Receptive Users and Time-Insensitive Recommendations Improve Tool Discovery

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Outline

Motivation

Methodology

Results

Discussion

Conclusion

Motivation

Software contains many useful tools.

- *tool*: a software command or feature that accomplishes a task
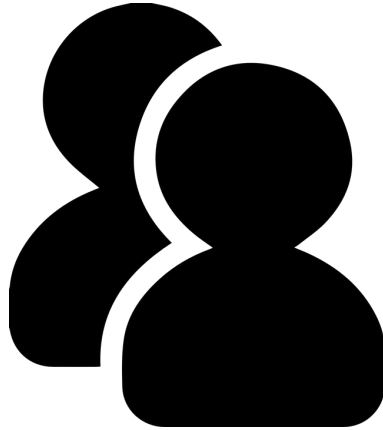
Barriers to Tool Adoption

[Davis, 2014]

Tool Discoverability

- Software Learnability [Grossman, 2009]

- Software Bloat [McGrenere, 2008]

Consequences

- Users ignore helpful tools
  – Software Engineering
    [Johnson, 2013] [Xiao, 2014]

- Wasted resources
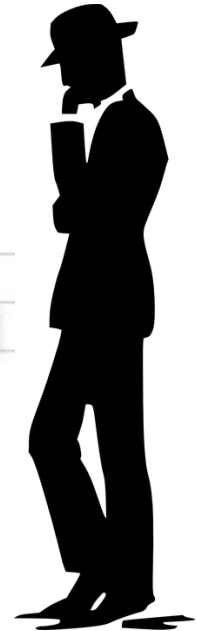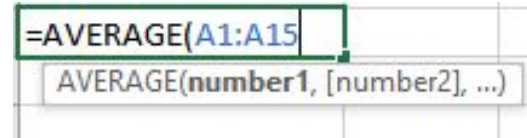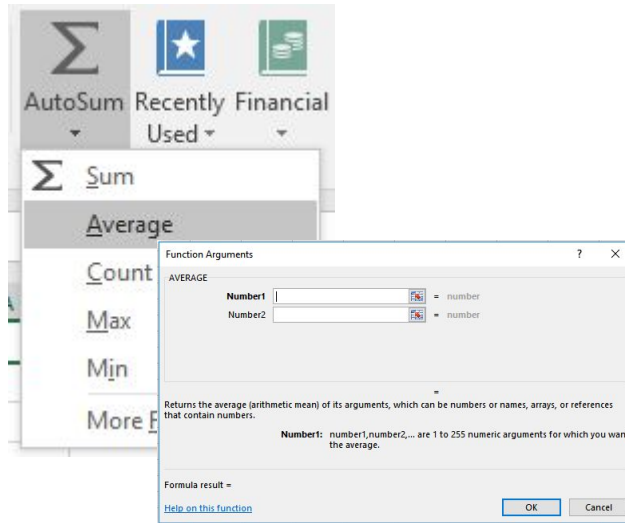 – 2.09 hours, $759 billion wasted
    [Malachowski, 2005]

Peer Interactions

- *peer interaction*: the process of discovering tools from colleagues during normal work activities [Murphy-Hill, 2011]

Peer Interaction Example

Peer Observation
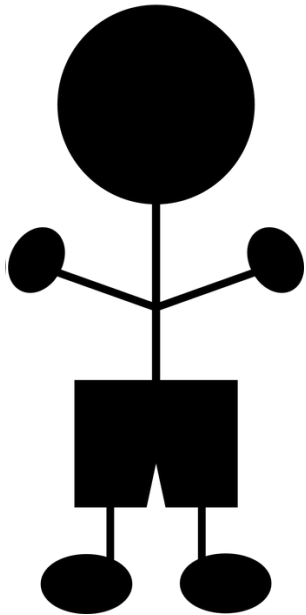
Peer Interaction Example

