Calculating the CPI of Akiyama's Pandemic Reasoning.

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Abstract

This research investigates the Cognitive Proficiency Index (CPI) of Shinichi Akiyama during the Pandemic Game. By analyzing the complexity of the mental tasks involved and estimating the time taken using Japanese dialogue speech metrics, we calculate a rough approximation of Akiyama's processing efficiency. This analysis will also assess the weaknesses of this method.

Pandemic Game Feat:

1. Memory works the status of all the players,
   After the virus spread among the players, is already calculating in his head how the virus spread that much, he calculates different situations in his head
2. 1 infected hypothesis,
   Akiyama calculates how much the virus would spread if only one person was infected among them, Akiyama calculates in his head: the order the players will have contact, the number of vaccines they generate after the contact while keeping in track the virus development, Akiyama is able to conclude that even with one infected the virus will spread maximum to two individuals
3. 2 infected hypotheses,
   After the result of this hypotheses doesn't matches the result of the game, Akiyama calculates the contact now with 2 infected people, again Akiyama processes the order the players will have contact, the number of vaccines they generate after the contact while keeping in track the virus development, the result is 4 players contaminated.
4. Active infected and passive infected theory,
   Finally, Akiyama processes the result of how the virus will spread with a contact seeker infected and a non-active infected, Akiyama here reaches the conclusion that the virus will spread after a round of contact made by the contact seeker infected and a round robin session In total, Akiyama calculated in his mind: 58 contacts, 52 vaccines, 63 fluctuant infected, 16 permanent infected, 158 normal statuses, and 120 results post contact, making a total of 467 objects Akiyama manipulated in his brain through all this process. This was done in a short amount of time, since right after the results of the rehearsal were revealed, Akiyama jumped to this conclusion immediately, so he calculated all of this in around 1 minute, since as he says "I know the process that made this result, as well as the guilty" to know the process that made the result, it means Akiyama already processed the 1 and 2 infected hypothesis to be sure the contact seeker infected and a non-active infected was the process that occurred in the game.

Methodology of time estimate

The segment of Liar Game which has the time that Akiyama will able to calculate the Pandemic Reasoning will be calculated through the dialogue in the segment. Using the syllables and the speaker changes, the time will be calculated through the average speech speed as well as the average gap between speaker changes. There will also be low ball and high ball estimates for the uncertainty.



ご覧の通り、中間発表の画面に表示されるのは感染者数と正常者数のみ – 33

もちろんゲーム終了時には全員の成績が開示されますがね – 31

……全員としても模擬ゲームの結果が感染者9と正常3 – 30

ふふふっ – 4

ゲーム開始までは、残り30分ほどとなりました – 29

それまでの時間、模擬ゲームの反省をするなり、本番への作戦を立てるなりしてお過ごし下さい – 50

では、30分後に再びお会いしましょう – 21

Changes Speaker

おい…… - 2

おっい…… - 3



いい加減白状しろよ。どっちとグルだったのか…って – 24

だから選んだんだ …俺は本当に… - 15

てめーっ！が吐けじゃ- 6

知らねーよ- 5

だから俺じゃねーって – 9

Changes Speaker

いや、問題はほかにもあるぜ - 12

ボード見ろよ – 6

感染者数は「9」じゃない。「10」- 13

Changes Speaker

ああ!! そうだ!! – 6

Changes Speaker

俺達の他10人のプレイヤーは、根絶ルール終了時… 実際、全員が感染+0だったって言ったよなァ!! – 57

誰かがウソをついてるって話さ – 16

Changes Speaker

何イィィィィィィッ!? – 8

お前、結局感染だったくせに最後はまんまと「正常」になりやがったなァ!! – 37

Changes Speaker

違うよ… 俺は本当に最後まで感染+0だったんだ – 24



…って事はほかにもウソをついてる人がいるかもって事か！- 24

Changes Speaker

だとすればそいつが本当の黒幕だと思うね – 22

Changes Speaker

マジか!? – 4

誰だよ!! - 4

Changes Speaker

誰!? – 2

Changes Speaker

お前かッ!? - 4

Changes Speaker

俺じゃねぇ!! – 5

Changes Speaker

やめてっ!! – 5

やめてくれぇっ!! - 8

こんなんじゃ… - 5

力を合わせて全員で勝ち上がるなんてできない… - 25

Total Syllables – 549

Total Changes in Speaker – 12

In casual everyday Japanese speech, native speakers typically talk at about 7.8 syllables per second

Low Ball: 6 syllables per second

High Ball: 12 syllables per second

(Koichi, 2012) (Mair, 2009)

In spoken Japanese conversation, the average time between one person's speaking turn ending and the next person beginning is extremely short, typically only 200 milliseconds (0.2 seconds).

