Discovering Affect-Laden Requirements to Achieve System Acceptance

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Software Architecture for Mental Health Self Management (**SAMS**)
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School of Computing and Communications

Dementia

- c. 900,000 people affected in the UK
  - Projected to reach over 1 million by 2021
  - Annual cost currently c. £23 billion
- Only 44% of people receive a diagnosis
  - Diagnosis is often late
- Being able to monitor the progression of dementia from the early ‘preclinical’ or ‘prodromal’ (e.g. MCI) stage is of potential benefit for prognosis of how the condition is likely to develop
- It also opens up the possibility of intervening with disease-modifying therapies, which may slow the progression

Neuropsychological deficits characteristic of dementia

- Deficits in attention, motor control, executive function, memory and language.
- Normally tested at a memory clinic by a range of paper-based tests, e.g. Montreal Cognitive Assessment (MoCA).

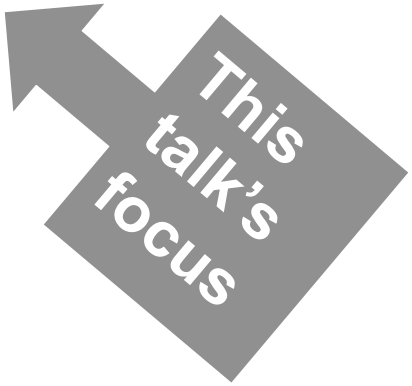
- Several online tests are available too, e.g. Cognitive Testing on Computer (CTOC).
- Most have reasonably good fidelity, but are vulnerable to **sampling errors** and rely on the person affected **taking the initiative**

SAMS' aim

- To collect evidence of cognitive health by monitoring a person's interaction with their computer
- Notify if something seems wrong
  - Avoids the self-referral problem
  - Strong ecological validity, lessens the sampling error problem
  - It has become common for older people to use computers and the Internet

The challenge

- Mapping what we can observe to the clinical indicators of cognitive decline
- Combining these to make a robust conclusion about the user's health
- Overcoming the barriers to adoption



Contributions

- Understanding the requirements
  - Insights into what will make people accept or reject systems that they aren't obliged to use, in affect-laden domains
- What is the method?
  - For understanding the requirements

Elicitation

- 5 workshops
  - 14 M, 10F, age 60-75
  - 2 facilitators, + 1 or 2 AS or DeNDRoN
  - Presentation of SAMS + design choices
  - Discussion of privacy & security, ethical issues, motivations & emotional reactions
- 13 interviews, following-up on themes to emerge form workshops
  - 4 M, 9 F, age 67-89
  - Probed barriers to adoption, reaction to monitoring, likelihood of acting on warning
  - Audio-recorded. Participant kept recorder for 1 week to add thoughts

Analysis

- Conventional analysis
  - consulting notes, listening to recordings, identifying issues and requirements
- Thematic analysis of transcribed recordings
  - Data-driven analysis
    - Follow the themes in the subjects' contributions
  - Hypothesis-driven analysis
    - Mine themes of possible significance

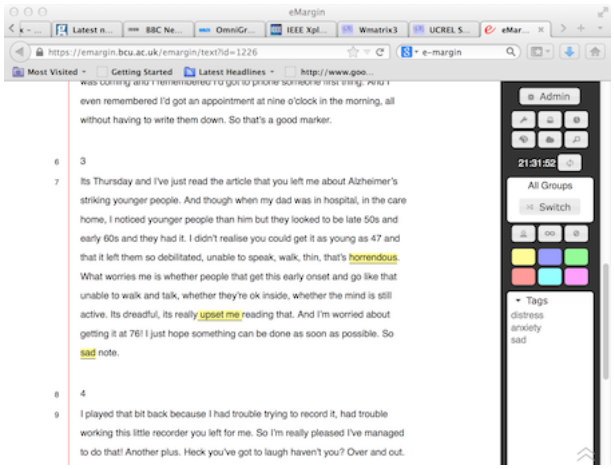
Thematic analysis

- Two sets of tags used
  - Set of markup codes tailored to SAMS domain, applied **manually** at the sentence or paragraph level.
  - General-purpose semantic (word class) tags, applied at the word level using **automatic** tagging and investigated in a **supervised** way.

