A comprehensive agent-centric approach to collective action

Abstract. Collective action is integral to human social activity. There are two major problems involved in collective action: participation and strategy agreement. Common solutions to these problems are centralized coercion, distributed heuristics, and opinion polling. While each is effective at solving aspects of collective action problems, each has drawbacks. I propose a collection of voluntary, agent-centric solutions to overcome these drawbacks: threshold-contingent commitments, equifinality-driven consensus and mutual goal-mapping.

1. Introduction

Virtually all social and political behavior can be described as forms of collective action. Also referred to by terms such as joint action, coordination or collaboration, the ability for a group to behave in a harmonious or synchronized manner allows individuals to use the synergistic power of collectives to meet their own needs. Achieving collective action is the primary function of governments, corporations and all organizations. Collective action dynamics are implicated in numerous scenarios, from day-to-day social interactions, to economic development and global action on climate change. A summary of the magnitude of this subject is provided in *Understanding Joint Action: Current Theoretical and Empirical Approaches*:

> *Joint actions form an integral part of the human experience, be it by fostering social connection and providing expressions of culture, or by extending the limits of our own bodies to accomplish goals we could not accomplish alone. The pyramids, the Eiffel Tower, or the grocery store down the street only exist due to the planning and coordination of joint actions across many individuals. By engaging in joint actions, people have made our world what it is today (van der Wel et al., 2021).*

Collective action is so important to human life that groups will go to horrifying extremes to achieve it. Hardin (1995) argued that nationalistic and ethnic superiority can be explained, at least in part, by their effectiveness at coordinating large groups:

> *Nationalism is often used as a means to mobilize a population for war, both during war and, often, in preparation for war. For example, the Nazi leadership first used nationalist appeals to mobilize the German people and then went to war. During that war, of course, they continued to use nationalist appeals … the popular nationalist intensity was heightened by national leaders as a means to mobilize for war. Such mobilization makes sense because coordination of a large population is a form of power. The ideal level of coordination for a government interested in fighting a war is likely to be at or near the whole-nation level.*

A similar phenomenon may exist for fervent and erroneous conspiracy theories. Marie & Petersen (2022) suggest that the tendency for groups to believe and perpetuate conspiracy theories and hard-to-falsify narratives may serve a function of coalition-building and more effective collective action:

> *Because conspiracy theories contain threatening information and are hard to refute, their public dissemination may help accomplish multiple coalitional goals, in ways that mutually benefit senders and receivers. Sometimes, asserting a conspiracy theory may succeed at persuading the audience of an impending threat in the sense of increasing individuals' willingness to take costly collective actions against the conspirators (which the brain would perceive as benefitting everyone in a group, just as mobilization against enemy tribes would have been ancestrally).*

Despite its enormous impact on human life, however, the subject of collective action is not a common topic of debate within real-world groups, and strategies for achieving collective action frequently emerge outside the realm of conscious choice. The most popular solutions tend to rely on a few consistent principles, which are somewhat functional, but imperfect. By revealing the major problems of collective action and analyzing popular solutions, new systems can be developed that overcome the pitfalls of conventional ones.

2. Problems of collective action

Small groups of people can typically work toward shared goals without formal structures or systems. Large groups, however, often run into issues. One early description of this phenomenon comes from David Hume's 1739 "A Treatise of Human Nature":

> *Two neighbours may agree to drain a meadow, which they possess in common; because 'tis easy for them to know each others mind; and each must perceive, that the immediate consequence of his failing in his part, is, the abandoning the whole project. But 'tis very difficult, and indeed impossible, that a thousand persons shou'd agree in any such action; it being difficult for them to concert so complicated a design, and still more difficult for them to execute it; while each seeks a pretext to free himself of the trouble and expence, and wou'd lay the whole burden on others.*

In this thought experiment, Hume identifies two major difficulties in achieving collective action: agreeing on strategy and ensuring participation. These two problems appear whenever groups attempt to work together. Addressing each one in turn, it is possible to investigate their cause and discuss their solutions.

