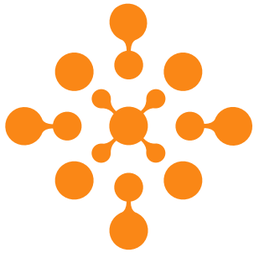


VIS 2020

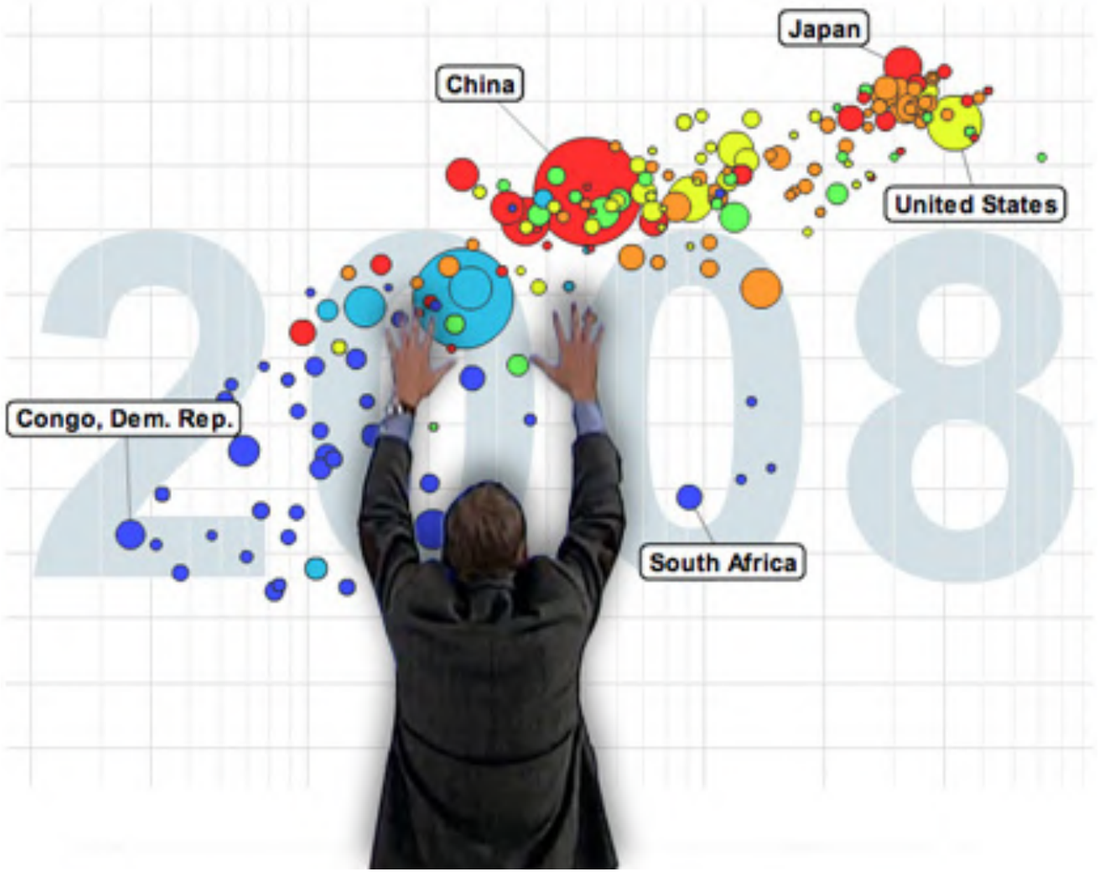
Improving Engagement of Animated Visualization with Visual Foreshadowing

Wenchao Li[1], Yun Wang[2], Haitong Zhang[2], Huamin Qu[1]

1 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

2 Microsoft Research 微软亚洲研究院

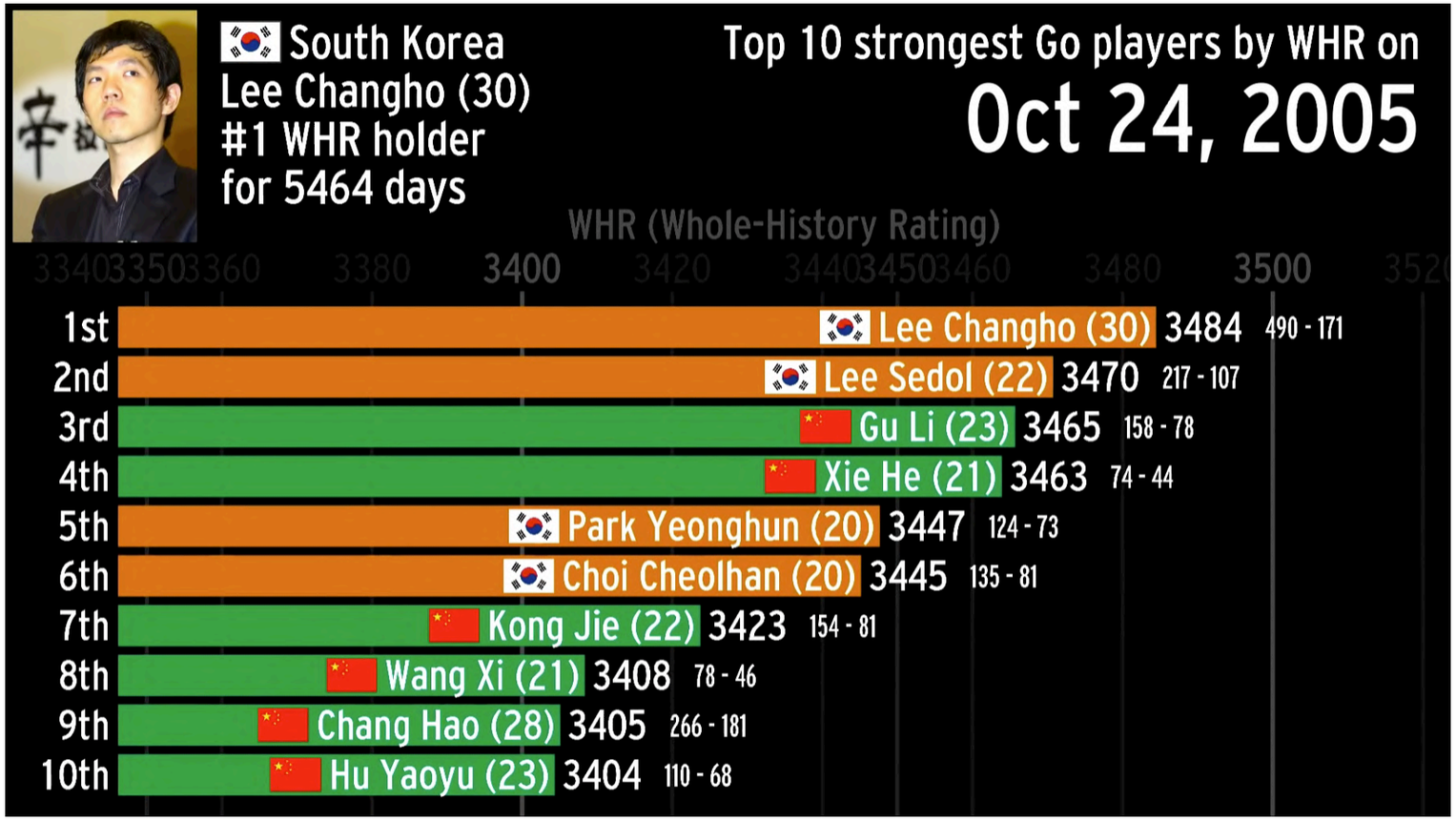
Animated Visualization



Hans Rosling's influential animated data presentation[1]

