



The Data Miners

Members:

Alexander Thomas Savvides
Hafsa Azeb
Ha Van Pham
Garima Sharda
Timon Knol



The Duo

Members:

Alexander T
Hafsa Azeb
Ha Van Phan
Garima Shar
Timon Knol



DUOLINGO

now

Hi! It's Duo.

Make your screen time count. Take a quick Japanese lesson now! 🍀



DUOLINGO

now

Hi! It's Duo.

Make your screen time count. Take a quick Japanese lesson now! 🍀



DUOLINGO

now

Hi! It's Duo.

Make your screen time count. Take a quick Japanese lesson now! 🍀



DUOLINGO

now

Hi! It's Duo.

Make your screen time count. Take a quick Japanese lesson now! 🍀

The Data Miners



DUOLINGO

now

Hi! It's Duo.

Good luck with you presentation!

Alexander Thomas Savvides

Hafsa Azeb

Ha Van Pham

Garima Sharda

Timon Knol

TABLE OF CONTENTS

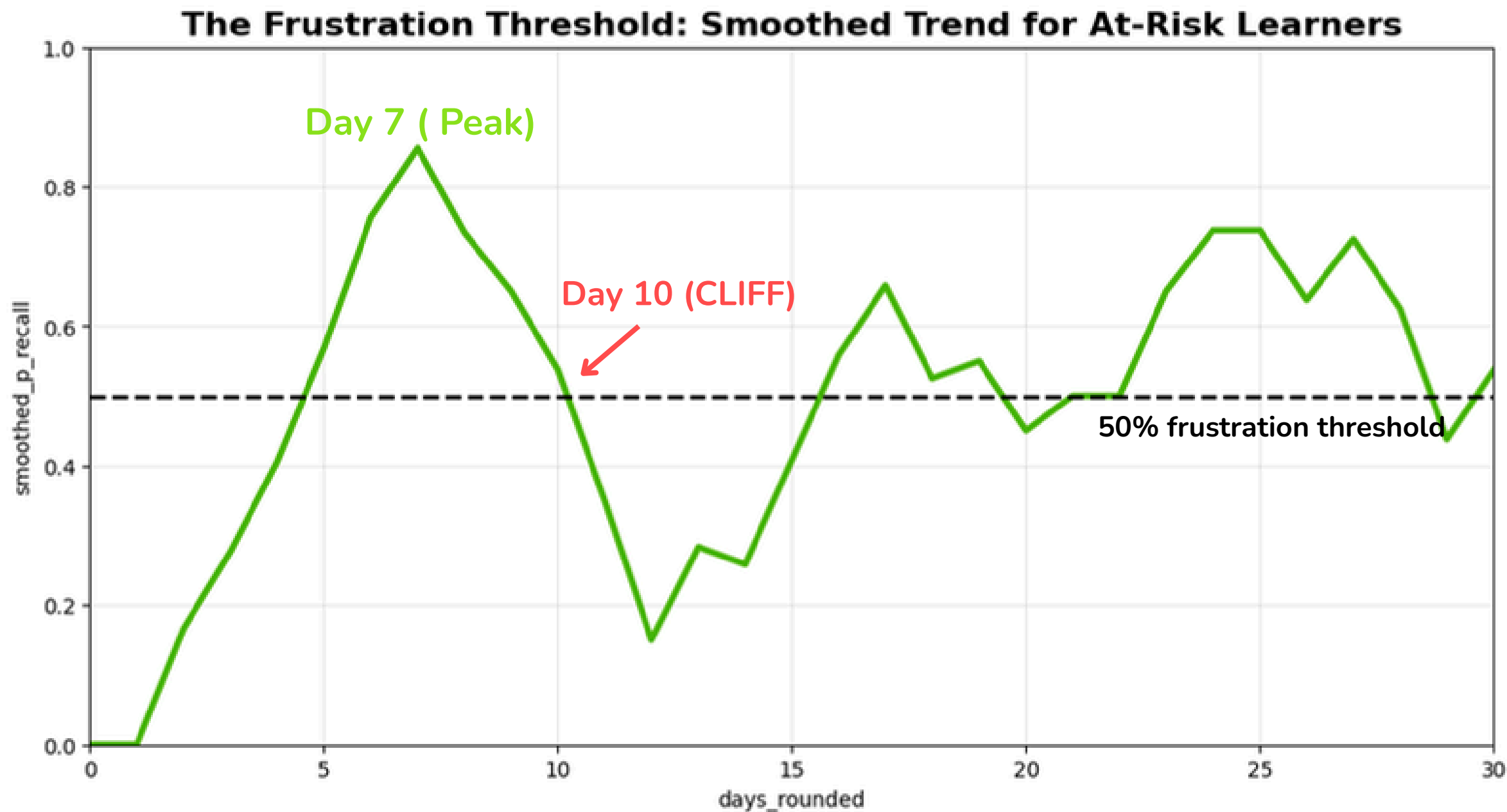
UNIT	Phase	Status
1	User Engagement	UNLOCKED
2	Quality of Education	LOADING
3	Quality of Content	LOADING



