

EXPLICITLY REPRESENTING CHANGE IN ANIMATED MAPS

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introduction

motivation . animated maps . change

background

bivariates . question . SAT . symbols

design

data . maps . tasks

experiment

build . pilot . main

results

preliminary

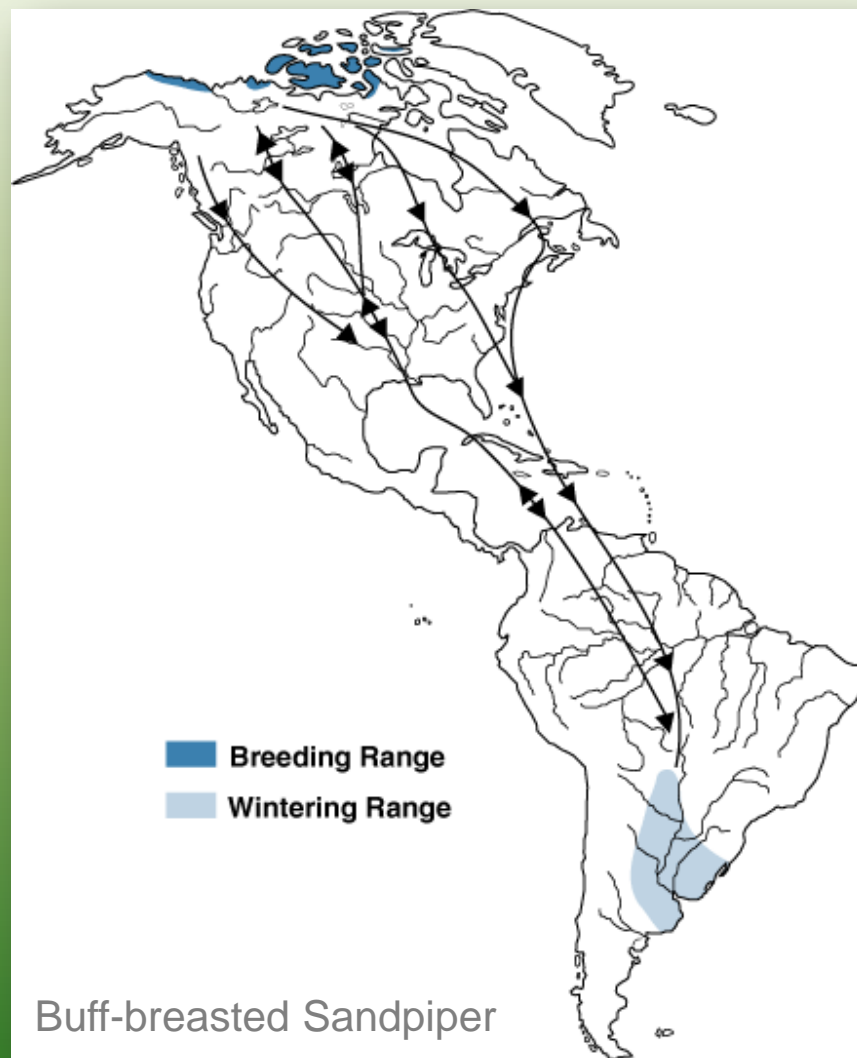
impacts

recommendations . outcomes

questions

?

motivation



(Lanctot and Laredo 1994)

What is the best way to visualize bird migration?

animated maps

...must create a sense of **motion**.

“Humans are particularly sensitive to motion.” (MacEachren 1995)

“motion is indeed an attention-focusing characteristic of visual displays” (Griffin et. al. 2006)

“To animate is to create the illusion of movement.” (Dorling 1992)

INHERENT CHOICE ?

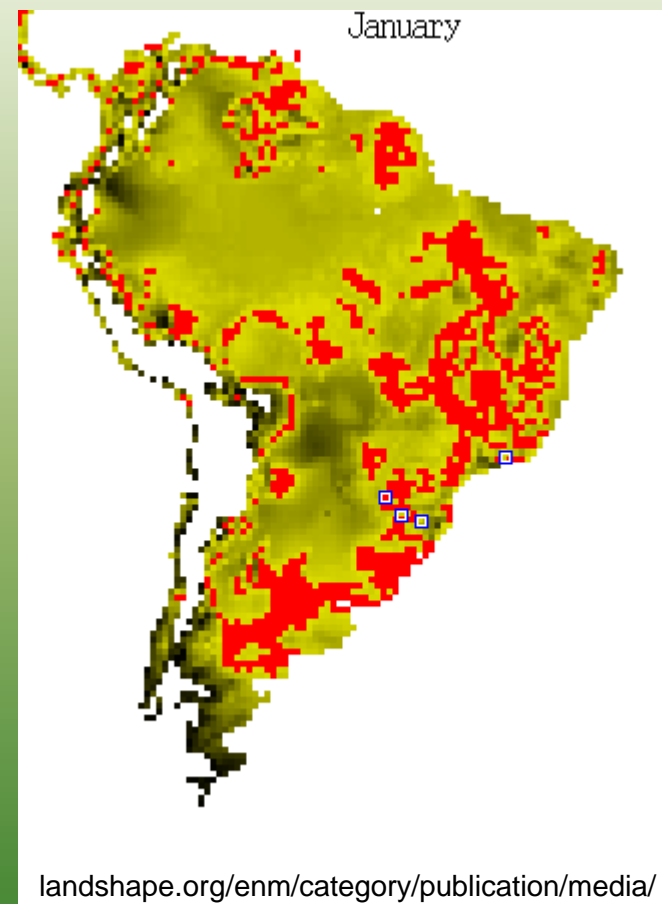
animated maps

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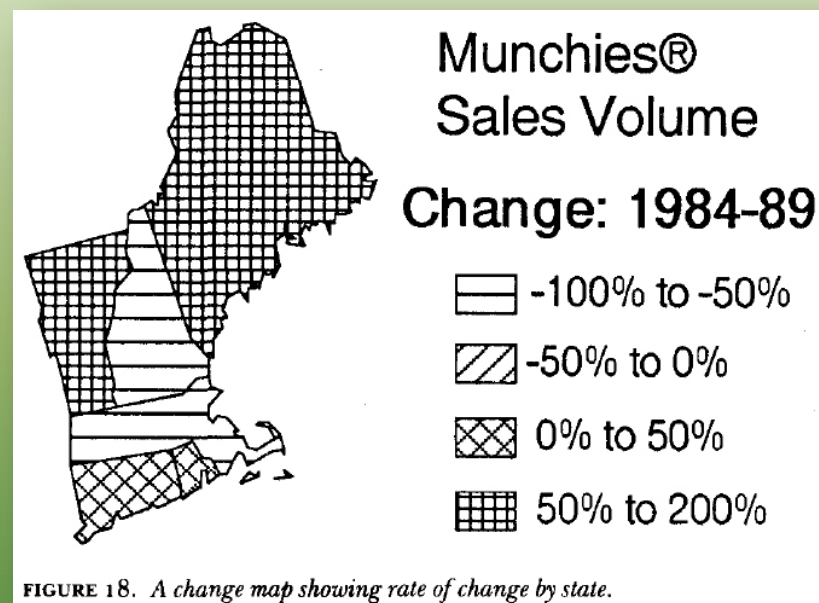
INHERENT CHOICE  MAP ANIMATIONS

change

...must also create a sense of change.

