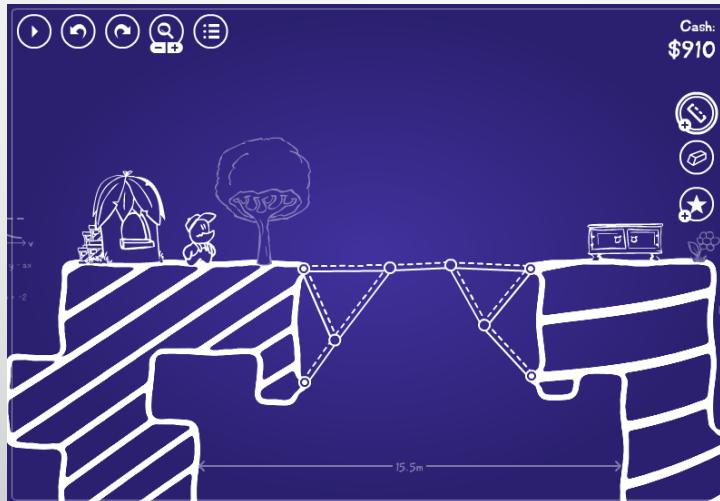




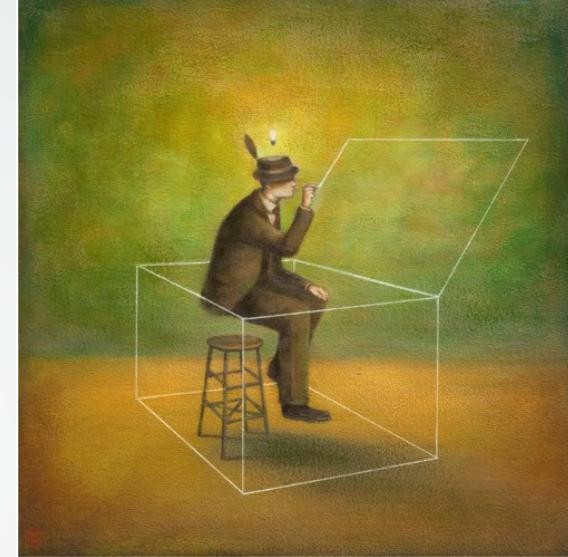
# A computer game to study design fixation

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DCC'16 Workshop:  
Games for Design Research and Education

# Design Fixation



The term 'Design Fixation' is often used to refer to situations in which designers limit their creative output due to an overreliance on features of pre-existing designs, or more generally, an overreliance on a specific body of knowledge directly associated with a problem

# How fixation effects have been studied

## Psychology studies

- Problem solving tasks requiring the identification of a novel or unusual solution
- Simple problems (e.g. measuring out precise volumes of water; tying two distant strings together; fixing a candle to the side of a wall with limited tools)
- Well-defined problems (i.e. problems with a pre-determined, limited number of solutions)



## Design studies

- Typical design tasks requiring the generation of many novel and diverse solutions
- Complex problems (e.g. designing a car-mounted bicycle rack; developing a concept for an automated rent-a-car facility; designing a device to retrieve a book from a shelf that is out of reach)
- Ill-defined problems (i.e. problems admitting an undefined or unlimited number of solutions)

# **From a *quantitative* to a *qualitative* approach...**

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- The complex and ill-defined nature of the design problems imply that performance in these tasks cannot be exclusively measured in terms of the quantity of solutions generated, but has to also be evaluated in terms of the quality of the solutions

**As a result...**

- The use of subjective metrics to evaluate the design outcome has become very common in design literature (e.g. novelty, practicality, feasibility, etc.)

## **Problems with this approach:**

- Very subjective
- Great diversity of the procedures
- Results that are often non-comparable
- Great variety in the outputs that participants can provide while working on the design tasks

**Our proposal:**

**Studying design fixation with computer games inspired by experimental paradigms used in psychology research**

# Using a computer game to study the *Einstellung* Effect

The *Einstellung* Effect, or Mental Set, is the development of a mechanized state of mind. It occurs when the first idea that comes to mind, triggered by previous experience with similar situations, prevents alternatives being considered. If this initial idea is not the best way to solve the problem, the optimum solution may be missed.

