# Model Merging to Maintain Language-Only Performance in Developmentally Plausible Multimodal Models

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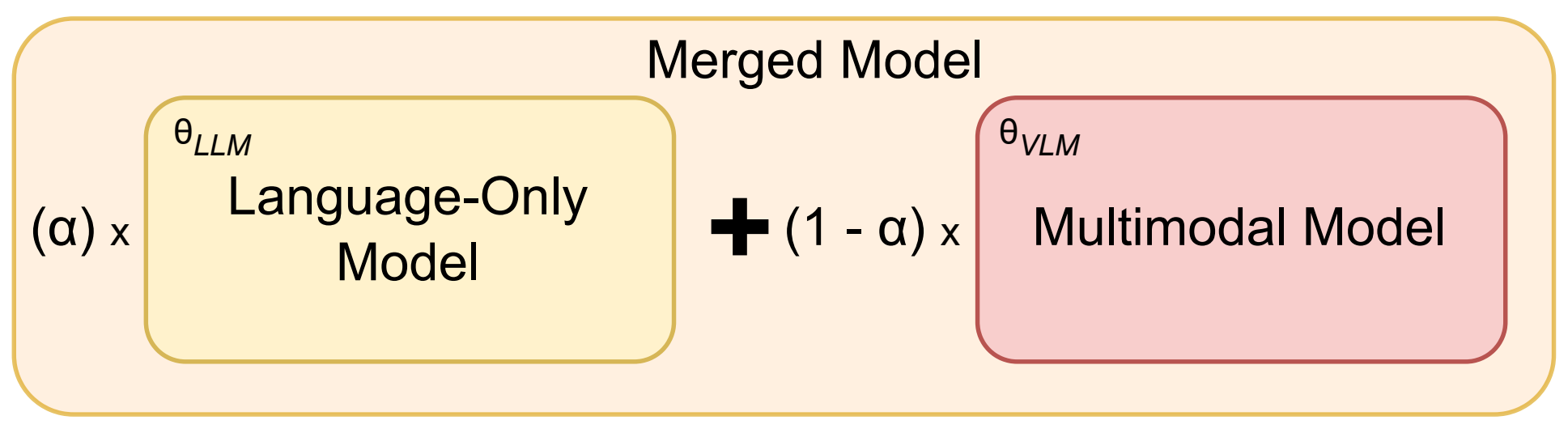
## Introduction

- **Multimodal Track of the BabyLM Challenge** [1, 2]
- Previous work, including BabyLM contributions, indicates that **multimodal data** has limited or no benefits in **language-only benchmarks** [3, 4, 5]
- We reach similar conclusions in our low-resource multimodal scenario
- Our multimodal models underperform in grammar-oriented benchmarks, although being exposed to the same language-only data as the language-only models (+ multimodal data from Conceptual Captions and Localized Narratives)
- **How can we mitigate this issue in developmentally plausible multimodal models and maintain language-only performance? Model merging**

## Model Merging



A technique that benefits multi-task and multi-language models, reducing the effects of catastrophic forgetting [6, 7]. We experiment with the **weighted linear interpolation** of language-only and multimodal models

## Training

- BabyLM data: language-only 50M and multimodal 50M words [2]. Trained a tokenizer: 1.36 word-to-subword ratio
- Modifying **LLaVa 1.5** [8]
- Vision encoder replaced with **mean-pooled representation from DINOv2-large** [9]
- Randomly initialized a 6-layer version of LlavaForConditionalGeneration and a multimodal projector
- Language-only input preceded by black image
- **Low-compute** setting with 2 parallel A10 GPUs, 10 epochs