2.1 Participation

One major challenge in organizing groups is the problem of convincing individuals to participate. Even in circumstances where working together would clearly benefit everyone, and where this benefit would clearly outweigh the cost of participation, individuals often choose not to participate due to a principle commonly known as the "collective action problem".

The first detailed description of the problem is found in Mancur Olson's (1965) "The Logic of Collective Action," where he argues that in large groups, individuals tend not to work toward collective goods without individual incentives, because it is irrational for them to do so. This theory is based on the notion that "What a group does will depend on what the individuals in that group do, and what the individuals do depends on the relative advantages to them of alternative courses of action." To achieve a collective good, he explains, individuals in a group must choose to contribute toward that good. However, if the good is

public, in that it is consumable by individuals regardless of whether they contribute, it is usually in the interest of an individual to let others contribute and "freeload" off of their labor. By following this calculation, no one will contribute. Groups in which cooperation would result in a benefit for each individual, but which do not cooperate are labeled by Olsen "latent".

An exception to this problem that Olson identifies is in groups or individuals for whom the collective good is so beneficial that it outweighs the cost of contribution even if no one else contributes. He labels these "privileged groups". Another exception is a group small enough that should one person fail to contribute, others will notice and also choose not to contribute. In this scenario, labeled an "intermediate group," the threat of non-participation from others can motivate an individual to contribute.

2.2 Strategy agreement

Even if a group is capable of mobilizing itself, members may disagree on what action to take. This disagreement can result in a group failing to execute any strategy. Often, members share common goals but cannot mobilize due to disagreement about optimal strategy or cost sharing. This is often the basis for intra- and inter-group conflict. This conflict can be as minor as a preference for different strategies, and as consequential as the cause of war.

3. Common solutions and their pitfalls

3.1 Centralized coercion

One system for collective action in latent groups is for a privileged or intermediate group to use its collective power to coerce a larger group into behaving collectively. This solves the problem of individual participation by creating artificial incentives (rewards and/or punishments) which alter individuals' cost-benefit calculation. It solves the problem of strategy agreement by placing the choice about strategy in the hands of an individual or group small enough to easily agree on strategy.

One major problem with centralized coercion is that the preferences of individuals outside of the controlling individual or group have no direct impact on the strategies engaged in by the group. While those individuals do consciously choose to engage in the collective action, their choices are disconnected from the result of the collective action. Because of this fact, the choices about group behavior are unlikely to reflect the motivations of anyone outside the controlling individual or group, and any good which results from the collective action is unlikely to benefit most of the group's members.

Another major problem is that coercion creates misaligned incentives for actors. If their personal goal is different from the goal of the collective action, they may find a way to achieve the former while sabotaging the latter. If this provides any benefit to the individual, they are in fact likely to do so. It is often very difficult to create artificial incentives that direct individual behavior in such a way as to effectively simulate the goal of a collective action.

3.2 Distributed heuristics

A second tool for collective action is the distribution of a set of behavioral heuristics throughout a population. These may take the form of moral or ethical codes that individuals are convinced to adhere to by punitive reinforcement or social indoctrination. This system solves the problem of individual

participation, as does centralized coercion, by creating individual incentives to contribute to public goods or otherwise engage in collective action. It avoids the problem of individuals or small groups directly exploiting the larger group by taking group decisions out of the hands of any individual. But in doing so, it takes group decisions away from any conscious decision or choice at all. Therefore, members' goals still do not directly impact decisions about collective action, and their will is not reliably implemented. Instead, these heuristics are created by a complex combination of cultural trends, tradition, average opinion over time, and influential leaders who convince large numbers of people to alter their personal heuristics. Furthermore, even if the results do benefit a majority of the group, they are unlikely to quickly and dynamically adapt to changing circumstance.

3.3 Opinion polling

A common attempt to introduce popular control over collective action is to use opinion polling as the basis for decisions around collective action. These polls are usually designed to have a conclusive result and result in unified group behavior. This can take the form of majoritarian voting or consensus systems.

