



Is a Picture Worth a Thousand Words?

An Evaluation of Information Awareness Displays

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Peripheral/Ambient Displays



Dangling String



Water Lamp and Pinwheels



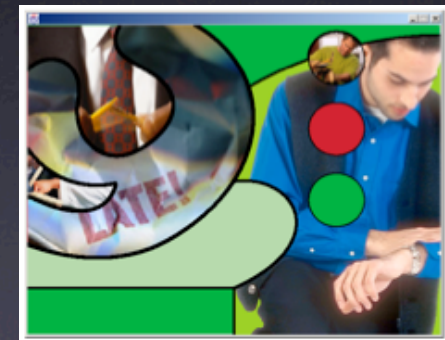
Informative Artwork



Digital Family Portrait



Information Percolator



Kandinsky System

Evaluation Challenges

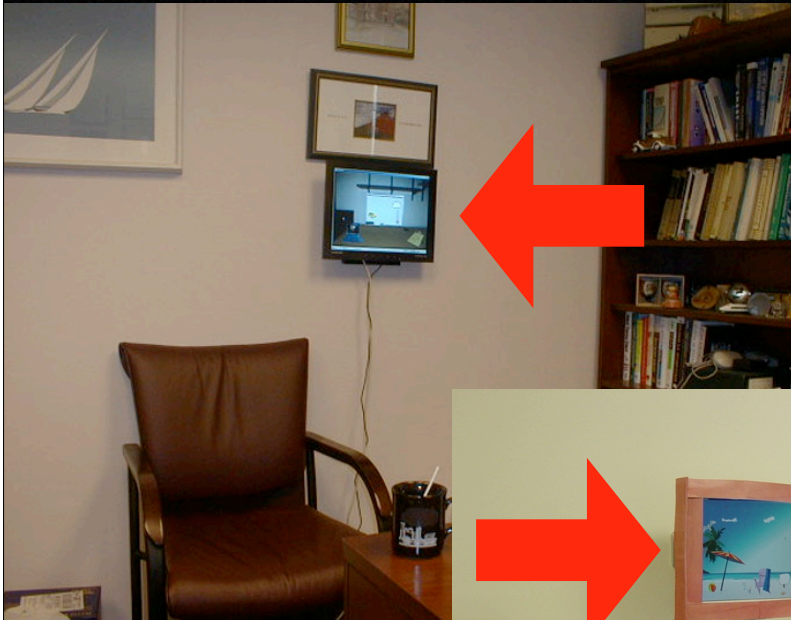
- Combination of utility, aesthetics, and long-term use
- Recent work in evaluation *techniques* include:
 - Mankoff *et al.*'s Heuristic Evaluation Criteria for Ambient Displays
CHI 03
 - McCrickard *et al.*'s Notification System Categorization Framework
TOCHI 03

The InfoCanvas



Highly personalized peripheral display placed in user's environment

The InfoCanvas



Highly personalized peripheral display placed in user's environment

The InfoCanvas

- Objects on InfoCanvas represent data
 - Example: Height of bird in sky represents stock value
- Users specify mappings between objects in scene and information presented
- Explicitly supports displaying multiple pieces of information simultaneously
- Personalization is important
 - Choose theme to fit mood, personality, etc.

User Study

- Focus on several displays' effectiveness at conveying info in a short period of time
 - InfoCanvas
 - Web Portal type display
 - Text-based display
- **Not** to evaluate peripheral displays in general

Information Nuggets

time of day

temperature forecast

stock update

website updates

baseball score update

weather forecast

traffic conditions

airfare prices

new emails

news headline

Miller & Stasko, AVI 2002

Text-Based Display

News

Iraq's Armed Forces Dissolved,
U.S. Says

BAGHDAD, Iraq – The military that failed to protect Saddam Hussein's regime took its final fall Friday, as the American occupation force ordered the dismantling of the Iraqi army and the

Personal Finance

Dow Jones	8117.23	+64.0	+ .99%
S & P 500	777.2	-3.30	-.15%
NASDAQ	1210.11	+1.23	+ .28%

Today's Forecast

Temperature: 53
Conditions: Cloudy

Traffic Conditions

Average Speed: 62 MPH

Travel

Airfare from ATL to LAX
Lowest Price: \$220

Communication

Photo Website: Unchanged
New Email Messages: 4

Sports

Atlanta Braves: 2
Pittsburgh Pirates: 1

Date & Time

Tuesday, September 8
3:34 AM

Web Portal Display

Date & Time
Monday, August 1
6:56 AM

Traffic
Current Conditions
Peachtree Hwy
Average Speed: 15

Communication
Email
New Email Messages: 16

Website Monitor
Family Photo Website
Recently Updated

News
Front Page News from MSNBC
Bali bombing suspect admits role
AKARTA, Indonesia -- A key suspect in last year's Bali attacks has admitted in court he was involved in the bombings.
Ali Ghufron, known by his alias Mukhlas, was testifying at the trial of Abu Bakar Ba'asyir, a Muslim cleric and the alleged spiritual head of Jemaah Islamiah (JI), the regional militant group agitating for a South East Asian Islamic state.

Weather
Forecasts
Rain
Temp: 88

Sports
Coverage from ESPN
Atlanta: 0
Pittsburgh: 0

Personal Finance
Stock Quotes

Name	Last	Change	%Change
Dow	8257.67 ▼	-35.00	-1.91%
S&P 500	900.1 ▼	-2.90	-2.12%
NASDAQ	1183.29 ▼	-1.39	-0.75%

