consider presentation mode in Omni?

Axel Standalone or Quicktime Player

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

76

4.5 x 3

950

3 Methods:
1. Present in Quicktime - standalone - all faked. All faked.
2. Present in Standalone - " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " 

650-

552

Capture size: 4.5 x 3

= 56 FOV

76

628
**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) { //v1.0
     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() { //v3.0
  var i, args=MM_goToURL.arguments; document.MM_returnValue = false;
  for (i=0; i<args.length-3; i+=2) eval(args[i]+".location="+args[i+1]+""");
}
```

The code - this bit goes into Axel

```javascript
MM_goToURL(‘parent.frames[‘mainFrame’],’;two.html’);return document.MM_returnValue
```
Browser should forego the banner—replace with banner that has new function—drag, hanging etc.

Why? Ability to drag groups of sites around.

Lebbeus Woods

"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.
Why separate banner?

Mid distance "shuffle" zone.

NEED TO SIMPLIFY X IDENTIFY:

As history build:
1. Where do the files stack?
2. What might does the user have?

X = Script
C X = Custom relation

CTRL - click zoom to back & auto arrange
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 20
Or. 0 0 0
Scale 1 1 1

use proximity reaction to toggle the XYZ custom script

No good!

Needs a simple button that toggles XYZ script.

Need to develop a code language for interaction editor.
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.

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. Users 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?
   OR.

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
TWO LISTS? — OR THREE?
1. First encountered
2. Last visited
3. Catalogued

"Roadways of history files?"

Scroller

(it's tricky...)
but this is how it's done!

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.
works 0.1x, 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 scroller. It's adding another interface metaphor, also is limited to 64 views at a time.
Perhaps files should just collect on "back wall"
Vertical stacks = days / sessions / groups of 10...

Link colours:
• Select Material of I
• Select other object
• Material Link
• If other object is then instanced, original 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.

Trigger when value changes:
 Sphere1.Position.x > 2

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 off and on 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.

Parameter Editor

Name: SnapCns1
 Active: X
 Weight: 50.00
 Constrained position: 0.00 0.00 0.00
 Transition period: 0.20
 Target (Cube1)
 Target (Cube2)
 Target (Cube3)
 ToggleParam1 (SnapCns1: Active)

Basically - all objects "snap" from place to place!

ON drag release, snap to 2, set constrain A => B
ON drag release, snap to 1, set constrain B => A
Banner is pose constrained to View panel.
- V is snapped to both S1 & 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 nearer, closer S2.

**VERSION 2** - Using position triggers to all free drag at front

Both Stop and Deactivate are required.

```
IF Cube.Z > 1
  STOP
  Deactivate
  Snap Cns
ELSE IF Cube.Z > 2
```

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

**NOW - How do we (simply) reverse this procedure?**

**ACTIVATE command and SWITCHES - They make reactions makejav not work.**

**EG**

- SPIN ME
- START
- SPIN Z
- Deactivate stops SPINZ from receive any commands
Activate do NOT turn a reaction off, if 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

*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 (Click, 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!**

This changes everything!

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

* Don't need to deactivate snap when on hold, use override option when dragging instead.

* Only need to shuffle downward, as long as we start from TOP DOWN, i.e. HANG.

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

May be use hold to deactivate snap to allow top to move down.

**Buggy Tip**

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

distance (Pink. Position, Blue. Position) <= 1

?? IF two conditions are met, do they both trigger?
Express snap on \[\Rightarrow\] snap off

Mouse down = drag
Mouse up = then play snap \[\Rightarrow\] then deactivate

Mouse up \[\Rightarrow\] Snap Active

IF 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!

Sure - might work - but not very "Lissitzky". Lissitzky'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.

Cool, but no cookie!
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, Luxe as template in Axel?

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

Click on yellow - camera moves to position by yellow. Camera orientation is controlled by constraints to both yellow and green. VERY interesting.

WICE 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 sit:

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>Active</th>
<th>Toggles the constraint on and off.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest length</td>
<td>Determines the distance in units at which the object comes to rest vis-à-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.

---

**Shift-clicked item**

Camera zooms in only on the shift-clicked item.

File 89 zoom_to draggable target.
PERFECT DRAG AND SNAP!

GETS CLOSE → AND USER CAN DRAG OFF EASILY

ON DRAG

- Proximity, limit 1
- onEnter
- onExit

ON DRAG OVERRIDE OTHER

TOGGLE PARAM SNAPE WEIGHT

START 100

STOP 0

Snap Constraint

Active ✓

Weight 0.00

Transition 0.3

MEGALITH?

CREATE CONSTRUCT "UNITS" - THESE CAN BE RANDOMISED IN ARK EASILY - NO NEED TO DO THIS IN MAYA

NEXT TASK!

DESIGN THE FARM

“ROAD”

VR CONCEPTUAL ANCHOR

SMALL 250 X 150

LARGE 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.

Expressions code:
```
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:
```
window -title "Grays GUI" -widthHeight 200 400;
setLayout -scr true -tv false;
string $parent = "columnLayout -adjustableColumn 1";
createLayout;

// 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"
This is NOT going to be easy!

Attempt at environ construction, combining "constructs" and larger layout devices.
Multiple floating constructs doesn't assist layout.
The large elements work well.
Still have issue with composing the space.
Need to look further at letting software create unique compositions (with 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 "feeders," dots, wires, etc. Need to construct central compositions FIRST!

WHAT IS THE FUNDAMENTAL STARTING SHAPE?
- Box?
- Roadway?
- Grid? - Flat? - Wall?
  - End?
  - Side?

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 speech 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,resizeable=yes,width=555,height=333')"><img src="Pic.jpg" width="47" height="42" border="0"></a></p>
```

