# How to Build a Motivated Research Group

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DOI 10.1016/j.molcel.2010.01.011

**Motivated group members experience a full sense of choice: of doing what one wants. Such behavior shows high performance, is enjoyable, and enhances innovation. This essay describes principles of building a motivated research group.**

Most students begin graduate school or a postdoc full of passion for science. They are given the resources to devote themselves to solving fascinating puzzles. Why is it, then, that in some groups students thrive, can't wait to come to the lab in the morning, can't stop thinking about their projects, and feel a sense of personal and intellectual growth, whereas in the lab next door, students after two years are depressed, unmotivated, and, by the end, are loath to even look at their own papers?

We all want to work with motivated students and keep ourselves motivated. But how? We are never taught about motivation or about most other essential topics related to the emotional and subjective aspects of being a scientist. A common implicit assumption is that motivation is the sole responsibility of the student: either you have it or you don't. This can lead researchers to blame group members for their lack of motivation. However, research in psychology has begun to demystify motivation and can offer useful concepts for scientists. The goal is to provide people with the conditions that enhance their natural self-motivated behavior. Here, I discuss simple principles that are useful for building a highly motivated research group.

The psychologists Deci and Ryan have, since the 1970s, studied conditions that enable self-determined behavior: behavior that is experienced with a full sense of choice, of doing what one wants, without coercion or compulsion. Such behavior shows high performance, is enjoyable, and enhances innovation. Of many experiments, here is an illustrative example: People are given interesting mechanical puzzles to solve. Group A is given a dollar for solving each puzzle; Group B is not. After 30 min, the researchers tell the groups that the experiment is done. It was found that Group A puts the puzzles down, whereas Group B keeps playing with them on their own time. The surprise was that money and other rewards in these types of tasks apparently act to reduce motivation. What makes people motivated?

Deci and Ryan found three conditions for self-determined behavior: competence, autonomy, and social connectedness. I'll now describe how these concepts are useful in the context of research groups.

Competence is a prerequisite for motivation. Peak performance—called "flow" in psychology—is achieved at intermediate difficulty of tasks: not too easy and not impossible. To demonstrate how advisers could go wrong, here is a mistake I made with my first graduate student. For his first project, I suggested that he rewire a commercial fluorimeter to oscillate its temperature control and see how bacterial growth is affected. This seemed reasonable to me coming fully charged from my postdoc, but for him was justifiably daunting, as a beginning student who had never even grown bacteria in a test tube. After a short while, I sensed the drop in motivation.

We started over: first grow bacteria in a test tube. Good. Now do a growth curve. Good. Now do it again and estimate the day-day error. Good. Easy steps allowed positive reinforcement. As his confidence increased, his motivation skyrocketed. The best part is that going slowly allowed us the time to find a different and much more interesting project than the one I first assigned. I have since been careful to gradually build competence and confidence for new group members, with the help of more experienced members, clearly stating the purpose at each step.

In addition to competence, autonomy is essential for motivation. Autonomy is the sense that the project emanates from the person and not from an external source. Using threats or punishment tends to decrease autonomy. One can also decrease autonomy in more subtle ways. One graduate student told me: "I have a question, but before I tell you, please promise not to solve it immediately by yourself—I want time to think about it." I realized that as experienced scientists, who see several steps ahead, we need to be mindful of sometimes letting students figure things out for themselves.

Autonomy is related to the amount of structure (instructions from the mentor): autonomy is optimal at intermediate structure, between the extremes of micromanagement and neglect. The optimal point is specific to each individual and changes over time because experienced group members need less structure. You thus need to determine and adjust this point together.

The third strand of motivation is social connectedness: having someone in the group care about you and your project. The need for connectedness encompasses the striving to care for others, to feel that others relate to you in mutually supportive ways, and to feel a satisfying involvement with the social world (and the scientific world) more generally.

I make our weekly group meeting an event that enhances social connectedness. The first half hour of the two hour meeting is devoted to nonscience. This at first may seem to eliminate one quarter of the time for talking science, but in the long term, gains from increased motivation more than make up for any losses. I begin by asking who is not here today, so that we feel a sense of responsibility for each other, contacting people who are sick, etc. We then celebrate lab rituals, such as birthdays. We spend time freely discussing the news, arts, etc. There is a time for anyone to make announcements to the group (new equipment, interesting papers, upcoming vacations). And then a student gives a scientific talk, in which the group is given a role: imaginary referees if the project is before publication, brainstormers if this is a preliminary talk about a future project. I am mindful to explain jargon to newcomers and to appreciate members for effort in the face of tough problems and for helping each other. Over the years, this has created a culture of connectedness in the lab that is one of my main joys.