Peer Recommendation
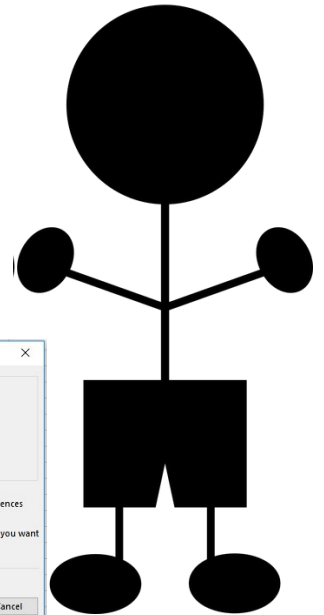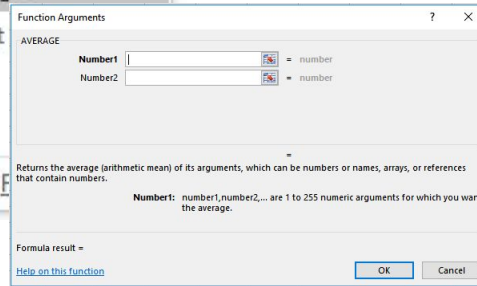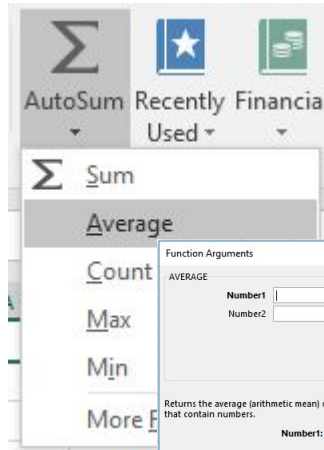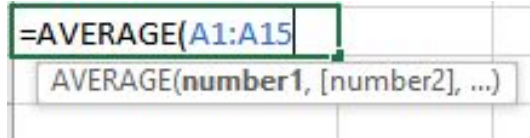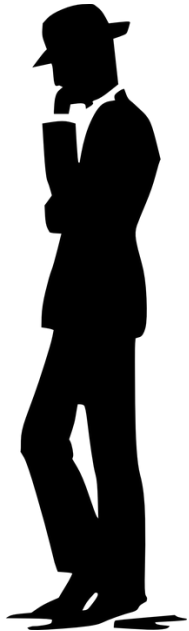
Contributions

- Analyze Peer Interactions
- Provide Implications

Research Questions

1. What **characteristics of peers** make recommendations effective?

2. What **types of tools** are most effectively recommended during peer interactions?

Characteristics of Peers

1. Politeness [Leech, 1983]
2. Persuasiveness [Shen, 2012]
3. Receptiveness [Fogg, 2009]
4. Time Pressure [Andrews, 1996]

[Murphy-Hill, 2015]