[1]https://www.gapminder.org

Hard to Maintain the Focus

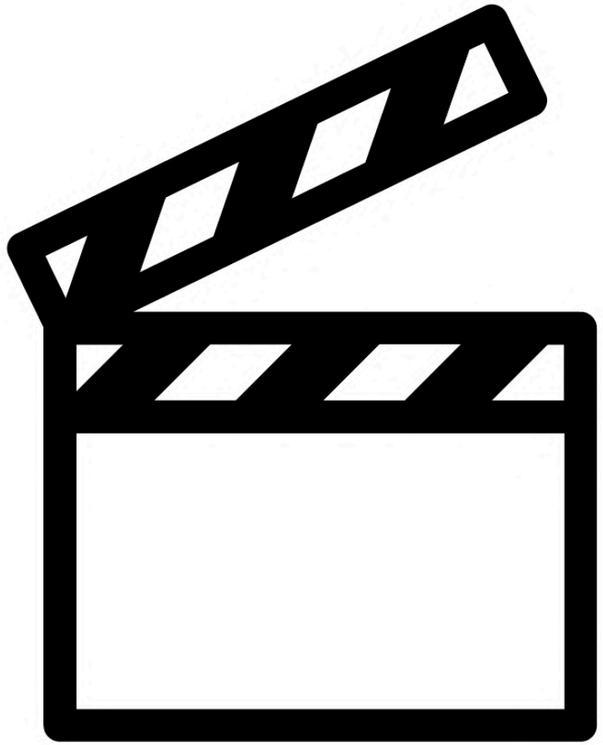


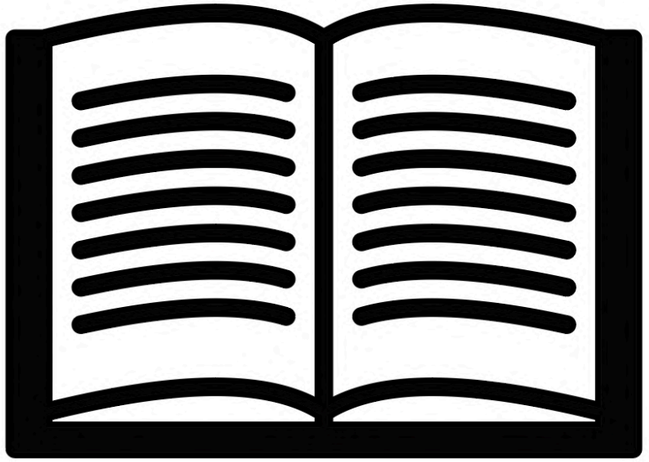
The history of the world's best Go players[1] (Abacaba, 2016)

Viewers are likely to become distracted and bored during the **ever-changing** animated visualization

[1]https://www.youtube.com/watch?v=oRvIyEpOQ-8

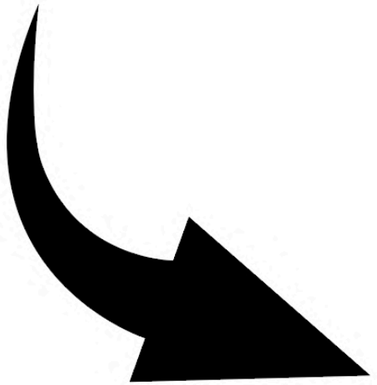
Foreshadowing in Film and Literature

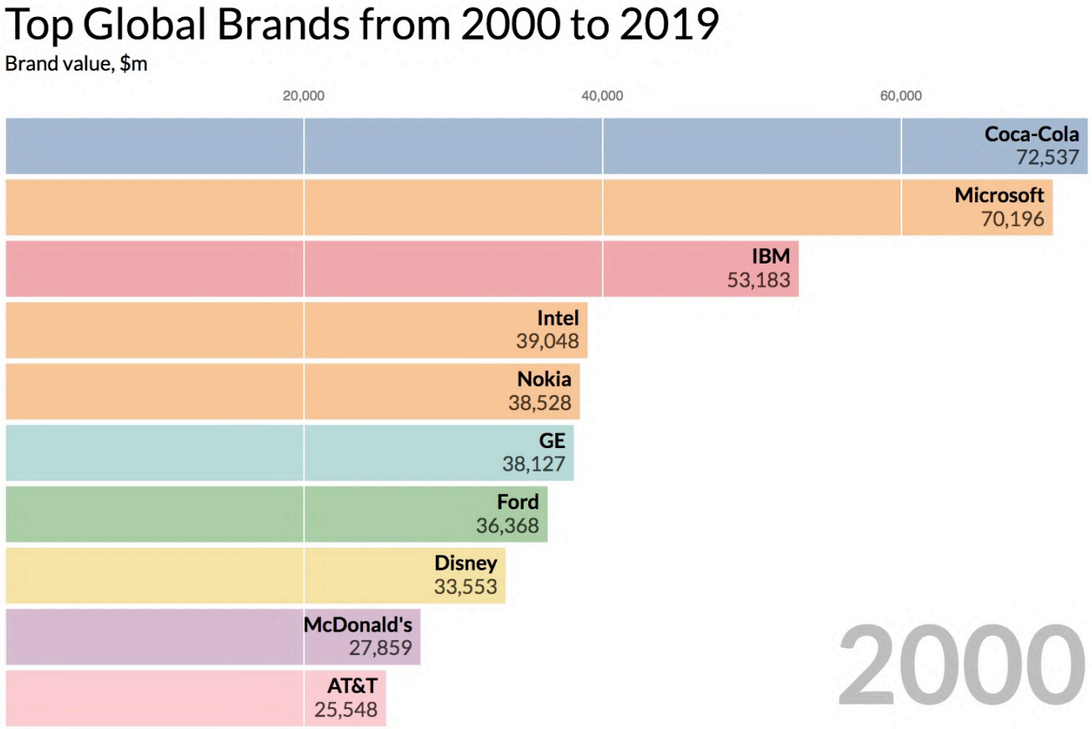




Visual Foreshadowing Definition

$$Visual\ Foreshadowing := (visual\ effect(s), timing(s), duration(s))$$



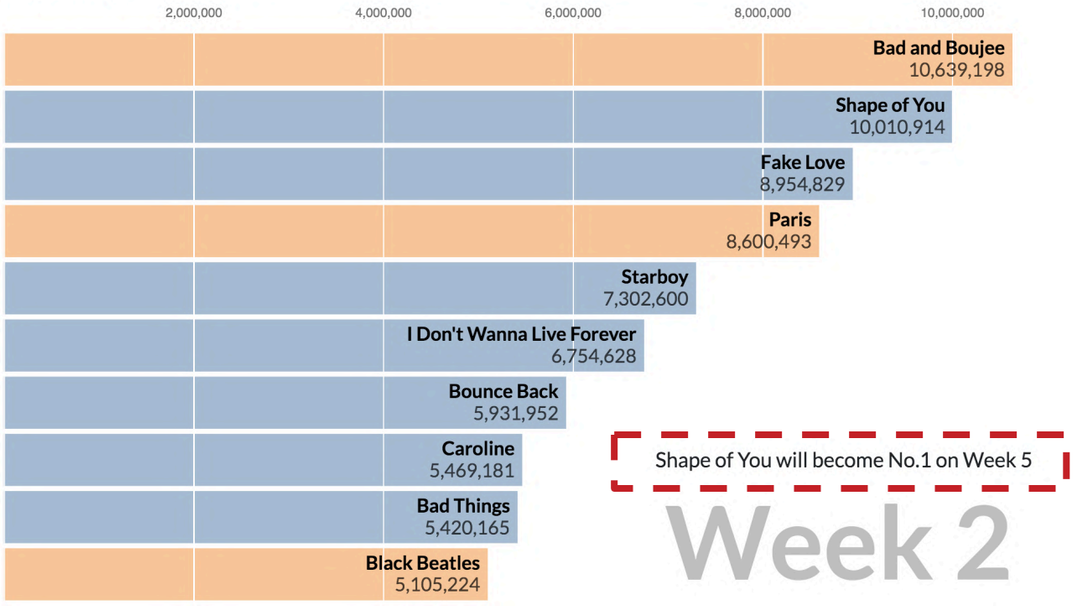


Fork of **Bar Chart Race**[1] by Mike Bostock

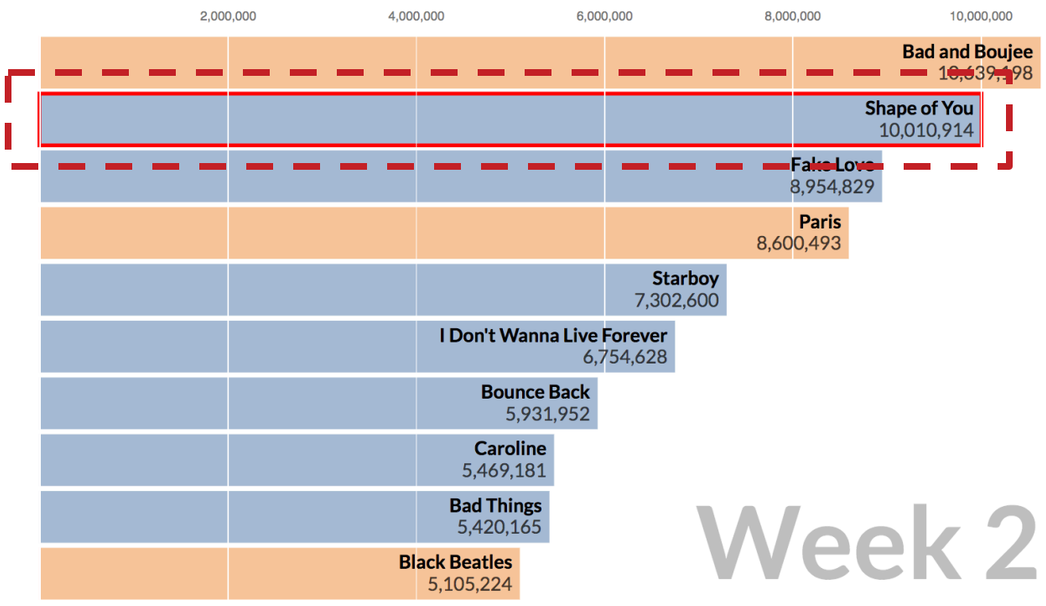
[1]https://observablehq.com/@d3/bar-chart-race

