Are the Yu-Gi-Oh cards with the highest ATK/DEF/Level more individualist?

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Introduction - In the famous Japanese card game Yu-Gi-Oh, there are thousands of ways to play by using card combinations that are more original than others. However, if there's one issue faced by all players, it's deck synergy — the ability of a 40-card deck (chosen by the player) to work as a coherent whole. This means having cards that can summon each other or interact effectively through their effects — specific powers unique to each card, described in a short piece of text. The only simple way to evaluate this synergy is by counting how many times other cards are mentioned in each card's effect text. **In this study, we aim to answer the following question: Are the strongest cards — in terms of attack, defence, and level — less likely to refer to other cards in their effects?**

To answer this question, we will study the impact of attack, defence, and level on a cooperation index, which we will call *coopIndex*, represented by the following DAG.
(We could also have studied the impact of potentially confounding factors such as the cards' release date, but this data is missing from our CSV file.)
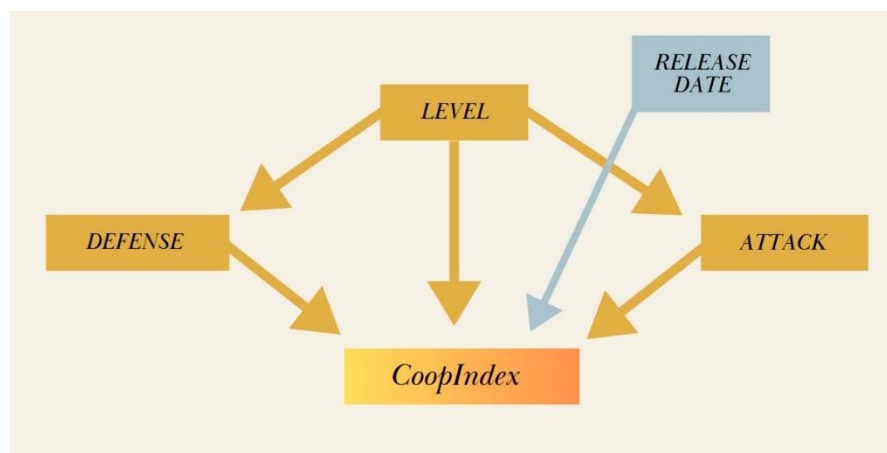

Figure 0 – Directed Acyclic Graph of our theory

I. Data Extraction and Structuring

As stated in the codebook attached to this analysis, our data is sourced from the YGOProDeck API. We will only focus on data such as the card's name, description, attack, defence, and level. (For a detailed explanation of the variables, see the codebook.) The goal is now to build a directed graph (like *Fig. 1*) where each node represents a card of the game, such that when card A references card B in its description, an edge will go from A to B.
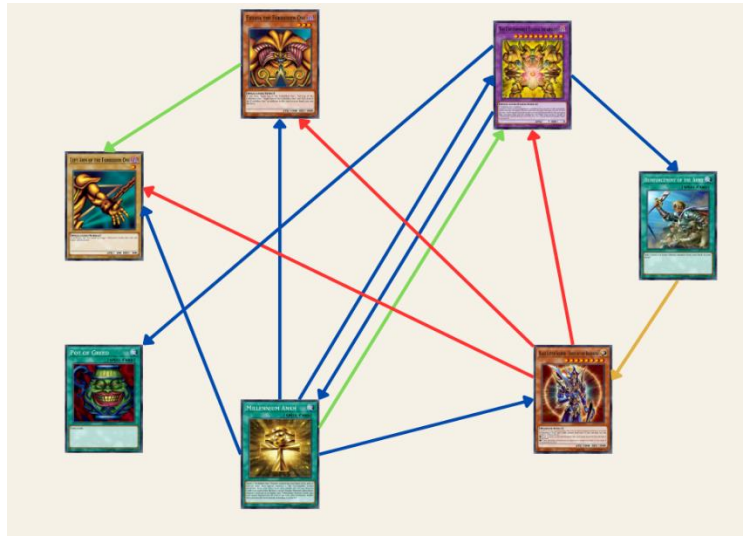
Figure 1 – Example illustrating what kind of graph we want

Each colour represents a different type of reference to another card in the description. We will only focus on the total number of outgoing and incoming references for each node. **Finally, we combine these two values to calculate the *coopIndex* variable we need.**

