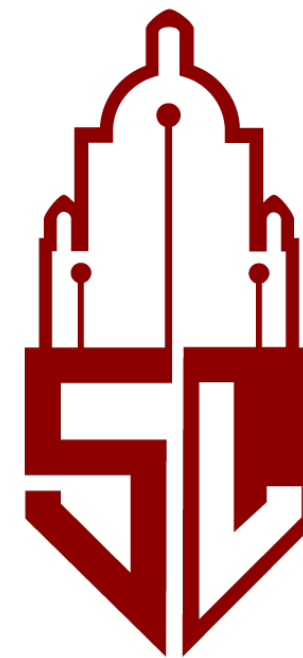


Mind Your Outliers!

*Investigating the Negative Impact of Outliers
on Active Learning for Visual Question Answering*



Siddharth Karamcheti



Ranjay Krishna



Li Fei-Fei



Christopher D. Manning

Prologue

“The scariest moment is always just before you start.”
— Stephen King

Understanding VQA Models in Terms of Capabilities



What is the woman to the right of the boat holding?



Is the umbrella upside down?

VQA Model

[Umbrella]

Capabilities:

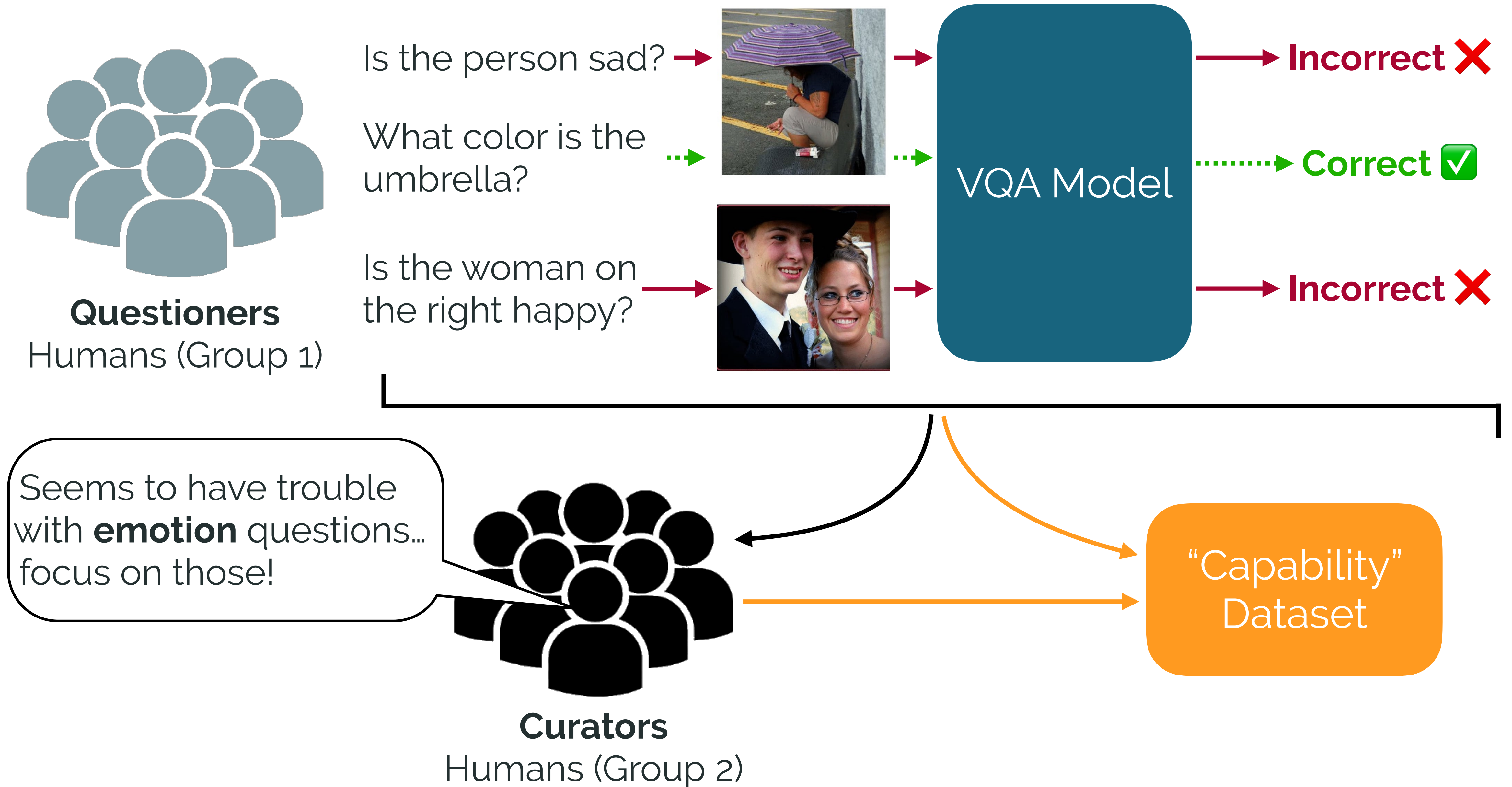
- Object Recognition
- Referring Expressions
 - w/ Nesting!

[Yes]

Capabilities:

- Object Recognition
- “Simple” Commonsense

Identifying & Augmenting Capabilities via Interaction



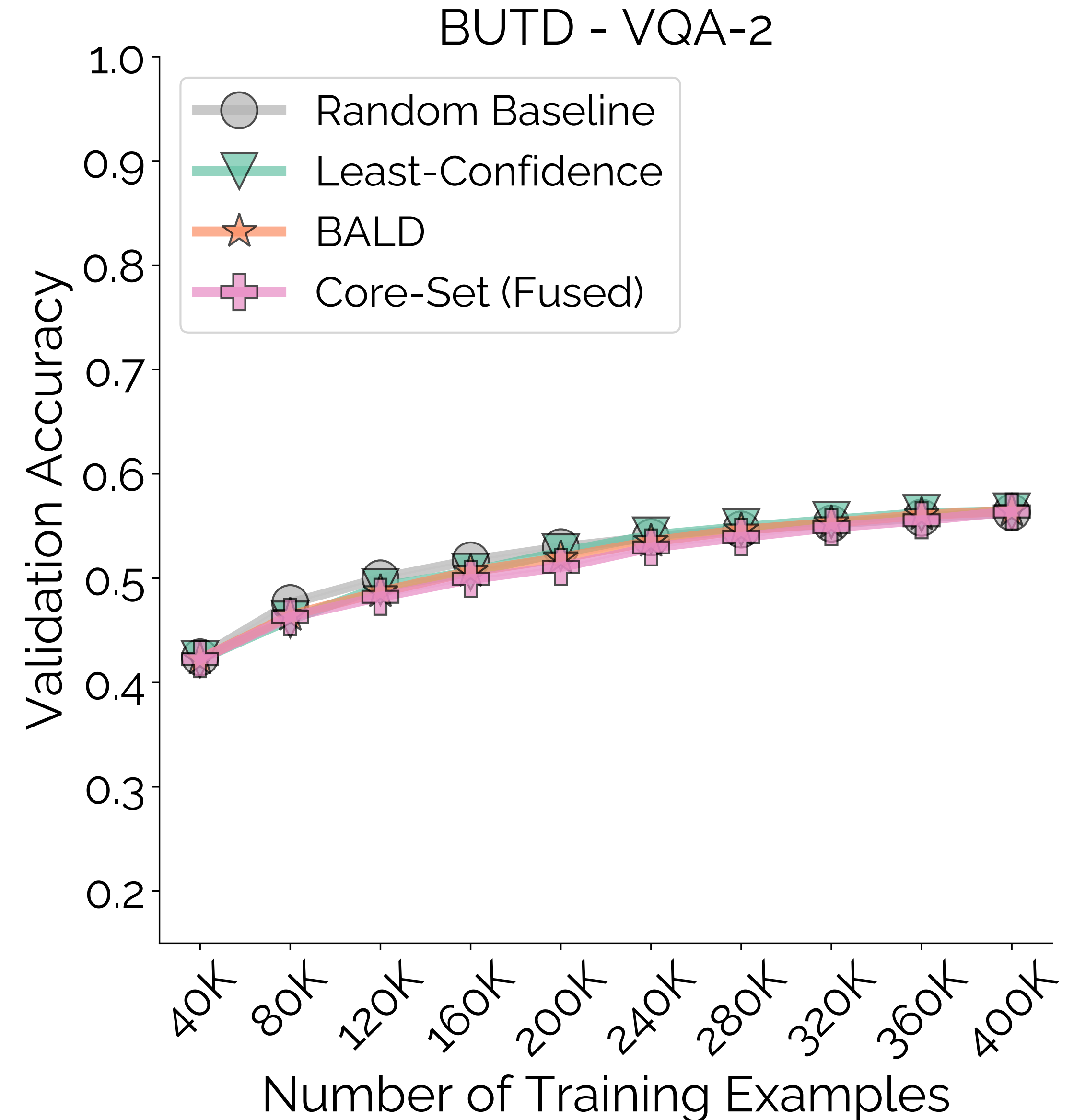
Alas...