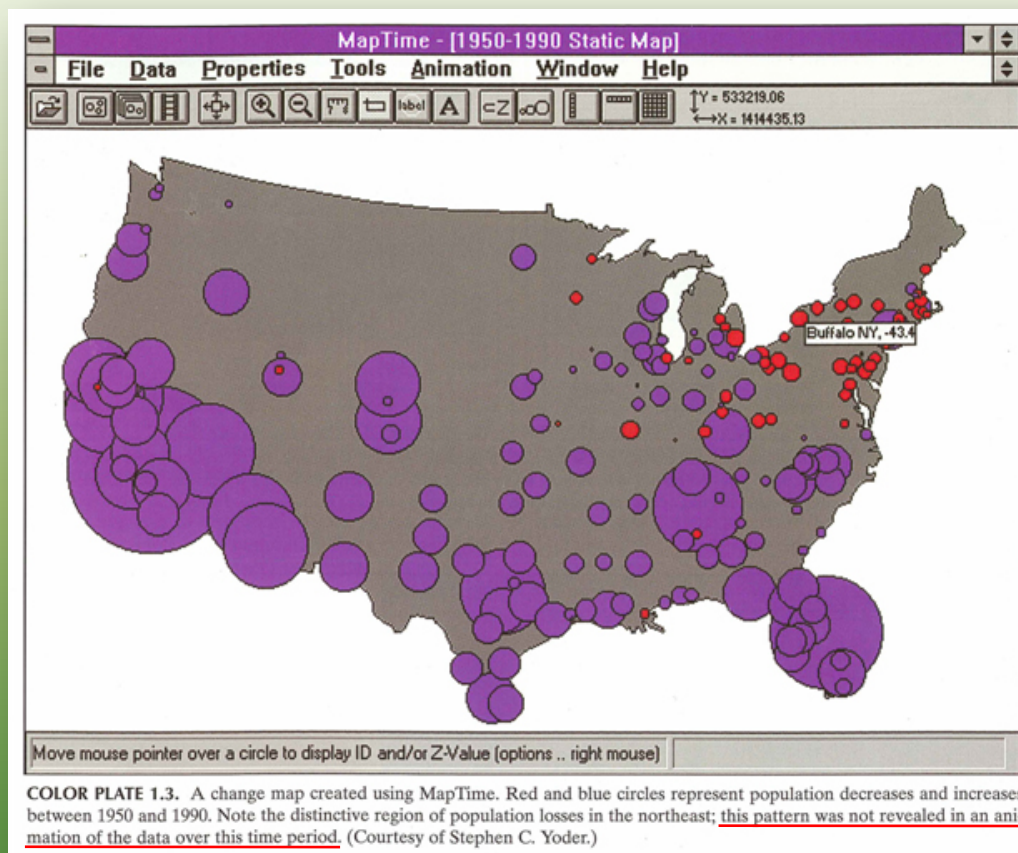
“Animated maps aid in the identification of change.” (Blok 1999)

“...the visual representation of change is a fundamental challenge for cartography.” (Harrower 2002)



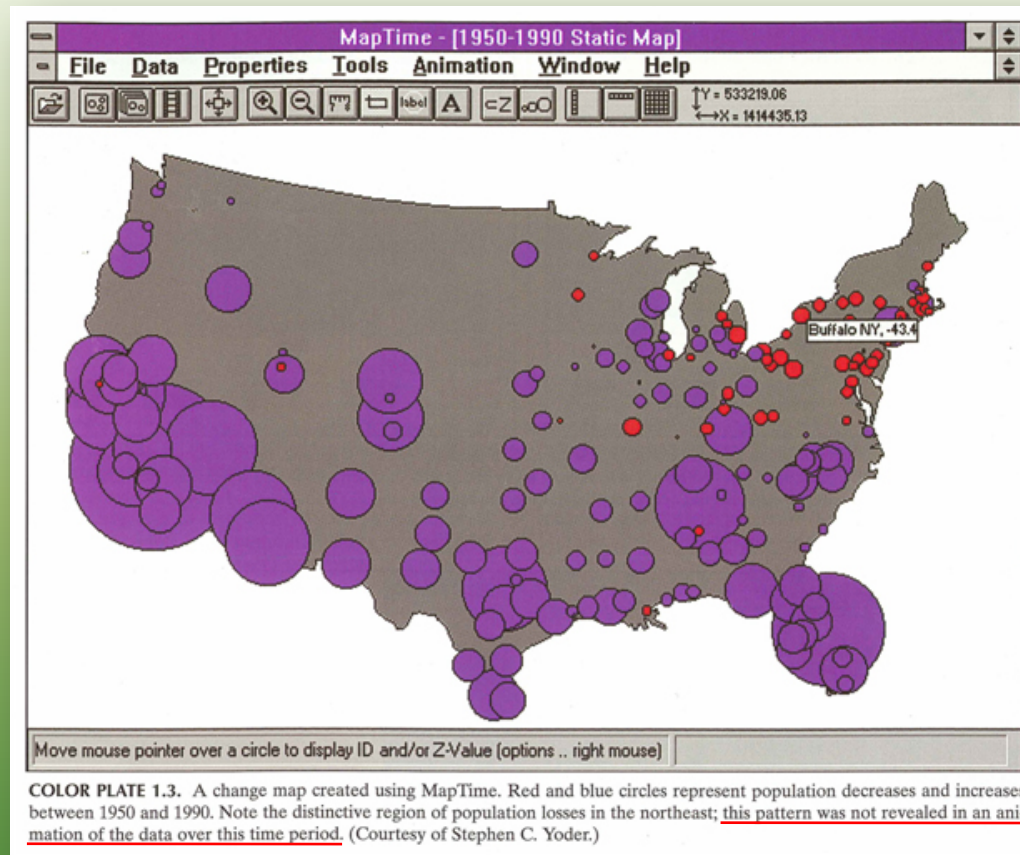
(Monmonier 1990)

bivariates



“...this pattern was not revealed in an animation of the data over this time period.” (Slocum 1999)

bivariates



“...this pattern was not revealed in an animation of the data over this time period.” (Slocum 1999)

