One Hundred Arrows: Changing Our Students' Perspectives on Design
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As design educators, we want our students to engage deeply in their work, to explore the boundaries of a particular problem, to experiment with various methods and approaches, to measure the breadth and depth of their subject, and always to generate and test alternatives. However, early in their studies, our students often have a much more limited view of design. They are apt to look for singular solutions to assignments, spending a great deal of time trying to dream up one idea that will show everyone how clever or creative they are. They then either feel "blocked" when they cannot come up with that idea, or are disappointed when we are less than fully impressed with their efforts. Our job as educators involves radically changing students' perspectives on the nature of the work they are undertaking, leading them to a new appreciation of the richness, complexity, and enjoyment of design thinking. If we can understand their initial attitudes and beliefs, those become markers for what we actually need to teach, for as Tolstoy wrote: "The best teacher will be he who has at his tongue's end the explanation of what it is that is bothering the pupil."[1]

I often use a short, in-class exercise to expose and discuss students beliefs about creativity and idea generation, and to introduce new concepts about the structure of design work. The exercise comes from a casual comment I once heard Shigeo Fukuda make: that one of the admissions tests for design graduate school in Japan was to have students draw eighty different arrows in twenty minutes.[2] Fukuda himself was a master of making multiple variations in any situation, so it made perfect sense for him to be interested in this sort of "test;" which embodies the notion that a flexible approach to generating ideas is an essential skill for designers.

In my version of the test I up the ante. Students are asked to draw one hundred different arrows in ten minutes. Their initial motivation is a story about a client calling on the phone to ask to see some specific samples of work, the "one hundred arrows." The client is across town, coming right over (in ten minutes), and before any questions can be asked or answered they hang up (or you lose their cell signal). As the exercise begins, no questions or conversations are allowed; the exercise is simply written on the board at the front of the room and paper and various writing implements are provided. When the ten minutes are up (culminating with the dramatic footsteps of the client coming to the door), we look at the work informally and begin a discussion of how students felt when they were working on the problem.

Many beginners are not able to come up with one hundred, but this is unimportant at this stage. I am quick to point out that we are not engaging in critique, or worrying about whether or not they succeeded. Those who do draw the full hundred use various methods

which provide additional interesting discussion points. The material simply gives us a base from which to examine attitudes and approaches to actually doing the work, and to surface some common difficulties everyone may have encountered.

As we look at the work, the first thing that becomes clear to everyone is that there are plenty of arrows out there – long, tall, short, fat, simple or ornate – and that everyone has a different take on the assignment. Some approach it in a very organized manner, others in a random way. Some maintain a consistent style or approach, while others jump from style to style. Someone almost always draws one hundred of the same kind of arrow, or uses words, or comes up with something clever or funny. I emphasize that there is no one correct way to solve this problem, only millions of possibilities.

But if there are so many possibilities for different kinds of arrows, why do so many people have trouble coming up with a mere one hundred? Students usually begin the exercise with a flurry of activity, but then report "hitting a wall" or experiencing a maddening slowdown in the flow of new ideas. Even if they work steadily, and come up with the requested number, most students feel that the project is difficult, or challenging, or at least vaguely frustrating.

The most common frustration is the shortage of time. Students always feel they would have been able to come up with more (or better) ideas if they could have just had a few more minutes. Many of them complain they have difficulty being creative under pressure. In the most extreme form of this complaint, the threat of a tight deadline shuts out any new thoughts and the student feels completely blocked.

Another common frustration is the idea of having to do something for someone else. One student commented: "I can only be creative in my own work." Others report being unclear on what is actually being asked for by the client ("what did they mean by that word 'different?'"), and this undermines their confidence. They fail to gain momentum because they are never quite sure they are headed in the right direction. Or worse, stymied by their own self criticism (that external voice from within), they hesitate before putting down ideas or fail to come up with any ideas at all.