Sanity Check: How does active learning fare?

Active Learning Preliminaries:

- Train VQA model on subset of dataset (e.g., 40K examples)
- Iteratively *acquire* batches of unlabeled data to grow train set.
 - *Baseline*: Randomly pick data!
 - *Uncertainty vs. Diversity*

**Why doesn't active learning
work for VQA?**



Related Work

- **Lin and Parikh 2017** — Explores active learning on the VQA v1 Dataset.
 - **Key Takeaway:** Active Learning doesn't work for VQA unless you *start* with a lot of labeled examples!
- **Siddhant and Lipton 2018** — Large scale study on Binary Classification for NLP.
 - **Key Takeaway:** Bayesian Active Learning (BALD) works well, but, hard to outperform random acquisition!
- **Lowell et. al. 2019** — Active learning performance doesn't generalize over models/tasks.
 - **Is Active Learning worth it?**

Our Work: Complementary; extends study scale (models, strategies), analysis of ***“what's holding active learning back”*** with these datasets!

[1] “Active Learning for Visual Question Answering: An Empirical Study,” Xiao Lin and Devi Parikh. *arXiv Preprint 1711.01732*.

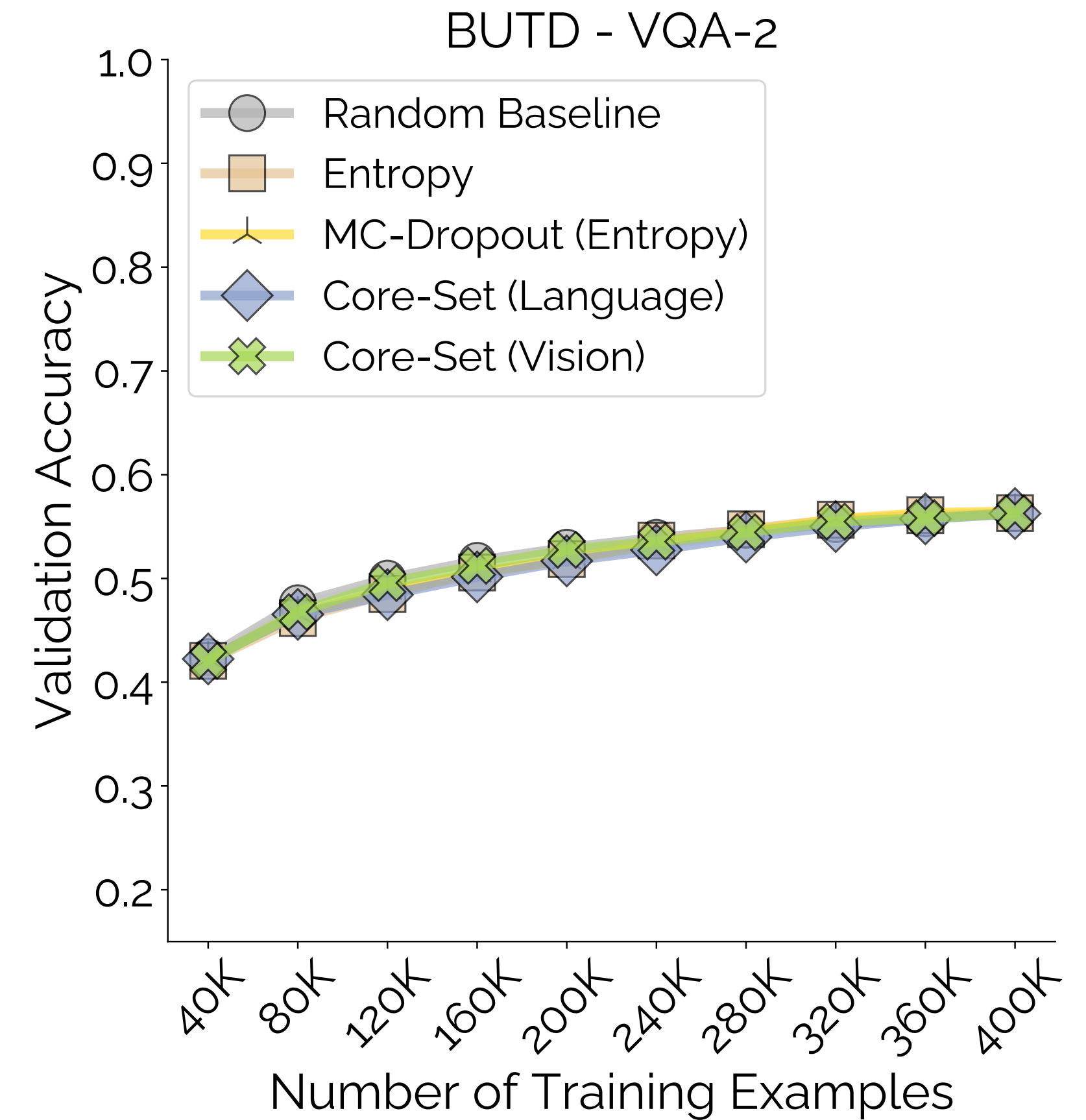
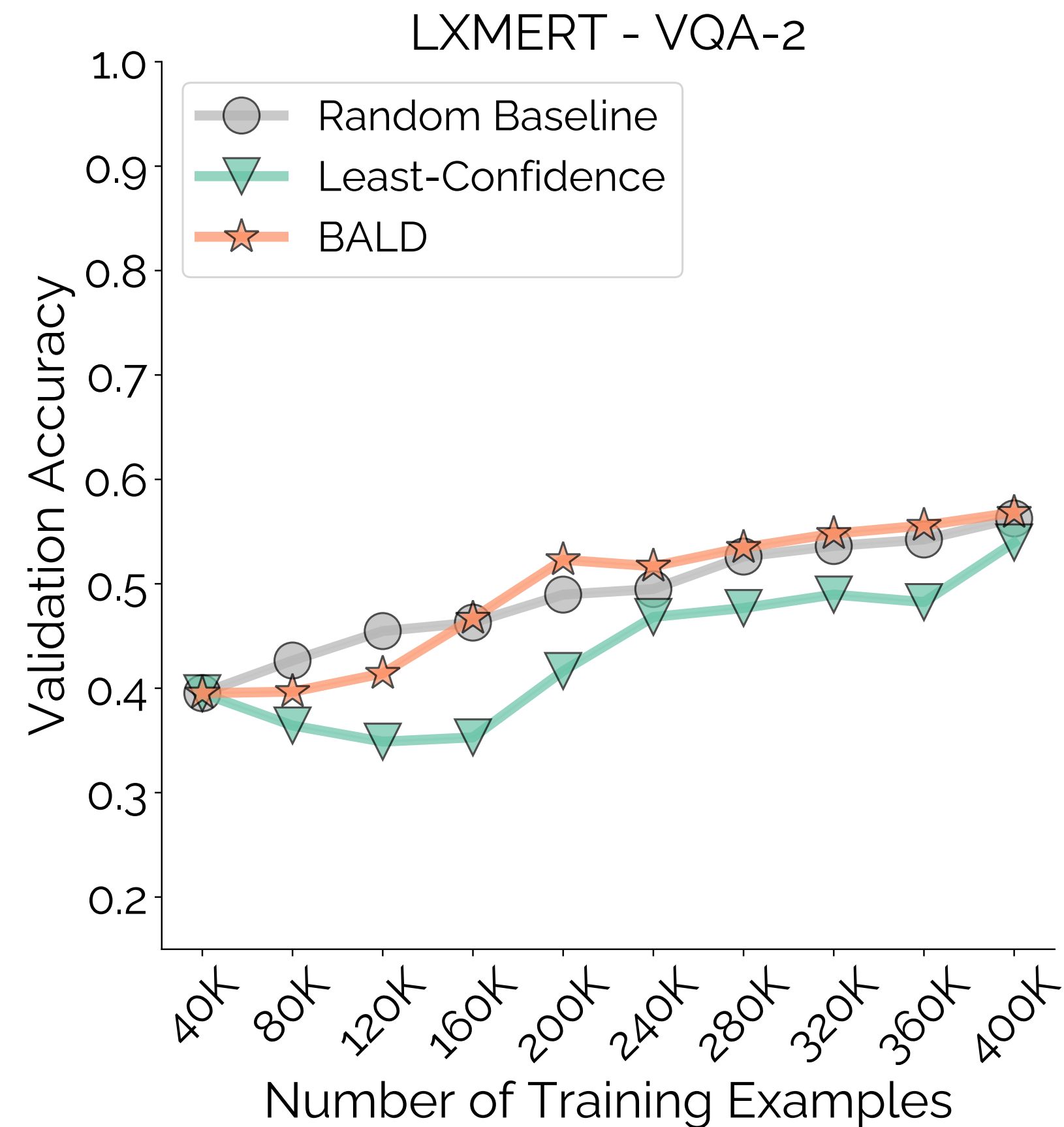
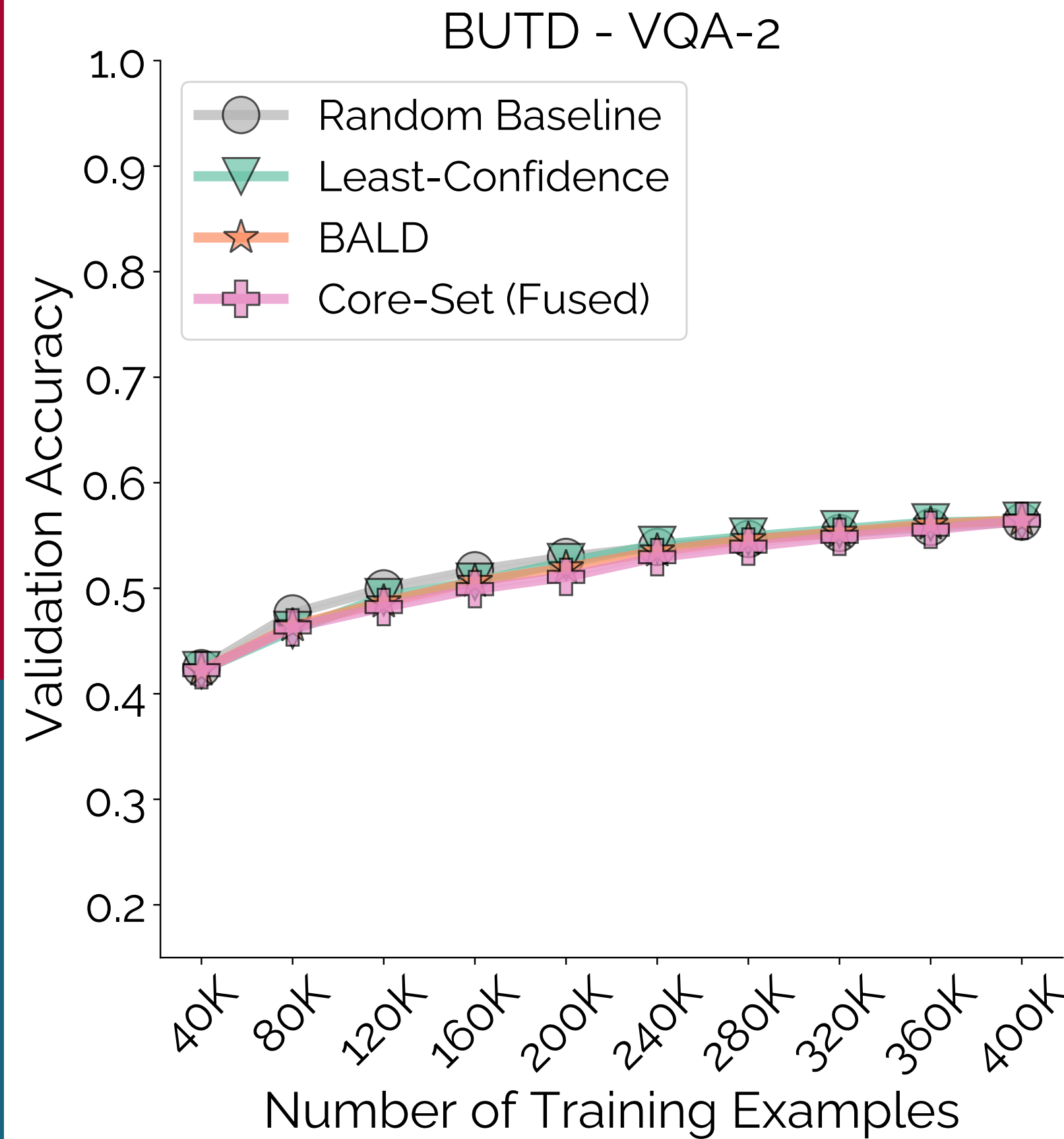
[2] “Deep Bayesian Active Learning for Natural Language Processing: Results of a Large-Scale Empirical Study,” Aditya Siddhant and Zachary C. Lipton. *EMNLP 2018*.

