WPI

CURIOUS BROWSERS:
Automated Gathering of
Implicit Interest Indicators
by an Instrumented Browser

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The User's Intentions

❒ Intelligent interfaces should understand the intentions of the user.

➥ e.g., by interpreting sequences of observable actions.

❒ Recommender systems require knowledge of user interests.

❒ Can we understand the "interest" the user has in some information?

➥ e.g., in a web page.

❒ Can low level actions indicate interest?

➥ e.g., mouse movement, scrolling, ...

Explicit Ratings

❒ User explicitly rates information.

    ➥ Common & fairly precise.

❒ Can interrupt normal patterns of reading or action.

❒ Users may tire of providing them.

...and...

❒ Users need to be convinced of the benefit in order to make the effort.

...but...

❒ Many ratings are needed before Collaborative Filtering can provide accurate predictions.

Implicit Ratings

❒ Not obtained directly from user.

  ↳ i.e., some inference needed.

❒ Removes cost of obtaining explicit rating.

❒ Every interaction could potentially contribute.

❒ Can be gathered at little/no cost.

❒ May be less accurate.

❒ Can combine many implicit ratings.

❒ Can combine with explicit ratings.

Research Overview

❐ Objective is to collect, measure, and evaluate the predictive power of **Implicit Interest Indicators** (i.e., of implicit ratings).

❐ Focused on prediction for single web page using a single indicator at a time.

❐ Developed web browser, **The Curious Browser**, that captured low level user actions.

❐ Used browser in 1st user study of about 80 people browsing 2,500 web pages.

❐ Used browser in 2nd user study of about 80 people browsing 1,000 web pages.

