Striking **Solidarity:**

Cooperation of UC Post-docs & Academic Researchers Can Aid

Graduate Students and Teaching Assistants and Result in More Noteworthy Strike

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Abstract

This paper builds a Bayesian game to model the ongoing strike throughout the UC system and the potential decisions of Post-docs and Academic Researchers (PD&AR) in regards to obtaining their goals of pay increases and other professional benefits for themselves and for others within the UC system. Our game considers PD&AR as either a high cooperation or low cooperation type, with each type corresponding to a different willingness to stand in unity with their fellow strikers. The resulting perfect Bayesian Nash equilibrium from this game is either a pooling or semi-separating equilibrium, depending on the probability of the two types of PD&AR. If the probability PD&AR is high cooperation is at least $\frac{1}{3}$, there is a pooling equilibrium where both types of PD&AR will choose to strike. If instead there is a low chance that PD&AR is high cooperation, there is a semi-separating equilibrium where the high cooperation type PD&AR always strikes, while the low cooperation type PD&AR mixes between striking and taking an offer just for themselves from the UC.

Background & Introduction

Today, unionization on college campuses across the United States are on the rise. Just twenty years ago, many universities and even the US National Labor Relations Board (NLRB) did not acknowledge graduate students as workers (Rogers et. al, 2013). Instead, they were classified as students, which prohibited them from the right to unionize. In recent years, the acceleration towards unionization has been noteworthy; according to a list compiled by the Washington University in St. Louis Undergraduate and Graduate Student Union, the number of graduate and undergraduate student unions certified by the NLRB or other employment boards has jumped by 50% since 2017—from 40 to over 60—taking the number of students represented from around 90,000 to more than 120,000 (Offord et al, 2022). These unions are not simply added bureaucracy, but instead act as a platform for non-professor university employees to advocate for fairer wages and benefits. In a study by Rogers (2013), they observed that graduate students at unionized universities reported better conditions: improved student-teacher relationships, more academic freedom, and greater economic well-being.[1] For the three ways they measured pay, union members always came out significantly ahead, with the improvement in their gross annual stipend and perceived pay adequacy being significant with $p=0.001$. The rising rates of unionization in college settings suggest that campus labor disputes are likely to become an increasingly relevant issue, and although some groups have been successful in negotiating formal contracts with their employers to enshrine better pay and employee protections, others groups have taken more direct action to speed things along: going on strike.

Among on-going strikes in the U.S., the recent University of California (UC) strike involving approximately 50,000 teaching assistants, grad students, post-docs, and academic

[1] Not all of the improved categories were statistically significant with the sample size, however most categories of "Personal Support from their Primary Advisor" were significantly better and every category in relation to pay is significantly better. However after controlling for age, race and region of the US the relationship between gross stipends and unionization is not as dramatic.

researchers is the largest academic strike in American history (Gurley, 2022). In this paper, we model the UC strike as a Bayesian game, with academic researchers & post-docs and UC administration being the main players. We present a solution to the game in the form of a perfect Bayesian Nash Equilibrium, as well as the implications of the game. This paper further explores the role of cooperation and signaling in strikes as a result of unions, and how the pre-game period can influence the likely outcome of the strike. Finally, we briefly discuss potential policy implications of our model along with caveats of its real-world applicability.

Context of the Game

On November 14, 2022, almost 50,000 teaching assistants, grad students, post-docs, and academic researchers at schools in the University of California system went on strike. This ongoing protest was primarily sparked by the low wages for non-professors, high costs of living—exacerbated by inflation pressures—and a persistent housing shortage in California (Karlamangla, 2022). Currently a majority of the strikers pay over 50% of their incomes on housing, classifying them as severely rent burdened. The protesters, represented by four United Auto Workers (UAW) bargaining units, are: academic student employees, graduate student researchers, postdoctoral scholars, and academic researchers. They are asking for significant pay increases, child-care subsidies, enhanced healthcare for dependents, longer family leave, public transit passes, and lower tuition costs for international scholars (Toohey et al, 2022).

