# Quantitative Observational Practice in Family Studies (1 of 3)

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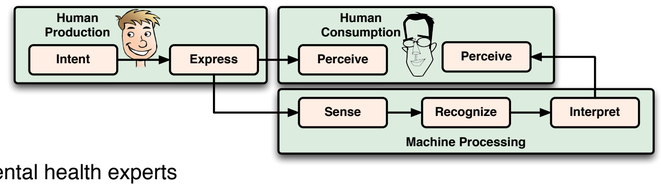
## Abstract

***Goal:***

- Transform observational behavior analysis
- Through computational framework
- Modeling of emotionally-rich human interactions
- Signal processing and machine learning
- Existing family therapy data
- Alleviate the tedium of manual annotation
- Offer new analysis capabilities and empower the mental health experts

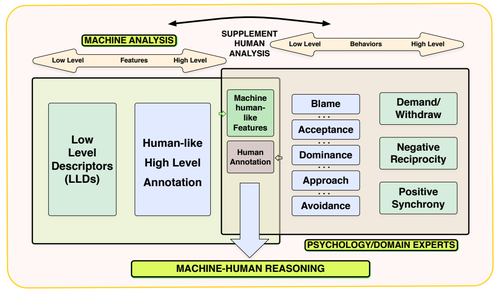



***Significance:*** USA-10mil people receive psychotherapy every year and state of the art hasn't changed for decades

## Approaches

**+ This poster**: [- Other two posters]

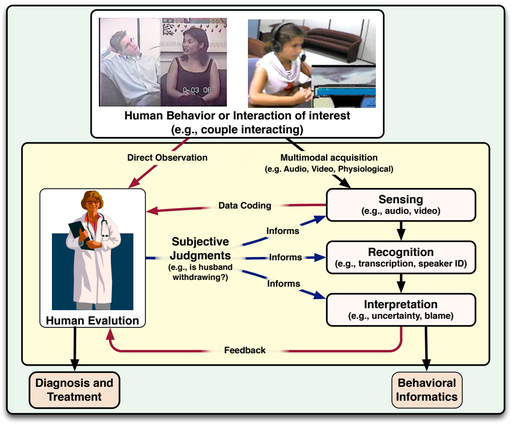
+ Model interlocutors independently:
  - ×Lexical, acoustic and visual modalities
- Model dynamics of interlocutors
- Incorporate Saliency




## Data

***Couple Therapy Corpus***

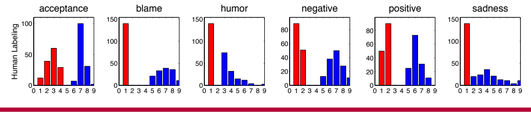
- 117 real distressed couples
- 10-minute dyadic interactions
- 596 sessions (96 hours)




## Data used

***Audio/Lexical and Visual subsets used***

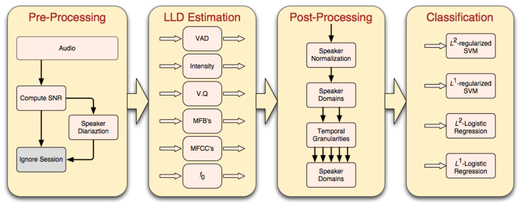
- Use top/bottom 20% for audio, lexical and 25% for video
- Choose subsets with acceptable audio/video qualities
- Used 6 codes with highest human agreement
- Some distributions skewed and not very separable



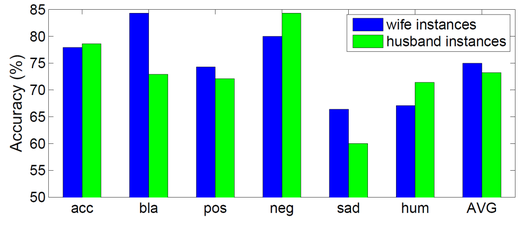

## Acoustic Classification

***Q: Does acoustic channel capture behavior?***

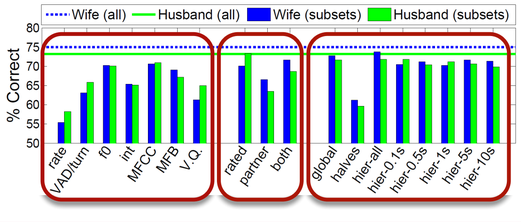
- Frame-level low-level descriptors (LLDs)
  - Prosodic: speech/non-speech, rate, f0, intensity
  - Spectral: 15 MFCCs, 8 MFBs
  - Voice quality: jitter, shimmer
- Separate features for (wife, husband, all)
- 7 temporal granularities
  - Global: entire session
  - Halves: 2nd half − 1st half
  - Hierarchical: 0.1s, 0.5s, 1s, 5s, 10s windows
- 14 static functionals (*e.g.*, mean, std. dev.)




