



# Understanding Client Support Strategies to Improve Clinical Outcomes in an Online Mental Health Intervention

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Prerna Chikersal, Danielle Belgrave, Gavin Doherty,  
Angel Enrique, Jorge E. Palacios, Derek Richards,  
and Anja Thieme



Microsoft  
Research



SilverCloud



The University of Dublin



# Outline

- Problem
- Solution
- Previous Work
- Research Goal
- Dataset
- Contributions
- Methods and Results
- Discussion



## Mental Health Crisis – Widespread!

- ▮ Leading cause of suicide and disability.
- ▮ Lifetime occurrence



- ▮ Current: Depression in employees



- ▮ Current: Depression in college students





# Mental Health Crisis – Huge Cost!



**long-term  
sickness  
absence**

in England attributed  
to mental ill health



Total Socioeconomic Cost  
in England is estimated to  
be £105 billion.



In 2016,  
**42.7%**  
**employment rate**  
for those who report mental illness  
as their main health problem (Mental  
illness, phobia, panics, nervous  
disorders (including depression, bad  
nerves or anxiety). **Compared to**  
**74% of all population**



# Mental Health Crisis – Lack of access!





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# Mental Health Crisis – A Solution!



Online Mental Health Services.

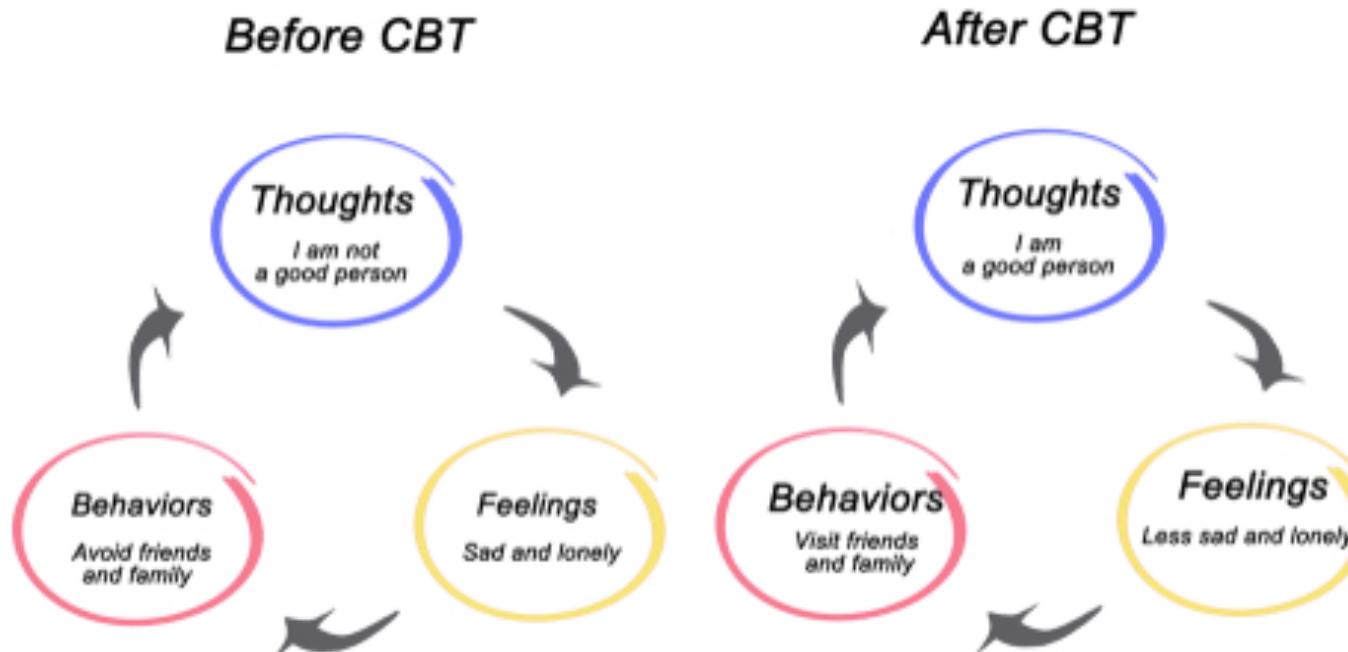


CBT → Very structured --> Software!



E.g.

Internet-based Cognitive Behavioral Therapy (iCBT)

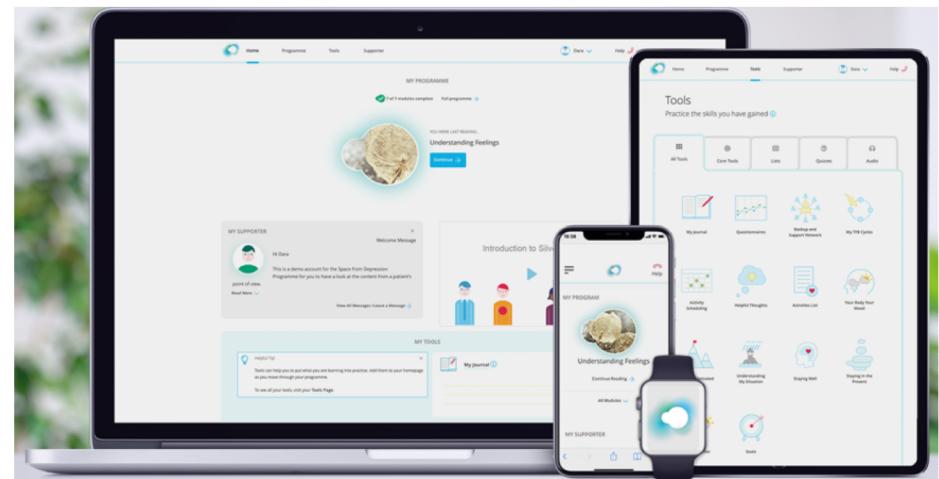




# SilverCloud Health



## SilverCloud



Space from

Anxiety



Space from

Depression



Space from

Chronic Illness



Space from

Eating Issues



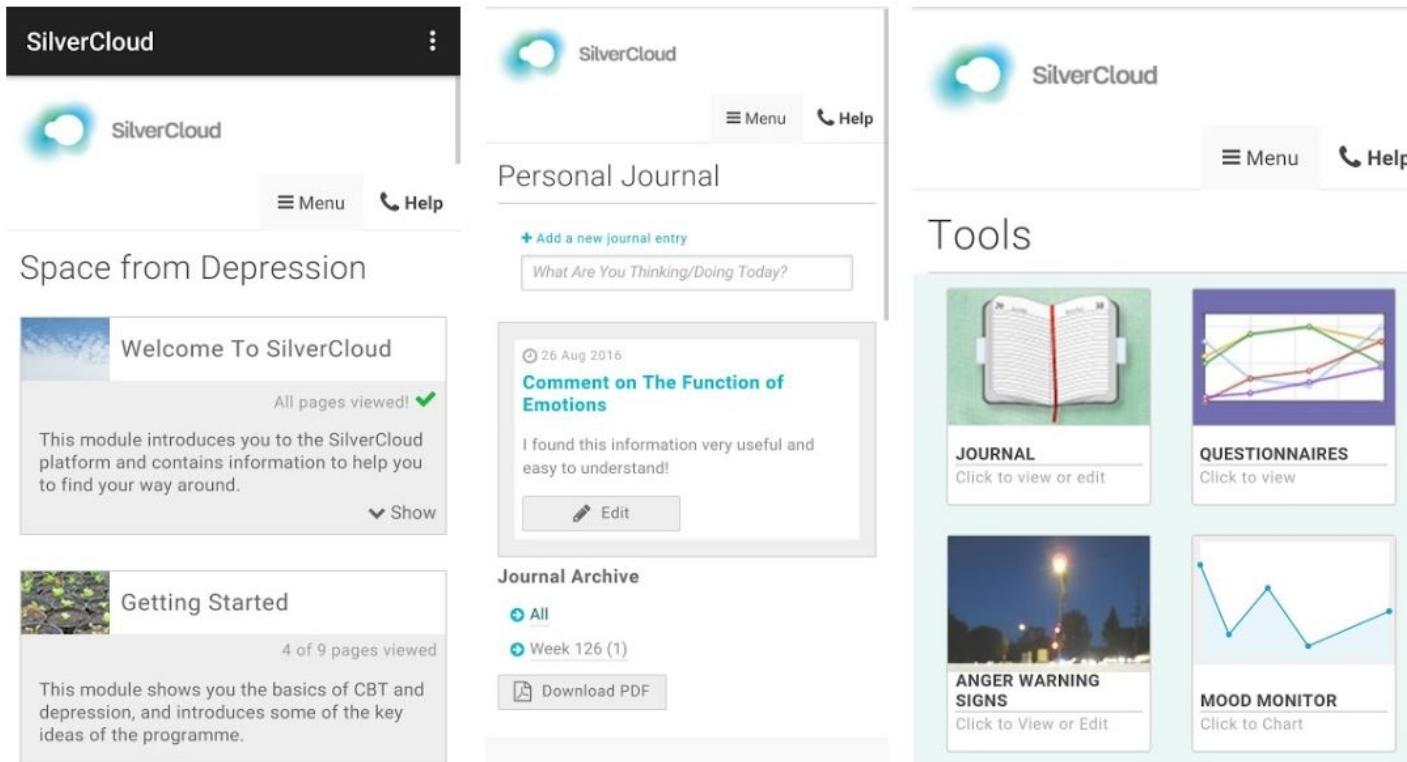
Space from

Stress



# SilverCloud – An Introduction

-  Content: a “online course” like structure.
-  Tools: accessed any time.
-  Supporter



The image displays three screenshots of the SilverCloud platform:

- Dashboard:** Shows the "Space from Depression" module. It includes a "Welcome To SilverCloud" section with a "Welcome" message and a "Comment on The Function of Emotions" section with a note about finding information useful. Below these are sections for "Journal Archive" (with "All" and "Week 126 (1)" options) and "Getting Started" (with a "Download PDF" button).
- Personal Journal:** Shows the "Personal Journal" section with a "Add a new journal entry" button and a text input field asking "What Are You Thinking/Doing Today?". It also shows a journal entry for "26 Aug 2016" with a note about the function of emotions.
- Tools:** Shows the "Tools" section with four cards: "JOURNAL" (represented by an open notebook icon), "QUESTIONNAIRES" (represented by a line graph icon), "ANGER WARNING SIGNS" (represented by a night scene with a street lamp icon), and "MOOD MONITOR" (represented by a line graph icon).