Significantly, these major areas of frustration involve the two qualities that students readily identify as making this exercise similar to a real world design project: the presence of deadlines and clients. Another significant feature is their repeated use of the word "creativity," even though it is nowhere mentioned in the original problem statement. Students obviously feel it is an important component of their work, and that being asked to come up with one hundred versions of anything requires some sort of creative leap. One student simply said "I can't be creative at this hour of the morning," and refused to draw anything at all. If creative situations involving deadlines and clients are going to cause anxiety and difficulty for our students, we clearly have our work cut out for us.

Specifically, the exercise shows that students often begin with an impoverished view of creativity, few specific problem solving skills, and a very limited view of design as "creative work for somebody else." They tend to view creativity as inspiration; something that appears in a mysterious flash as a result of staying up late enough and drinking enough coffee. While this may indeed be one useful method, creative professionals know that there is more craft and hard work involved, or as Edison said of genius: more perspiration than inspiration.

The students' most immediate frustrations with the exercise point to the need to teach them basic idea generation techniques, and to show them how to work their way through common creative blocks. This often means teaching specific generative tools, such as brainstorming, mind mapping, or manipulative verbs, and concepts such as vertical and lateral thinking. [3] It also involves teaching them to use the subject matter of their projects as a deep well of ideas, concepts, and connections.

But the most important issue the one hundred arrows exercise exposes, is that students' limited perspective on the nature of design makes it much more difficult for them to draw from that deeper well. They will eventually need to go beyond a conventional view of design as "problem solving for someone else," in order to help them internalize their design explorations rather than take their primary motivational clues from clients. (This is not to suggest we teach students to ignore client or project needs, but only to point out that these function best as a catalyst to our own creative chemistry.)

As far back as 1980, in the second edition of *Design Methods,* John Chris Jones wrote: "To think of designing as "problem solving" is to use a rather dead metaphor for a lively process and to forget that design is not so much a matter of adjusting the status quo as of *realizing new possibilities and discovering our reactions to them."* [4] [italics added] Another way to look at this is that while a particular problem may beg for a specific solution, a design situation is ripe for exploration. This viewpoint acknowledges our multiple possible starting points, the wide variety of available methods, and the unpredictable nature of the outcome. Every time you make a mark, a sound, or a movement you create new possibilities that you can react to. It is this particular quality of action and reaction that enlivens any creative dialogue and draws us through the design process.

To demonstrate these points I like to return to the words of the exercise, which can be shown to represent elements that occur in all design projects: goals, criteria, constraints, areas of exploration, and the tools, materials and methods we use to explore. Then, breaking down the overall goal into more manageable parts can help students sort out what is really being asked for, and show them how we use the structure of the project itself to fuel our creativity.

Let's first look at the time constraint, ten minutes, which features so prominently in discussion. A constraint is best understood as an externally established boundary, over which you have no control. (Our only hope is that the client will get stuck in traffic.) Charles Eames, in an interview titled "What is Design?" described design as "a method of action," and later in the interview pointed out that "Design depends largely on constraints." [5] As already seen, students view constraints as serious obstacles, but good designers, artists, and creative thinkers know they are merely boundaries within which to explore. Paul Rand, in his essay "Design and the Play Instinct," quotes the painter Braque: "Limited means beget new forms, invite creation, make the style. Progress in art does not lie in extending its limits but in knowing them better."[6]

In his book, *Conceptual Blockbusting: A Guide to Getting Better Ideas,* James Adams describes a number of conceptual blocks to creative thinking. In one example, using a familiar "nine-dot puzzle," he points out that people often impose constraints on themselves that don't actually exist.[7] In our exercise, this is often revealed when discussing a solution that shows one hundred of virtually the same arrow. One student will claim this is

"cheating" until someone else points out that each arrow is separate and minutely different from all the rest, and therefore technically correct. "Oh," comes the reply, "I thought you wanted us to be really creative." This dissatisfied student is imposing a constraint on the project that isn't stated or required. In a more general sense, everyone who creates big differences between their arrows and fails to reach one hundred by not trying some smaller variations is imposing a similar constraint: they are trying to be "more different" or "more creative." While constraints are always in the picture, it is very important to be clear about what they really are, not just what we imagine them to be. In our problem, the ten minute time constraint precludes focusing any elaborate attention on any one single arrow, nothing more.