SOLUTION

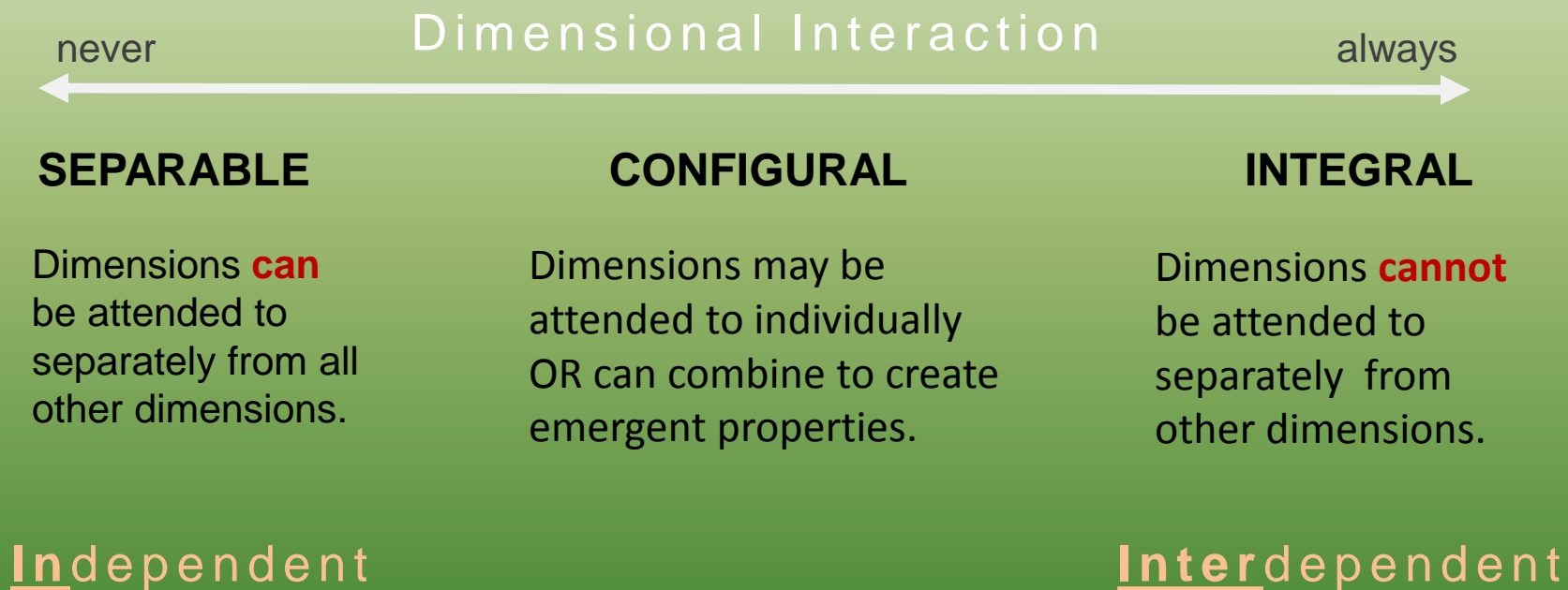
“...proposed shading the interior of the circle to represent the degree of change.” (Slocum 2000)

question

Does explicitly representing both the *magnitude of temporal point data* and the *magnitude of change* between frames in the data of an **animated** geographic time-series enable users to quickly, easily and accurately answer questions about **patterns of change**?

selective attention theory

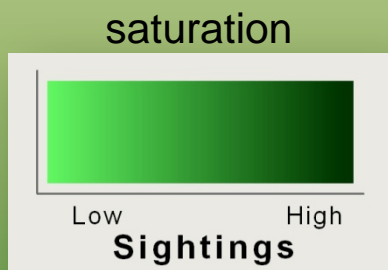
Definition : "...a way of measuring the perceptual grouping of features in a visual image." (Nelson 2000)