Opinion polling solves the problem of strategy agreement by creating a definitive answer to disagreements about strategy, and basing this decision on the greater opinion of the group. The first downside of this system is its failure to solve the problem of participation. Instead, it usually relies on some combination of centralized coercion and distributed heuristics to ensure its results are realized. This makes it ultimately subject to the drawbacks of those systems. If the heuristics of the population, or the goals of the enforcing group misalign with the goals of the larger group then the results are unlikely to be implemented in good faith, or at all.

Another drawback of this system is that it only provides a system for choosing between strategies, not for inventing strategies that have maximum support. In majoritarian systems, this can lead to decisions supported by a small majority in situations where a far larger majority could have agreed under a different strategy. In consensus systems, this prevents any new changes from being made until full agreement is possible, which favors existing solutions over new ones.

4. Proposed alternative solutions

The following solutions are designed to overcome the pitfalls of previously described options by being agent-centric and adaptable to change. They do not rely on coercion to incentivize participation, and they do not rely on rigid heuristic prescriptions for behavior. Instead, they utilize the rational decision-making capacity of free agents to achieve social harmony via mapping shared goals, increasing agreement about strategies and increasing voluntary participation in those strategies.

4.1 Threshold-contingent commitments

This section describes a solution for Olson's collective action problem described in section 2.1.

4.1.1 Theoretical framework

In his explanation of the collective action problem, Olson distinguishes three groups with regard to their capacity to achieve shared goals: privileged, intermediate and latent groups. Privileged groups contain members who are willing and able to bear the entire cost of achieving a shared goal. Intermediate groups

are small enough to allow feedback to members about the behavior of other members. In Intermediate groups, when an individual member decides not to participate in a collective action, other members may recognize that participation is no longer in their interest and also choose to not participate. This threat of non-participation by others dis-incentivizes non-participation by the individual. Latent groups are groups for which the benefit of collective action to each participant outweighs the cost of their participation, but which fail to operate collectively because members do not know whether other members will also participate. Therefore, in latent groups collective action is rational, but individual action is irrational.

In support of this notion, several studies have found a negative correlation between group size and the effectiveness of cooperation between humans (Alencar et al., 2008; Duffy & Xie, 2016; Hamburger et al., 1975). This effect has also been observed in bird flocks (Papageorgiou & Farine, 2020). But while Olson appears to be correct in his assertion of a relationship between group size and propensity for collective action, according to his reasoning latent groups are only incidentally defined by their size, while their primary distinction is individual members' insufficient access to information about the behavior of other members. The deciding factor of latency, then, would be a group's common knowledge about the behavior of its members.

Various fields of research support a link between cooperation and an individual's ability to predict the behavior of other members. In human crowds, self-organization is more likely to occur when individuals can predict the behavior of other members (Murakami et al., 2020). A neurological association has been found between participating in collaboration and activity in brain regions involved with understanding the intentions of others (Yang et al., 2021). Finally, artificial intelligence models achieve more efficient cooperation when they incorporate theory-of-mind to better predict the behavior of other agents (Murakami et al., 2020). Together, these findings provide evidence for a relationship between individual group members' ability to predict other members' behavior and the group's probability of successful collective action.

Olson calls to the ability to predict the behavior of other members "noticeability". He mentions that while it seems unlikely, a group could in theory artificially increase noticeability to overcome latency:

> *The standard for determining whether a group will have the capacity to act, without coercion or outside inducements, in its group interest … depends on whether the individual actions of any one or more members in a group are noticeable to any other individuals in the group … The noticeability of the actions of a single member of a group may be influenced by the arrangements the group itself sets up. A previously organized group, for example, might ensure that the contributions or lack of contributions of any member of the group, and the effect of each such member's course on the burden and benefit for others, would be advertised, thus ensuring that the group effort would not collapse from imperfect knowledge. I therefore define "noticeability" in terms of the degree of knowledge, and the institutional arrangements, that actually exist in any given group, instead of assuming a "natural noticeability" unaffected by any group advertising or other arrangements.*

Olson views noticeability as essential for dis-incentivizing freeloaders, and a dynamic that may be improved on with the right system. However, Olson questions the possibility of creating such a system, and only provides general assertions about its possibility. Olson also fails to provide a fully fleshed-out

game-theoretical explanation of the effect of noticeability on collective action. Therefore in order to utilize this concept, I will first expand on it.

