Observational Studies of new i* Users: Challenges and Recommendations

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Abstract. As users and teachers of i* and related frameworks, we work with certain assumptions about which concepts and conventions are easy or more difficult for new i* users to learn and use. As part of a recent research initiative examining the possible synergies between goal modeling and creativity techniques for requirements engineering, I have conducted an exploratory study examining groups of graduate and undergraduate students working together to draw i* models. Several observations were made about the way students worked together to draw models, including the areas and concepts in which they had particular difficulty. I summarize and report on these findings, in the hope that it can have a positive impact on the way i* and other goal modeling frameworks are taught or introduced to new users.

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1 Introduction

When teaching goal models (such as i* [1]) to new users, we gradually gain an impression of the concepts and relations with which users struggle. Typically we gain these insights through questions asked in classes, tutorials, office hours, or by grading models as part of student assignments (see [2], for an example of observations made from student assignments). Occasionally we have the opportunity to observe students creating their models, perhaps as part of an in-class work session, but typically, as goal model instructors, we make our observations either before or after student modeling, not as the modeling occurs.

As part of an exploratory study aimed at understanding potential synergies between creativity techniques and conceptual modelling for RE, the author had the opportunity to observe nine groups of one to four students (23 participants in total) work together to create i* models. A short description of the exploratory study, including results from the creativity perspective appears in [2]. Although the study was performed as part of a larger project focusing on creativity and goal modeling, many observations made during the study were relevant specifically for goal modeling. In this paper I describe my observations from the goal modeling perspective, including general observations on student difficulties and experiences. A first attempt is made to provide ideas and recommendations to help mitigate some of the student difficulties. It is my

hope that these observations and recommendations can help to improve the way we teach goal modeling in practice.

The setup of the study is described in more detail in Section 2. Study observations are summarized in Section 3, while Section 4 provides some initial advice and recommendations. Section 5 concludes the paper.

2 Study Setup

In order to explore the relationship between creativity and goal modeling, the author performed nine one-hour sessions with groups of one to four students, all of whom had some coursework experience with goal (i*) models. Students were recruited from the Requirements Engineering (RE) course taught at City University (City U), open to both Undergraduate and Masters students. Two groups, used as pilot studies for the two treatments, were comprised of current graduate students and researchers at the center who had taken the RE course in the past. Sessions involved a total of 23 participants, (two undergrad and 21 Masters Students) studying a range of Information System-related topics, including Business Analysis and Design, Software Engineering, Information and Technology, Business Systems, and Business Computing.

Although our study was exploratory in nature, we were guided by research questions, including: a) should goal modeling be performed before or after creativity techniques? b) can goal models effectively capture creative ideas? c) does the structure of the models impede creative thought?

In the sessions, student were given an i* refresher, a small example Strategic Dependency (SD) and Strategic Rationale (SR) model. They were then given a toy scenario involving a parking garage, and were asked to sketch a goal model and come up with creative ideas guided by selected creativity triggers (participation, connectivity, convenience, boundaries). Goal models were drawn on large sheets of paper. Five groups performed goal modeling then creative thinking, while the other four groups did the reverse. Approximately 20-30 minutes of the session were devoted to goal modeling. Participants reflected on the process via a short survey, including the ordering of activities and potential synergies between modeling and creative thought.

The author facilitated the session, explaining tasks, making observations and taking notes. When progress was stalled, the author would try to provide guidance, but otherwise did not interfere. Audio and video were not taken; the facilitator took notes and kept the resulting models. From the perspective of the students, there were no explicit rewards, but the sessions were advertised as a chance to practice their i* skills with an i* "expert". I was available to answer any i*-related questions and to help them with their models when requested. Observations on the submitted assignments for this session of the course ("module" in UK terms) are provided in a companion paper [3].

3 Observations

Some observations made during the sessions were in line with previous observations made from assignments and teaching experience. For example, students had difficul-

ty distinguishing between goals and tasks and they had to be urged to make their SD models consistent with their SR models. Other observations were more surprising.

Progress. First, although I realized that timing in the activities would be tight, it was surprising how little progress most groups made with their i* models. Many groups (4/9) made progress on an SD model, but did not get a chance to start SR modeling. Even when working on their SD models, groups made fairly slow progress. Often much time was spent in discussing ideas, dependencies and actors, with very little writing or drawing of the content of their discussions. It took groups some time to even begin modeling. Those groups who did get to some SR modeling struggled a lot with internal SR relationships (decomposition, means-ends, contribution). Statistics on the number of i* elements and relations drawn by each group can be found in Table 1. We can see that the first group of pilot participants, P1, who had more experience in i* modeling, performed better than the rest of the groups (P2 and S1-7).

