

A Hierarchical Theme Recognition Model for Sandplay Therapy

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Background & Motivation

Task: Sandplay theme recognition

1. Sandplay therapy functions as a pivotal tool for psychological projection, where testers construct a scene to mirror their inner world while psychoanalysts scrutinize the testers' psychological state.
2. Recognizing the theme (i.e., identifying the content and emotional tone) of a sandplay image is a vital step in facilitating higher-level analysis.

Challenges:

1. Gathering high-quality and enough sandplay images paired with expert analyses to form a scientific dataset is challenging, due to this task relies on a specialized sandplay environment.
2. Theme is a comprehensive and high-level information, making it difficult to adopt existing works directly in this task

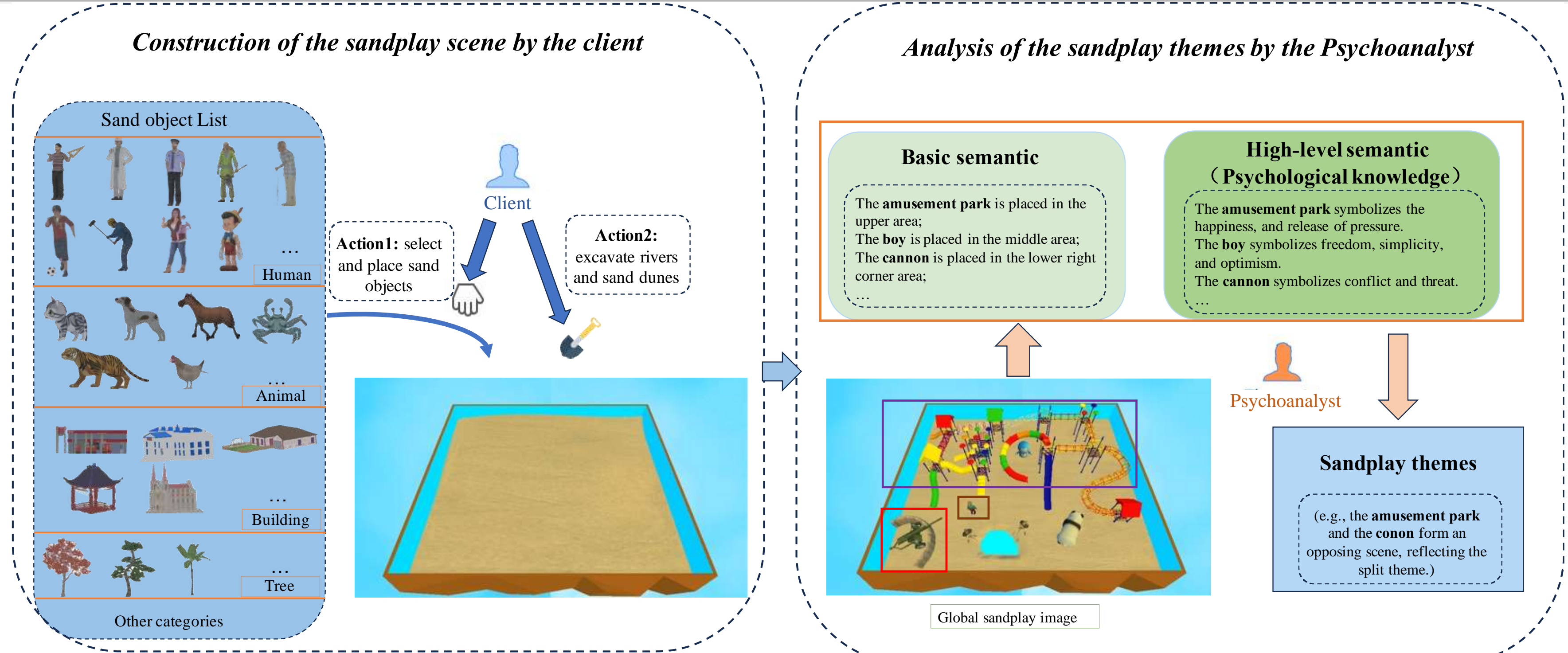


Fig. 1. Framework of sandplay themes recognition process on 3D electronic sandplay platform. Firstly, the client constructs a sandplay scene based on inner thoughts. Then, the psychoanalyst analyzes the sandplay themes by synthesizing basic semantic information and high-level semantic information (i.e., psychological knowledge).

