

From academia to technology start-up: Scaling up monitoring of intervention mechanisms via AI technologies

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Acknowledgements and Disclosure

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AI/ML Development

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K02 AA023814

R56 MH118550

Clinical technologies

R44 AA028463

R44 DA046243

R42 MH123215

R42 MH128101

R44 MH133517

The Annie E. Casey Foundation

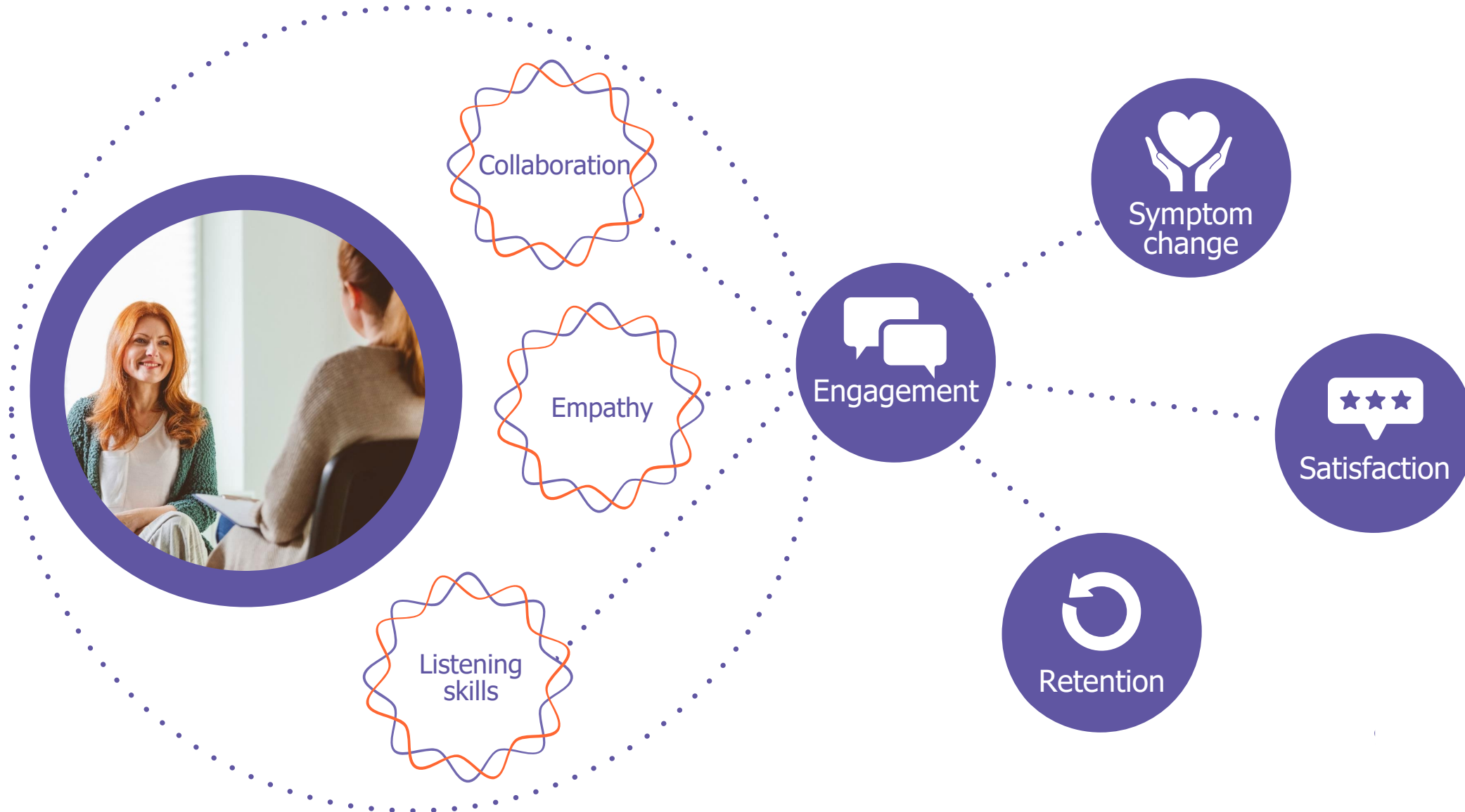
Disclosure:

I am a co-founder with equity stake in Lyssn.io, Inc., a start-up focused on tools to support training, supervision, and quality assurance of psychotherapy and counseling.

All opinions and content are my own and do not necessarily reflect views of NIH or AECF.



Problem: We don't know what happens in behavioral healthcare conversations, and it matters.



There is no relationship between self-reported EBP usage and what occurs in session

Adm Policy Ment Health

DOI 10.1007/s10488-014-0618-5

ORIGINAL ARTICLE

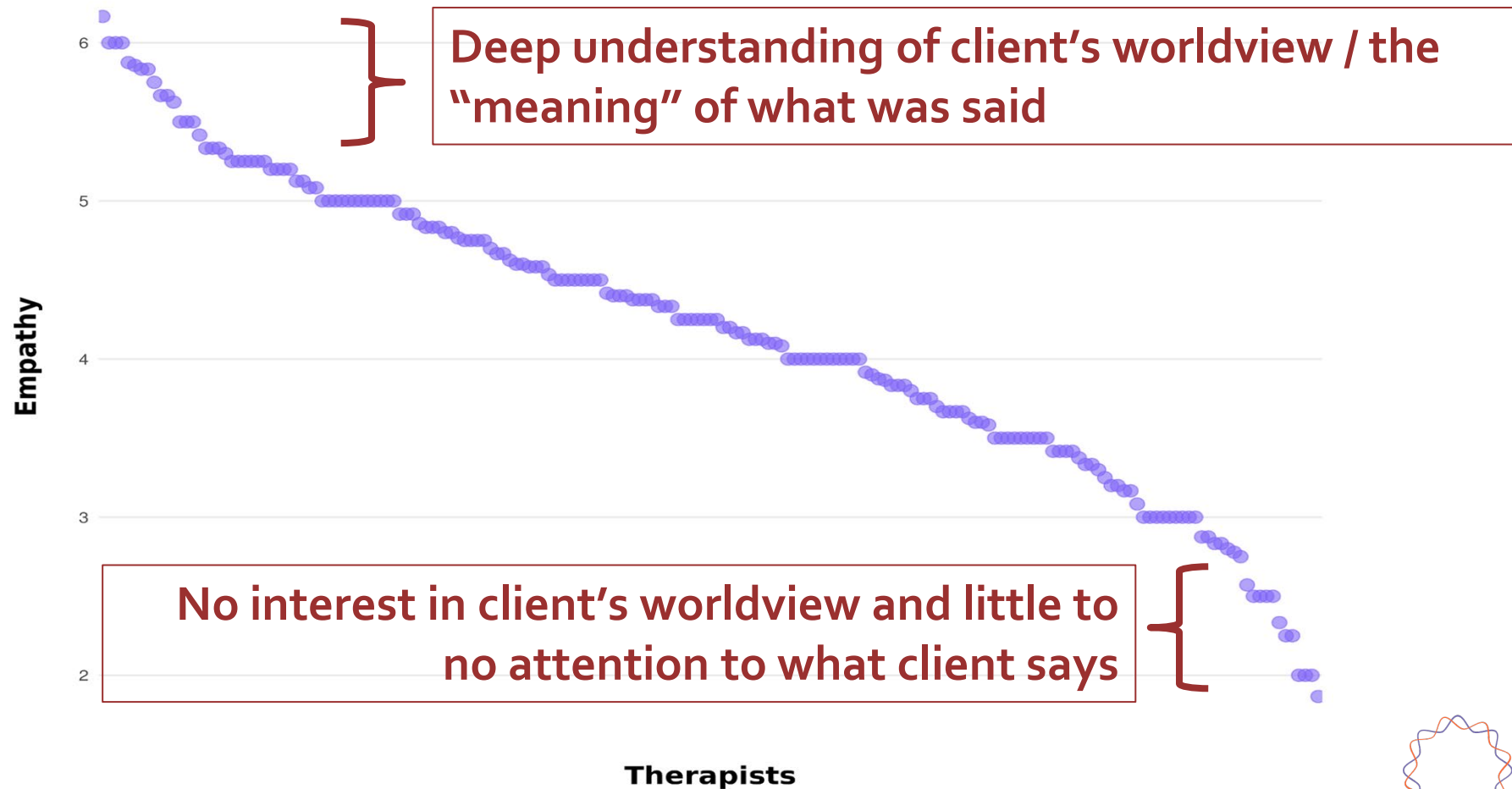
Beyond the Label: Relationship Between Community Therapists' Self-Report of a Cognitive Behavioral Therapy Orientation and Observed Skills

**Torrey A. Creed · Courtney Benjamin Wolk ·
Betsy Feinberg · Arthur C. Evans · Aaron T. Beck**



There are 100M counseling sessions each year, and we do not know the quality of any of them