Definition

$$\textit{Visual Foreshadowing} := (\textbf{\textit{visual effect(s)}}, \textit{timing(s)}, \textit{duration(s)})$$



Textual element



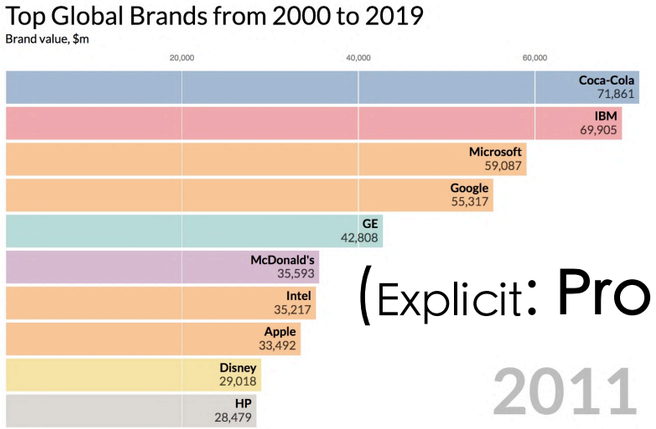
Visual element

Definition

$$\textit{Visual Foreshadowing} := (\textit{visual effect(s)}, \textbf{\textit{timing(s)}}, \textbf{\textit{duration(s)}})$$

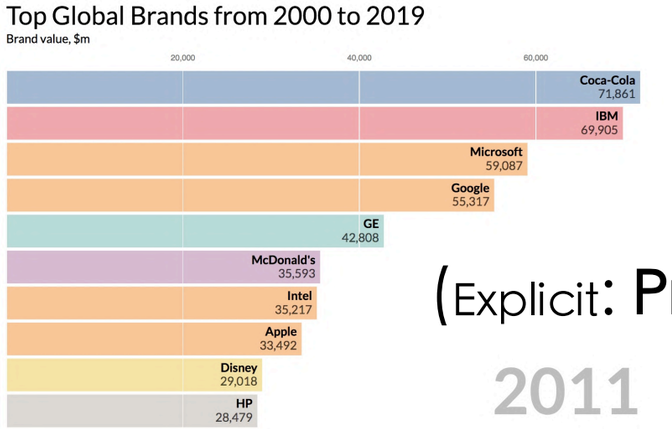
Visual Foreshadowing Examples

Explicit: openly suggests the outcome



(Explicit: **Prologue**)

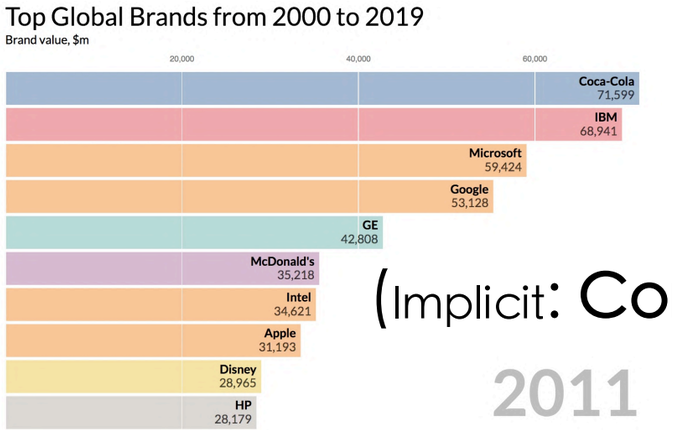
2011



(Explicit: **Pre-scene**)

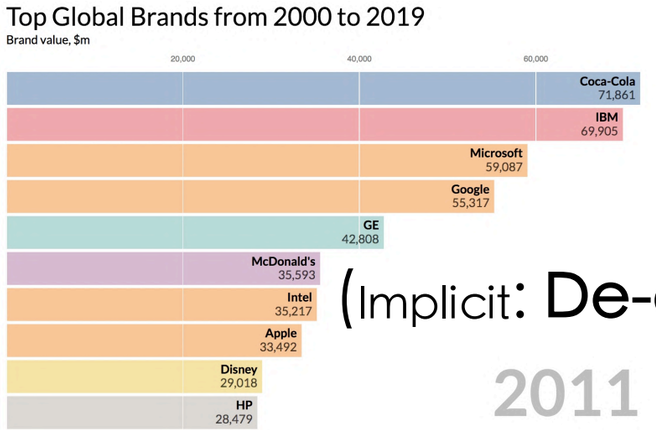
2011

Implicit: leaves subtle clues by hinting the relevant items



(Implicit: **Contour**)