In most public good scenarios, there is a threshold (T) of participation (N) at which a payoff becomes available, or more importantly, becomes greater in value (V) than the cost to a player (C). When players know this threshold, and can reliably predict the behavior of others, they are able to determine the bayesian probability (P) that their own behavior will contribute to achieving that threshold. If the threshold appears unlikely to be met, participation will result in wasted effort. If the threshold appears likely to be met, it is in the interest of each player to freeload. However, if participation from a player appears likely to make the difference between meeting or not meeting the threshold, there will be ample motivation to participate. Such a calculation can only be made if the behavior of other members is noticeable.

If this explanation is accurate, then an increase in cooperation would be seen with (a) the presence of a clear payoff threshold and (b) players' ability to make bayesian predictions about the probability of meeting that threshold before and after their own participation. It is also important to note that in private good scenarios, a threshold may also be present. In these cases, threshold clarity and noticeability may still improve cooperation as it would be rational for players to contribute only if they believe it likely either that their contribution will result in meeting the threshold, *or* that the threshold will be met without their contribution.

The function that determines individual participation can be described for public goods games with the equation $C < V * P (N = T - 1)$, and for private goods games with the equation $C < V * P (N >= T - 1)$. With low noticeability, it is unlikely that players' probabilistic predictions will be high enough to overcome C when multiplied by V. With more noticeability, players have more information with which to make more accurate probabilistic predictions, and the likelihood that the right side of the equation overcomes the left side increases steadily.

This hypothesis is supported by research suggesting that the presence of thresholds in public goods games increases cooperation (Jordan et al., 2017). This effect can also be seen in real-world applications, such as the success of all-or-nothing over keep-it-all crowdfunding (Cumming et al., 2019). Furthermore, common knowledge of thresholds in public goods games has been shown to increase cooperation, and this effect seems to be mediated by the predicted number of group members contributing and confidence about these predictions (Deutchman et al., 2022). That is to say that, when individuals in a group all know that a public good will only be achieved with a minimum threshold of participation, they appear to try to calculate how likely others are to contribute, and therefore how likely that threshold is to be met, and this calculation determines their own likelihood of contributing.

Such a calculation should be expected to become more accurate with open communication. If players discuss their likelihood of contributing, they can assess whether their participation is likely to make the difference in meeting the threshold. If players form an agreement in which each player's participation is pivotal, cooperation would seem likely. In support of this hypothesis, at least two studies have found that when common knowledge thresholds and open communication are combined, groups demonstrate a dramatic increase in successful cooperation (Agastya et al., 2007; Palfrey et al., 2017).

Using this framework, it is possible to invent a model for solving Olson's collective action problem and improving cooperation by using thresholds and participation-related communication to transform latent groups into intermediate groups.

4.1.2 Solution design

The proposed solution is a protocol for individuals to commit to collective action with minimal risk of failure due to non-participation by others and sufficient information to gauge their effect on meeting public good thresholds. This is achieved by creating threshold-contingent commitments that are invalid until a critical mass, or threshold is achieved.

Threshold-contingent commitments are achieved by a collection of individuals each indicating a version of the sentiment "I will if you will." First, someone writes a detailed plan explaining a potential collective action. They include a list of roles that need to be filled, and how many people are needed for each. They specify for each role the minimum and/or a maximum number of people it requires. If any role does not meet its minimum participation (it's participation threshold), no one is expected to act. If every role achieves its participation threshold, everyone who committed to a role is notified and is expected to act. For critical actions, participants may be required to reaffirm their commitment after the threshold is met.