# SilverCloud – Content



“Space” or program dependent, and “prescribed”.

The screenshot shows a module titled "Understanding Feelings" with a sub-header "1 of 10 pages viewed". The main text describes the module's purpose: "This module takes a closer look at moods and emotions. In this module you can explore different aspects of emotions, physical reactions, action and inaction, and see how they are all connected." Below the text is a list of ten topics, each with an icon and a brief description:

- ✓ Introduction
- ❓ Emotions & Your Body Quiz
- 📄 Understanding Emotion
- 📄 Physical Body Reactions
- 📄 Lifestyle Choices
- 👤 Personal Stories
- ⌚ The TFB Cycle
- 📍 Mapping Lifestyle Choices
- ⌚ Staying In The Present
- ⌚ Review





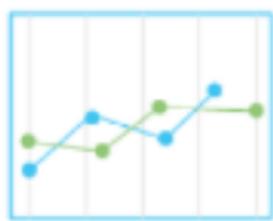
# SilverCloud – Interactive Tools



Accessible anytime



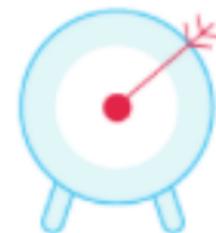
My Journal



Questionnaires



Backup and Support Network



Goals



Staying in the Present



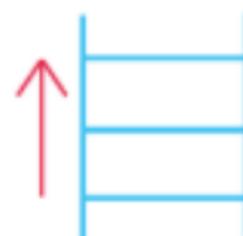
Goals



Mood Monitor



My TFB Cycles

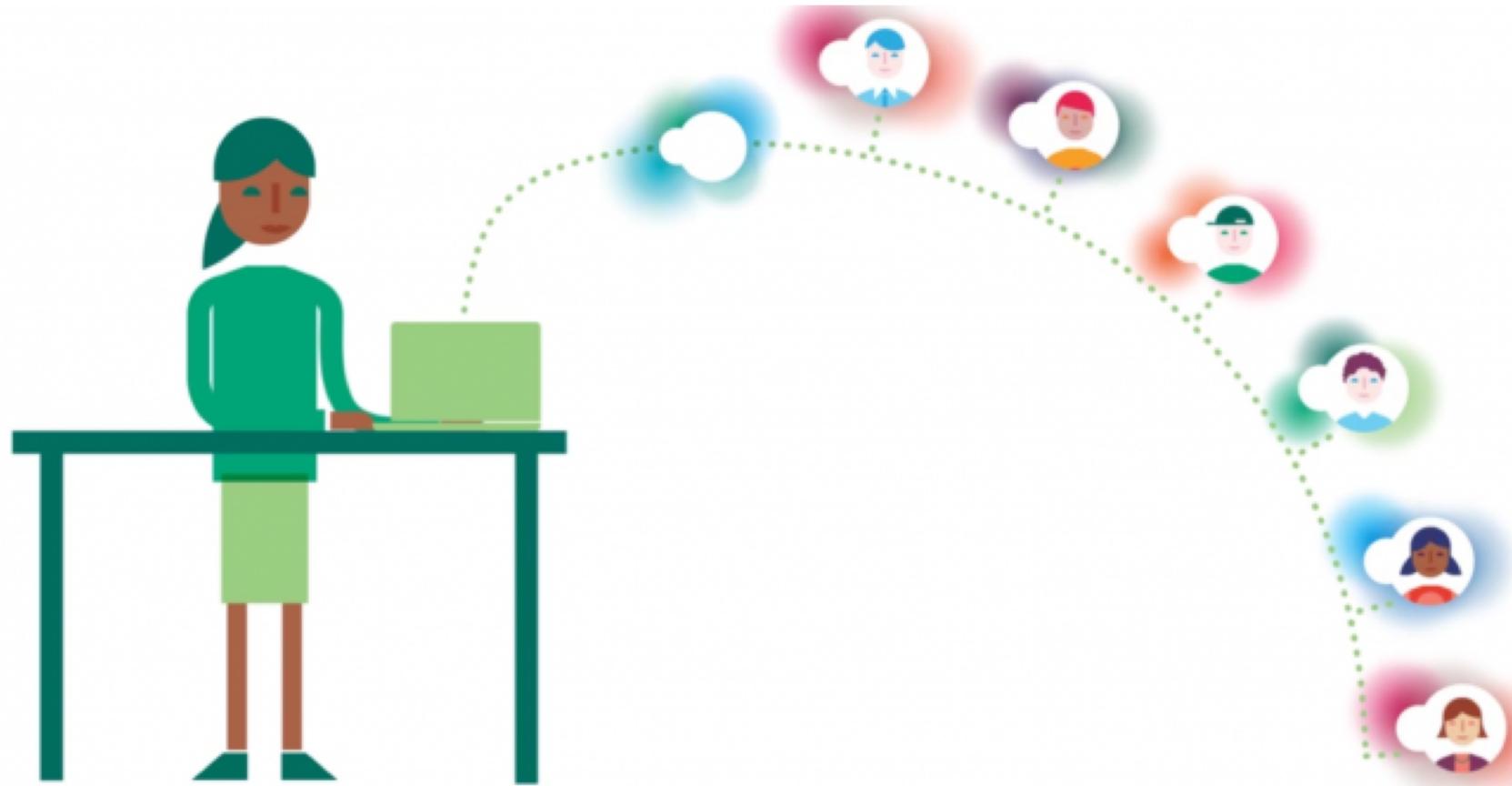


Hierarchy of Fears



## SilverCloud – Supporter

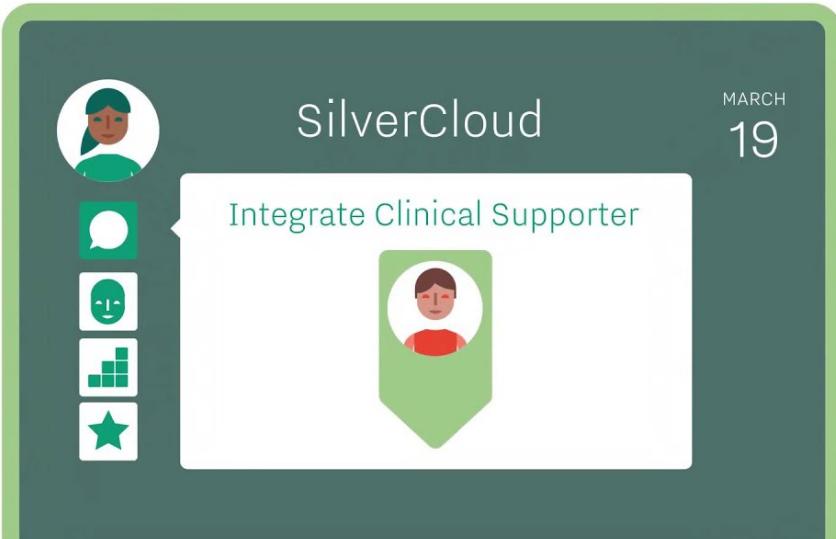
- 💡 Adherence and Attrition Issues  
→ Human supporter
- 💡 Increased accountability



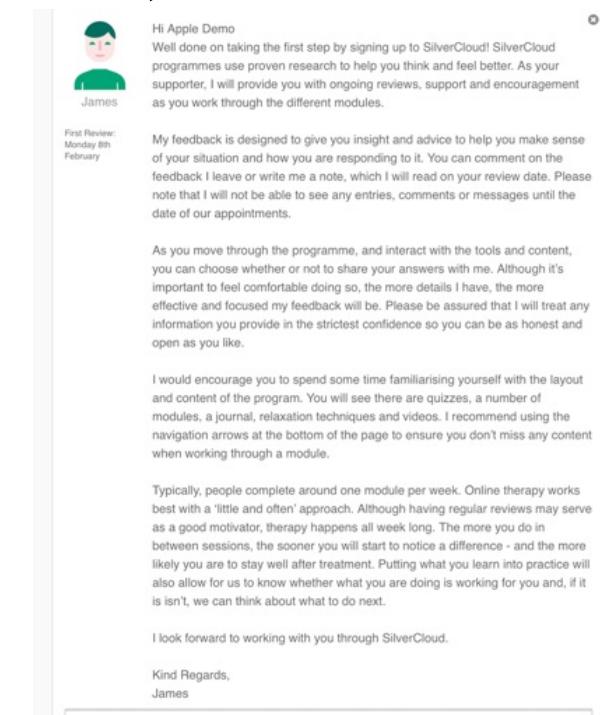


## SilverCloud – Supporter (contd.)

-  Reviews progress weekly. Provides feedback.
  -  Should spend 10 min per message.
  -  Should send 6-8 such messages.
  -  Other guidelines (e.g. answer questions, promote engagement with platform, be positive)



The image shows a screenshot of the SilverCloud mobile application. At the top, there's a circular profile picture of a person with dark hair and a teal headband. To the right of the profile picture, the word "SilverCloud" is written in white. Below this, the date "MARCH 19" is displayed. A white speech bubble-like box contains the text "Integrate Clinical Supporter". Inside this box is another circular profile picture of a person with short brown hair and a red shirt. To the left of the main content area, there are four small icons stacked vertically: a white speech bubble, a green smiley face, a bar chart, and a gold star.



