Coding Severe Behaviors in Children with Autism Spectrum Disorder to Train Machine Learning Algorithms

Toluwa Davies
Munroe-Meyer Institute

Walker Arce
Munroe-Meyer Institute

Jordan DeBrine
Munroe-Meyer Institute

Katelyn Malick
University of Nebraska Medical Center

Carter Welch
Munroe-Meyer Institute

See next page for additional authors

Recommended Citation

Author

Toluwa Davies, Walker Arce, Jordan DeBrine, Katelyn Malick, Carter Welch, James E. Gehringer, Seth
Walker, and Amanda Zangrillo

Coding Severe Behaviors in Children with Autism Spectrum Disorder to Train Machine Learning Algorithms

Toluwa Davies, SURP[1], Walker Arce[1], Jordan DeBrine M.A., BCBA[3], Katelyn Malick, SURP[1], Carter Welch, SURP[3], James E. Gehringer, PhD[1,2], Seth Walker, PhD, BCBA-D[3], Amanda Zangrillo, PsyD, BCBA-D[3]

Virtual Reality Lab, Munroe-Meyer Institute[1]. Physical Therapy Department, Munroe-Meyer Institute[2]. Severe Behavior Department, Munroe-Meyer Institute[3].

Background

- One in 44 children are diagnosed with autism spectrum disorder (ASD)[3], which can result in challenging behaviors that negatively affect both them and their caregivers[4].
- Function-based treatment (FBT) is effective but rare, due to intense training and time requirements.[2] This translates to limited access for families.
- At the Munroe-Meyer Institute (MMI), 30-40% of staff time is allocated to collecting observational data alone, limiting potential availability for clinical treatment.
- Machine learning algorithms (MLAs) have been used for automation in a variety of fields; however, data on their efficacy in observing challenging behaviors is limited.

Purpose

The goal of this study is to train MLAs to identify challenging behaviors and to assess their accuracy within- and between-subjects.

Methods

Participants

- Nine male youths, ages 4-18
- Diagnosis of ASD or other intellectual/developmental disability (IDD)
- Participants were patients receiving FBT in the Severe Behavior Department at MMI

Data Extraction For Development of MLAs

- Series of 20-minute videos featuring recorded footage of participants during delivery of FBT.
- A custom software ,"cometrics", developed to facilitate and streamline video coding/data collection process[1]
- Coding performed by two researchers per video
- Coders looked for 21 challenging behaviors from the perspective of MLA

Coding Process in "cometrics"

- Coder fills out "Patient Information" section (Fig. 1)
- Coder loads video and starts session (Fig. 2)
- Coder refers to key bindings listed on left side of screen to tag behaviors as they happen in the video (Fig.3)