Types of Tools

1. Observable

2. Non-Observable
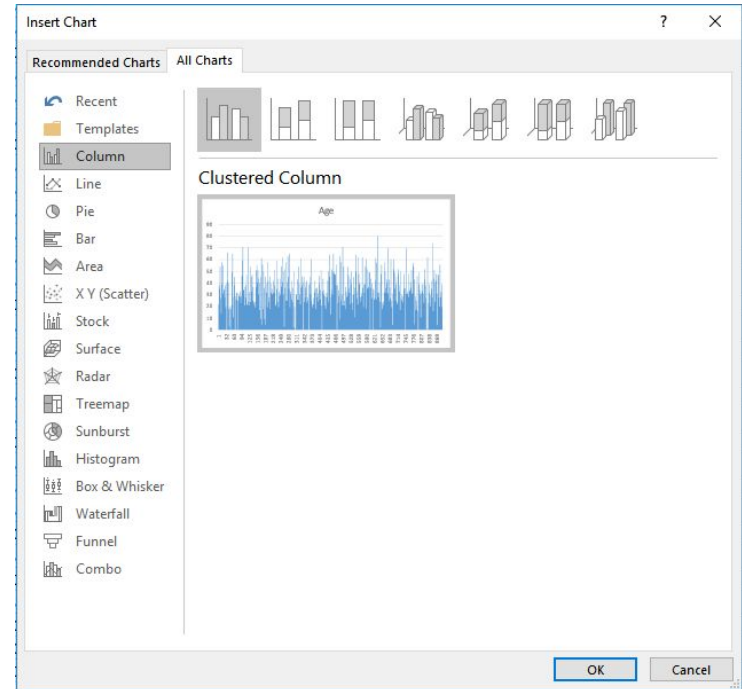
[Murphy-Hill, 2015]

Methodology: *Participants*

Phase 1

Phase 2

Methodology: *Experiment Setup*

- Participant Pairs

- Software Request

- Internet Restriction

Methodology: *Tasks*

- Preliminary Tasks
- Final Task
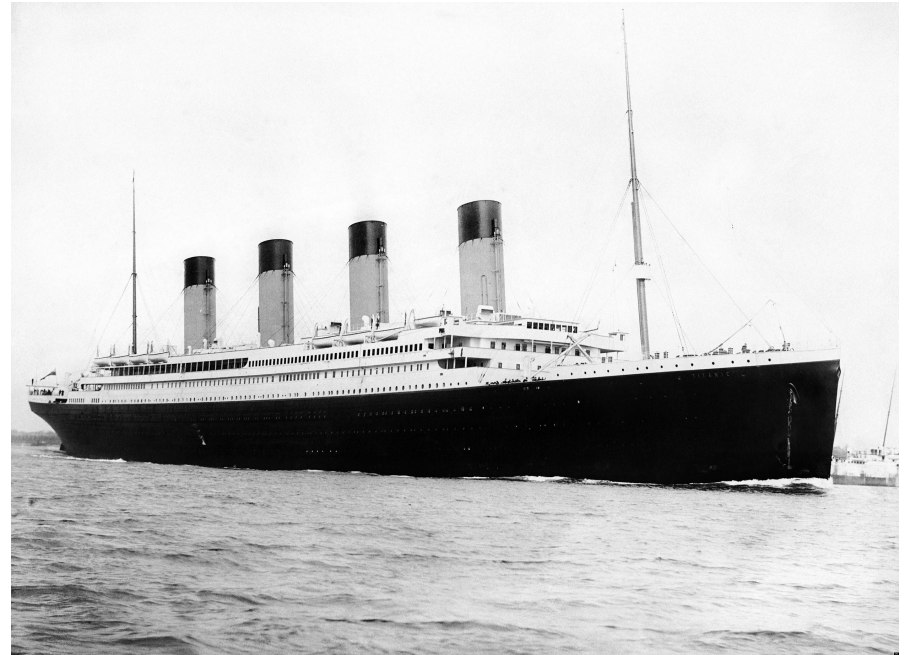
[Stuart, 1912]

Methodology: *Scoring*

Politeness, Perceived Effectiveness, Process, Receptiveness

Recommendee mostly ignores or never uses recommended tool

1 Recommendee mostly ignores or never uses recommended tool

Peer Characteristics

1. Politeness [Leech, 1983]
2. Persuasiveness [Shen, 2012]
3. Receptiveness [Fogg, 2009]
4. Time Pressure [Andrews, 1996]

Receptiveness

Criteria	Definition
Demonstrate Desire	User showed interest in discovering, using, or learning more information about the suggested tool
Familiarity	User explicitly expresses familiarity with the environment

Receptiveness

Demonstrate Desire

"Oh! Add level! Yes, awesome!" - L14

Familiarity

"I don't know R." - S9

Data Analysis
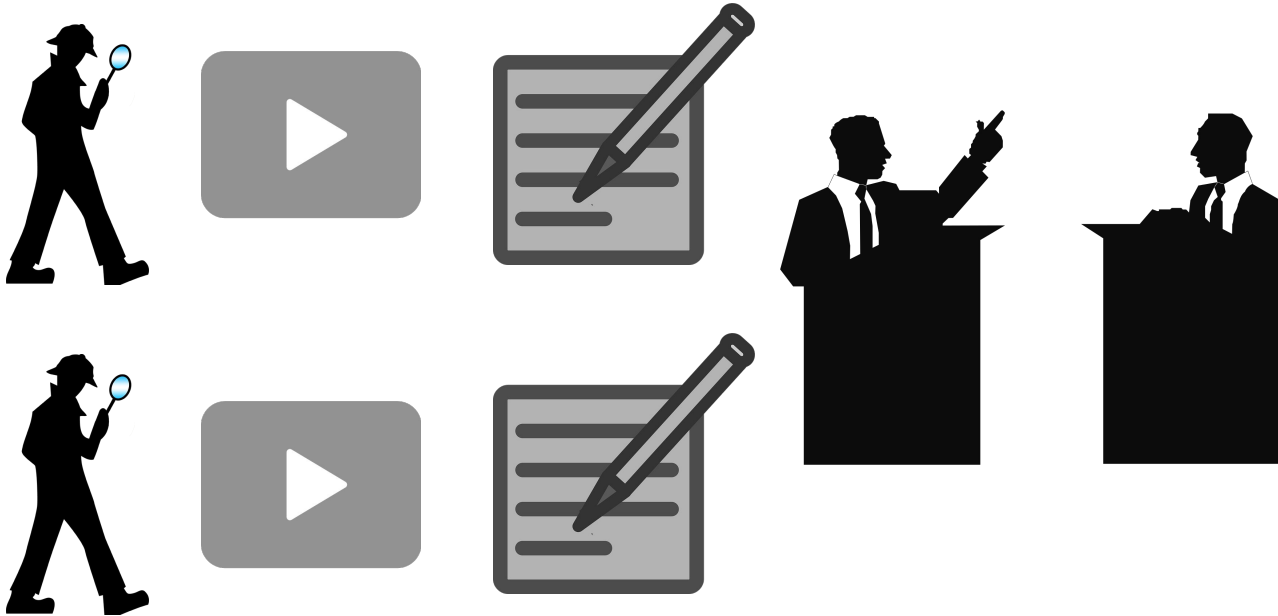
	Cohen's Kappa
Pol.	0.50
Per.	0.28
Rec.	0.51