A screenshot of a mobile messaging interface. On the left, there's a profile picture of a person with short brown hair and a teal headband, labeled "James". To the right of the profile picture, the text "Hi Apple Demo" is at the top, followed by a message: "Well done on taking the first step by signing up to SilverCloud! SilverCloud programmes use proven research to help you think and feel better. As your supporter, I will provide you with ongoing reviews, support and encouragement as you work through the different modules." Below this, a section titled "First Review: Monday 8th February" contains a message: "My feedback is designed to give you insight and advice to help you make sense of your situation and how you are responding to it. You can comment on the feedback I leave or write me a note, which I will read on your review date. Please note that I will not be able to see any entries, comments or messages until the date of our appointments." Further down, another message reads: "As you move through the programme, and interact with the tools and content, you can choose whether or not to share your answers with me. Although it's important to feel comfortable doing so, the more details I have, the more effective and focused my feedback will be. Please be assured that I will treat any information you provide in the strictest confidence so you can be as honest and open as you like." Another message encourages the user to familiarize themselves with the program: "I would encourage you to spend some time familiarising yourself with the layout and content of the program. You will see there are quizzes, a number of modules, a journal, relaxation techniques and videos. I recommend using the navigation arrows at the bottom of the page to ensure you don't miss any content when working through a module." The final message in the thread is: "Typically, people complete around one module per week. Online therapy works best with a 'little and often' approach. Although having regular reviews may serve as a good motivator, therapy happens all week long. The more you do in between sessions, the sooner you will start to notice a difference - and the more likely you are to stay well after treatment. Putting what you learn into practice will also allow for us to know whether what you are doing is working for you and, if it isn't, we can think about what to do next." At the bottom of the message, there's a signature: "I look forward to working with you through SilverCloud." and "Kind Regards,  
James".

## SilverCloud – Outcome-based

- 💡 Clients also fill out weekly surveys that measure symptoms of depression and anxiety.





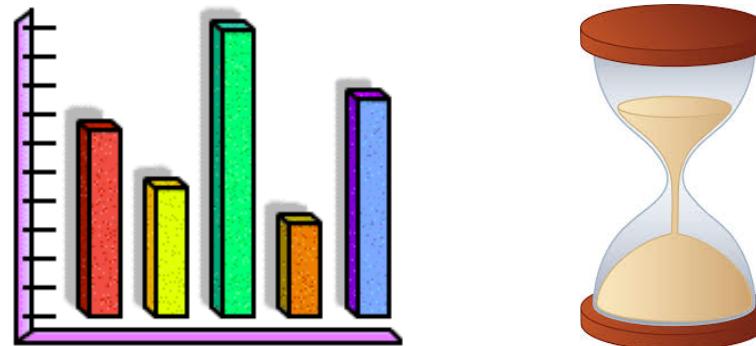
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## Previous Work – In Short

- 💡 Previous work focusses on duration and frequency of human support.



- 💡 Little is known about how supporter behaviors impact client outcomes.



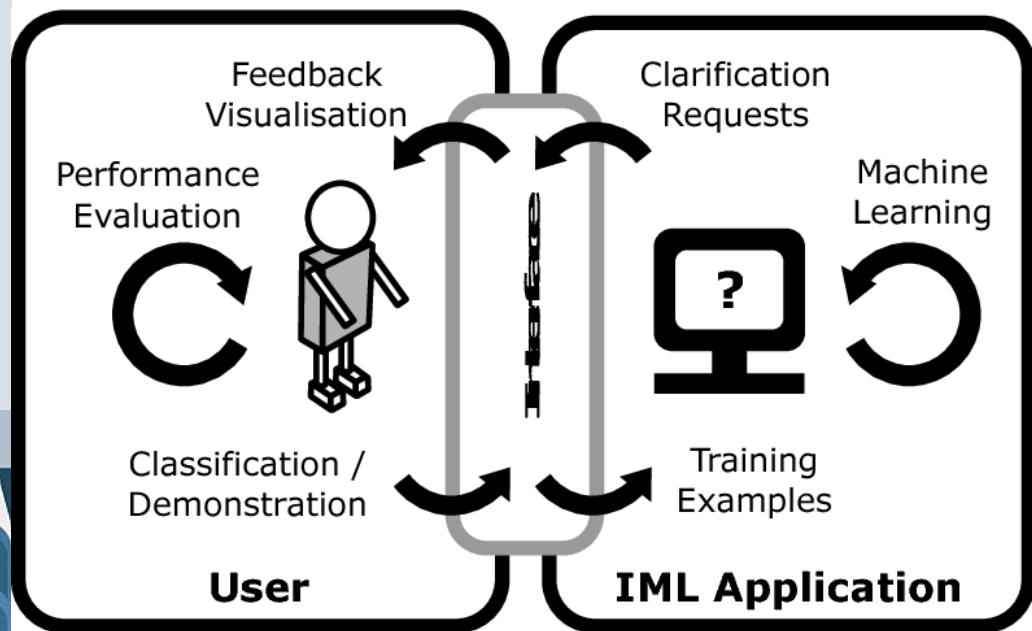


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# Research Goal

- 💡 More nuanced understanding of supporter behaviors:
  - 💡 → Better Supporter Training.
  - 💡 → ML for Recommending Supporter Behavior.





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## Dataset

- Space for Depression and Anxiety.
- >200,000 messages sent by ~3500 supporters to ~50,000 clients.



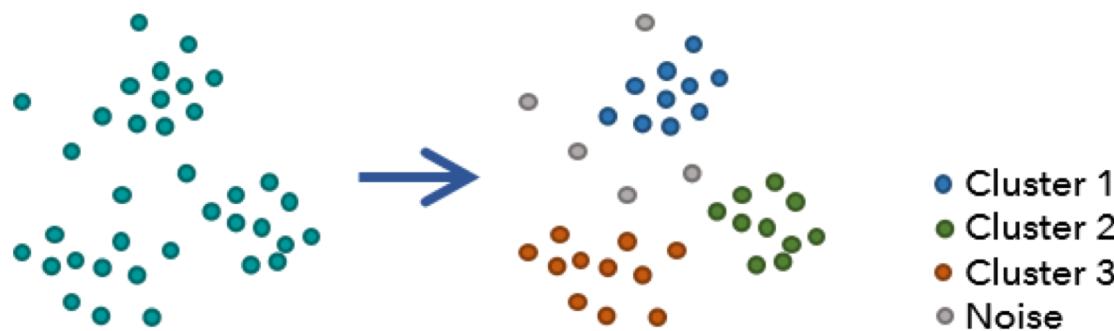
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# Contributions

1. *Cluster supporters* based on how their support messages correlate with client outcomes.



2. *Extract linguistic features* indicative of supporter behaviors that correlate with “high” outcomes across clients in different contexts.



## Contributions (Contd.)

3. *Identify salient context-specific patterns of support, while taking into account co-occurrent patterns of different context variables.*



**Spoiler ☺** *Concrete, positive, and supportive messages from supporters that reference social behaviors are strongly associated with better outcomes.*



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# Outline

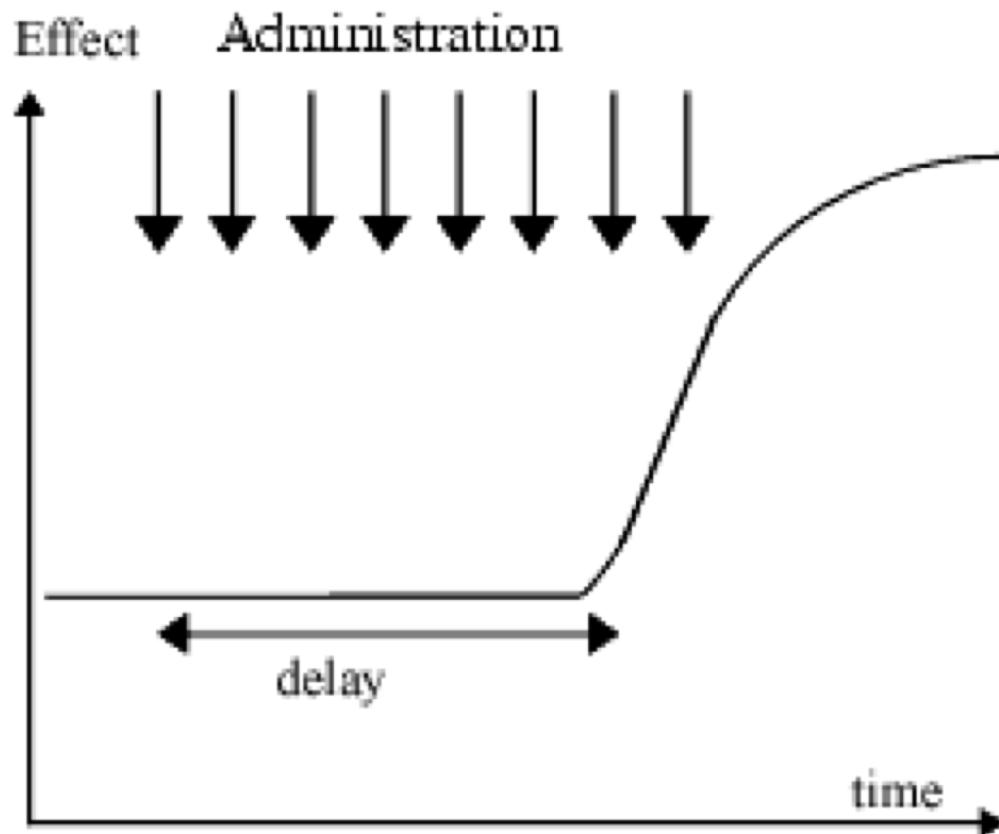
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Clustering Supporters
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## Clustering Supporters – Motivation

Support messages may not directly impact immediate outcomes → **Focus on improvement over time.**

E.g.



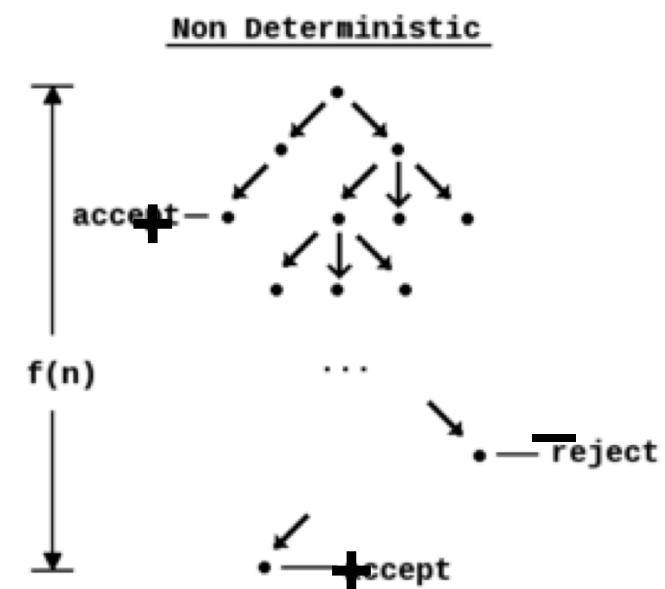


## Clustering Supporters – Motivation (contd.)

Some clients will not improve despite the use of good support strategies in supporter messages.