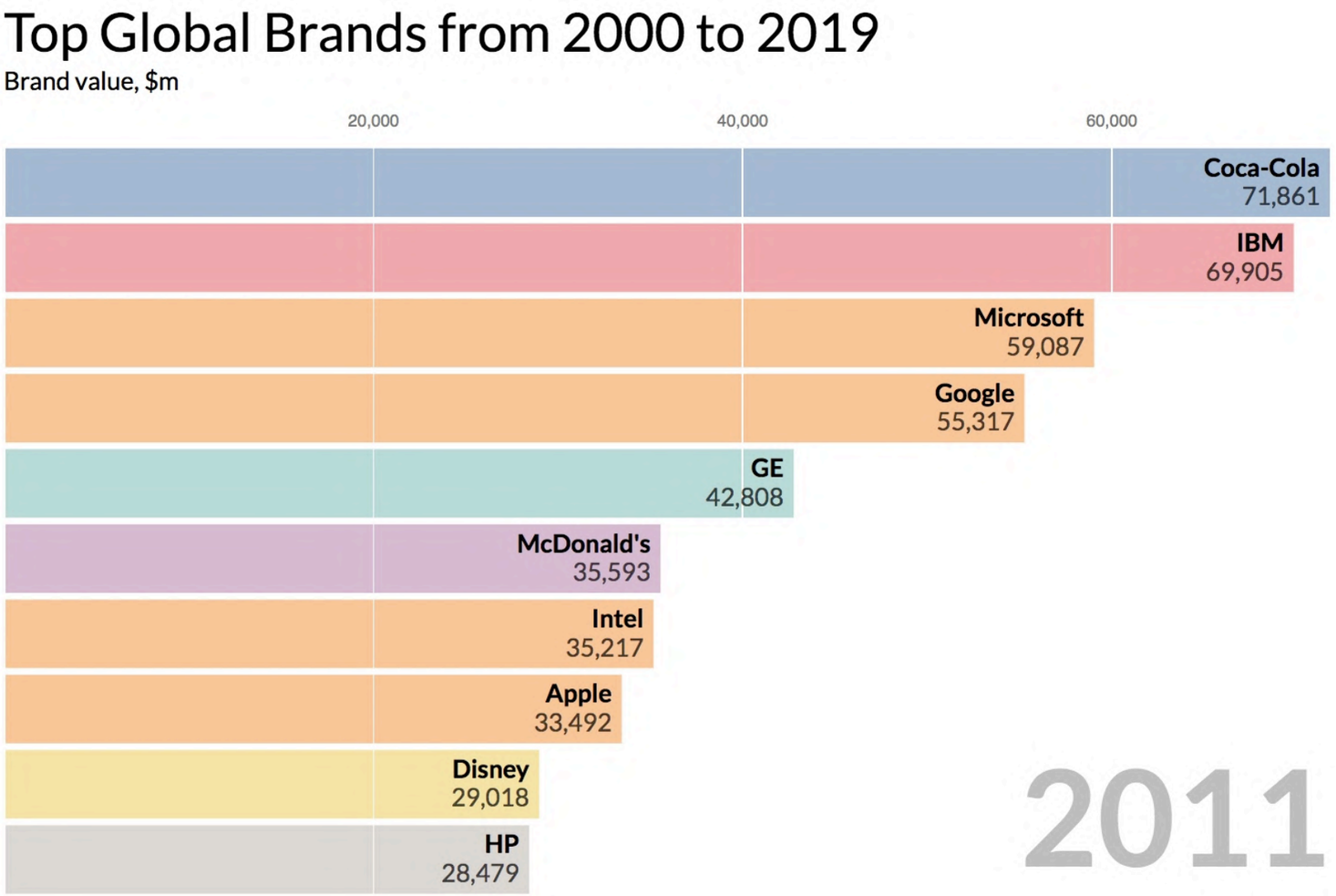
2011



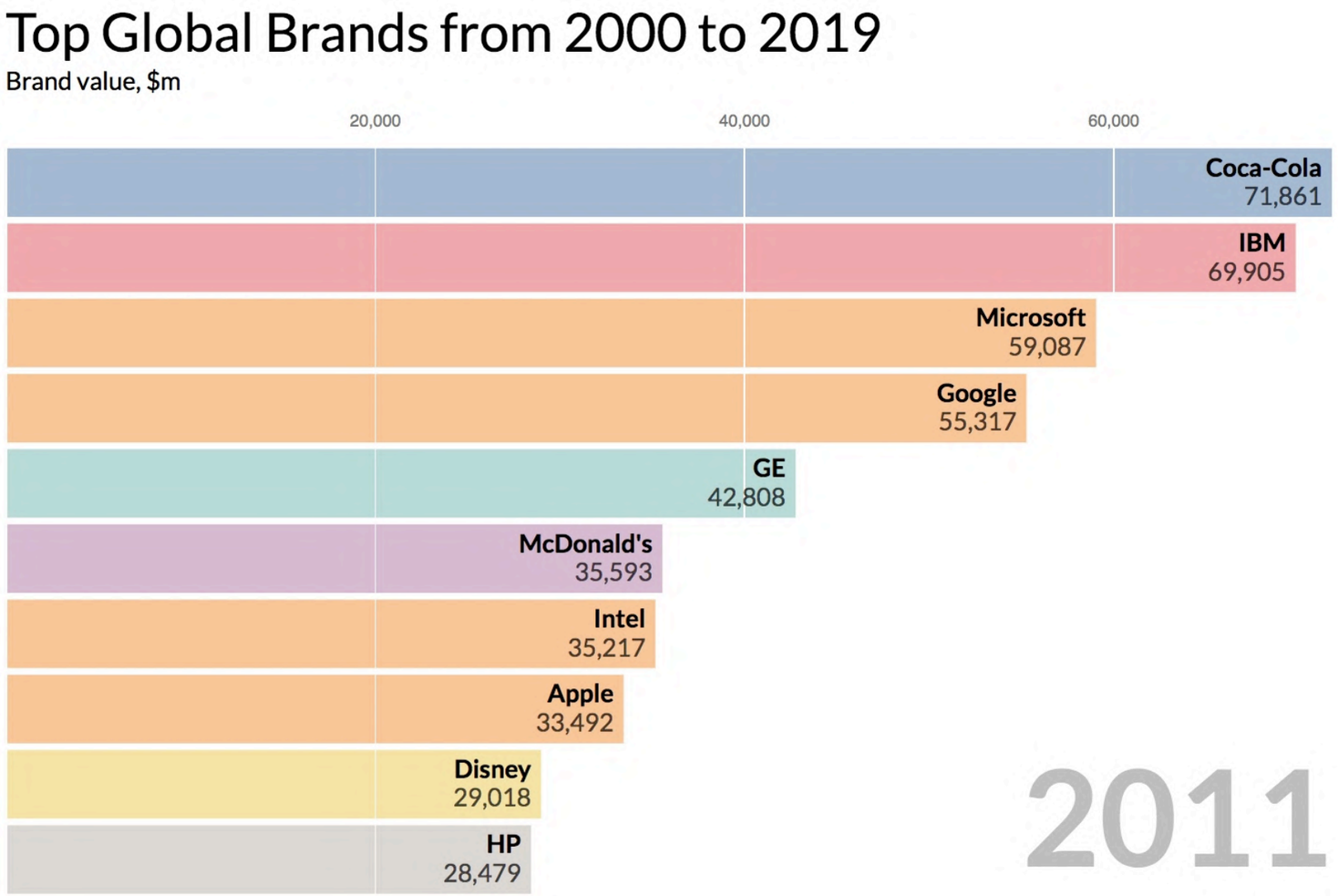
(Implicit: **De-emphasis**)