SD First. While observing the students starting with SD models, I noticed they often came up with many ideas for elements that did not fit well in the constraints of SDs. For example, reading the domain description, students would find a softgoal vehicle safety. This could be drawn as a dependency, but is most likely a softgoal of the Manager, represented inside an SR actor. In these cases, the students either had to figure out how to draw the element as part of a dependum, or temporarily drop the concept. As the process of drawing an SD is consuming, students didn't think to record these elements for later SR use. In this way, students were either overloading their SD models or losing ideas for elements that better belonged in the SR models.

System Actors. Students also had difficultly knowing that they should explicitly model the as-is system (in this case Parking Garage System) as an explicit actor. Other actors like Attendant and Driver were identified easily, but more abstract actors were less obvious. In retrospect, the example i* model they had been given as a refresher was too simple, not IT-specific, and therefore did not have an example system actor.

Table 1: Resultant Goal Model Counts from Study (blank cell = 0 count)

		P1	P2	S1	S2	S3	S4	S5	S6	S7*		
SD	Actors	4	4	4	4	4	3	5	4	2	4	4
	Goal	2	2	4	1	1	1	1	1	1	1	1
	Softgoal	4	4	7	6	2		2	3		3	5
	Task		1	1	1	1	2	2	1	1		
	Resource		1	5	1						1	
	Sum Dependencies	6	8	17	9	4	3	5	5	2	5	6
SR	Goal	4			1	1				1		1
	Task	11			3	2			2	2	4	4
	Softgoal	5				1						2
	Resource	1			1				2	2	3	1
	Sum SR Elements	21			5	4			4	5	7	8
	Decomposition	14			4	1			2	1	5	5
	Means-end	2							1	1		2
	Contribution	1				2						

* drew 3 separate models

Actor vs. Resource. Similarly, 7/9 groups debated whether or not the parking lot sensor, measuring occupancy at each level, was an actor or a resource. In several cases I stepped in to help the groups, explaining that it would depend on whether the sensor had intentionality, its own set of goals, tasks, and dependencies. The idea that a non-human entity could be an actor was not intuitive.

Dependency Rule. As this study was conducted using students at City U, I had the opportunity to evaluate some of the i* conventions specific to this university, developed based on their modeling and teaching experiences. As part of their course material, students were taught a particular rule helping them to move from SD to SR models, specifically, the dependum in a dependency relationship in an SD model is always modelled inside the boundary of the depender in the SR diagram [5]. Similarly, according to City U convention, goal, task and resource dependencies correspond to decreasing levels of delegation. The rationale for this convention is that in a goal dependency the dependee has great freedom in how to satisfy the goal, thus the level of delegation is stronger, while there is less freedom and weaker delegation for a task, and even less so for a resource.

Observing the students, the first dependency rule caused some confusion and had to be reiterated and reviewed several times. There were a few cases where dependencies seemed sensible, but violated the rule. For example, in the left side of Figure 1, the Driver depends on the Attendee to Give Directions, which seems to be a sensible dependency. The rule would state that Give Directions must be inside the Driver, when really it's the Attendee Giving Directions, as in the associate SR, which is wrong according to the rule (note that a further City U convention is that SR models have no dependums). As tasks have a greater degree of delegation than resources, perhaps a more correct way to model this would be to model the dependency as a resource, as shown on the right of the Figure. However, these types of rewriting solutions were not easy for the students to come up with on their own; usually they could only do so with some help from the author/facilitator.

Tables. I observed that many of the students started their SD models by drawing tables, recommended in their course slides. This appeared to be a helpful intermediate way for them to start the course slides, less intimidating than drawing shapes.