Due to the motivational formula in the previous section, it will be within the interest of each individual to act should minimum participation be achieved, and each member believes her participation likely to be pivotal in achieving the group's shared goal. However, it is possible that individuals will either behave irrationally, be forgetful, or that a large enough excess of participation may incentivize freeloading. For these reasons, it may be helpful to have frequent reminders and mutually administered direct incentives included in the commitment. With proper administration, threshold-contingent commitments provide a safe and reliable solution to the collective action problem.

4.2 Equifinality-driven consensus

Solving the problem of individual motivation in collective action is not enough to coordinate large groups; there is still the issue of potential conflict between members. Solutions to this problem, however, are abundant. The past decade has seen a significant amount of research in Consensus Reaching Models (CRMDs), Large Scale Decision Making (LSDM) and Large Group Decision Making (LGDM). Most consensus-reaching processes involve establishing criteria with which to rank a list of options. These criteria are generated through complex algorithms based on the aggregated diverse opinions of decision makers. The process is repeated until a high enough threshold of agreement or low enough disagreement is met. These systems have been applied to a diverse selection of issues including making investment decisions (Song & Hu, 2019), choosing an emergency rescue plan for trapped miners (Li et al., 2022), and managing global supply chains (Choi & Chen, 2021). By combining CRMD/LSDM/LGDM models with threshold-contingent commitments, large-scale decisions can be agreed to and acted upon by the voluntary participation of free agents.

4.2.1 Theoretical framework

While many LSDM models may function well in various circumstances, in the interest of versatility I propose a specific model based on principles from the group consensus-reaching process "Convergent Facilitation" detailed in *The Highest Common Denominator* (Kashtan, 2021). Convergent Facilitation has seen numerous real-world successes, most significantly with its use to solve a decades-long dispute

among the Minnesota legislature on child custody law after the Governor refused to sign a controversial bill that had passed the house 86:42 and the senate 46:19 (Levison, 2016; HF 322 Status in the House for the 87th Legislature [2011 - 2012], n.d.). The process resulted in a bill which passed the house 120:0 and the senate 61:3 (Kashtan, 2016). The proposed model was studied in relation to decision making in an autism human service organization (Michaels, 2020).

Like other LSDM systems, the proposed model focuses on the development of shared criteria, shifting the focus within a group from conflict over solutions to more fundamental issues. However, unlike most LSDM models, instead of relying heavily on decision-makers to adjust their opinion about criteria, it focuses on transforming criteria so as to become less controversial. By viewing decision criteria as goals, the success of this method can be understood in terms of "equifinality". To explain equifinality, it is first necessary to understand the psychology of goal-directed behavior.

Goals are "internal representations of desired states" (Austin & Vancouver, 1996, p. 338). Goals have been theorized to reside in associative networks and to be interconnected through goal systems (Kruglanski et al. 2002). A goal system requires coordination among goals within the system, meaning a goal pursuit does not exist in isolation relative to the other goals within the system; rather, goals are linked to one another. Goals are associated with their corresponding means of attainment, triggering response plans and stirring action (Bayer et al., 2009). Kruglanski et al. (2002) specify that goal systems contain vertical links that connect higher-order, or superordinate goals, to lower goals and that connect goals to their respective means.

There are many potential means that can help an individual move toward and ultimately satisfy a given goal. The fact that multiple links emerge from a goal to subordinate means, that vary in their ability to address the goal, is called equifinality (Kruglanski et al. 2002). When one route to goal pursuit shuts down, another can substitute in its place because of this equifinal configuration within the goal system.

Goals of individuals can be shared with other individuals. Finding strategies that can achieve shared goals is often the purpose of LSDMs. However, when multiple incompatible goals are held, it can cause conflict between (or within) individuals. In the proposed model, criteria (goals relevant to the decision) that are in conflict with other criteria are substituted for equifinal criteria, which also share equifinality with the conflicting criteria. Once a list of criteria with broad support is created, solutions can be evaluated by their expected fulfillment of that list.