2011

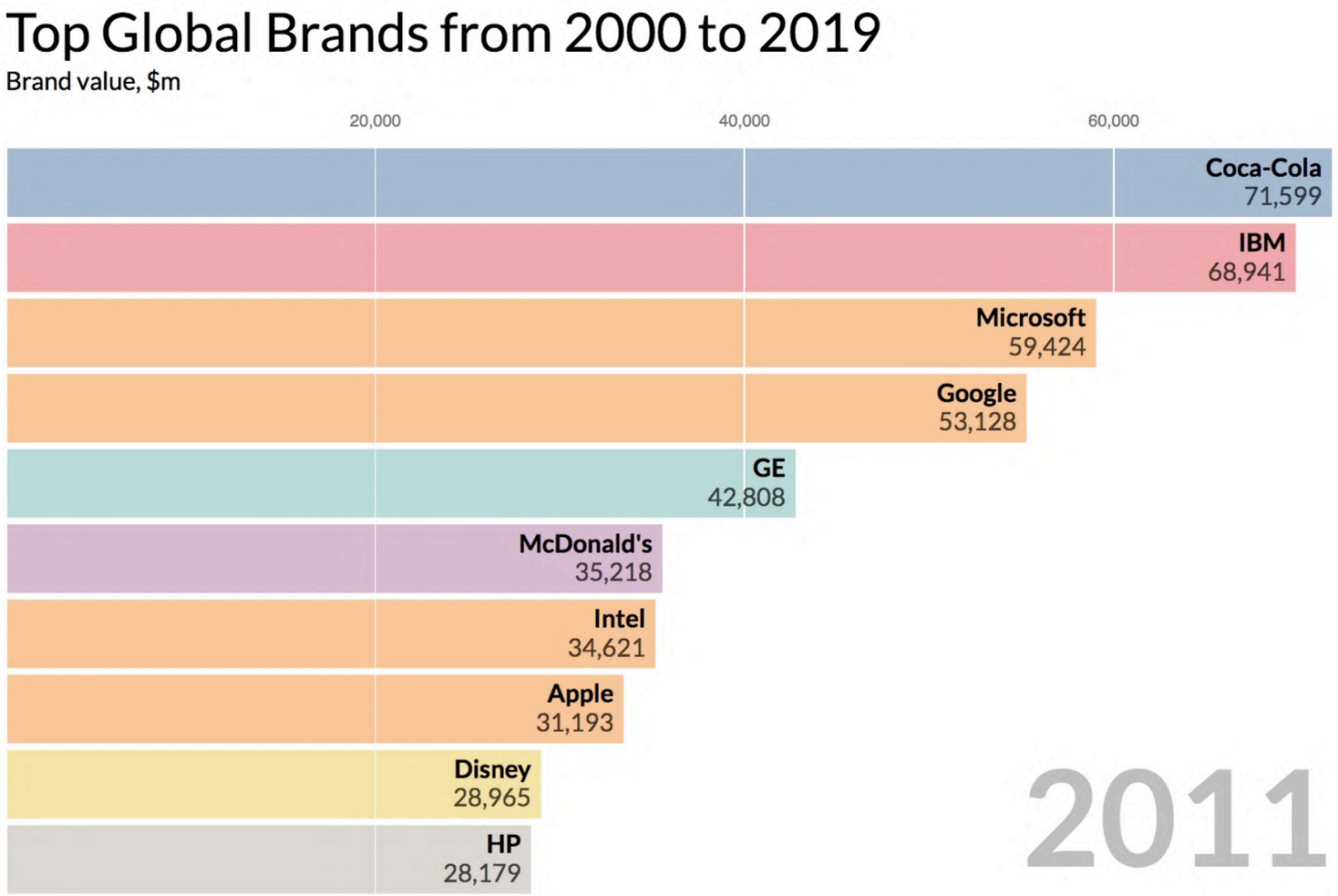
Explicit: Prologue



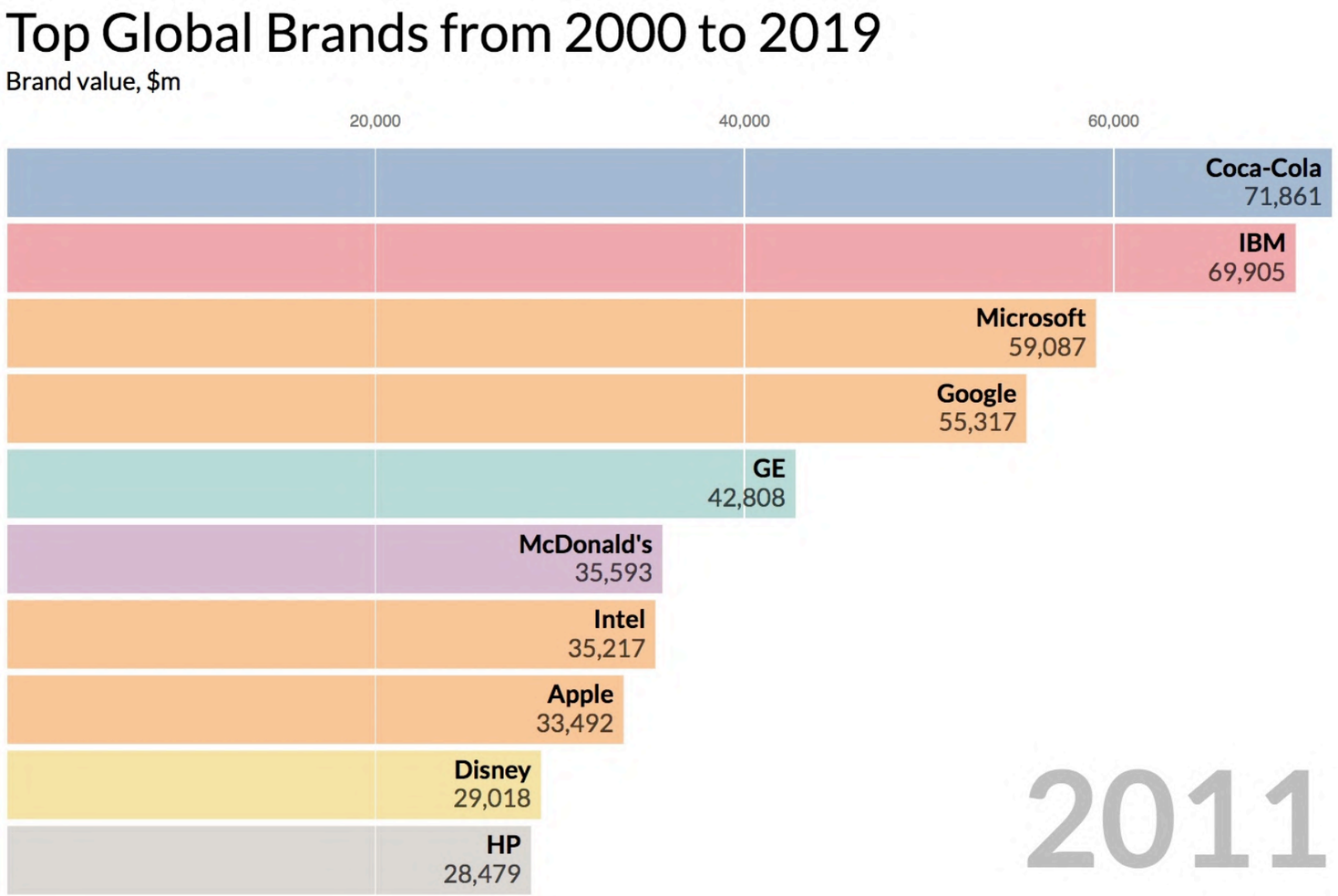
Explicit: Pre-scene



Implicit: Contour



Implicit: De-emphasis



Proof-of-concept Authoring Tool

