

# Automated Classification of Solution-Focused Caregiver Strategies for Personalized Early Intervention Service Design

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## Community-Identified Problem

- The Participation and Environment Measure Plus (PEM+) guides caregivers online to contribute their expertise when designing their child's early intervention (EI) service plan with providers.<sup>1-3</sup>
- Caregiver acceptability results indicate need for further personalizing PEM+ (e.g., how caregivers search for and exchange solution-focused caregiver strategies for EI goal attainment).<sup>3</sup>

## Intellectual Merit

- Our project advances a smart and connected approach to family-centered EI service design by 1) upgrading the PEM+ prototype (e.g., applying natural language processing (NLP)) and 2) evaluating the upgraded PEM+ version within EI.
- The first year focused on PEM+ upgrades, including the development of predictive models to implement into PEM+, to help reduce caregiver burden when completing PEM+ to engage in designing their child's EI service plan to be responsive to family priorities.

## Project Activities

- We introduced a new dataset of 780 caregiver strategies mapped to four key predictors of child participation (environmental/context [EC], sense of self [SOS], preferences [P], activity competence [AC])<sup>4</sup> and a non-strategy [NS] class.
- We defined two types of classification tasks for this dataset: 1) a 5-category multinomial classification task, and 2) a pipelined and more simplified strategy classification tasks, including binary strategy detection and a fine-grained strategy classification (see Figure 1).
- We experimented with classical machine learning and Transformer-based classification models including logistic regression,<sup>5</sup> naïve Bayes,<sup>5</sup> Bidirectional Encoder Representation from Transformers (BERT),<sup>6</sup> and Bio-Clinical BERT,<sup>7</sup> to compare model performance.
- We implemented strong benchmark classification models using BERT to solve the classification tasks, achieving performance ranging from  $F_1=0.51-0.79$  (see Table 1).
- We conducted a clinically-informed analysis of these results to offer real-world next steps for making use of our models.

Figure 1. 5-Class and Pipelined Classification Tasks Considered in our Experiments.

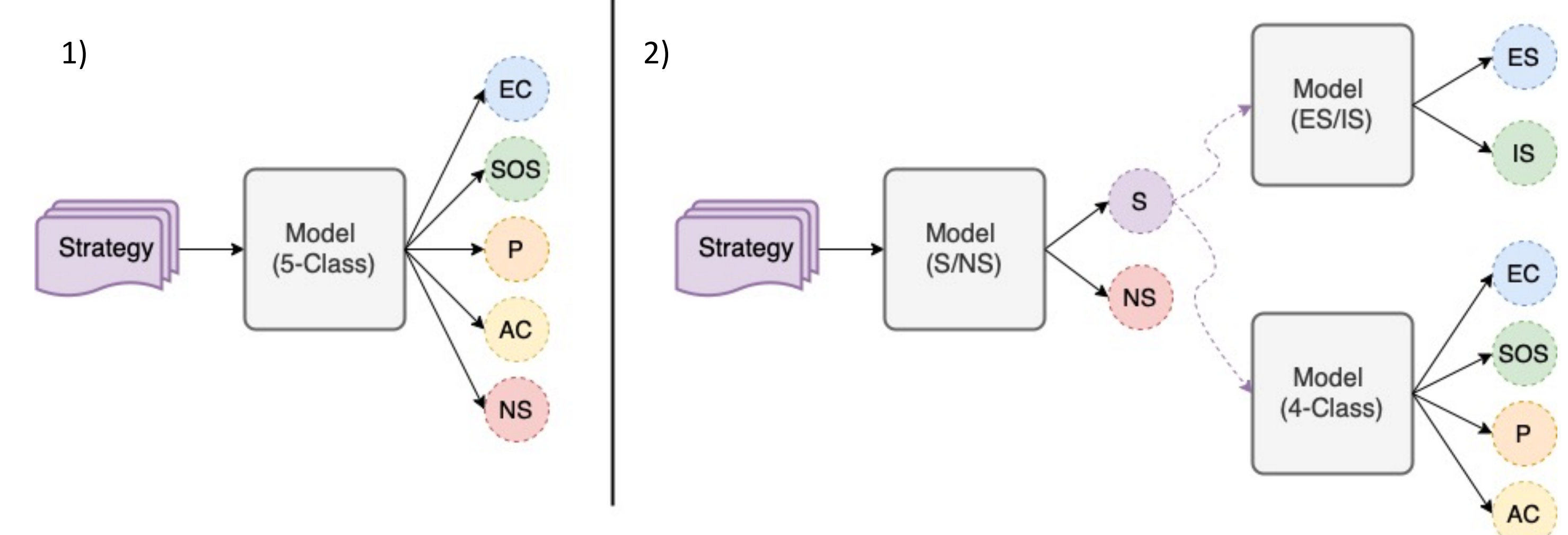


Table 1. Model Comparison of the 5-Class and Pipelined Classification Tasks.

Classification Task (BERT)	Accuracy	F <sub>1</sub>
Strategy/Non-Strategy (S/NS)	88.15	0.79
Extrinsic/Intrinsic Strategies (ES/IS)	58.06	0.53
4-Class	61.29	0.51
5-Class	64.47	0.56

## Immediate Broader Impact

- Results support feasibility of the 5-class multinomial classification and the pipelined classification for implementation into PEM+ to personalize EI services.
- Detecting non-strategies can prompt caregivers towards submitting valid strategies when using PEM+.

## Lasting Broader Impact

- This research contributes to the study of novel NLP techniques in health domains not yet explored.<sup>8</sup>
- Results yield new functionality, which an agent could use to support user navigation in complex goal setting.<sup>9</sup>

## Next Steps

- We plan to augment data to improve models.
- We are developing a prototypic conversational agent to support PEM+ user navigation.
- We will embed the new functionality and agent into our PEM+ prototype prior to further testing.