Average empathy for 200 community providers

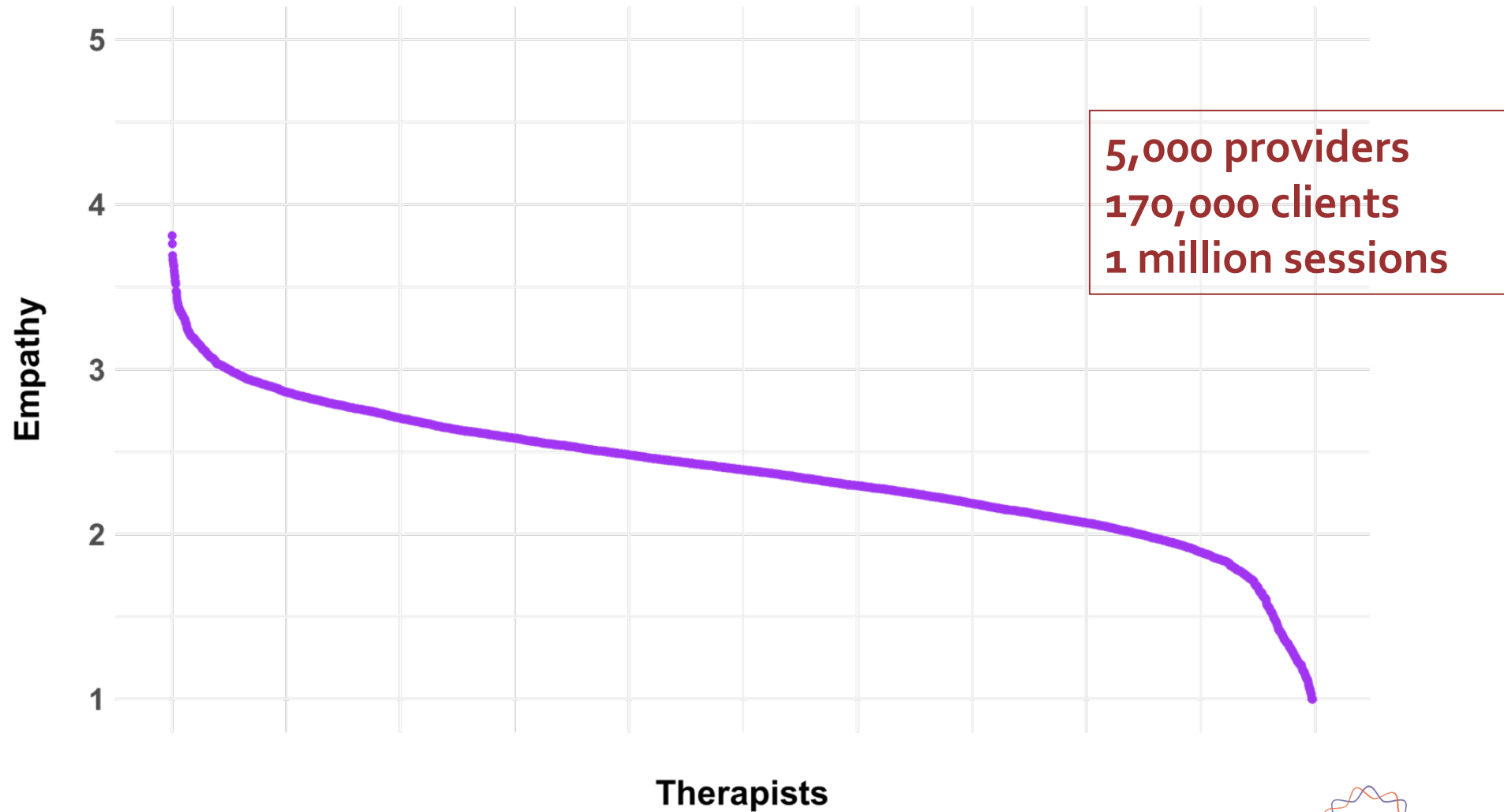


“Not everything that can be counted counts, and not everything that counts can be counted.”

Albert Einstein



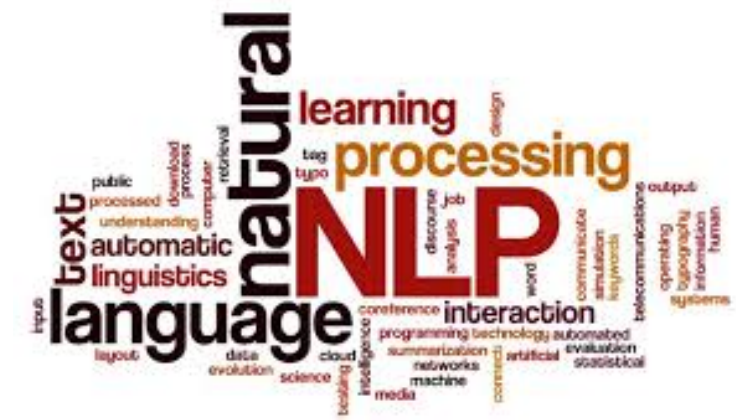
Reliable, well-trained AI scales up evaluation and supports skills-focused training, supervision, and quality assurance



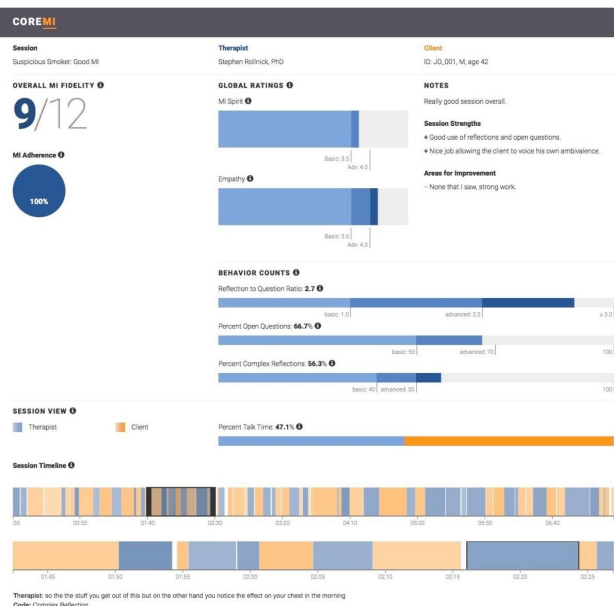
The basic arc from here...

1. Initial ideas, grant, and development of AI for MI fidelity

2. Prototype, start of Lyssn, and AI technologies 'in the real world'



3. What if you want to try something like this?

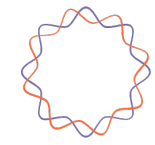


CANDY LAND

A Milton Bradley® Game



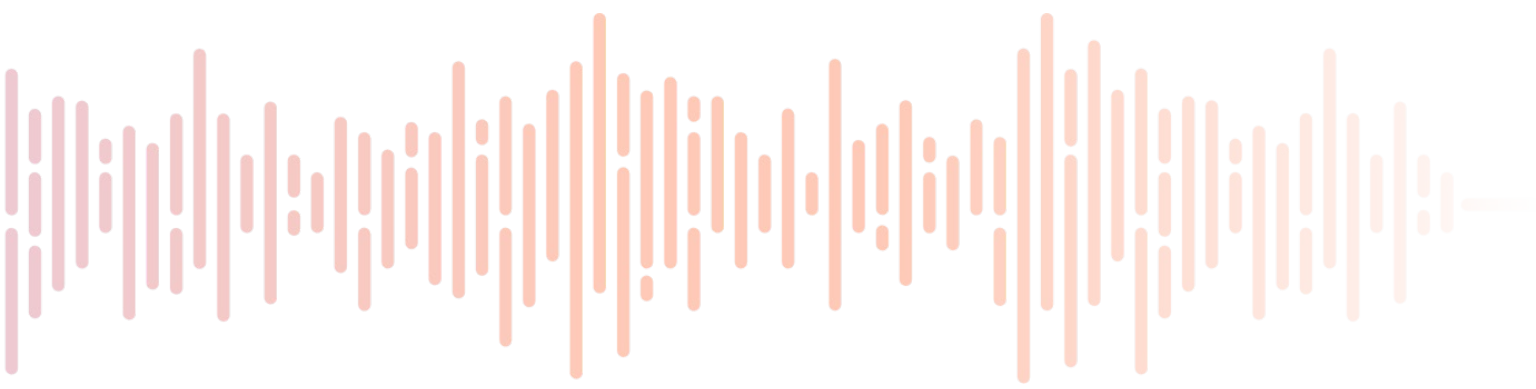
© 2004 Hasbro, Pawtucket, RI 02882. All Rights Reserved. 04700-G



LYSSN

Consciousness raising: There is something called... natural language processing, machine learning, and computational linguistics

(Or, how I stumbled upon AI at a Seminary)

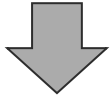


2003 job interview: Latent semantic... what?