But, good strategies used consistently with a set of clients will lead to improvement for the majority.

→ Focus on the supporters.





## Clustering Supporters – Motivation (contd.)

- Hence, we cluster supporters into supporters based on the success of their strategies.
- Success?



## Clustering Supporters – Method

Compute 4 outcome measures for each supporter and cluster them using K-means with K=3.

**Message-level  
change**

**Client-level  
change**

**Message-level  
improvement rate**

**Client-level  
improvement rate**



## Clustering Supporters – Method (contd.)

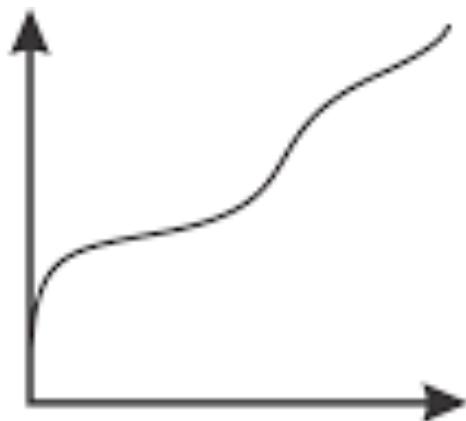
1. Message-level Change (MC): Average change in scores across all messages sent by supporter  $s$ .
2. Message-level Improvement Rate (MR): Percentage of messages sent by supporter  $s$  that were followed by an improvement.



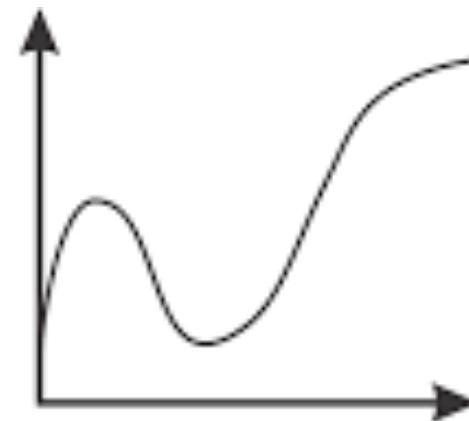
## Clustering Supporters – Method (contd.)

Message-level outcomes don't capture client-level differences.

E.g.



**Good things happened!**



**Something bad happened**



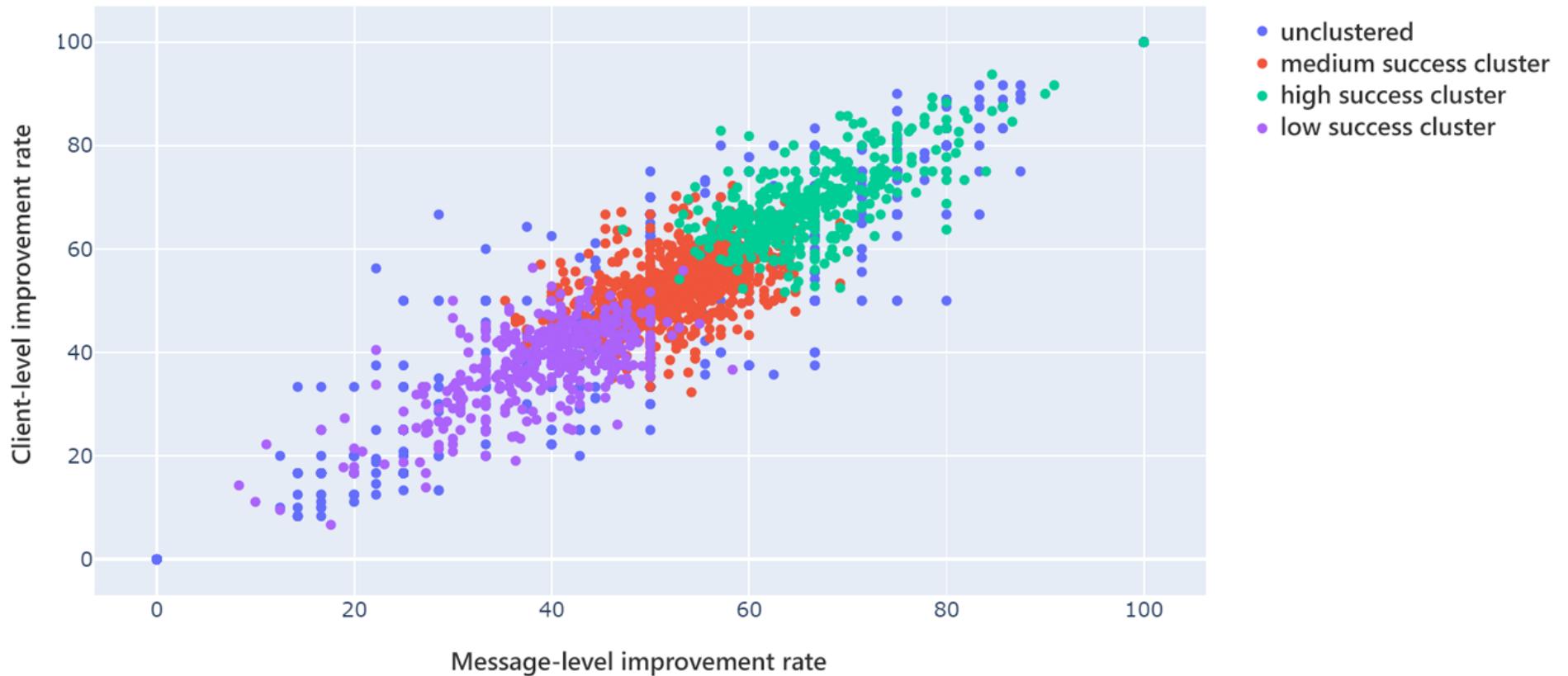
## Clustering Supporters – Method (contd.)

Better account for client-level differences:

3. Client-level Change (CC): Compute Message-level Change for each client, and average it.
4. Client-level Improvement Rate (CR): Compute Message-level Improvement Rate for each client separately, and average it.

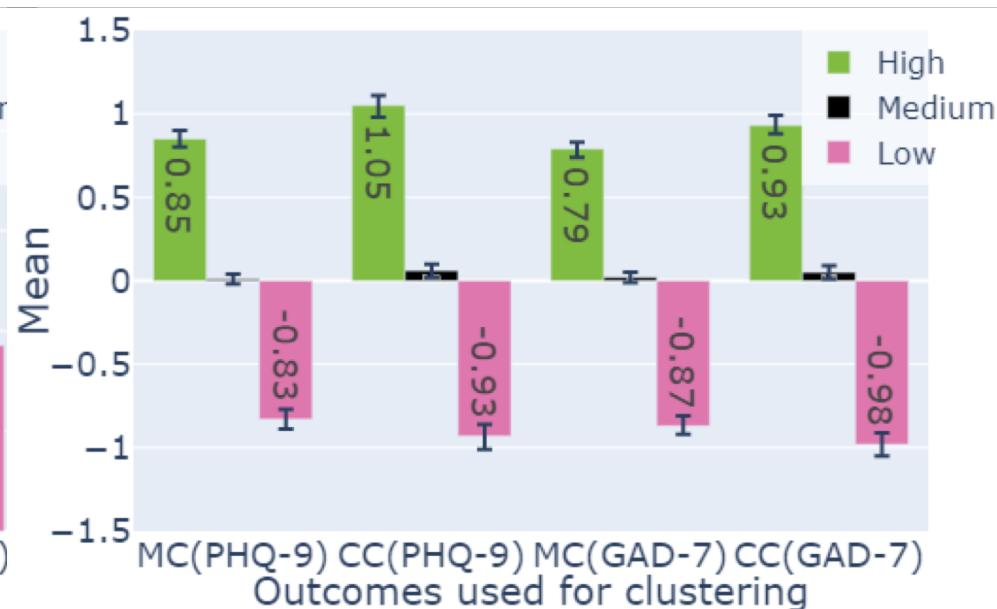
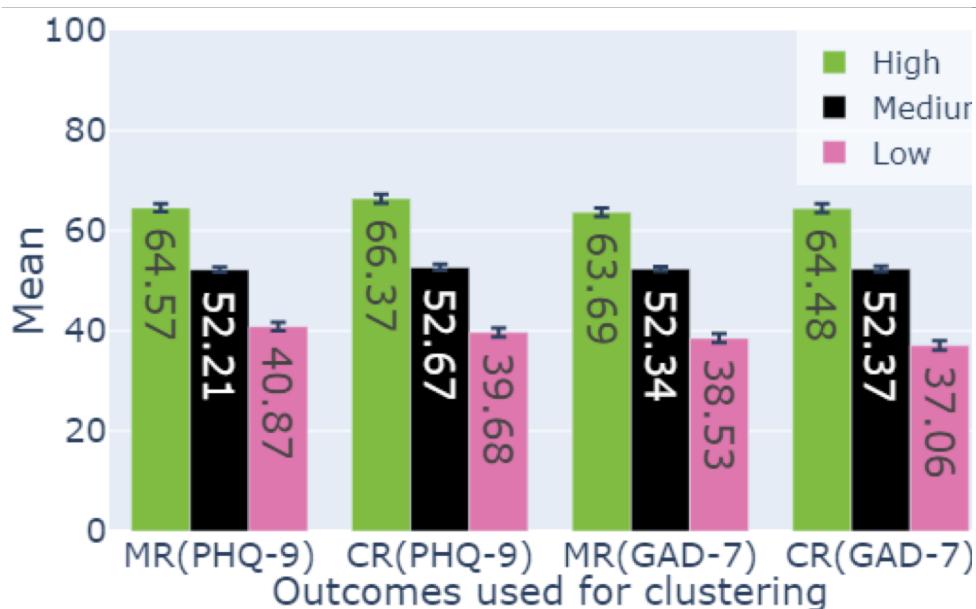
# Clustering Supporters – Results

K-means with K=3



# Clustering Supporters – Results (contd.)

Cluster	#Supporters	#Clients	#Messages	#Messages Labeled
<b>High</b>	438	11068	42734	14519
<b>Medium</b>	767	31789	123303	42740
<b>Low</b>	393	10828	47023	14266





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Successful Support Strategies
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## Successful Support Strategies – Features

- Client <Context> Variables:
  - 5 Variables:  
ContentViews,  
Shared,  
MessageNumber,  
CurrentPHQ-9, and  
CurrentGAD-7.
  - BINNED





## Successful Support Strategies – Features (contd.)



Hi Apple Demo

Well done on taking the first step by signing up to SilverCloud! SilverCloud programmes use proven research to help you think and feel better. As your supporter, I will provide you with ongoing reviews, support and encouragement as you work through the different modules.