This is the biggest school strike in American history with protesters banding together across the 10 UC campuses and spread between many different roles in each institution. The timing of the strike is strategically interesting: it happened just weeks before finals season, and many of those on strike are in the most "student facing" positions on campus, causing classes to

shut down or go remote. Yet, this interaction did not just start in November. This strike dates back to 2019, when workers at UC Santa Cruz proposed a new wage system that would tie salaries to cost of living in respective communities (Lerner, 2022). As both parties negotiated, the workers' demands from 2019 have been reformulated to stipulate that graduate school students receive an annual base salary of $54,000, with different levels of yearly wage increase associated with cost of living in respective campuses (Lerner, 2022). As of November 29, 2022, 12,000 postdoctoral researchers and academic researchers were able to reach a tentative agreement with the UC administration that included pay increases up to 29% (Lerner, 2022).

The UC strike setting is strategically interesting because of the timing and cooperation involved in this interaction: given that the issues started many years ago, it is intriguing that the students chose to strike now. Additionally, cooperation is vital to this game—the strike is getting heavy media attention due to the sheer number of people striking. This cooperation across campuses and positions allows the strike to get more attention and bargaining power. However, the UC is also already attempting to break up the strike by negotiating with each bargaining bloc separately, in order to gain a better outcome by reducing cooperation in the game. We are modeling the game using the post-docs & academic researchers (labeled PD&AR in our game) as a unified bloc of decision makers, strategically interacting with the UC administration since they are the group that the UC seems most willing to negotiate with. The graduate students and teaching assistants are being treated as secondary by the UC, meaning they do not have the option of abandoning the post-docs & academic researchers. Meanwhile, the post-docs & academic researchers have more bargaining power because they can indeed leave behind the graduate students and teaching assistants. This is in part due to the scarce pool of post-docs and

academic researchers that universities compete for, whereas graduate students tend to compete for spots at universities.

This problem is non-trivial primarily due to the role of cooperation in the game: when the strikers cooperate across bargaining groups, they have more power. However, each bargaining group has their own specific demands, so if one group's demands are met (e.g. PD&AR), they may not have the incentive to continue to protest for the other groups. Meanwhile, the UC gets better outcomes by reducing the cooperation of the strikers. Before this game, in November 2021, the UC successfully negotiated with lecturers across all campuses. The lecturers obtained 30% pay increases with specific contracts, thereby allowing the UC to avoid the negative media of a strike (Alfred, 2021). Now, the UC is attempting to resolve the current strike by negotiating with each bargaining bloc separately and prioritizing PD&AR, in order to reduce cooperation and to incentivize some protesters to stop striking and leave the remaining strikers with less power.

There is no easy answer to this strike for either player. The UC likely cannot afford to meet every single demand for every single striker (and they do not want to set such a precedent). If the UC chooses to break the strike by only providing wage raises to a small subset of workers, they may be subjected to the possibility of future strikes, which could have further detrimental effects on UC schools' operations, talent attraction, and academic reputation. If the UC administration wants to solve the pay system issue permanently, they would need to adjust their budget both in the short-term and long-term to meet such a goal. For the strikers, even though they are paid from a strike fund during the strike, it's less money than usual. Thus, the strike is not sustainable in the long-term for the strikers. However, if the strike goes completely unresolved, it means the strikers have an incentive to organize again and further damage the UC's

reputation with even more negative media coverage. Thus, it is in neither the UC's nor the strikers' favor to continue striking indefinitely or to leave all issues unresolved. Therefore, in our model, the UC does not have the option to completely ignore the strike and must instead enter into negotiations with all of the strikers or specific bargaining blocs.