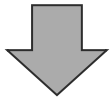
Journal of Family Psychology
2012, Vol. 26, No. 5, 816–827

© 2012 American Psychological Association
0893-3200/12/\$12.00 DOI: 10.1037/a0029607

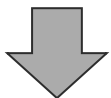
Latent Semantic Analysis (LSA)



Supplemental NIMH grant



"I have no idea what I'm doing."



"You don't know me but can I buy you lunch?"

Topic Models: A Novel Method for Modeling Couple and Family Text Data

David C. Atkins
University of Washington

Timothy N. Rubin and Mark Steyvers
University of California, Irvine

Michelle A. Doeden
Fuller Theological Seminary

Brian R. Baucom
University of Southern California

Andrew Christensen
University of California, Los Angeles

Apply for my first NIAAA R01 !!

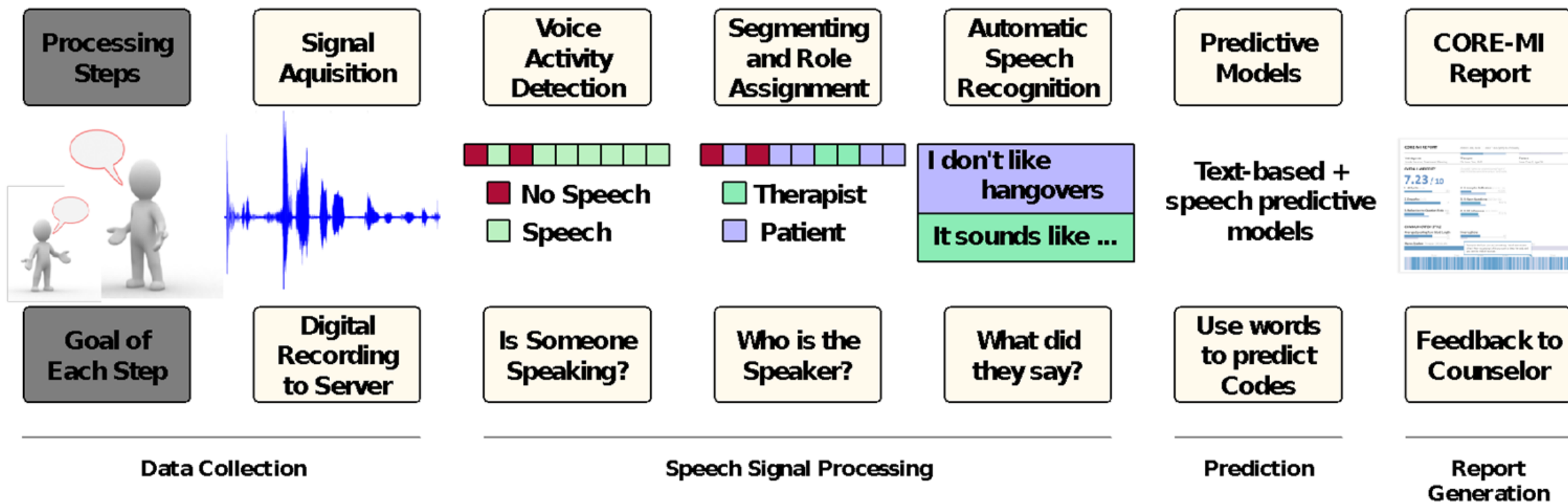


“This sounds great. This sounds like science fiction.”

AA-3 Committee Discussion, 2009



Building blocks for an automated technology to go 'sounds to codes' (2010-2018)



Flemotomos et al., 2022; Xiao et al., 2015, 2016

Professional journey: Down the ML / AI / NLP rabbit hole...

Using Prosodic and Lexical Information for Learning Utterance-level Behaviors in Psychotherapy

*Karan Singla¹, Zhuohao Chen¹, Nikolaos Flemotomos¹, James Gibson¹, Dogan Can¹,
David C. Atkins², Shrikanth Narayanan¹*

¹Signal Analysis and Interpretation Lab, University of Southern California, Los Angeles, CA, USA

²Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA

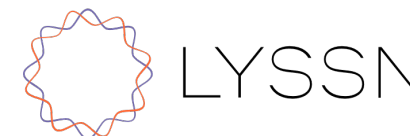
¹sail.usc.edu, ²datkins@u.washington.edu

ROLE SPECIFIC LATTICE RESCORING FOR SPEAKER ROLE RECOGNITION FROM SPEECH RECOGNITION OUTPUTS

Nikolaos Flemotomos¹, Panayiotis Georgiou¹, David C. Atkins², Shrikanth Narayanan¹

¹ Department of Electrical Engineering, University of Southern California, Los Angeles, CA, USA

² Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, USA



Three slides on modern NLP methods

(Yes, we'll briefly touch on ChatGPT...)



Client I wouldn't mind coming here for treatment but I don't want to go to one of those places where everyone sits around crying and complaining all day. CL

Counselor You don't want to do that. RE

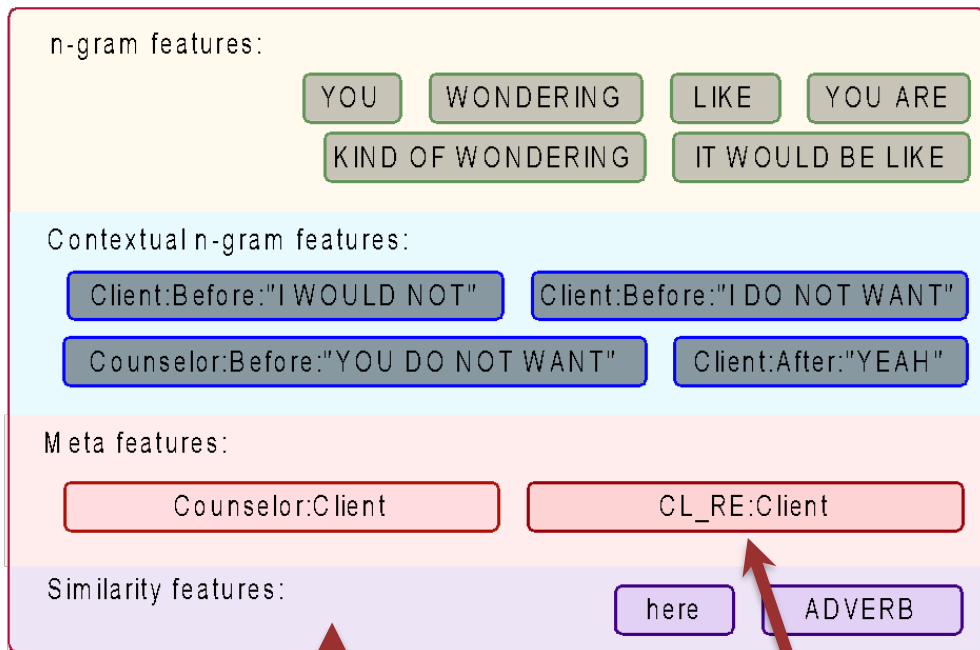
Counselor So you're kind of wondering what it would be like here. RE

Client Yeah. CL

Early NLP (pre-2012) used 'n-gram' models for language

Think: Dummy-coding vocabulary

Can et al., 2016

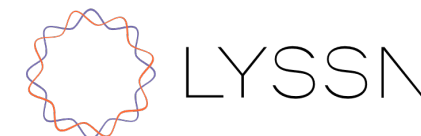


Who is speaking? What was previous code?

Directly overlapping words or parts of speech

Words in local context (before or after)

Individual vocabulary words and common 2 to 3 word phrases



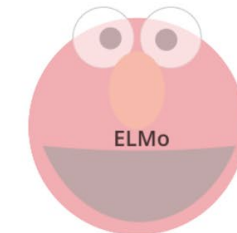
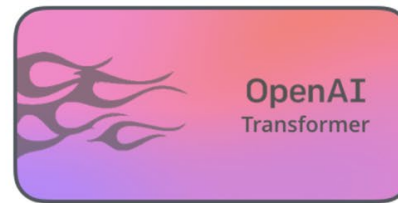
n-grams suffer from lack of **meaning** and **context**

Step #1:

'word embeddings'

Step #2:

Transformers



(Also... deep learning models do away with 'feature engineering'... but are also black boxes...)