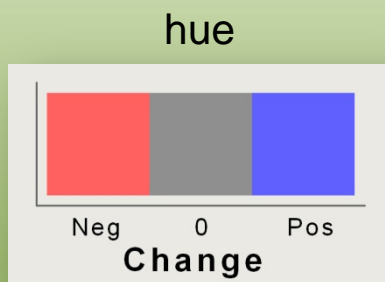
symbols

UNIVARIATE

NON-CHANGE

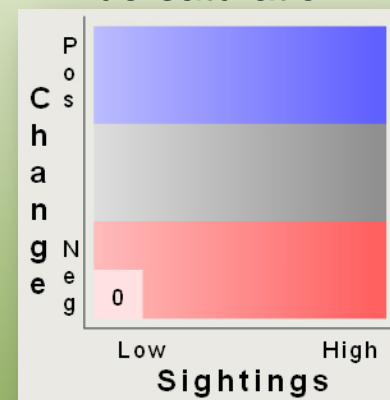


CHANGE



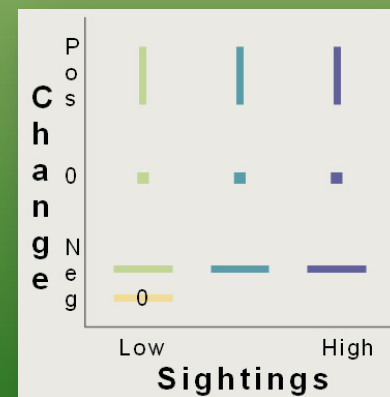
BIVARIATE

hue-saturation



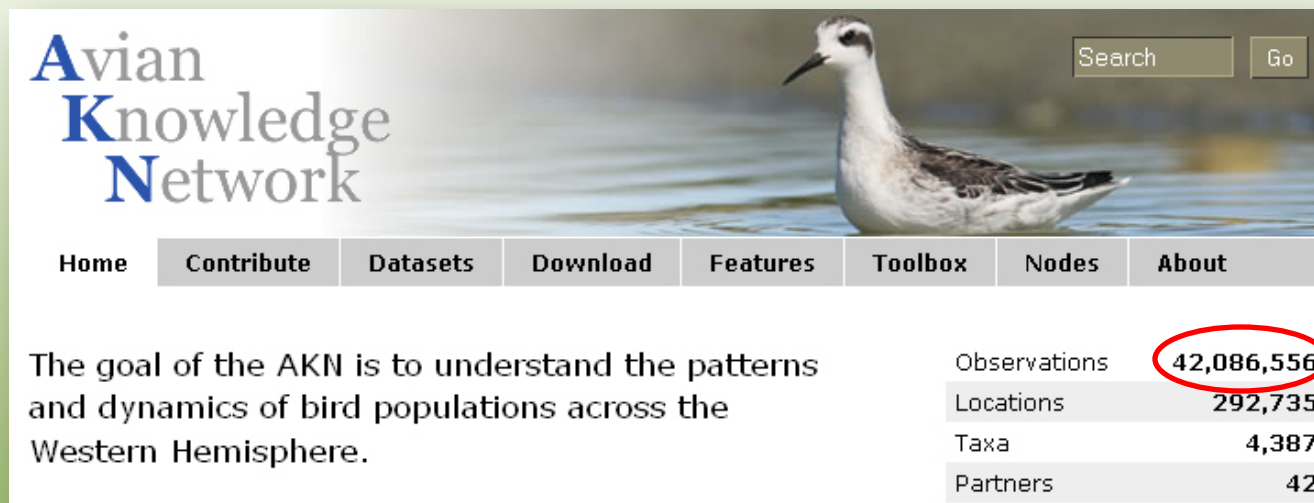
Integral

Separable



orientation-hue

data



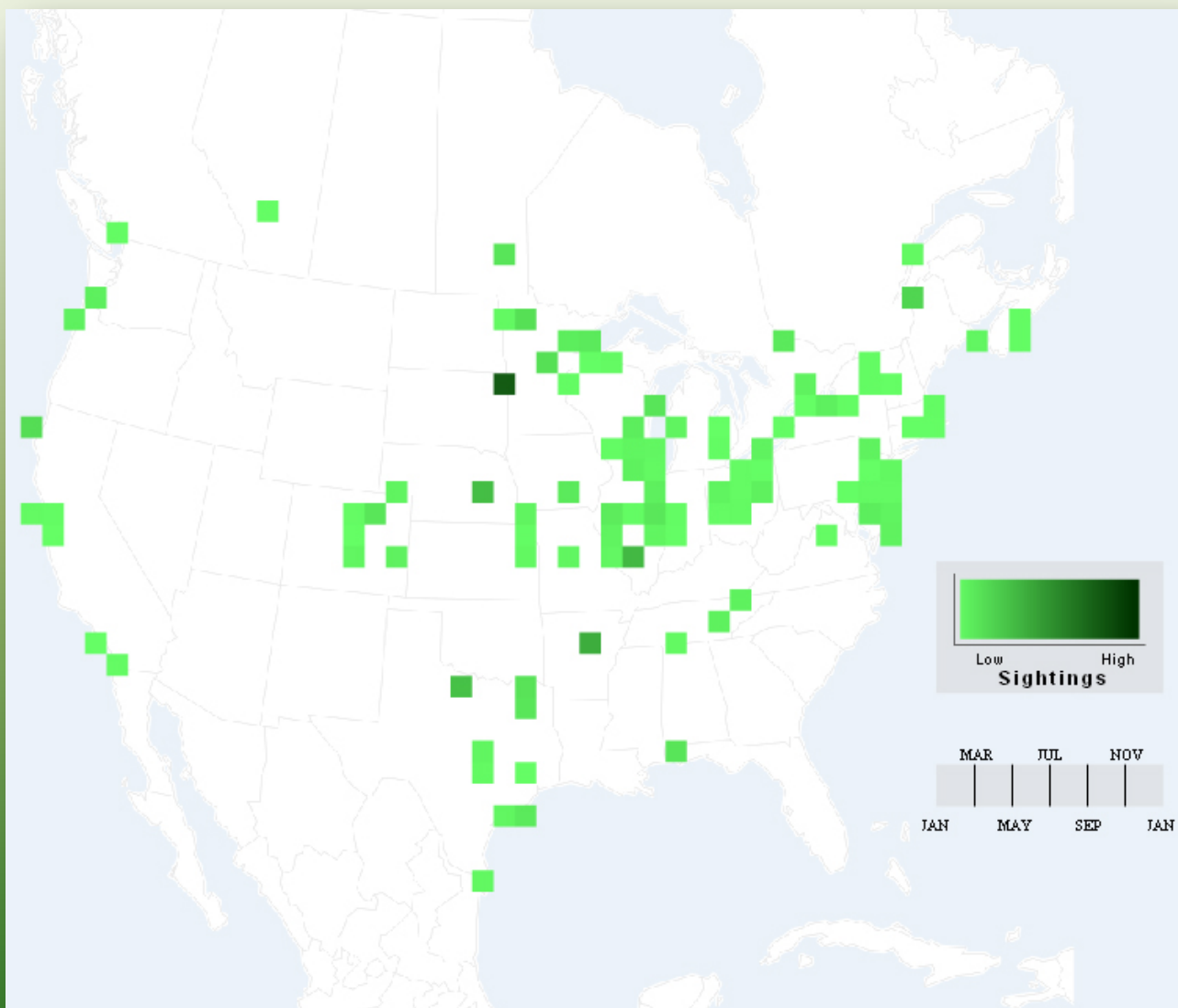
The goal of the AKN is to understand the patterns and dynamics of bird populations across the Western Hemisphere.

Observations	42,086,556
Locations	292,735
Taxa	4,387
Partners	42



AGGREGATE

data



maps

DESIGN ELEMENTS

Legend: Unclassified

Temporal Legend: Linear (with “Rewinding” screen)

Spatial Extent: Lower 48 & S. Canada

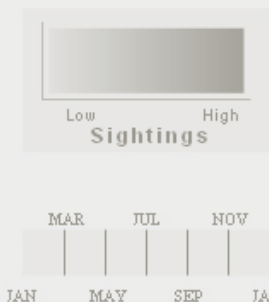
Spatial Resolution: 100km grid cells

Temporal Extent: One Year

Temporal Resolution: One Week

Temporal Smoothing: [0.2 / 0.6 / 0.2]

Frame Rate: 500ms/frame (2 fps)



tasks

Four categories of tasks about...

...trend in **Value**

(number of sightings per location)

"Over time, the trend in the number of bird sightings at initial locations is INCREASING."

...trend in **Geography**

(number of locations)

"Over time, the trend in the number of locations with bird sightings is DECREASING."

...trend in **Change**

(number of locations showing positive change)

"Over time, the trend in the number of locations showing POSITIVE CHANGE is REMAINING ABOUT THE SAME."

...focus on Value **vs.** Geography

(more increase in value, geography, or are they equal)

"Over time, there is more increase in NUMBER OF SIGHTINGS PER LOCATION than in NUMBER OF LOCATIONS."

build

SURVEY ORDER

Legend & Format Info

Pre-test (3)

Practice Animations (4)

Main Animations (24)

Balanced Latin Squares

Six of each Task

Half Agree/Half Disagree

Data Collection

Age

Sex

Cartography?

Birder?

GROUPS

Each participant put into one of five groups.

Univariate Non-Change

Univariate Change (Hue)

Univariate Change (Orientation)

Bivariate Integral

Bivariate Separable

DATA

For each animation rank...

Agreement (0 – 10)

As “Difference”

Certainty (0 – 10)

Reaction Time recorded

Entire survey coded from scratch in Adobe ActionScript 3.0 for Flash.

build

Adobe Flash Player 9


File View Control Help

Pre-Test 1 (of 3) - Question 1 (of 1)

Please read the statement below and click the letter for the answer that you believe best completes the statement and then click submit.

Over time, the trend in the number of bird sightings is:

CLICK TO START



SUBMIT

build

Adobe Flash Player 9

File View Control Help

Pre-Test 1 (of 3) - Question 1 (of 1)



Please read the statement below and click the letter for the answer that you believe best completes the statement and then click submit.

