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## Recommender Systems For Computer Tailored Health Communications

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# Recommender Systems For Computer Tailored Health Communications

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# Computer Tailored Health Communication (CTHC)

- Personalizing health communications to individual patients using computer programs
- Collect baseline subject “profiles” consisting of demographic and domain specific information

## Subject Profile



Gender: Female  
Age: 20-29  
Readiness to Quit: High  
Cigarettes per day: 2

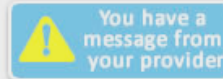
## Subject Profile



Gender: Male  
Age: 60-69  
Readiness to Quit: Medium  
Cigarettes per day: 6

# Example CTHC Intervention

DECIDE 2QUIT



How do I use this site?

Home

My Health Risks

Thinking About Quitting

Family Tools

Health Provider Tools

The Library

Web Resources

Log out



## Our Advice

Useful hints from ex-smokers and experts! Check back often for updates.

### A Message from Decide2Quit

#### Take two deep breaths and call me in the morning

If you are having trouble with stress, your healthcare provider is there to help. They are a valuable resource and have options that can help you stay smoke-free while dealing with stress.

### A Message from your peer

#### Stop, think, learn: A Message from Your Online Community

Wendall, a 49-year-old, found that when he slipped and smoked it was helpful to... think about what made you pick up and then get back on track by fixing that problem and starting over again.

If you happen to slip and smoke, remember that this is a normal part of the quitting process. Reflect on what made you smoke and prepare for how you can handle the situation without smoking.



## My Mail



Know Your Advisor  
Heather

Communicate with your advisor! Use the boxes below to type your message. Don't forget to check your inbox to reply to received messages!

### Subject

(You are limited to only 100 characters including spaces.)

### Message

(You are limited to only 1500 characters including spaces. Red background indicates you have exceeded the limit.)

SEND MESSAGE

### RECENT MAIL FROM ADVISOR

Subject: test

Message: test



## Your Online Community

Decide2Quit partnered with Become An Ex - an online community of people helping others quit! Here are a few recent posts. Use the link below to read more.

Setting up profile in preparation



I am 50 yrs old and soooo sick of being a smoker. When I wake in the morning I will begin my 3 days of tracking cigarettes. In the past, I just quit. I like this programs 3 days of...

[More...](#)

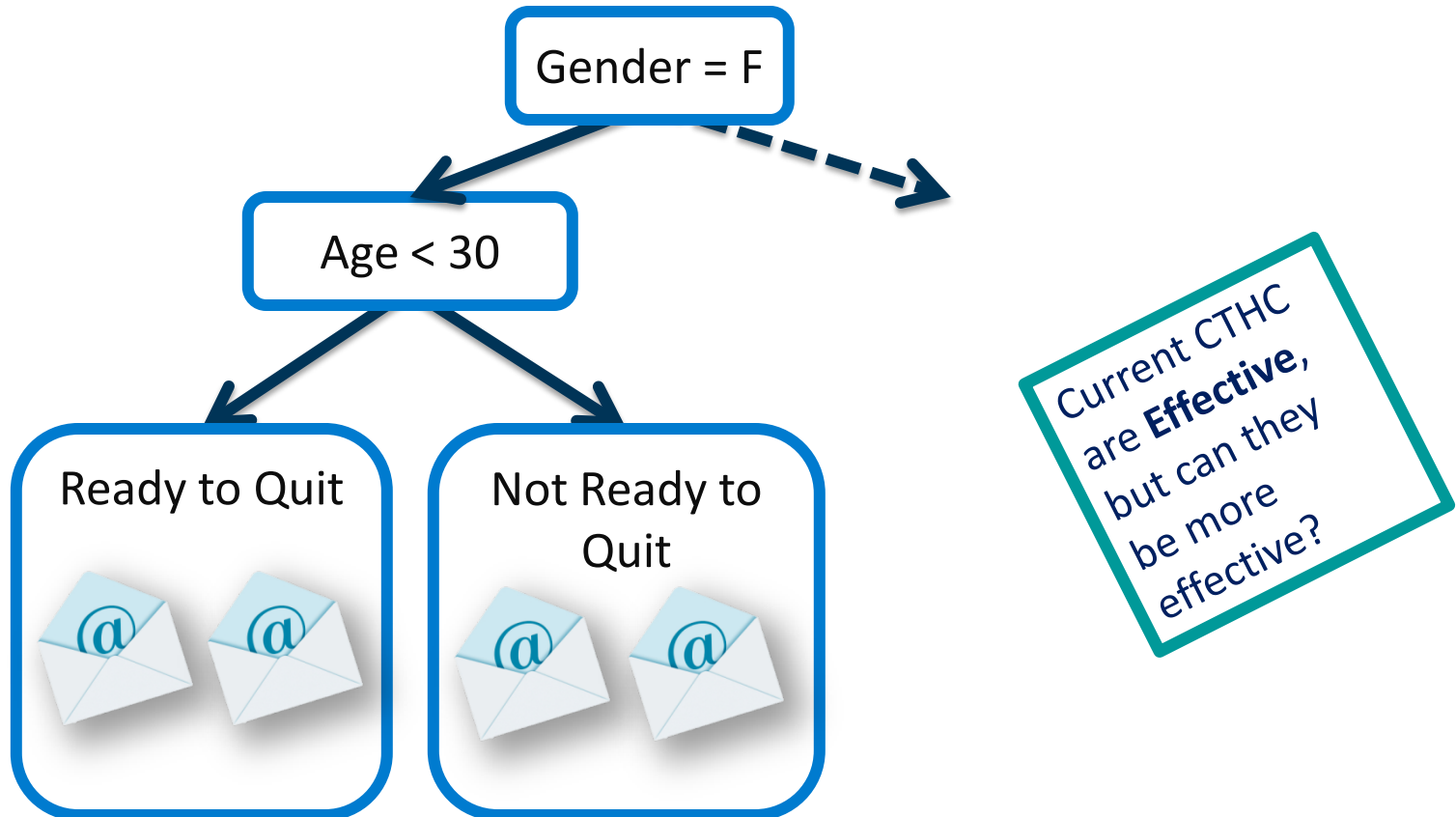
[New Here](#)