NEW APPROACH ➔ How about utilizing Lissitzky'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.
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 — through 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!

"Floating"

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

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

Axisymmetric - 3D confusing

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

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

Recognition value

Better-than Stacking

Attached to a "hanger" of varying colour & possibly shape

The clusters themselves will have shading & randomly generated stack positions

Random is good; re surprise reward guaranteed (!)

A back shape has a stronger "window" feel.
History "timeline" descending into the past. Autocreated chosen pages can be dragged down into a cluster.

Custom reaction to ascertain position.
Custom relation to maintain snap, but this will reposition the centre point!

Basic geometric shapes as the handles. Vary in colour. Users simply selects the handle of choice, collects pages.

Offset parameter of Standard Pose Constraint between B1 and P1

PoseCns1.Position_offset =

\[
\text{random}(0,1), \text{random}(0,1), \text{random}(0,1)
\]

Custom scripts

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

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

WASTEFUL CODING! SO, REDUCE OBJECT NUMBERS?
Parallel Projections

- Orthographic
  - Multiview
    - Axonometric
      - Isometric
      - Dimetric
      - Trimetric
    - Oblique
      - Cavalier - true length of sides
      - Cabinet - \( \frac{2}{3} \) 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?

\[ x + (c \times 5) = 15 \]

Cabinet decrease - need to use best length or similar.

Distance (value1, value2)

Zoom in/out to Cam.

Distance Constraint
- Go away
- **Come back**

Group
- Go away on
- Go away off
- Come back on
- Come back off

Works BETTER than supplied Toggle Param.
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 to this size.

This can all 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 into storage
- Visual 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 & tiles available.**

```javascript
function zoom(me) {
  _root.onEnterFrame = function() {
    me._x = tl._x;
    me._y = tl._y;
  };
}

on (release) {
  zoom(d1);
}

on (press) {
  startDrag(this);
}

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

# Flash Button

**ON BUTTON**

**ALL WORKS!**
Frame Script

```javascript
function lock(me) {
  t1.onEnterFrame = function() {
    me.x += t1.x1;
    me.y += t1.y1;
    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");
  }
}
```

```javascript
on (release) {
  stopDrag();
  if (equal(this._droptarget) !=
    root.t1) {
    this.x += t1.x1;
    this.y += t1.y1;
    root.lock(p1(root.p1));
  }
}
```

Whoops—The unlock script unlocks both objects.

Problem with _droptarget—it doesn’t seem to be able to cope with two objects...

Mouse down — release snap

Move up — if read snap

Can’t nest clip events!

Try — Dropping onto a fake target, then release to +1

- Use hit test instead. Hit test will use entire shape of object (?)

Why not use hit test when select yellow hit test if.

true switch on are good eg set a variable scooby = true

Then test for it if scooby = true

etc

//P1 Lock function