Travel
Airline Fare (ATL to LAX)
Delta \$62

- Design choice of more graphics and images than on a typical Web portal

InfoCanvas





A News Headline

Slider Data Elements

Kite::Airfare Price





A News Headline

Slider Data Elements

Kite::Airfare Price

\$400

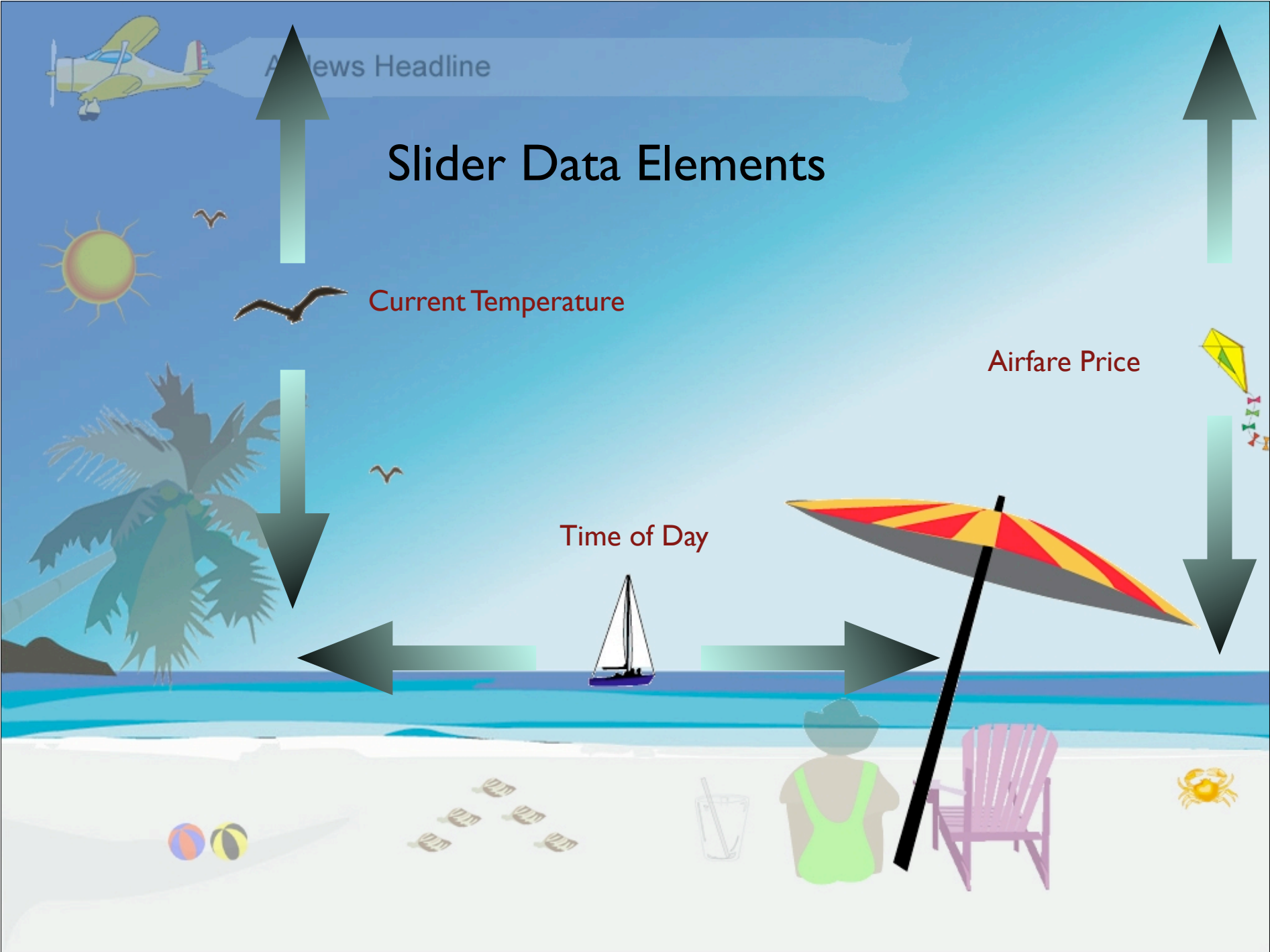
\$300

\$200

\$100

\$0