[3] “Practical Obstacles to Deploying Active Learning,” David Lowell, Zachary C. Lipton, and Byron C. Wallace. *EMNLP 2019*.

Part I: Curiosities

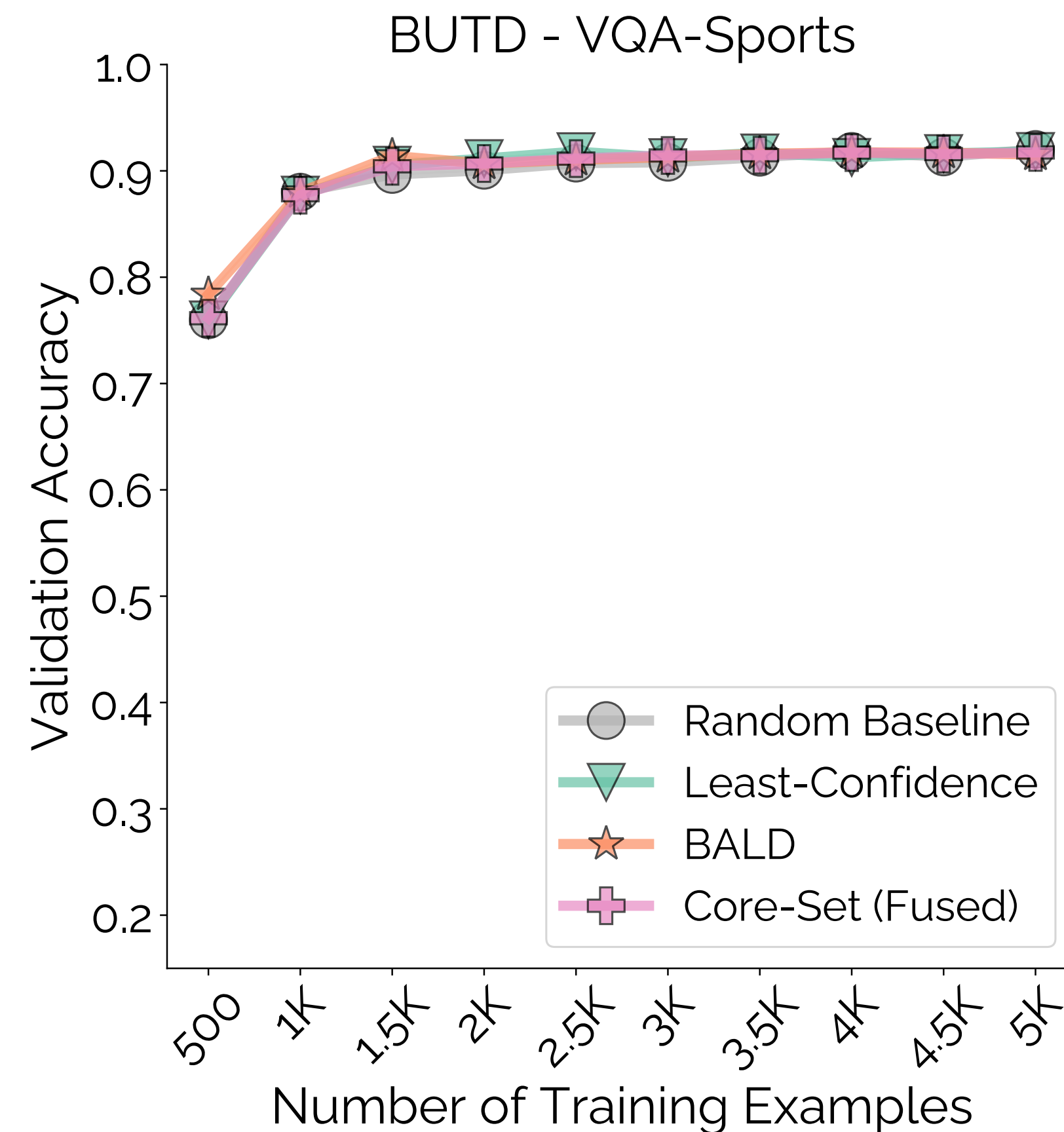