[New here today and thinking about quitting!](#)

VIEW ALL >>

# Current State of the Art

- Behavioral experts write rule-based systems to select messages by matching subject profiles to message content.



# Limitations of CTHC Systems

- The rules may fail to capture concepts that are important and relevant to individual subjects or patient sub-populations.
- There is no mechanism for adapting the rule to better serve the users over time.
- Cannot easily develop high-tailoring interventions

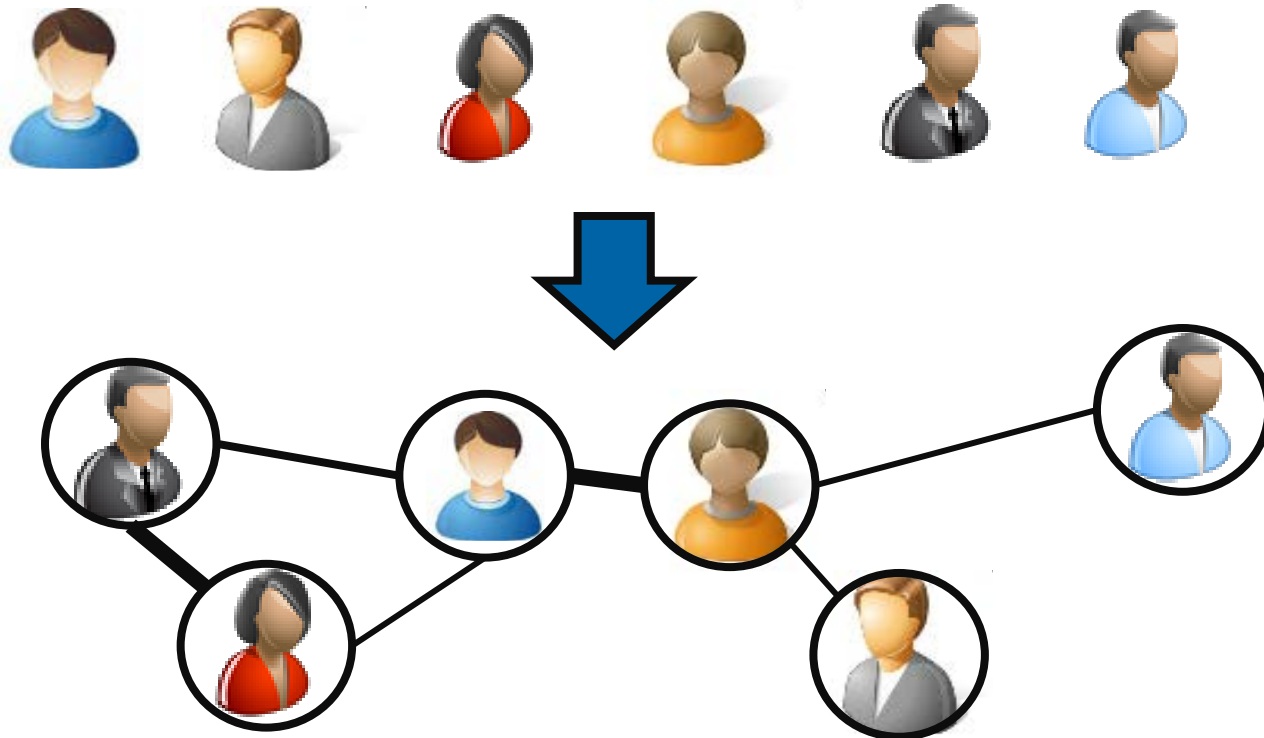
# Collaborative Filtering Recommenders Systems