First Review:  
Monday 8th  
February

My feedback is designed to give you insight and advice to help you make sense of your situation and how you are responding to it. You can comment on the feedback I leave or write me a note, which I will read on your review date. Please note that I will not be able to see any entries, comments or messages until the date of our appointments.

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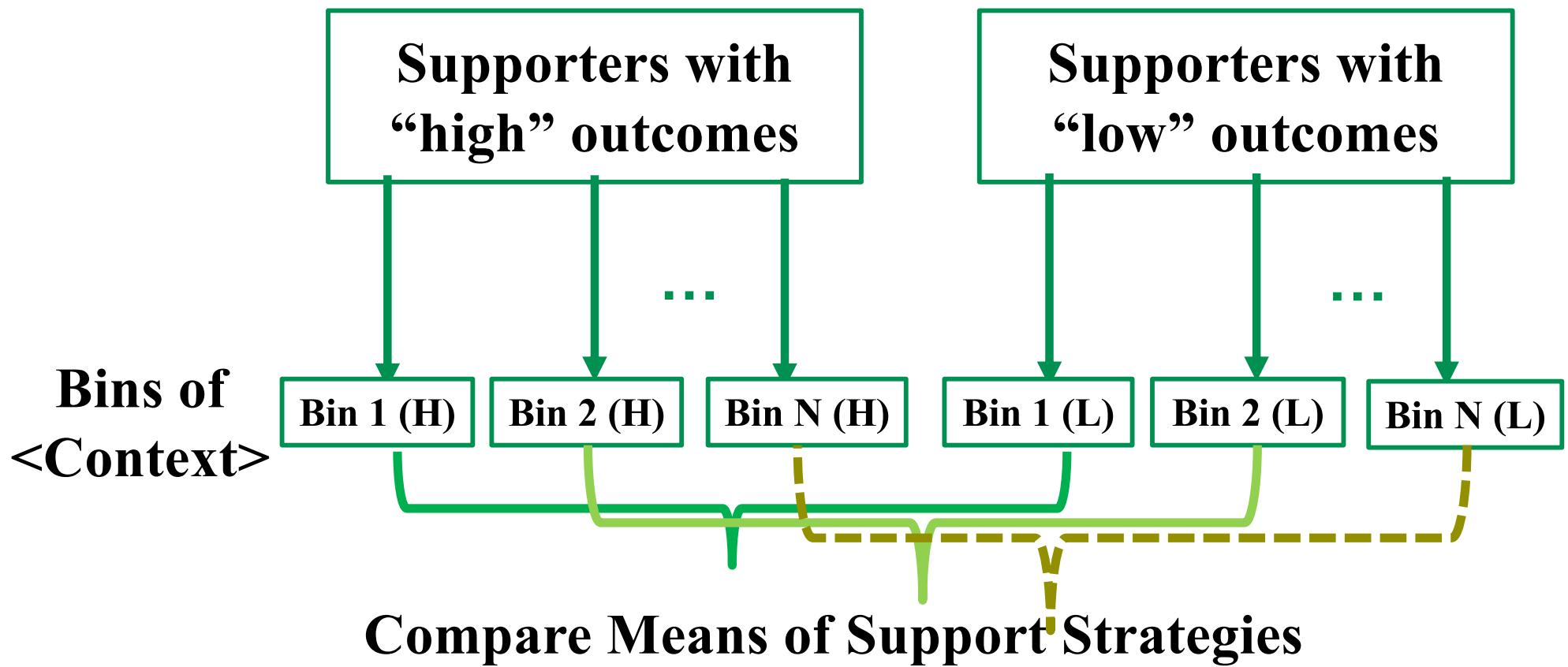


- Support <Strategy> Variables:
  - 23 variables calculated using validated lexicons and NLP techniques.
  - Can be divided into 6 categories: Sentiment, Emotion, Pronouns, Encouraging Phrases, Mental Processes & Behaviors, and Quantity.



# Successful Support Strategies – Method

- For each <context, strategy> pair ( $NP=23*5=115$ ),
  - Divide messages as follows:





# Successful Support Strategies – Method

- To compare Means for messages in each bin:
  - 95% bootstrapped confidence intervals for “high” and “low” clusters.
  - Using bootstrapped resampling test.
- Bootstrapping was done on the supporters.
  - Gold standard for similar hierarchical data.
  - (i.e. Supporter → Client → Message)
  - No independence assumption for messages.



# Successful Support Strategies – Method

- We make these comparisons using:
  - By comparing means obtained through hierarchical bootstrapping.
  - We compute the p-values and 95% confidence intervals to assess the significance of these findings

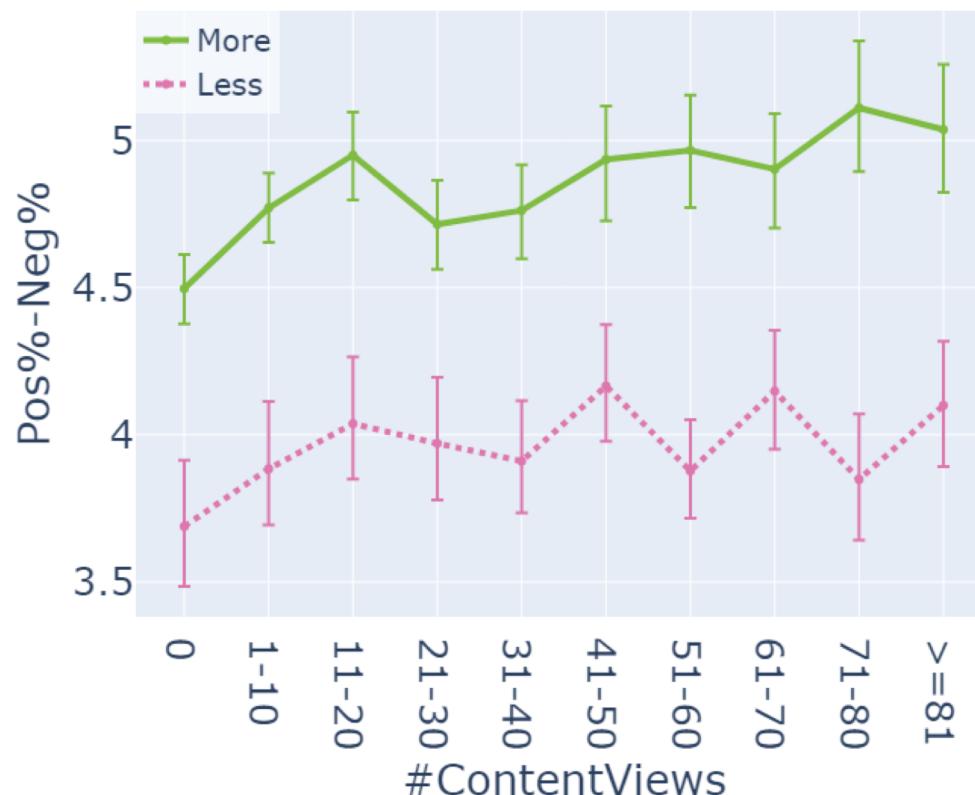


# Successful Support Strategies – Method

- Compare Means: For messages in each bin, compute the following:
  - 95% bootstrapped confidence intervals for “high” and “low” clusters, and check for overlap.
  - Compare means across the “high” and “low” clusters using bootstrapped resampling test.
- Messages are Hierarchical Data  
(i.e. Supporter → Client → Message)
  - Bootstrapping was done on the supporters.

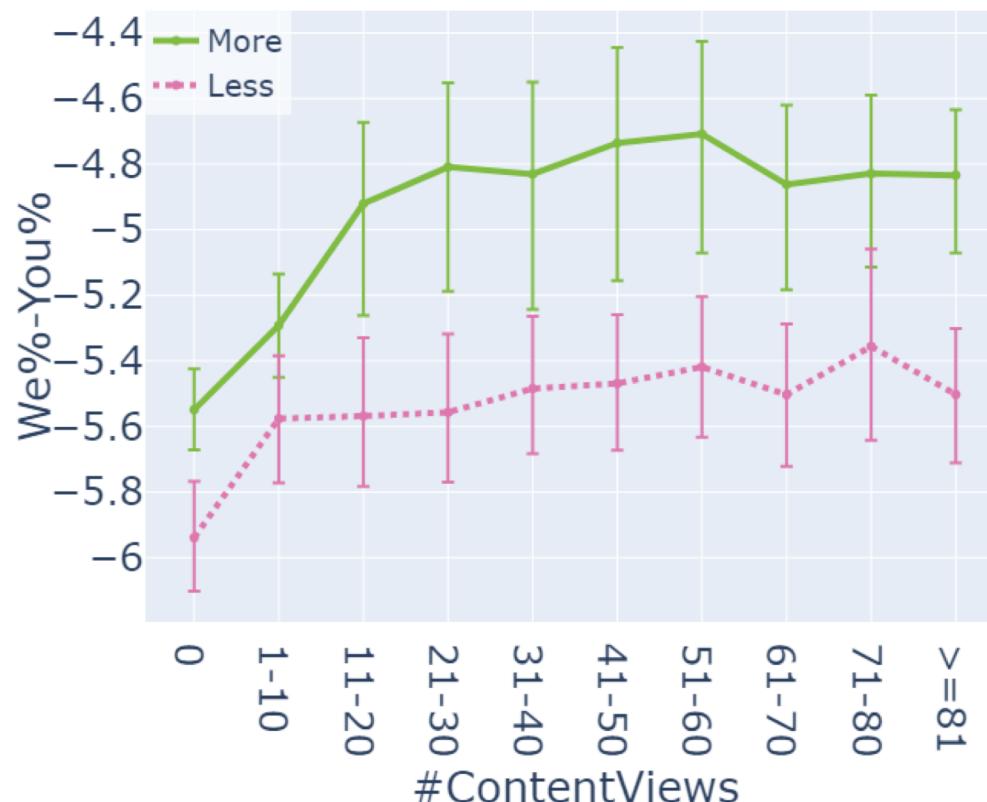
# Successful Support Strategies – Results

- More successful messages had:
  - Used **more positive** and **less negative** words.
  - Used **less** words associated with negative emotions such as **sadness** and **fear**.