News Headline

Slider Data Elements

Current Temperature

Airfare Price

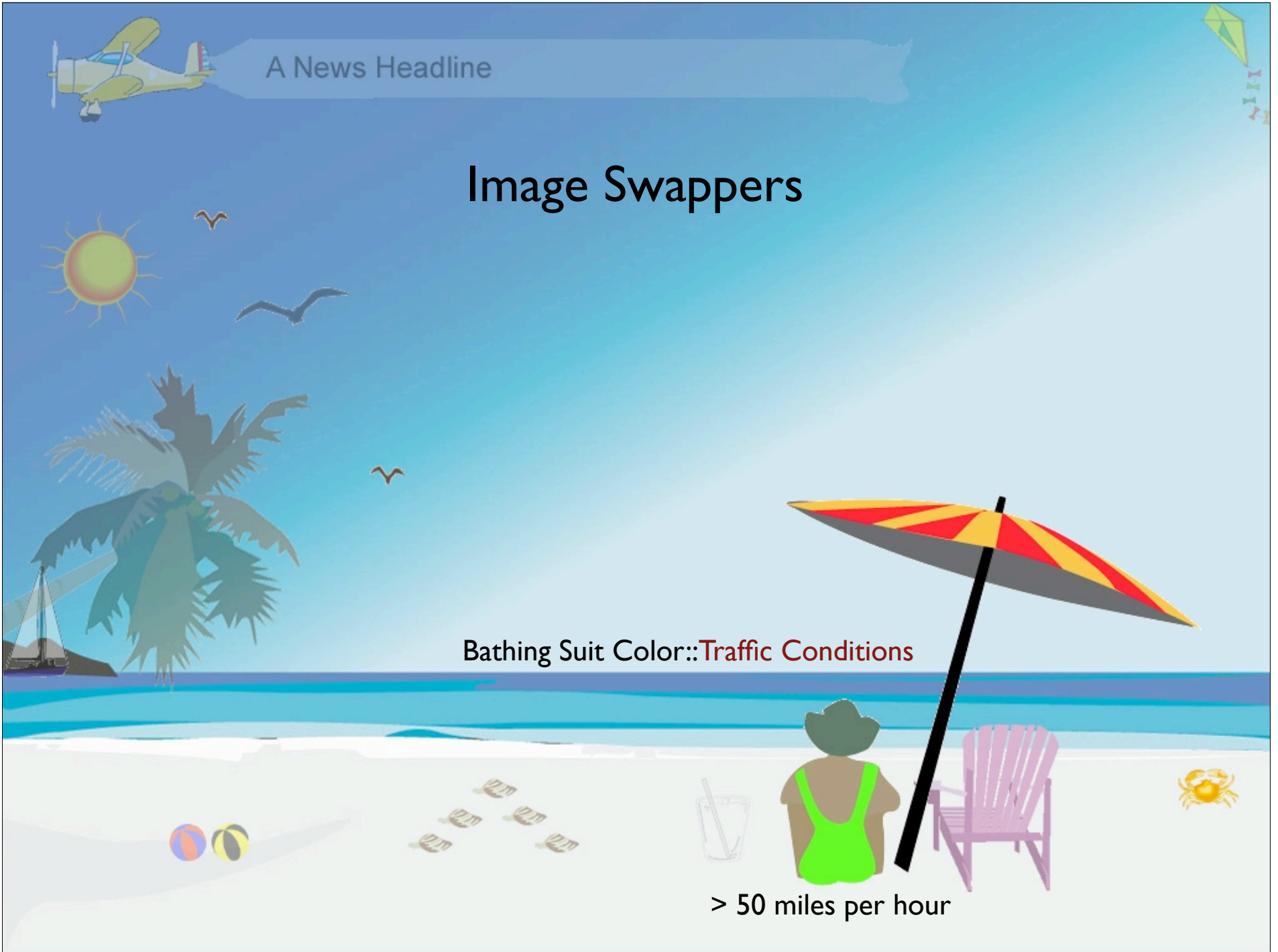
Time of Day

A News Headline

Image Swappers

Bathing Suit Color::Traffic Conditions

> 50 miles per hour

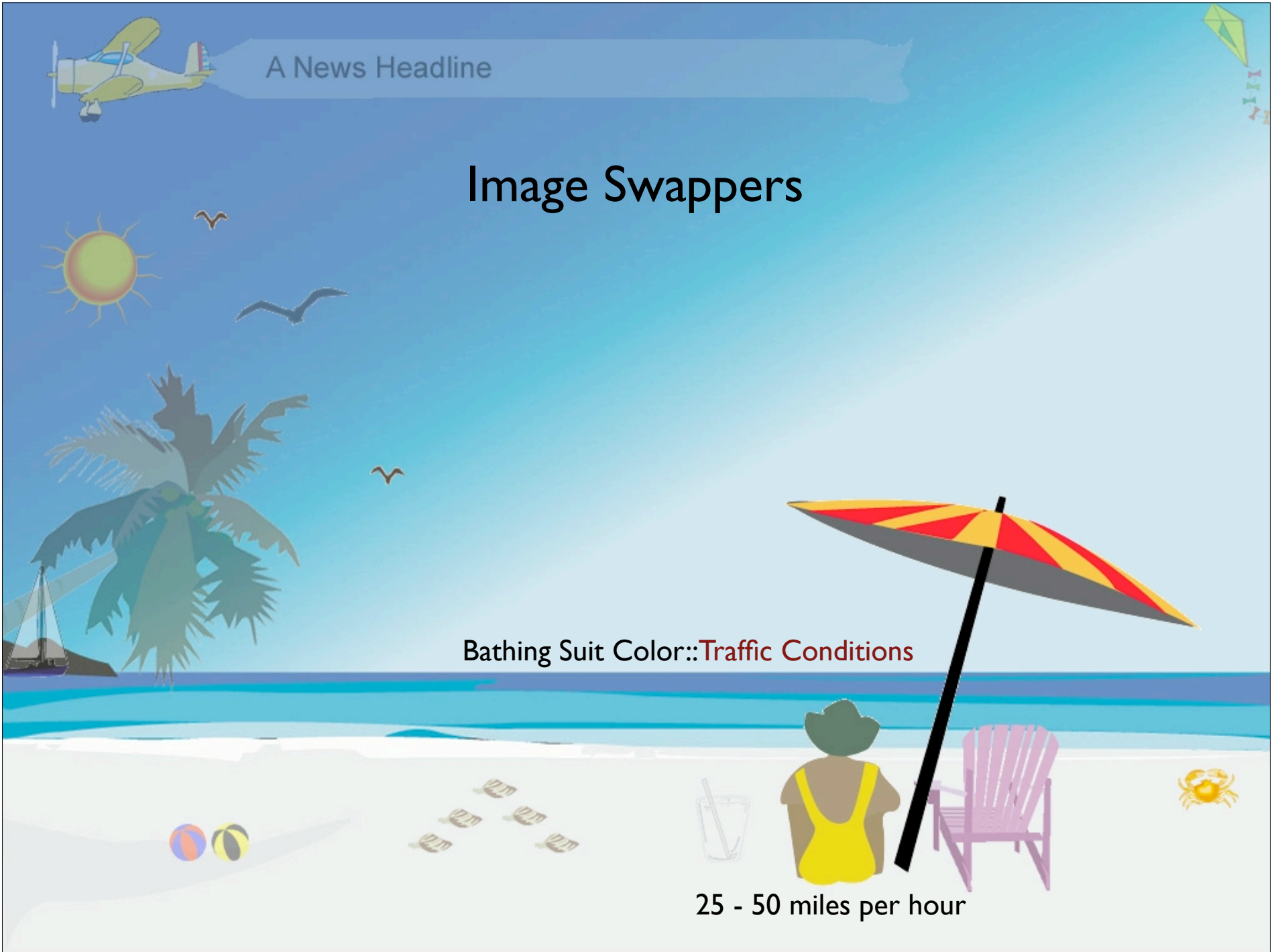


A News Headline

Image Swappers

Bathing Suit Color::Traffic Conditions