- Explicit or implicit user feedback from a large community of users has been used successfully to personalize product recommendations in internet-based systems.

The Google logo, featuring the word "Google" in its characteristic multi-colored font (blue, red, yellow, blue, green, red).The Amazon.com logo, featuring the word "amazon.com" in black, lowercase, sans-serif font, with a yellow curved arrow underneath the "a" pointing to the "z".

# Collaborative Filtering Recommenders Systems

- Collaborative filtering systems work by identifying user's with similar preferences. The assumption is that if a user like you liked an item, you'll like it to.





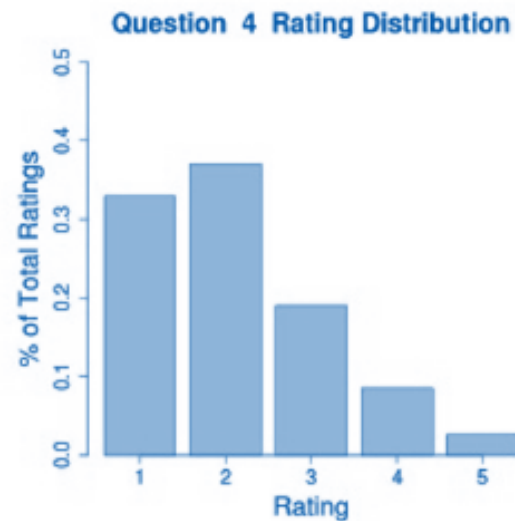
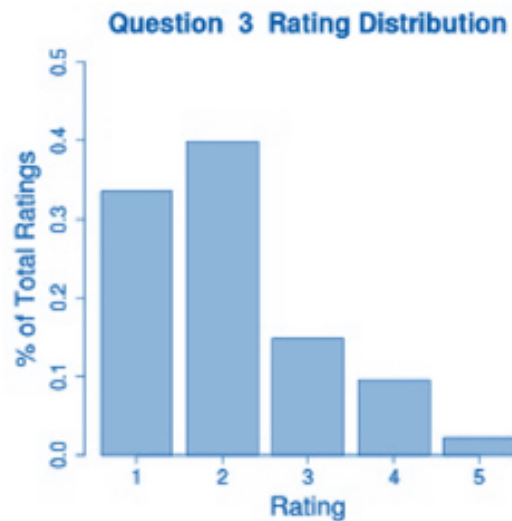
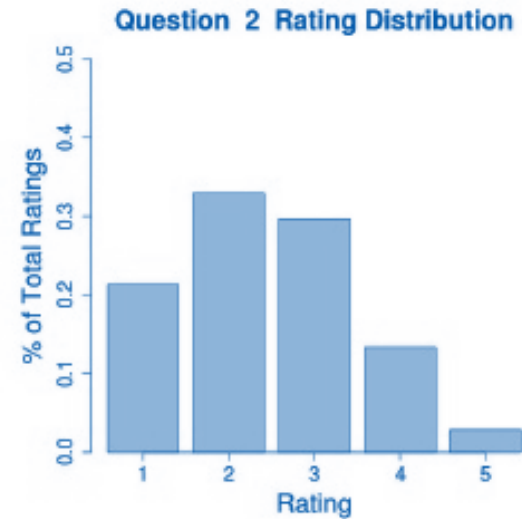
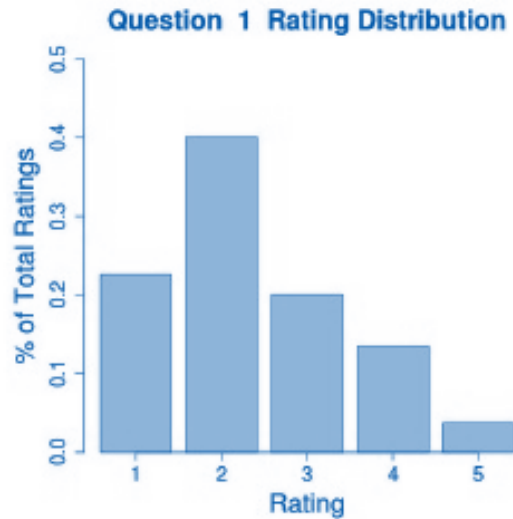
# Collaborative Filtering CTHC