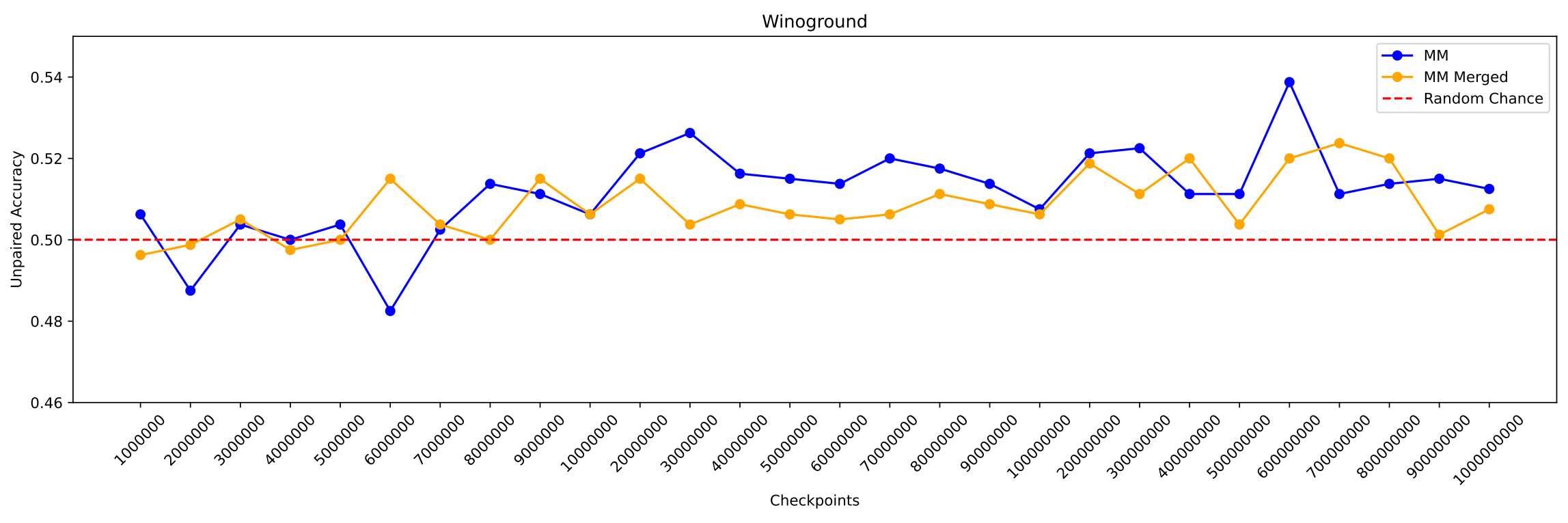
## Multimodal Benchmark

**Winoground** is a challenging benchmark, requiring fine-grained visual and linguistic analyses involving unusual images and texts [10]

painting the white wall red

painting the red wall white

Merging with $\alpha = 0.3$, in some checkpoints, can actually be beneficial without decreasing scores