Social connectedness is a major motivating factor for many scientists. Though there is a romantic notion that scientists are solitary people, there are many people that think best in discussions and gain great satisfaction from helping others. And sometimes it's even simpler than that: a lot of lab work is dull, and having people to joke with and chat to can turn a mundane day into a fantastic one. A colleague of mine said that she became a scientist because she likes scientists and enjoys their way of looking at the world. Our connection to a community and a culture provides us context and empathy during our struggles, celebrations and acknowledgment during our successes.

If you are feeling unmotivated, these concepts might give clues on how to ask for help in competence, autonomy, or social connectedness. If the situation is such that help cannot be found within the group, it might help to nurture yourself by doing something that you love outside the lab.

As we end this essay, I'd like to describe an approach to choosing a project with a student (or for myself) that enhances self-determination. The goal is to choose a project that aligns with the student's unique set of skills and interests. It is a simple graphic called the TOP model (Figure 1). Imagine three circles. The first is T, for talents. The second is P, for passions, which intersects (but does not completely overlap) with T. The homework for the student is to list his or her talents and passions, even those that do not seem related to science. The final circle is O, objectives of the lab. The ideal project lies in the intersection of the three. This provides constraints that, as in all creative work, can lead you to unexpected and original projects.

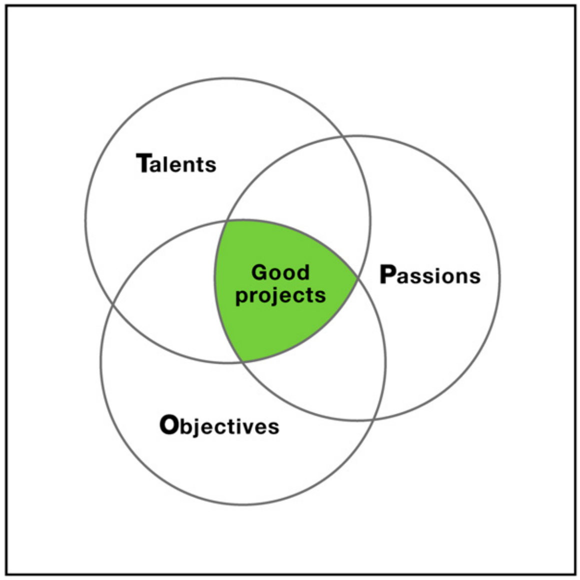


**Figure 1. The TOP Model**
Good projects are found in the intersection of one's talents and passions and the objectives/scientific interests of the group.

Being in the intersection of talent, passion, and scientific objectives is motivating, because talent is related to competence, passion is an ingredient of autonomy, and shared objectives enhance social connectedness. I like to use this especially when students consult with me about choosing a field for a postdoc or starting a new lab. Here, we open a wide search, with O serving as the general objectives of science: Greek literature is not yet in O. If you cannot find anything in O that overlaps your talents and passions, perhaps it is time to leave science for something you are passionate about.

Interaction between people is of course far more complex than can be captured with such simple concepts. Still, these concepts are useful to me as diagnostics and guides. They sometimes are at odds and must be balanced, for example, in choosing a project for a new student: competence considerations may require finding a group member who can help, causing overlap in projects, which can reduce autonomy. Autonomy considerations suggest clear separation between student projects. However, having a project that is too different from all the others in the group can decrease the sense of connectedness. There is no formula, but concepts can help guide common sense. Open conversations with colleagues who struggle with similar decisions and with your own group can help you adjust and enable your group and yourself to reach the full potential of intrinsic motivation.

## ACKNOWLEDGMENTS

These ideas were presented to me as gifts by teachers, students, and peers or are the fruits of learning from my own mistakes, and they are presented here again as a gift. I thank Amir Orian and Jonathan Fox for training on building groups that nurture inclusiveness, innovation, creativity, and humor, based on traditions of playback theatre and psychodrama; Dan McAdams for his book *The Person*; Angela DePace, Galit Lahav, Mike Springer, and Ron Milo for discussions; and Allan Drummond for inspiration and introducing me to the TOP model. See also the Forum on how to choose a scientific problem (Alon, 2009).

## REFERENCES

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