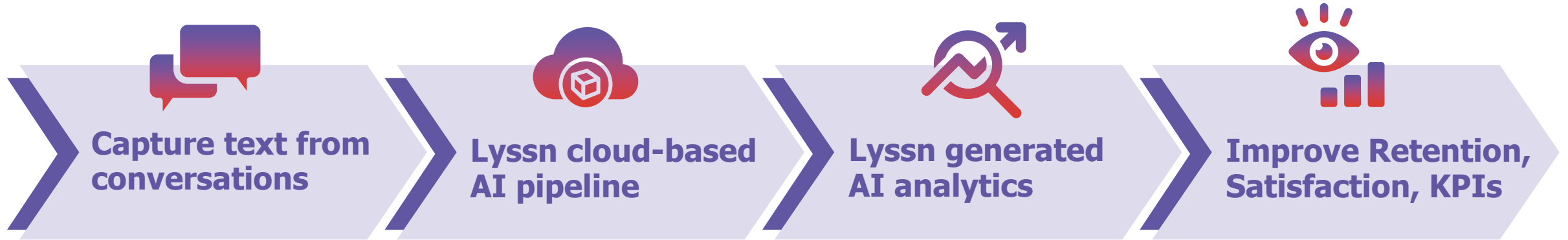
GPT models are 'generative pre-trained transformers'

GPT

Introduced by Radford et al. in [Improving Language Understanding by Generative Pre-Training](#)

GPT is a **Transformer**-based architecture and training procedure for natural language processing tasks. Training follows a two-stage procedure. First, a language modeling objective is used on the unlabeled data to learn the initial parameters of a neural network model. Subsequently, these parameters are adapted to a target task using the corresponding supervised objective.

Lyssn uses these advances in AI as the backbone of our AI pipeline



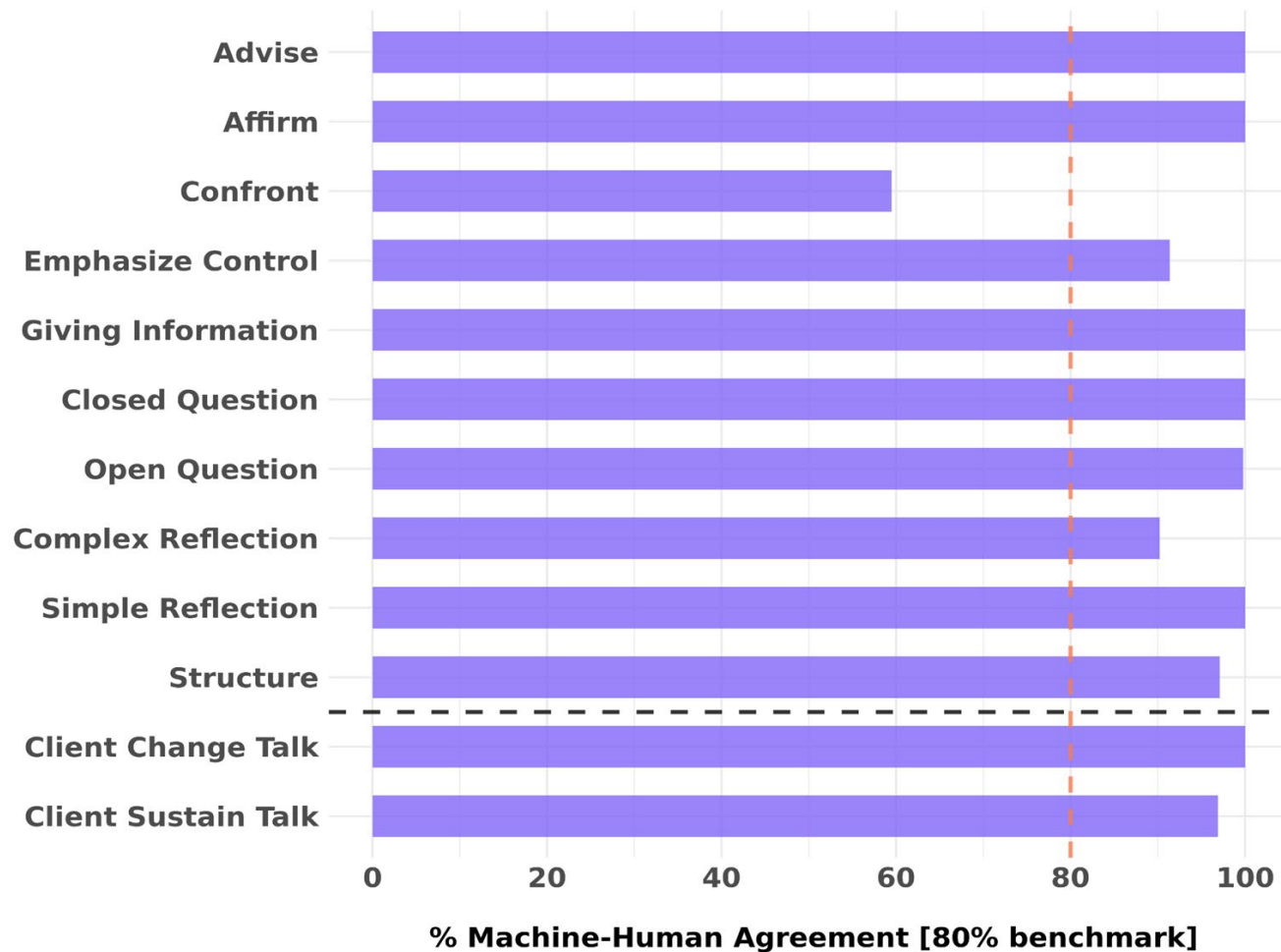
Here's something crazy: We do a *ton* of old school human coding

AI predictions relative to human experts

Atkins et al. 2014
Can et al. 2015
Cao et al., 2019
Pace et al. 2017
Tanana et al. 2016
Xiao et al. 2016; 2018

Lyssn's internal coding team:

- 25K+ sessions / calls
- 2.8M+ utterances



Lyssn AI metrics

General

- Speech: separating speakers & roles
- Empathy & talk time
- Active listening, collaboration & understanding

Cognitive Behavioral Therapy

- CTRS focused
- 11 dimensions
- Overall competency

Suicide Risk Assessment

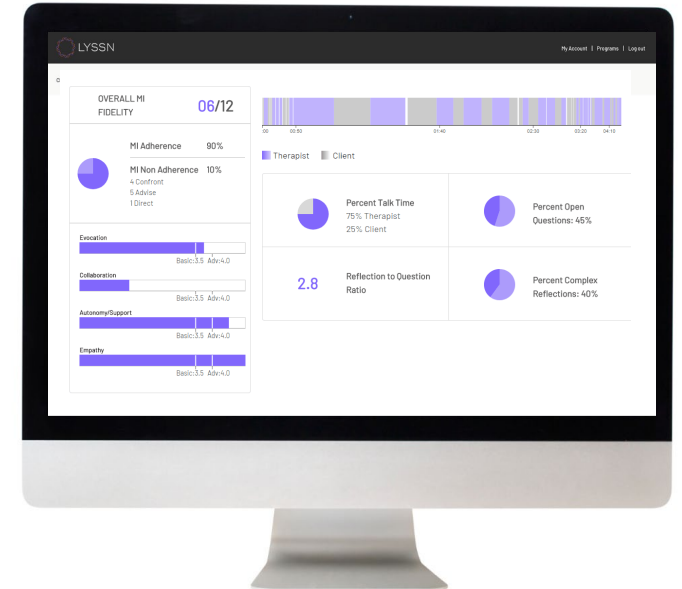
- Current ideation, intent, means, plans, current / past behavior
- Client clear and passive suicidality