## Water-jar problem (Luchins, 1942)

How would you use three jars with the indicated capacities to measure out the desired amount of water?

Problem	Jar A	Jar B	Jar C	Desired quantity of water	Solution
1	21	127	3	100	B - A - 2C
2	14	163	25	99	
3	18	43	10	5	
4	9	42	6	21	
5	20	59	4	31	
6	23	49	3	20	B - A - 2C
7	15	39	3	18	or A ± C
8	28	76	3	25	A - C
9	18	48	4	22	B - A - 2C
10	14	36	8	6	or A ± C

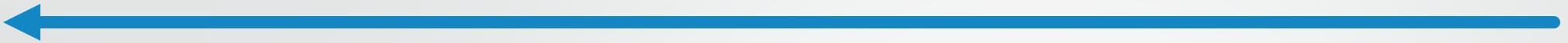
Einstellung trials

Critical trials

Extinction trial

Critical trials

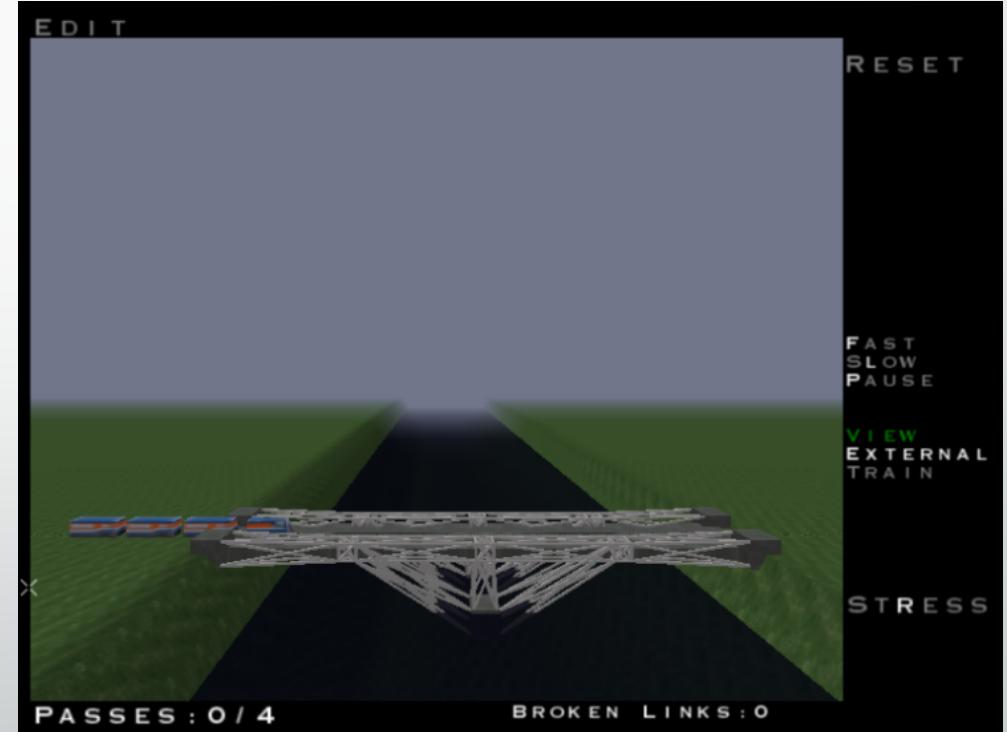
# *... From a qualitative to a quantitative approach*



Our computer-based task will consist of a simple game-like design activity. The overall purpose of the game is to design a bridge across a river that can support the specified load without exceeding the specified budget



Design Mode



Test Mode

Screens from the game Pontifex, developed by Chronic Logic



**Show them the Pontifex game,  
why not?**

# Game details

## RULES

To design bridges that are strong enough to support their own weight and other loads that are placed upon them;  
To pass each trial, the bridge must withstand the load of a train passing across it without suffering any broken links;  
If that happens, the bridge must be redesigned and retested;  
There is (currently) no limit for the number of attempts (i.e. testing the bridge);  
There is (currently) no time limit for each trial