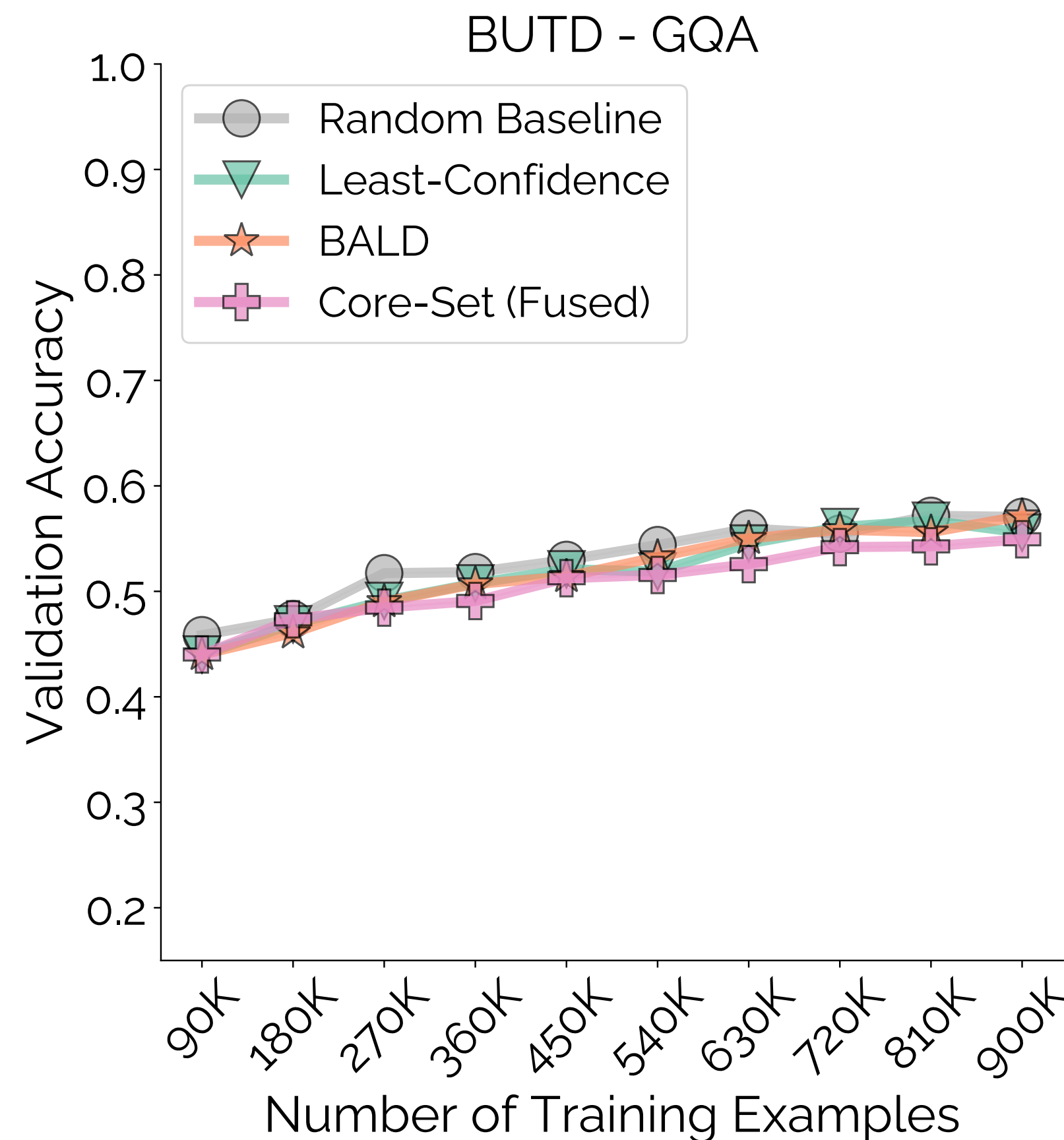
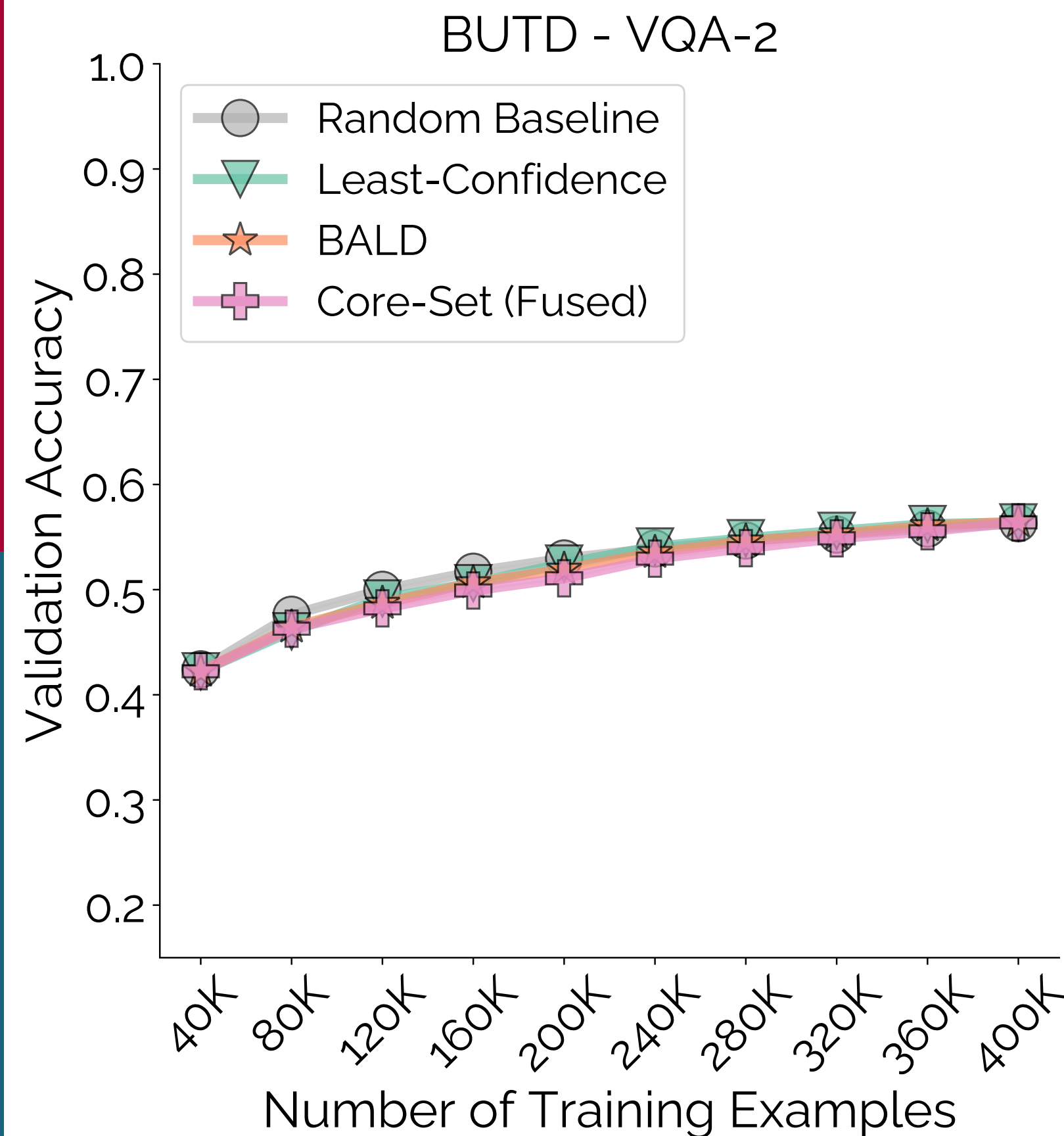
“Discontent is the first necessity of progress.”
— Thomas Edison