This study aims to train machine-learning algorithms to code severe behaviors automatically, giving staff more time to engage with patients directly.
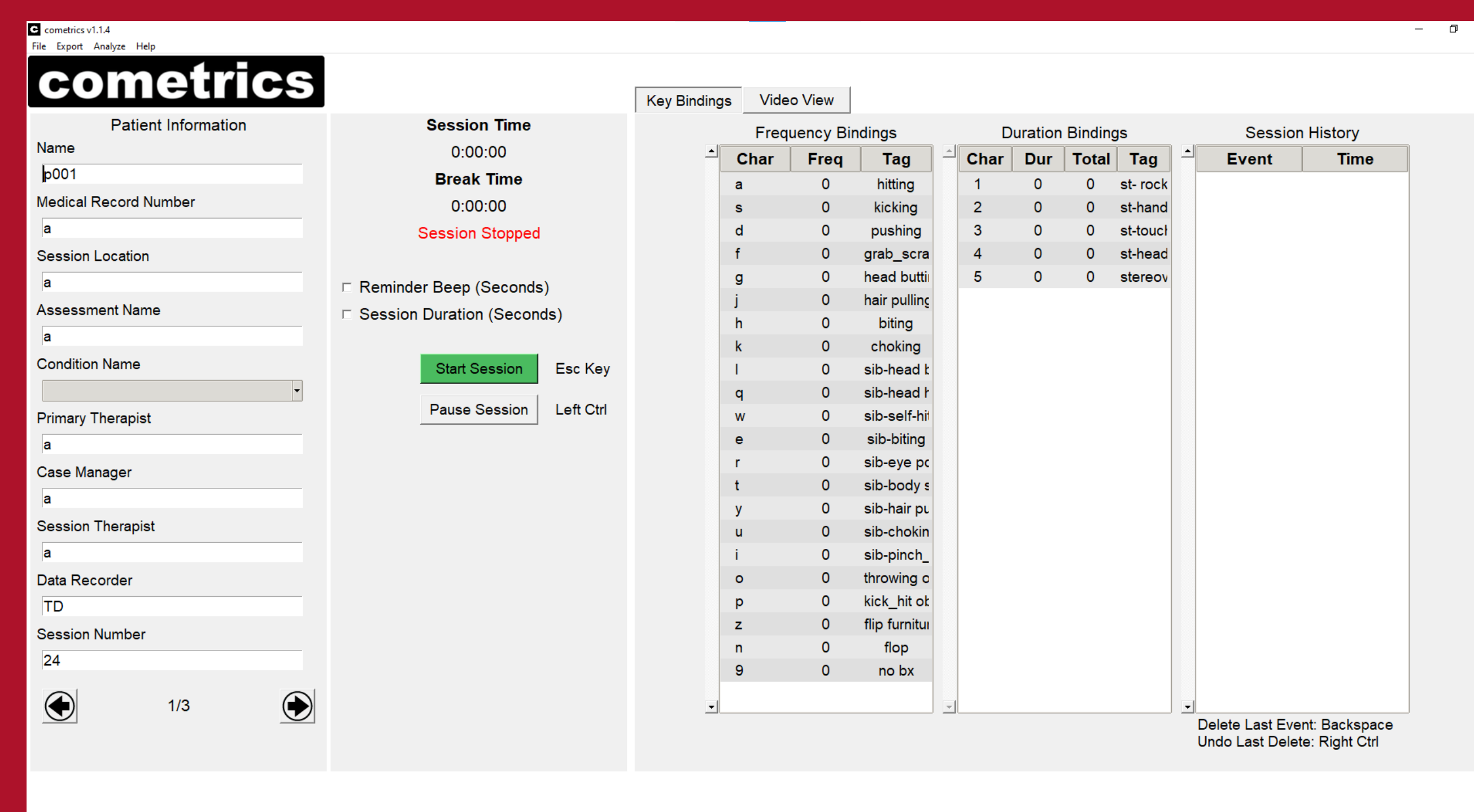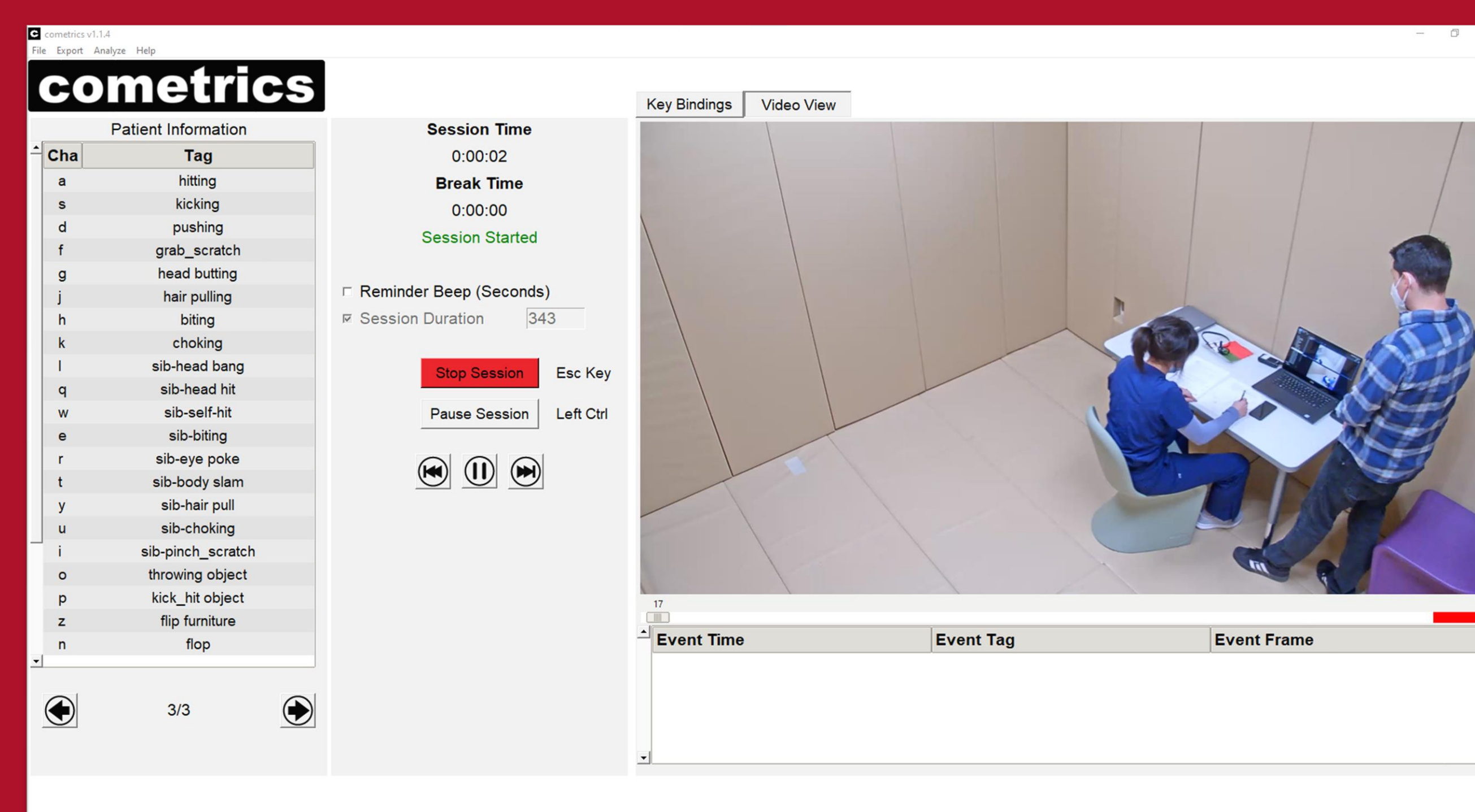