Unit 1: User Engagement



The "Cognitive Cliff"



Analysis on the Bottom 25% learners

Key Takeaways

Day 1-7: False sense of security.
Recall peaks.

Day 10: The Cognitive Cliff.
Recall plummets to 20% by Day 12.

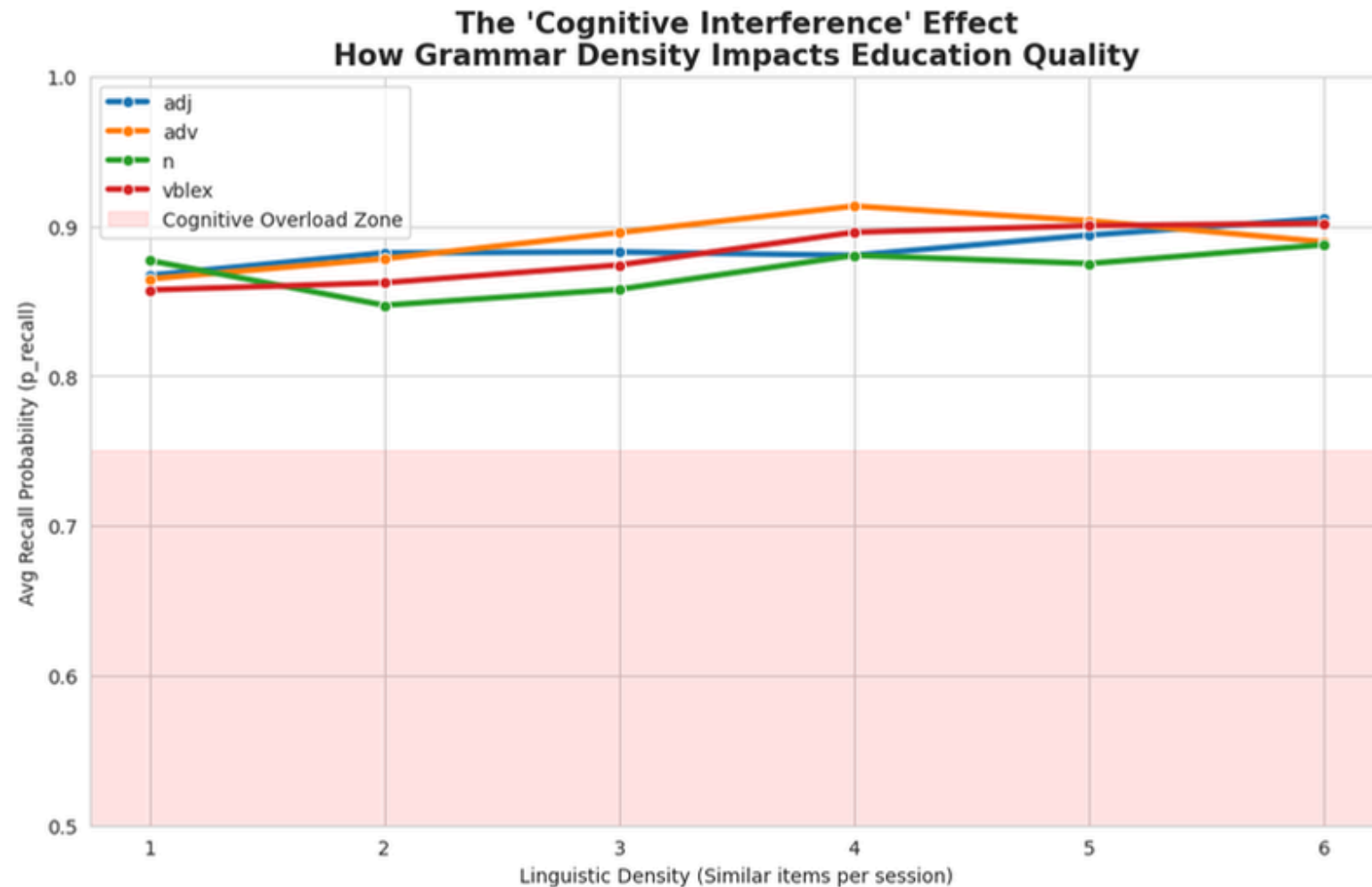
Solution

DON'T Wait until Day 12 to prompt review.
The user loses the information and the motivation to continue.

Intervention Required:
Day 9 Engagement Buffer.

Mythbuster:

Users are Resilient

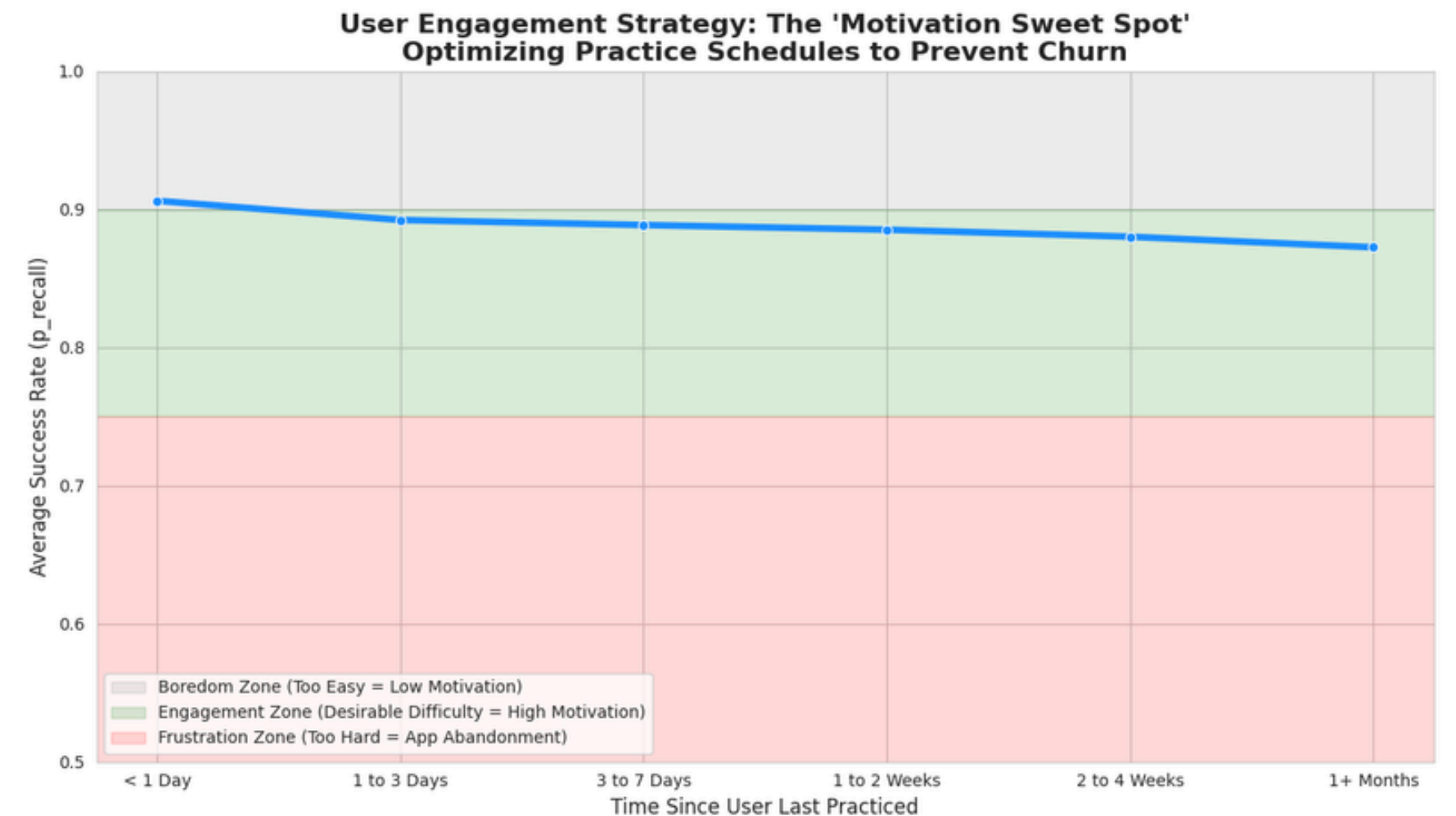


'Cognitive Interference': Traditional education warns against introducing too many similar concepts at once.

Our data completely disagrees.

- Recall stays rock-solid (**85-90%**) whether a user sees 1 or 6 verbs.
- Nouns, adjectives, and verbs all show identical stability.

