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You Are How Often You Like - Facebook User Profiling:
Where the Game Theory Meets Psychology

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1. The Dynamics of The "Liking" Behaviours

The number of "Likes" on social media relates directly to the user's happiness feelings as the "Like" is a sign of affirmation of the content one shares. It's universal, a feeling we share. And as our friends don't "Like" our posts, we would feel sad as we care about our friends' views on the post and give their responses about it.

There's a population among the teenagers that are overreacting about these feelings —— Feeling a greater loss as if being rejected and that their emotional reactions are greater than the average while on the other hand, they want the admiration or attention from the other users, and this kind of behavioural manifestation is correlated to the anxiety level (or more specifically rejection sensitivity) they are perceiving. [Bettmann et al., 2021] Psychologically we would describe these people are of higher rejection sensitivity. People with higher rejection sensitivity expect to be rejected all the time and constantly look for signs that they're about to be. They tend to respond dramatically to any hint that someone doesn't want to be with them. [London et al., 2007]

In return, in alleviating their pain, they will tend to surf Facebook more, share only the attractive part of their lives on Facebook and give "Likes" more, in exchange for others'. [London et al., 2007] These behavioural manifestations are not necessarily conscious to the users. Anxiety is a pain that works unconsciously. Just as Horney's Neo-Freudian interpretations of one of the three neurotic personalities —— the "Moving Toward People" subtypes, craving for approval, affection, social recognition, and personal admiration. [Horney, 2013] Anxiety acts as fuel in propelling the dynamics of the users' online behaviours, as a parodical interpretation of Adam Smith's "Invisible Hands".

Another common psychological phenomenon —— Projection, is a tendency of how we humans tend to think, under the condition of lacking information of how the others are thinking, by substituting our thoughts onto the others'. It's an unconscious process that we're doing now and then without realizing it. The empirical findings of this study suggest that while the users' behaviours reflect their expectations —— the more I "Like", the more I'm expecting "Likes" from the others. The users are using Facebook not knowing who they are encountering.

While from the mathematical modelling perspective, the psychological construct of ones' anxiety could be best described and captured by the Incomplete Information Game framework —— as a self-regulating, dynamic system dictating ones' behaviours once reaching theoretical equilibria. The user has no prior information regarding the other users' personality types. We turn our heads to another way of framing this case.

With the reference to Harsanyi's Purification Theory, we care much about the mixed-strategy equilibrium in this case and we give the interpretation of why the user is playing mixed-strategically. Harsanyi mentioned that: The mixed strategy equilibria are explained as being the limit of pure strategy equilibria for a game of incomplete information in which the payoffs of each player are known to themselves but not their opponents. [Harsanyi, 1973] The case is just so similar to mine. I'm adopting it by modelling in a mixed-strategical way.

An online survey *Selfies on Facebook: Practices and Interpretations* with the targeted 18 – 22 aged Taiwanese university Facebook users population, is conducted and succeeded by a maximum sample of 717 individuals. [Wang, 2018] This open dataset is used to validate the model proposed, empirically.

To sum up the case:

- The Facebook users are interacting among each other --- whether to like or not to like, depends on the others' acts & the users have the incentive to pursue a higher payoff (of psychological interpretation).
- The users' anxiety, which leads to their behavioural manifestation could be modelled under the Game Theory framework
- The construction of our payoff matrix is theoretically driven, it's intuitive and it's empirically validated.

2. The Game Theory Modelling Approach

We can tell the feelings of these anxious users under these four conditions:

		The other	
		Like	Not Giving Like
The user	Like	A, which is a positive number indicating emotional positivity, as a payoff gain	-B – t*Anxiety Level, B and t are positive, indicating emotional negativity or loss. (Again, we see the overreaction of the anxious one: If I'm not anxious at all, I'm feeling -B, while the anxious one is feeling -B – t*HisAnxietyLevel, which is much more intense than mine.)
	Not Giving Like	A + k*Anxiety Level, k is a positive number, as the anxiety level of the user correlates to his overreaction in response to the likes from the others. (He only wants the likes from the others. If I'm not anxious at all, my feelings under this condition would be the same as the above, an A.)	-n*Anxiety Level, n is positive, the more anxious the more sense of emotional negativity. The relationship is a negative but not necessarily a perfect substitute. This is the baseline emotional negativity of the user, given both not giving "Likes". (If I'm not anxious at all, both I and the other not giving a "Like" are just fine to me, feeling nothing; while the anxious would expect the other's not giving "Like" as an act of rejection, hence the emotional loss under this condition.)

