



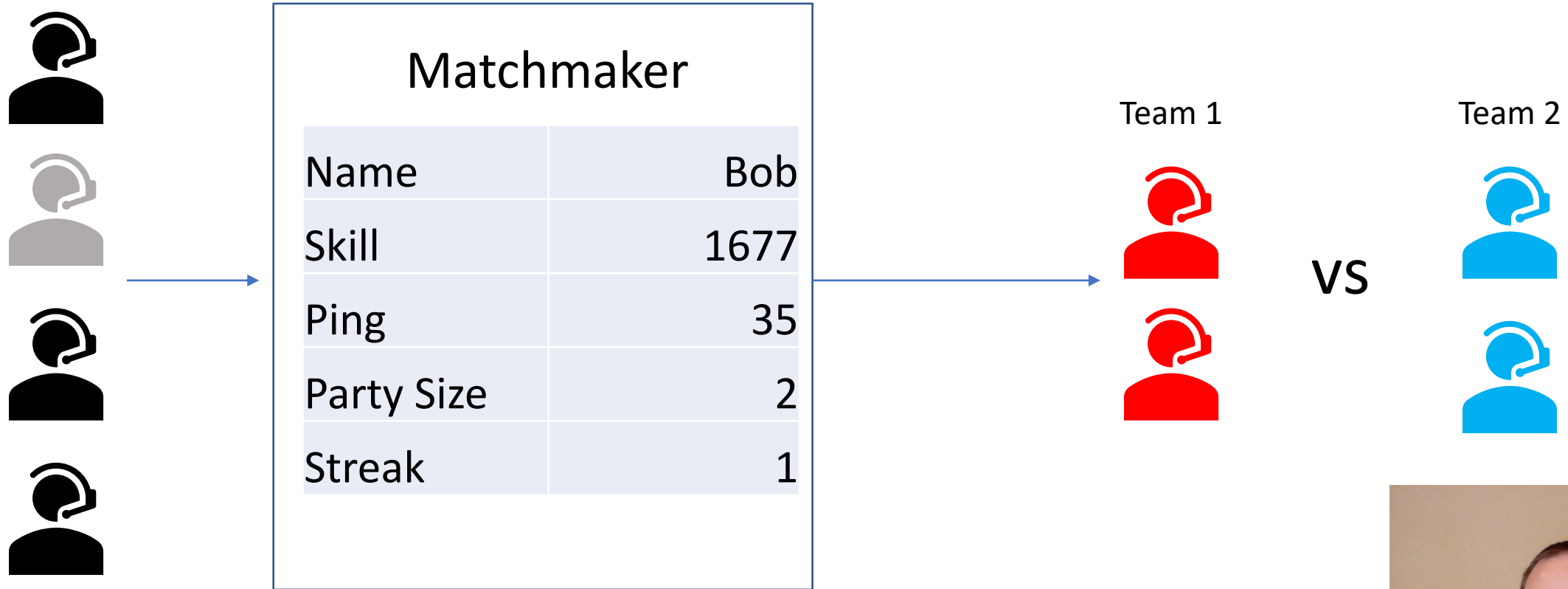
Matchmaking for Engagement

Learnings from Halo 5

Josh Menke, 343 Industries



What is matchmaking?



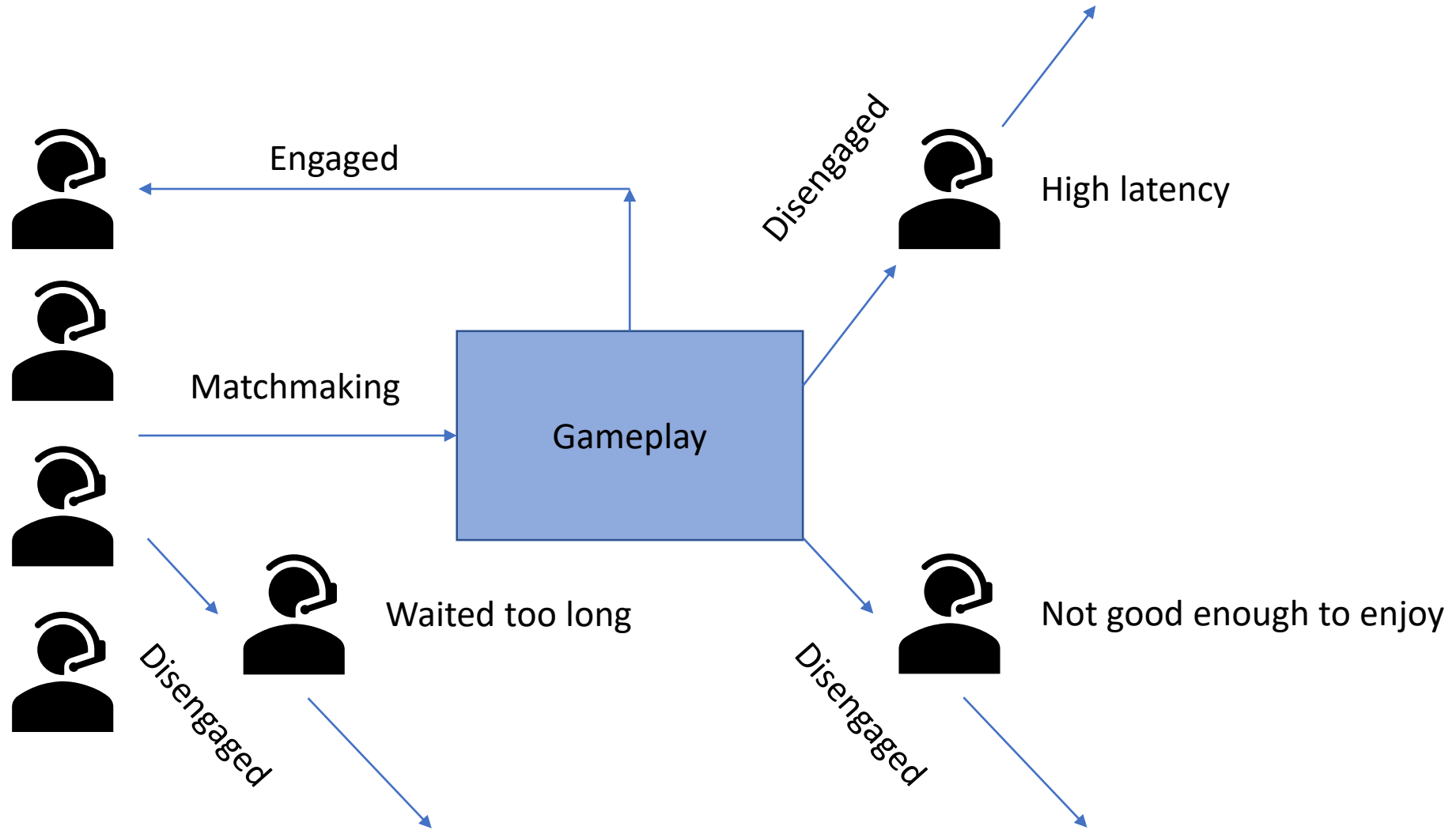


What is engagement?