Users get Bored

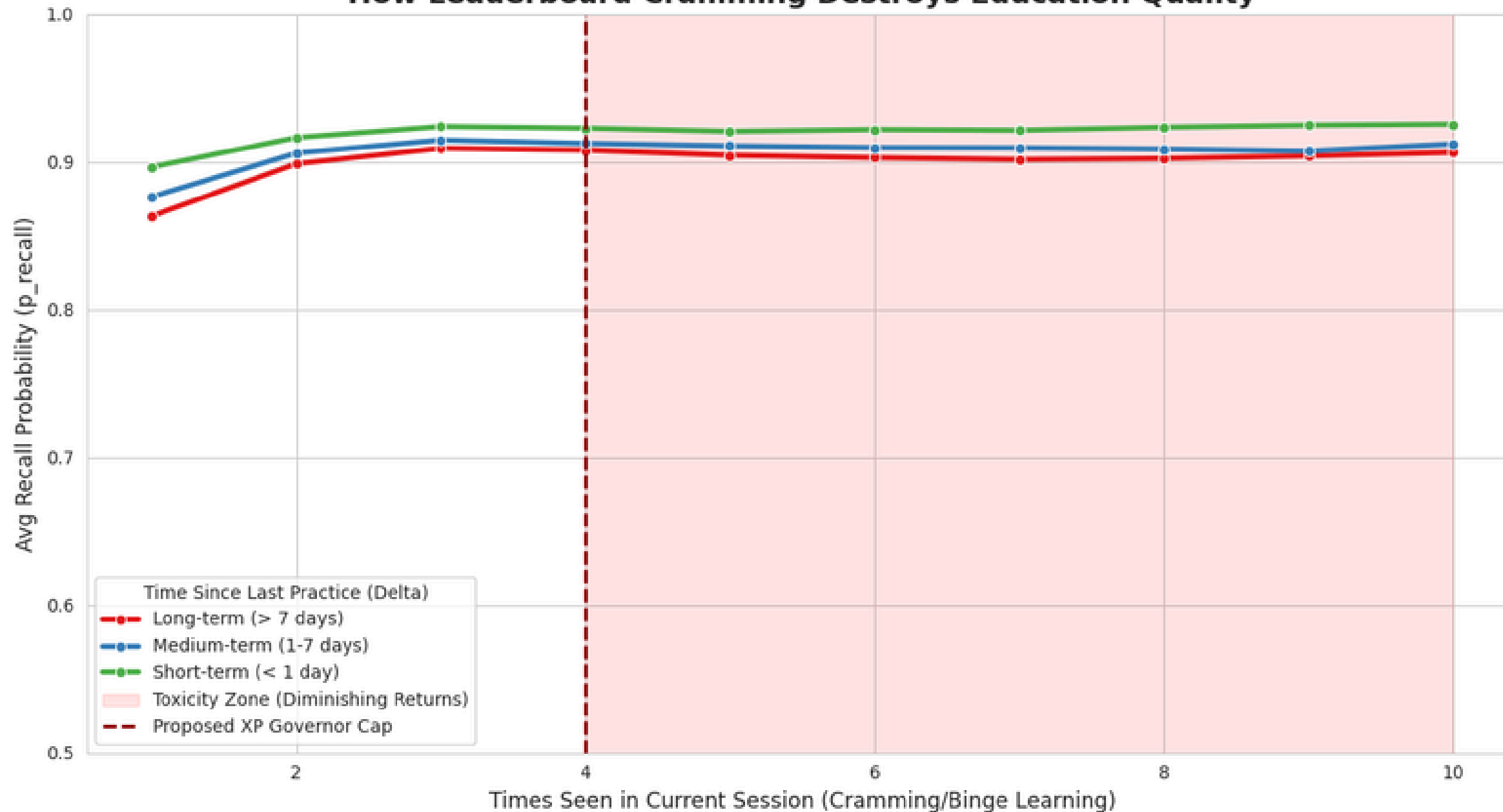


Assumption: Stepping away for 1 month, leads to forgetting everything. **Result:** crash into the red "Frustration Zone," and quit.

- After 1 month away from a word, **users still get it right 87%** of the time.
- The app is keeping users hovering near the **'Boredom Zone'**.
- Data proves **Duolingo is playing it too safe.**

Zero ROI after the 4th Repetition

The 'Gamification Toxicity' Test
How Leaderboard Cramming Destroys Education Quality



Key Insights

- Reps 1-3: Memory benefit improves.
- Reps 4+: Benefit completely flatlines.

Solution: Target lower amounts of repetition

Users stops earning Leaderboard points after repeating a word 4 times.



TABLE OF CONTENTS

UNIT	Phase	Status
1	User Engagement	COMPLETE
2	Quality of Education	UNLOCKED
3	Quality of Content	LOADING