Here we have our assumption that: -B – t*Anxiety Level > -n*Anxiety Level

(Given the others don't give a "Like", the anxious one tends to "Like" as he's expecting his act of giving a "Like" is beneficial to his interpersonal relationship, in exchange for others' "Like", he can't bear the pain of both him and the other users are standoffish ⸺ it's a sign of rejection to him!)

So given the not at all anxious user (Anxiety Level = 0, a.k.a the Independent type), his feelings would be:

		The other	
		Like	Not Giving Like

The user	Like	A	-B
	Not Giving Like	A	0

The construction of this payoff profile isn't just ad hoc, here's the observation from the empirical data, we try to justify them in 2 ways:

- First, the not anxious user feels happy (A) gaining "Likes" from the other while their feeling is independent of their actions, whether they "Like" or "Not Giving a Like" while the anxious one is feeling more intense than the average about the "Like" from the others.
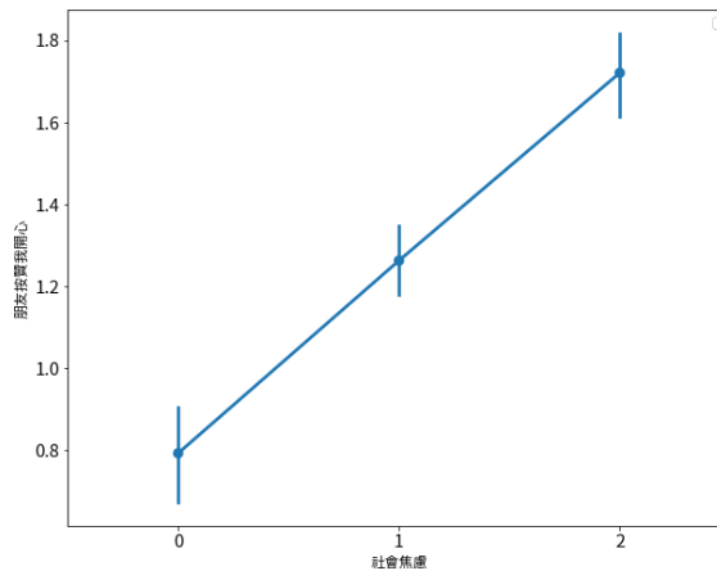

FIGURE 1: The linearity of the relationship in between anxiety level and the sense of happiness by gaining "Likes" is significant and it's upward sloping. The greater the anxiety level the happier by gaining "Like"

Then comes the second question about the setting of the payoff profile: Why is it that it's only a positive feeling of A under the condition both the anxious and the other user give "Like" to each other; while only exaggerating the anxious' feeling ($A + k*Anxiety Level$) of positivity under the condition that the other "Likes", he remains cold (Not giving Likes)?

As we hold an emotional interpretation of the payoff of the user, we could only assume that the anxious are feeling better as the others are admiring him so much while he remains cold (Egoistically, he only wants "Likes" but is stingy in sharing). However, in today's society, giving "Like" is like a manner, similar to why we clap after someone's performance, we clap while not necessarily relating perfectly to what we think about the performance, the same things go to the action of "Like" on Facebook.
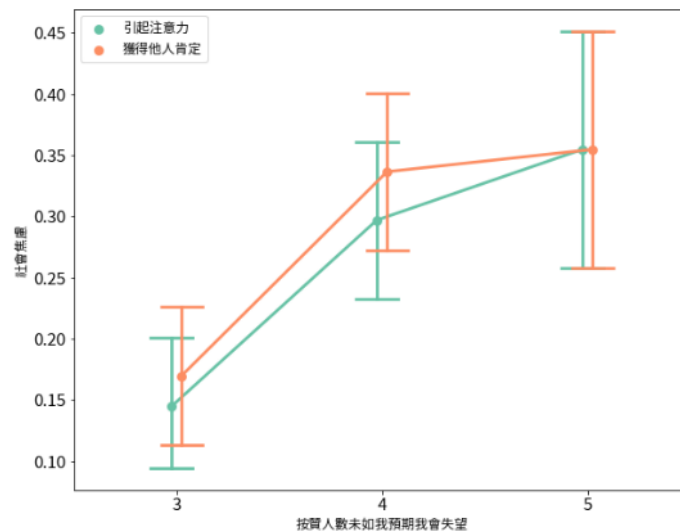
FIGURE 2: The anxious' motive are more prone to gain social approval or attention

We're convinced that although the anxious and the not at all anxious are giving "Likes", the motive behind their actions are not similar ── The not at all "Likes" in spontaneity and as a symbol of appreciation while the anxious "Like" in a manner, a mere façade (more or less).