- Relevant dictionary definition for **Engaged: Greatly Interested**
- Ideally players are greatly interested in your game
- Primarily Accomplished by **Gameplay**
- Matchmaking guarantees **Gameplay** experienced as intended
Prevent Disengagement where possible



How is matchmaking related to engagement?



How important are the characteristics we think we should match on?





Why do we care what's important?

Can't we just add it all and let the matchmaker sort it out?



Too many buckets



My Skill bucket: 15%



My Ping bucket: 10%



My reputation bucket: 5%



Overall Bucket: $15\% * 10\% * 5\% = 0.075\%$



Used Halo 5 for Analysis



Quick Skill System Review



1677



1412



1505



1257

VS



1300



1700



1450



1199

Skill Gap = $1677 - 1300 = 377$
Red wins most of the time

Team Skill gap:
= $\text{avg}(\text{red}) - \text{avg}(\text{blue})$
= $1463 - 1412$
= 51
Red still wins most of the time.



Another Skill Gap we Care About



1677



1412



1505



1257

VS



1300



1700



1450

Average blue



1199

Personal Gap

= Player – Avg(blue)

= 1505 – 1412

= 93

Player feels good vs. blue



What do we think is important?

☐ Team and Personal Skill Gap

☐ Latency

☐ Wait Time

☐ Losing Streaks



How do we test if something is important?

Matchmaking Breaks A/B Testing



Observational Study

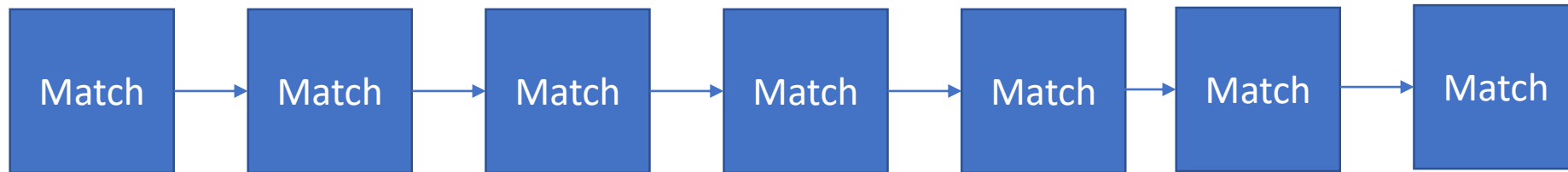
- Find past matches where ping was low, or high and see how players reacted
- Find past matches where the skill was fair, or unfair, see what happened



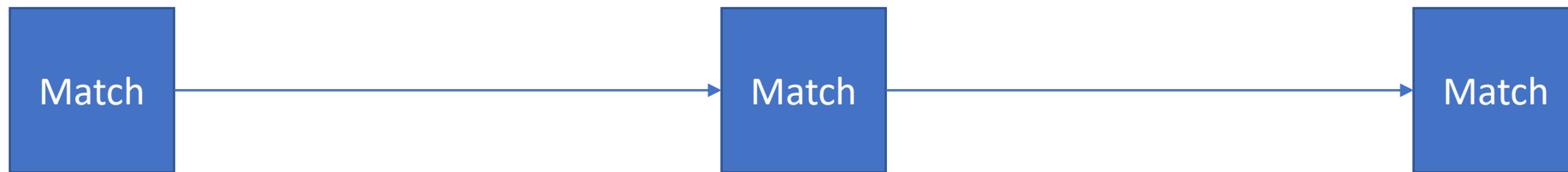
If Personal Skill Gap Really is Important ...

... Players will Play More Matches when the gap is smaller

Small Personal Gap, Happy Player, Plays More Matches

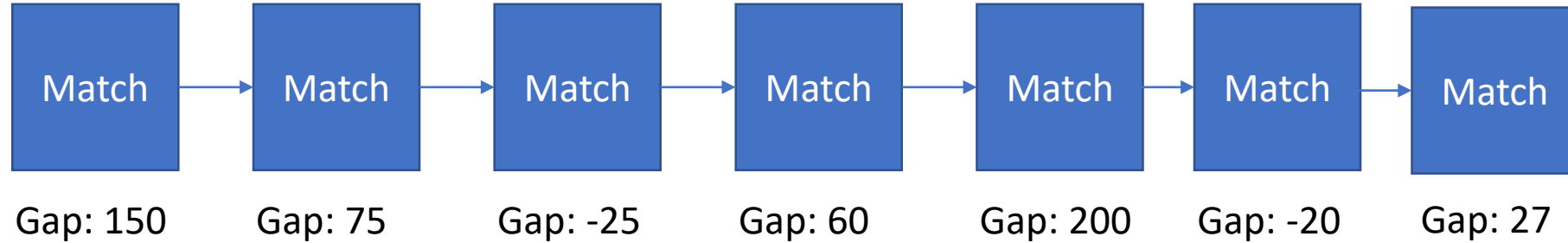


Large Personal Gap, Angry Player, Plays Less Matches



So Let's Average Gaps and Count Matches

Bob's
history



Player	Average Personal Gap this Month	Matches played this Month
Bob	67	7
Alice	250	3