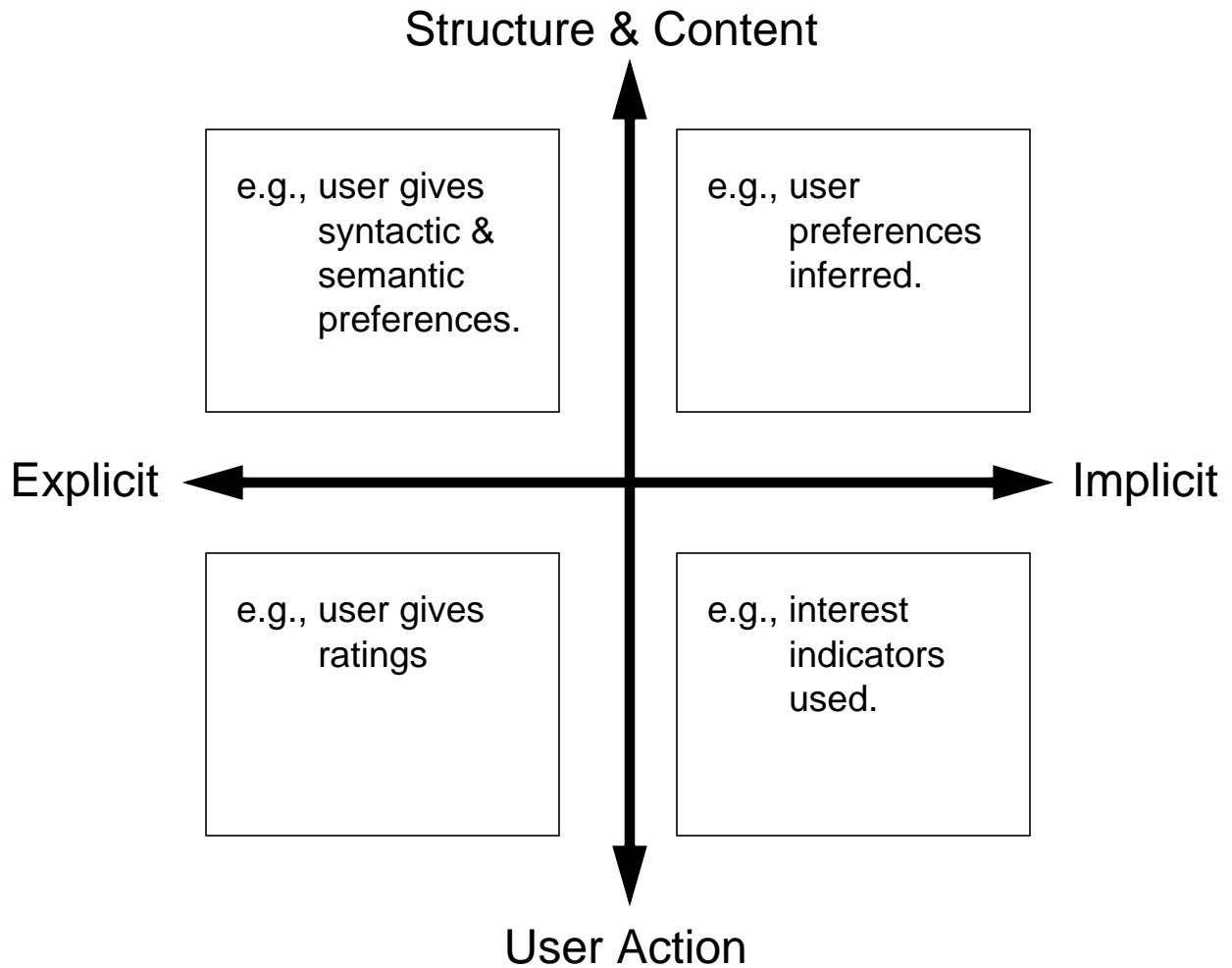# Dimension of Interest

Explicit   Mixed   Implicit

❑   **Explicit:** current user action
to express interest;
no inference.

❑   **Mixed:**   past user action
(e.g., keywords);
some inference.

❑   **Implicit:**   no user action;
inference
(e.g., from reading time).

Categorizing Indicators

Structure & Content

e.g., user gives syntactic & semantic preferences.

e.g., user preferences inferred.

Explicit ← → Implicit

e.g., user gives ratings

e.g., interest indicators used.

User Action

Indicator Types

❐ *Explicit:* user selects from scale.

❐ *Marking:* bookmark, save, print, ...

❐ *Manipulation:* cut/paste, scroll, search, ...

❐ *Navigation:* follow link, read page, ...

❐ *External:* eye movement, heart rate, ...

❐ *Repetition:* repeated visits, ...

❐ *Negative:* not following a link, ...

The Curious Browser
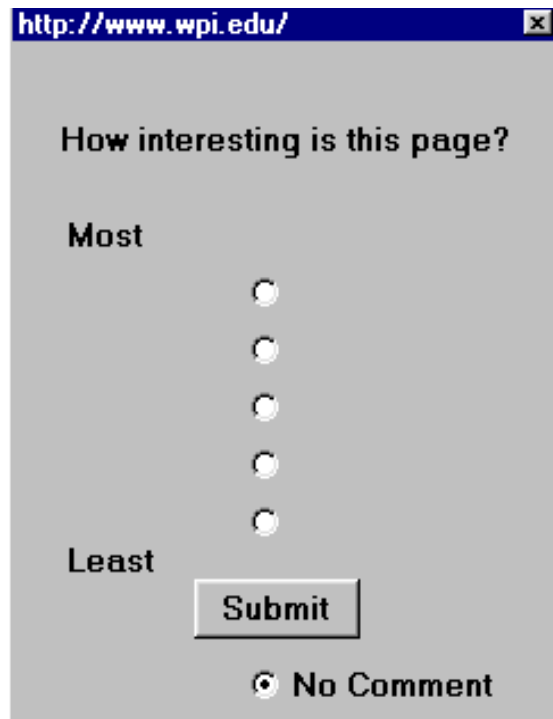
❒   Familiar GUI.

❒   Captures mouse and keyboard actions,
     and times, to a database, for each page
     and user.

❒   Used Visual Basic, with Internet
     Explorer version 5.0 html layout engine.

Browser Interface

<In color>

Evaluation Window

❒ Prompts user for an Explicit Rating when leaving a web page.

❒ "No Comment" is default.

Activities Captured (1st expt)

❐ Mouse:

➥ Number of clicks.

➥ Time spent moving cursor.

❐ Scrollbar:

➥ Clicks on scroll bars.

➥ Time spent Scrolling.

❐ Keyboard:

➥ Page Up/Down.

➥ Up/Down Arrow.

➥ Time spent holding down key.

❐ Rating:

➥ Explicit.

Experiments

❏ Browser installed on about 40 PCs running Windows 98 in two WPI Labs for about 2 weeks.

❏ Users told to use it for "browsing", with no additional task instructions.

❏ Users were not told the purpose of the experiments.