# Successful Support Strategies – Results

- More successful messages had:
  - Used **more 1<sup>st</sup> person plural pronouns** (e.g. we), and had greater difference between frequencies of 1<sup>st</sup> person plural pronouns and 2<sup>nd</sup> person pronouns.



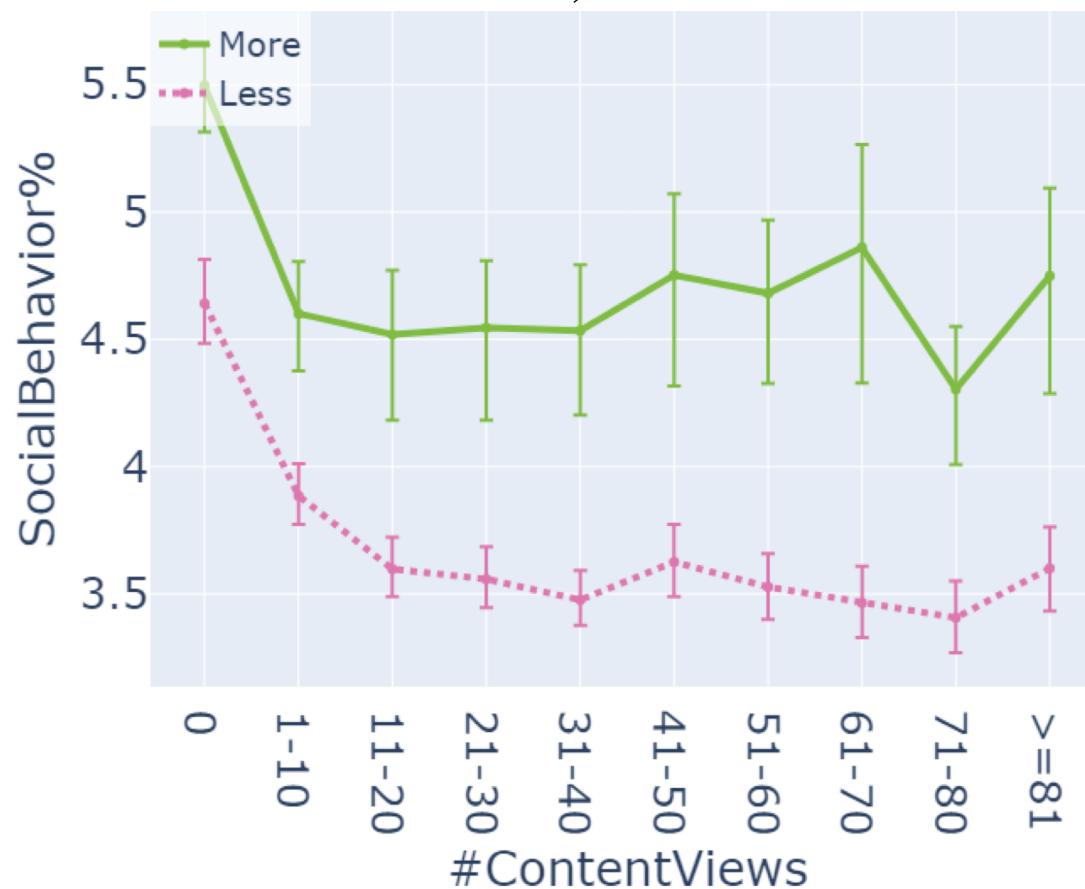


# Successful Support Strategies – Results

- More successful messages had:
  - Used **more encouraging phrases** (e.g. well done, good job).

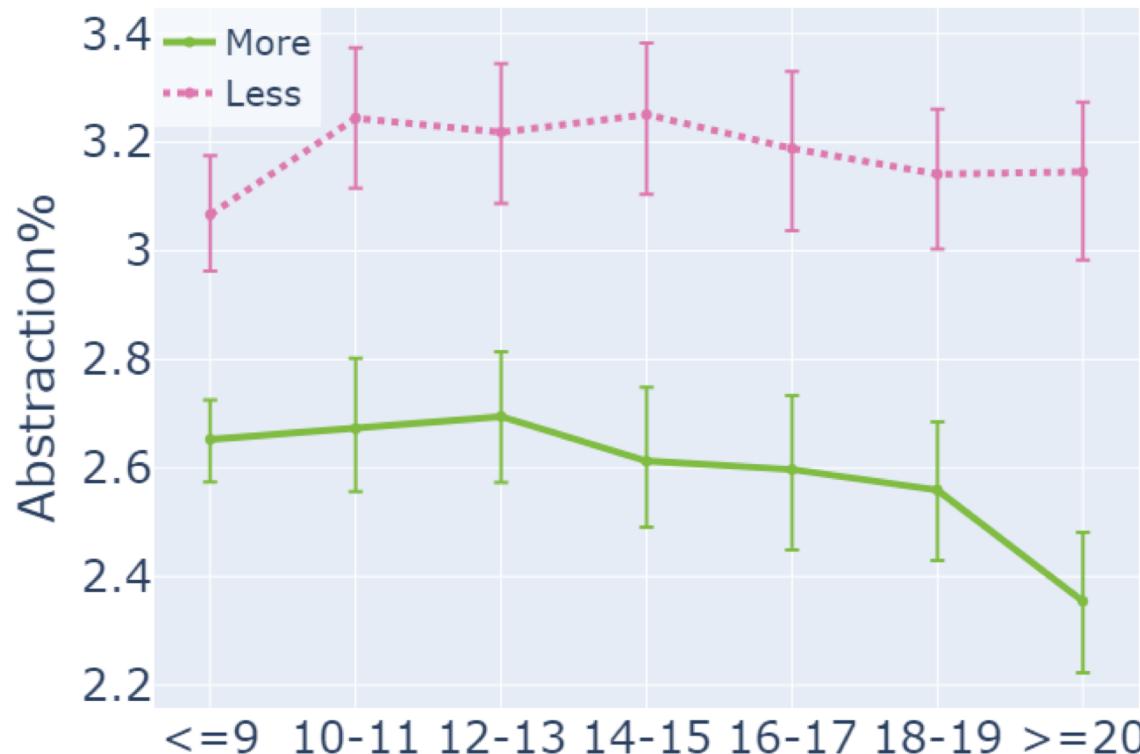
# Successful Support Strategies – Results

- More successful messages had:
  - Used **more** words associated with **social behavior** (*E.g. help, call, discuss, and share.*)



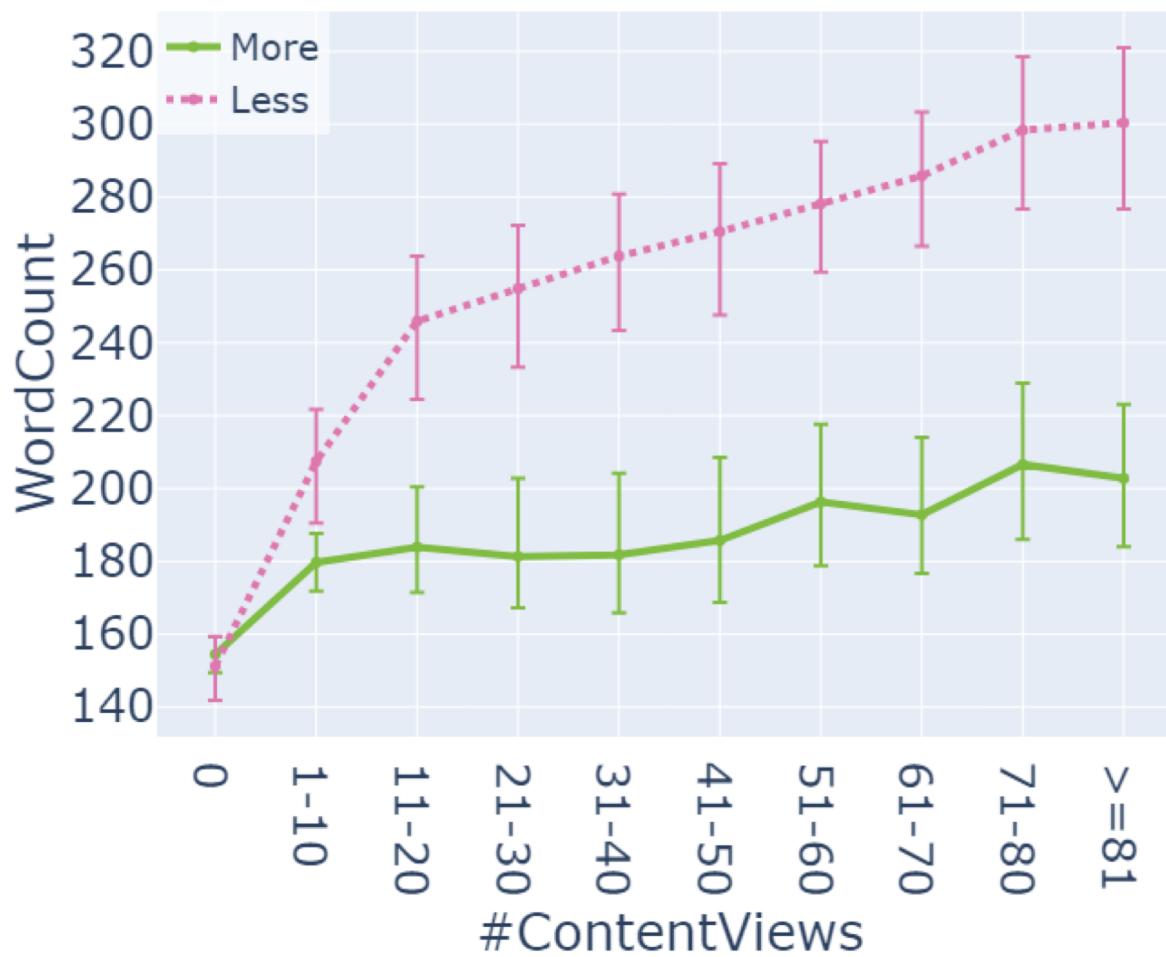
# Successful Support Strategies – Results

- More successful messages had:
  - Used **less** words associated with **abstraction**.  
(E.g. think/thought, know, understand, and learn)



# Successful Support Strategies – Results

- More successful messages were shorter!