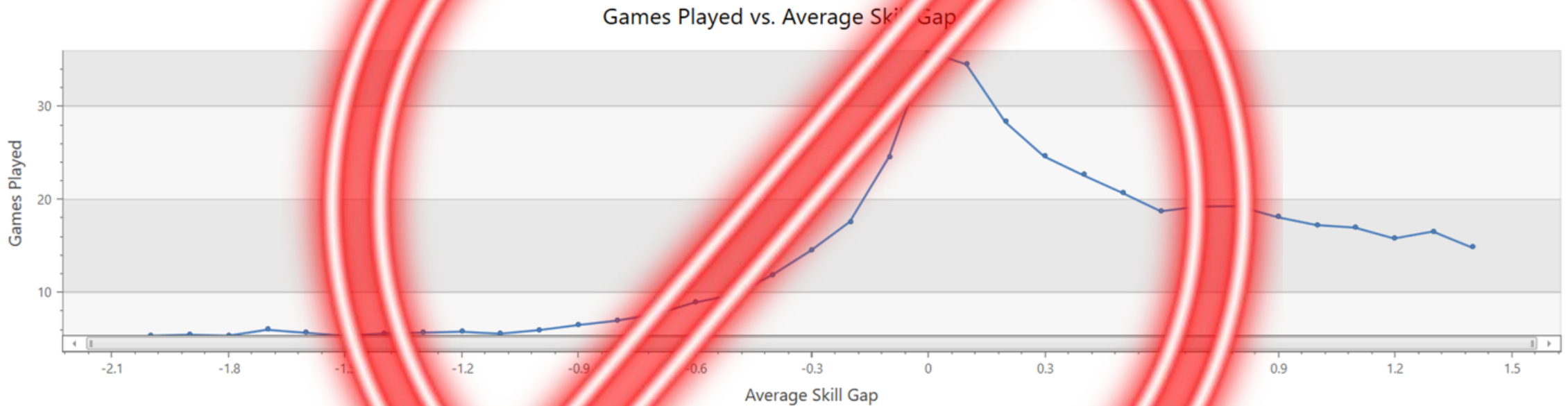
Bucket Those Matches to Graph Easier

Personal Skill Gap Bucket	Average Matches played this Month
50	100
100	90
150	50
200	20

Now Plot gap bucket vs. # of matches played



Skill Gap vs. Number of Matches Played



Must be important since Players play more!

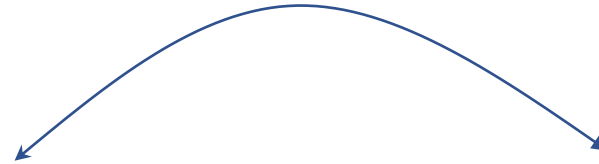


Reverse the Hypothesis



Reversal

If the average gap is small, players will play more



→ If players play more, will the average gap be small?

Yes, because of skill matching



Make sure that your metric is the **effect**
and not the **cause**.

CAUSE

EFFECT

Takeaway



RAGE QUIT!

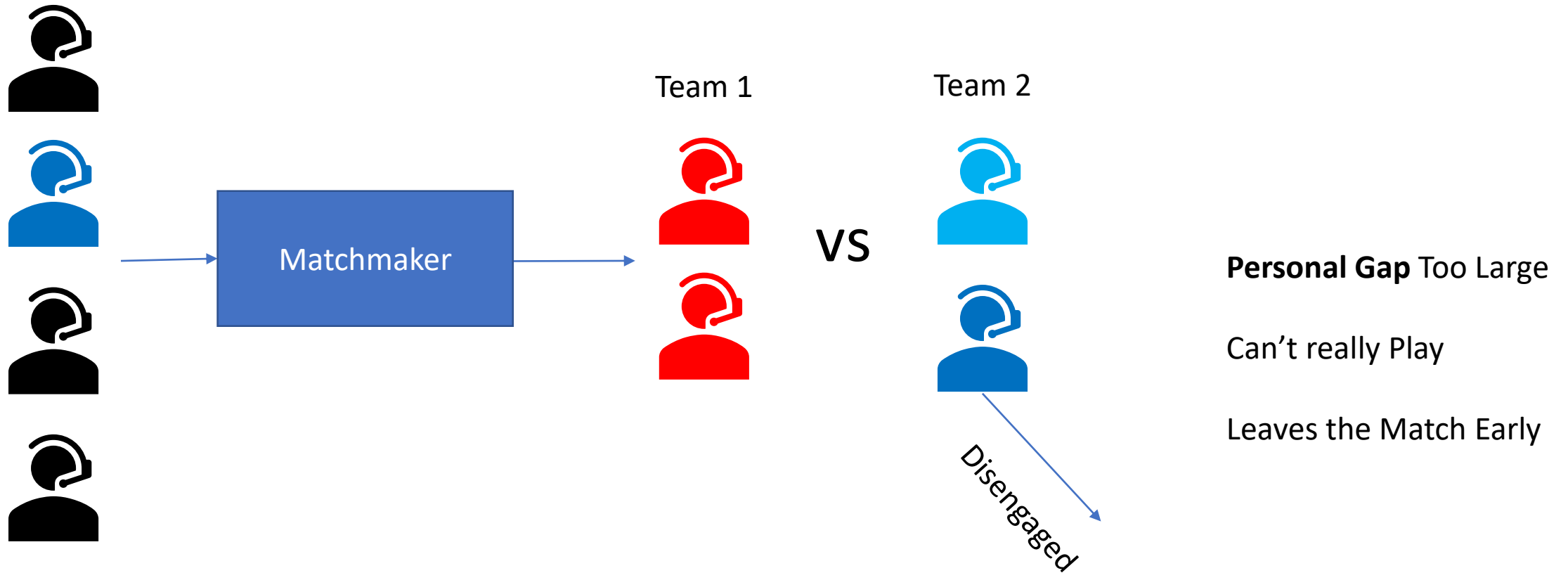
Now What?
See if it Makes
them Quit

- If something is really important to matchmaking, players will leave the middle of a match since their gameplay is bad. Let's call this “**quitting**”
- There's more to engagement than leaving one match but...
...**quitting** ruins matches for everyone else, not just the quitter



If Personal Gap Really is Important...