Is it... the Architecture? Acquisition Function?



Also holds for LSTM-CNN & Logistic Regression Models!

Is it... the Dataset?



Holds across other models and acquisitions strategies!

Part II: Contextualizing Acquisitions

“Never give up, for that is just the place
and time the tide will turn.”
— Harriet Beecher Stowe

What's Going On? Peeking at Acquisitions!



What does the symbol on the blanket mean?



What is the first word on the black car?



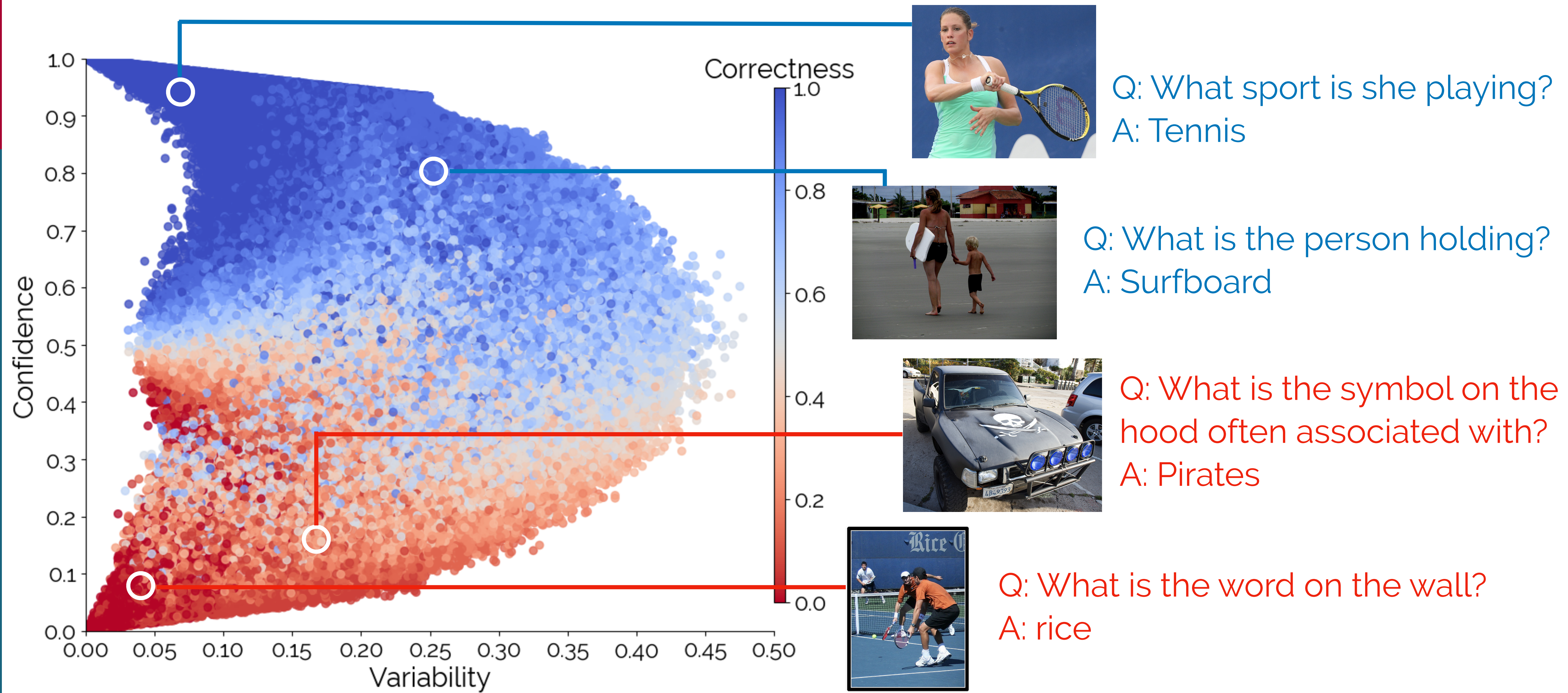
What is on the shelf?

Collective Outliers!

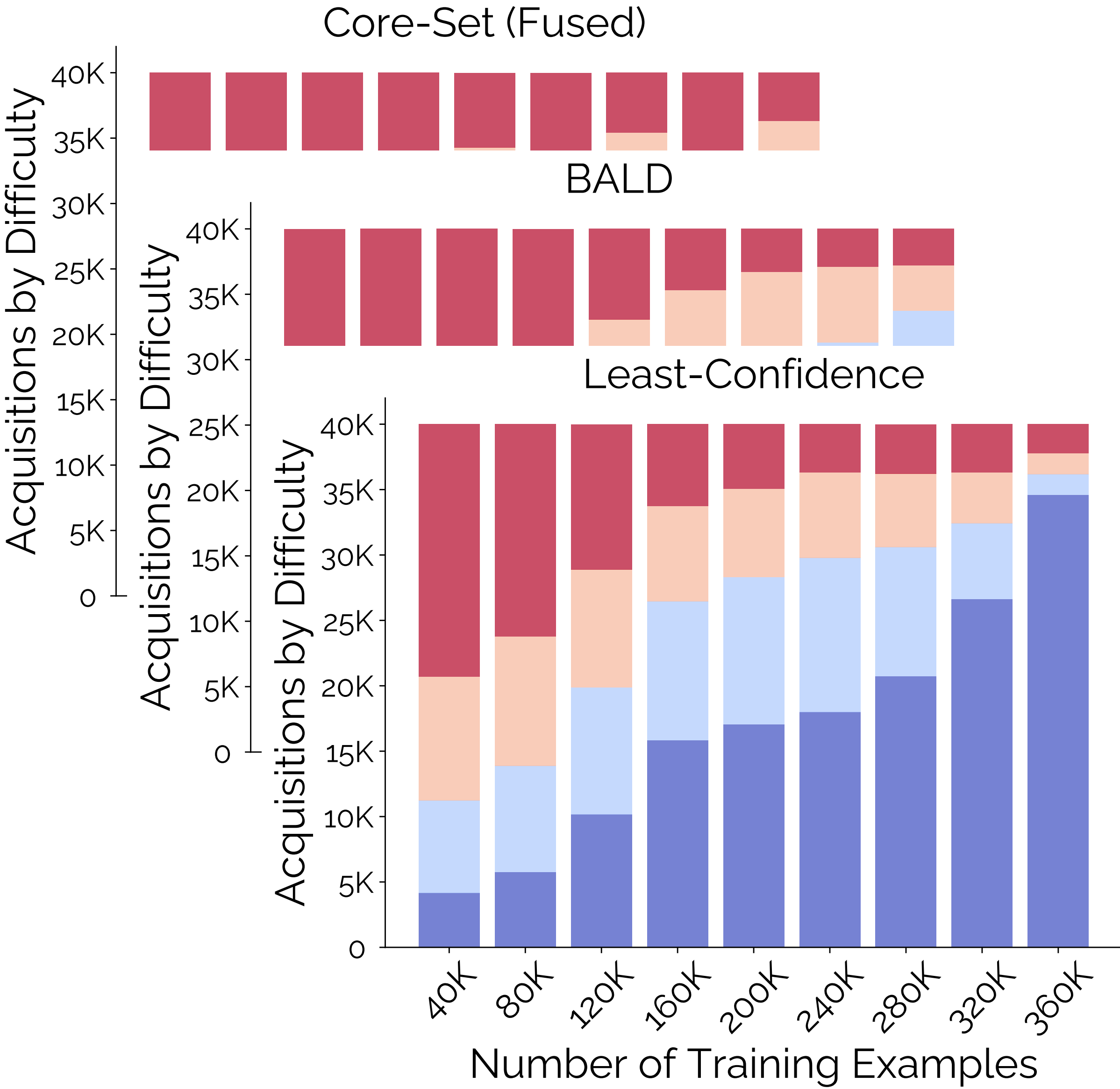
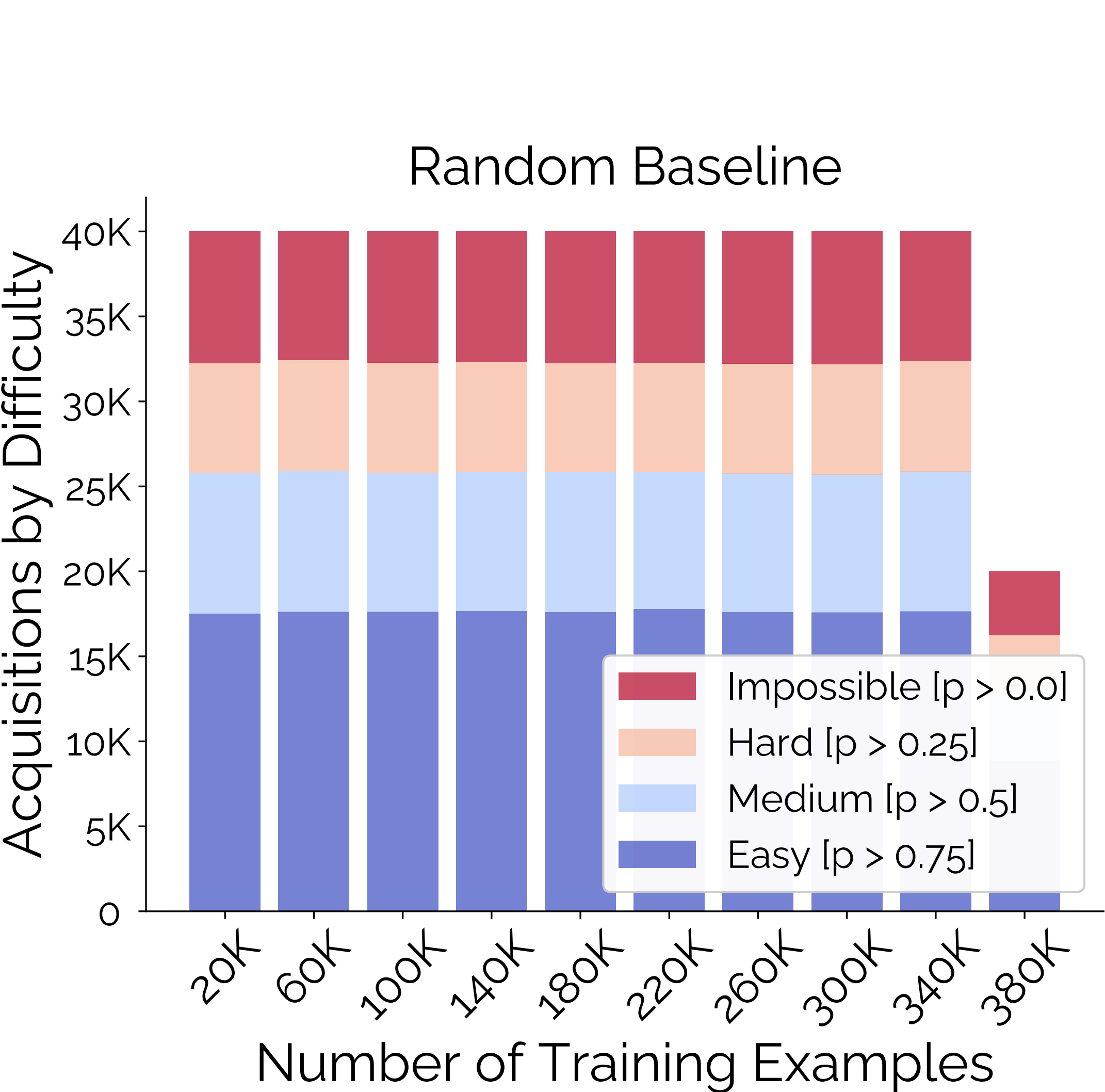
Groups of examples beyond the “capabilities” of VQA models!

