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### **Author**

Seifert, Colleen M.

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## Planning Principles Specific to Mutual Goals

Colleen M. Seifert  
Institute for Cognitive Science - UCSD  
and Navy Personnel Research and Development Center

### Abstract

A theory of planning should provide a model of how planning knowledge might be learned and stored in memory so as to be available and utilized in appropriate situations. This paper presents a content theory of the planning strategies and constraints on planning specific to joint planning situations. The categorization helps to explain what information is relevant to this general class of planning problems, namely goal pursuit situations where goals cannot be satisfied without the participation of another planner. The taxonomy of planning principles presented outlines the common problems in mutual goal pursuit situations, and provides strategies for resolving the problematic interactions. The principles apply to a variety of types of mutual goal pursuit arrangements such as business partners, a political coalition, or social relationships.

Various types of planning principles have been proposed to account for constraints on the planning process based upon the type of goal pursuit involved; for example, the characterization of goal interactions in terms of whether the goals involve one planner or more than one, and whether the relationship between the planners is positive (concord) or negative (competition) has been proposed by Wilensky (1983). *Mutual goal pursuits* pose a unique class of planning problems having to do with the involvement of another planner in joint operations. Wilensky defined the positive goal relationship between two actors as "goal concord," where a planner has the same goal as someone else, resulting in the plan to accomplish the goal together. The goals of different planners can be mutually beneficial; such a shared commitment to a goal is termed an alliance (Wilensky, 1983). However, in this paper I explore the planning situation where the mutuality of goals involves not simply having the same goals (e.g., both parties want to be in New York), but rather that the mutual goals are *joint* goals -- the goals can not be satisfied without the active participation of the partner in the goal, and they involve a particular partner rather than any agent who happens to share a goal. In a mutual goal pursuit, two or more partners pursue shared goals with shared responsibility, forming the basis for a relationship between the planners defined by the content of the mutual goal (or goals) involved. This definition of mutual goal pursuit therefore includes an important class of planning situations: namely, the relationships people form to satisfy their goals, such as marriages, collaborations, and business partnerships.

The planning theory presented here is a type of memory-based planning, where appropriate plans and planning heuristics are retrieved from memory based upon the features of the planning situation. Relevant planning strategies retrieved from memory aid the planner in decisions about the mutual goal pursuit in relation to other goals the planner is pursuing. Characterizing the planning constraints for different types of planning situations provides a means to access general knowledge about planning strategies from many different contexts, and this knowledge can be used to prevent planning errors from recurring in similar situations (Schank, 1982; Dyer, 1983). Each principle describes a constraint on planning in terms of a causal vocabulary of goals, plans and their context, and

provides inferences applicable to the situation as well as possible repair strategies for the problem. Examples of problems evident in mutual goal pursuit (MGP) situations were analyzed to determine the interactions and strategies that arise which affect such situations. Basically, the job of categorizing the planning strategies involved in joint planning situations requires specifying the types of things that can go wrong, and characterizing the many factors that may affect MGP arrangements. These factors break down into three categories:

- assignment of responsibility for pursuit
- amount of effort towards pursuit from either partner
- differences in criterion of satisfaction for partners

The importance of characterizing the planning strategies involved in MGP is that they provide information about people's behavior in mutual goal situations. From the specification of planning strategies in MGP, it will be possible to explain problems by identifying the planning principles operating in them and perhaps their misuse, and it will be possible to predict which strategies may be useful in particular problem situations. The MGP strategies proposed in the next sections allow for planning within the constraints of the factors unique to MGP situations. In addition to these strategies, general plans to motivate another person to work on a goal, such as the power to remind them of the commitment they made to the goal pursuit, provide common sense solutions based upon the problem and the variables within the MGP.

#### **Assignment of Responsibility for Pursuit**

A main source of problems in MGP is the assignment of responsibility. Since the mutual goal pursuit situation is characterized by the joint effort of two planners, it requires coordination beyond that required of two actors who happen to have the same goal at the same time. When an agent is hired to adopt your goal (i.e., a housekeeper who will also have the goal of keeping your house clean), responsibility for pursuit is clear. The agent relationship is invoked simply to pass responsibility to the agent. However, MGP is much more complicated: not only are there joint goals which both partners want achieved, such as keeping the shared household clean, but there are mutual goals where the successful attainment of the goals *requires* the efforts of both partners (e.g., communication). The possible ways for the actors to fail to satisfy their responsibility for goals are correspondingly complicated. Further, the two partners may not agree upon the coordination of responsibilities for the mutual goal pursuits. Thus, MGP situations must settle the question of the *assignment* of responsibility among partners as well as *execution* of plans for which each partner is responsible.