• Second, while both the anxious and the not anxious are feeling emotional negativity under the condition the other remains cold (Not giving "Likes") while he "Likes". The anxious are experience more intense negativity than the average.

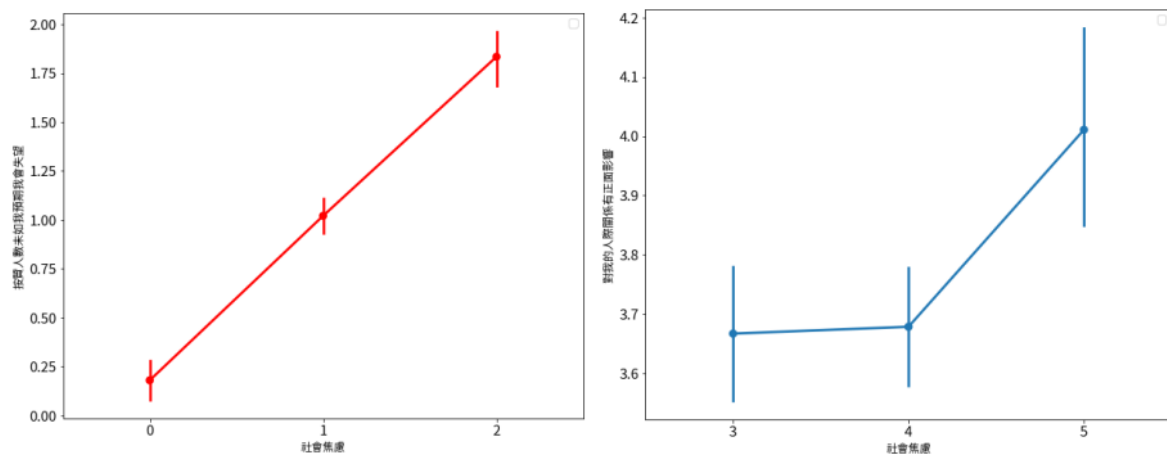And about the assumption that: -B – t*Anxiety Level > -n*Anxiety Level,

FIGURE 3 and 4: The relationship between the anxiety level and the sense of disappointment if gaining less than expected "Likes"; The belief that social media is beneficial to the users' interpersonal relationship

From Figure 3, we can see that the more anxious the more disappointed by not gaining "Likes", affirming the negative correlation between the anxiety level and the payoff. We are assuming that the anxious tend to "Like" as an exchange for the others' "Likes", he is more convinced that the actions of

"Like" are beneficial to his interpersonal relationship, while the not anxious may not think in this way, they could bear with the condition that nobodies are giving "Like" and not relate the action of "Like" as beneficial.

Apart from this, there's another group of users who doesn't care about the use of Facebook, they don't relate their lives on Facebook as a part of them (relates to their identity), so when the other doesn't give a "Like" to their post, they would just feel nothing (As it is just not related to him). So their feelings under these four conditions would be:

		The other	
		Like	Not Giving Like
The user	Like	A	0
	Not Giving Like	A	0

After making the construction of our payoff profile clear, we're ready to investigate the interaction of these 3 types of users in cyberspace. That's where the Game Theory blends in.

This is what a payoff matrix between 2 users is going to look like, given the user is the anxious type:

		The other	
		Like	Not Giving Like
The user	Like	A, ?	$-B - t*$Anxiety Level, ?
	Not Giving Like	$A + k*$Anxiety Level, ?	- Anxiety Level, ?