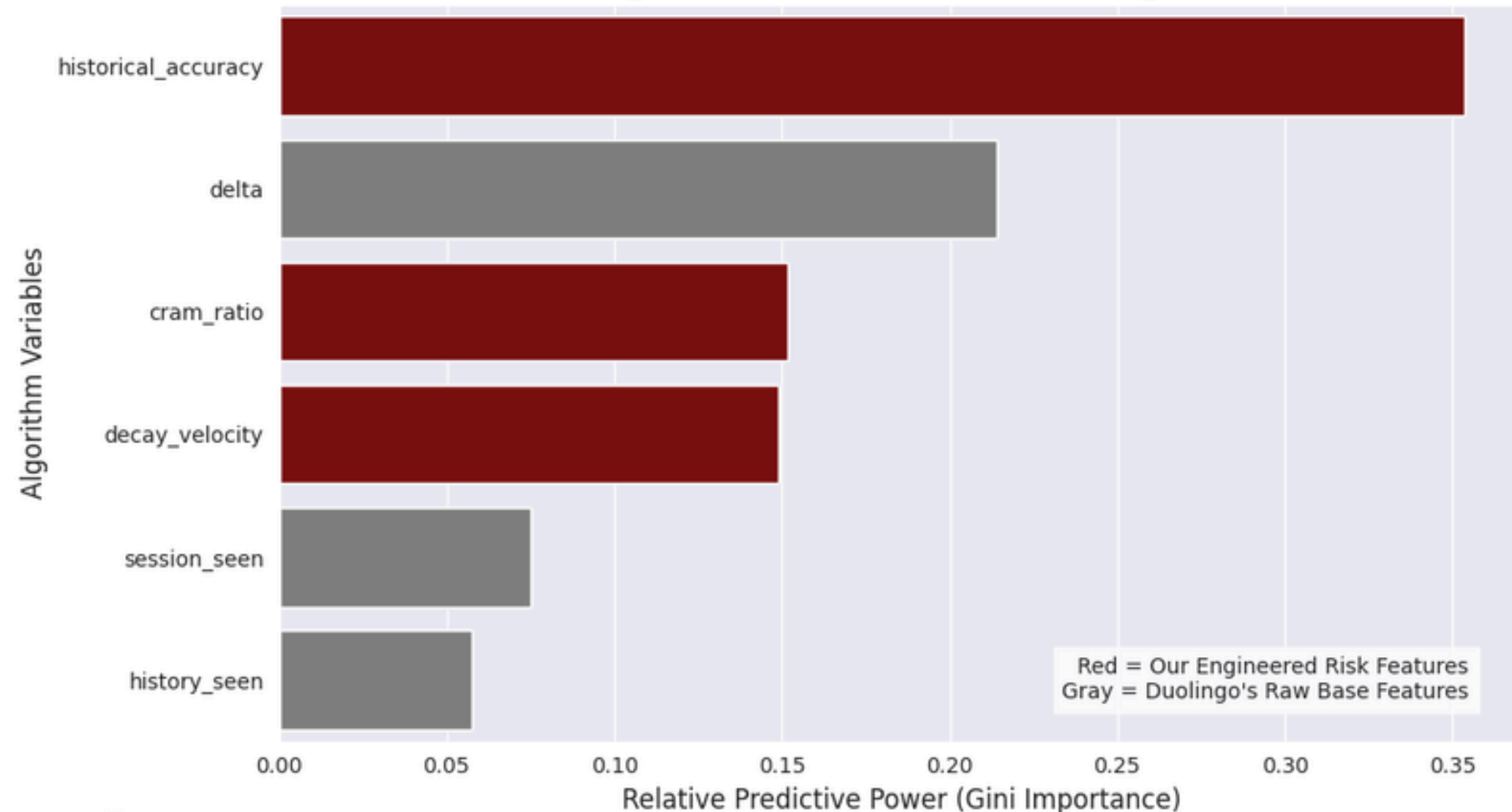


Unit 2: Quality of Education



What Really Predicts Memory: Accuracy, Time, or Behavior?

Predictive Power Audit:
Beating the Baseline Half-Life Regression



Key Insights

Confidence > Recency

→ Prioritize performance history over time decay

Time is Secondary

→ Avoid over-weighting Half-Life scheduling

Volume ≠ Learning

→ Raw repetition counts add little predictive value

Behavior > Exposure

→ Optimize how users learn, not how often they click





Duolingo Behavioral Routing Engine

Adjust the metrics below to diagnose the learner's state, forecast recall via Random Forest, and prescribe an automated product intervention.

Live Routing Engine

Global Analytics (13M Rows)

Methodology

User Context & Metrics

Total Times Word Seen

150



1 5000

Total Times Correct

140



0 5000

Times Seen Today (Session)

5



0 1000

Time Elapsed Since Last Review (Hours)

24



0 720

ANALYZE USER STATE & PREDICT RECALL

ML Engine Output

Detected Persona

Recommended Product Action

RF Predicted Recall Probability

Metric Visualization



TABLE OF CONTENTS

UNIT	Phase	Status
1	User Engagement	COMPLETE
2	Quality of Education	COMPLETE
3	Quality of Content	UNLOCKED



Unit 3: Quality of Content



Duolingo Grading Simulator

The Problem

- Duolingo learners can submit many correct translations for one English sentence
- Traditional grading systems only accept one "correct" answer
- **How do you grade fairly when there are 10+ valid translations?**

The Solution:

Create a weighted grading system:

- Track how often real learners use each translation
- Assign **confidence scores** based on frequency
- Grade translations by how **common/natural** they are, not just correctness

Confidence Level	Frequency	Stars	Points
High	>10% of learners	★★★	10
Medium	1-10% of learners	★★	8
Low	<1% of learners	★	6



OUR GRADING SIMULATOR



Choose your language

pt Portuguese	jp Japanese	vn Vietnamese
hu Hungarian	kr Korean	

Choose your exercise

can i have a bottle of water?	i do not want to see you suffer.	my brother had earned more than my father.	the book shows brazil.
he came home yesterday.	i finally got an answer.	she did not follow the writer.	they will be able to exercise.
he is afraid of the dog.	i had arrived at school.	she thinks he's a nice guy.	we made pasta with fish last week.
he is older than her.	i touch my plate.	thank you and you are welcome.	we will see a big castle.
i am yours.	it will rain this saturday.	the attack came from the right.	what do you want to drink?