Method: Hierarchical Sandplay Theme recognition (HIST) model

Inspired by the hierarchical analysis process of psychoanalysts, we propose HIST model, including three hierarchical processes:

- Basic semantic perception
- External knowledge incorporation
- Theme classification

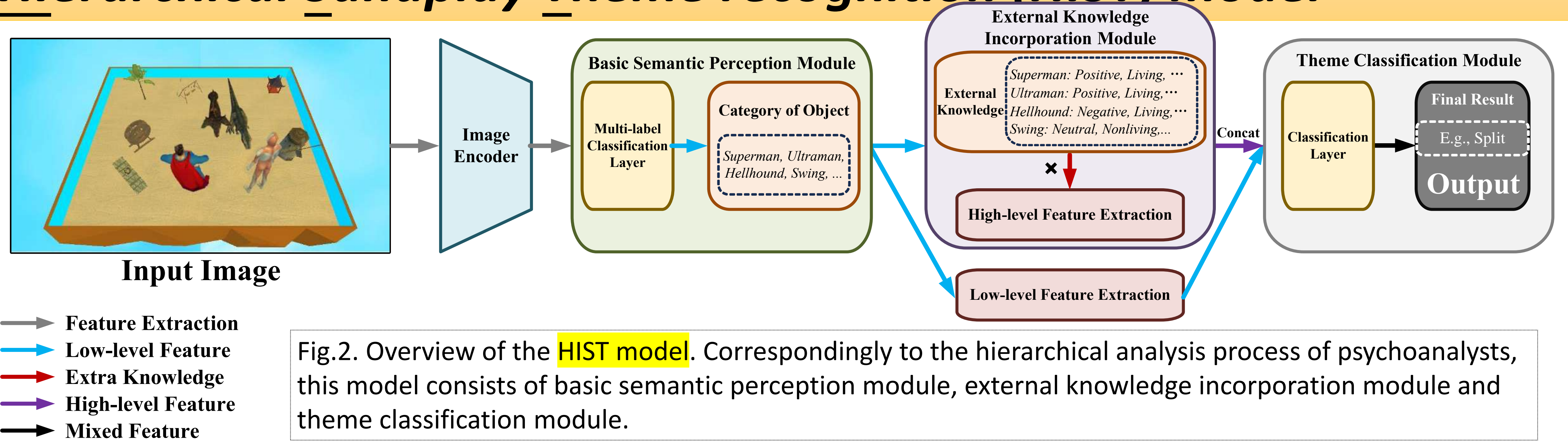


Fig.2. Overview of the HIST model. Correspondingly to the hierarchical analysis process of psychoanalysts, this model consists of basic semantic perception module, external knowledge incorporation module and theme classification module.

Dataset: SandPlay Split (SP²) Dataset

- We take the representative split theme as the example, and construct the SP² dataset. Split theme exhibits connections with various psychological symptoms, including some common emotional issues (e.g., depression, negative study experiences) and personality problems (e.g., compulsion, paranoia, marginalization, aggression).
- Sampling of sandplay samples: one sample/one tester; 5,000 sandplay samples totally
- Labeling of sandplay samples: psychoanalysts are engaged to discern split theme through binary classification.

