

# Suggested Interactivity: Seeking Perceived Affordances for Information Visualization

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**Tony Abbott**  
Datablog

## Tony Abbott was prime minister for fewer days than Gillard or Rudd - chart

This graph shows total days in office (including multiple, non-consecutive terms) for all Australian prime ministers, from the longest-serving, Robert Menzies, to the eight days of Francis Forde. Having just been ousted by Malcolm Turnbull, Tony Abbott has had the 10th shortest time in office

Nick Evershed

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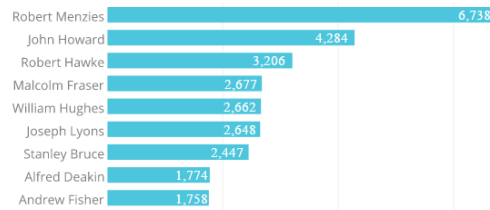
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Australian prime ministers: total days in office



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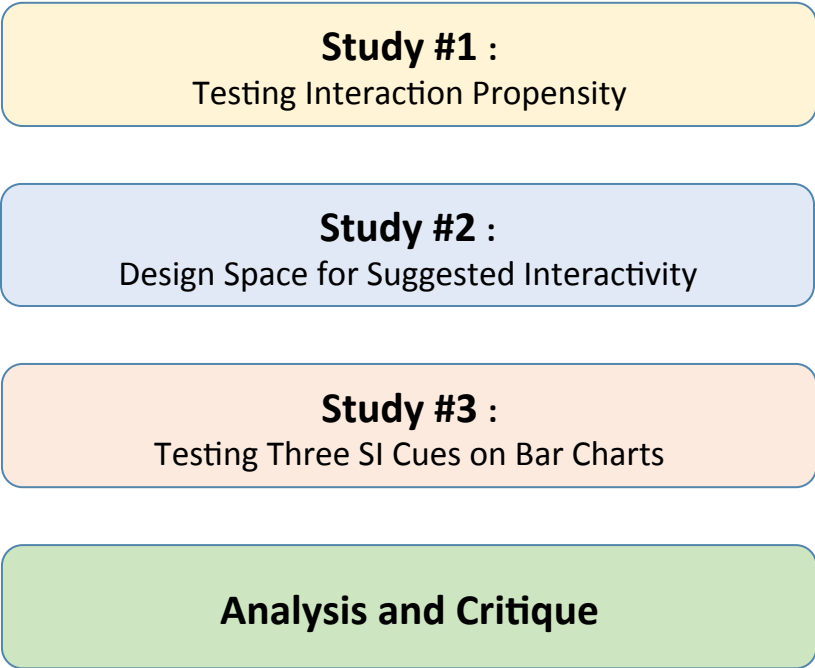
How can we attract these users' attention to a visualization and suggest its interactivity through design?

# Background

- Affordances
  - **Real affordances:** the actual physical properties of an artifact that call for action
  - **Perceived affordances:** the perception and/or understanding a person has of the actions that can be performed with that artifact
- **Feedforward:** tells users what the result of their action will be



# Breakdown



**Study #1 :**  
Testing Interaction Propensity

# Setup

- 7 simulated articles with text and visualizations
- **Layout:** Wikipedia
- **Data and Text:** OECD Better Life Index website
- **Task:** simple fact-checking task
  - Multiple choice extraction task
  - Possible to do task with text and with visualization

The screenshot shows a browser window displaying a Wikipedia article titled "Income in the OECD area". A fact-checking task is overlaid on the top of the page, asking: "Which country was the anchorman talking about?" with radio button options for Switzerland, Luxembourg, the United States, and "I don't know". A "Submit" button and a "Timeout: 0:50 minute(s)" are also visible.

The article content includes:

**Statement:** A certain country "is the best place to live regarding income: households in this country have both the highest net adjusted disposable income, and the highest net financial wealth in the OECD area".

**Income in the OECD area**

While money may not buy happiness, it is an important means to achieving higher living standards and thus greater well-being. Higher economic wealth may also improve access to quality education, health care and housing.