Results

	Effective	Ineffective	Unknown	Total
n	77	37	37	151

Average = 11.62
Maximum = 28
Minimum = 5

Results: *Peer Characteristics*

	Polite	Neutral	Impolite
n	31	108	12

(p = 0.6244) [W]

	Persuasive	Unpersuasive
n	15	136

(p = 0.2191) [W]

	Receptive	Neutral	Unrecpetive
n	70	57	24

(p = 0.0003) * [W]

	Time Pressure	No Time Pressure
n	21	130

(p = 0.0283) * [C]

W = Wilcoxon rank sum, *C* = Pearson's chi-squared, * = significant

Results: *Tool Observability*

	Observable	Non-Observable
n	123	28

(p = 0.4329) [C]

W = Wilcoxon rank sum, *C* = Pearson's chi-squared, * = significant

Implications

Receptiveness

Demonstrate Desire   *Foster Familiarity*

Time Pressure

Limitations

Internal

- Microsoft Excel

- Software Request

- Criteria

- Valence Scale Scoring

External

- Long-term Adoption

- Explicit vs. Implicit

- Culture Norms

Future Work

- Integrate Results in Automated Systems

- Additional Characteristics

- Different Participant Population and Tasks

Conclusion

- Tool Discoverability

- Peer Interactions
  - Characteristics of Peers
  - Types of Tools

- Receptiveness and Time Pressure

- Prioritize Users

Thanks

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Back-Up

Recommendation Model

Task Analysis → Task Execution → Dialogue → Reaction

1. Task Analysis

Peers analyze goal and define operations to reach desired state.

2. Task Execution

Driver applies selection rule and begins executing their method.

3. Dialogue

- *Unexpected Recommendation:* Navigator interrupts to ask about unexpected tool.
- *Expected Recommendation:* Driver asks for help from navigator.
- *Unexpected Observation:* Driver explains actions and navigator reacts.
- *Expected Observation:* Navigator asks question concerning tool used.

4. Reaction

The recommendee decides whether or not to adopt the new tool.

Study Phases

Phase 1

- Students
- 6 Preliminary Tasks
- Survey sent by email

Phase 2

- LAS analysts
- 4 Preliminary Tasks
- Semi-structured interview

Politeness Criteria

Politeness Criteria		
Tact	Definition	Minimize cost and maximize benefit to peer
	Polite	"We can do all of it together, just sort by level." - S9
	Impolite	"We can do a histogram...which is always sort of a pain in the butt to do in Excel." - L14
Generosity	Definition	Minimize benefit and maximize cost to self
	Polite	"CONCATENATE you can do. I can do this for you, very easily." - S10
	Impolite	"Maybe you should write a python script for this." - L6
Approbation	Definition	Minimize dispraise and maximize praise of peer
	Polite	"I'm not as good at the Excel stuff as you are." - L5
	Impolite	"This is useless." - S14
Modesty	Definition	Minimize praise and maximize dispraise of self
	Polite	"From whatever limited knowledge of data analysis I have, I think you need to create a linear regression model..." - S14
	Impolite	"I'm very good at Paint." - S10
Agreement	Definition	Minimize disagreement and maximize agreement between peers
	Polite	"Do you want to use Python?" - S8
	Impolite	"No, no, no...Don't you want it comma separated? That's what I'm doing." - S14
Sympathy	Definition	Minimize antipathy and maximize sympathy between peers
	Polite	"We can try JMP..." ["I haven't done anything in JMP."] "Neither have I!" - L14
	Impolite	"It doesn't matter how you do it." - L16

Persuasive Criteria

Persuasiveness Criteria		
Content	Definition	Recommender provides credible sources to verify use of the tool
	Persuasive	"Go here, go to Data. Highlight that...Data, Sort, and it lets you pick two." - L8
	Unpersuasive	"Let's try to text filter, right?" - S5
Structure	Definition	Messages are organized by climax-anticlimax order of arguments and conclusion explicitness
	Persuasive	"I know that SUMIF is a type of function that allows you to combine the capabilities of SUM over a range with a condition that needs to be met." - S3
	Unpersuasive	"There's a thing on Excel where you can do that, where you can say if it is this value, include, if it is not, exclude...Yeah, IF." - S11
Style	Definition	Messages should avoid hedging, hesitating, questioning intonations, and powerless language
	Persuasive	"Control-Shift-End" - S1
	Unpersuasive	"I guess we're going to have to use some math calculations here, or a pivot table." - L9