25 - 50 miles per hour

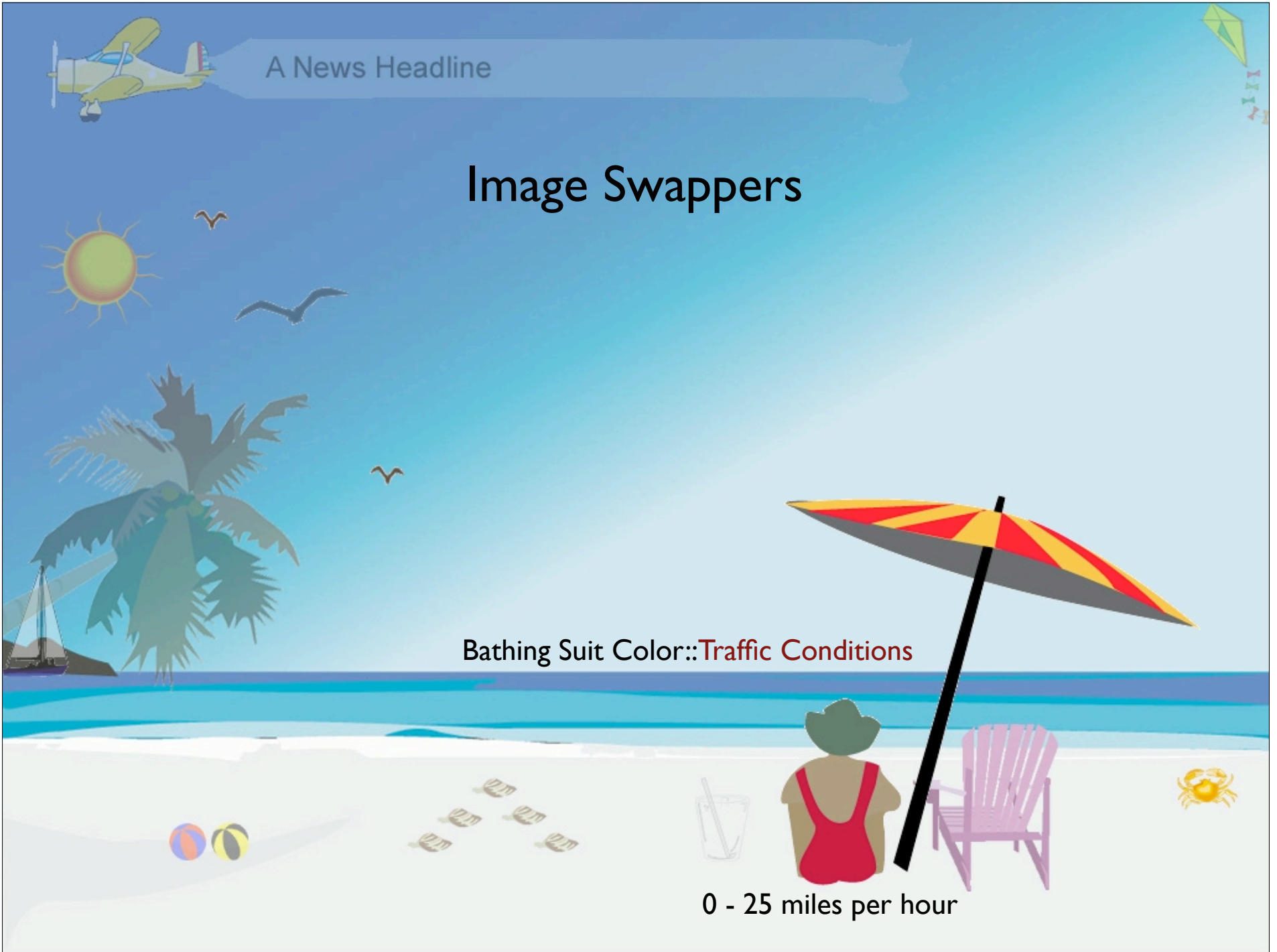


A News Headline

Image Swappers

Bathing Suit Color::Traffic Conditions

0 - 25 miles per hour



A News Headline

Image Swappers

Weather Forecast

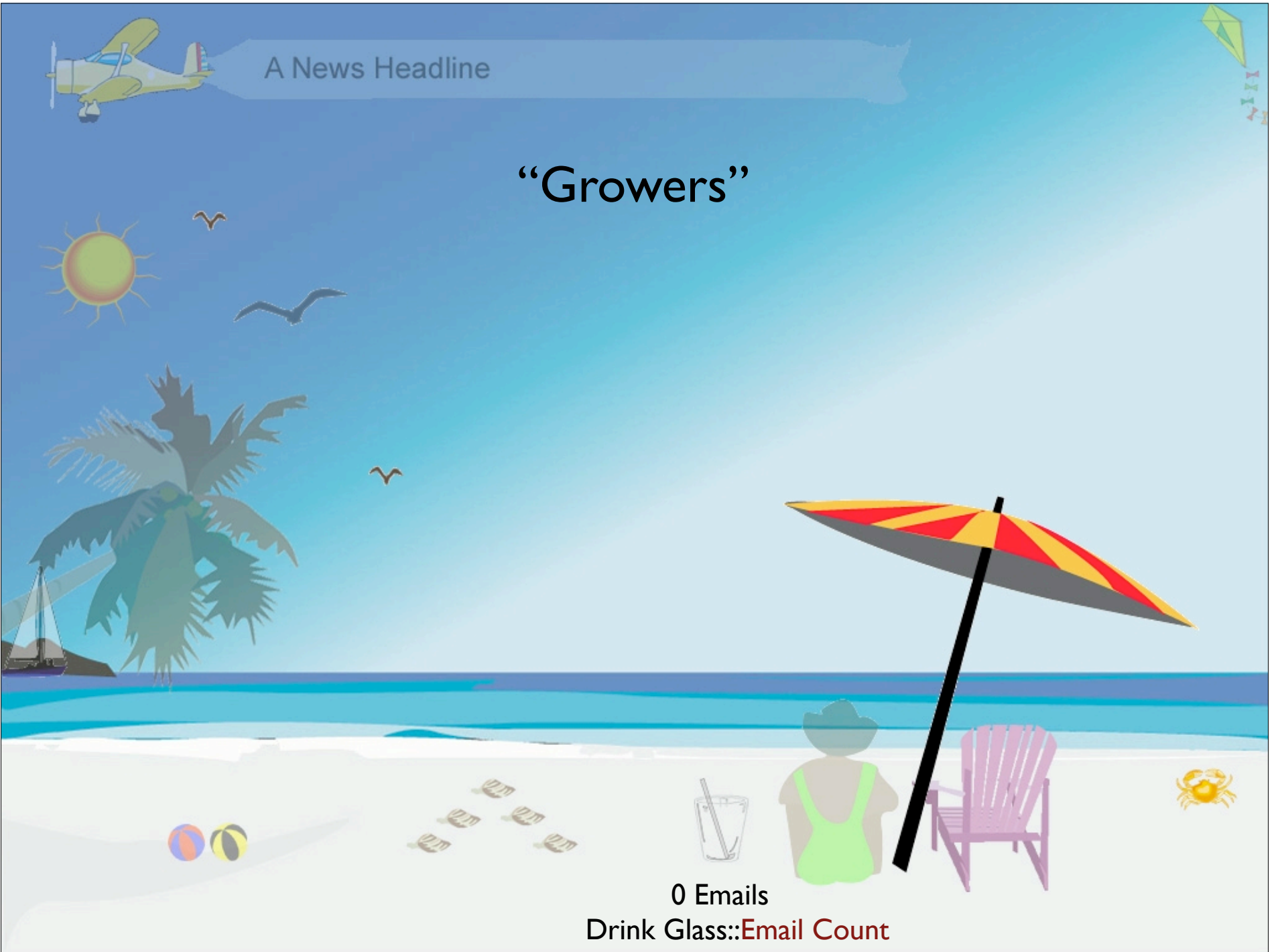
Website Updates

Traffic Conditions



A News Headline

“Growers”