The payoff of the other user depends on which types they are. The users are using Facebook not knowing who they are encountering. Under the condition of incomplete information, the users are prone to refer to themselves in expecting what others would think, in carrying out the optimum act to maximize their payoff, in this case, happy feelings. Projection is the very core assumption of this model. On Facebook, we know nothing about who's viewing our posts. We project our image unto our picture of the others. In other words, we're playing this game with our MIRROR REFLECTION.
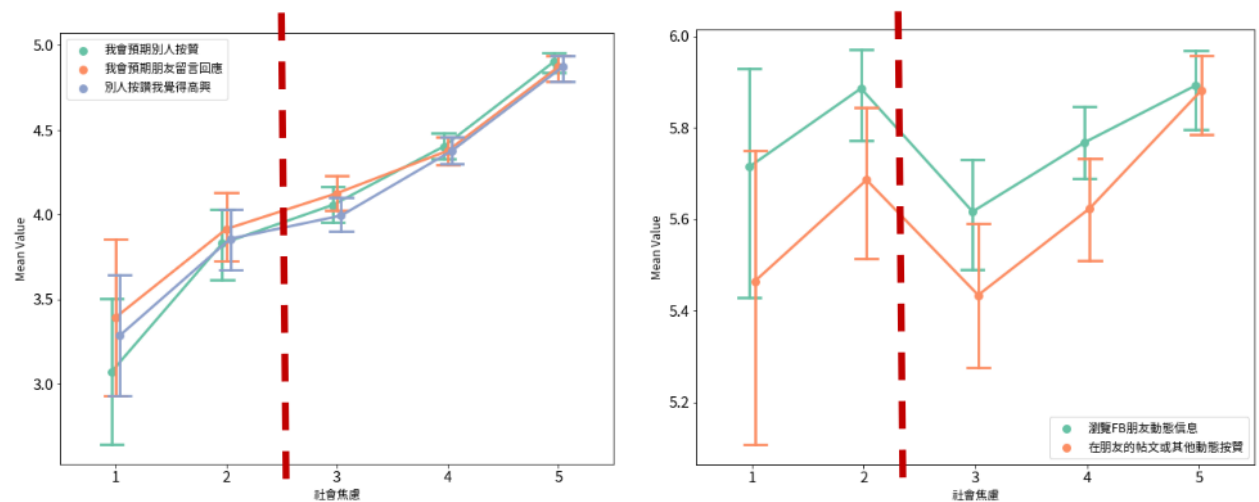
FIGURE 5 and 6: Beyond the level 3, the anxious act correspondingly to their expectation (the projection).

This is what the payoff matrix is going to look like by playing with our projection:

The Anxious':

		The other (The user's Projection)	
		Like	Not Giving Like
The user	Like	A, A	-B – t*Anxiety Level, A+k*Anxiety Level
	Not Giving Like	A + k*Anxiety Level, -B-t*Anxiety Level	- n*Anxiety Level, -n*Anxiety Level

The Independents':

		The other (The user's Projection)	
		Like	Not Giving Like
The user	Like	A, A	-B, A
	Not Giving Like	A, -B	0, 0

And the Indifferent:

		The other (The user's Projection)	
		Like	Not Giving Like
The user	Like	A, A	0, A
	Not Giving Like	A, 0	0, 0

To solve for the equilibrium:

We know that there are 3 equilibria in the case of the anxious',

2 pure strategy equilibria: (Like, Not Giving Like) & (Not Giving Like, Like)

And another1 in mixed-form: The user expects the other (his projection) plays "Like" with

$$q = \frac{B + (t - n + k) * Anxiety\ Level}{B + (t - n - k) * Anxiety\ Level} = p$$

while he plays p = q correspondingly, p and q correlate positively to the anxiety level.

3 equilibria in the case of the independents,

2 pure strategy equilibria: (Like, Like) & (Not Giving Like, Not Giving Like)

And another 1 in mixed-form: The user expects the other (his projection) plays "Like" with q=1 and he plays "Like" with p=1

5 equilibria in the case of the indifferent's,

4 pure strategy equilibria: All of the four conditions

1 in mixed-form: $0 \leq p \leq 1$

We have solid pieces of evidence that:

- Based on the anxiety level, we can cluster out two groups of users: the anxious and the not anxious.
- For the anxious type, we can see that they expect how others would act and how they actually act on Facebook in accordance to anxiety level —— the greater the anxiety, the more often that they would "Like" on Facebook.
- For the not anxious type, we can further cluster out two groups of people: the independent type and the indifferent type and they act similarly to our descriptions and predictions.