Explicit Rating Histogram
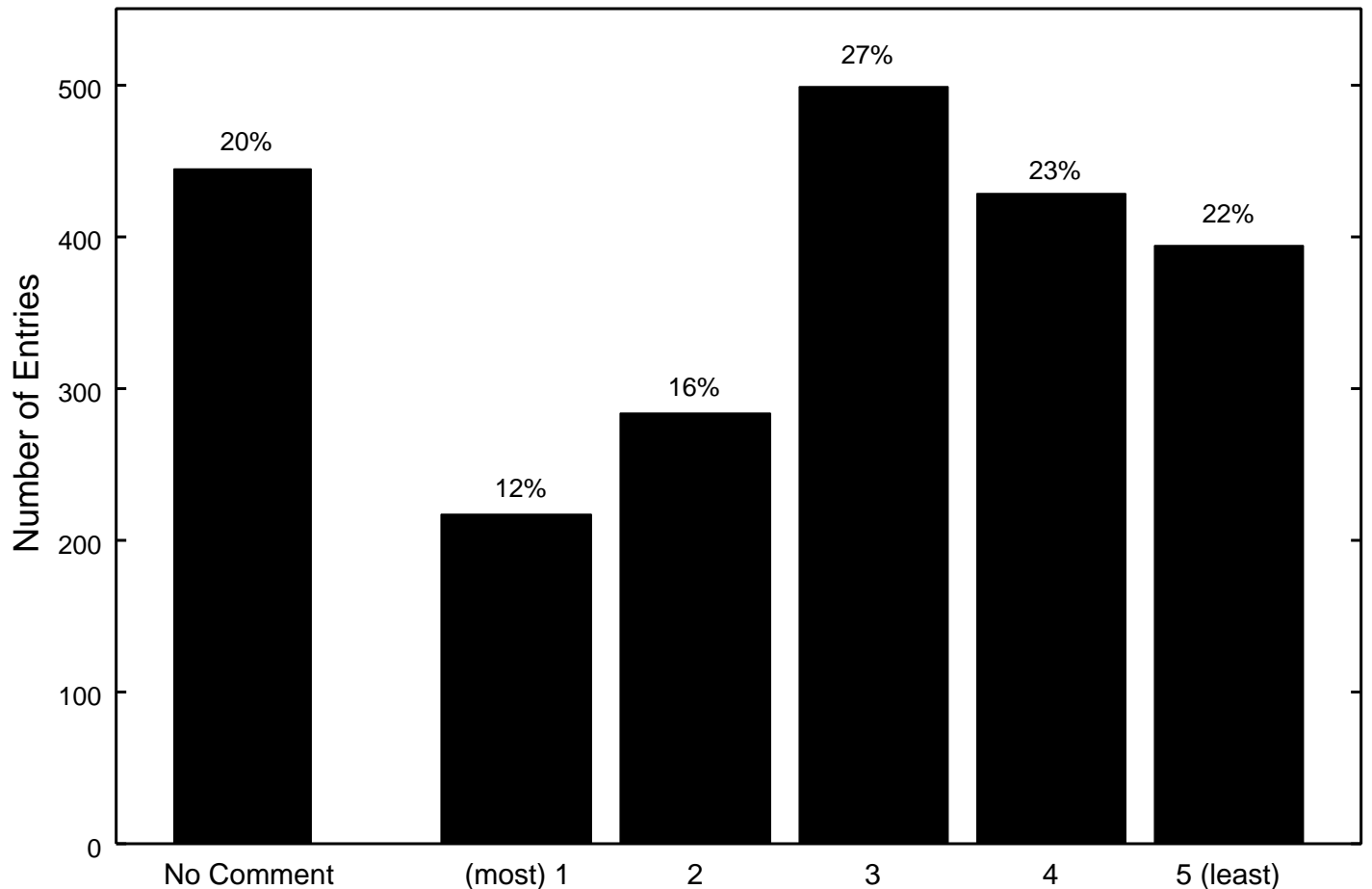
☐ 80% of URLs were rated.