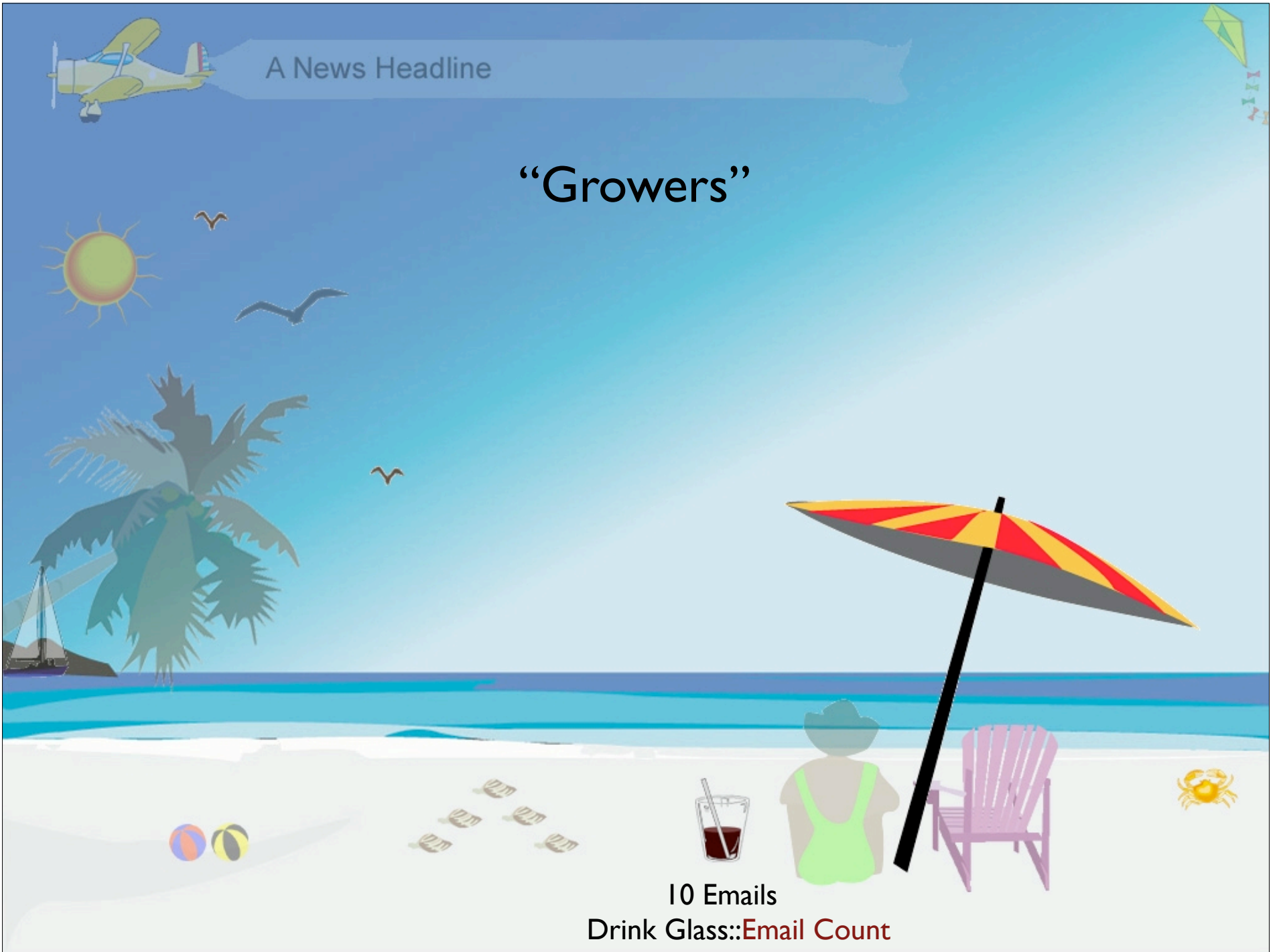


0 Emails

Drink Glass::Email Count

A News Headline

“Growers”