...players will quit if it's too large



Personal Skill Gap vs. Single Match Quit

Match Id	Player	Personal Gap this Match	Did They Leave the Match Early
1481	Alice	100	0
1481	Bob	250	1

Bucket it again before graphing

Personal Skill Gap Bucket	What % in that bucket quit?
50	7%
100	10%
150	13%
200	20%

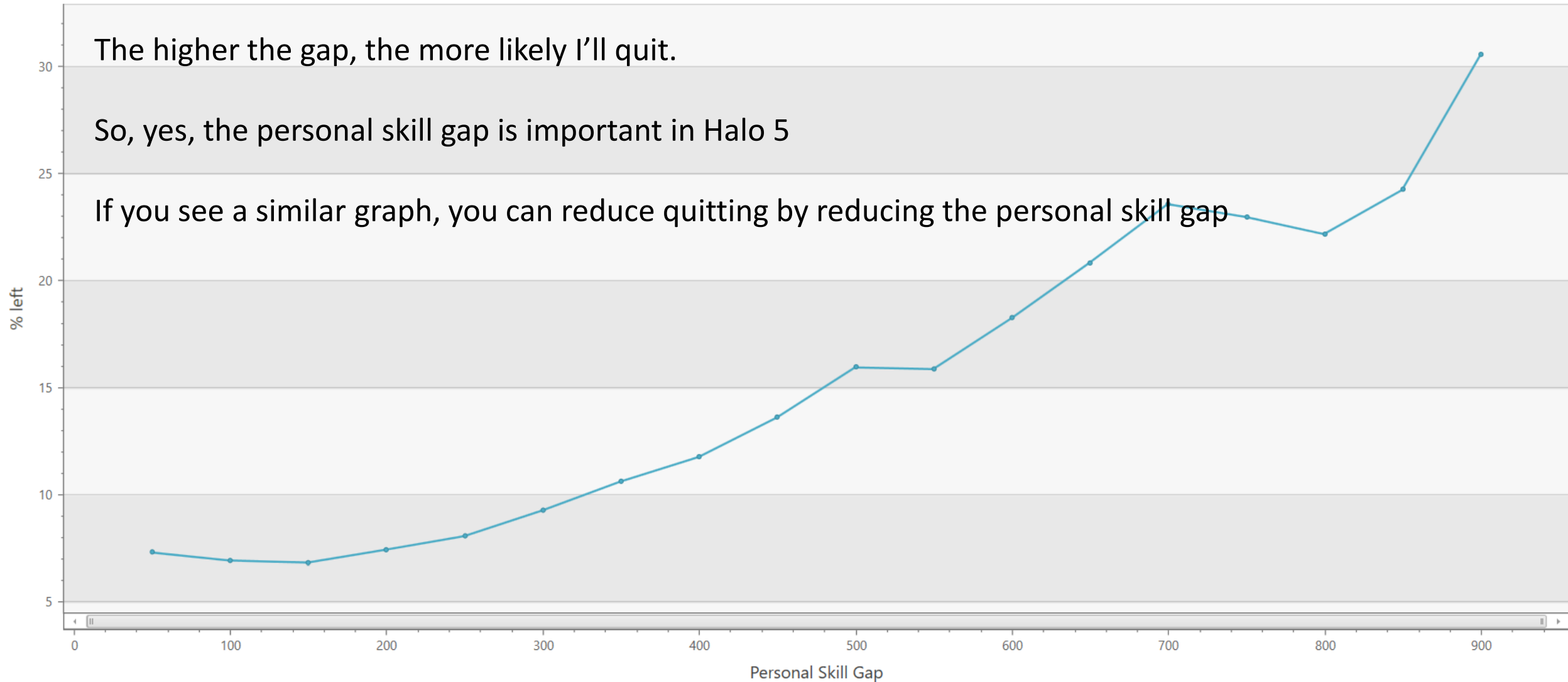


Will They leave the match?

The higher the gap, the more likely I'll quit.

So, yes, the personal skill gap is important in Halo 5

If you see a similar graph, you can reduce quitting by reducing the personal skill gap



Takeaway



Less Rage Quitting!
More Finishing the Fight!

- Personal skill gap is **important**
- Tune gap to lower quit rates



What about Team Gap?



1677



1412



1505



1257

VS



1300



1700



1450



1199

Team Skill gap:

`= avg(red) - avg(blue)`

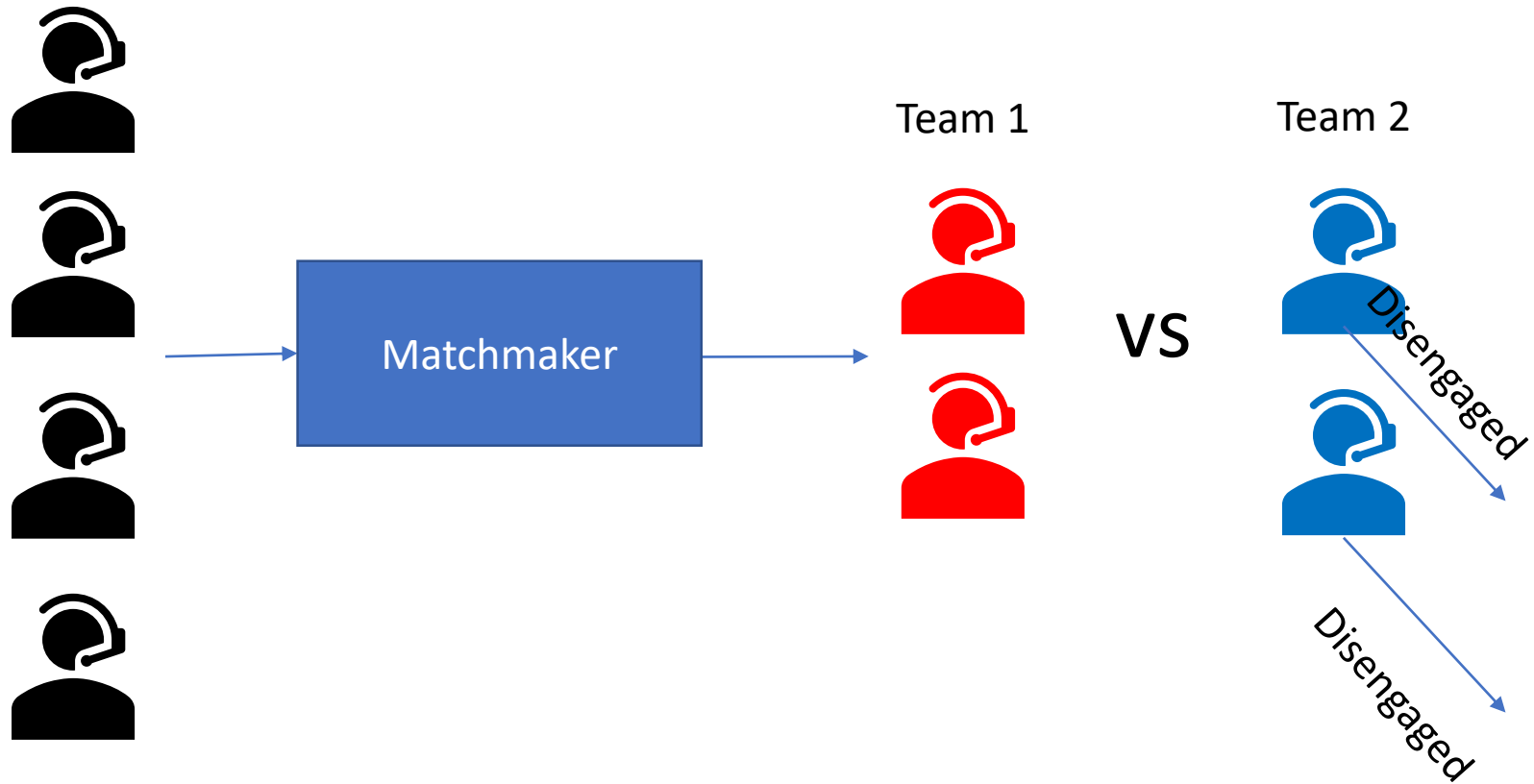
`= 1463 - 1412`

`= 51`

Red still wins most of the time.



If Team Skill Gap is important ...



$\text{avg}(\text{red}) - \text{avg}(\text{blue})$ too large

No Chance of winning

Might as well leave the match

...players leave early if it's too large.



Team Skill Gap Setup

Player	Team Skill Gap this Match	Did They Leave the Match Early
Alice	100	0
Bob	250	1

Bucket it again before graphing

Personal Skill Gap Bucket	What % in that bucket quit?
50	7%
100	10%
150	13%
200	20%

Multiply by
Team Size:
Rough
Approx



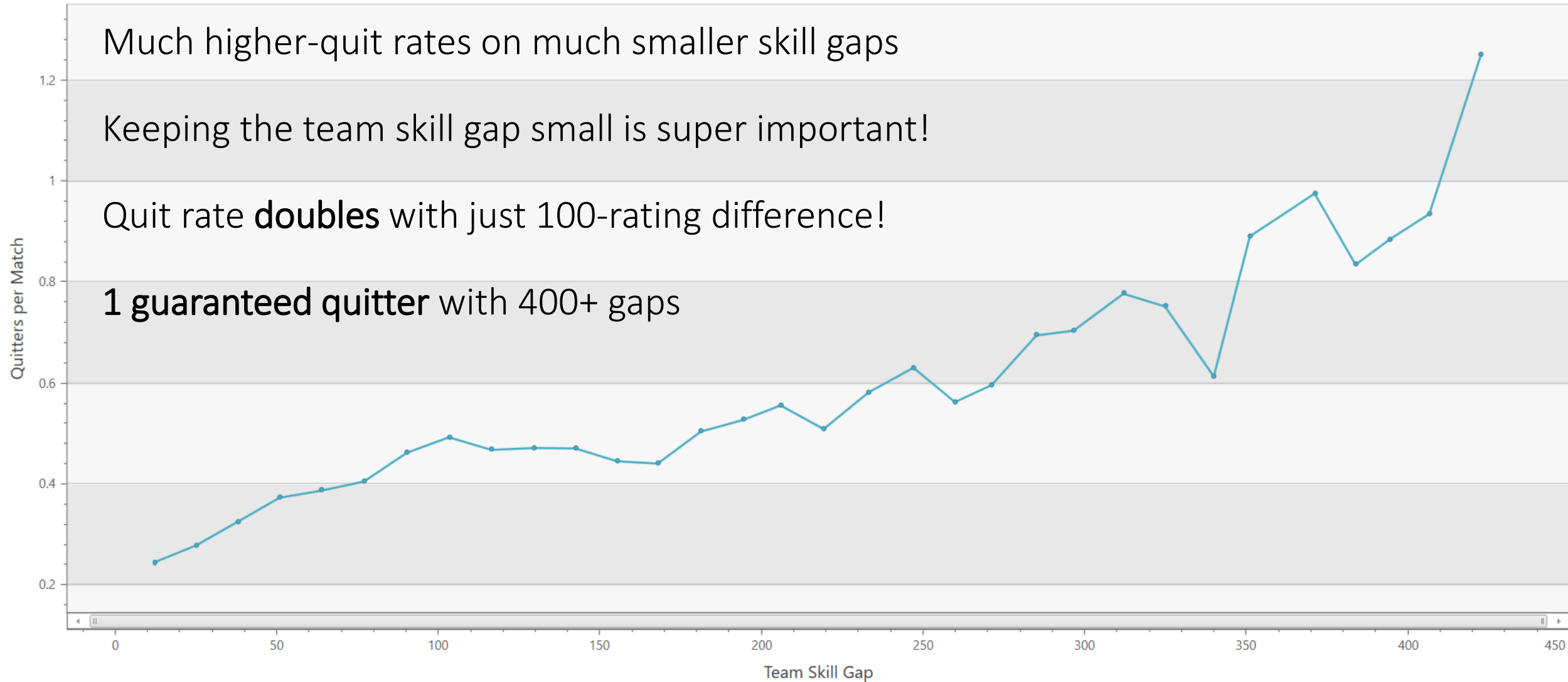
Will they leave the match?

Much higher-quit rates on much smaller skill gaps

Keeping the team skill gap small is super important!

Quit rate **doubles** with just 100-rating difference!