- **Deploying collaborative filtering recommender systems in the CTHC case involves several challenges:**
  - Unclear what aspect of messages users should be rating (preference, relevance, influence, emotional impact,...)
  - Small data set sizes when system first start's operating
  - Limited interaction with user (one message rating per day)
- **We are exploring several solutions to these issues:**
  - Pre-pilot study to assess four possible questions
  - Development of a hybrid system that uses explicit ratings, implicit data from website visits, user profile information and message content information.

# Pre-Pilot Data Collection

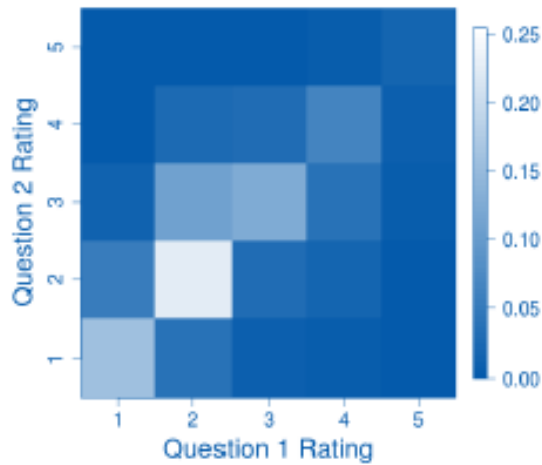
- 100 subjects each supplied ratings for four aspects of five randomly selected messages from a pool of 50 messages.
- We had subjects rate the following four message aspects:
  - Question 1: This message influences me to quit smoking
  - Question 2: This message affected me emotionally
  - Question 3: This message was relevant to my everyday life
  - Question 4: I would like more messages like this one
- Analyzed the resulting data for quantitative difference between questions as well as ability to predict ratings.