**Household Net Adjusted Disposable Income**

Household net-adjusted disposable income is the amount of money that a household earns, or gains, each year after taxes and transfers. It represents the money available to a household for spending on goods or services. Across the OECD, the average household net-adjusted disposable income per capita is 23 047 USD a year; and the highest household net-adjusted disposable income (in the United States) is more than three times higher than the lowest (in Brazil).

**Household Financial Wealth**

Household financial wealth is the total value of a household's financial worth, or the sum of their overall financial assets minus liabilities. Financial wealth takes into account: savings, monetary gold, currency and deposits, stocks, securities and loans. Such wealth makes up an important part of a household's economic resources, and can protect from economic hardship and vulnerability. Across the OECD, the average household net financial wealth per capita is estimated at 40 516 USD, but in the United States where it is highest, it is estimated at 115 918 USD.

Categories: OECD | Better Life Index



# Setup

- Participants from Amazon Mechanical Turk
  - Native English speakers
- Coding
  - Brush interactions
  - Decisive brushes
  - Number of subsequent trials decisive brushes were used
  - Participant's answers
- Analysis
  - Point estimates and 95% CI based on 10 000 percentile bootstrap replicates

## Experiment #1:

*Are people inclined to interact with charts to carry out fact-checking tasks?*

- **H1.1:** A majority of participants will not know that the charts are interactive, and therefore they will not use them to complete trials
- **H1.2:** a majority of participants who 'discover' the interactivity of the charts will use them throughout all subsequent trials

# Experiment #1: Important Results

- Only used participants with score > 0
  - 59 participants
- **H1.1 & H1.2** confirmed
- Layout contribution
- Charts perceived as efficient

Measure	Percentage
> 1 Brush	42.4 %
>1 Decisive	28.8%
(Decisive   Brush)	68%
(Brush in all 7 trials   >1 Brush)	52%
(Brush in subsequent trials   Brush)	60%
(Decisive in all 7 trials   >1 Decisive)	58.8%
(Decisive in subsequent trials   Decisive)	88.2%

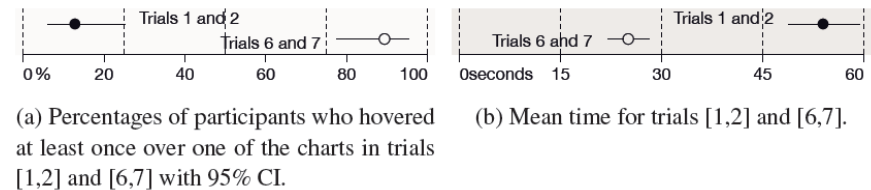
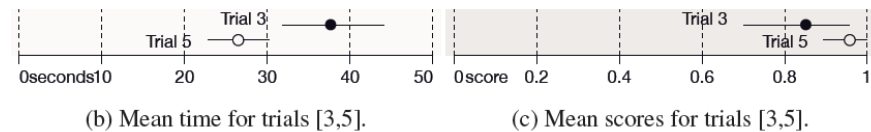
## Experiment #2:

*Are charts more efficient than text?*

- Trials 3,4,5 were replaced with just charts
- **H2.1:** all participants will interact with the charts in trials [3-5]
- **H2.2:** majority of participants will use the charts in trials [6-7]
- **H2.3:** there will be good evidence that more participants interact with the charts in trials [6,7] than in [1,2]
- **H2.4:** participants should complete trials [6,7] faster than [1,2]

## Experiment #2: Important Results

- **H2.1** failed: not all participants interacted with charts
  - Visualization literacy
- Needed to get used to charts
- **H2.2, H2.3, H2.4** confirmed
- Charts are more efficient
- Conclusion: charts are more efficient



## Experiment #3 + Results:

*Is Wikipedia layout choice biasing results?*

- Ran experiment #1 again without Wikipedia styling attributes
- **H3:** results will be consistent with **Experiment #1**, meaning Wikipedia styling did not bias participants' behaviour
- **Results:** consistent with Experiment #1

## Study #1: Conclusions

- Lack initial propensity to interact with charts embedded with text
- Visualization literacy problems
- Charts are more efficient
- People can be motivated to interact with visualizations if they are shown the possibility
- Highlights the need for suggested interactivity