1 guaranteed quitter with 400+ gaps



Takeaway

- Team gap even more important
- Again, tune the gaps with the graph



Skill Gap
doesn't matter
in our Game

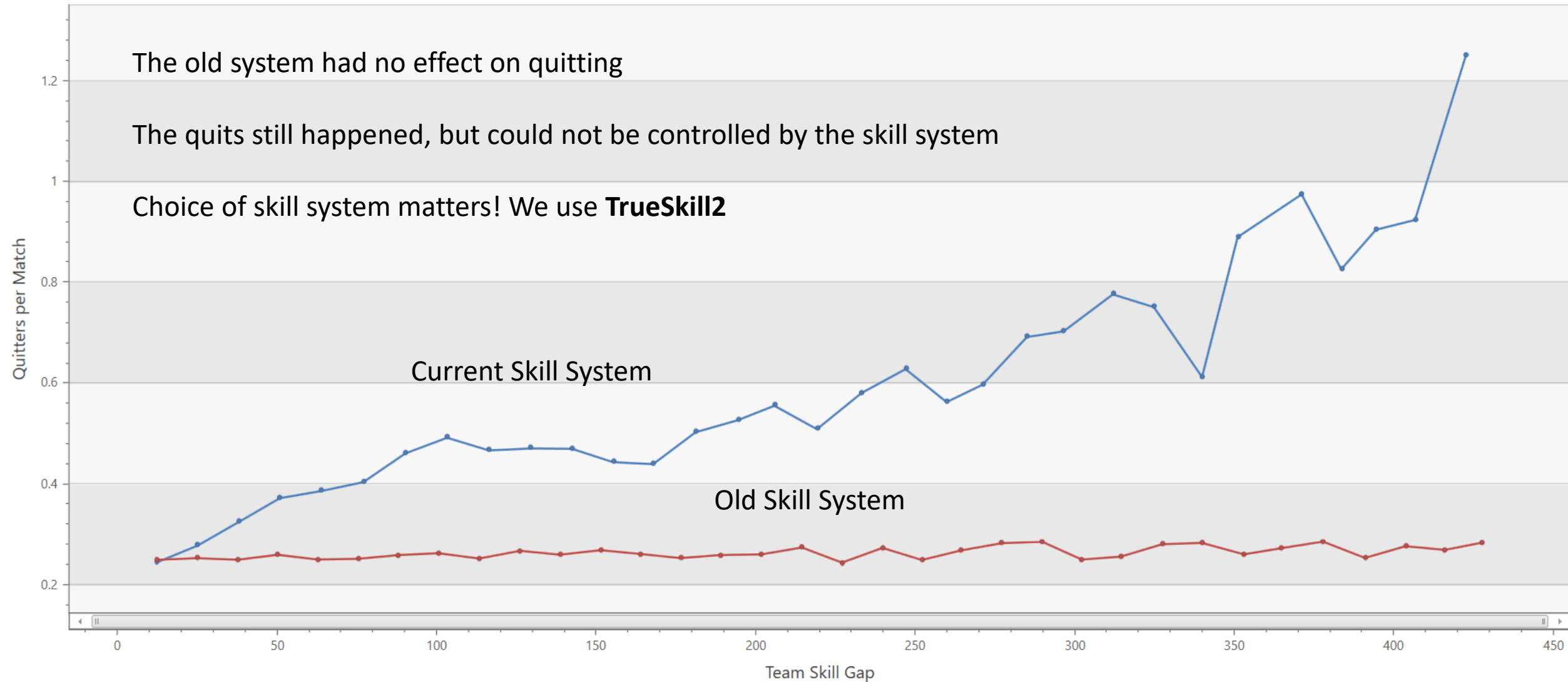


Will they leave the match?

The old system had no effect on quitting

The quits still happened, but could not be controlled by the skill system

Choice of skill system matters! We use **TrueSkill2**



New vs. Old Skill System

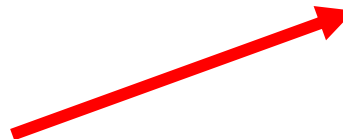
Old: Classic TrueSkill

- Winning Team
- 80-120 matches needed

New: TrueSkill 2

- Winning Team
- Games played so far
- Party Size
- Kills
- Deaths
- Quits
- 1-2 Matches Needed
- Much more accurate as well

Important to
Engagement



Both boil down to just one number



A promotional image for Halo Infinite featuring two blue Spartan supersoldiers in the foreground, one holding a long-barreled rifle. In the background, two red Covenant enemies are visible in a dimly lit, industrial environment. The scene is set within a large, metallic structure with various platforms and walkways.

Takeaway

Skill System Matters



Skill Gap Importance Summary

- Personal Skill Gap is Important:
4x+ drop in quits (30% down to 7%)



Skill Gap Importance Summary

- Team Skill Gap is very important!
6x drop in quits (1.2 per game down to 0.2)



Skill Gap Importance Summary

- Which matters more?

Players are more sensitive to the team balance, fortunately it's easier.



Skill Gap Importance Summary

- **Find out if the skill gap is important for you!**
- **Pick your quit rates using the graphs!**

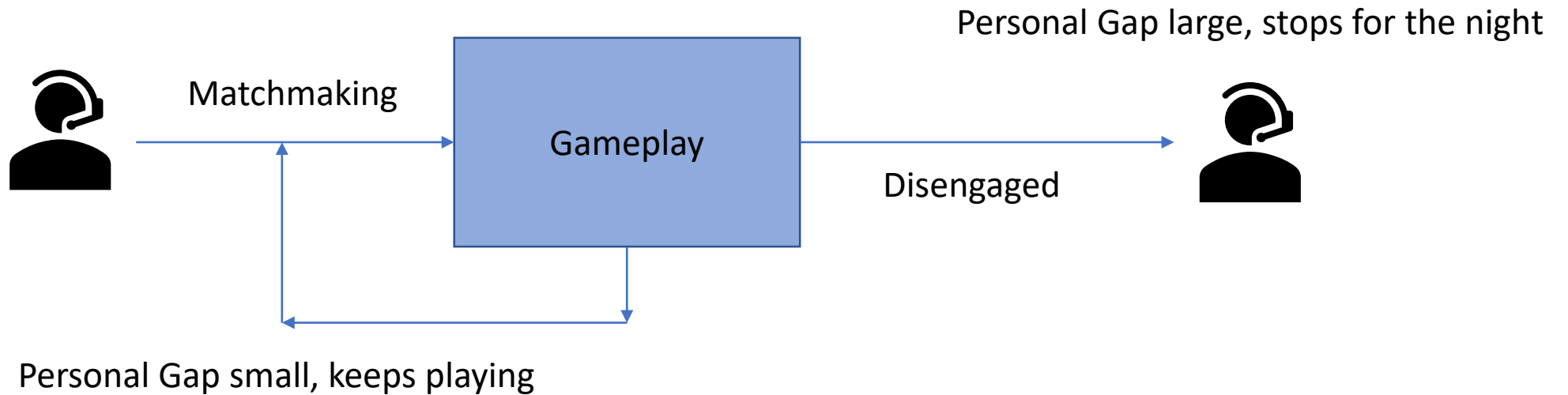


Skill Gap Importance Summary

- **Skill System Matters!**



Can We Go Beyond Leaving One Match?



