ASSESSING THE READABILITY OF STACKED GRAPHS
STACKED GRAPHS
EVOLUTION OF STACKED GRAPHS

Stacked Area Chart

Themeriver

Streamgraph
INFORMATION LEVELS

Elementary

INFORMATION LEVELS

Elementary

Intermediate

INFORMATION LEVELS

Elementary

Intermediate

INFORMATION LEVELS

Elementary

Intermediate

Global

INFORMATION LEVELS

Elementary

Intermediate

Global

STREAM (STREAM)

INTERACTIVE STACKED GRAPH (INT)
DATASETS

Random | 30 time-series | 30 time-points

311 Calls in NYC (Calls) | 10 time-series | 35 time-points

Box Office Revenue Dataset (Movies) | 300 time-series | 20 time-points
The following graph represents a music listening history. Each stream shows the number of listeners for one artist over time. Which is larger: the number of listeners of Artist 1 at A or Artist 2 at B?

Answer: A

The following graph represents a music listening history. Each stream shows the number of listeners for one artist over time. This area chart represents the number of listeners for one artist. In the graph below, which stream represents the same artist?

Answer: A

The following graph represents a music listening history. Each stream shows the number of listeners for one artist over time. Is the combined number of listeners for all artists larger at A or B?

Answer: A
I. INDIVIDUAL DISCRIMINATION

Which is larger: the value of the blue time-series at A or the value of the yellow time-series at B?
II. STREAM COMPARISON

The following area chart represents [time-series data]. In the graph below, which stream represents the same [time-series]?
III. AGGREGATE DISCRIMINATION

Is the combined value of all time-series larger at A or at B?
HYPOTHESES

H1: Correctness for Aggregated Discrimination (III):

STACK > THEME > STREAM

More Correct > Less Correct
HYPOTHESES

H2: Correctness for *Individual Discrimination (I)* and *Stream Comparison (II)*:

INT > STREAM > THEME > STACK

More Correct Less Correct
HYPOTHESES

H3: Completion Time for all tasks:

STACK

THEME

STREAM

Faster

INT

Slower
16 PARTICIPANTS

9 male, 5 female, 2 did not specify
18–65 years
various occupations
The following graph represents a music listening history. Each stream shows the number of listeners for one artist over time. This area chart represents the number of listeners for one artist. In the graph below, which stream represents the same artist? Click on a stream to select it.
STUDY DESIGN

within-subjects design

balanced 4x4 Latin square

training with all tasks for each condition

4 cond × 3 tasks x 3 datasets = 36 trials
The following graph represents a music listening history.
Which is **larger**: the number of listens of

- A
- B

Answer: [ ] Listens

Got it!

---

Please indicate approximately **how often** you use the following choice:

- **Technology**
  - never
  - a few times
  - very often
  - always
  - [ ] never
  - [ ] a few times
  - [ ] very often
  - [ ] always

- **Computers**
  - [ ] 1
  - [ ] 2

- **Internet**
  - [ ] 1
  - [ ] 2

- **Visualizations**
  - [ ] 1
  - [ ] 2

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**Demographic Information**

This information is collected for demographic purposes only. All questions are voluntary.

- **Age**
  - [ ] 18-25
  - [ ] 26-35
  - [ ] 36-45
  - [ ] 46+  

- **Gender**
  - [ ] Male
  - [ ] Female

Please indicate the **highest** level of education you have completed:

- [ ] High school or equivalent
- [ ] Bachelor's degree
- [ ] Master's degree
- [ ] Other
- [ ] Vocational/Technical school (2 year)
- [ ] Doctorate
EFFECT SIZES

strong & large effect

strong & small effect
EFFECT SIZES

weak & large effect

weak & small effect
INDIVIDUAL DISCRIMINATION
INDIVIDUAL DISCRIMINATION

Correctness

STREAM

THEME

More Correct

INT

STACK

Less Correct

Strong & small effect
INDIVIDUAL DISCRIMINATION

Completion Time

STACK > STREAM

Strong & small effect

Faster

INT

Slower
STREAM COMPARISON

Correctness

Strong & small effect > Strong & small effect > Weak & large effect

More Correct  Less Correct
STREAM COMPARISON

Completion Time

Strong & small effect

Weak & small effect

Weak & small effect

STACK

THEME

STREAM

Faster

Slower
AGGREGATE DISCRIMINATION
AGGREGATE DISCRIMINATION

Correctness

STREAM > THEME

Strong & small effect

More Correct

Less Correct
AGGREGATE DISCRIMINATION

Correctness

STREAM: Strong & small effect

INT: Strong & small effect

THEME: More Correct

STACK: Less Correct
AGGREGATE DISCRIMINATION

✓ Correctness

STREAM  THEME  INT  STACK

≈ 100% Correctness
AGGREGATE DISCRIMINATION

Completion Time

STACK > THEME

Strong & small effect

Faster

Slower
AGGREGATE DISCRIMINATION

**Completion Time**

STACK (Strong & small effect) > THEME (Strong & large effect) > STREAM (Strong & large effect) > INT (Strong & small effect)

- Faster
- Slower
AGGREGATE DISCRIMINATION

Completion Time

STACK

Strong & large effect

STREAM

Faster

INT

Slower

Strong & large effect
IMPLICATIONS
WHEN TO USE WHICH STACKED GRAPH?

STREAM for elementary and global level tasks with static graph
WHEN TO USE WHICH STACKED GRAPH?

STREAM for elementary and global level tasks with static graph

INT for intermediate and global level tasks
WHEN TO USE WHICH STACKED GRAPH?

STREAM for elementary and global level tasks with static graph

INT for intermediate and global level tasks

STACK did not provide advantage, but perceived as pleasing and easy to read
OTHER IMPLICATIONS

Theoretical Models

can work to predict perceptual advantages

do not show extent of advantages
OTHER IMPLICATIONS

Theoretical Models

- can work to predict perceptual advantages
- do not show extent of advantages

Interaction

- can be used for mitigating perceptual difficulties
- avoid increasing memory load
THANK YOU!

Project Page: http://j.mp/stackedgraphs