Figure 1: Initial screen once inside "cometrics"
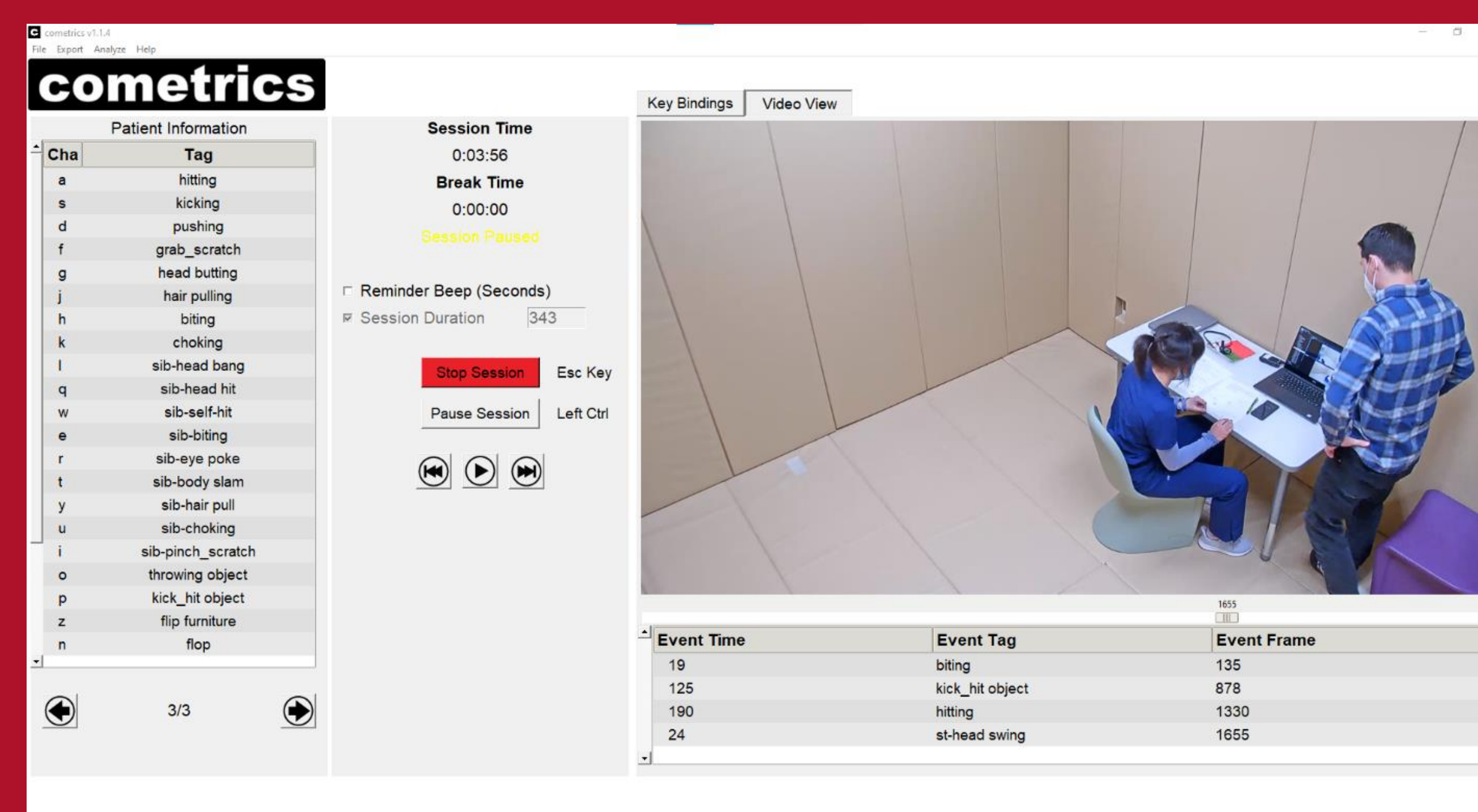