Over time, the trend in the number of bird sightings is:

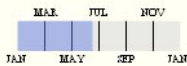
A INCREASING

B DECREASING

C ABOUT THE SAME



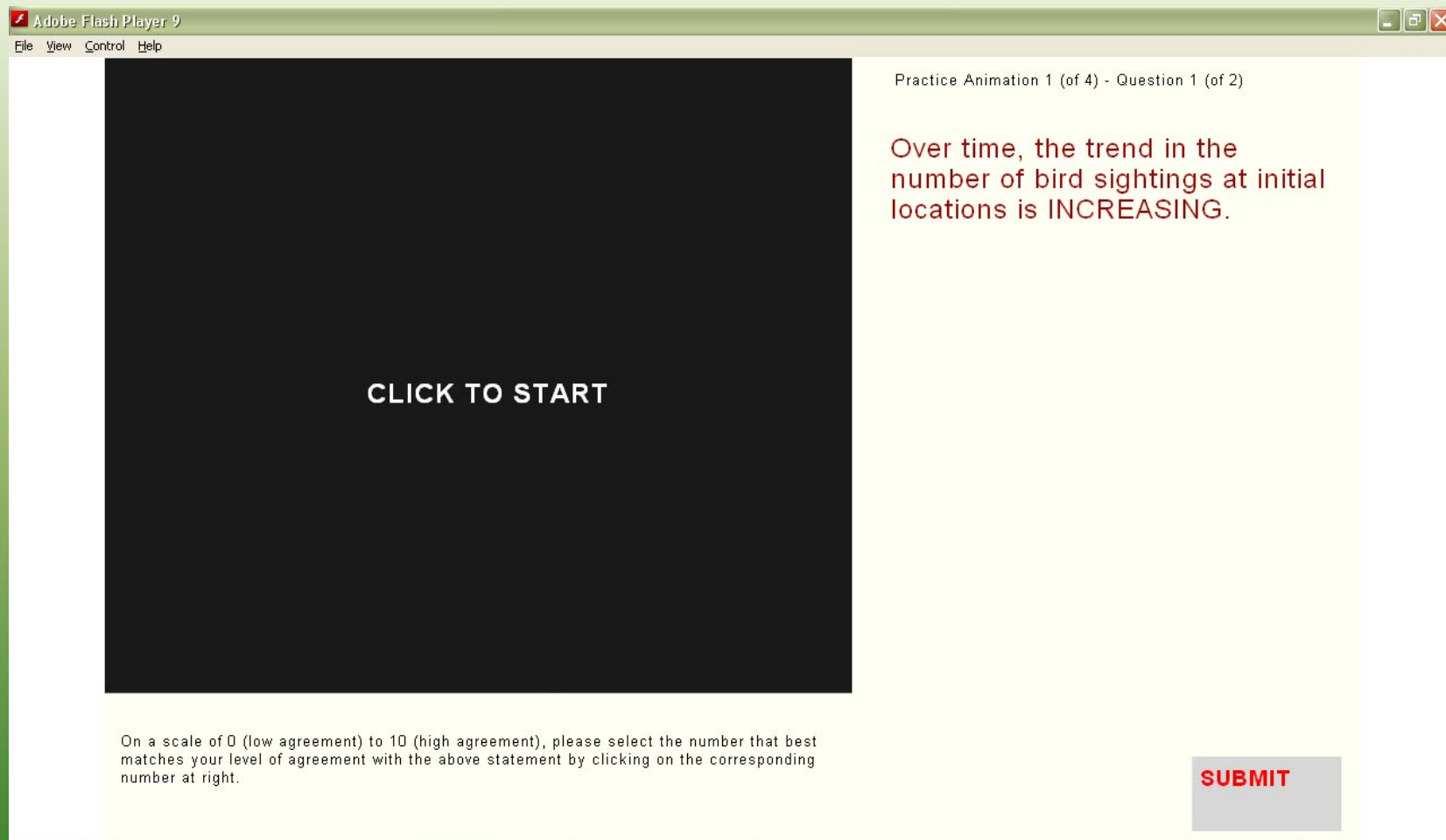
Low High
Sightings



JAN MAY JUL SEP NOV
JAN

SUBMIT

build



Adobe Flash Player 9

File View Control Help

Practice Animation 1 (of 4) - Question 1 (of 2)

Over time, the trend in the number of bird sightings at initial locations is **INCREASING**.

CLICK TO START

On a scale of 0 (low agreement) to 10 (high agreement), please select the number that best matches your level of agreement with the above statement by clicking on the corresponding number at right.

SUBMIT

build

Adobe Flash Player 9

File View Control Help

Practice Animation 1 (of 4) - Question 1 (of 2)

Over time, the trend in the number of bird sightings at initial locations is INCREASING.