Explore Learner Translations

Translation	Confidence %	Ranking	Total points
a férfi a lánynál idősebb.	0.33	★	6
a férfi a lánynál öregebb.	0.33	★	6
a férfi a nőnél idősebb.	0.33	★	6
a férfi a nőnél öregebb.	0.33	★	6
a férfi idősebb a lánynál.	0.33	★	6
a férfi idősebb a nőnél.	1.60	★★	8
a férfi idősebb nála.	0.33	★	6
a férfi idősebb őnála.	0.33	★	6
a férfi idősebb tőle.	0.33	★	6
a férfi idősebb, mint a lány.	0.33	★	6
a férfi idősebb, mint a nő.	2.86	★★	8
a férfi idősebb, mint ő.	0.33	★	6
a férfi nála idősebb.	0.33	★	6
a férfi nála öregebb.	0.33	★	6
a férfi őnála idősebb.	0.33	★	6
a férfi őnála öregebb.	0.33	★	6
a férfi öregebb a lánynál.	0.33	★	6
a férfi öregebb a nőnél.	0.79	★	6
a férfi öregebb nála.	0.33	★	6
a férfi öregebb őnála.	0.33	★	6
a férfi öregebb tőle.	0.33	★	6
a férfi öregebb, mint a lány.	0.33	★	6
a férfi öregebb, mint a nő.	1.56	★★	8
a férfi öregebb, mint ő.	0.33	★	6
a fiú a lánynál idősebb.	0.33	★	6
a fiú a lánynál öregebb.	0.33	★	6
a fiú a nőnél idősebb.	0.33	★	6
a fiú a nőnél öregebb.	0.33	★	6
a fiú idősebb a lánynál.	1.14	★★	8
a fiú idősebb a nőnél.	0.33	★	6
Total	1,994.89		21406