How can we better formalize or diagnose these examples?

A Primer on Dataset Maps — ft. VQA-2

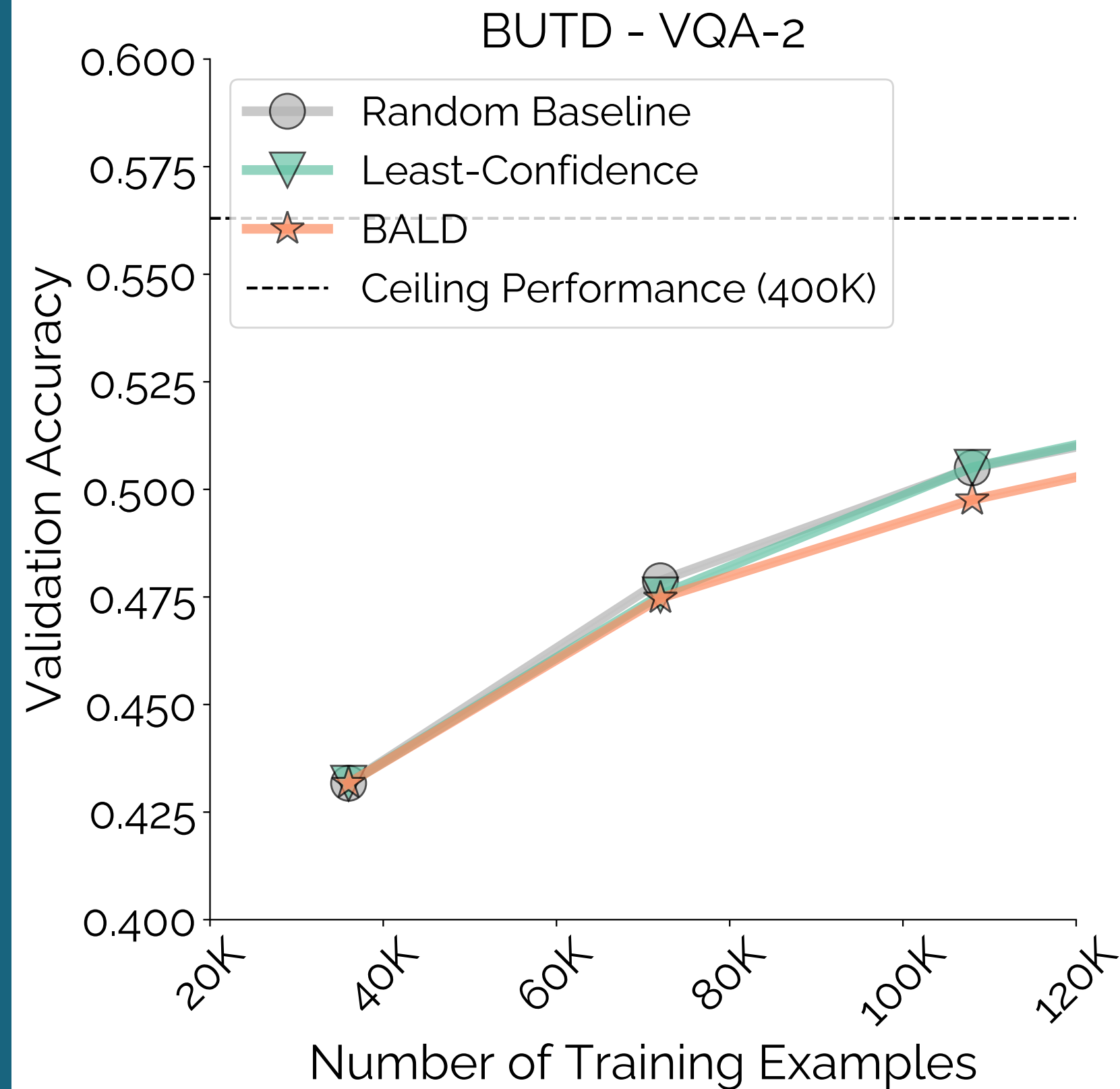


Contextualizing Acquisitions with Dataset Maps



Ablating “Outliers” fixes Active Learning — Aha!