## MECHANICS

There is a design mode to design the bridge and a test mode to test it;  
Bridges are made out of segments that are linked to each other with anchor points;  
Not all anchor points can or should be used in order to construct the bridges;  
Bridge links break when the structure is not strong enough to support either its own weight or other loads;  
For each trial, there is a limited budget;  
Each piece of the bridge costs money

## GOAL

**To construct the cheapest bridge possible!**

# *Einstellung trials*

Problem



Solution



Solution: Using all the anchor points

# Critical trials

## Problem



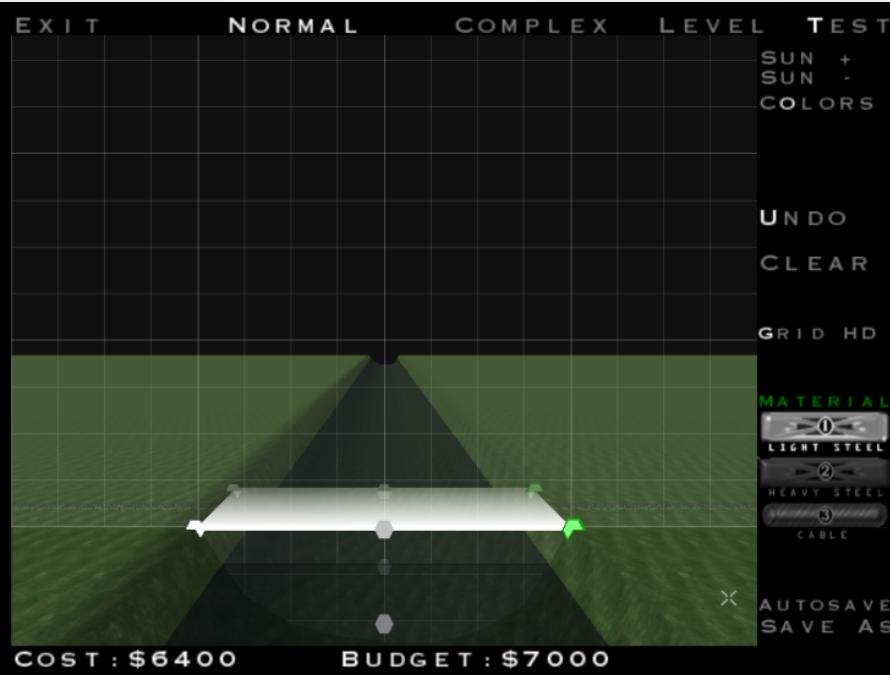
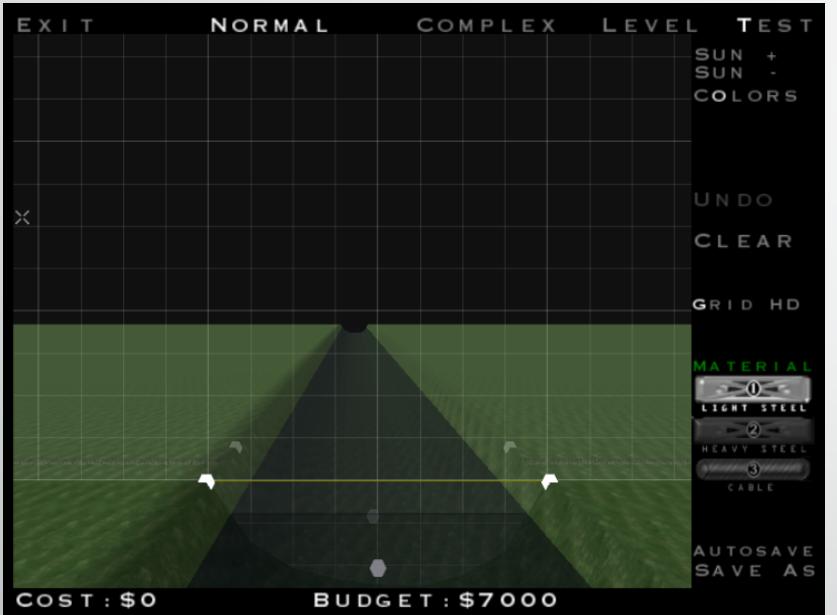
Cheaper Solution:  
Using not all the anchor points