Receptiveness Criteria

Receptiveness Criteria		
Demonstrate Desire	Definition	User showed interest in discovering, using, or learning more information about the suggested tool
	Receptive	"That was cool, how [the column] just populated." - S4
	Unreceptive	"No, don't do a sort. Use a filter." - S10
Familiarity	Definition	User explicitly expresses familiarity with the environment
	Receptive	"Control shift...how do I select it completely?" - S2
	Unreceptive	"I've never done anything in JMP." - L10

Time Pressure

Criteria	Definition
Time Pressure	Driver, navigator, or moderator makes a statement about time before or during a recommendation

Results: *Students vs. LAS*

Phase	Effective	Ineffective	Unknown	Total	Average
1	50	23	30	104	14.9
2	26	14	7	47	7.8

Results: *Students vs. LAS*

	Polite	Neutral	Impolite
Phase 1	19	78	7
Phase 2	12	30	5

	Receptive	Neutral	Unreceptive
Phase 1	40	44	20
Phase 2	30	13	4

	Persuasive	Unpersuasive
Phase 1	11	93
Phase 2	4	43

Time Pressure?	Yes	No
Phase 1	11	93
Phase 2	4	43

Results: *Students vs. LAS*

	Observable	Non-Observable
Phase 1	83	21
Phase 2	40	7

RQ1: *Politeness*

Politeness	Effective	Ineffective	Unknown
Polite	52% $(n = 16)$	19% $(n = 6)$	29% $(n = 9)$
Neutral	51% $(n = 55)$	26% $(n = 28)$	23% $(n = 25)$
Impolite	50% $(n = 6)$	25% $(n = 3)$	25% $(n = 3)$

$(p = 0.6244)$ ^{W}

W = Wilcoxon rank sum, *C* = Pearson's chi-squared, *** = significant

RQ1: *Persuasiveness*

Persuasiveness	Effective	Ineffective	Unknown
Persuasive	33% $(n = 5)$	33% $(n = 5)$	33% $(n = 5)$
Unpersuasive	53% $(n = 72)$	24% $(n = 32)$	24% $(n = 32)$

(p = 0.2191) [W]

W = Wilcoxon rank sum, *C* = Pearson's chi-squared, *** = significant

RQ1: *Receptiveness**

Receptiveness	Effective	Ineffective	Unknown
Receptive	61% ($n = 43$)	13% ($n = 10$)	24% ($n = 17$)
Neutral	49% ($n = 28$)	25% ($n = 14$)	26% ($n = 15$)
Unreceptive	25% ($n = 6$)	54% ($n = 13$)	21% ($n = 5$)

(p = 0.0003)* ^{W}

W = Wilcoxon rank sum, **C** = Pearson's chi-squared, ***** = significant

RQ1: *Time Pressure**

Time Pressure?	Effective	Ineffective	Unknown
Yes	33% $(n = 7)$	43% $(n = 9)$	24% $(n = 5)$
No	54% $(n = 70)$	22% $(n = 28)$	25% $(n = 32)$

(p = 0.0283)* [C]

W = Wilcoxon rank sum, ***C*** = Pearson's chi-squared, ***** = significant

RQ2: *Tool Observability*

Tool Type	Effective	Ineffective	Unknown
Observable	50% ($n = 62$)	26% ($n = 32$)	24% ($n = 29$)
Non-Observable	54% ($n = 15$)	18% ($n = 5$)	29% ($n = 8$)

(p = 0.4329) [C]

W = Wilcoxon rank sum, *C* = Pearson's chi-squared, *** = significant

Additional Results

Type	Effective	Ineffective	Unknown
POE	17% $(n = 1)$	0% $(n = 0)$	83% $(n = 5)$
PRE	67% $(n = 6)$	22% $(n = 2)$	11% $(n = 1)$
POU	32% $(n = 15)$	11% $(n = 5)$	57% $(n = 27)$
PRU	62% $(n = 55)$	34% $(n = 30)$	5% $(n = 4)$

Interaction: *p = (0.2597)* [c]

Expectation: *p = (0.4235)* [c]

Qualitative Results

- Why did you decide to make this recommendation?
  - 69%

- Why did you phrase it this way?
  - 74%