Tailored manually-applied tags

Questions of the interviewer	These were to do with *monitoring privacy* issues, clarification of the *scenarios* being presented, or *other*
Reaction to scenario Qs	Classified as *positive*, *negative* or *neutral*
Reaction to issue Qs	Also classified as *positive*, *negative* or *neutral*
Justification	For the responses given
Reflection	Classified as *general*, *personal history* (dementia experience, kin, etc.) or *self*
Computer experience	Classified as *general* (novice/expert), *use-specific episodes*, *devices and applications*, kinds of *activity.*
Other conversation	

VME tags	
Values	privacy, security, trust, cooperation, empathy, ethics
Motivations	well-being, altruism, self control, curiosity
Emotions	anger, anxiety, fear, frustration, distress, hate, guilt, relief, sadness



General-purpose automatically-applied tags

- USAS semantic tag set
  - c. 270 tags, of which this frequency list derived from the interviews represents just a few .. …

			Item	O1	%1	O2	%2	LL	
1	List1	Concordance	Y2	215	0.76	480	0.05 +	704.74	Information technology and computing
2	List1	Concordance	A7+	893	3.15	15034	1.53 +	358.66	Likely
3	List1	Concordance	X2.2+	358	1.26	5481	0.56 +	178.72	Knowledgeable
4	List1	Concordance	A1.5.1	142	0.50	1213	0.12 +	175.06	Using
5	List1	Concordance	Z6	894	3.16	19932	2.03 +	146.77	Negative
6	List1	Concordance	Z8	5853	20.67	172345	17.54 +	144.97	Pronouns
7	List1	Concordance	Q1.3		0.36	783	0 +	141.28	Telecommunications
8	List1	Concordance	X2		0.09	12		132.81	Mental actions and processes
9	List1	Concordance	A1		.11	5457		116.42	Degree: Boosters
10	List1	Concordanc			87			97.96	Objects generally
11	List1	Conc						88.25	Investigate, examine, test, search
12	List1						0.01	85.37	Alive
13	Li					24	0.10 +	82.76	Medicines and medical treatment
14	L					7031	0.72 +	74.60	Thought, belief
15	Li					115	0.01 +	69.22	Games
16	Lis					0	0.00 +	57.20	Degree
17	List					1056	0.11 +	57.01	Difficult
18	List					7	0.00 +	54.99	Seem
19	List1					1105	0.11 +	52.62	Language, speech and grammar
20	List1				58	88	0.01 +	52.22	Unwanted
21	List1				0.22	733	0.07 +	49.58	Worry
22	List1			18	0.06	76	0.01 +	41.21	Like
23	List1			66	0.23	959	0.10 +	36.70	Disease
24	List1	C		137	0.48	2728	0.28 +	34.20	People
25	List1	Co	S1.2	10	0.04	22	0.00 +	33.00	Personality traits

Ranked by deviation from expected frequency, not by raw number of occurrences

Can inspect words corresponding to a semtag, and their context

Word	Semtag	Frequency	Relative Frequency	
worry	E6-	11	0.04	Concordance
worried	E6-	10	0.04	Concordance
concerned	E6-	9	0.03	Concordance
uneasy	E6-	4	0.01	Concordance
anxious	E6-	4	0.01	Concordance
worrying	E6-	3	0.01	Concordance
concerned_with	E6-	2	0.01	Concordance
caring	E6-	2	0.01	Concordance
concerns	E6-	2	0.01	Concordance
distress	E6-	2	0.01	Concordance
stress	E6-	1	0.00	Concordance
unnerving	E6-	1	0.00	Concordance
niggling	E6-	1	0.00	Concordance
worries	E6-	1	0.00	Concordance
unease	E6-	1	0.00	Concordance

So I 'm used to the expectation at something one day will pop up to say please come for a further test . So I think while I would be **worried** it would be , I would be capable of controlling my anxiety sufficiently to go to the test

If my computer gets hacked into what happens ? It might have consequences as far as financial sense I 'm concerned or something like that , which I 'm inclined to be **worried** about . Its complicated is n't it ?