# Initial Results: Marginal Rating Distributions

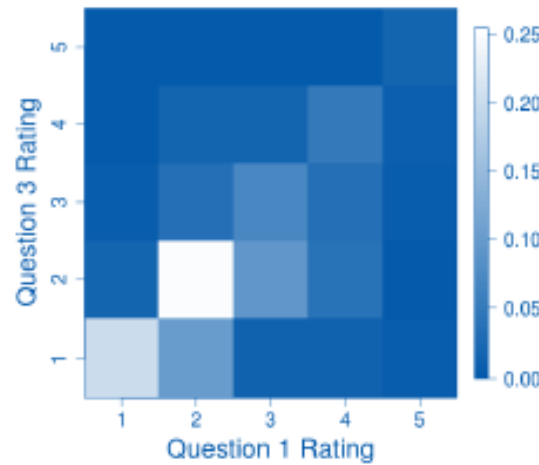


# Initial Results: Joint Rating Distributions

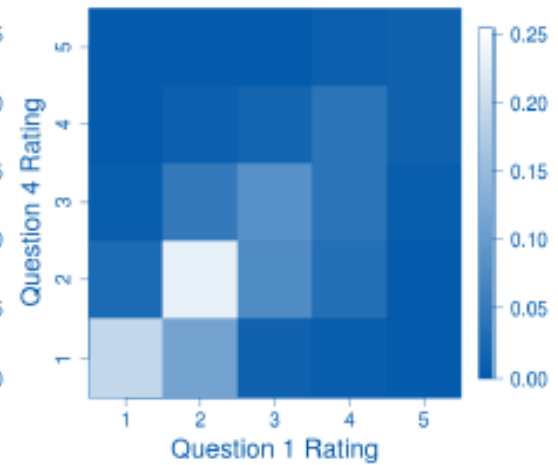
Joint Histogram of Q1 and Q2



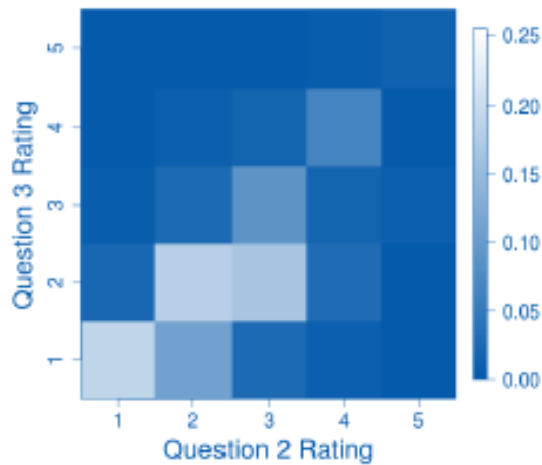
Joint Histogram of Q1 and Q3



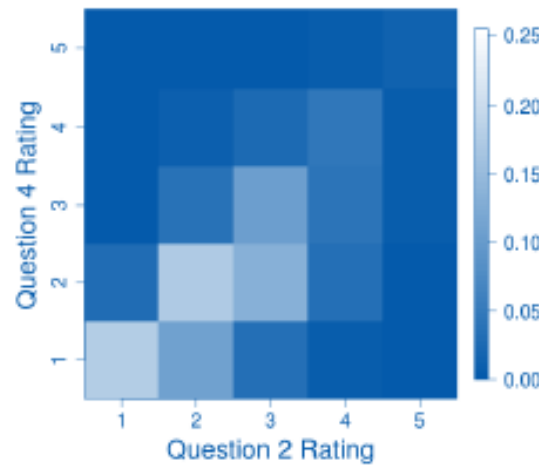
Joint Histogram of Q1 and Q4



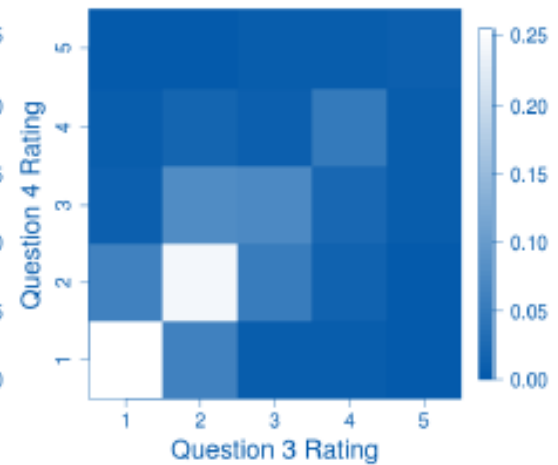
Joint Histogram of Q2 and Q3



Joint Histogram of Q2 and Q4

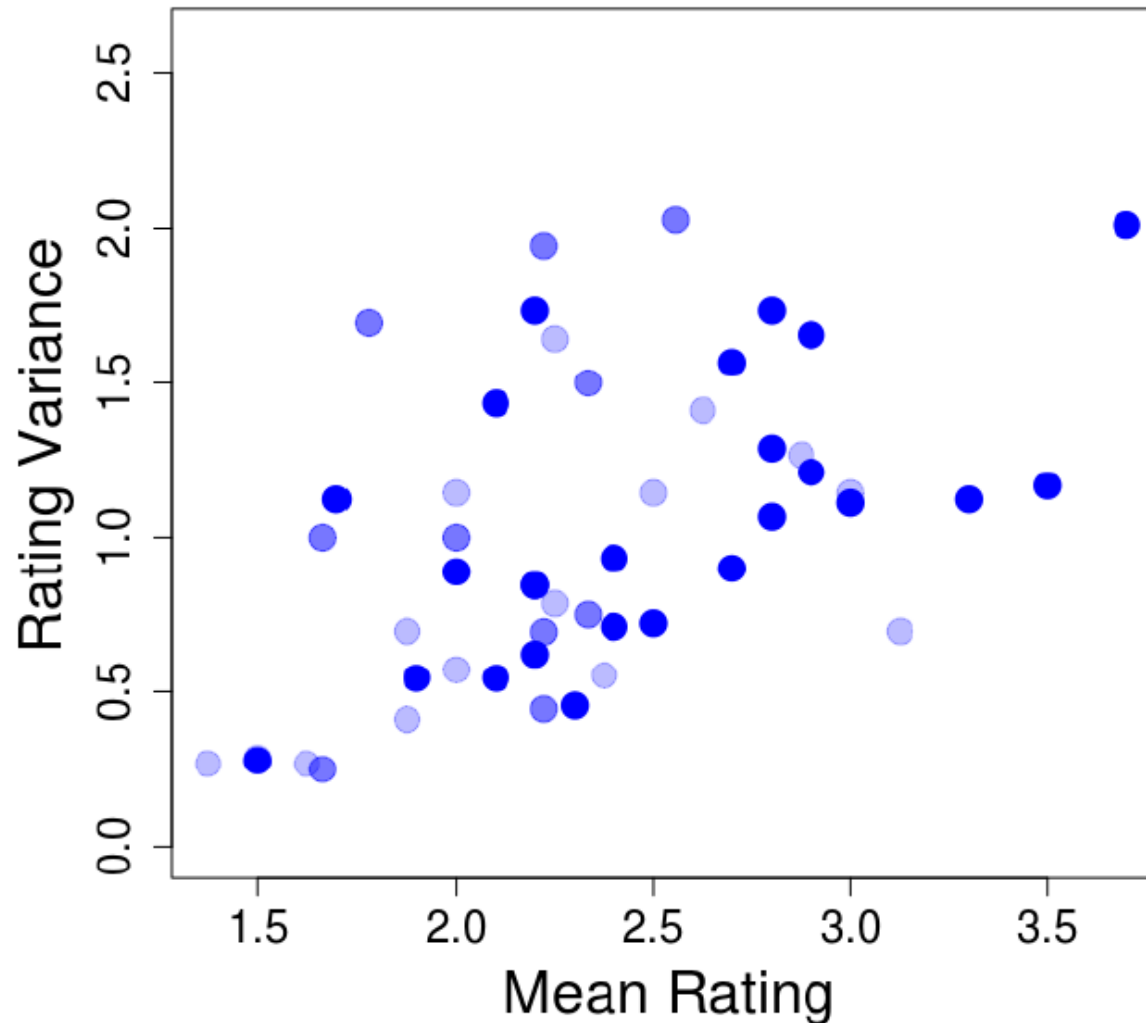


Joint Histogram of Q3 and Q4



# Initial Results: Variance vs Mean by Message

## Mean Rating v Rating Variance (Q1)



# Initial Results: Rating Prediction

- We assess rating prediction accuracy by holding out some rating values, using a model to predict their values and then computing the average prediction error. The model can base predictions on different information sources.

Question	B	BU	BM	BF	BUM	BUF	BMF	BUMF
Q1: Influence	0.8783	0.8663	0.8783	0.7672	0.8667	0.7612	0.7734	0.7612
Q2: Emotion	0.8929	0.8746	0.8929	0.7893	0.8747	0.7547	0.7766	0.7538
Q3: Relevance	0.7648	0.7649	0.7648	0.7655	0.7637	0.7556	0.7656	0.7510
Q4: Preference	0.8844	0.8915	0.8860	0.8327	0.8913	0.8551	0.8350	0.8506

B: Bias term, U: User profile information, M: Message content information, F: Latent factors

# Conclusions

- Rating data from different questions are highly correlated
- The data indicate that there is a possibility for personalization
- Initial predictive results are positive