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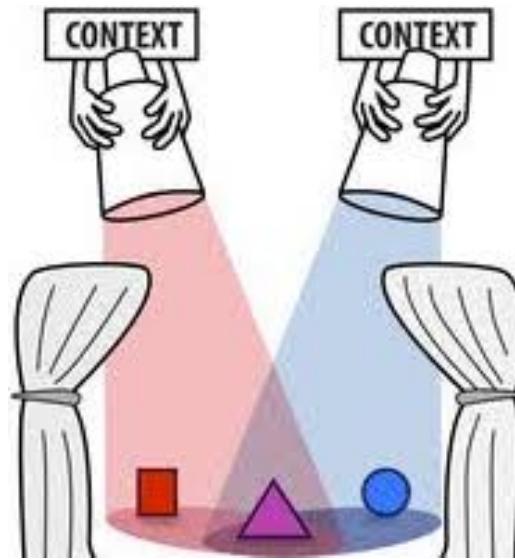


## Salient Context-Specific Support Strategies

- Client Context, Supporter Behavior, and Client Outcomes → More complex relationship
  - E.g. Multidimensional Context.



# Salient Context-Specific Support Strategies



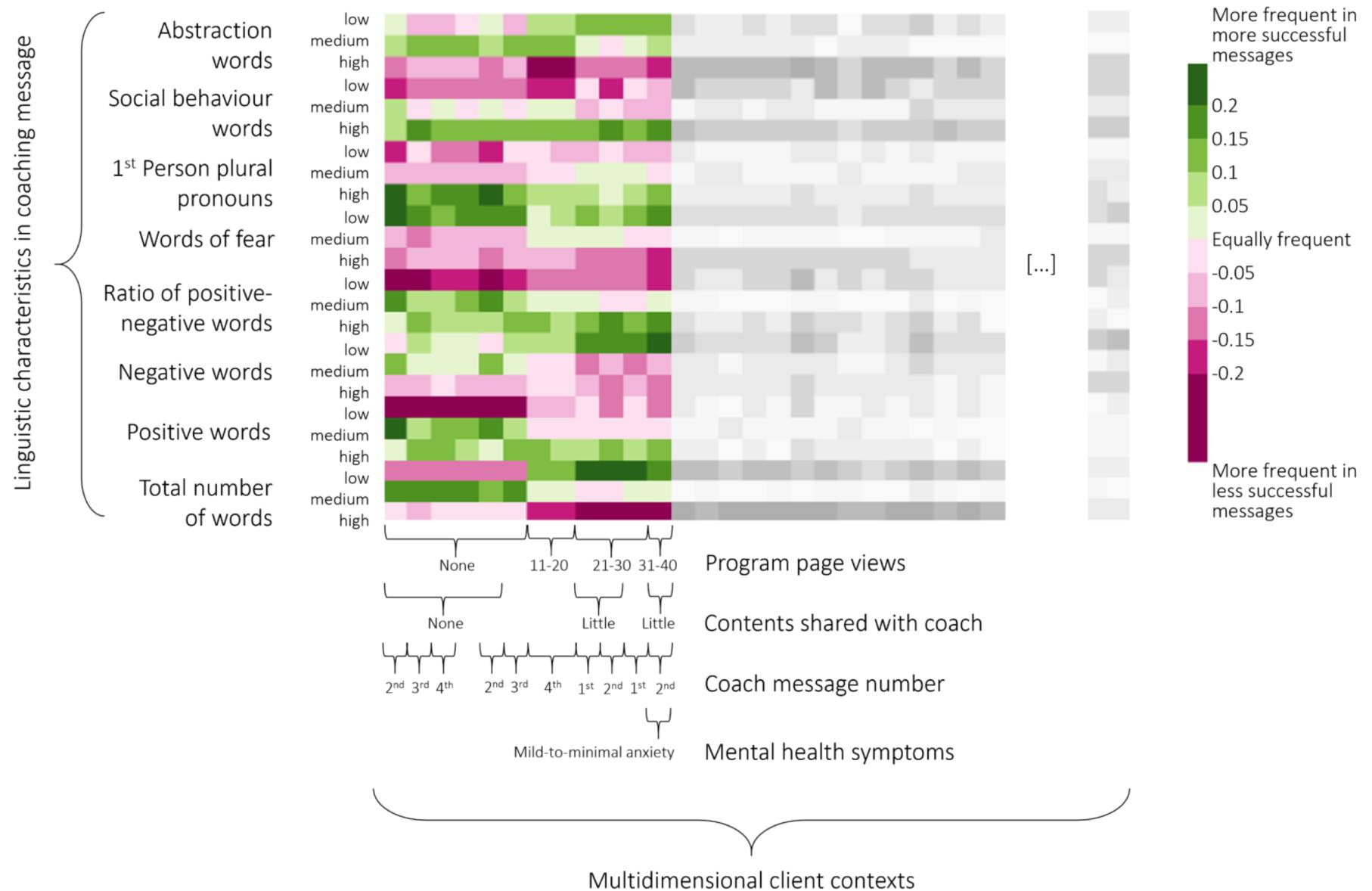
- Multidimensional Context
  - How may considering the combination of multiple context variables shift how salient a specific support strategy is?
  - Interesting for personalization!



## Salient Context-Spec. Supp. Strategies – Method

- Apriori algorithm to mine frequent co-occurrent patterns of multidimensional contexts.
- For each frequent multidimensional context  $MC$  and each individual support strategy  $S$ , we can compute  $P(S|MC)$  for “*high*” and “*low*” clusters separately.
- **Confidence Diff** =  $P_{\text{high}}(S|MC) - P_{\text{low}}(S|MC)$
- **Salience** =  $\text{abs}(\text{Confidence Diff})$

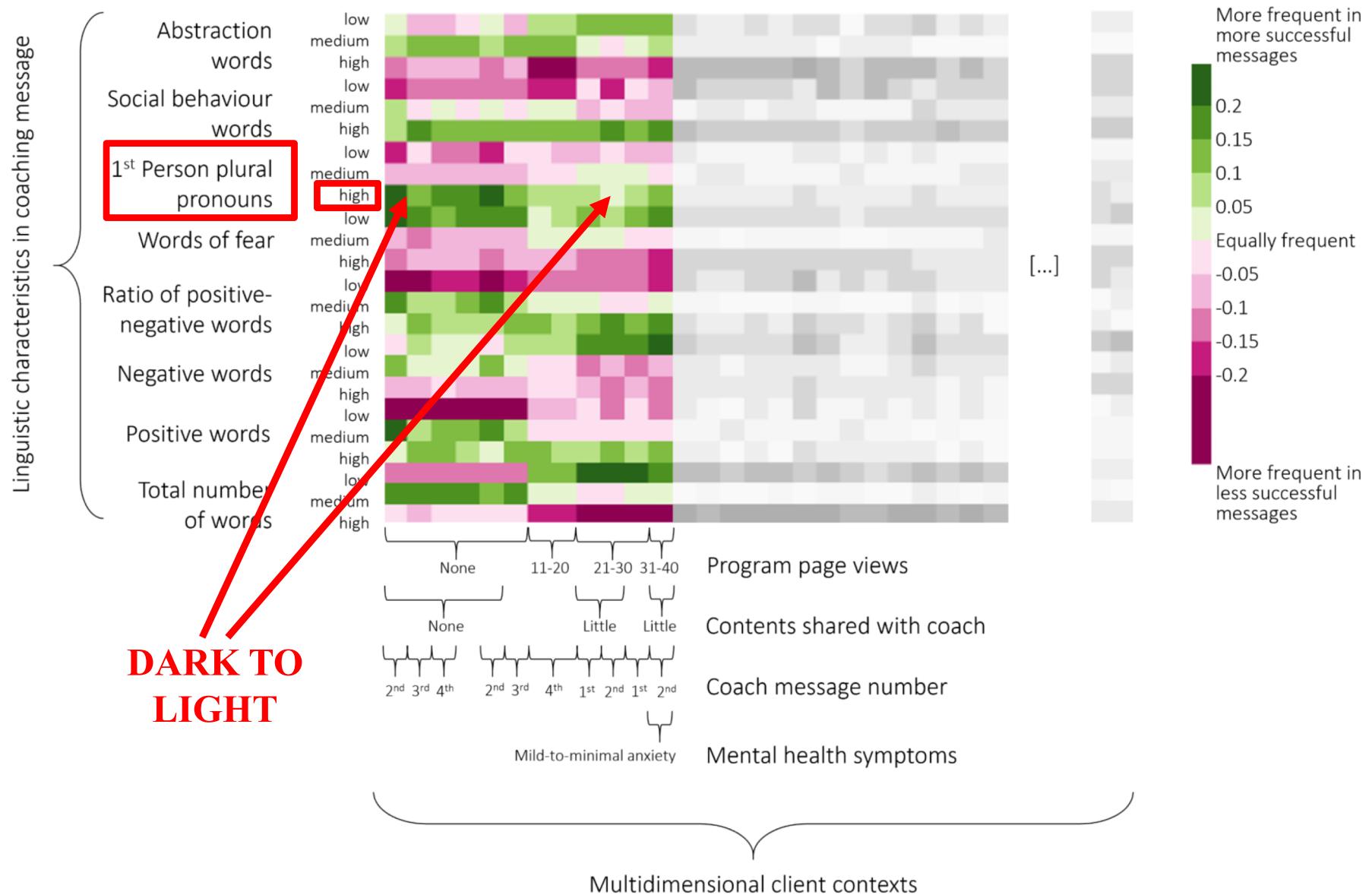
# Salient Context-Spec. Supp. Strategies – Results