```javascript
function p1_lock_t1(me) {
  p1.onEnterFrame = function() {
    me.x += t1.x1+5;
    me.y += t1.y1+5;
    readout1 = "lock1";
  }
}
```

//P2 Lock function

```javascript
function p2_lock_t1(me2) {
  p2.onEnterFrame = function() {
    me2.x += t1.x1+10;
    me2.y += t1.y1+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);
  }
```
recreate FH mockup in Flash MX 2004

- Decide example sites — Apple, OM Exposure, ED-Media, Vast 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 2 works ok.
- What sort of zoom?
  - Entire page?
  - Per object?
  - By key?
  - By button?
All objects zoom
Main BG can drag
Individuals objects can drag.

**NESTED Clips works WELL!**

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 0.56 behind the Target.
This is NOT caused by the Target, but contradicting depths.

**SOLUTION**

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

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

Single action partner to onEnterFrame:
This is onload

```javascript
_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;
  }
};
```

Alternative
Simply scale up the objects

* Bitmap images are likely to not scale smoothly.

Two options:
1. Use blanks for the scaling stage — (weird, disruptive)
2. Zoom up in stages.
   - slides = 100 = 1 x
   - slides = 200 = 2 x etc.

```javascript
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;
  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);
      curveTo(_xmouse+20, _ymouse-40, _xmouse, _ymouse);
    }
  };
}
// Line drawing function b1 to b3
function joinline() {
  b2.onEnterFrame = function() {
    _root.createEmptyMovieClip("linejoin1", -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 druggable. 
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.

BRILLIANT!

on rollover readout 2 = 3 (e.g. number specified to tool thumbnail)

on spacebar down
it readout 2 = 3
make big

The SPACEBAR command is a problem - it is 'GLOBAL' - i.e., 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.
What needs to be refined, debugged & tested?
- Main interactive 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!

Leaves stage drag out of 1st test.
So incorporate icon zoom.
ALL ICONS?
JUST ON ROLLOVER?

WHAT am I trying to ascertain?
- Key questions
  1. Do target objects assist with grouping files, cognitive associations & recall
  2. Do lines...!!

Find paper that supports legibility of angled thumbnails
This would require complete dragging of entire view - do we want this?
Consider straight lines?

Should the pages come in with "links" already?
- Does NOT require stage drag!
- Requires stage drag

Indicates same site

Rollover
Pipe/zoom
To browser
Hold down key
on click
User browses pages

1. Then presented with normal history list
   - Present with questions that require accessing history in a specific order.
   - Ask to re-order pages in accordance to differing criteria (by model, date, color, price)

B. Then presented with interface and asked same tasks

C. User's questioned.

TESTING
Qualitative Methods (Tochrim)
- Direct Observation
- Followed by Unstructured Interview

My Method chapter says:
- Expert Appraisal
- Followed by interview

MY NOTES NOW-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. eg: an expert will be easier to brief than a less skilled user.

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

Jordan
- Interviews - Semi structured.

(201)

iPod
- Photo
- Mini-iPod
- U2 iPod
- iShuttle

How many pages? (more than prototype 1)
How ASSEMBLE?

Stages
web browsing

standard browsing

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

Reversing

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

Pages

Apple.com
iPod tab
20 20Gb iPod pic
iPod mini iron at top
Tech specs
Goback
Goback

iPod Tech Specs

Want to buy a 20Gb colour iPod

1 2 3 4 5 6

Music and More
iPod camera connector
Store
1Pool
From $249

Tech Specs
Google search for "ipod nano nz"
Mac Warehouse
Scroll down to 4.6B prices more info
$372 + S&T
Go History, Back to Google
Totally Mac
Totally Mac Nano
Back Back Back
Choose USE
McSE Nano
DSE 4.6B
Choose trademe
Trademe Nano
17-back 2
17-back 3

Users to arrange:
1. By Price
2. By Product - iPod or nano(?)
3. By Source - Apple
   - Mac Warehouse
   - Magnum Mac
   - Trademe

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

Create a faked Google page with
- Magnum Mac
- Mac Warehouse
- DSE
- Trademe
  all included

Use, "Buy iPod NZ"?