Results with logistic regression (L2-regularized)

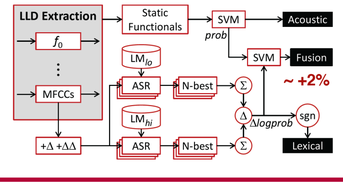



Importance of different features




## Fusion

Modalities provide complementary information:




## Lexical

***Q: Does lexical channel capture behavior?***

- Test from reference text
- Test from (unoptimized) ASR output

Example Transcript

| Partner | Transcript |
|---|---|
| H | WHAT DID I TELL YOU YOU CAN DO THAT AH AND EVERYTHING |
| W | BUT WHY DID YOU ASK THEN WHY DID TO ASK |
| H | AND DO IT MORE AND GET US INTO TROUBLE |
| W | YEAH WHY DID YOU ASK SEE MY QUESTION IS |
| H | MM HMMM |
| W | IF IF YOU TOLD ME THIS AND I AGREE I WOULD KEEP TRACK OF IT AND EVERYTHING |
| H | THAT'S THAT'S |
| W | **THAT'S AGGRAVATING VERY AGGRAVATING** |
| H | A BAD HABIT THAT |
| W | VERY AGGRAVATING |
| H | CAUSES YOU TO THINK THAT I DON'T TRUST YOU |
| W | THAT'S EXACTLY WHY THAT'S ABSOLUTELY THE WAY IT IS |
| H | AND IF I DON'T THE REASON FOR THAT IS AH |
| W | I DON'T CARE THE REASON YOU GET IT I GET IT TOO |
| H | THE REASON IS THE LONG TERM BAD PERFORMANCE |
| W | YEAH AND YOU KNOW WHY |
| H | MM HMMM |
| W | ALL YOU GET IS A NEGATIVE REACTION FROM ME |

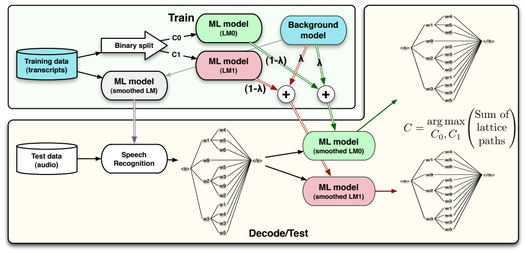
- Train ngram-models (here n=1) in ML manner
- Smooth with UBM
- Score transcripts to classify

Oracle classification results

| Results on reference transcript (% correct) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| code vs λ | 0.01 | 0.05 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.95 | 0.99 |
| acceptance | 91.4 | 91.0 | 91.0 | 90.0 | 90.3 | 89.2 | 88.5 | 87.5 | 86.4 | 75.3 | 60.5 |
| blame | 91.0 | 91.4 | 91.8 | 91.0 | 90.3 | 89.2 | 89.2 | 88.5 | 88.2 | 78.1 | 63.4 |
| humor | 71.3 | 72.4 | 72.0 | 71.3 | 69.5 | 69.9 | 67.5 | 67.0 | 65.2 | 61.6 | 57.3 |
| negative | 83.8 | 84.9 | 86.7 | 86.7 | 86.4 | 85.7 | 86.0 | 86.0 | 85.3 | 74.9 | 60.2 |
| positive | 89.6 | 89.6 | 89.6 | 88.9 | 87.5 | 87.8 | 87.8 | 87.5 | 87.8 | 76.7 | 63.8 |
| sadness | 59.0 | 61.6 | 60.9 | 61.3 | 60.6 | 60.2 | 58.8 | 59.5 | 59.1 | 57.7 | 58.5 |

- In real-world no transcripts, transcription error high so:

Decode and classification




Latice classification results

| Results through ASR lattices (% correct) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| code vs λ | 0.01 | 0.05 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.95 | 0.99 |
| acceptance | 71.4 | 72.9 | 75.4 | 73.6 | 73.6 | 73.2 | 71.8 | 71.1 | 68.9 | 64.6 | 63.6 |
| blame | 75.0 | 76.8 | 77.9 | 78.6 | 78.2 | 77.9 | 76.8 | 76.4 | 73.9 | 67.5 | 63.9 |
| humor | 57.9 | 58.6 | 58.6 | 57.5 | 57.1 | 56.4 | 57.9 | 56.1 | 55.4 | 55.0 | 50.7 |
| negative | 64.3 | 66.1 | 69.6 | 71.1 | 70.4 | 69.3 | 69.3 | 67.9 | 65.7 | 60.7 | 58.9 |
| positive | 72.9 | 73.2 | 74.6 | 74.6 | 72.5 | 72.9 | 73.9 | 73.6 | 71.4 | 66.1 | 64.6 |
| sadness | 52.5 | 55.0 | 55.7 | 52.1 | 50.4 | 50.7 | 51.1 | 51.8 | 52.1 | 54.3 | 52.1 |