☐ Mean explicit rating was 3.3

Analysis
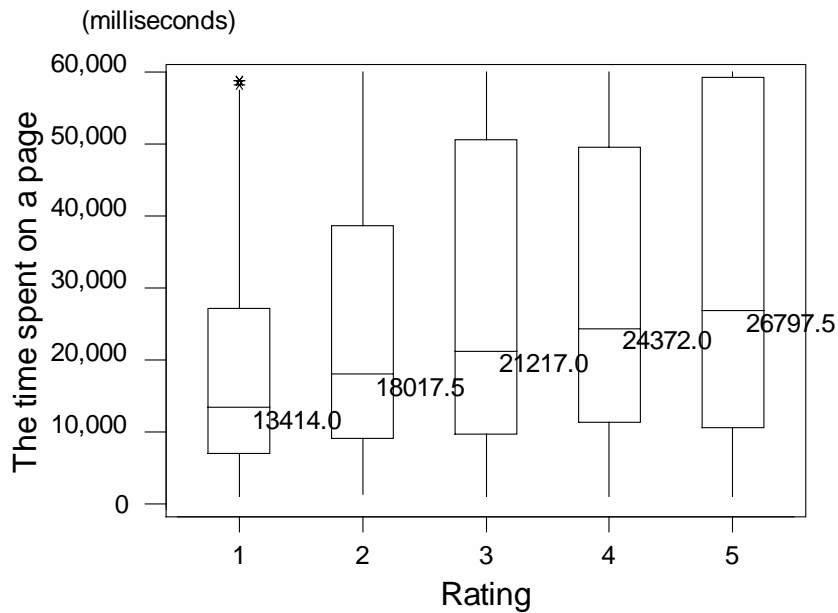
❒ Filtered extreme outliers

 ↳ (e.g., >20 minutes).

❒ Examined Explicit Rating vs. Indicator.

❒ Kruskal-Wallis test:

 ↳ the degree of independence of the medians for each rating.

❒ Box plots:

 ↳ line shows median.

 ↳ shows 25% to 75% quartiles.

Time on Page

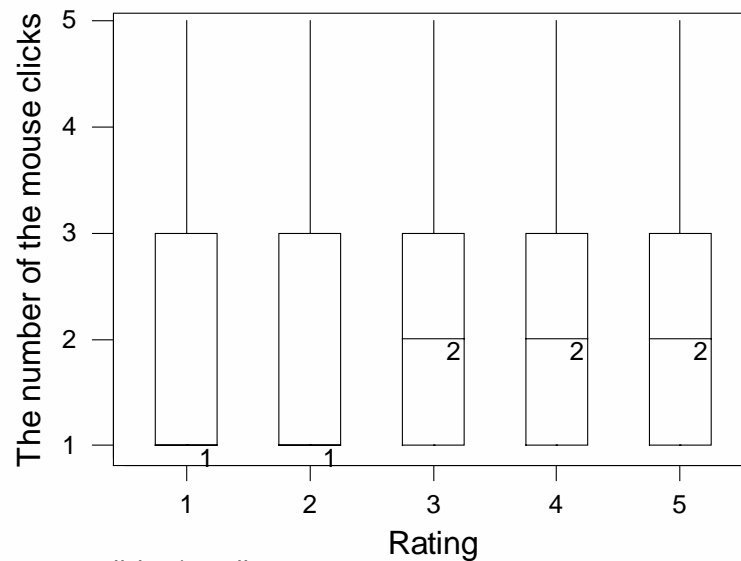### The time spent on a page vs. The explicit rating

(milliseconds)

Y-max: 60,000 msec, *: outliner

❒   median values different.