4.2.2 Solution design

Equifinality-driven consensus starts with someone identifying an issue or dilemma that need a solution with broad agreement. They then invite all stakeholders to provide a list of the criteria they would want a solution to meet. Next, stakeholders determine whether they have conflict or agreement with each others' criteria. If there is agreement, they may record their support. If there is conflict, they may record their dissent and include an explanation. For controversial criteria, everyone is encouraged to suggest criteria that are equifinal to the goals of both proponents and opponents. If such a criterion is found, stakeholders may voluntarily transfer their support to it. Through this process, stakeholders gradually "converge" around a set of criteria which have broad support and little controversy. Finally, solutions are proposed and each stakeholder may evaluate whether or not they believe each solution meets each criteria.

By combining the support and dissent of stakeholders, criteria can be weighed so as to vary the influence they have on evaluating solutions. The scoring system is designed to give more weight to criteria that have more support, and to reflect the amount of disagreement that remains between stakeholders. Therefore, the weight of a criterion is determined by the number of supporters minus the number of dissenters. Solution scores equal the sum of these scores multiplied by the average evaluation of whether they are met by the solution, all divided by the highest possible score if no criterion had dissent and no evaluator believed a criterion was unmet by a solution (Figure A).

Figure A
Solution scoring function

$$\frac{\sum \max(0, s_i - d_i) a_i}{\sum s_i}$$

s = supporters
d = objections
a = polling average
i = criterion

Because the solution scoring function gives more weight to criteria with more support, but accounts for dissent, supporting controversial criteria is disincentivized. Transferring support to an equifinal, less controversial criteria improves the odds of a stakeholder's goals influencing a solution score in their favor. Thus, finding criteria that have broad support (or at least acceptance) becomes a mutually beneficial and desired endeavor. In this way, conflict can be transformed to agreement, and result in successful collective action.

4.3 Mutual goal-mapping

Threshold-contingent commitments and equifinality-driven consensus address the two major problems in collective action: ensuring participation and strategy agreement. However, one more issue is worth addressing for a comprehensive approach to collective action: the development of long-term strategy. Having a shared understanding of long-term strategy can help foster easier LSDM agreement and improve trust in threshold-contingent commitments.

4.3.1 Theoretical framework

As explained in section 4.2.1, human goals exist in a fabric of superordinate and subordinate positions. Any given goal may have any number of subordinate and superordinate goals that it exists in relation to. For instance, I may have the goal of a clean home, and in order to achieve it, I may create subordinate goals to take out the trash, and to sweep the floor. These goals can be represented as a hierarchical network of connected goals. By allowing individuals to share information with one another about the structure of their own goals, it is possible to develop strategy where their goals overlap.

4.3.2 Solution design

To create a goal map, anyone may create a public list of their own goals. Other people can choose to adopt any of these goals that they share. In doing, they add the goal to their personal map. Anyone may add subordinate, superordinate or equifinal goals to their public map. By adopting goals from others' maps, anyone will be able to identify goals that they share with others. A single map of the most popular goals can also be generated, allowing a group to see the strategy that has the most support.

5. Tying it together

The three solutions detailed in this paper can be combined in a single framework. This is most easily achieved with an online digital platform. It could also be achieved with facilitated in-person meetings using paper and pen or a whiteboard. By providing a way for groups to create mutual goal maps, they can

see where they agree on broad goals. These goals can be linked to equifinality-driven consensus processes to create a specific plan to achieve a goal. The solutions that are found from these processes can be proposed as threshold-contingent commitments. Thus, every step in collective action from long-term planning to immediate action can be achieved without any centralized coercion or distributed heuristics.

6. Summary and conclusion

Collective action is integral to many aspects of human life. To achieve collective action, groups must overcome the obstacles of strategizing and ensuring participation. These obstacles are usually approached with a combination of centralized coercion and distributed heuristics, with occasional opinion polling as guidance. These approaches are difficult to guide according to the will of the participants, and groups might benefit from alternative solutions based in the free will of individual agents. Participation can be achieved with threshold-contingent commitments. Strategy agreement can be achieved through equifinality-driven consensus. Finally, long-term strategy can be achieved with mutual goal-mapping. Together, these protocols allow for groups lacking centralized leadership to organize and achieve collective action.

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