Besides having the choice to negotiate a deal with all the strikers or a particular subset of strikers, the UC is subject to asymmetric information as it doesn't know how strong the cooperation of the strikers is, adding a Bayesian element to the game. Nok Chun et al's (2020) review of recent economic literature for why strikes occur suggests that workers can be modeled as having two types of identities: individualistic or in unity with the union. They find that when there is solidarity based on identification with the union, strikes can occur. If the cooperation of PD&AR is low, then by negotiating directly with this group, the UC may get them to leave the strike, thus reducing the bargaining power of the remaining groups to almost nothing. This is a good outcome for the UC, since they can end the negative media attention by spending a minimal amount to stop the protests. On the other hand, there is a chance that the strikers are playing with a high amount of cooperation. In this case, the UC would waste their time by attempting to deal with each group individually, since they will all continue to strike together, which would only prolong the negative media attention. With the timing of this strike, if it continues on for too long, the UC may lose out on talented grad students and undergrads who may choose a different school with less controversy.

While the game models the strategic interaction between PD&AR and the UC, there is also a pre-game stage. In this pre-game stage, the UAW tries to build solidarity among the various bargaining groups so that there is practical organization and robustness to ensure the groups can strike successfully. In a game theoretic analysis of the biracial strikes on steel

companies in 1919, Brown and Boswell (1995) found that cities with a history of successful union activity had a higher probability of experiencing solidarity between Black and White workers during the strike (p. 1483). In their model, Black and White workers with the same employers formed separate bargaining blocs with similar but different demands, just as the post-docs and academic researchers have congruent yet differing demands than the grad students and teaching assistants in the UC strike. In the pre-game stage of the UC strike, the UAW is the union that attempts to build solidarity between PD&AR and other student workers in order to increase the probability that the high cooperation version of the game is played (leading to better outcomes for all the strikers instead of individual bargaining groups).

Modeling the UC Strike as a Bayesian Game

Players:

- PD&AR (type C_L–Low Cooperation; type C_H–High Cooperation)
- UC

Actions:

- Each type of PD&AR can choose to either accept to the deal on the table or join the strike with the other protesters.
- If PD&AR chooses to join the strike, then UC can choose to continue to attempt private negotiations with PD&AR or they can enter into negotiations with all of the strikers.

Payoffs:

- C_L PD&AR:
    - Strike:
        - UC decides to maintain the status quo offer (proposed to pdar):

- Accept gives PD&AR a payoff of 50 because the low cooperation type would be decently happy as long as they get a pay raise, even when they have to strike. Accepting here is worse than if PD&AR took the offer right off the bat because they went on strike, so they got paid less while on strike.
- Don't accept gives PD&AR a payoff of -100 because not accepting the offer means that they are not gaining any benefits, and they had to suffer the toils of going on strike.

■ UC decides to extend the offer to all strikers:

- Accept gives PD&AR the highest possible payoff of 100 because all the strikers obtained a better offer.
- Don't accept gives PD&AR the worst possible payoff of -100 because not accepting the offer is irrational—there is no reason to not accept an offer that benefits all strikers.

○ Take offer: If PD&AR takes the offer on the table, they get a payoff of 75, the second highest possible payoff. Since PD&AR is the low cooperation type, they are not as invested in well-being of grad students and teaching assistants, so they are very happy that they got their demands met.

- C_H PD&AR:
  - Strike:
    - UC decides to maintain the status quo offer (pdar):
      - Accept gives PD&AR a payoff of 25 because although they gain some satisfaction from getting their demands met, they feel bad for

abandoning the grad students and teaching assistants. However, accepting here gives PD&AR a better payoff than if they just took the deal right off the bat, because PD&AR feels better that they at least attempted to stand in solidarity with the grad students and teaching assistants by striking.

- Don't accept gives PD&AR a payoff of 50 because the high cooperation type PD&AR cares about the well-being of grad students and teaching assistants so they would rather hold out instead of accepting an offer that only benefits themselves.

■ UC decides to extend the offer to all strikers:

- Accept gives PD&AR the highest possible payoff of 100 because all the strikers obtained a better offer.
- Don't accept gives PD&AR the worst possible payoff of -100 because not accepting the offer is irrational—there is no reason to not accept an offer that benefits all strikers.