# Salient Context-Spec. Supp. Strategies – Results

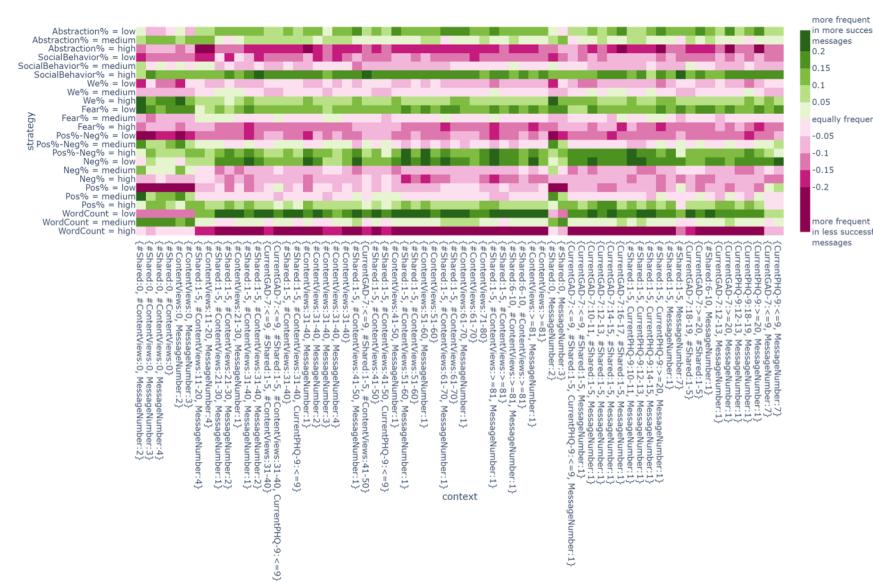


# Salient Context-Spec. Supp. Strategies – Results



# Salient Context-Spec. Supp. Strategies – Results

- For less engaged clients, writing longer, more positive and more supportive reviews is linked with greater outcomes.
  - More engaged clients appear to benefit more from messages with less negative words, less abstraction, and more references to social behaviors.



**See Paper!** 



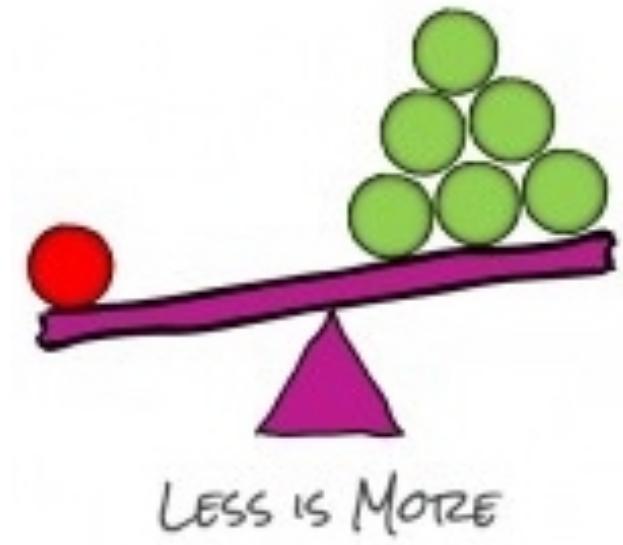
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## Discussion – Summary of Findings

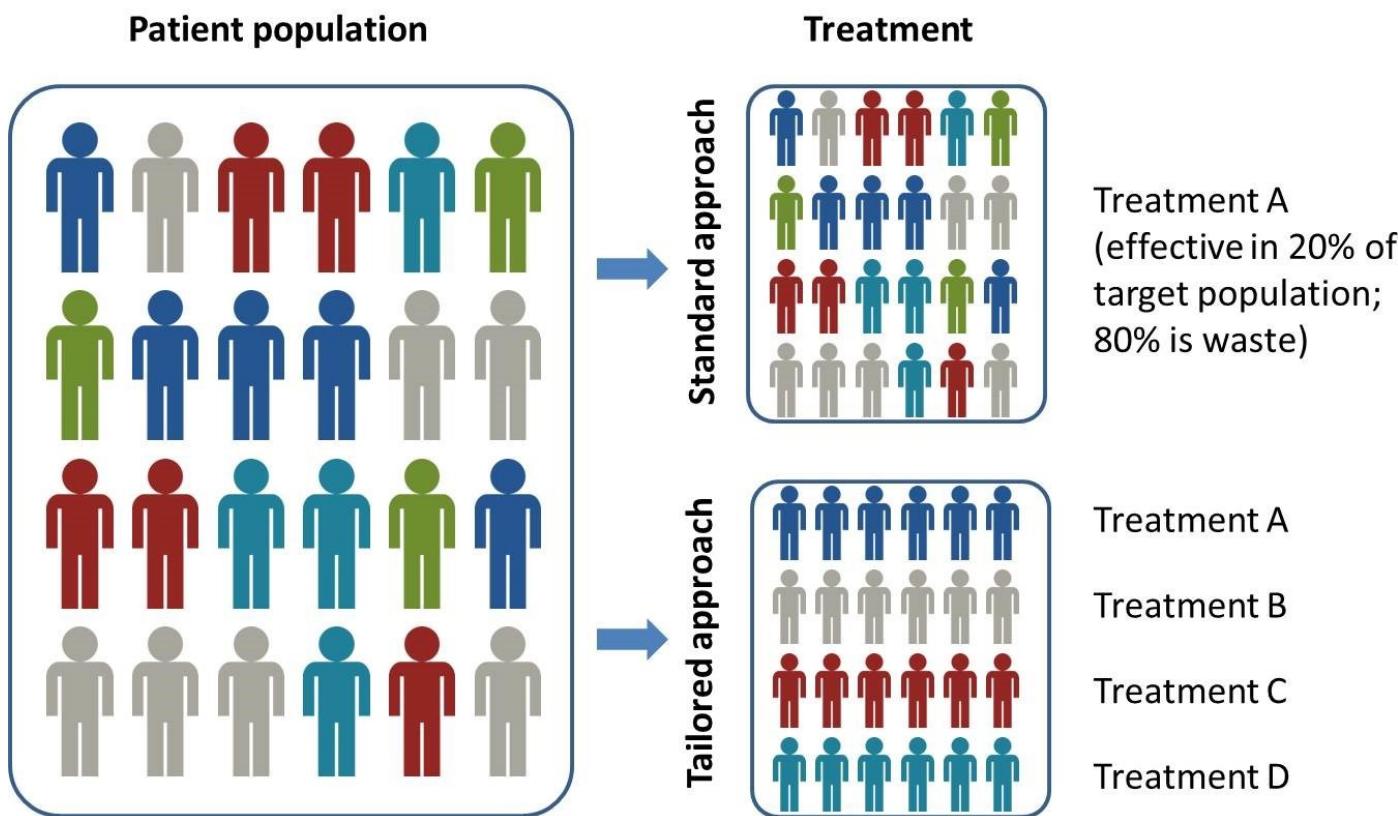
- Supporter messages that typically achieve higher client outcomes contain more words that are **positive, supportive, related to social behaviors, and less abstract**; and those messages tend to be **shorter** than less successful message.





## Discussion – Implications for Personalization

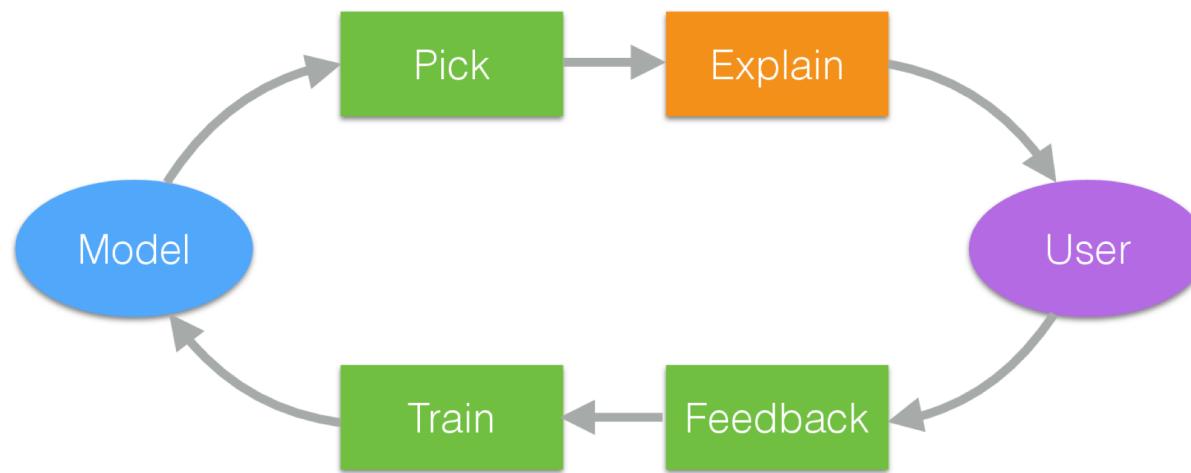
- Further, we demonstrated how the salience and associated success of identified **support strategies can vary dependent on a specific client context.**





## Discussion – Conclusion

- Maintaining the Human Touch & Enhancing Supporter Agency
  - Genuine human connection important for working alliance.
  - Creates opportunities to empower supporters → better training or data-driven tools for supporters.



Boomerang  
Respondable

Very unlikely  
to receive a response

Subject Length ?  
5

Word Count ?  
280

Question Count ?  
0

Reading Level ?  
12+

### ADVANCED FEATURES

Positivity ?  
22

Politeness ?  
73

Subjectivity ?  
48



# Thank you! 😊

Prerna Chikersal

- [prerna@cmu.edu](mailto:prerna@cmu.edu)
- <http://prernac.com/>