❒   appears to be a good interest indicator.
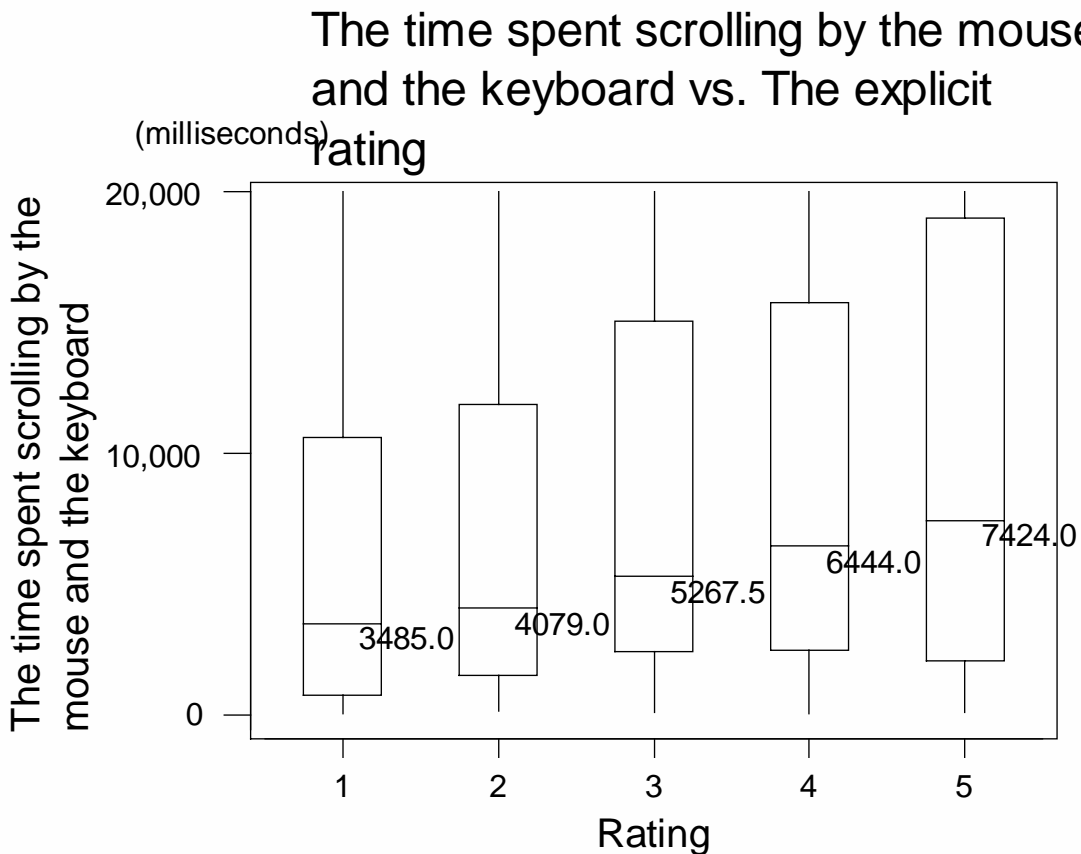
Number of Mouse Clicks

The number of the mouse clicks vs. The explicit rating

Y-max: 5 mouse clicks, *: outliner

❒   median values not different.

❒   appears not to be an interest indicator.

Combined Scrolling Time

The time spent scrolling by the mouse and the keyboard vs. The explicit rating

(milliseconds)

The time spent scrolling by the mouse and the keyboard

20,000	
10,000	
0	

3485.0   4079.0   5267.5   6444.0   7424.0

1   2   3   4   5

Rating

Y-max: 20,000 msec, *: outliner

❒ median values different.

❒ appears to be a good interest indicator.

Rough Accuracy

❐ Assume explicit rating is accurate.

❐ Assume a "false" prediction is off by >2 wrt explicit interest value.

❐ Considering only "true" predictions, time and scrolling each provide about 70% accuracy.

❐ In our experiment, explicit rating provided 80% accurate coverage, while implicit interest indicators could provide about 70% accurate coverage.

Activities Captured (2nd expt)

In addition to those from the 1st expt:

❒ Mouse wheel activity.

❒ Status bar changes.

❒ Size of html file.

❒ User's self-declared familiarity with the page.

❒ Trace of mouse coordinates.

    ➥ extracted vertical movements
    ➥ extracted horizontal movements

Results of 2nd Experiment

❐ Informal observation that cursor movements formed patterns that might provide indication of interest.

  e.g., text following

❐ SAS Genmod procedure used.

❐ Horizontal movements correlate quite well with explicit interest.

❐ Total number of horizontal plus vertical movements correlate well with explicit interest.

❐ No other indicators were significant in this experiment, but visually...

  Time on page
  Time on mouse
  No. of status bar changes

Contributions

❐ correlated with explicit interest:

➥ time spent on page.

➥ amount of scrolling.

➥ mouse movement

❐ not well correlated with explicit interest:

➥ number of mouse clicks

❐ categories of implicit indicators.

❐ the Curious Browser itself.

❐ the dataset from the user experiments.

Future Work

❏ Combinations of Interest Indicators:

➥ e.g., time spent + amount of scrolling.

❏ General and personal interest prediction functions.

❏ Task dependent interpretation of Interest Indicators.

❏ Task determination from Interest Indicators.

❏ Additional Interest Indicators:

➥ e.g., bookmarking, printing,...