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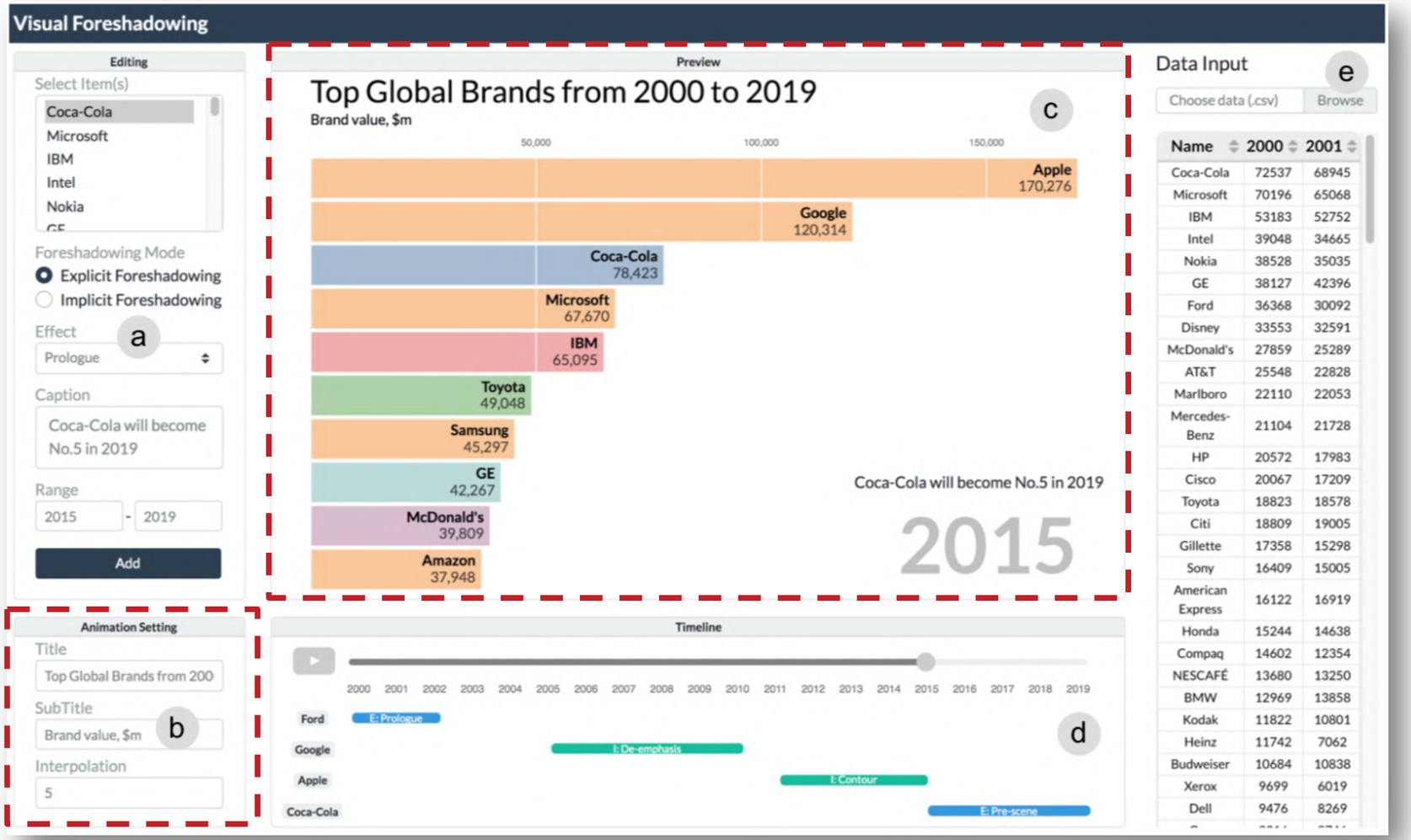
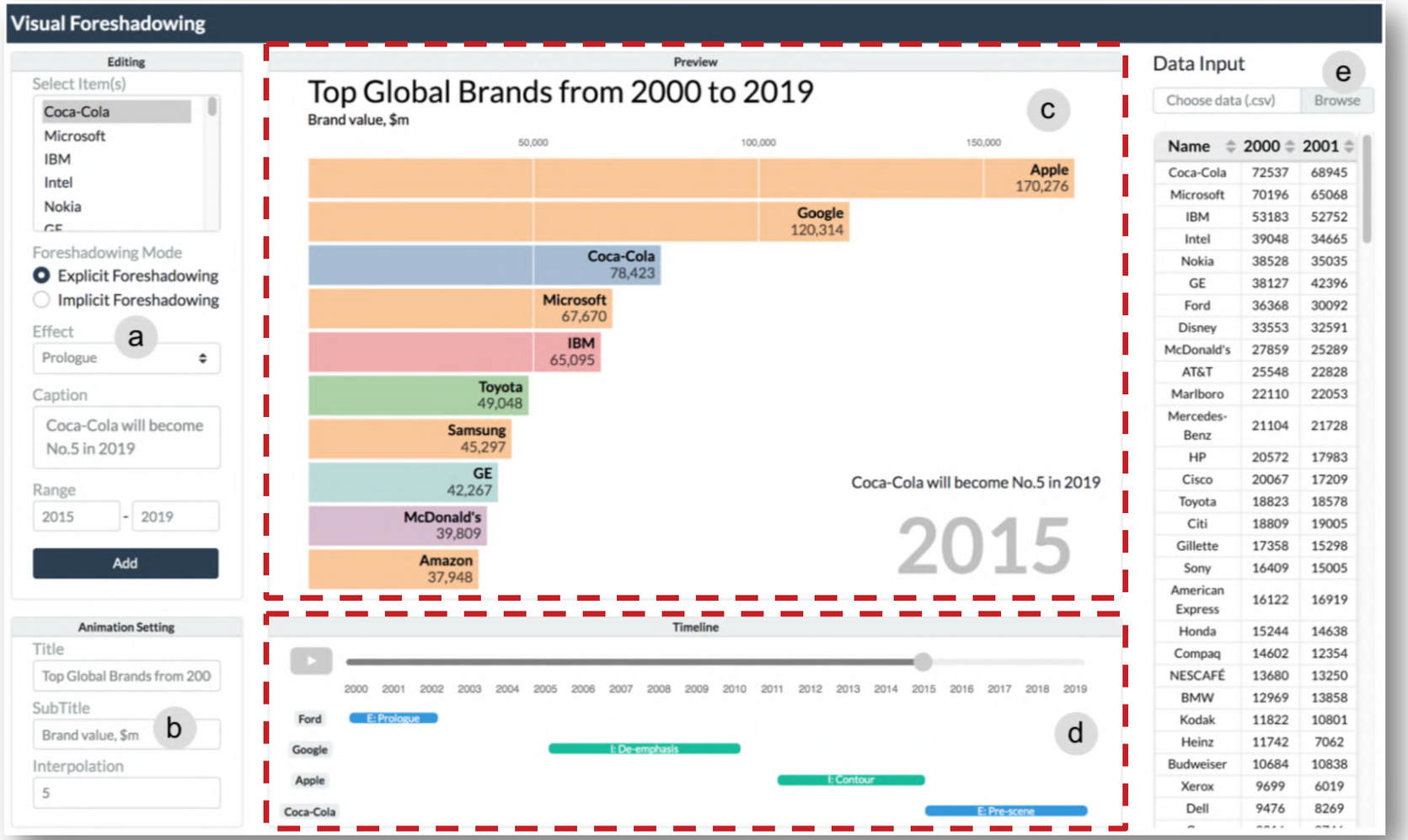
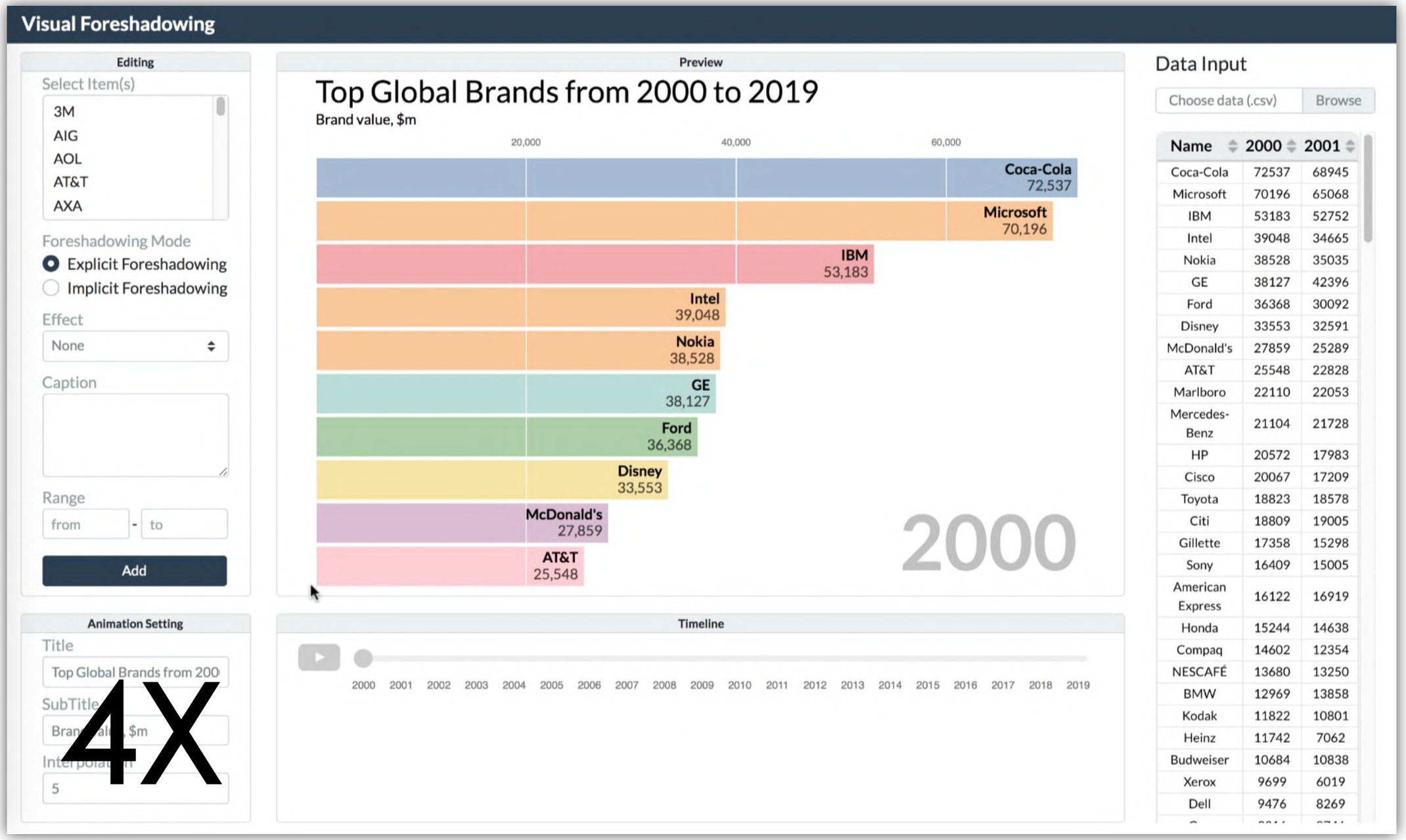
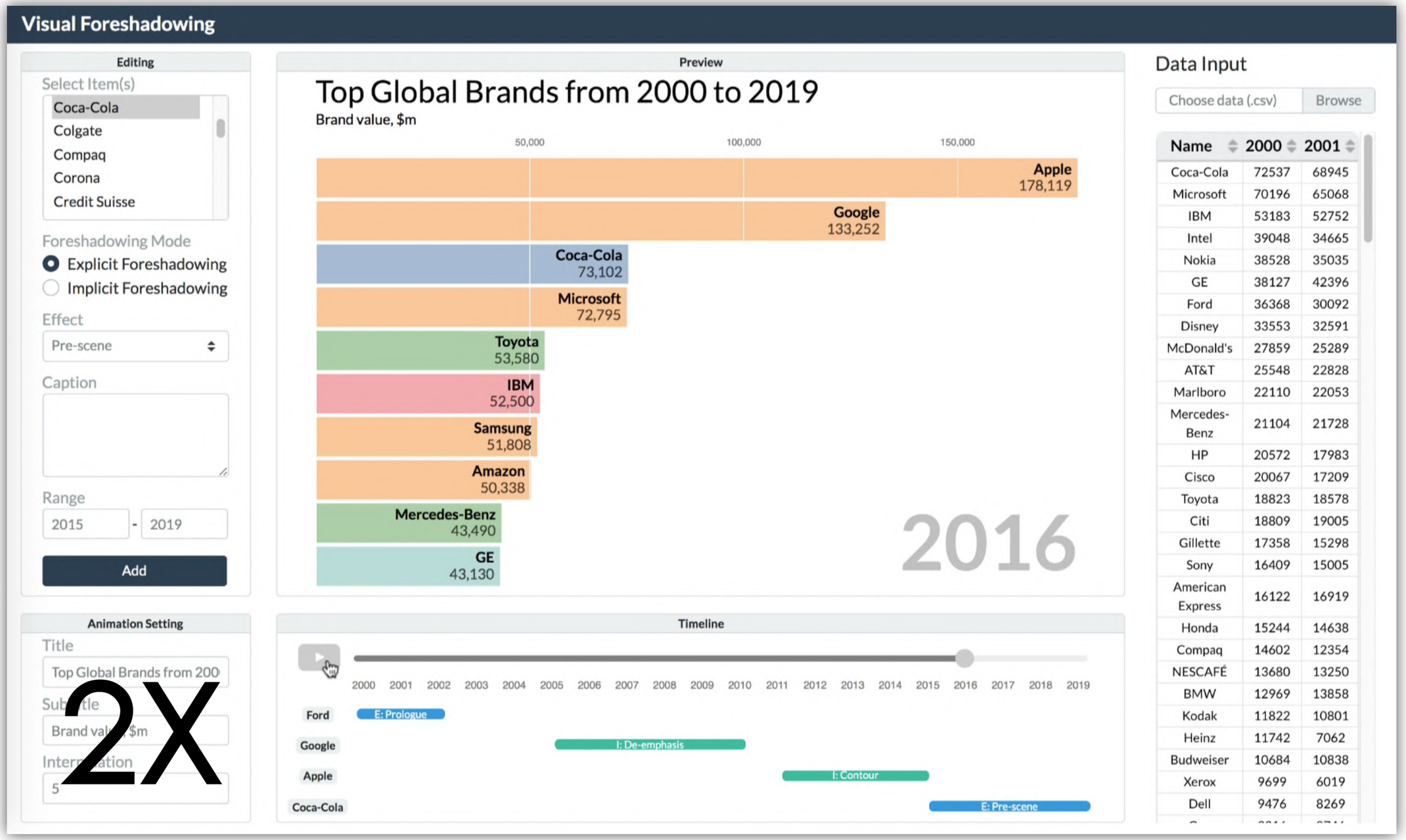