Motivational Interviewing

- MISC focused
- Global / utterance
- 'high point' codes

Session Summaries

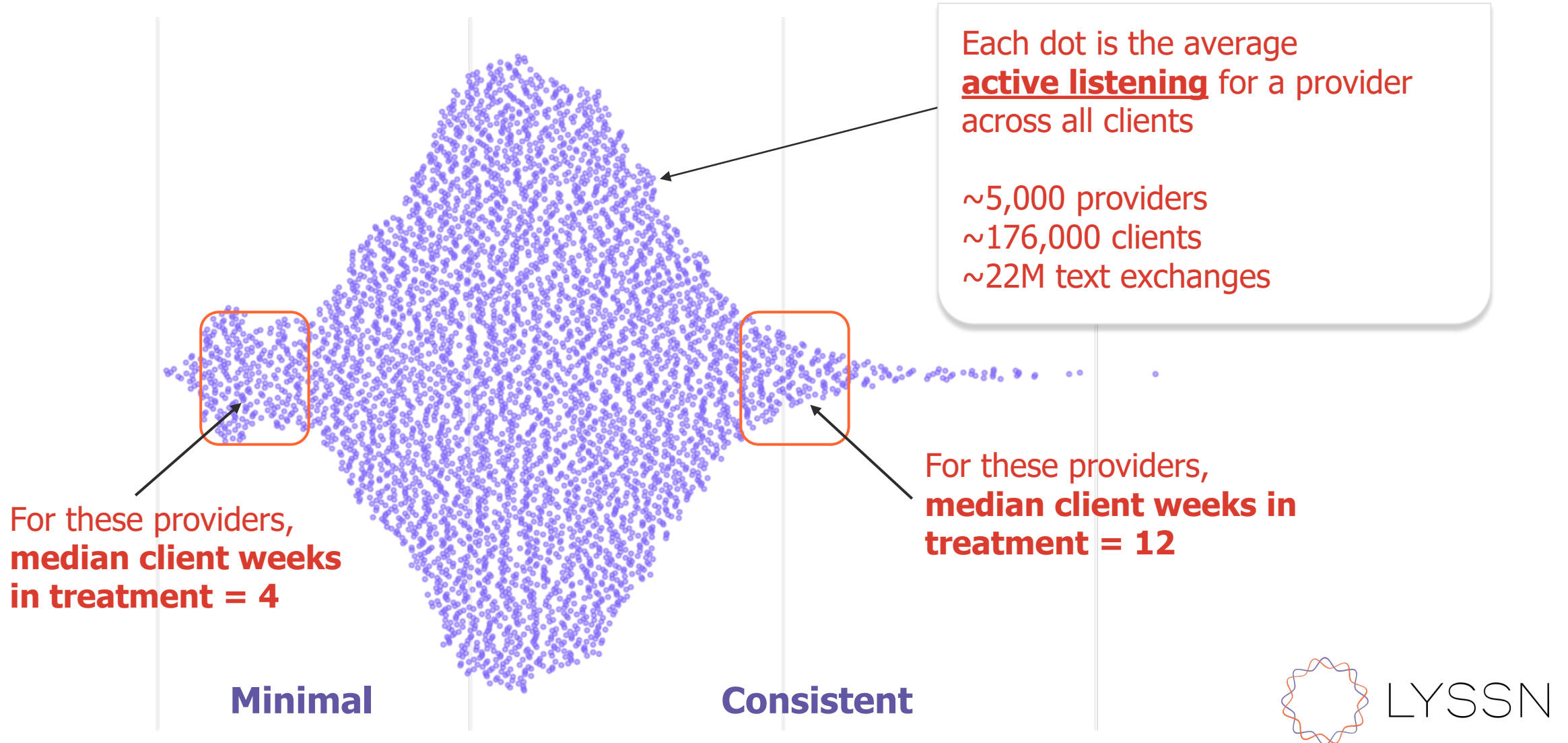
- 28 unique content codes
- Psychosocial functioning, symptoms & suicide ideation
- Retention & satisfaction



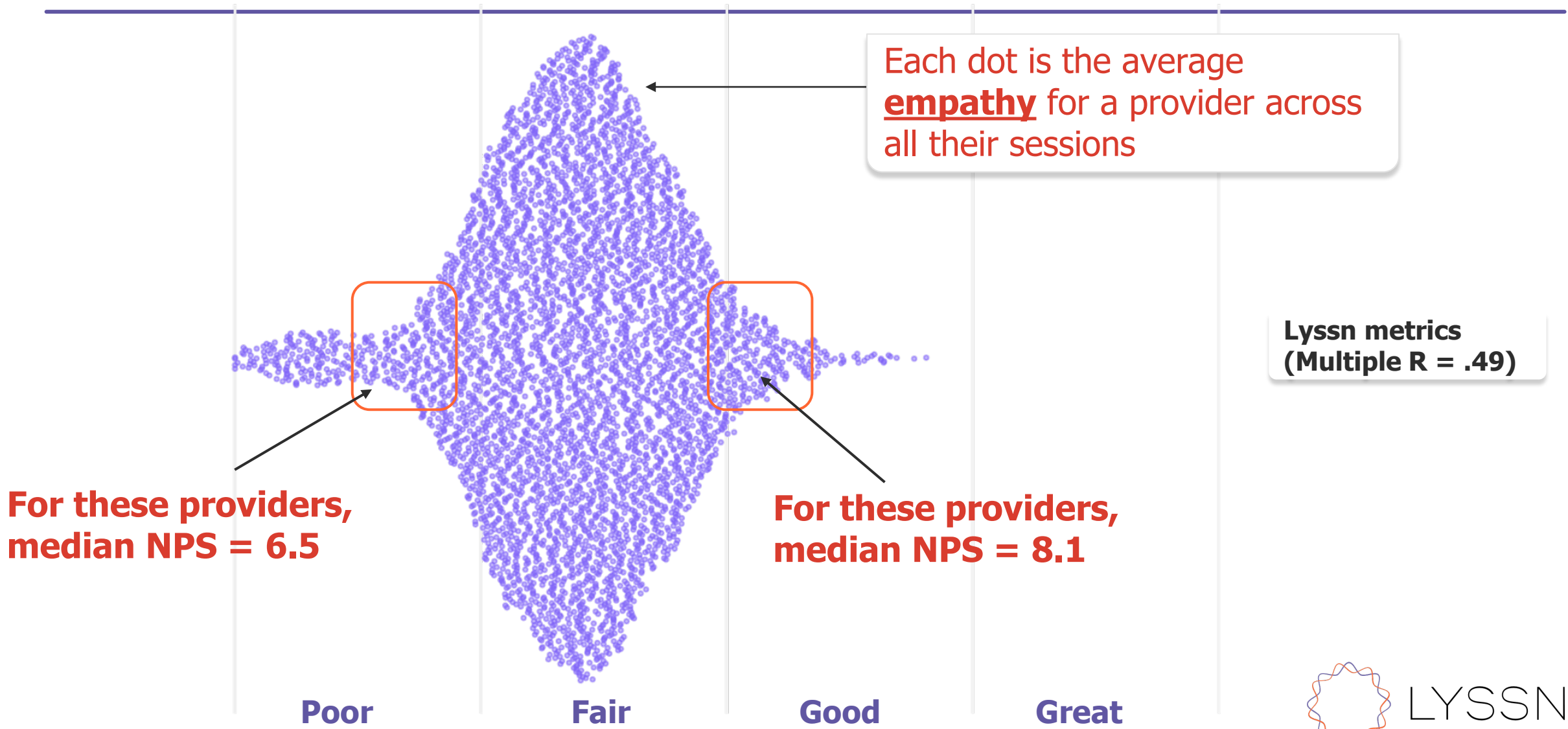
So what, does it matter?



Sessions → AI pipeline → Regress on outcomes



We see similar effects across fidelity metrics and outcomes



And... findings largely support clinical theory

Decrease engagement

- Assertive therapist behaviors
- Focus on assessment & case management
- Advice giving

Increase engagement

- Active listening skills
- Focus on mood & relationships
- Empathy

The combination of all 54 Lyssn metrics predict **20% of variance** in client engagement (**Multiple R = .41**)

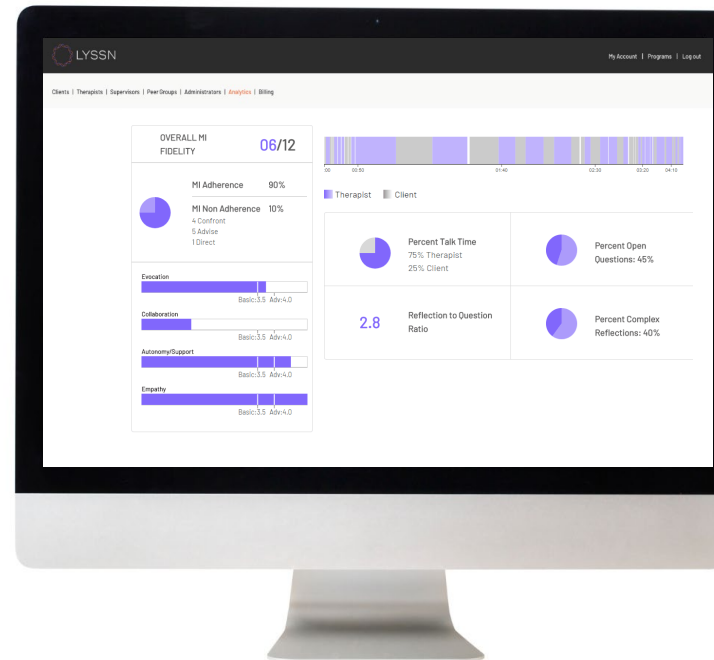


Lyssn's core AI powers products for training, quality improvement, and clinical documentation

Training

The screenshot shows a training interface with a video player at the top. The video is titled 'Angel' and has a play button in the center. Below the video is a progress bar and a 'Listen to your response' section with a play button. At the bottom, there are three profile cards for 'Dale', 'Elijah', and 'Rosie', each with a play button. A 'Next Module' button is located at the bottom right.

Supervision & QA/QI



Documentation

The screenshot shows a documentation interface. At the top, there is a 'Note Support' section with a dropdown menu set to 'DAP'. Below this is a 'Data' section with a 'Draft 1' entry. The draft text reads: 'Client reported that she has been drinking a lot since her 21st birthday a few weeks ago. She drank too much and ended up in the hospital. She stated that she will get a DUI soon. She is worried about her relationship with her boyfriend because she doesn't want to hang out with him when she is drunk. She has been dating him for 6 months and they have different work schedules so they don't hang out together as often as she would like. She reported that they used to just watch movies and drink together.'