# Next Steps

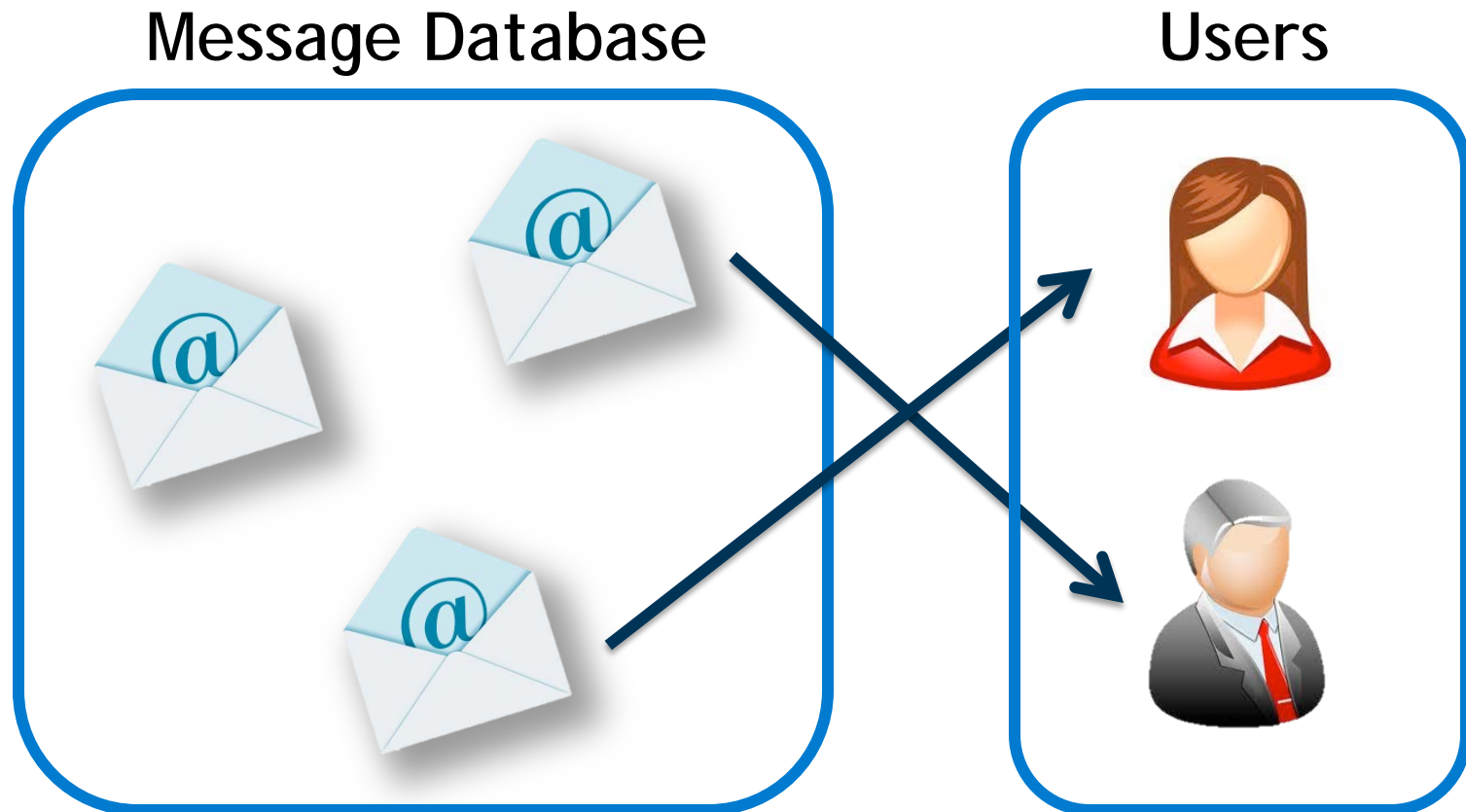
- Launched an expanded rating data collection effort - 20 ratings per user from 700 users
- Estimate a more detailed model which will be deployed and tested as part of a recommendation system within Decide2Quit.org.
- Evaluate the system in terms of the ratings users supply for the messages the system selects for them.





# Computer Tailored Health Communication (CTHC)

- Induce the adoption of healthy behaviors by sending personalized health communication messages to individual subjects.



# Computer Tailored Health Communication (CTHC)

- **CTHC Applications:** There are many possible applications of CTHC systems.



**Healthy Eating**



**Medication  
Compliance**



**Smoking  
Cessation**

# Computer Tailored Health Communication (CTHC)

## ■ Example Messages:



**Breathing gets easier:** *Everyone knows that smoking is bad for you. However, after you quit you may notice that you can breathe better and that you have more energy. Quitting also lowers your risk of getting cancer from smoking.*



**Why quitting makes you look younger:** *Smoking ages. It ages women's skin more than men's. After you quit smoking, your skin will begin to look younger. Your complexion will be a healthier color within weeks.*



**Dying from Smoking:** *Did you know? Each year 440,000 U.S. adults die from smoking. This means that smoking plays a part in 1 out of every 5 deaths.*