Proof-of-concept Authoring Tool

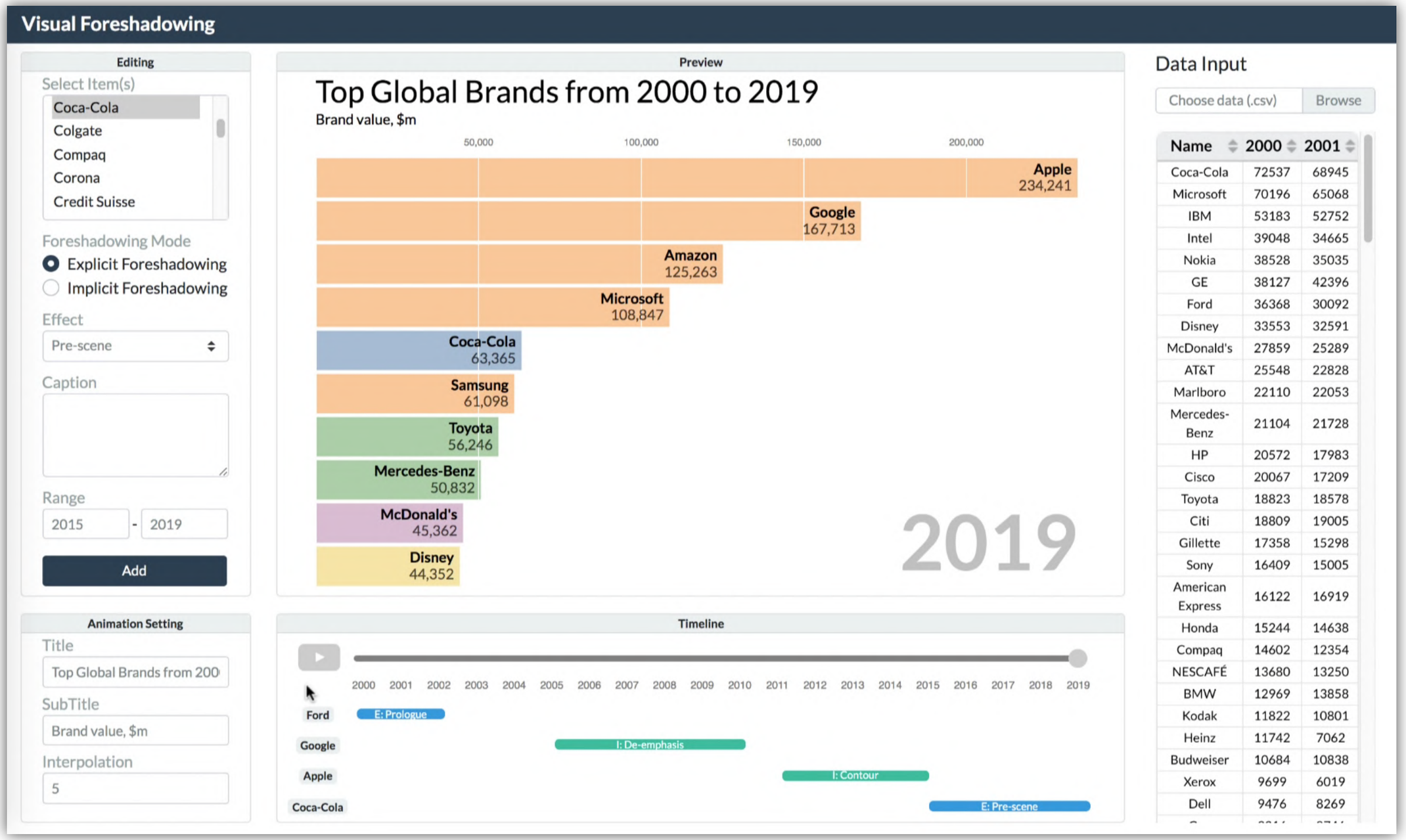


Proof-of-concept Authoring Tool


Visual Foreshadowing
Editing
Select Item(s)
3M
AIG
AOL
AT&T
AXA
Foreshadowing Mode
Explicit Foreshadowing
Implicit Foreshadowing
Effect
None
Caption
Range
from
to
Add
Animation Setting
Title
Top Global Brands from 200
SubTitle
$m
5
4X
Preview
Top Global Brands from 2000 to 2019
Brand value, $m
20,000
40,000
60,000
Coca-Cola 72,537
Microsoft 70,196
IBM 53,183
Intel 39,048
Nokia 38,528
GE 38,127
Ford 36,368
Disney 33,553
McDonald's 27,859
AT&T 25,548
2000
Timeline
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Data Input
Choose data (.csv)
Browse
Name 2000 2001
Coca-Cola 72537 68945
Microsoft 70196 65068
IBM 53183 52752
Intel 39048 34665
Nokia 38528 35035
GE 38127 42396
Ford 36368 30092
Disney 33553 32591
McDonald's 27859 25289
AT&T 25548 22828
Marlboro 22110 22053
Mercedes-Benz 21104 21728
HP 20572 17983
Cisco 20067 17209
Toyota 18823 18578
Citi 18809 19005
Gillette 17358 15298
Sony 16409 15005
American Express 16122 16919
Honda 15244 14638
Compaq 14602 12354
NESCAFÉ 13680 13250
BMW 12969 13858
Kodak 11822 10801
Heinz 11742 7062
Budweiser 10684 10838
Xerox 9699 6019
Dell 9476 8269



Name	2000	2001
Coca-Cola	72537	68945
Microsoft	70196	65068
IBM	53183	52752
Intel	39048	34665
Nokia	38528	35035
GE	38127	42396
Ford	36368	30092
Disney	33553	32591
McDonald's	27859	25289
AT&T	25548	22828
Marlboro	22110	22053
Mercedes-Benz	21104	21728
HP	20572	17983
Cisco	20067	17209
Toyota	18823	18578
Citi	18809	19005
Gillette	17358	15298
Sony	16409	15005
American Express	16122	16919
Honda	15244	14638
Compaq	14602	12354
NESCAFÉ	13680	13250
BMW	12969	13858
Kodak	11822	10801
Heinz	11742	7062
Budweiser	10684	10838
Xerox	9699	6019
Dell	9476	8269