**Study #2 :**  
Design Space for Suggested Interactivity



# Definitions

**Suggested Interactivity (SI)** : set of methods for indicating that a graphical area can be interacted with by subtly directing a user's attention so as not to impede too heavily on this person's focus or on the rest of the interface design

**SI cues** : specific graphical elements or attributes that are used for suggesting interactivity

# Design Space for Suggested Interactivity

- **Attractor:** the object that attracts attention to the interactive area
  - Object of interest
  - External object
- **Animation:** the state of the attractor over time
  - Staged: blink
  - Interpolation: unique or looped
  - dynamic
- **Trigger:** the event that initiates the animation
  - System event
  - User event
- **Visual attributes:** the specific visual variables and/or marks the animation is applied to
- **Persistence:** the ongoing display or not of the cue once the interaction has been performed

Study #2

<http://www.cs.ubc.ca/~tmm/courses/547-15/>

## Study #2

- sequenced interaction with same object or area
- sequenced interaction with different object or area
- user event performed on the 'whole-page' level

Scene1 (1) Scene2 (1) Scene3 (14) Scene4 (1) Scene5 (1) Scene6 (5) Scene7 (1) Scene8 (1) Scene9 (2) Scene10 (1) Scene11 (1) Scene12 (1) Scene13 (1) Scene14 (2) Scene15 (2) Scene16 (6) Scene17 (1) Scene18 (1) Scene19 (1) Scene20 (2) Scene21 (3) Scene22 (1) Scene23 (1) Scene24 (1) Scene25 (1) Scene26 (2) Scene27 (2) Scene28 (1) Scene29 (1) Scene30 (1) Scene31 (1) Scene32 (1) Scene33 (4) Scene34 (2) Scene35 (1) Scene36 (2) Scene37 (2) Scene38 (1) Scene39 (1) Scene40 (2) Scene41 (1) Scene42 (8) Scene43 (7) Scene44 (1) Scene45 (3)

Attractor	Object of interest																																															
Animation	None																																															
	Staged	Blink	Unique																																													
		Looped																																														
	Dynamic	Interpolated	Unique																																													
			Looped																																													
System																																																
Trigger (event)	User	PageLoad/update																																														
		Mousemove																																														
		Mouseover																																														
		Click																																														
		Drag																																														
	Variable	Mousewheel																																														
Visual attribute	Extra mark	Non-textual																																														
		Textual																																														
Persistence																																																
Intended interaction	Mouseover																																															
	Click																																															
	Drag																																															
	Mousewheel																																															
Feedforward																																																

## Study #2: Results and Observations

- SI cues are mostly applied to object of interest
- Animation is determined by what triggers it
  - Staged animation-> system events
  - Dynamic animation -> user-events
- Combinations: interest attractor and external object attractor
  - Feedforward

Dimensions useful for analyzing current visualizations but too complex when it comes to creating new ones

# Design Considerations

- Visualisations as attractors
  - Already depend on visual marks
  - Should not play with free visual attributes
  - Required animation:
    - staged : organic motion: heart beat
    - dynamic: attractive motion: orienting, squeezing, stretching depending on how far mouse is
- Icons as attractors
  - Focal icon
  - Identifier icon
  - Demonstrator icon

**Study #3 :**  
Testing Three SI Cues on Bar Charts

# Suggested Interactivity #1

- **Attractor:** visualization
- **Animation:** staged, looped
  - organic motion- heartbeat
- **Trigger:** page-load
- **Persistent:** no

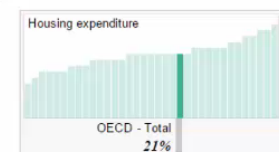
essential to meet basic needs, such as shelter, but it is not just a question of four walls and a roof. Housing should also be able to raise a family. All of these elements help make a house a home. And of course there is the question of housing conditions.

Belgium more than 93% of households expressed satisfaction, while the level was below 75% in Korea, Turkey and other countries with less favourable housing conditions.

Factors, such as the average number of rooms shared per person and whether dwellings have access to basic facilities, are living in crowded conditions. Overcrowded housing may have a negative impact on physical and mental health.