Data-driven analysis

Word-sense clouds

Interviews

Solution domain focus

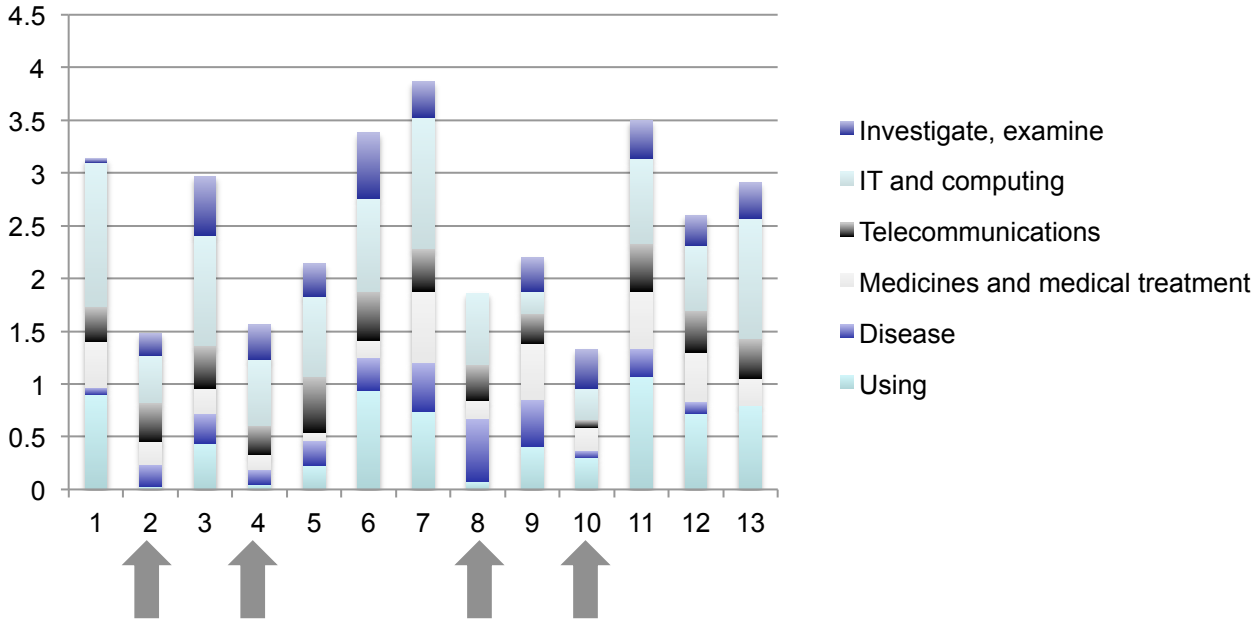
Problem domain focus

Post-interview recordings

Can drill into individuals' contributions ….

Respondents' interview contributions

- w.r.t. most significant tags:



Respondents making relatively little contribution?
What does it mean?
Sometimes they just didn't say much.
Sometimes they were simply preoccupied with other things.

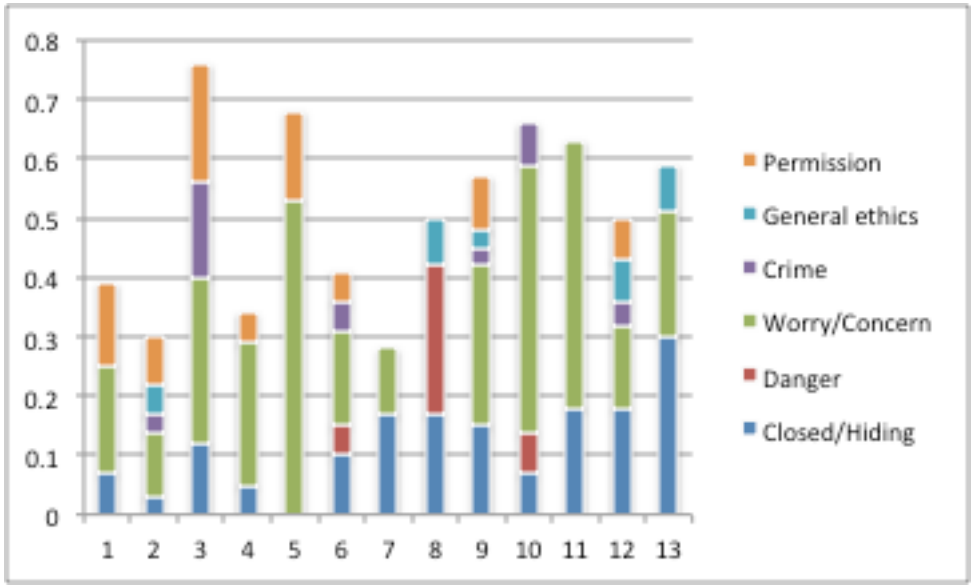
Manual discourse function analysis

Resp. no.	Qs	Net reaction		Net valency
		privacy	scenarios	
1	19	1	7	8
2	14	-1	7	7
3	43	0	-1	-1
4	10	-1	-2	-3
5	13	1	-4	-4
6	14	6	5	11
7	29	6	6	12
8	9	6	9	15
9	37	-1	0	-1
10	9	3	4	7
11	16	8	2	10
12	22	1	5	6
13	12	-1	-2	-3
Totals		+28	+34	

Negative valency – What does this mean?