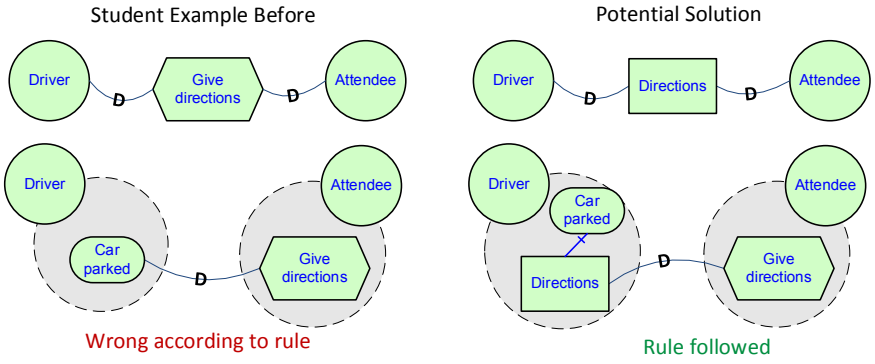

Figure 1: Example of City U Dependency Rule Violated and Followed

Other observations. Although students were given short questions guiding how to start i* modeling, almost all participants ignored the instructions, perhaps because there were already too many study-related sheets and forms to read. Also, there didn't seem to be an obvious difference in modelling effectiveness between pre-formed and randomly formed teams of modelers. Finally, the effects of physical modeling should be considered. It's difficult to know if using tools would help the students, making it easier for them to start the process of modeling, or easier to maintain consistency between SD and SR. Several groups complained about having to model on paper, i.e., it was hard to move shapes and fix mistakes. However, using a tool with the modeling view, for example, projected on a screen, may have inhibited collaboration and teamwork. Future studies should look more closely at paper vs. electronic modeling.

Creativity. In terms of the relationships between goal models and creativity, almost all participants indicated that if they had to do the activity again, they would perform both creativity and goal modeling: there was a general agreement that these activities work well together. Participants were often able to express their creative ideas in terms of the model, e.g., adding new actors or softgoals. Goal modeling did not appear to over-constrain creative thought, but gave group members a common understanding by which to ground their ideas. More details can be found in [6].

4 Recommendations

Based on the observations of this exploratory study, I can provide recommendations for future i* instruction. First, it's important not to underestimate the amount of effort and time it takes new learners to draw i* models, particularly in the first steps of getting the modeling started. Although we want to encourage independent thought, it may be useful in some contexts, e.g., tutorial exercises, to provide skeleton models with some completed actors and elements as a starting point for modeling.

Regarding the common practice of starting with SD models, the rationale behind this practice is clear – SD models consist of a simpler subset of goal modeling concepts. However, observations have led me to believe that dependencies are not the most intuitive or easily found concepts by new learners. In many cases it may be easier to say that an actor has a goal or performs a task than to identify specific types of dependencies between actors. I suggest that students start with a hybrid SD/SR model, including actors, boundaries, elements inside boundaries, and some dependencies, but without filling in the details of the internal SR relationships. An example of such a model is shown in Figure 2, capturing the concepts of an SD, but allowing modelers to record SR ideas. In fact, the process of SD and SR modeling is ideally iterative, but it was not clear during the observations if the students were willing or able to change their SD models based on their SR progress. Starting the modeling process in this way could help to emphasize the tight linkage between SD and SR.

Observations indicate that we, as instructors, must place more emphasis on less "concrete" actors such as various systems; our examples should include actors of this type. Similarly, we should provide examples in which we decide whether an entity is a resource or an actor, i.e., should a system entity be ascribed intentionality or not?

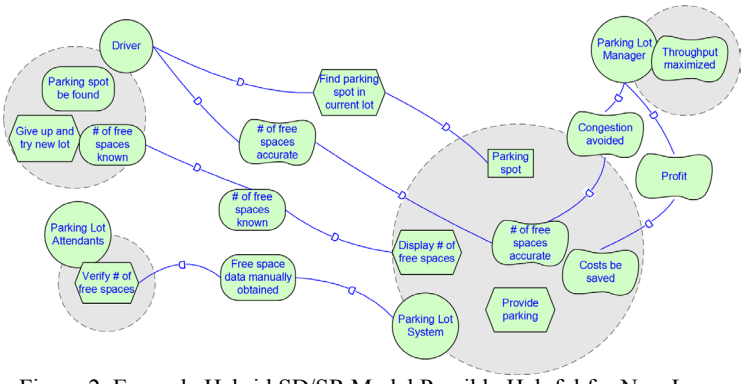

Figure 2: Example Hybrid SD/SR Model Possibly Helpful for New Learners

Dependency rules, such as those taught at City U, seem to cause confusion more than provide guidance. As the intention of teaching new i* users is to get them thinking systematically from a broader perspective, one could argue for less rules altogether.

The use of tables as an intermediate artifact appeared to be helpful for students. We could also think about using tables to help create SR models, e.g., list all the goals/tasks for an actor without worrying about internal links or dependencies. It would be helpful if the tools we used in teaching had tabular views of actors and dependencies, even if these views only showed a subset of the information in the model.

5 Conclusions

The author has used her experience observing new i* users in an exploratory experiment to understand modeling challenges, providing a list of recommendations based on these observations. Although the observations and recommendations are specific to i*, many are applicable to other goal modeling frameworks using actors and dependencies. These recommendations are meant to act as a starting point for discussion, with the hope that follow-up work will test their effectiveness.

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