Low Ball: 7 milliseconds

High Ball: 1–8 seconds (will be taking the mean of 4 seconds)

(Yong, 2016) (ゆうどう, 2025)

I'm going to be pairing the Low Ball of the speech speed with the High Ball of the gap in speeches and the High Ball of the speech speed with the Low Ball of the gap in speeches to get the lowest and highest times possible respectively (For the Low Ball and the High Ball)

Speech Time is calculated by Total Syllables (Which is 549 in this case) divided by Speech per Second

Rate Type	Syllables/Sec	Speech Time = 549 / sps
Low Ball	6	91.5 s
Mid Ball	7.8	70.38 s
High Ball	12	45.75 s

Total Gape Duration = Total Changes in Speaker (Which is 12 in this case) × Gap Time

Rate Type	Gap Time	Gap Duration = 12 × Gap Time
Low Ball	0.007	0.084 s
Mid Ball	0.2	2.4 s
High Ball	4	48 s

Total Dialogue Time:

Rate Type	Calculation
Low Ball	139.5 s
Mid Ball	72.78 s
High Ball	45.834 s

Cognitive Proficiency Index Calculation

In standardized tests like the WAIS-IV, CPI measures:

- Speed of mental processing
- Visual scanning
- Attention and accuracy under time pressure
- Working memory span
- Mental manipulation
- Focused attention
- Resistance to distraction

How Can We Estimate CPI?

We'll base this on the rate of distinct cognitive comparisons, associations, and updates per second, which simulates CPI test conditions. This includes the number of mental manipulations (WMI) and quick decision based comparisons (PSI) performed over a period of time. By converting these into standardized rates and averaging them, we can estimate a Cognitive Proficiency Index that reflects both depth and speed of mental processing.

Assumptions:

- Each of the 467 manipulations requires at least one perceptual comparison, rule check, or inference

Calculation:

The Processing Rate (PR) equation

$$PR = \frac{N}{t}$$

Where:

- PR is processing rate
- N is the number of discrete operations (In this case, 467)
- T is the time in seconds taken to complete them

So, when we plug in the values of t into the equation:

Rate Type	Time (s)	Operations per Second
Low Ball	139.5	467 ÷ 139.5 ≈ 3.35

Mid Ball	72.78	467 ÷ 72.78 ≈ 6.42
High Ball	45.834	467 ÷ 45.834 ≈ 10.19

This is both the number of operations and memory manipulations done per second.

Limitations:

Akiyama's Calculation's Time Frame

- Akiyama's calculations might have ended earlier than the time taken from the start of the dialogue to the end, so it could've been much faster than the high ball estimation, but it could also be slower as Akiyama could've anticipated the infected to non-infected to look like what was shown, meaning he could've calculated it before it was revealed and even into the dialogue time. Which would mean it took him much longer than the low-ball estimation.

The Time Calculation:

- It assumes speech rates and gap durations are consistent across scenes, which is good enough for an estimate, but the answer gotten from this could be very different if the actual scene itself had a time frame linked to it.
- It also does not account for nonverbal pauses.

Why is this feat impressive?

Besides the obvious high number of mental processes and short time-frame Akiyama executed the feat, he executed it as well with high mental pressure. Pandemic is probably the most collaborative-based round in the Liar Game. At that point, if Akiyama couldn't uncover the truth of the virus spread, all players would have remained static, since they'd think "this will happen again if I have contact". Based on this, Akiyama, knowing the connections the Corporation had with the Black Market, feared about the integrity of the participants, as well Nao's and his. By Akiyama uncovering the process and the culprit, it allowed the game-flow to advance, since now at least people knew who the "secure" normal players were, forcing those with "unknown" status to cooperate yes or yes since they knew Yokoya's nature is selfish and egoistic. This feat was key to setting the game in motion, and later, it allowed Akiyama to secure everyone's pass to the next round.

Koichi. (2012, May 1). Why do Japanese people talk so fast? *Tofugu*. https://www.tofugu.com/japanese/why-do-japanese-people-talk-so-fast/

Mair, V. (2009, 26 Apr). *Language Log » Fast talking*. https://languagelog.ldc.upenn.edu/nll/?p=63362

Yong, E. (2016, January 5). How Turn-Taking and short gaps in conversation are universal. *The Atlantic*. https://www.theatlantic.com/science/archive/2016/01/the-incredible-thing-we-do-during-conversations/422439/

ゆうどう. (2025, April 21). 会話の科学 あなたはなぜ「え?」と言ってしまうのか. *ゆうどうの読書記録*. https://gotobooks.blog.ss-blog.jp/2023-07-24