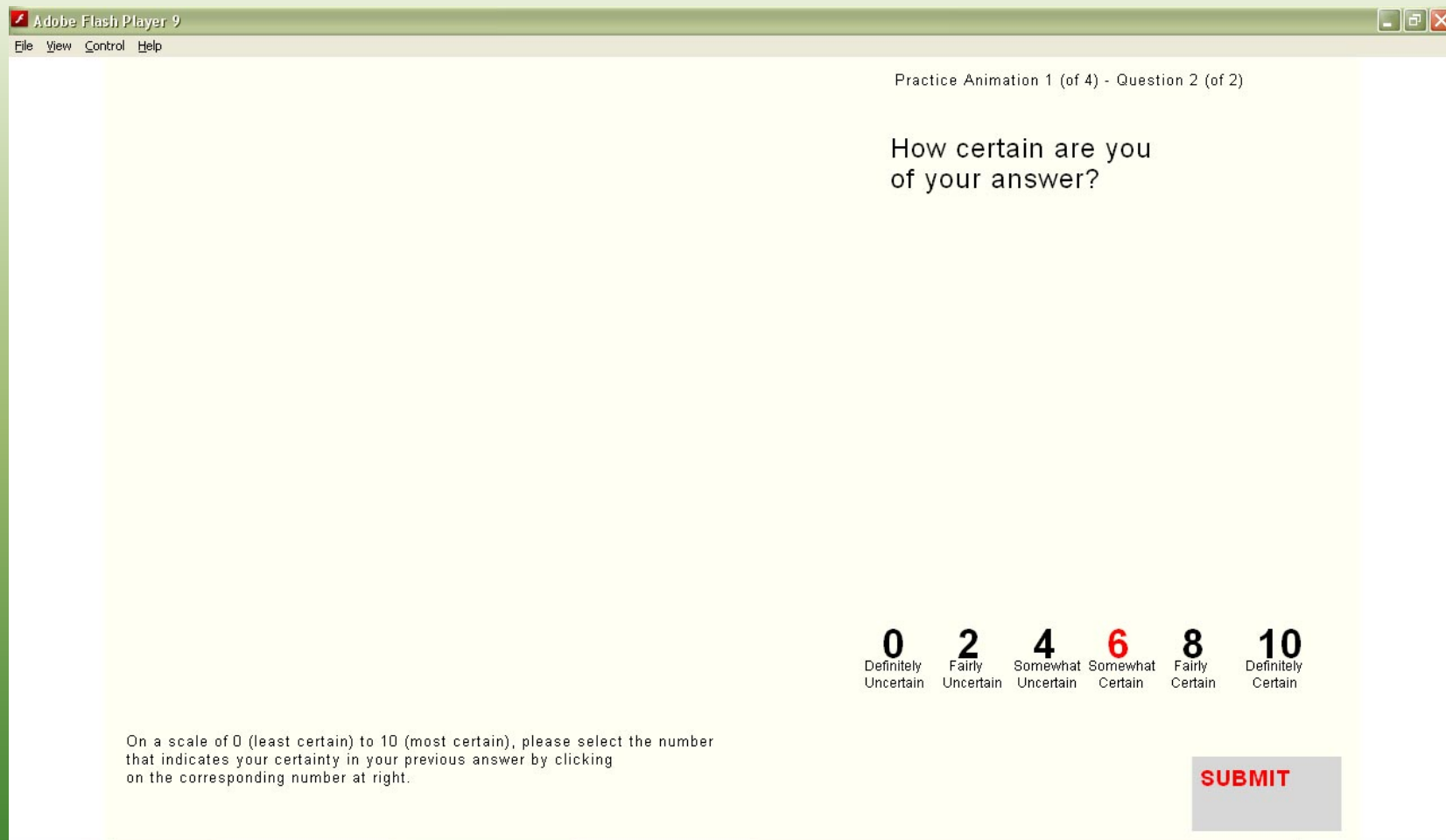


On a scale of 0 (low agreement) to 10 (high agreement), please select the number that best matches your level of agreement with the above statement by clicking on the corresponding number at right.

0 Very Strongly Disagree 2 Strongly Disagree 4 Disagree 6 Agree 8 Strongly Agree 10 Very Strongly Agree

SUBMIT

build



Adobe Flash Player 9

File View Control Help

Practice Animation 1 (of 4) - Question 2 (of 2)

How certain are you of your answer?

0 2 4 6 8 10

Definitely Uncertain Fairly Uncertain Somewhat Uncertain Somewhat Certain Fairly Certain Definitely Certain

On a scale of 0 (least certain) to 10 (most certain), please select the number that indicates your certainty in your previous answer by clicking on the corresponding number at right.

SUBMIT

pilot

GOALS

Evaluate:

- Interface
- Design
- Language
- Tasks
- Dynamic Variables

Refine Survey

Test Statistical Model

METHOD

“Free-form Response”

Participants:

- 20 Grad Geog Students
 - 10 GIS
 - 10 Non-GIS

Completed Survey

Provided Written Feedback

Collected Response Data

main

METHOD

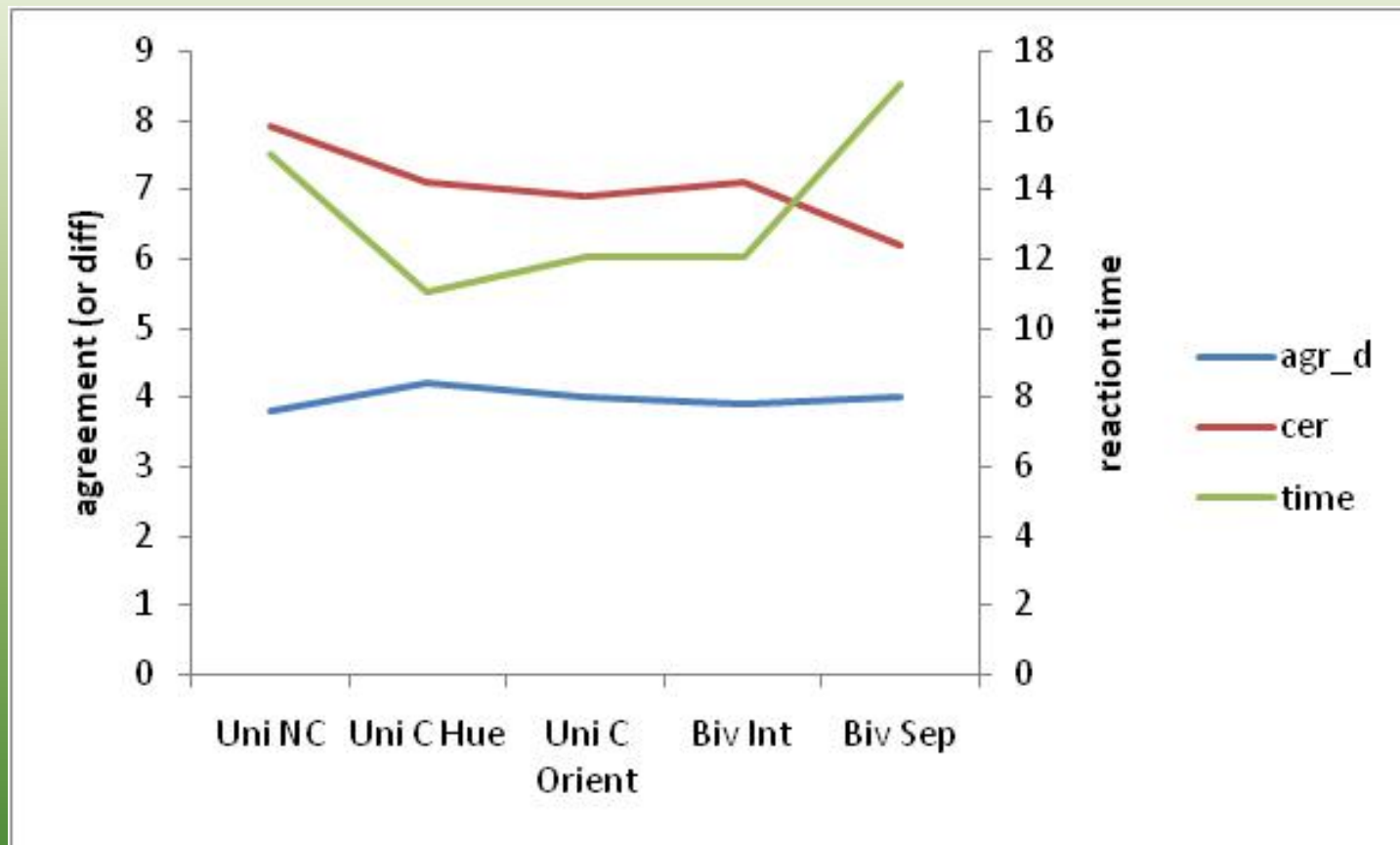
Recruit 125 **Penn State** undergrads. *(only 38 so far)*

Have them **take** the survey.