**Agree on assignment of responsibilities.** If the responsibility for a particular goal or plan is not clearly defined, several outcomes are possible:

- Both planners can independently assume responsibility and pursue the goal. This will satisfy the goal, but will result in a waste of resources, since the goal will be satisfied twice, or twice the necessary effort will have been expended.
- One planner can assume responsibility and pursue the goal while the other does not. This will satisfy the goal, but will result in a long term commitment to taking care of the goal without the advantage of sharing the goal pursuit with the partner who benefits from it.

- Both partners assume their coplanner is responsible for the goal, therefore neither partner pursues it. This results in goal failure, which may be further complicated by a difficulty in quickly detecting this problem.

The repair for these bugs is to coordinate responsibility. It is not always easy to do this since multiple goals may be involved, but some long term arrangement is essential, as the recurrence of goals will make errors in assignment very costly.

**Separate responsibility.** How responsibility is assigned may result in other MGP problems:

- Both partners pursuing a plan may impede plan execution. This is represented by the adage *too many cooks spoil the broth*: separate actors may undo or adversely affect each others' goal-directed actions.
- A plan may require more than one actor; if so, the actions in service of the plan must be coordinated to avoid unplanned interactions of each partner's efforts while accounting for who is responsible for what parts of the plan.
- A planner assigned responsibility should be allowed to function independently. Once assignment of responsibility has been made, interference or assistance on the part of the other planner may be problematic. "Kibitzing" is greatly resented once responsibility is undertaken by one planner.

**Communicate plan contents to coplanner.** At times, the particular plans or steps involved in pursuing a goal may require informing the coplanner of the contents of the plan. Failure to do so may result in the following problem configurations:

- One partner inadvertently undoes the plan steps already executed by the other partner.
- One partner misunderstands the other's actions as failing to pursue the goal.
- One partner believes a deceptive plan that is intended by the other to foil outsiders. The coplanner must be informed of deceptive tactics.
- Coplanners must be informed of changes in plans; otherwise, they may take further action based upon presumed outcomes that will not occur. This involves "counting your chickens before they have hatched" through the lack of courtesy of the coplanner to inform.
- Coplanners must communicate planning decisions involving shared resources. This is illustrated by the story "Gift of the Magi."
- While communication is necessary in all of these cases, there is a caveat: overinformation may be the equivalent of forcing the coplanner to perform the goal pursuit themselves.

**Optimize planning choices over the mutual pursuit**

- Use the individual planner's abilities to their advantage. While each partner may be capable of handling each goal pursuit, the optimal arrangement for the MGP is to place the individual best suited for the goal in the position of responsibility.

- Use the mutual resources to the best advantage. Since resources are joint and are involved in many plans, coordination of resources will be necessary.
- Take advantage of joint planning ability. For some planning needs, the partnership will provide an advantage in ability to plan for complicated needs. This is captured by the adage, "two heads are better than one."

#### **Amount of Effort towards Pursuit from Either Partner**

A second major source of problems in MGP situations involves the expenditure of effort towards mutual goals. In a mutual goal situation, where effort is required of both partners, a variety of responses are possible. The two partners might not be willing to put forth the same amount of effort to satisfy the goal: one or the other partner may expend too little or too much effort on the goal pursuit, according to the judgment of the other partner. This conflict is due to the individual's goal structure, which includes the MGP, competing with the MGP's needs for effort from the planner. Because of the meta-plan to "minimize effort in goal pursuit," it is always advantageous to find optimal arrangements in goal pursuit to avoid wasting resources, noted by Zipf (1949) as the principle of least effort. The decision about the amount of effort to put forth towards a goal is particularly important when it comes to recurring goals. When the satisfaction of a goal is going to be periodically required, then attention towards minimizing the expenditure of effort towards the goal is more important than when pursuing a goal that is only satisfied once. The resolution of the conflict in amount of effort expended towards goals results in these patterns of MGP interactions and strategies for their solution:

- **Pull your own weight.** When you are in a mutual goal pursuit, you have equal responsibility with your partner for the goal pursuit; therefore, you should expend equal effort in the goal pursuit. Abandon this strategy if your partner fails to make effort in goal pursuit.
- **Optimize effort.** When you are in a mutual goal pursuit, and a recurring goal makes optimizing effort important, make little effort in the pursuit and your co-planner will be forced to satisfy the goal. Abandon if this strategy threatens the mutual goal (no one serves the goal) or threatens the basis of the mutual goal (the partnership agreement).
- **Playing hard to get.** When you are in a mutual goal pursuit, and your co-planner fails to pursue a mutual goal, abandon the goal until the co-planner carries out pursuit. Abandon if the basis of the mutual goal (the partnership agreement) is in question.
- **Expend effort only when detectable.** No "credit" will accrue for work on a MGP if the effort required is not observed by the coplanner. Coast along without effort if the effort will not be perceived, and draw attention to effort when it is made.
- **Expend effort only when required.** Perfunctory performance on recurring goals is adequate unless circumstances require a best effort. An example is going through the motions instead of hustling during practice drills in sports events.
- **Fill the gap.** Let your partner pursue the goal, and match your effort to the difference between your partner's effort and the required level. Since your effort is required for successful achievement, you contribute without bearing heavy



burden.

- **Tit for tat.** Match your effort to your partner's. If it is sufficient, you can try to adjust the amount to avoid wasting effort. If it is insufficient, it will convince both partners that more effort is required from both.

Some general strategies for goal pursuit are of particular importance in mutual goal pursuit situations. These include:

- **Juggle effort towards threatened goals.** Work hardest on those goals that threaten to fail imminently; coast on those that are currently satisfactory. This refers to the carnival trick of keeping a set of dishes spinning on individual rods -- adding spin must be done to the plate that needs it most first, leaving the others to struggle on until their turn.
- **Prioritize goals for extra effort.** Place more effort into those goals considered important. Less important goals can suffer from little effort better than important ones.
- **Cut your losses.** Minimize effort towards failing *and* unimportant goals. This is "not throwing good money after bad."

#### **Differences in Criterion of Satisfaction for Partners**

Another source of MGP problems lies in differences in the criterion of satisfaction for the different partners. If both partners agree about the amount of effort required to satisfy a goal, then the problem of optimizing the planners' efforts to achieve that level is relatively straightforward. However, the two partners in the MGP may not agree on the nature of the mutual goal: X may think that particular plans or actions he performs are in service of the goal pursuit, but Y may think the efforts do not lead to goal satisfaction. In addition, the two parties might not agree on the importance of the goal; for example, one partner might feel that financial support is most important, and pursue it over the emotional support the other prefers. Finally, the problem is greatly complicated by the nature of the goals commonly pursued in mutual goal situations. For example, suppose the mutual goal is emotional support; the level of satisfaction required for one individual may not be the same as that required for the other. Because of the "fair play" notion of effort in mutual goal pursuits, the partner more easily satisfied will complain about the extra effort required to satisfy the more demanding partner. The principle of fair exchange (Blau, 1964) forms the basis for a standard of what can be expected of a partner. This is a frequent problem in MGP situations, and the following strategies propose some responses:

- **Adopt your partner's satisfaction criteria.** When your partner's criterion requires more effort than yours, accept the additional demands and work to satisfy them if possible.
- **Attend to your partner's priority goals.** Expend the effort demanded on those goals deemed most important by your partner; slack off on the rest. For example, if being a good economic provider is most important to your partner, decide to work late rather than spend the evening at home.
- **Increase your criterion on goals important to you.** Make up the difference in effort that you expend on a demanding partner by increasing your criteria on goals more important to you.

- **Quid pro quo.** Make a clear exchange of needs. Offer to satisfy your partner's particular satisfaction criteria in exchange for the satisfaction of one of yours.

The MGP requires planners to make decisions not only about their individual planning efforts, but also to influence another planner's efforts in order to achieve the goal. Even when there are problems in the MGP, and one partner has to plan to get the other to live up to his side of the agreement, this does not mean that the relationship is competitive. You are not out to cause your partner to fail; you are out to influence him into cooperating. Therefore, even when you are "counterplanning" against him, the end goal is to enlist his cooperation. This puts definite constraints on what plans can be used to influence the other planner; for example, avoiding strategies that might produce negative responses which may linger after the issue is resolved. Resolving problems in MGP situations requires strategies that elicit increased cooperation from the partner while minimizing your own effort.

### Conclusion

The purpose of the theory of planning is to account for the choices a planner makes in attempting to reach a goal, and to provide a model of how planning knowledge might be learned and stored in memory so as to be available and utilized in appropriate situations. The above categorization outlines the common problems in MGP, and provides strategies for resolving the problematic interactions. The principles are general enough to apply as well to MGP with any number of actors, and to a variety of types of MGP arrangements. A taxonomy of constraints specific to MGP planning situations provides an understanding of what features of the planning environment are relevant to plan selection and planning failures, and therefore serve as specifications for planning rules in computer models of planners. The content theory presented advances an understanding about what information is relevant to planning situations and broadens the scope of problems that memory-based planning theories can account for.

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