○ Take offer: If PD&AR takes the offer on the table, they get a payoff of just 10 because although PD&AR is satisfied that they got their demands met, they feel bad for not trying to help the grad students and teaching assistants also get their demands met. Since PD&AR is the high cooperation type, they care about the well-being of the grad students and teaching assistants.

- UC:

○ If PD&AR accepts the deal without going to strike, the UC gets a payoff of -10. This is a negative payoff because they lose money by submitting to some of the

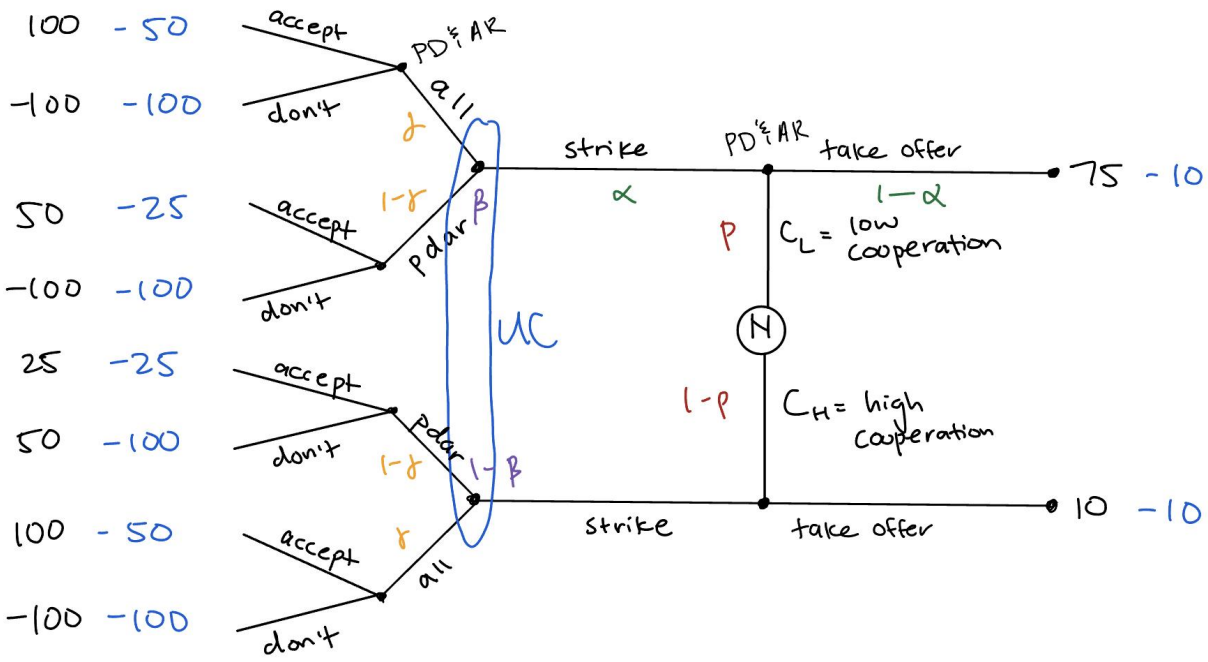
demands of PD&AR but they avoid the negative media attention of a strike. This is the best possible outcome of the game for UC.

- If PD&AR chooses to strike and does not accept the deal offered by the UC (either just to PD&AR or to all of the strikers), then the UC get's a payoff of -100. This is their worst outcome of the game because it leaves the strike unresolved, leading to more negative media attention and further disputes between the strikers and the schools.
- If PD&AR chooses to strike and accepts the offer just to negotiate for PD&AR's benefits, the UC gets a payoff of -25. This is worse than if PD&AR had just accepted the offer, because the school takes on the cost of the negative media of the strike, but they end the strike with only the added costs of improving PD&AR's salaries.
- If PD&AR chooses to strike and accepts the UC's offer to negotiate with all of the strikers, the UC gets a payoff of -50. The strike is still resolved, but the UC incurs the costs of both the strike and also the increased pay/benefits of all parties striking.