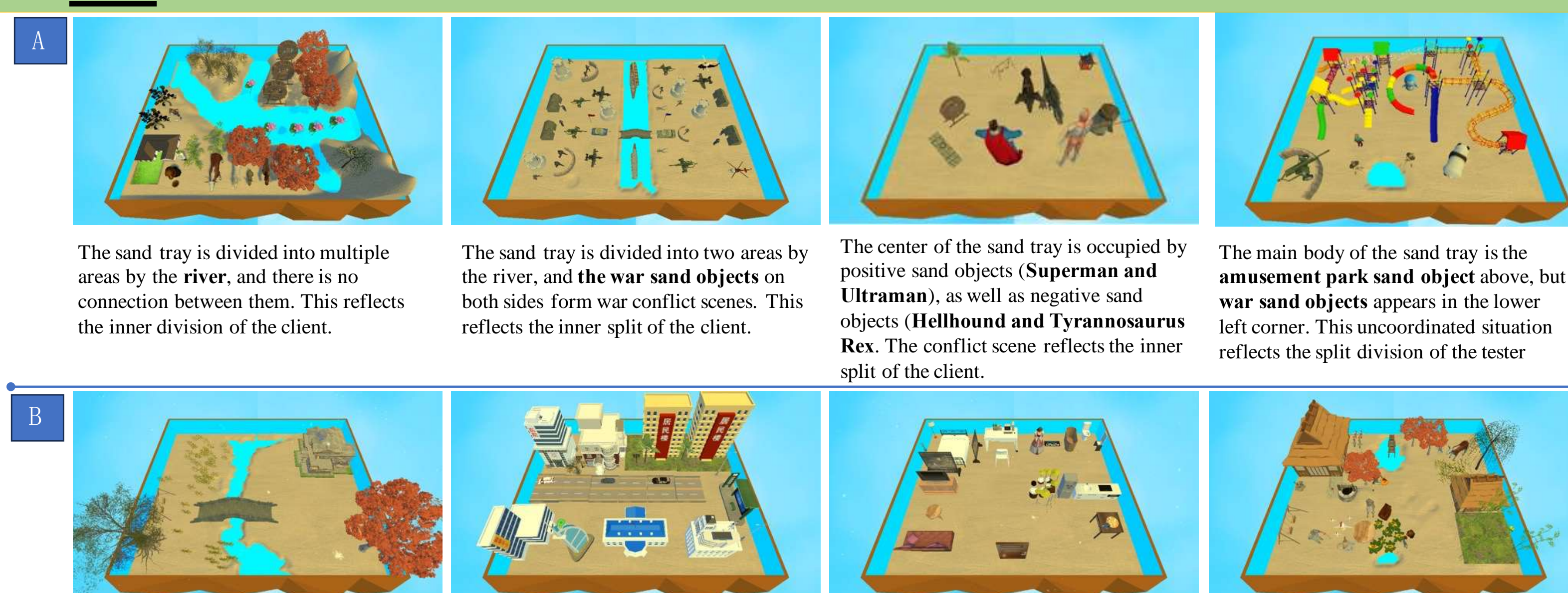


Fig. 3. Examples from the SP² dataset. Panel A represents sandplay samples with the split theme, accompanied by explanatory descriptions for the judgment (bold font indicates the concerned sand objects during judgment); Panel B represents sandplay samples without the split theme.

Results

Table 1. Comparison with the state-of-the-art models on SP² dataset. The best and second-best results are marked in bold and underline.

Model	Acc	F1
AlexNet	0.717	0.676
VGG	0.727	0.707
ResNet	0.742	<u>0.727</u>
ViT	0.731	0.712
MldrNet	0.723	0.710
zhang 2020	0.729	0.707
BiGRU	0.734	0.712
PadNet	<u>0.745</u>	0.722
HIST (Ours)	0.790	0.765

Table 2. Results of ablation experiments. The best and second-best results are marked in bold and underline.

Variants	Acc	F1
ViT-based	0.761	0.745
Without- L_{cl}	<u>0.764</u>	<u>0.750</u>
Without- K_h	0.747	0.723
HIST (Ours)	0.790	0.765

- Our proposed model shows great performance.
- External knowledge incorporation module is vital.

Conclusion

- Based on the sandplay therapy, sandplay theme recognition task relies on sandplay images and the corresponding theme annotations provided by psychoanalysts. This task offers an opportunity to explore the modeling of psychoanalysts' hierarchical analysis capabilities.
- Inspired by the analysis process of psychoanalysts, we propose HIST model.
- To facilitate the sandplay theme recognition task, we construct SP² dataset, focusing on split theme.
- Our proposed model outperforms existing baseline models on the SP² dataset, and ablation experiments demonstrates the significance of incorporating external knowledge.