Analyze the results!

preliminary

VALUE TASKS



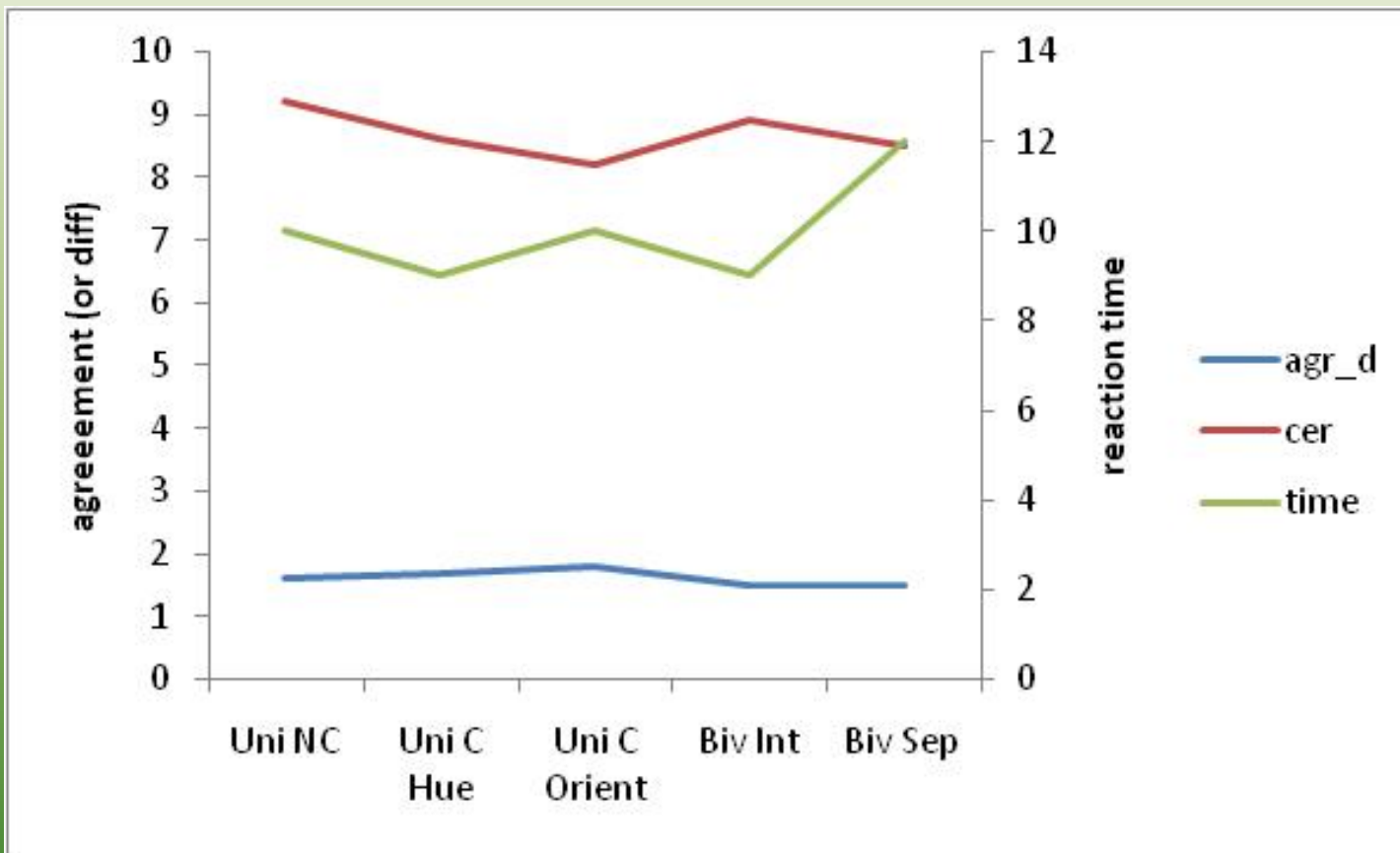
EXPECTATIONS

Least Successful > Univariate Change ✓

Most Successful > Univariate Non-Change ✓

preliminary

GEOGRAPHY TASKS



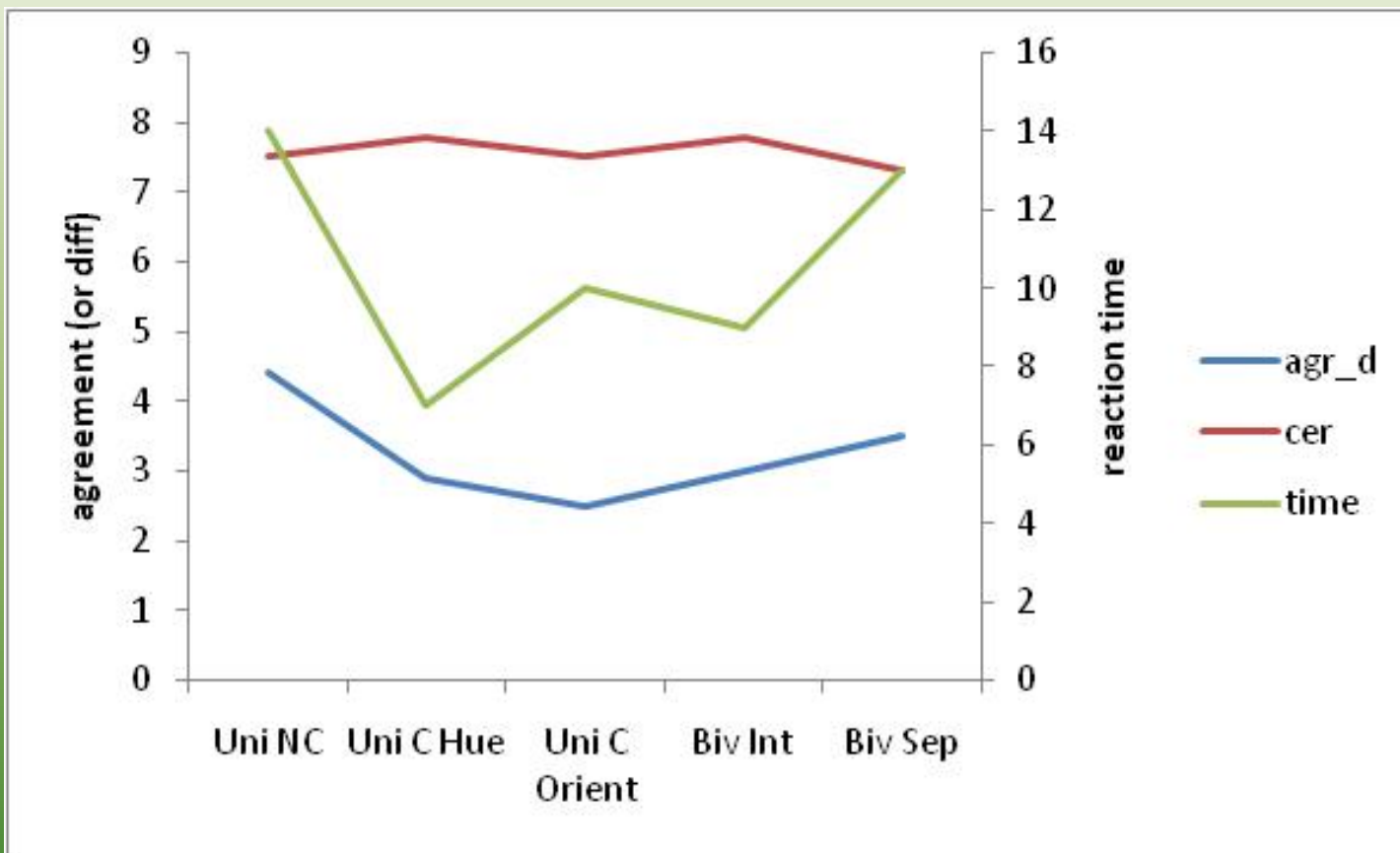
EXPECTATIONS

Most Successful > Any Change Form ✗

Slowest > Bivariate Forms ✓

preliminary

CHANGE TASKS

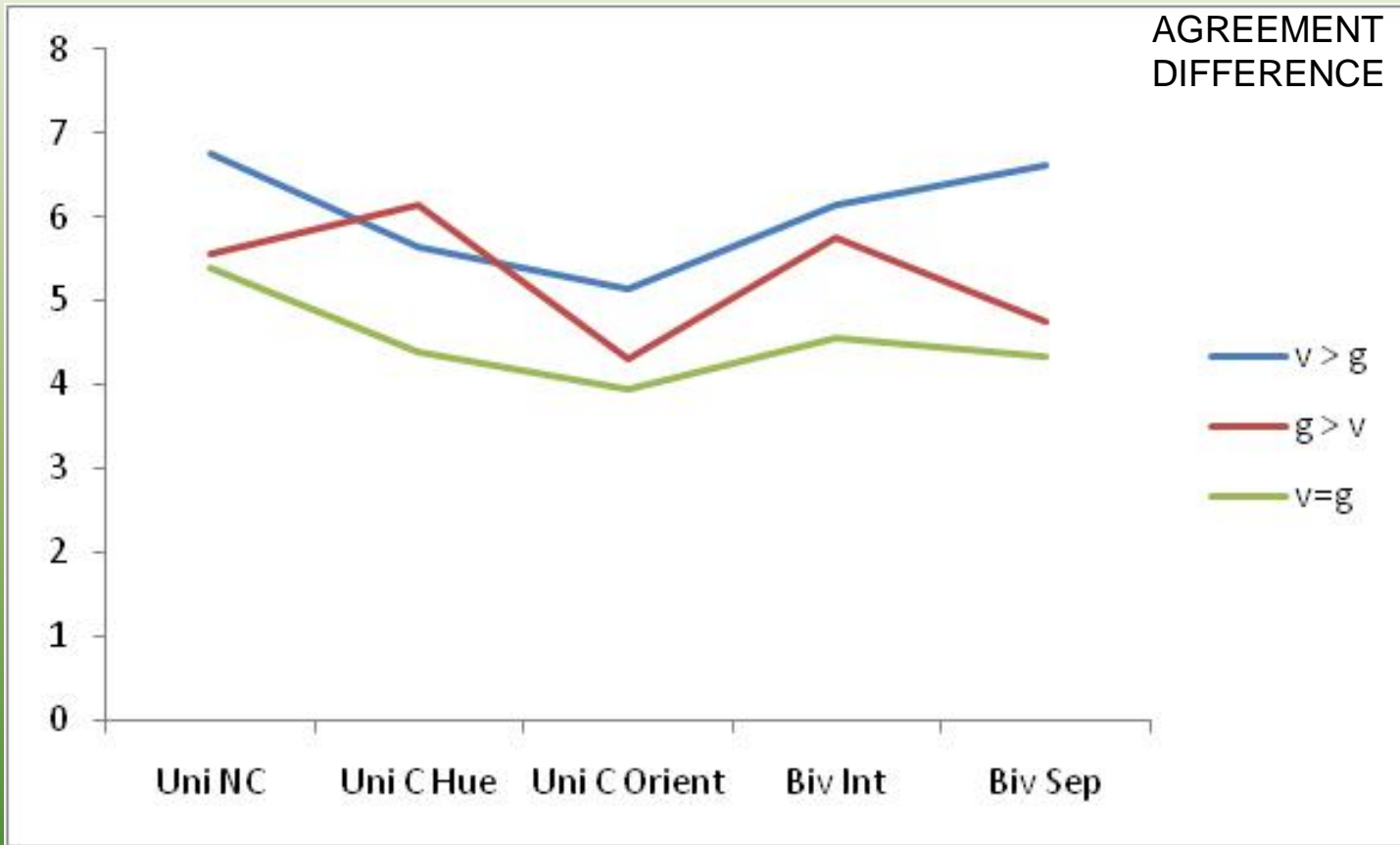


EXPECTATIONS

Most Successful > Bivariate Separable ❌

preliminary

VS. TASKS



EXPECTATIONS

Location Focus > Univariate Change Forms

Value Focus > ???

recommendations

Task Dependent!

Animations are strongest with trend type tasks.

Focus: Value as strong as Geography

Should select a form that works for both.