Information:

- PD&AR knows their type and moves first.
- The UC does not know what type PD&AR is, though they see whether they choose to strike or negotiate right off the bat.

Using a stylized approach, we can model the game as shown below:



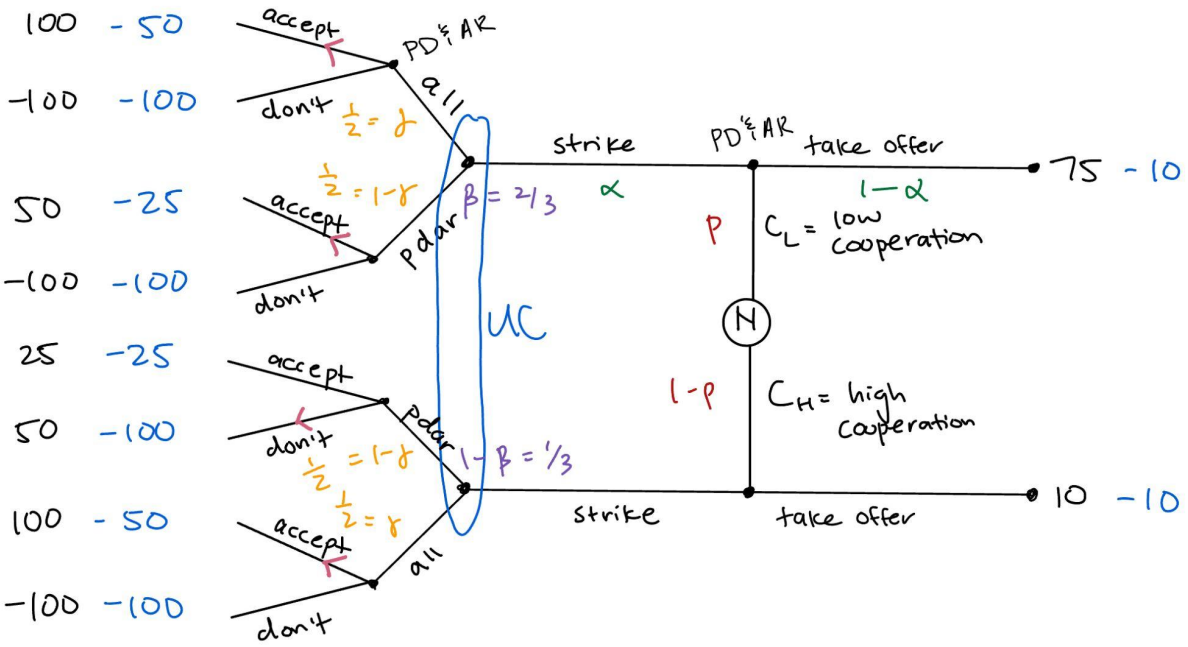
In the main portion of the game, we model the situation as if there is already a deal on the table for PD&AR to accept if they would like. Then, depending on whether PD&AR is high or low cooperation (how much they care about the benefits of graduate students), they choose whether to take this offer or go on strike. The UC, without knowing which type PD&AR is, then decides whether to attempt to break the strike by negotiating just with PD&AR, offering the same deal as before, or to negotiate with all of the strikers. This model makes sense, because PD&AR know their importance to the UC system, so they know they can automatically enter private negotiations if they would like.