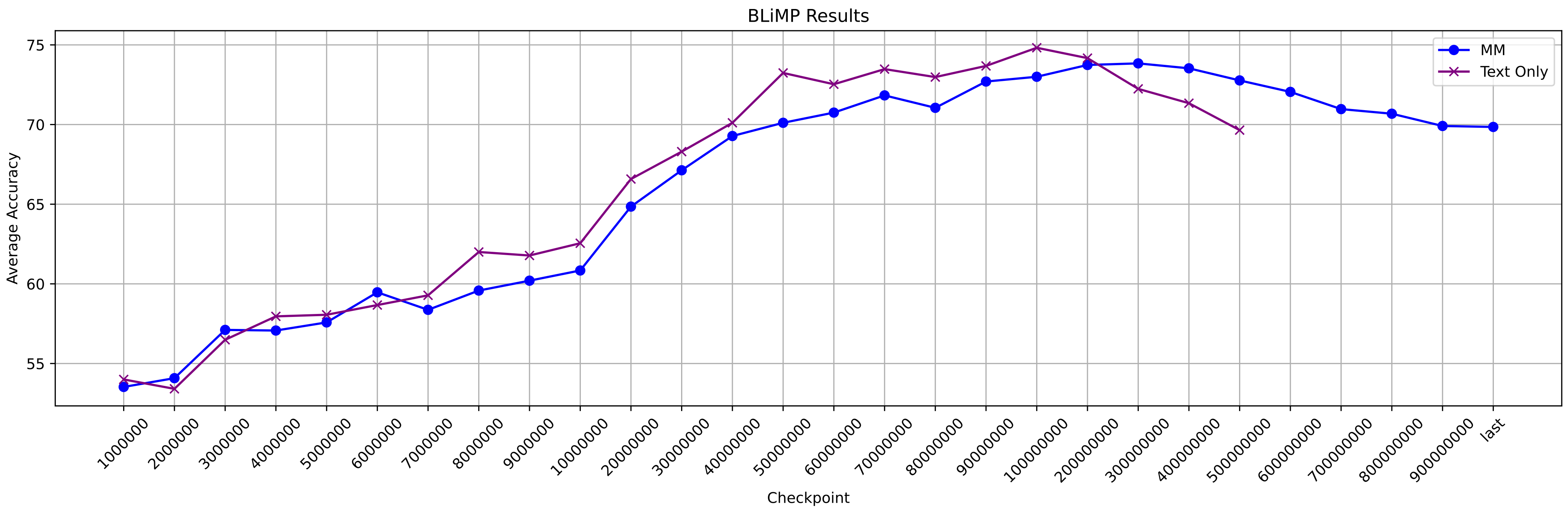


## Conclusion

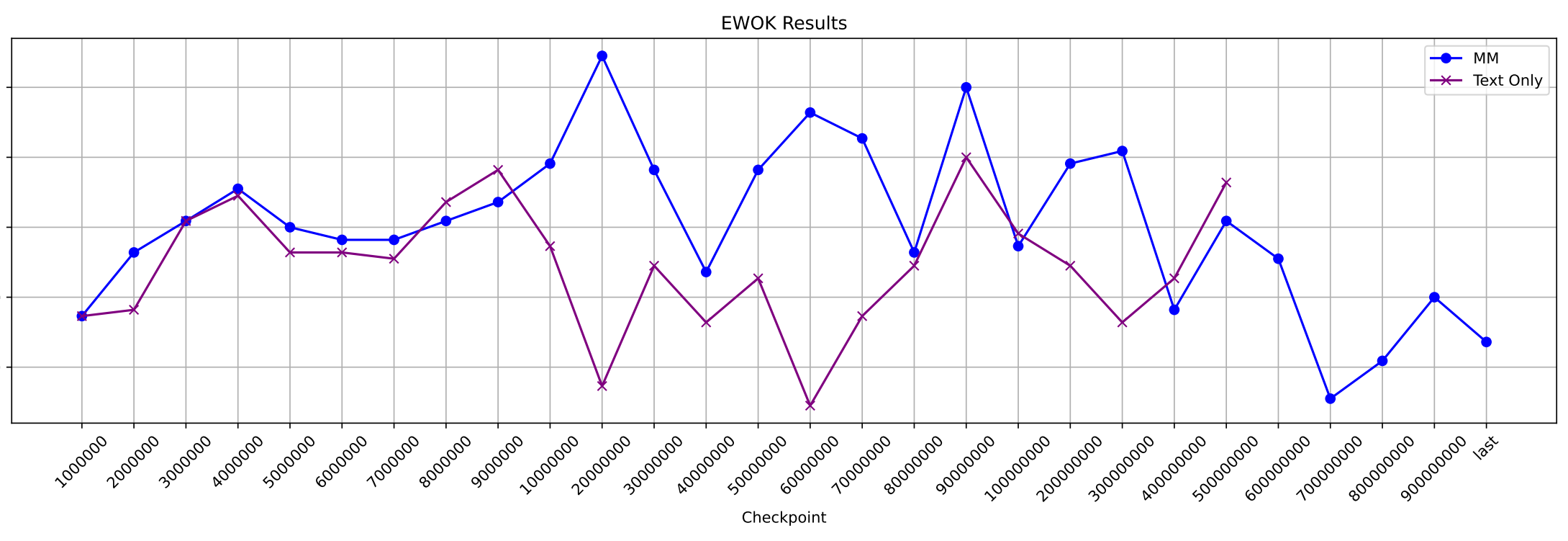
- Our multimodal BabyLM model surpasses previous baselines and submissions on the leaderboard
- Yet, it tends to underperform in text-only benchmarks that focus on grammar compared to language-only models
- Model merging with language-only checkpoints helps alleviate this issue to some extent, benefiting performance in language-only benchmarks and not disrupting accuracy in multimodal tasks heavily
- Future work can explore other model merging techniques and their effects in a wider set of benchmarks