Example Module (Exploring Questions)

Watch

Learn

Practice

Orientation > Training Room > Skill Module 2: Existing Motivation and Exploring Questions

[← Back](#)

Skill Module 2: Existing Motivation and Exploring Questions



0:00 ● 2:54



Watch

Learn

Practice

want him to be respectful to other people when he grows up and that starts with me right now. I'm not doing him any favors by letting him grow up to be a loud-mouthed jerk.

Client

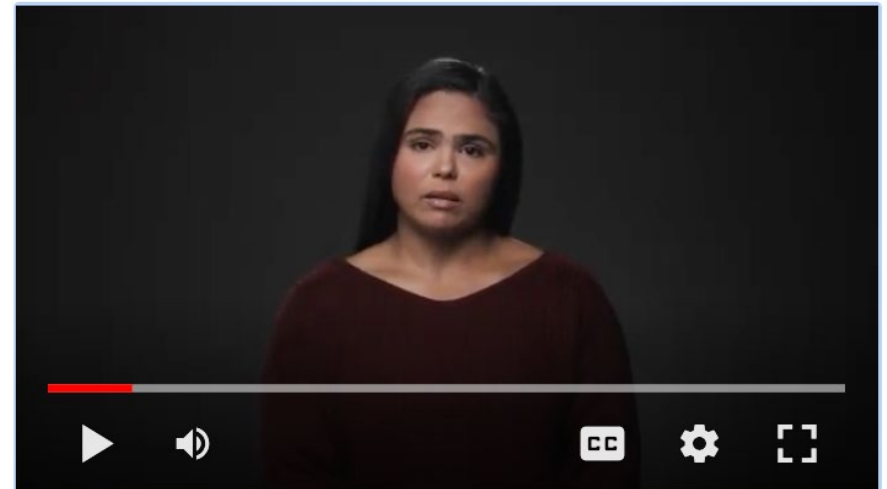
Tell me a little bit more about what you want for your son when he grows up. **EXPLORING QUESTION**

Provider

Practice with your clients.

So there is your second tool: Exploring Questions that dig in to the client's own motivation for change. Now it's your turn to try!

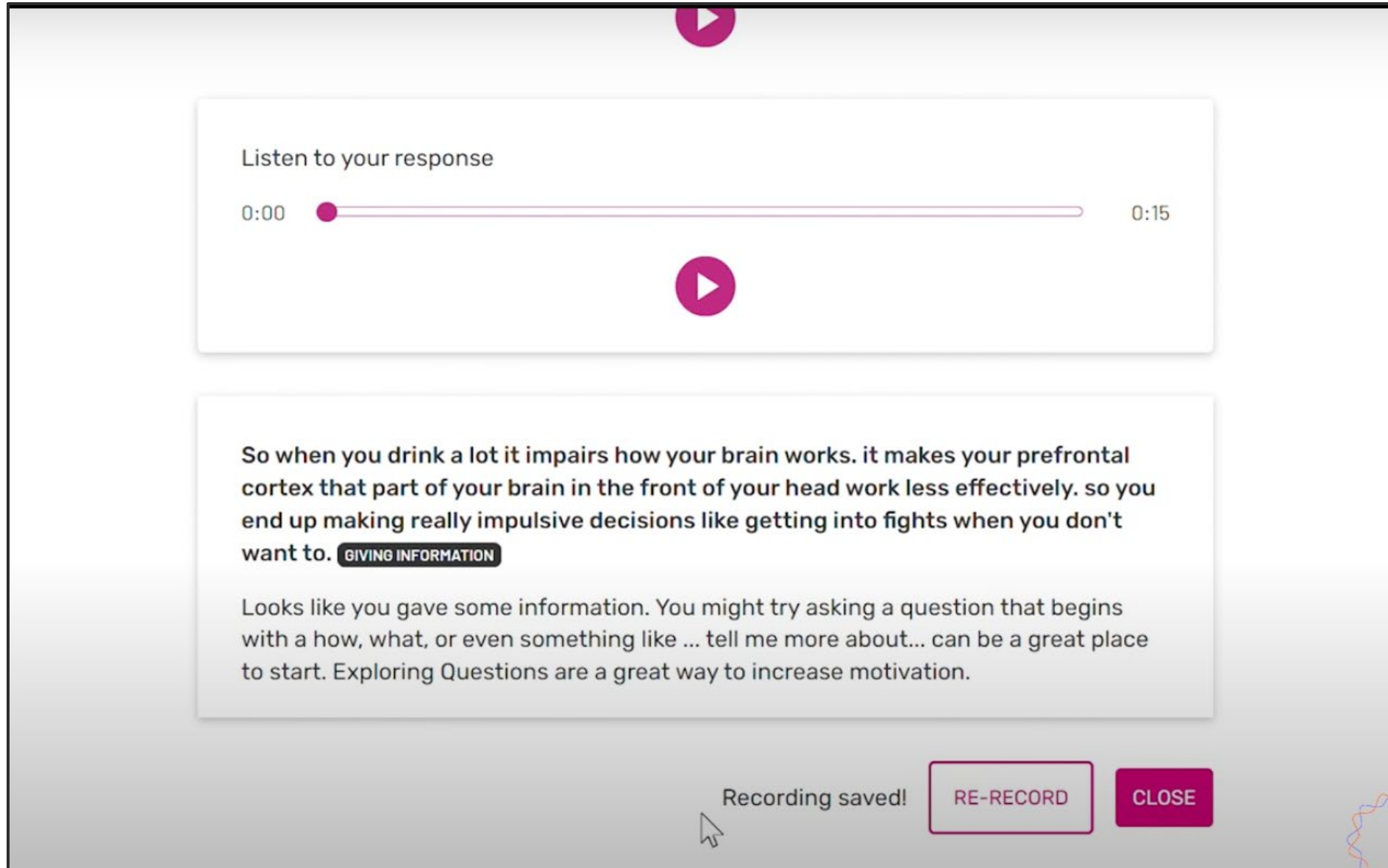
Gabriella [about](#)




0:00 ● 0:43




Trainees get to practice with immediate and specific feedback on their practice




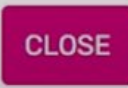
Listen to your response

0:00  0:15



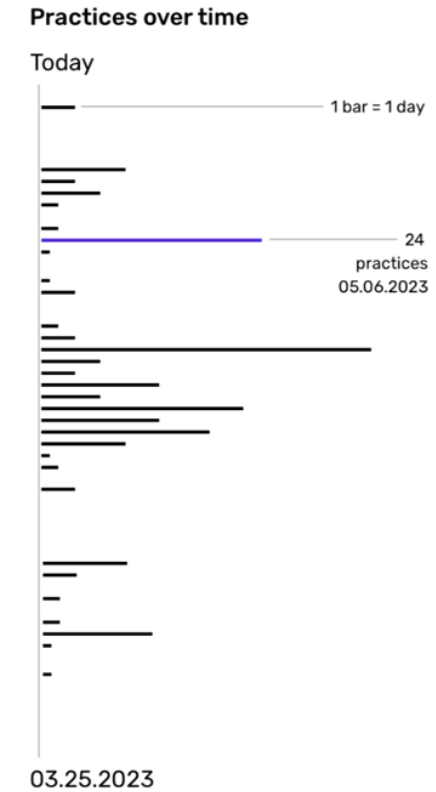
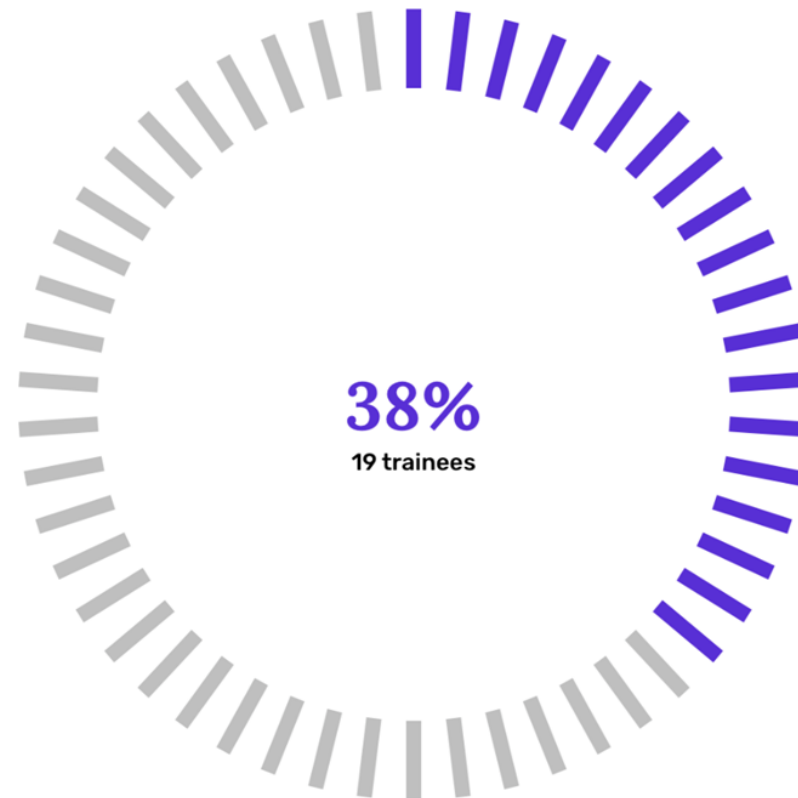
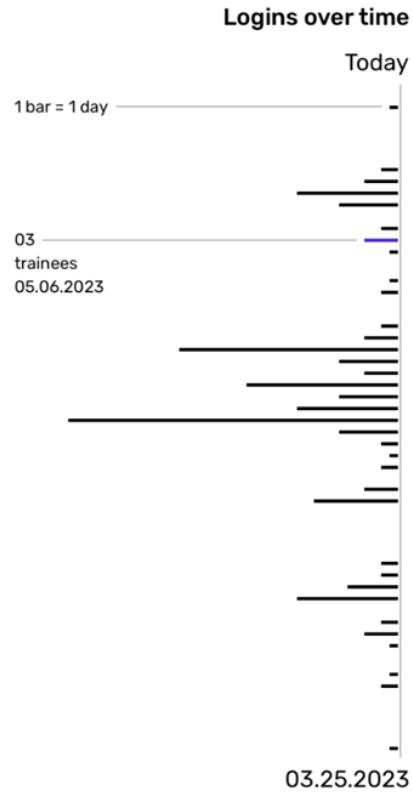
So when you drink a lot it impairs how your brain works. it makes your prefrontal cortex that part of your brain in the front of your head work less effectively. so you end up making really impulsive decisions like getting into fights when you don't want to. **GIVING INFORMATION**