Inadequate water and sewage supply. In the OECD, the average home contains 1.6 rooms per person; this is below the OECD average of 2.2. A significant proportion of people across the OECD live in dwellings with private access to an indoor flushing toilet. However, while in most countries there are the most dwellings without basic facilities, only 67.3% of people have private access to an indoor flushing toilet.

For many individuals and families, by the time you add up elements such as rent, gas, electricity, water, furniture and other household expenses, spending a roof over their heads; this is also the case in Iceland, Turkey, Germany, Austria, Israel, France, Brazil, Korea. In the Russian Federation, spending on housing accounts for just 11% of the household budget.





## Suggested Interactivity #2

- **Attractor:** focal icon
- **Animation:** no
- **Trigger:** page-load
- **Persistent:** yes
  - Visible when out of focus

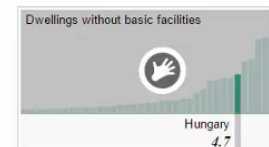
essential to meet basic needs, such as shelter, but it is not just a question of four walls and a roof. Housing should also be able to raise a family. All of these elements help make a house a home. And of course there is the question of housing conditions.

Belgium more than 93% of households expressed satisfaction, while the level was below 75% in Korea, Turkey and other countries.

conditions, such as the average number of rooms shared per person and whether dwellings have access to basic facilities.

People are living in crowded conditions. Overcrowded housing may have a negative impact on physical and mental health. In the OECD, the average home contains 1.6 rooms per person; this is the case in many countries. In the OECD, the average home contains 1.6 rooms per person; this is the case in many countries. In the OECD, the average home contains 1.6 rooms per person; this is the case in many countries.

For many individuals and families, by the time you add up elements such as rent, gas, electricity, water, furniture and other household expenses, spending on housing accounts for just 11% of the household budget. In the Russian Federation, spending on housing accounts for just 11% of the household budget.



## Suggested Interactivity #3

- **Attractor:** visualization and demonstrator icon
- **Animation:** looped staged
- **Visual mark:** text label
- **Trigger:** page-load
- **Persistent:** no

essential to meet basic needs, such as shelter, but it is not just a question of four walls and a roof. Housing should also be able to raise a family. All of these elements help make a house a home. And of course there is the question of affordability.

Belgium more than 93% of households expressed satisfaction, while the level was below 75% in Korea, Turkey and other countries with poor housing conditions.

Factors, such as the average number of rooms shared per person and whether dwellings have access to basic facilities.

People who are living in crowded conditions. Overcrowded housing may have a negative impact on physical and mental health. Inadequate water and sewage supply. In the OECD, the average home contains 1.6 rooms per person; this is significantly below the level of people across the OECD live in dwellings with private access to an indoor flushing toilet. However, while here there are the most dwellings without basic facilities, only 87.3% of people have private access to an indoor flushing toilet.

For many individuals and families, by the time you add up elements such as rent, gas, electricity, water, furniture and other household expenses, spending a roof over their heads; this is also the case in Iceland, Turkey, Germany, Austria, Israel, France, Brazil, and Korea. In the Russian Federation, spending on housing accounts for just 11% of the household budget.



## Follow up study results

- Conducted follow-up study on AMT
- Reproduced **Experiment #1** three times applying each SI
- between subjects design
- **H4:** more participants will perform brush interactions and decisive brushes when an SI cue is applied to the charts
- **Results:** H4 failed
  - No evidence that SI1 or SI2 had any effect
  - SI3 had an effect

## **Analysis and Critique**

# Analysis: What, Why, How

What	Any Visualization embedded in text	
Why	Suggested Interactivity	
How	SI1	Motion
	SI2	Overlay Focal icon
	SI3	Motion + external icon

# Critique

- Small scope
  - Only visualizations embedded in text
  - Only considered 3 SI options
  - Specific task
- Only focused on hovering on bar charts
- Didn't consider age or experience of users
- Only a transition phase



# Overall Conclusion

- Lack initial propensity to interact with charts
- Low interaction literacy
- Suggested Interactivity is necessary
- Subtle cues are not effective
- Feedforward is crucial

Questions?