Figure 2: Screen once video for coding is selected

Figure 3: Screen during coding session in "cometrics"

Next Steps

1. **Use the coded datasets to train MLAs**
   - Multi-Class Classification: allows for training of one MLA to detect several behaviors, rather than one MLA per behavior

2. **Test MLA performance for accuracy**
   - MLA will analyze short videos featuring novel instances of the behaviors it's been trained for.
   - MLA will provide binary output on either the presence or absence of those behaviors every two seconds.
   - Results will be compared to actual number of behaviors predetermined by human analysis.

Expected Results and Conclusion

- If MLAs can identify severe behaviors at a level close to that of humans, the task can be reassigned from human to machine.
- By automating the behavioral coding process, applied behavioral analyst staff will be have more time they can dedicate to serving more patients.
- The more data we process through "cometrics", the more successful the MLA training process will be.
- Eventually, we plan to apply these technologies to real-time monitoring during FBT sessions as well.
    - Benefits include increased safety for staff, as well as reducing the number of staff needed on standby during sessions (automatic alerting system).

References

1. Arce, W. S., Walker, S. G., Hurtz, M. L., & Gehringer, J. E. (2022). cometrics (Version v1.1.4) [Computer software]. https://github.com/Munroe-Meyer-Institute-VR-Laboratory/cometrics
2. Ghaemmaghami, M., Hanley, G. P., & Jessel, J. (2021). Functional Communication Training: From Efficacy to Effectiveness. Journal of Applied Behavior Analysis, 54(1), 122-143.
3. Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, A., ... & Cogswell, M. E. (2021). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—autism and developmental disabilities monitoring network, 11 sites, United States, 2018. MMWR Surveillance Summaries, 70(11), 1.
4. Newcomb, E. T., & Hagopian, L. P. (2018). Treatment of Severe Problem Behaviour in Children with Autism Spectrum Disorder and Intellectual Disabilities. International Review of Psychiatry, 30(1), 96-109.