- Can inform experts:

| Most blaming words in terms of discriminative contribution | | | | Least blaming words in terms of discriminative contribution | | | |
|---|---|---|---|---|---|---|---|
| Word | No Bl. log prob | Blame log prob | Δ | Word | No Bl. log prob | Blame log prob | Δ |
| YOU | -95.49 | -85.88 | -9.61 | EXPECTS | -16.70 | -17.84 | 1.14 |
| YOUR | -51.24 | -47.18 | -4.06 | CONSIDERATION | -16.11 | -17.31 | 1.21 |
| ME | -40.27 | -37.74 | -2.53 | KNOW | -35.10 | -36.62 | 1.53 |
| TELL | -33.97 | -32.46 | -1.51 | INABILITY | -16.76 | -18.32 | 1.55 |
| ACCEPT | -25.44 | -23.99 | -1.45 | SESSION | -20.51 | -22.07 | 1.56 |
| CARING | -27.05 | -25.91 | -1.14 | OF | -44.50 | -46.26 | 1.76 |
| KITCHEN | -21.22 | -20.21 | -1.02 | ANTICIPATION | -22.22 | -24.21 | 2.00 |
| TOLD | -29.04 | -28.19 | -0.85 | THINK | -35.70 | -37.77 | 2.07 |
| NOT | -40.32 | -39.59 | -0.73 | WE | -29.39 | -31.75 | 2.36 |
| WHAT | -51.47 | -50.77 | -0.69 | I | -99.92 | -102.49 | 2.57 |
| INTIMACY | -43.16 | -42.53 | -0.63 | THAT | -91.30 | -93.97 | 2.67 |
| IT | -42.70 | -42.18 | -0.52 | UM | -64.75 | -70.76 | 6.01 |

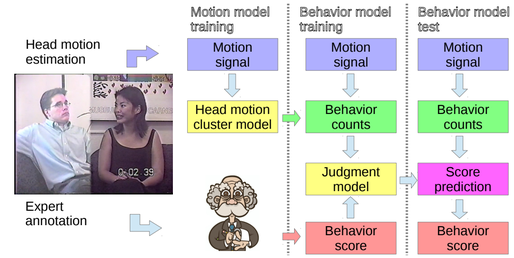
## Future Work Highlights

- Introduce "latent layer" of behavioral primitives
- Improve on individual modalities. *e.g.* optimize ASR
- Implement fusion based on modality saliencies

## Head motion modeling

***Q: Does head motion capture behavior?***

**Overview of the system flow**

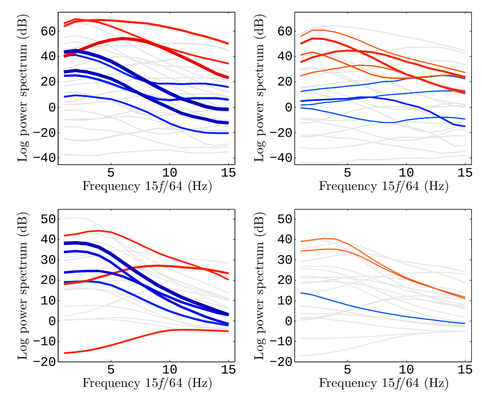



**Method**

- Head motion: face recognition & feature point tracking
- Motion event: moving window of 2 sec long, 1 sec shift
- Motion model: linear prediction coeff. (10 order LSF) & power spectrum (2nd to 16th point in 128-FFT, <3.5 Hz)
- Motion clustering: K-means with $K = 4, 5, \cdots, 25$
- Feature: counts of motion events (kinemes) in each cluster
- Classification: linear support vector classifier

**Case study: M2/Wife/Blame**

- Power spectrum of cluster centroids, test mean dif (ANOVA)
- Red/blue — high/low blame, width — test significance




**Data split**

- Middle 50% of each code — training head motion model
- Upper and bottom 25% of each code — binary classification

**Training configuration**

- M1 — Gender generic, combine X and Y dir. for clustering
- M2 — Gender generic, X and Y separately, combine counts
- M3 — Gender specific, X and Y separately, combine counts
- Cross-validation: Two-layer leave-one-out to select $K$

**Behavior code classification accuracies**

| Feature | M2-W | M2-H | M3-W | M3-H | Average |
|---|---|---|---|---|---|
| PS | 0.77 | 0.73 | 0.73 | 0.77 | 0.75 |
| LSF | 0.80 | 0.64 | 0.75 | 0.70 | 0.72 |

Comparison of average accuracies by PS and LSF

## Citations, Acknowledgments

Full list of publications at `http://scuba.usc.edu`
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