Looks like you gave some information. You might try asking a question that begins with a how, what, or even something like ... tell me more about... can be a great place to start. Exploring Questions are a great way to increase motivation.

Recording saved!  

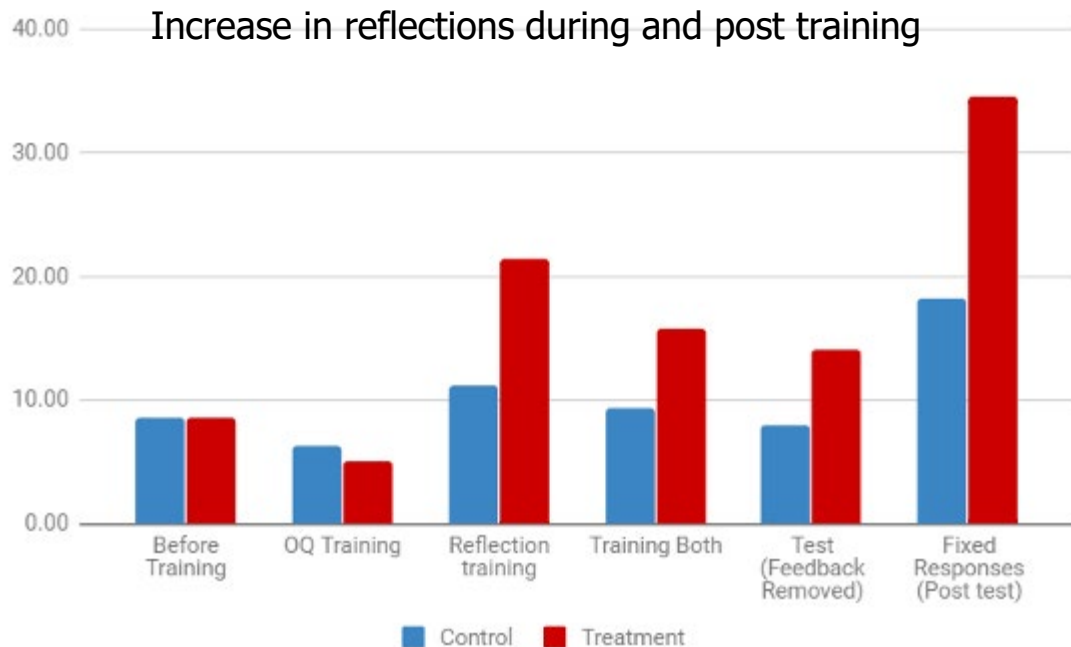
Dashboards summarize usage and performance

38% of trainees have logged in



Immediate AI-feedback enhances skill retention, with large randomized trial starting shortly

	Open Questions			Reflections			Reflection or Open Questions			n	
	Control	Treatment	p	Control	Treatment	p	Control	Treatment	p	Control	Treatment
Before Training	25.5	23.8	0.97	8.6	8.6	0.81	34.1	32.4	0.77	86	86
OQ Training	22.4	30.4	<.001	6.3	5	0.14	28.6	35.2	<.001	82	82
Reflection training	15.6	11	0.003	11.2	21.4	<.001	26.8	32.4	0.002	80	75
Training Both	18.4	20.9	0.07	9.3	15.8	<.001	27.7	36.8	<.001	79	74
Test (Feedback Removed)	16.7	18.3	0.16	8	14.1	<.001	24.7	32.5	<.001	79	74
Fixed Responses (Post test)	40	35.1	0.29	18.2	34.6	<.001	58.2	60.7	0.01	78	71



Tanana MJ, et al. Development and Evaluation of ClientBot: Patient-Like Conversational Agent to Train Basic Counseling Skills. *J Med Internet Res.* 2019 Jul 15;21(7):e12529.



So, maybe you want to try this?

Thoughts on tech development in behavioral health



Don't settle for an easy or available problem

NLP Researcher: "That psychotherapy data is really cool!"

Psychologist: "AI is really cool!"

Dave's own example

(J of Family Psych, 2012)

EMOTION-BASED TOPICS											
Negative Emotional Content					Positive Emotional Content						
Topic 3	.009	Topic 46	.008	Topic 79	.010	Topic 14	.010	Topic 95	.007	Topic 10	.011
angry	.170	give	.023	upset	.113	good	.039	[laugh]	.383	good	.101
anger	.072	shit	.021	back	.030	thought	.036	guess	.031	nice	.078
hurt	.047	pissed	.021	mad	.030	[laughing]	.031	good	.017	thought	.070
frustrated	.037	point	.019	temper	.024	pretty	.029	work	.017	felt	.048
trying	.032	whatever	.019	talk	.021	people	.025	thank	.012	appreciate	.033
upset	.027	man	.018	crying	.020	talk	.020	give	.012	week	.031
mad	.020	fuck	.017	angry	.018	part	.019	wow	.012	remember	.026
point	.018	care	.016	sorry	.018	summer	.017	definitely	.012	day	.026
sad	.016	god	.016	understand	.017	enjoy	.017	[laughing]	.010	couple	.020
emotional	.016	black	.015	fact	.015	remember	.016	back	.010	notice	.019
part	.016	problem	.015	late	.015	fun	.016	obviously	.010	work	.019
felt	.014	fine	.015	apologize	.013	u	.016	you'll	.010	great	.019
whatever	.014	walk	.014	fine	.012	nice	.014	hard	.009	pretty	.017
express	.014	white	.013	ready	.012	great	.014	relax	.009	thank	.016
respond	.014	cannot	.013	reason	.012	vacation	.014	[all laugh]	.009	realize	.015

Build interdisciplinary relationships, aligned on overall goals

*"...when I think of new fields in science that have been opened, I don't think of interdisciplinary teams combining existing skills to solve a defined problem—I think of **single interdisciplinary people** inventing new ways to look at the world."*

- Sean Eddy, *Antedisciplinary Science*

*"Our overall argument is that marginal [problem] solvers are not bound to the current thinking in the field of the focal problem and therefore can **offer perspectives and heuristics that are novel** and thus useful for generating solutions to these problems."*

- Jeppesen & Lakhani, *Marginality and Problem-Solving Effectiveness*

Know the end-user (and, like, include them)



What is the actual clinical use case... and do those end-users benefit from the solution?



“What would I do with that? Why would I want that?”

Why will someone use it? (not implementation science...)

Money*

**What is the “value proposition”
to your future customer?**

How will you help them:

- **Make more money?**
- **Save money?**
- **Meet some required,
regulatory need?**

“Let’s say I use your software and I learn that there are therapists in my network who are providing... ‘less good’ care. What am I supposed to do, fire them?”

- Chief Medical Officer, BH Insurer

* = Specific to the United States



Final thought: The skills that are in this room are *incredibly* relevant and necessary to the work of building effective, reliable AI-based tools.

Dave Atkins, PhD
dave@lyssn.io



Ethical AI: Preventing and Monitoring Bias

Lyssn is committed to transparency and quantifying and resolving algorithmic bias

Starting Aug 2023 we will produce an annual report that compares Lyssn's performance for racial/ethnic groups.