Solution to Game

The correct solution to this game is a perfect Bayesian Nash equilibrium. First, we note that there is no separating equilibrium in the game. Notice that if PD&AR is high cooperation,

then their dominant strategy is to strike. Thus, if a separating equilibrium did exist, the low cooperation type would have to take the offer. In this case, if the UC gets to their information set, they would believe that they are at the lower node of their information set with probability $1-\beta=1$. In turn, the UC will play all as they know that the high cooperation PD&AR would not accept the pdar only offer. However, this is not a Nash Equilibrium because the low cooperation type would have an incentive to deviate and effectively masquerade as the high cooperation type. Knowing the UC will play all, the low cooperation type would rather strike and then accept the offer to negotiate with everyone, leading to their best outcome of the game: a payoff of 100 versus the payoff of 75 they get by taking the offer without striking. This lack of a separating Nash Equilibrium is reasonable in our game, because the UC is not immediately submitting to the strikers' demands. In other words, the UC seems to believe that there is a probability that the PD&AR involved in the current strike may be the low cooperation type.

Depending on the value of p, the probability PD&AR is low cooperation, there could either be a pooling equilibrium or a semi-separating equilibrium. We define α to be the probability that the low cooperation type strikes, noting that the high cooperation type will always choose to strike. Similarly, β is the probabilistic belief the UC has that they are playing a low cooperation PD&AR and γ is the probability that the UC plays all. Using the red arrows on the tree below, we note that if PD&AR chooses to strike, a low cooperation PD&AR will accept any offer to negotiate by the UC and a high cooperation type will only accept a deal that benefits all of the strikers. We show our calculations for the BPNE of the game below.



We begin by solving for the semi-separating equilibrium of the game, where the low cooperation type of PD&AR mixes. In this equilibrium, to keep the low cooperation type indifferent among their pure strategies, $\gamma = \frac{1}{2}$ so the low cooperation PD&AR will mix.

EU (UC | pdar) = β(-25) + (1 - β)(-100) = -75β

EU(UC | all) = -50

In order for the UC to be indifferent between their strategies, and thus willing to mix, we need

EU (UC | pdar) = EU(UC | all) → -75β = -50 → $\beta = \frac{2}{3}$

Now we can solve for α given p. Using Bayes' rule, we know

$$\beta = \frac{2}{3} = \frac{p\,\alpha}{p\,\alpha + (1-p)}$$

→ 2 (1 - p) = pα

$$\rightarrow \alpha = \left(\frac{2(1-p)}{p}\right)$$

Additionally, observe that

$\rightarrow 2(1 - p) = p\alpha$

$\rightarrow 1 = (\frac{\alpha}{2} + 1)\, p$

$\rightarrow p = (\frac{2}{\alpha + 2})$

Since we are solving for a semi-separating equilibrium, we assume $\alpha < 1$. Thus, in the semi-separating equilibrium, $p \geq \frac{2}{3}$. $p = \frac{2}{3}$ is the "switch-point" between the pooling and semi-separating equilibria.

If $p < \frac{2}{3}$, we have a pooling equilibrium where both types of PD&AR strike. In this case, $\beta = p$ according to Bayes' rule, and so

EU (UC | pdar) = $p(-25) + (1 - p)(-100) = -75p \geq -50$ = EU(UC | all).

Therefore, the UC will always choose to negotiate with all of the strikers and each type of PD&AR will accept this offer.

In summary, if $p < \frac{2}{3}$, the game has a pooling equilibrium where $S(C_L)$ = strike and always accept, $S(C_H)$ = strike and only accept all, and S(UC) = all, with beliefs for the UC described as above. If $p \geq \frac{2}{3}$, the game has a semi-separating equilibrium where $S(C_L)$ = strike with probability $\alpha = (\frac{2(1-p)}{p})$ and always accept, $S(C_H)$ = strike and only accept all, and S(UC) = all with probability $\beta = \frac{2}{3}$, with beliefs for the UC described as above.

Both solutions are realistic for our game. If there is a relatively high probability that PD&AR is high cooperation, it is risky for the UC to try to break the strike by negotiating with just PD&AR since they may get their worst outcome. Thus, it is in the UC's best interest to negotiate with all of the strikers. However, this is not what we are seeing play out in the ongoing

interaction between the UC and the protesters since it is likely p is high. With 12,000 people in PD&AR, who are spread across 10 different campuses and each battling their own struggles to afford the cost of living in California, it is likely that PD&AR is low cooperation. In this case, the semi-separating equilibrium occurs, as a low cooperation PD&AR can sometimes reach their best outcome by pretending to be high cooperation.