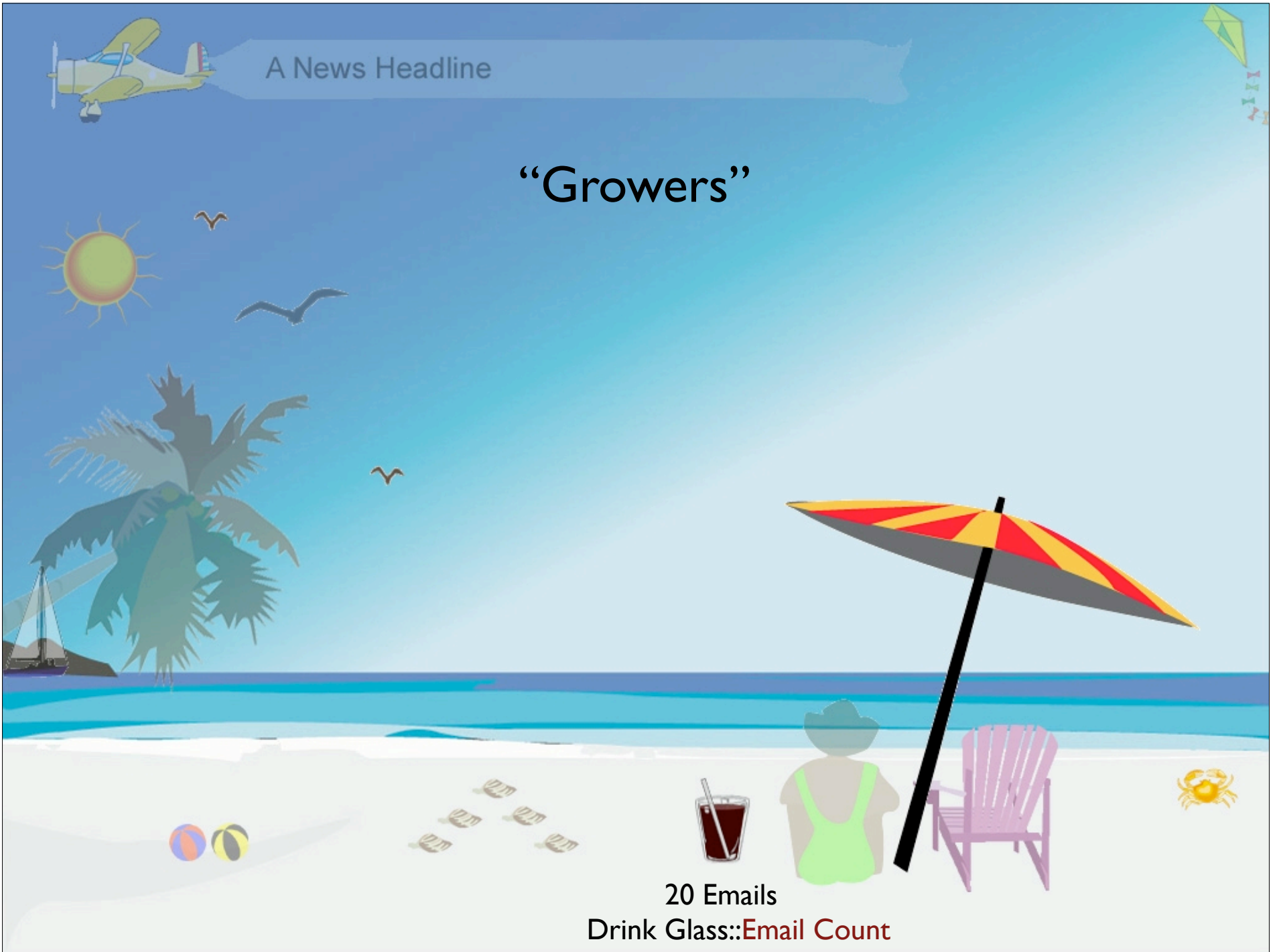


10 Emails

Drink Glass::Email Count

A News Headline

“Growers”



20 Emails

Drink Glass::Email Count

A News Headline

“Growers”



>20 Emails

Drink Glass::Email Count



A News Headline

“Growers”



Baseball Score



Stock Update



Email Count





Lingerie Store Robbed--Thief Gives Cops The Slip



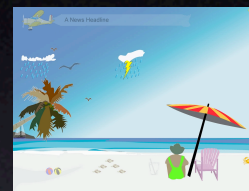
Plane Banner::News Headline

Text



Information Awareness Displays

Highly Graphical



Highly Textual

Mail & Tools
Monday February 1
4:54 AM

Mail
New Email Messages: 0

Family Photo Website
for Chicago-Denver

News
Cavaliers' veterans get last look before report

Weather
Forecast

Personal Finance

Symbol	Last	Change	%Change
IBND	1839.43	+12.00	+0.65%
S&P 500	629.4	-0.43	-0.24%
NASDAQ	1850.11	-0.84	-0.04%

News	Today's Forecast	Communication
Iraq's Armed Forces Disbanded, U.S. Says	Temperature: 53 Conditions: Cloudy	Photo Website: Unchanged New Email Messages: 4
BAHAGAD Iraq - The military that failed to protect Saddam Hussein's regime took its final fal	Traffic Conditions	Sports
Friday, as the American occupation force disbanded the remnants of the Iraqi army and the	Average Speed: 62 MPH	Atlanta Braves: 2 Chicago White Sox: 1
Personal Finance	Travel	Date & Time
Dow Jones: 8117.23 +64.0 +.78%	Atlanta from ATL to LAX	Tuesday, September 8
S&P 500: 629.4 -0.43 -.68%	Lowest Price: \$220	3:18 AM
NASDAQ: 1850.11 +1.23 +.07%		

Study Details

- 49 participants
 - Mostly male (11 female)
 - Ranging in age between 18 and 61
 - 27 grad students, 17 undergrads, 5 other
 - Financially compensated

Experimentation

- Individually tested
- Seated directly in front of display
- Within-subjects design w/ counterbalancing

Introductory Tour

Preparation Task

Practice Task

Actual Trials

Experimentation

- Individually tested
- Seated directly in front of display
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Introductory Tour

Preparation Task

Practice Task

Actual Trials



Duration:

InfoCanvas: ~ 3.5 minutes

Web Portal: ~1.5 minutes

Text-based: ~1.5 minutes

Pilot testing alleviated concerns that participants wouldn't be able to learn the mappings used on the InfoCanvas

Experimentation

- Individually tested
- Seated directly in front of display
- Within-subjects design w/ counterbalancing

Introductory Tour

Preparation Task

Practice Task

Actual Trials

Shown an example display and completed a sample recall questionnaire (coming up)

No time limit enforced

Allow for additional questions

Experimentation

- Individually tested
- Seated directly in front of display
- Within-subjects design w/ counterbalancing

Introductory Tour

Preparation Task

Practice Task

Actual Trials

Recall questionnaire face down

Info display shown for 8 seconds

Prompt to turn over and answer
recall questionnaire



Experimentation

- Individually tested
- Seated directly in front of display
- Within-subjects design w/ counterbalancing

Introductory Tour

Preparation Task

Practice Task

Actual Trials

3 information display exposures & recall pairs using different data sets/displays

Specific emphasis made not to guess



Recall Questions

- Varied question topic order across trials
- Incorporated confidence scale
low / medium / high

What is the current time of day?

4:32 AM
7:40 AM
3:20 PM
7:55 PM

What is the current news headline?

Pair pleads not guilty to embezzlement
Pair pleads guilty to obstruction charges
Jury hung on money launderer
Couple found not guilty on conspiracy charge

What is the lowest airfare price
from Atlanta to Los Angeles?

\$330
\$292
\$160
\$99

How many new emails were present?

22
16
1
0

Recall Questions

- Questions were designed to elicit comprehension and recall of information in the same manner that it was encoded.

What is the status of the Dow Jones?

- + 89 points
- + 42 points
- 2 points
- 75 points

What is the status of the Dow Jones?