We are committed to constantly taking steps to ensure equity in how our software evaluates providers



Visualize population quality down to individual sessions

Therapist Summaries

DOWNLOAD DATA

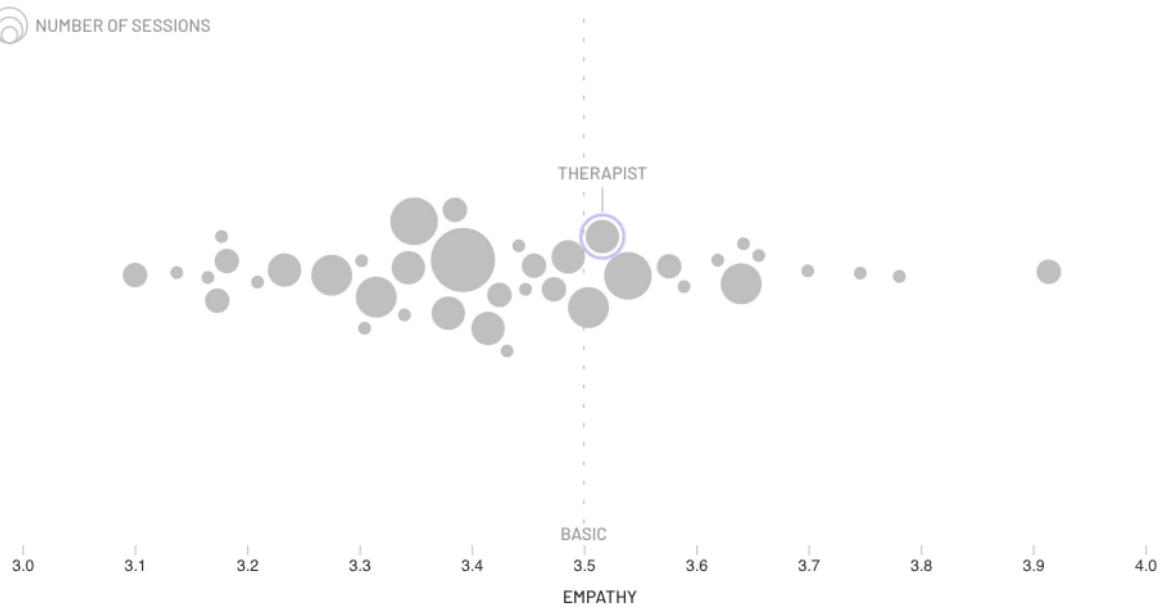
TIMEFRAME

past week

METRIC

empathy

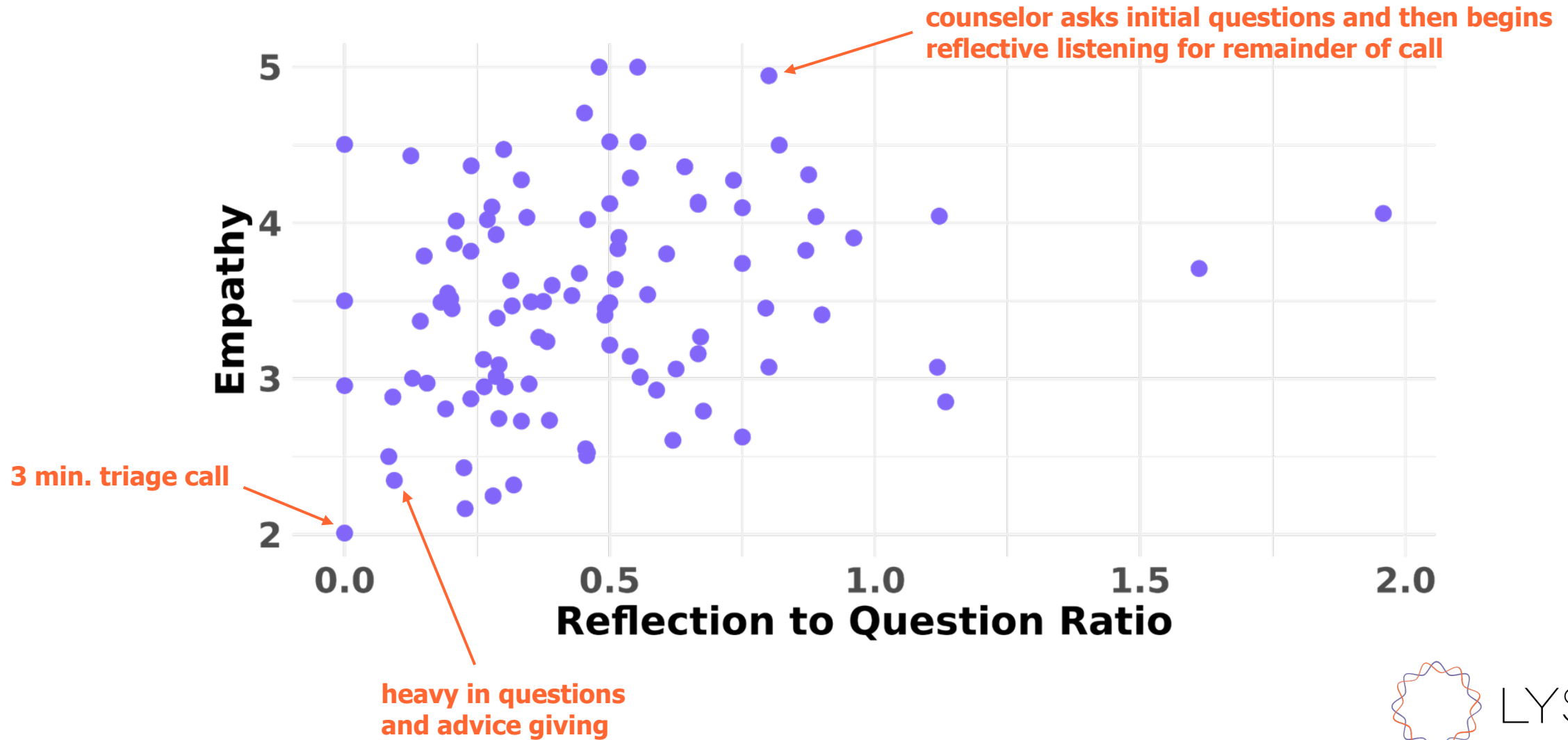
NUMBER OF SESSIONS



THERAPISTS

- Aikin, Rebecca
- Aikin, Helen
- Bateman, Elle
- Bowers, Jack
- Cast, Mark
- Deitz, Dan
- Deitz, Betsie
- Dewalt, Aaron
- Hancock, Faye
- Haworth, David
- Hesch, Thomas
- Lawicki, Steve
- Lawless, Ike
- Lawless, Matthew

Empathy correlates with reflection to question ratio



Lower empathy example

COUNSELOR | Okay. And um do you take any medication um for behavioral health needs? **closed question**

CLIENT | No.

COUNSELOR | And have you um talked to your counselor about your suicidal thoughts or is it they are reoccurring I I understand so you know is this something that's still been ongoing or that you've had conversations about? **closed question**

CLIENT | Um I haven't talked to her about it no because I'm worried she's going put me in the hospital.

COUNSELOR | Okay. Well and you know and that's one thing that it it's really important that you do talk to her about so because to look at um ways of addressing them so that they don't become a planner in action. Um you don't necessarily be put in the hospital for having suicidal thoughts if you know f that were the case probably the majority of the population would be in the hospital um because um unfortunately suicidal thoughts are quite normal. Um and you know the importance of expressing them and talking about them and you know figuring out like where they're coming from and and ways to you know kind of put a stop to them while there's still that thought before it becomes that plan in that action is really important. So um I encourage you to talk to your counselor about them and and another thing you know you you don't have anyone to talk to about it and any kind of feel that isolation and um you know not having those support so um you know having that resource to go to and to talk to about um you know can believe part of that also

CLIENT | Um

COUNSELOR | And then also just making sure that you're talking to your friends and and your family and not being afraid to um let them know how you're feeling um definitely talk to you know your counselor first 'cause you can um figure out ways of communicating how you're feeling. Um so that it's well received. Um but you know just being able to talk to your friends and family even even if it's not about like what's going on or these thoughts. But having conversations with them just so that you don't feel isolated. Like you know what I'm having a bad day today. Can we go hang out or even just hey what's up? Want to go do something you know? Um so you don't necessarily have to get into the details but making sure that you're communicating with them n and doing you know as as much as you can. Um to keep that socialization

CLIENT | Um

advice giving and
giving information

advice giving and
giving information

AI writes a draft summary of the session

Client reported that she has been drinking a lot since her 21st birthday a few weeks ago. She drank too much and ended up in the hospital. She stated that she will get a DUI soon. She is worried about her relationship with her boyfriend because she doesn't want to hang out with him when she is drunk. She has been dating him for 6 months and they have different work schedules so they don't hang out together as often as she would like. She reported that they used to just watch movies and drink together.