If Personal Skill Gap is Important, wouldn't they stop for the night?



Personal Gap vs. Quit for the Night Data

Player	Team Skill Gap this Match	Did they stop playing for 8 hours?
Alice	100	0
Bob	250	1

Bucket it again before graphing

Personal Skill Gap Bucket	What % in that bucket stopped playing?
50	7%
100	10%
150	13%
200	20%

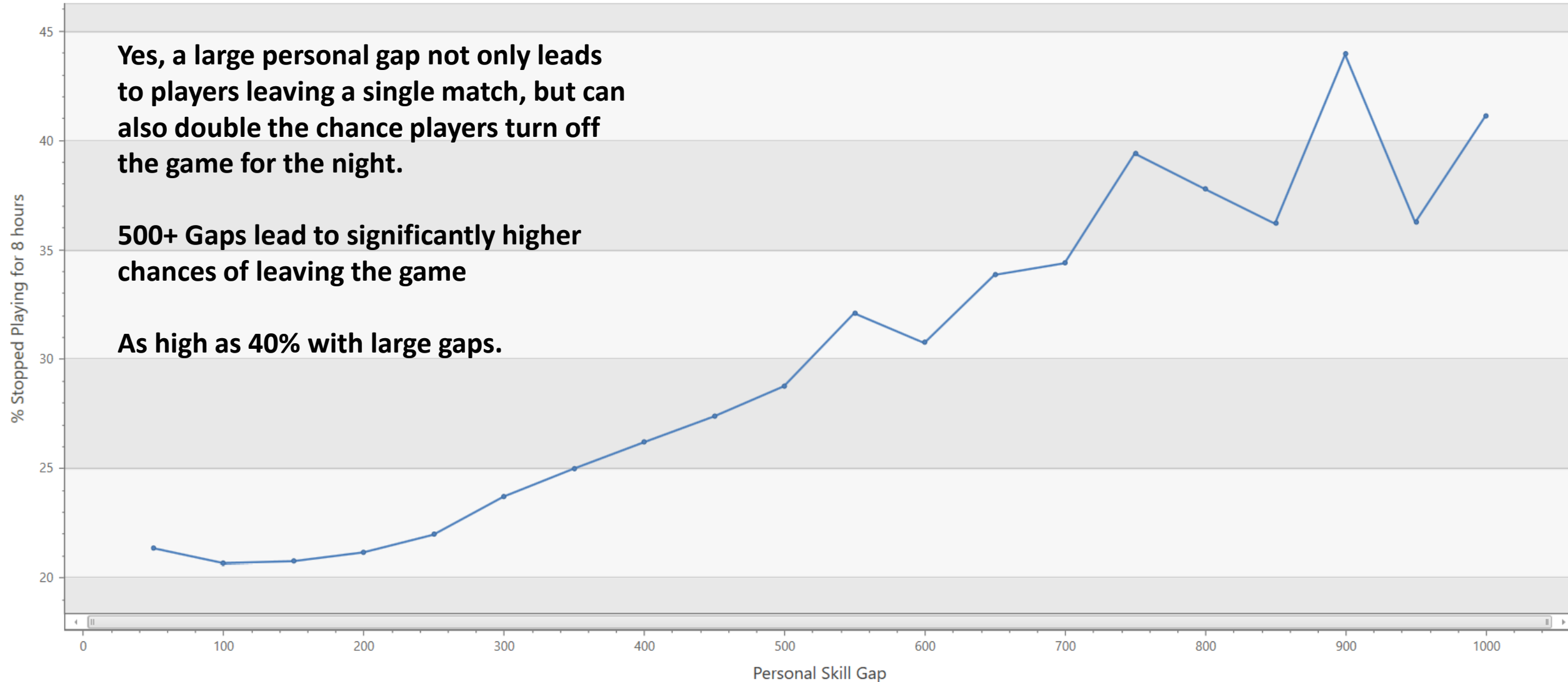


Will they quit for the night?

Yes, a large personal gap not only leads to players leaving a single match, but can also double the chance players turn off the game for the night.

500+ Gaps lead to significantly higher chances of leaving the game

As high as 40% with large gaps.



Takeaways



Players will disengage if the personal skill gap is too large.



Tune to reduce disengagement



We can go beyond one match



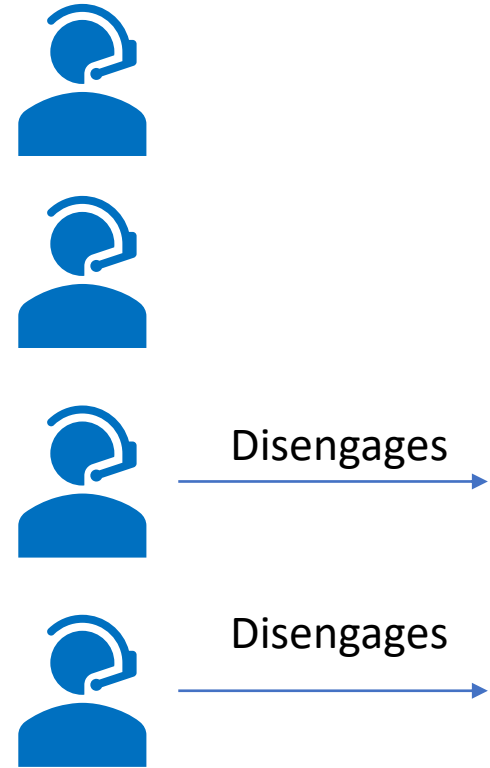
What about stacked parties?