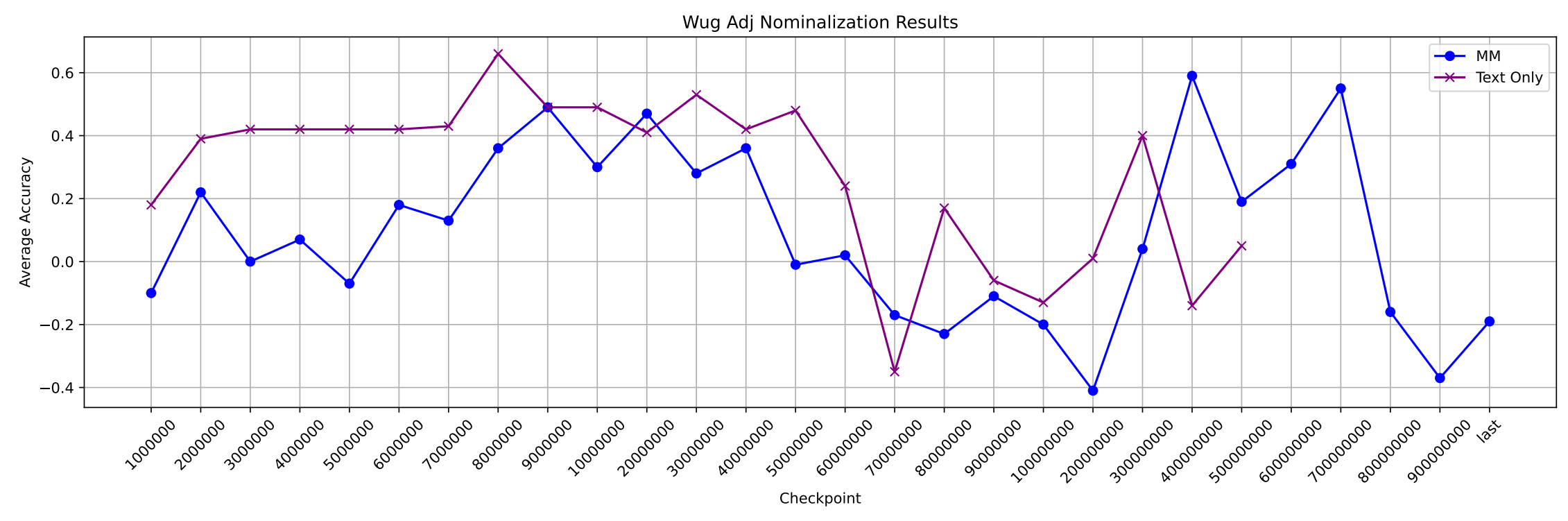
## Language-Only Benchmarks

- Our multimodal model outperforms the multimodal BabyLM baselines and the current submissions on the multimodal leaderboard on the BLiMP benchmark [11]



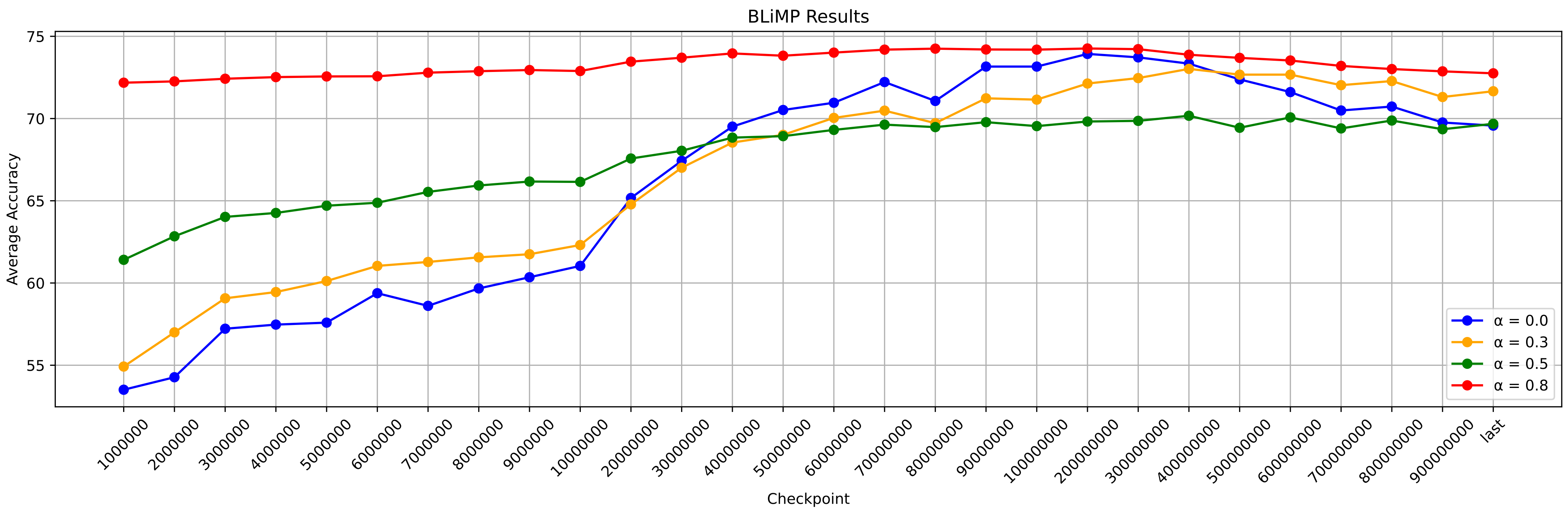
- Benchmarks focusing on grammar **(BLiMP, Wug past tense and Wug adjective nominalization)**: Our multimodal model performs worse than our language-only model
- Knowledge-, semantics- and reasoning-oriented benchmarks **(EWOK and Entity Tracking)**: Multimodal model performs better





### Merging with the best language-only checkpoint

- Early checkpoints: **Merging the multimodal checkpoint with a language-only model leads to better results in BLiMP**
- Later checkpoints: When the multimodal model's language-only capabilities begin to drop, merging can help **maintain language-only capabilities**



## References

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