Discussion

The game solution of two possible equilibria depending on employee cooperation supports the results of a previous study on unions and solidarity, which finds that strike likelihood is only bolstered by the co-presence of union presence and previously established worker solidarity (Dixon et al., 2004). Dixon et al explained that while classic literature on social perspectives of unionization agrees on its importance in fostering collective action and mobilizing workers of decentralized entities, worker solidarity is a factor usually neglected. They noted that worker solidarity may in fact be mutually-reinforcing with union presence in facilitating strikes. Although worker solidarity in the study refers to what is already established on the shop floor, as the study focuses on industrial literature and data, the definition of worker solidarity as formed by "day-to-day experiences," "grievance sharing," and "perceptions of the workplace, fairness, and justice" aligns with our intuition in modeling the game and its respective outcomes (Dixon et al., 2004). This solidarity between university employees being connected with unionization is further shown by Rogers et al. (2013), who demonstrate that graduate students and teaching assistants report stronger relationships with their professors at unionized universities.

In order to further understand the role of already established worker solidarity in facilitating strike action, we assess our logic in assigning low and high cooperation types to PD&AR. If PD&AR share common social experiences and grievances that are often discussed with students and teaching assistants, then they are of high cooperation as they feel a sense of solidarity with each other. This is plausible given the economic climate of California, such as high costs of rent and transportation, inflation, as well as the social environment of the UC system itself, which presents numerous shared difficulties. Therefore, our model and results of the game reflect potential equilibria where the high cooperation type of PD&AR will always choose to strike. Conversely, if there is no strongly established solidarity between PD&AR and other employees, perhaps due to different grievances, workplaces, schedules, and seniority, then PD&AR will be a low cooperation type who are sometimes likely to accept UC's pdar only offer instead.

PD&AR starts the game knowing their own level of cooperation, in other words, understanding their already established solidarity. The outcomes of the game depend on their level of cooperation, and this resonates with the study that worker solidarity and unionization are mutually reinforcing in facilitating strikes. Our model can be applied to real-world settings in relation to the importance of unions aligning interests of different worker entities in universities. Our game showcases that information regarding established solidarity is crucial in predicting strategies and outcomes. There is a question of how applicable our finding with the UC strike might be to other strikes, as non-professors at universities occupy a gray-area between employees and students. However, Rogers et al. (2013) compares this to an apprentice relationship, so our model of a strike may be applicable in other fields where there is a long

learning process, such as in trade fields where the apprentice is both learning and producing value for their mentor.

It is worth pointing out that game theory is not descriptive; rather, strategies described in equilibrium are conditional on the rationality of different players (Colman, 2003). In fact, Camerer (1997) proposed the concept of behavioral game theory to potentially achieve better predictions in real world applications. Fairness equilibrium is such an example. In fairness equilibrium, game theorists adjusted the payoff based on whether one player acted kindly or helpfully to the other player (Rabin, 1993). More specifically, a variable, such as α, was introduced to quantify the payoff adjustments; player 1's payoff improves by α proportion of player 2's payoff if player 2 acts partially in the interest of player 1, while player 1's payoff worsens if player 2 acts against the interest of player 1 (Rabin, 1993).

In the context of this paper, if we include graduate students and teaching assistants (the less-prioritized subset that made up ~70% of the protesters) as a third player in the game, the concept of fairness equilibrium could potentially change the solution to this game, dependent on the value of α. This will make our game even more strategically interesting, because based on how helpful the grad students and teaching assistants are to PD&AR in terms of escalating the size and intensity of the protest, it can affect willingness of PD&AR to remain in solidarity with them instead of taking the proposed offer from UC. Interaction of high vs low cooperation type and fairness equilibrium could thus potentially improve the applicability of our model in real world settings.

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