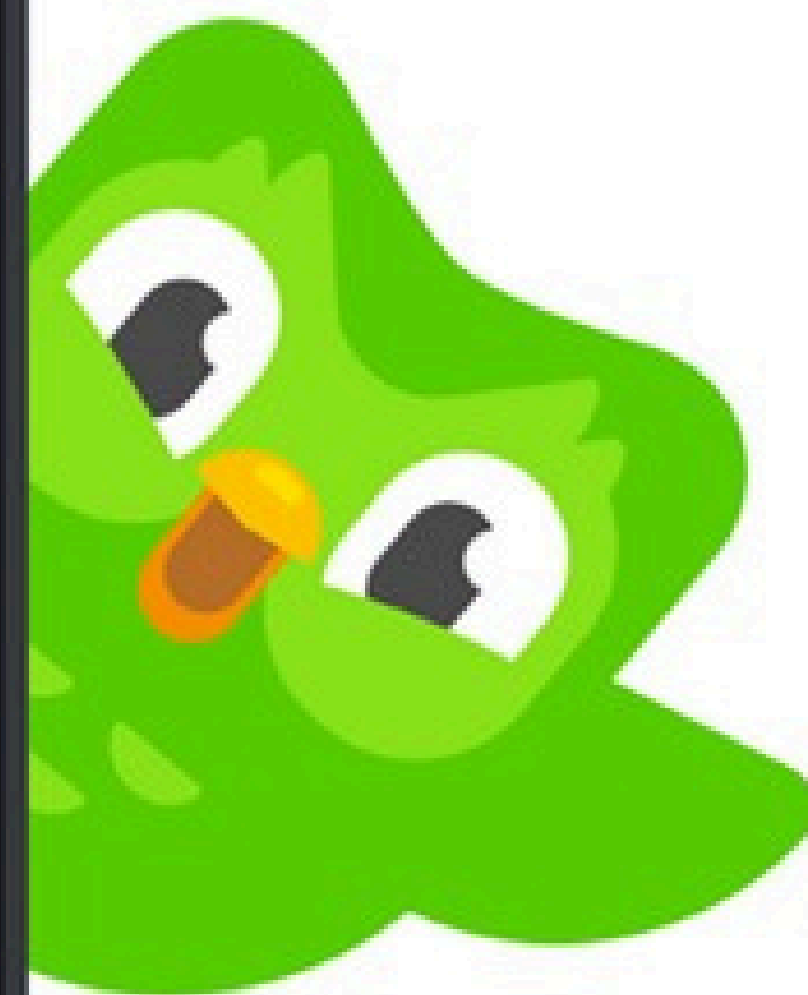
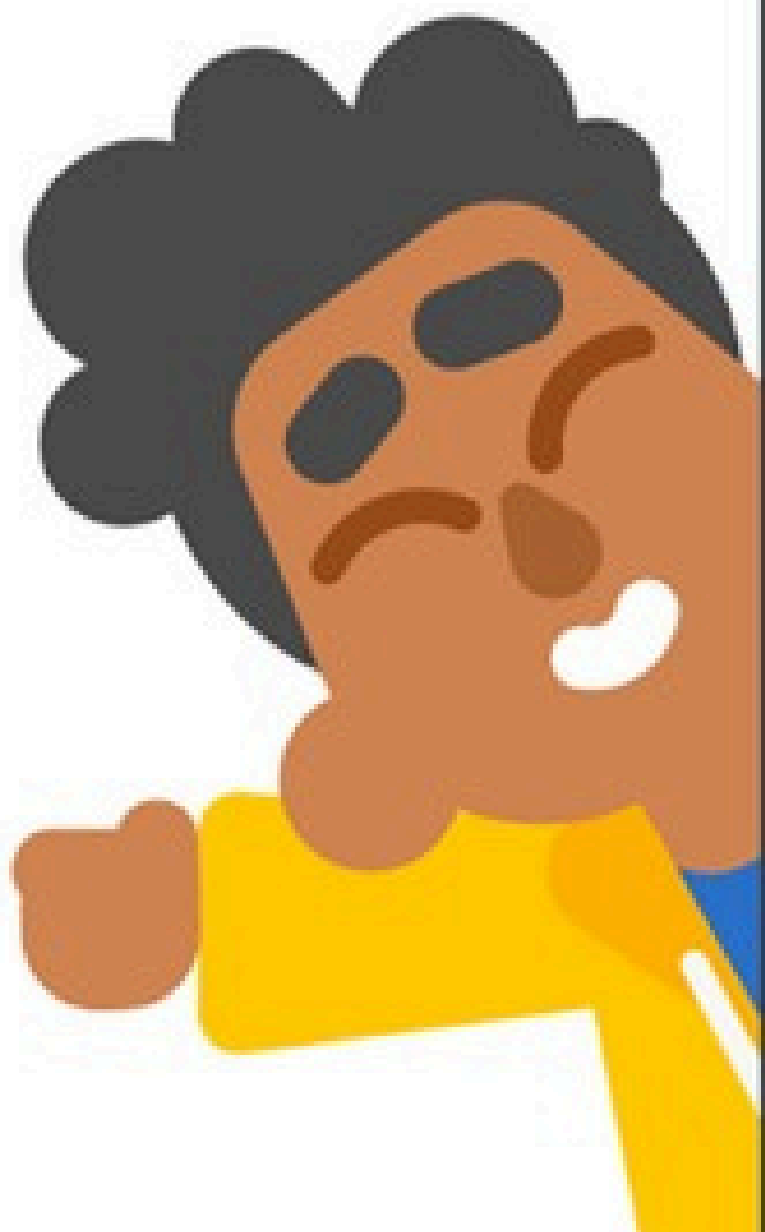
Key Insights

- **Not all correct answers are equal** - frequency matters
- **Language patterns emerge** - Vietnamese uses/omits "con", Hungarian has "férfi" vs "fiú" variations
- **Real learner data beats theory** - most common translations aren't always the most "textbook" correct
- **Grading can be nuanced** - reward natural language use, not just grammatical correctness

Why This Matters for Duolingo

- **Better grading** - matches how real humans speak
- **Improved learning** - students learn which translations are most natural
- **Data-driven insights** - understand language patterns across 5 languages
- **Scalable** - could work for any language pair

Thank you



Any Questions?

