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# Constraint relaxation in the processes of insight

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Research on insight has accumulated experimental evidence on its cognitive processes. However, there is little agreement on what problem-solvers learn from their initial failure and at what point an insight actually takes place. To explore these issues, we propose a general framework that involves three constraints, *object-level*, *relational*, and *goal*. The object-level and relational constraints represent people's natural preference of how objects and relations in a given problem are represented. The goal constraint evaluates a degree of match of the current state to the goal, and forces problem-solvers to select specific combinations of the representations of objects and relations. In the processes of insight, we claim that these constraints operate simultaneously and are gradually relaxed by repeated impasses.

We used the T puzzle, similar to the tangram, as material. The goal of this puzzle is to construct the shape of a "T", using four pieces depicted in Figure 1. At first glance, it appears to be very easy to solve, since there are only four pieces and one can easily identify possible positions that some of them should be placed. However, a pilot study, in addition to our own experiences, showed that no one, without having experience with this kind of puzzle, could solve it within five minutes.

From the general framework and its derivatives, we form several hypotheses to be tested empirically. Two of them are described below. First, since the object-level constraints force subjects to place the pentagon with either the longest or the second longest side at the base, subjects' use of the pentagon will mainly be horizontal before insight. Second, repeated failures should relax all the constraints that have enforced subjects to place the pentagon in wrong ways and to fill the notch. As a result, the relative frequency of the proper placement of the pentagon will increase gradually.

## Preliminary Observation

Six undergraduate students were participated in the study. Since one subject was suspected of having prior experience on this puzzle, data from remaining five were analyzed. Subjects were just asked to place the pieces to form the shape of "T."

We sliced an entire problem-solving process of a subject to segments. A segment roughly corresponds to an attempt that begins with connecting pieces and ends up with noticing failure or achieving the goal. A segment is operationally defined as a series of actions that was

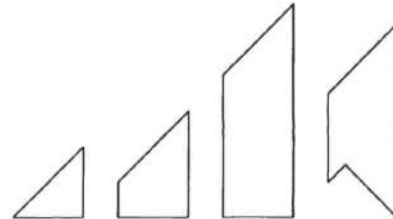


Figure 1: The T puzzle: Construct a shape of "T," using four pieces above.

initiated by joining two pieces and terminated by their separation.

In order to test the first hypothesis, we compared the proportions of the types of pentagon placing. Table 1 shows the types of placing the pentagon. We can easily find that the subjects placed the pentagon horizontally or vertically more often than in the other ways.

Table 1: Percentages of the types of the pentagon placement. H/V denotes the placement of pentagon horizontally or vertically.

	Subjects				
	H	M	K	O	A
H/V	62	66	85	91	76
Other	38	34	15	9	24

As noted at second hypothesis, we predicted that the number of pentagon placements that violate the initially dominant object-level and relational constraints should increase. In order to test this hypothesis, we simply divided an entire problem-solving process of each subject into the first and second halves and compare the frequencies of placements where the initial constraints are violated. The number of such placing dramatically increased in the second half. While the total number of constraint violating placement was 16 in the first half, the number in the second half was 37. This strongly supports our claim that the object-level and relational constraints be relaxed in the course of problem-solving.

The above results suggest that the initial persistence in a wrong approach could be explained by the object-level and goal constraints, and that subjects could reach an insight by relaxing the object-level constraints as well as having the goal constraint easy to operate.