Univariate Non-Change

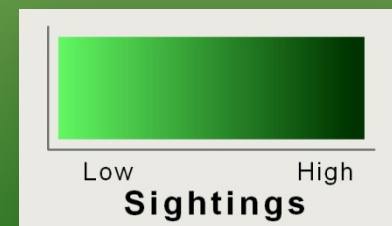
Univariate Change Hue and Bivariate Integral are faster.

Value tasks may be harder.

Change Tasks

Univariate Change Hue (slightly faster) or Bivariate Integral

Otherwise ...



outcomes

Integrated perception may help users understand interdependent variables.



Separable attention may result in a significant increase in reaction time.



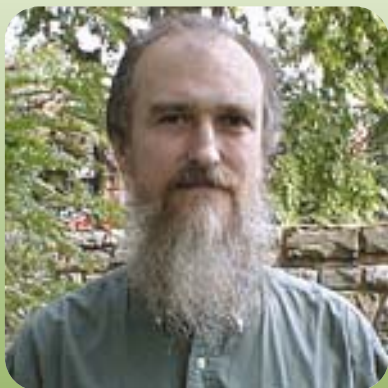
Symbol appearance and design may be a **strong** factor.

Need to test different variable relationships.

Results could change!

thanks...

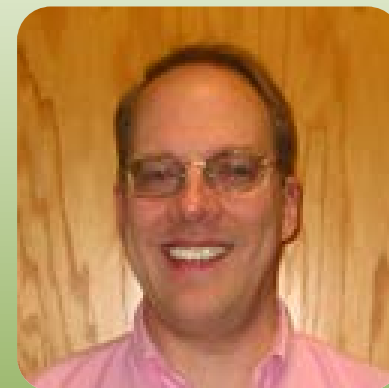
Committee



Dr. Alan MacEachren
(Advisor)



Dr. Cindy Brewer



Dr. Doug Miller



questions

?