Filtering on privacy and security-related USAS tags

- Needs care – expressions of **Worry/ Concern** from 5 and 11 overwhelmingly related to fear of illness, not fear of loss of privacy or data
- 3, 9, 10 and 13 were the most concerned about privacy and security



Hypothesis-driven analysis

Focus on Values, Motivations and Emotions (VME)

- We conjecture that a low level of emotional engagement suggests someone will be a reluctant adopter
- To discover respondents' VME engagement we performed
  - Manual analysis
  - Automatic tagging and supervised investigation

Manual analysis

Resp. no.	Interview emotion	Post interview emotion	Net affect
1	0	6	6
2	5	1	6
3	5	3	8
4	0	No data	0
5	4	8	12
6	0	0	0
7	0	0	0
8	3	4	7
9	4	4	8
10	4	No data	4
11	3	7	10
12	1	1	2
13	1	No data	1
Totals	30	34	64

Most commonly occurring VME values:

- **Values**: privacy/security
- **Motivations**: altruism (to aid research)
- **Emotions**: anxiety, distress, sadness, frustration

Relatively low emotional response

Automatic analysis

Compared to instances of Emotions in manual VME analysis, the automatic technique performed with 75% recall and 27% precision

- Subset of USAS tags
  - Emotions only - no USAS tags correspond well to Values or Motivations

			Item	O1	%1	O2	%2	LL	
1	List1	Concordance	E6-	62	0.22	733	0.07 +	49.58	Worry
2	List1	Concordance	E2++	18	0.06	76	0.01 +	41.21	Like
3	List1	Concordance	E6+	27	0.10	292	0.03 +	24.66	Confident
4	List1	Concordance	E4.2-	8	0.03	88	0.01 +	7.13	Discontent
5	List1	Concordance	E4.1+	36	0.13	782	0.08 +	6.57	Happy
6	List1	Concordance	E4.2+	1	0.00	178	0.02 -	4.90	Content
7	List1	Concordance	E4.1+++	1	0.00	2	0.00 +	3.44	Happy
8	List1	Concordance	E2+++	4	0.01	47	0.00 +	3.23	Like
9	List1	Concordance	E1	1	0.00	137	0.01 -	3.09	Emotional Actions, States And Processes General
10	List1	Concordance	E4.1-	18	0.06	400	0.04 +	3.00	Sad
11	List1	Concordance	E2-	13	0.05	286	0.03 +	2.26	Dislike
12	List1	Concordance	E3+	9	0.03	207	0.02 +	1.29	Calm
13	List1	Concordance	E3-	22	0.08	959	0.10 -	1.21	Violent/Angry
14	List1	Concordance	E4.1++	1	0.00	10	0.00 +	1.02	Happy
15	List1	Concordance	E2+	60	0.21	2255	0.23 -	0.38	Like
16	List1	Concordance	E5+	1	0.00	55	0.01 -	0.24	Bravery
17	List1	Concordance	E5-	11	0.04	398	0.04 -	0.02	Fear/shock

What we learned (1)

- The conventional analysis revealed most of the key requirements
- The thematic analysis gave us more insights into the role of values, motivations and emotions in probable system acceptance

What we learned (2)

- Obstacles to adoption:
  - Privacy and security concerns
    - **Evidenced by -ve valency in the interviews**
    - Anonymize data, off switch, user-authored text only (c.f. email), quantitative analysis only
  - Reluctance or indifference
    - **Little contribution in interviews or post-interview recordings**
    - Dialogue-based interaction (e.g. use empathic avatar?)
    - **Little value or emotional engagement**
    - Work on motivation (e.g. explain more, praise?)

What we learned (3)

- Valenced reaction to design options seems robust
  - Unexpected correlation between question asking and –ve valence
  - Potential for sentiment analysis?
- Automatic, data-driven analysis:
  - *Slicing and dicing* – e.g. different foci of different elicitation sessions
  - Supported the manual analysis of VME

What we learned (4)

- The manual analysis is time consuming
  - For the 13 respondents
    - c. 2 weeks' of work
- The tool is much faster
    - c. 1 day of work
  - Care needed in interpretation of results
  - Best for spotting patterns, "following the data", rapidly testing hypotheses

Conclusions

- We propose a method for discovering requirements for a novel class of application
- Combines conventional elicitation techniques with close textual analysis, using tool support where useful
- Has yielded insights. How useful these turn out to be is untested as yet