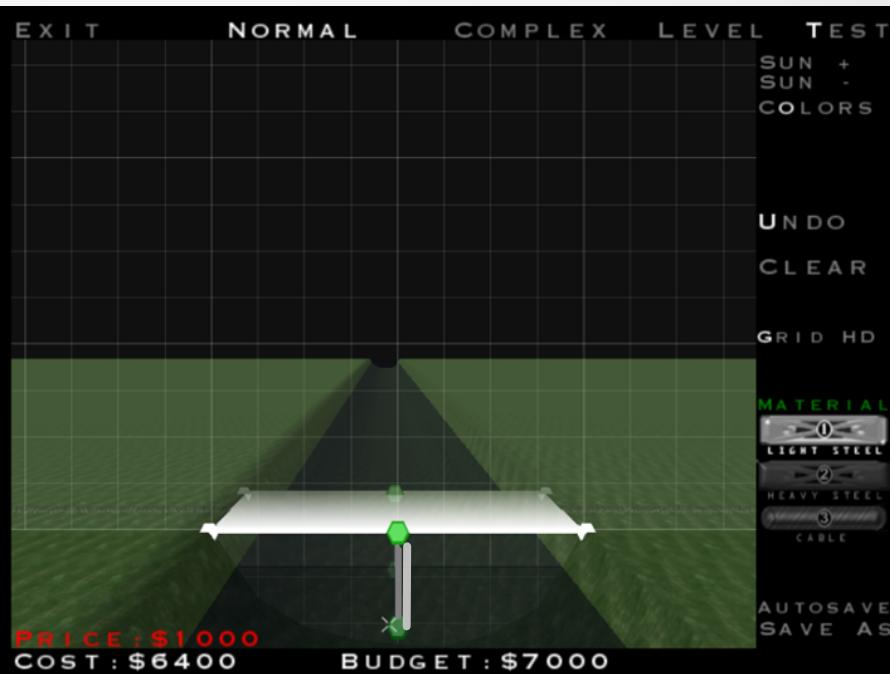
More expensive Solution:  
Using all the anchor points

# Extinction trials

## Problem



Possible  
Solution:  
Using not all  
the anchor  
points



Not possible  
Solution:  
Using all the  
anchor  
points

# Possible variations for future studies

- Varying or limiting the number of trials
- Giving a time constraint to complete each trial
- Including an incubation period after the *Einstellung* trials
- Evaluating the efficacy of particular strategies, such as writing “Don’t be blind” on the performance
- Comparing the performance of novices vs. expert designers
- Comparing the performance of designers with different academic backgrounds
- Evaluating the effect of age on performance
- Etc.

# Using our computer game for fixation experiments

## Advantages

- Increased engagement and immersion, thus lower chances of hypothesis awareness and other participants' bias
- Strong compatibility with other data capture tools such as audio (e.g. verbal protocols) and video (e.g. eye-tracking)
- More controlled data capture and a more objective analysis of design behavior
- Reduced variability in the type of outputs that participants can provide
- More comparable results within and between studies
- More direct assessment of the effects of particular constraints (e.g., time, budget)

## Disadvantages

- The number of possible solutions is still limited if compared to other creative design tasks
- Many confounding variables can influence performance (i.e. experience with computer games or with the design activity)
- Limited possibilities to extend the results to other design domains
- Research taken less seriously by the scientific community?

# Benefits of creating our own game

- Increased customisation of levels
- Chance to adopt a more cartoon-like appearance
- Chance to create more riveting and unrealistic scenarios
- Increased control over our 'fixation metrics', such as resources, time, number of moves, and number of attempts

# **Thank you for your attention!**

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