$$coopIndex_i = \frac{OutgoingSum_i - IncomingSum_i}{8}$$ (we divide by 8 because there is 4 types of reference)
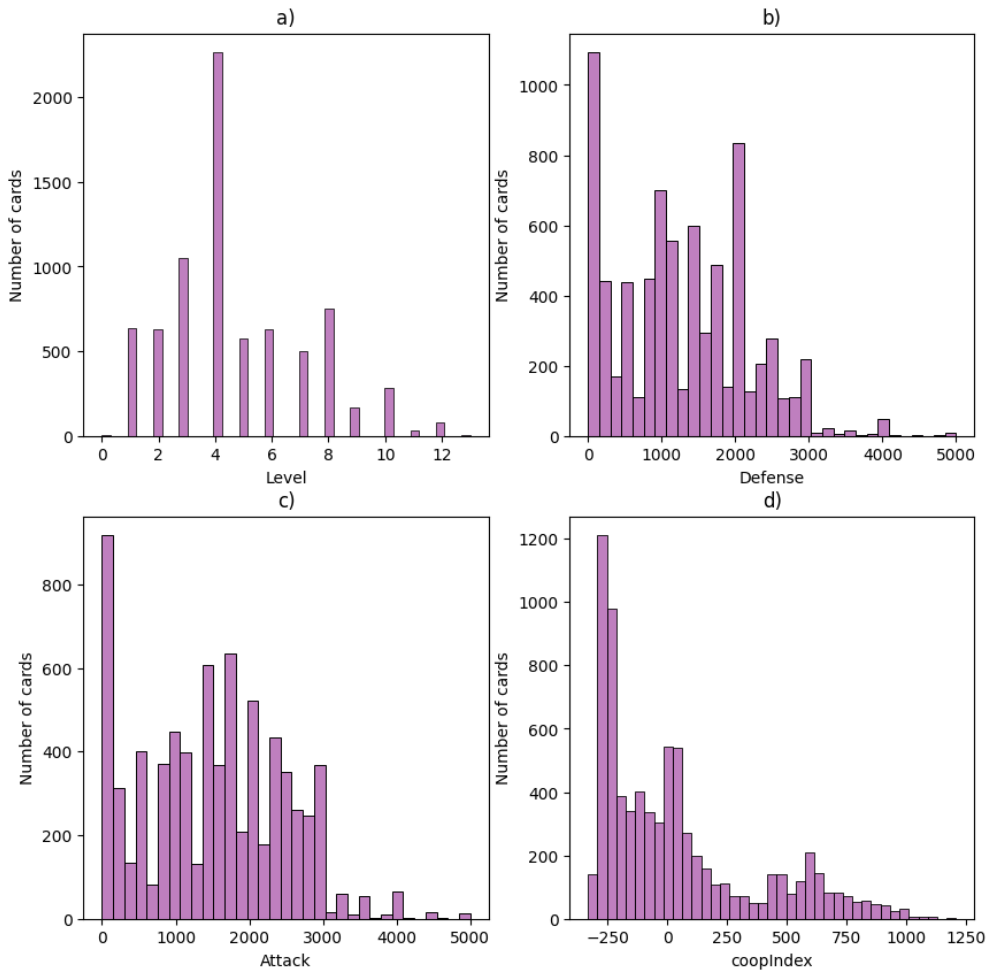
II. Data Description

Figure 2 – Distributions of data we need

Figure 2 shows the distributions of all the data we need (N = 7613). We now just need to normalize data, since attack and defence range from 0 to 5000, while level ranges from 0 to 12, and *coopIndex* from -300 to 1250.

III. Data Modelling

We've completed the bulk of the work; now all that remains is to use a multivariate model corresponding to the equation below:

$$coopIndex_i = \beta_1 Atk_i + \beta_2 Defe_i + \beta_3 Level_i + \epsilon_i$$

VI. Results

Only level and defence appear to have a significant positive impact on the cooperation index ($\beta_2 = 0.07$, $\beta_3 = 0.15$, $R^2 = 0.04$, $p_2 < 0.001$, $p_3 < 0.001$, $\varepsilon_2 = \varepsilon_3 = 0.02$, see ***fig. 3***), while the impact of attack is not significant ($\beta_1 = 0.03$, $R^2 = 0.04$, $p_1 = 0.066$, $\varepsilon_1 = 0.02$, see ***fig. 3***).
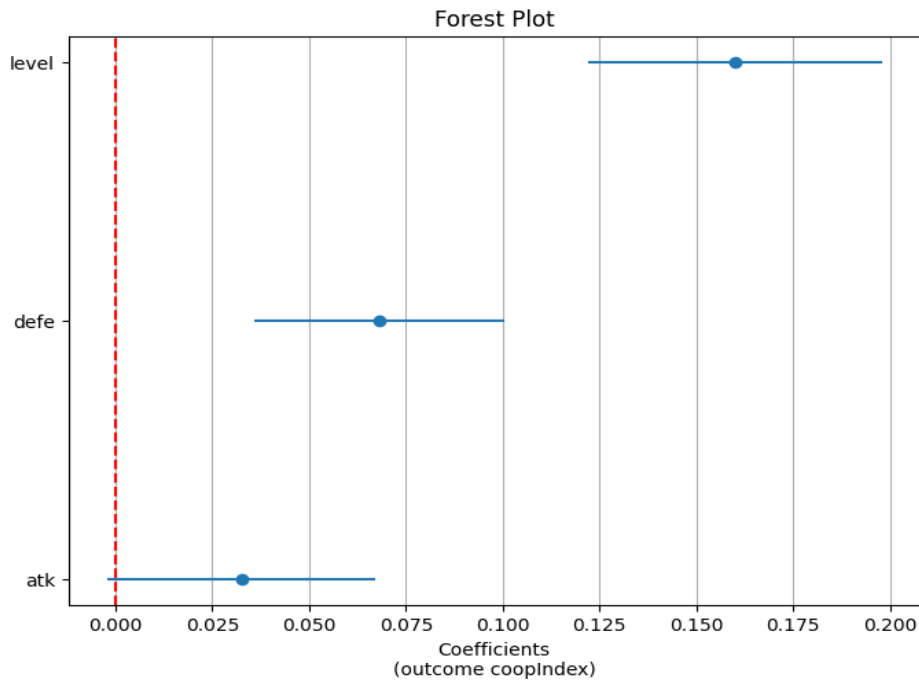

Figure 3 – Multivariate description of coopIndex in function of level, defence and attack

V. Conclusion

In conclusion, our analysis suggests that there is indeed a link between attack, defence, level, and cards' level of cooperation. However, this is unfortunately not satisfying for an experienced player. Moreover, the *coopIndex* does not accurately represent a card's potential to interact because cards which are mentioned and which mention a lot of other cards might have a *coopIndex of zero*.

Our analysis is therefore limited by the data and the way it is structured, but to my knowledge, this document is the only one offering an analysis about this question, and any improvements would be most welcome!