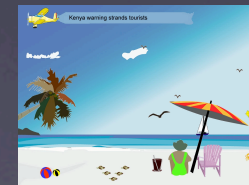
- Up over 50 points
- Up 0 - 50 points
- Down 0 - 50 points
- Down over 50 points

“Exact-Value”

The screenshot shows a desktop interface with several widgets. The 'Personal Finance' widget is highlighted, displaying a table of stock market data:

Name	Last	Change	%Change
Dow	1242.48	+12.00	+0.94%
S&P 500	862.07	+0.45	+0.52%
NASDAQ	1239.01	+4.10	+0.33%

“Categorical”

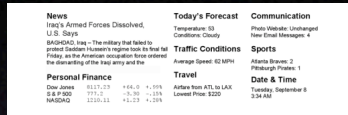


Results

1st Trial

2nd Trial

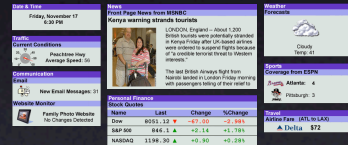
3rd Trial



5.14 (1.59)

5.12 (1.33)

5.02 (1.57)



5.67 (1.61)

5.65 (1.54)

5.29 (1.89)



6.27 (1.80)

6.22 (1.79)

6.31 (1.76)

Recall score out of 10 questions

Statistical Significance for:

InfoCanvas over Web Portal (F(1,48) = 14.65, MSE = 2.66, p < .0005)

Web Portal over Text-Based (F(1,48) = 8.17, MSE = 1.76, p < .007)

InfoCanvas over Text-Based (F(1,48) = 40.1, MSE = 2.51, p < .0001)

Results: Another Take

- Weighted Scores: Taking into account confidence levels

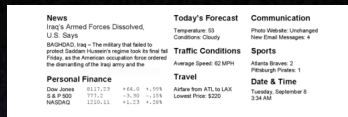


Weighted Results

1st Trial

2nd Trial

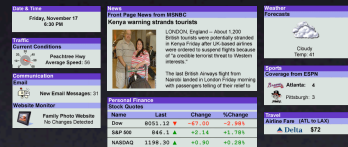
3rd Trial



11.47 (4.92)

11.78 (4.81)

10.57 (5.02)



12.88 (5.09)

12.35 (5.84)

11.27 (6.40)



13.88 (5.96)

14.02 (5.89)

13.82 (6.63)

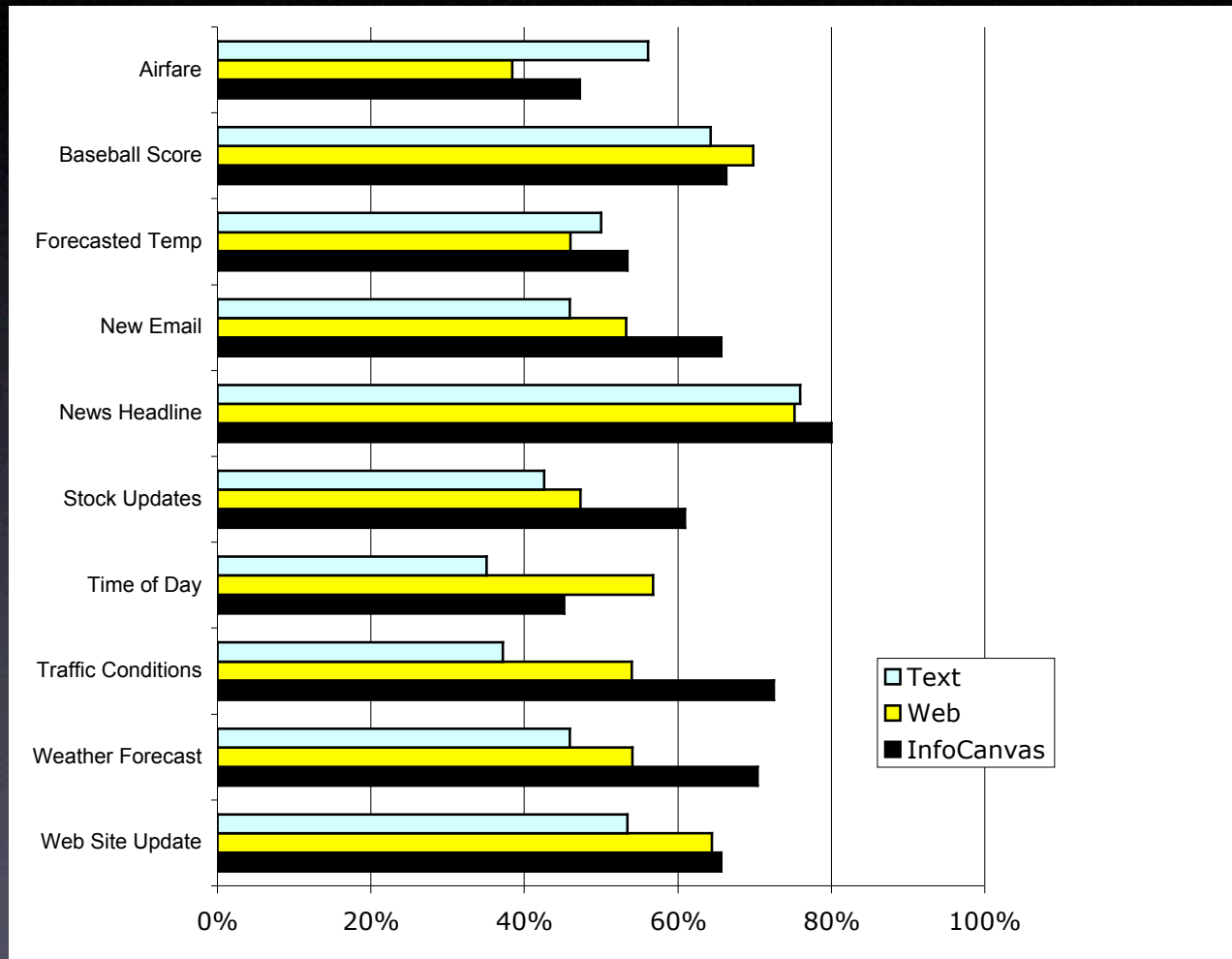
Recall score out of 10 questions

Statistical Significance for:

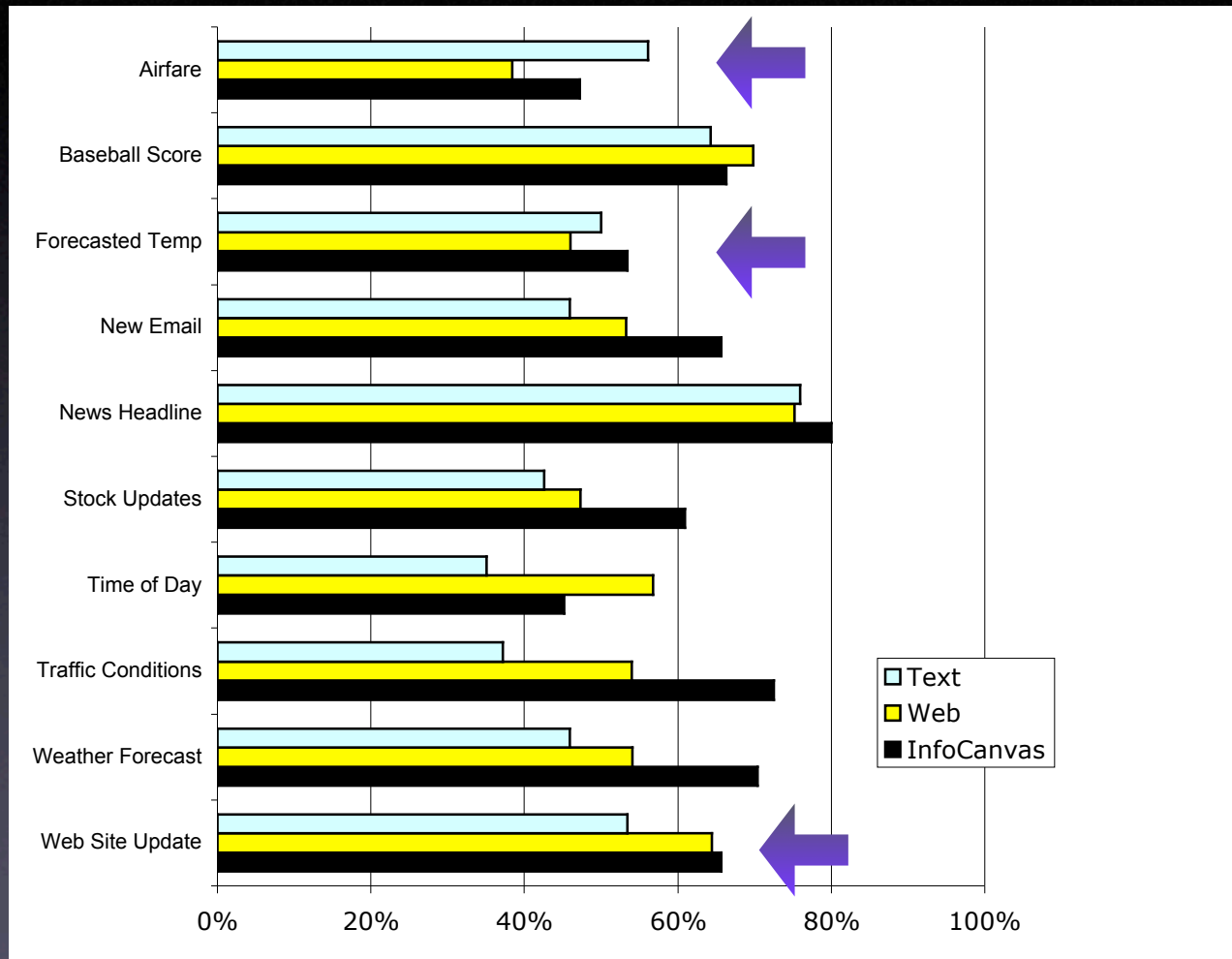
InfoCanvas over Web Portal (F(1,48) = 7.29, MSE = 30.56, p <.0095)

InfoCanvas over Text-Based (F(1,48) = 22.21, MSE = 22.93, p <.001)

Item by Item



Item by Item



Summary

- Participants able to recall significantly more information with the InfoCanvas
 - 7 of the 10 data items averaged best recall rate with InfoCanvas
- Suggests benefits for comprehension

Analysis

- Results shouldn't be too surprising
 - Leverage high bandwidth perceptual system
 - Graphics conducive to recall tasks (Umanath and Scamell, CACM '88)
- Concrete confirmation of intuition

Tree→Website Update?

- Would data→object mappings limit recall?
- Authors, not participants, designed mappings
 - “I struggled with the visual mappings”
- InfoCanvas still performed well

Tree→Website Update?

- Would data→object mappings limit recall?
- Authors, not participants, designed mappings
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InfoCanvas is designed to be a highly personalized display consistently in a user's environment!

Subjective Results

	Text	Web	InfoCanvas
Best Recall Facilitator	4%	33%	63%
Worst Recall Facilitator	84%	10%	6%
Most Preferred	4%	71%	25%
Least Preferred	71%	4%	25%

Interesting

- Participants generally expressed preference for the Web Portal over InfoCanvas
- Participants felt that the InfoCanvas best facilitated the recall of information
 - Felt that Web Portal was “more professional looking”
 - Web Portal displayed information in a “logical and precise manner”

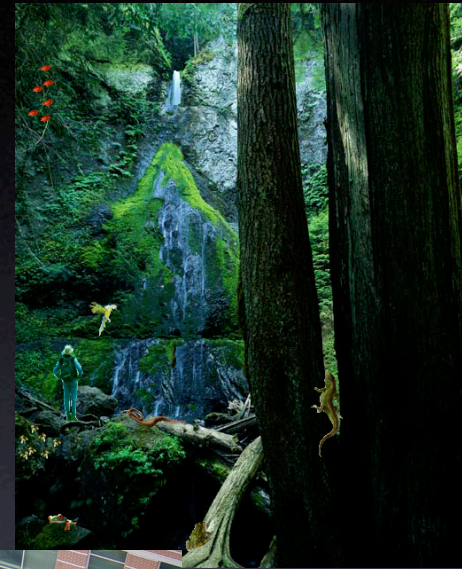
Yet Others...

- ...captured the essence of InfoCanvas
 - “I think I could choose to ignore it while I was working. I think once I got to used to what all the icons meant and what the scales were, I could easily look at it to see the information I was interested in.”
 - “[InfoCanvas] is the quickest and easiest to see at a glance the information you want.”
 - “[I am] able to keep working and not get distracted by details; [InfoCanvas] is faster to see and interpret from a distance.”

Ongoing Work



Ongoing Work



Ongoing Work

- Explore performance in a more peripheral nature
- Long-term general study
- End-user InfoCanvas creation tool



Acknowledgments

- **InfoCanvas Development Team:**
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Visit the InfoCanvas Web Site at:
<http://www.cc.gatech.edu/gvu/ii/infoart/>

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Potential Followup

- Compare with other highly graphical systems, such as Sideshow / Scope.

Scope
AVI 2002



Sideshow
CSCW 2002