3. The Facebook Users Profiling

1. **The Anxious:**

   The model predicts that p = q, p and q correlate positively to the anxiety level. In other words, the greater the anxiety, the more often that they would "Like" on Facebook, in exchange for the others' approval and recognition.
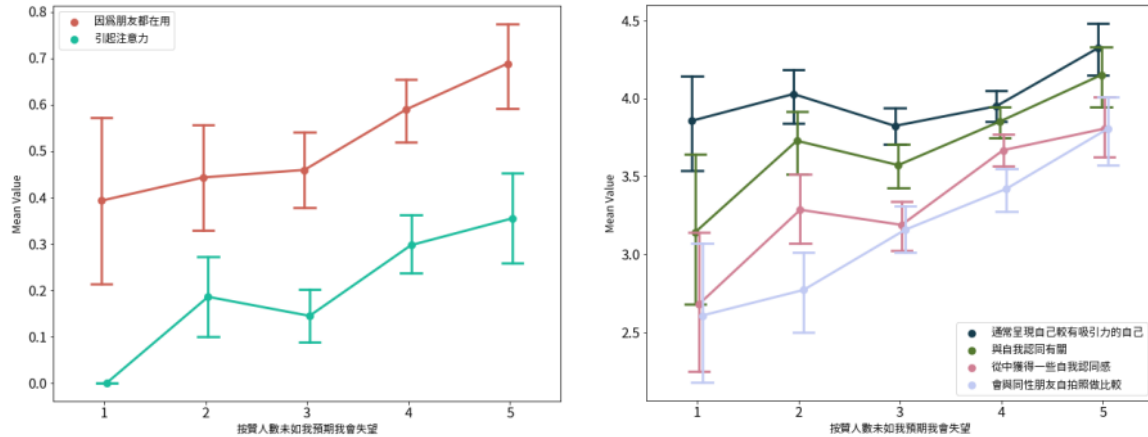

Figure 7 and 8: From these graphs, it's notable that the greater anxiety correlates with the motives to impress or draw attention from others and they would more relate their posts to their identity.

2. **The Not Anxious's (The Independent's & the Indiffetent's):**

   The model predicts that for the independent's, p = 1 while the indifferent's, $0 \leq p \leq 1$. In other words, the independent would love to "Like" on Facebook, while the indifferent's are unpredictable as their psychological payoff does not correlate to the others' actions.

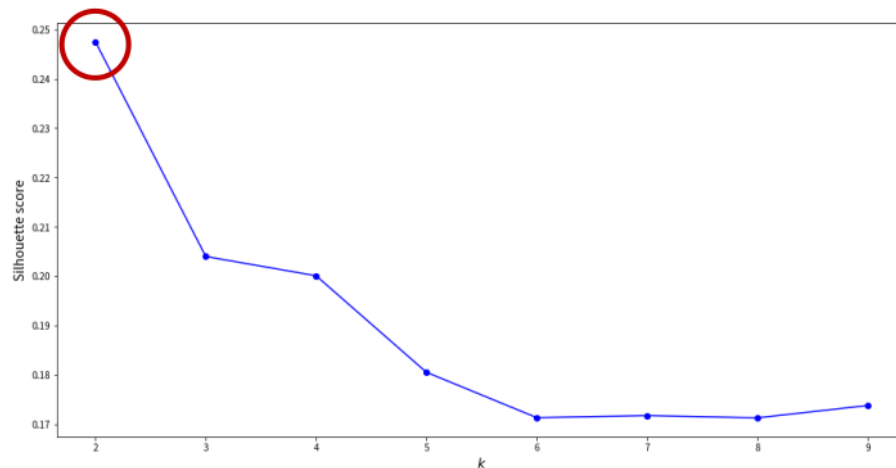   K-means clustering method is used to cluster these two populations:

Figure 9: We could see from this Silhouette Score that there are 2 clusters within the pool of not anxious type, which is data-driven-ly solid evidence.
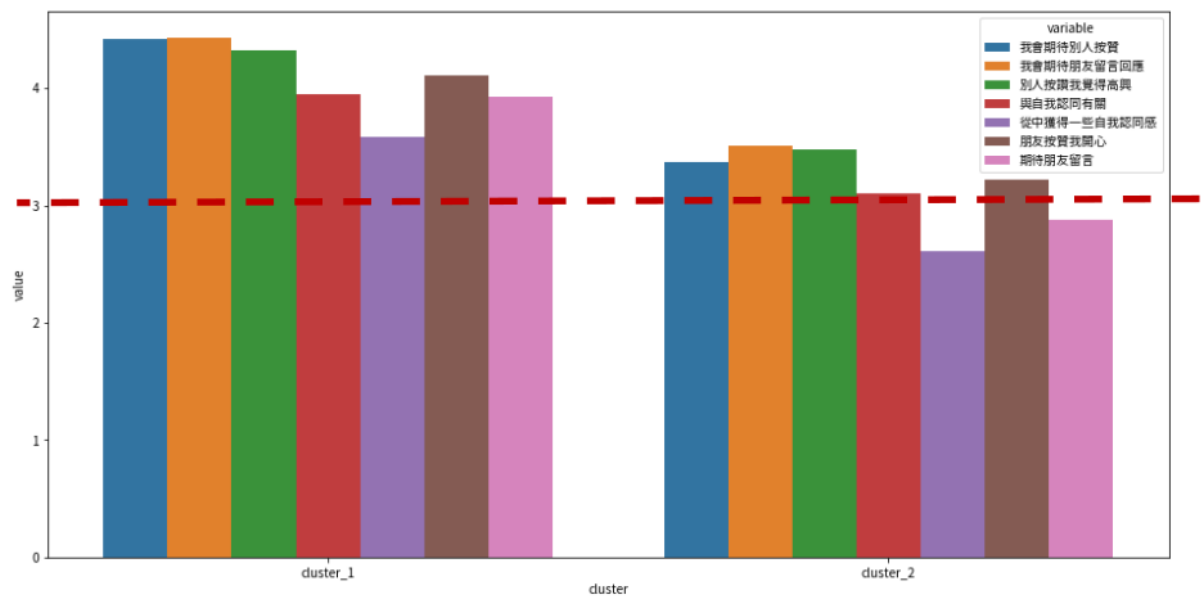
Figure 10: Based on these features we manage to find 2 clusters and grasp the image of the Independent (Cluster 1) and Indifferent types (Cluster 2).

We can infer that the independents' are generally open to novel experiences, and accept the comments from others while not overreacting to them. They love social approval but do not crave for it. The image on social media is congruent to their realities' and it relates to their identity. They "Like" spontaneously, instead of in exchange for the other's "Likes".
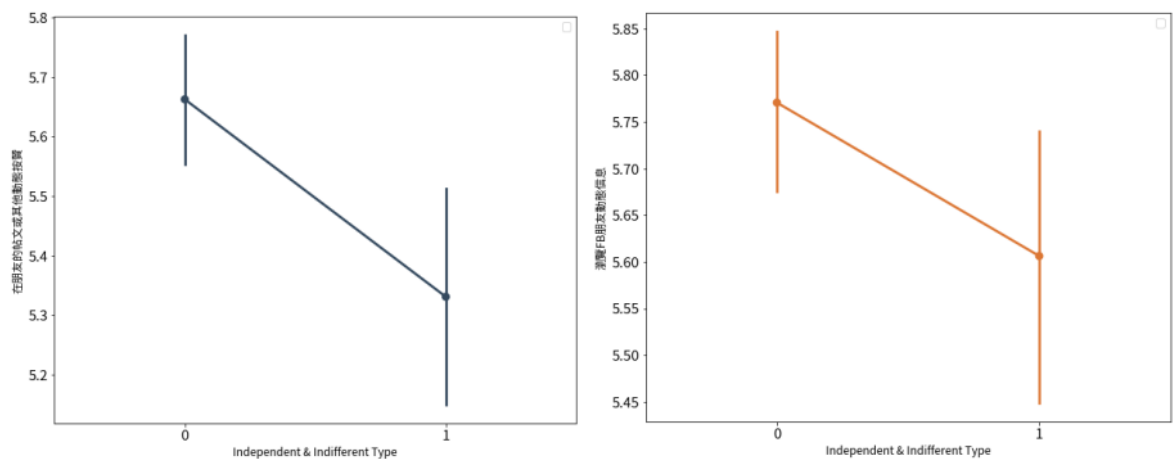

Figure 11: The "Liking" behaviours of the independent and indifferent type of users.

The independent cluster shows a greater tendency in "Liking" and "Leaving Comments" (p = 1); the indifferent cluster is generally more dispersed in these acts ($0 \leq p \leq 1$).

4. Practical Implications

Academically, the try of blending Game Theory and Psychology is novel and inspiring, mathematical formulation diminishes the ambiguity and brings about clarity (if not complexity) in the usage and manipulation of these psychological concepts while on the other hand, providing insights through the reframing of the question itself.

Apart from this, this study has its practical value in terms of user profiling and behavioural micro-targeting which could be applied to tons of leagues —— cyber psychological interventions and help or marketing.

Reference

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