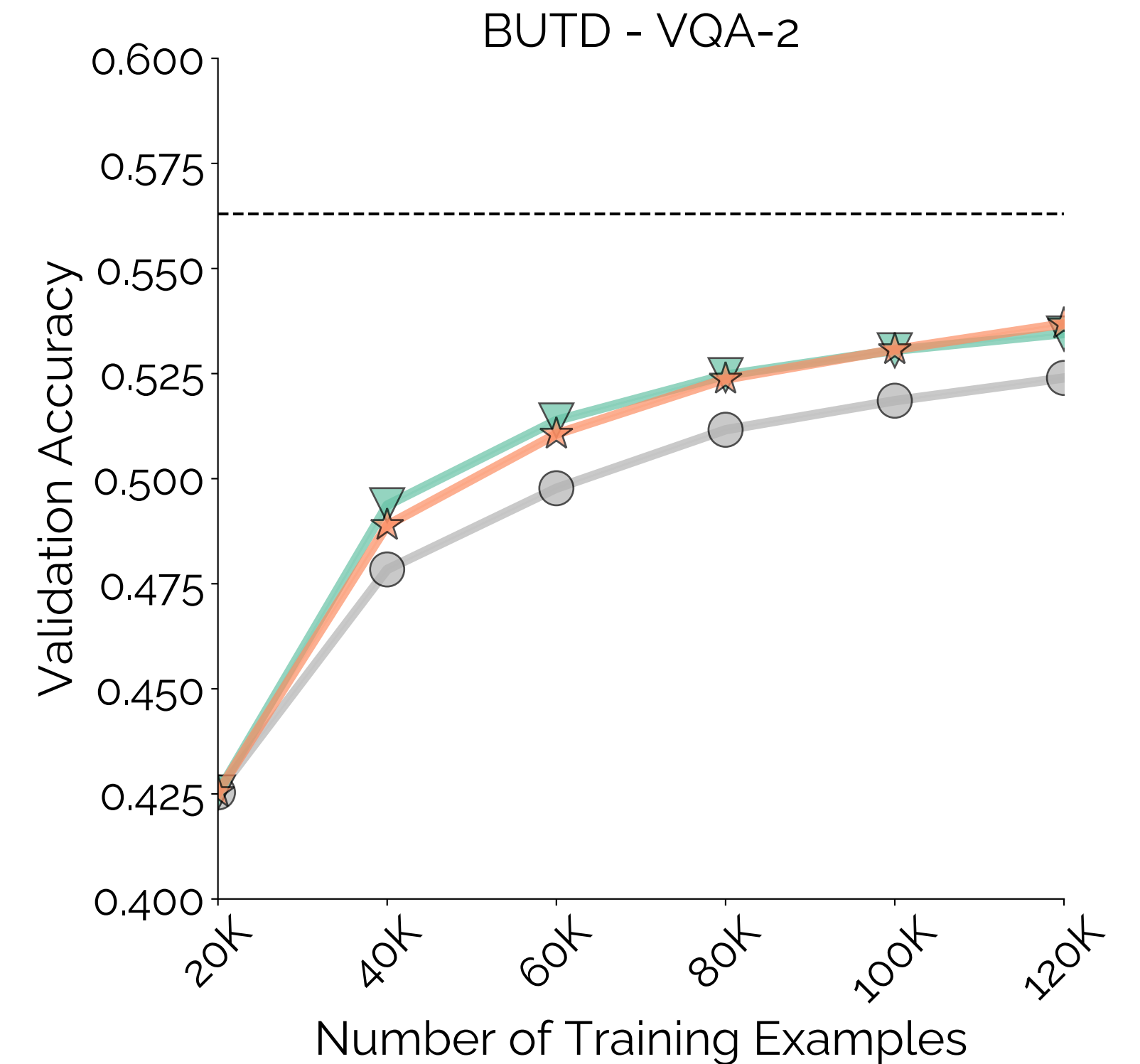
Procedure: Remove “hard” outliers subject to Y-Axis of Dataset Map!



90% of Original Dataset



75% of Original Dataset

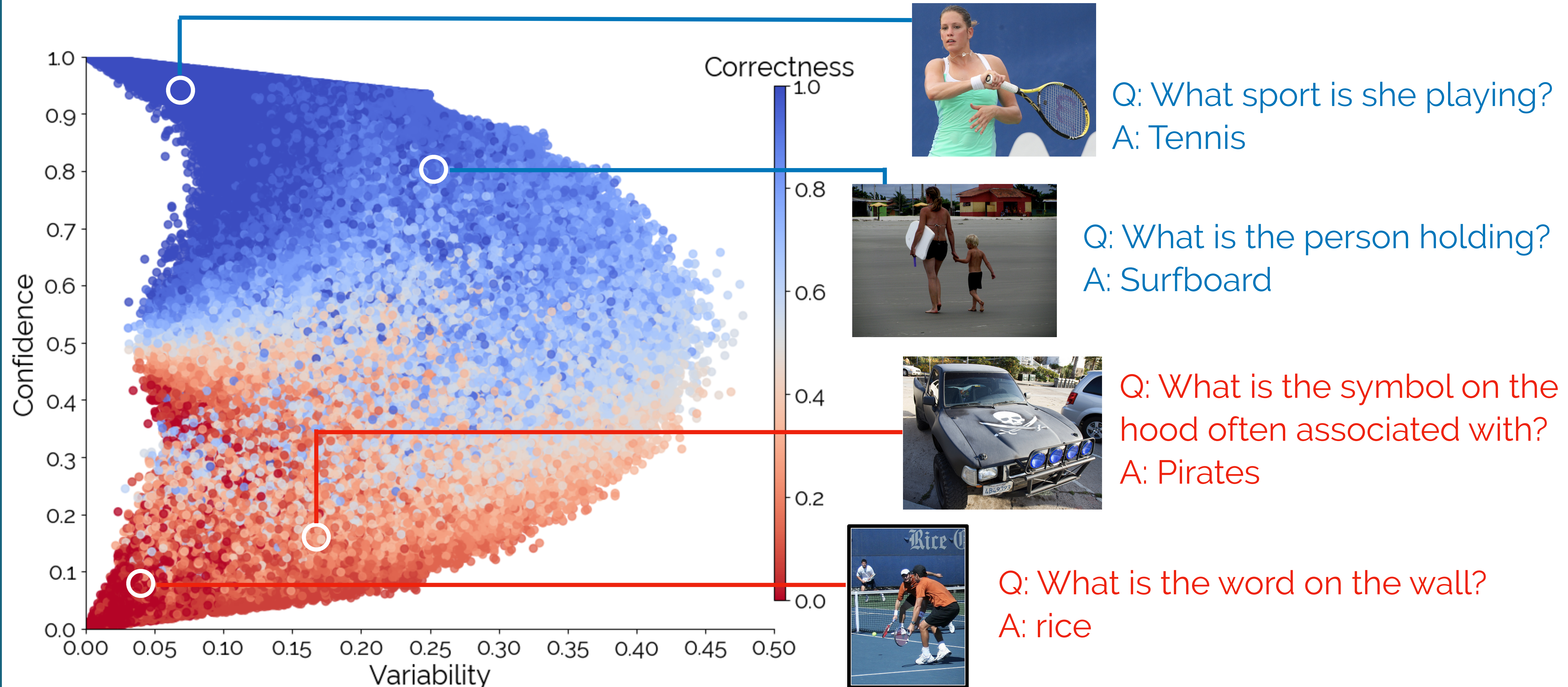


50% of Original Dataset

Part III: Takeaways

“A wrong that cannot be repaired must be transcended.”
— Ursula K. Le Guin

Mind Your Outliers — What's Next?



Thanks so much!

Code: <https://github.com/siddk/vqa-outliers> | Questions/Comments: skaramcheti@cs.stanford.edu