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

Try

Make all on-screen instructions use an appealing, shiny, ruler-like whole feel needs to be
assuming & usually professional

Share sets - which is unhelpful.
Google example?
Consider floating interface over background!

Also consider:
- OMNI web icons
- Opera history

History created by test sequence.
- Make this just a history slider.
- This stays static?

Good idea. Let's this space become a "working area". Can deal with rows of large numbers later - once key principles have been tested.

- Pop up URL's can get very long - how to deal?
- Go for pic.

- URL's & page titles can get VERY MEANINGLESS!
- Need a mechanism where individual pages can be kept large. E.g. 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
  mouseY + 2

  Hit Test

- Watch out for hotspots - always square!
- USE

  if (root.object.hitTest(this.x, this.y, this.x + true))

  Target object
  moving object or current object.

  Action: 
  (me) {
    me._width = 100;
  }

  on (release) {
    zoom(object);
  }

  Small icons should have a zoom preview - ideally using simple keystroke, i.e. spacebar.
  - Prefer 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 Browsing" button. Eg Go to end - all pages browsed.

NOTE: If we have a MC with two MCs/Butts inside, DO NOT forget the overall 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 on block B
- Line then appears

Code: on release T1.lx = 1
on release T2.lx = 2

Then a bunch of functions:

OnEnterframe = function () {
  if T1.lx = 1 and T2.lx = 2
    T1, T2비스에.visible = 1
};
Each click needs to set a variable:
- on click
  - b1 = readout1
  - b2 = readout2
  - if readout1 = b1 and readout2 = b2
    - line draw 1-2.

Can have one function with all possibilities
- Delete?
  - use double click
  - click once to set var
  - if var is "this"
  - delete.

Use a var
- on click if var = 1:
  - make 0
  - else 1

Then:
- IF var1 = 1 and var2 = 1
  - show lines
- IF var1 = 2 and var2 = 1
  - show lines

Notes from MW AM - 16:06:06
- Focus on Lessitying "SPACE" | more from linear space to "constructed" space.
- Abstract shape thing can go.
- Allow naming groups
- Action: Research
  - Names from Websites - select one or custom?
  - Include icons - eg. iPad
  - Q's on concept - drag/drop/group/more
  - Thumbnails like 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;
  }
}
```

USE ICONS?
(Created 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!

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 unbalanced. Not ideal.

DRAG IN

Pop up to select colour

How do control this 3rd line?
So - Generic geometric shapes
- colour coded

How select colour?

- click + set var = x
- if var = x, make yellow
- $R, O, Y, G, B, Purple, Grey$

Two methods:
- Change object - requires making up more objects
- Change colour - requires rebuilding objects

- and using RGB values

- but once setup, endless colour range

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

EG

on (release) {
    thing.attachMovie("circle", "circle1", 2);
}

Use MovieClip.removeMovieClip() to remove */
_root.icon_change.but.onPress = function() {
    tagbar1._width = 200;
    _root.b2.attachMovie("ipod_icon", "ipod_icon", 2);
    _root.b2.blue_box_gpx._alpha = 0;
}

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

This didn't work!!
Too many actions failed, set ups, volleys etc - go back to adding a web page into the background to "fake" a float over panel
Need a "double click" to open URL. Keys - e.g. Ctrl space, don't work inside the browser, only as long SWF! We already have Press & Release on the P's - so need to watch contacts.

```
onpress / First click
  set timer

on press / drag function
  timers function

on release / stop drag
  if timer within range
    go to URL.
```

**VERY CLEVER double click script - totally original - works well!**

```
_root.pzone.onPress = function(c)
  bar.width += 50;
  if (bar.width >= 100)
    getURL("p1.html", _self);

  bar.onEnterFrame = function()
    bar.width -= 1;
end;
```

Each click add 50 pixels to bar length  
And if bar gets to 100 (two clicks)...
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 original, 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!!
```

GRANTE "SYMBOLIC SCALE"
A study of user-behaviour when contrasted 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