Premade Stacked Party



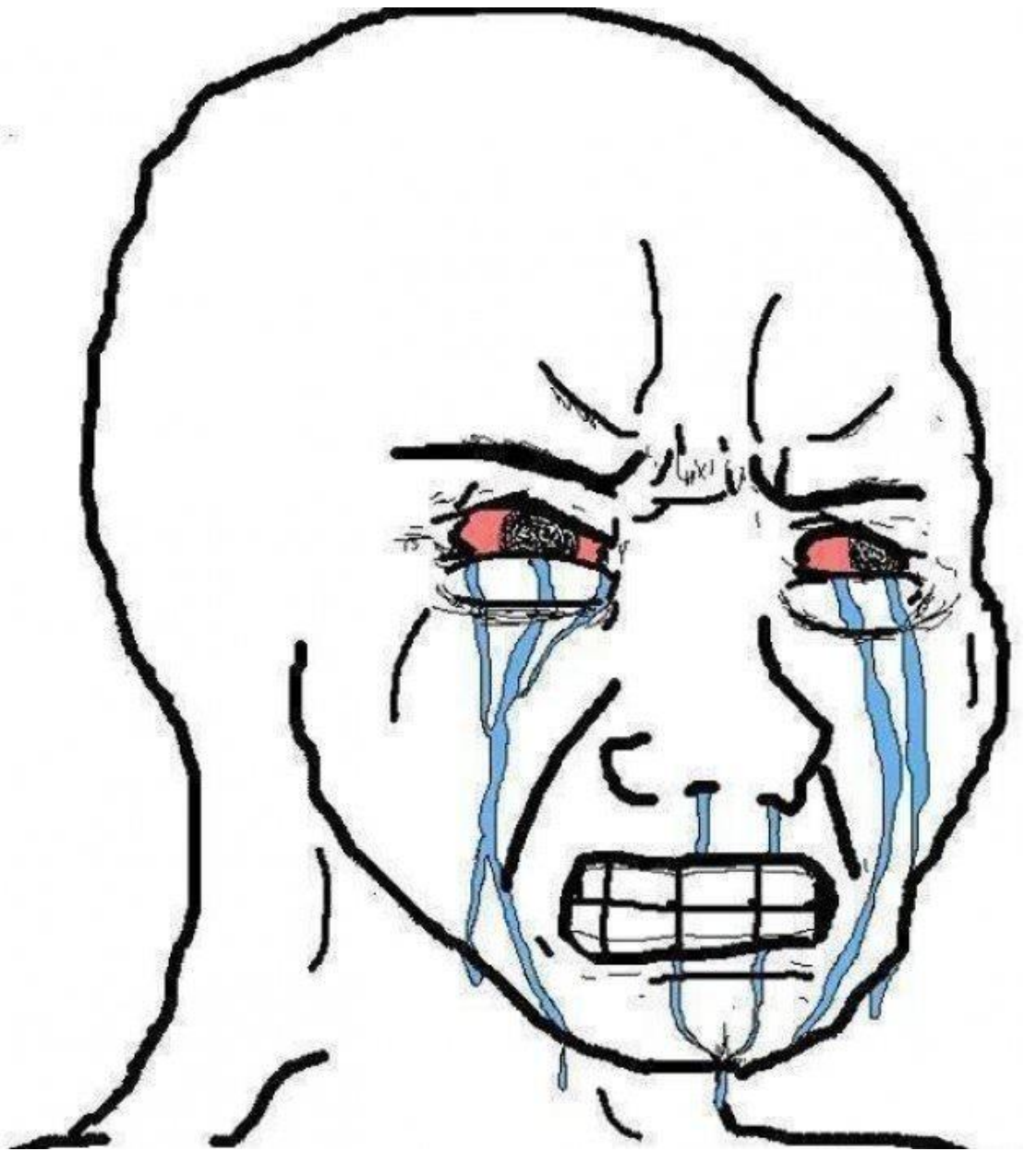
stomps

Premade Good Party



Disallow stacked parties?

Disallowing means your best
players can't play together



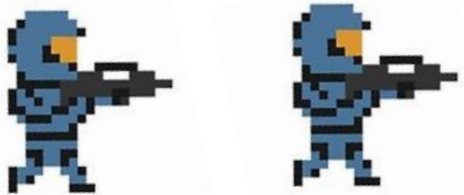
Allow stacked parties?

Allowing is unfair to everyone they play against, a larger group



Allow stacked parties?

A single 4-player party can scare away 20 players per hour



Stacked Party Solutions

- Halo 5:
 - Matchmaking won't make unfair matches
 - Better for population overall, disappointing for some players



Stacked Party Solutions

- LoL (unofficial observation):
 - Solo/Duo queue. Doesn't protect other party sizes
 - Shards population



Stacked Party Solutions

- Overwatch (unofficial observation):
 - Stacked parties aren't allowed to matchmake at all
 - Grandmaster+ are only allowed to solo/duo queue



Stacked Party Solutions

- NFL, NHL, NBA
Hard or soft salary caps to promote competition for similar reasons



What do we think is important?

✓ Team and Personal Skill Gap

☐ Latency

☐ Wait Time

☐ Losing Streaks



Ping Graph was Flat

Players not sensitive to ping
Quits and Leaving the Game



What do we think is important?

✓ Team and Personal Skill Gap

✓ ~~Latency~~

☐ Wait Time

☐ Losing Streaks



Wait Times?

Longer than usual wait times
don't stop people playing



Losing Streaks?

Losing Streaks don't stop people
from playing



What do we think is important?

✓ **Team and Personal Skill Gap**

✓ ~~Latency~~

✓ ~~Wait Time~~

✓ ~~Losing Streaks~~



Core Approach



Choose characteristic (ping, skill gap)



Choose metric (quits work well!)



Create data points
from match history:

Per player per match

Example 1: Skill-gap vs. quit

Example 2: ping vs. stopped



Plot characteristic vs. metric



Overall Takeaways



WHAT YOU THINK IS IMPORTANT
MAY NOT BE!



FIND WHAT'S IMPORTANT USING
OBSERVATIONAL STUDIES!



TUNE TO REDUCE QUITTING OUT
OF MATCHES AND FOR THE NIGHT!



A background image from the game Halo Infinite showing two blue Spartan supersoldiers in the foreground, one holding a rifle and the other a shotgun. In the background, two red Covenant enemies are visible in a dimly lit, industrial environment.

Takeaway

Skill System Matters



Future A/B Testing

Research Shows
Optimal Skill Gap
Depends on
Population

A/B Test Splits pop,
learning the wrong
gap

Instead:

Flip a coin every hour
to choose A or B

Run entire pop on
result (A or B)

Do for an extended
period of time, track
which matches made
w/ A vs. B

Check metrics (quit
rates, stop playing
rates, etc.)



Thanks for
Coming!



Questions?



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