Visual Foreshadowing
Editing
Select Item(s)
Coca-Cola
Colgate
Compaq
Corona
Credit Suisse
Foreshadowing Mode
Explicit Foreshadowing
Implicit Foreshadowing
Effect
Pre-scene
Caption
Range
2015
2019
Add
Preview
Top Global Brands from 2000 to 2019
Brand value, $m
50,000
100,000
150,000
200,000
Apple 234,241
Google 167,713
Amazon 125,263
Microsoft 108,847
Coca-Cola 63,365
Samsung 61,098
Toyota 56,246
Mercedes-Benz 50,832
McDonald's 45,362
Disney 44,352
2019
Data Input
Choose data (.csv)
Browse
Name 2000 2001
Coca-Cola 72537 68945
Microsoft 70196 65068
IBM 53183 52752
Intel 39048 34665
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Animation Setting
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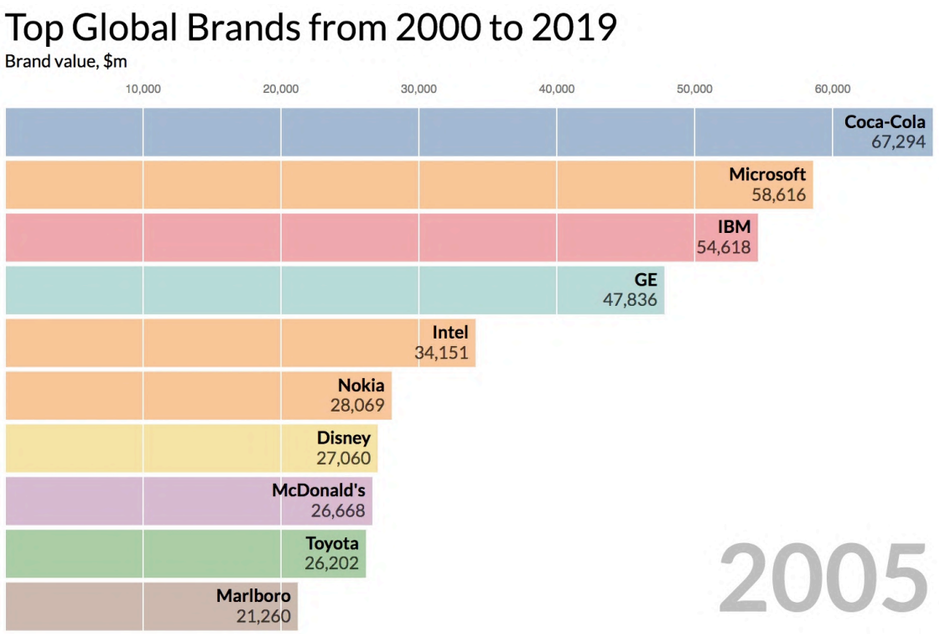
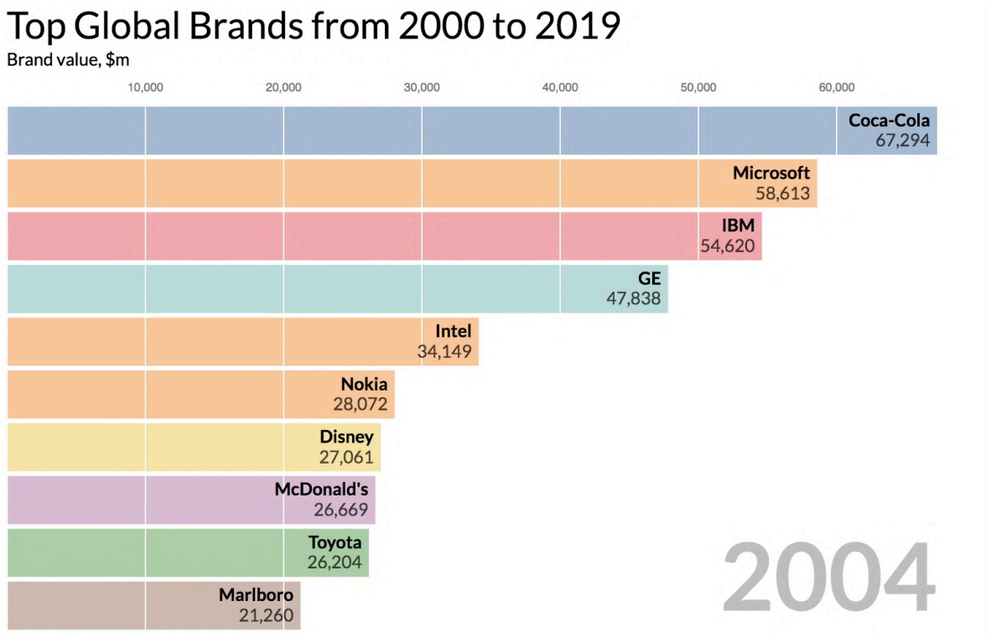
Top Global Brands from 200
SubTitle
Brand value, $m
Interpolation
5
Timeline
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ford
E: Prologue
Google
I: De-emphasis
Apple
I: Contour
Coca-Cola
E: Pre-scene

User Study



VS.



With foreshadowing

Without foreshadowing

Study Design

- 12 Participants (5 males and 7 females; aged 20 - 27)
- 2 different ranking animated visualizations
- 2 visual foreshadowing settings (**with** and **without**)

Study Design

- A **survey** consists of **12** questions (referenced from previous study [1])
- A semi-structured **interview** for collecting feedback
- **20** minutes to complete the whole study

[1] Amini et al., Hooked on data videos: assessing the effect of animation and pictographs on viewer engagement, AVI 2018.

Study Results

- Average ratings of the user engagement survey questions (7-point Likert scale)

Assessment	Foreshadowing	Mean	SD
Enjoyment	Without	4.13	0.61
	With	6.54	0.54
Focused Attention	Without	3.71	1.03
	With	6.17	0.72
Cognitive Involvement	Without	4.50	1.04
	With	6.04	0.58

- Interview feedback

"The additional visual effects are useful and make the animation more like a story. Otherwise, I don't know where to look at and forget almost all the changes."

Conclusion

- Visual Foreshadowing (**explicit** and **implicit**)
- A proof-of-concept animated visualization **authoring tool**
- **Initial evaluation** on improving engagement for animated visualization

Future work

- Future extensions of visual foreshadowing
  - Visual effects
  - Animated visualization types

Future work

- Future extensions of visual foreshadowing
  - **Visual effects**
  - Animated visualization **types**
- In-depth Investigation on Effectiveness
  - Which is the most effective **visual foreshadowing design**?
  - Which is the most effective **setting** (in terms of timing and duration)?
  - …

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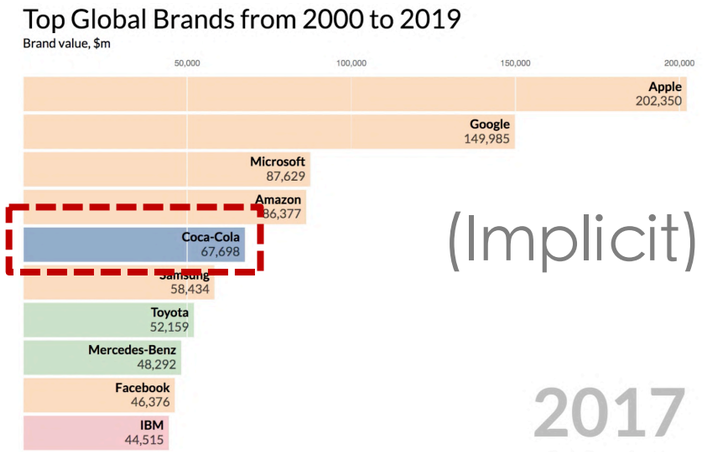
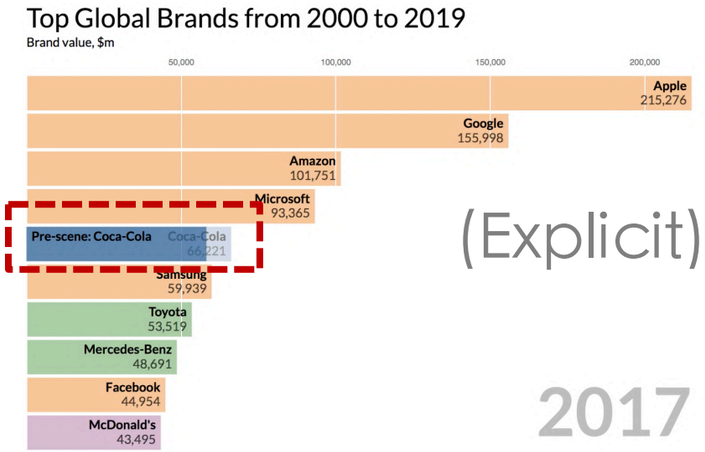
THANK YOU!

Improving Engagement of Animated Visualization with Visual Foreshadowing



(Implicit)

2017



(Explicit)

2017

Wenchao Li

wenchao.li@connect.ust.hk