The other number in our exercise, one hundred, is our "criterion for success." Unless you reach one hundred you have not solved the problem as stated – you may have a very beautiful or interesting set of arrows, but you haven't met the specific criterion. It is always useful to isolate, identify, and agree on criteria because they define what you are aiming at: aspects of the goal that are measurable or that we can make judgements about in an unambiguous manner.

In contrast the word "different" represents the persistent ambiguity that defines all design situations. It is common for designers to be faced with a mix of goals, criteria, and constraints, or for goals to be hidden or unarticulated until the work begins. In a deeper sense, our examination of various alternatives causes constant recalibration or adjustment of the original goals. We have already mentioned that some students define the word "different" in such a narrow way that it becomes a constraint. Because it is something the client has asked for, but not defined, they limit themselves. But no limit has been applied, and "different," combined with "arrows," opens up a broad area for investigation. Here, in the face of ambiguity, experienced designers learn to jump in. They question, propose, present, generate, invent, and test as many alternatives as possible.

It is worth noting that "arrows," the subject of our exploration, are recognizable in many forms. They can be pointers, traffic signs, weapons, or sports equipment. Most people begin (and often stay) with the general category of pointer. In *The Language Instinct,* Steven Pinker points out that "…more than one word can be applied to a thing: Peter Cottontail is not only a rabbit but an animal and a cottontail. Children have a bias to interpret nouns as middle-level kinds of objects like "rabbit"…"[8] It would not be surprising to find a similar cognitive preference to interpret visual concepts at some general schematic level.

As pointer, our arrow no longer has to function physically, to fly through the air, or hit a target. But, if we focus only on the notion of arrow as a basic sign we may forget all about a solution with feathers. We might miss a source of ideas that is built into the subject matter. In fact, any additional cultural or historical knowledge adds variety to our subject, and takes us one step further from the straight and narrow. With an interest in archeology we think of arrowheads, mythology reminds us of Cupid. Once we are smitten with an arrow through our heart, we might think of one through an apple on our head, or of Steve Martin with an arrow through his ears. Each new way of understanding the subject – formally or functionally, semiotically or structurally, culturally or critically – is a lens that produces a different set of images. One of the values of new theories in all these conceptual areas is that they can focus our attention on working methods or visual possibilities we may have previously overlooked.

Finally, we come to the word "draw," which in a very general way represents our tools, materials, and methods. When the exercise begins, everyone picks up their pencils or pens and begins making marks on paper. Very few students change tools or surfaces in the short time they are working. While it is understandable for them to charge ahead in one direction when they only have ten minutes, it is also revealing that they seldom change direction even when at a dead end. Very few ever pick up a different colored pen, crayon, or marker. Those who have the most difficulty getting to one hundred often stay with one size of arrow, one particular mark or kind of arrow, or marks that all point in the same direction.

As a method, formal manipulation of the material itself has always been an endless source of ideas for designers. Here there are numerous techniques that can be used to extend your reach. In addition to the previously mentioned "manipulative verbs," consider a matrix which can mix and combine two characteristics in any work. By combining ten different arrow heads with ten different shafts one can quickly produce one hundred variations from only 20 different parts. The addition of a mere ten ideas for feathers would produce an astonishing total of one thousand arrows, without even breaking a sweat. It is no wonder that formal variation, on its own and without any reference to concept or subject, is such an intoxicating area of inquiry for designers.

In a very basic way, teaching people to be better designers involves showing them how to access a greater range of ideas, so they become willing to produce and examine alternatives at every level. From the broadest concepts to the smallest typographic details, this is a large part of the work designers do. This exercise does not favor any one formal or conceptual approach. Instead it demonstrates that as teachers we can go beyond claiming "design is process" in order to demonstrate precisely what that process is and most importantly, to understand what impediments there are to achieving it. Those impediments include not only lack of skills or experience – which would be expected – but also specific attitudes and beliefs that make learning to design more frustrating.
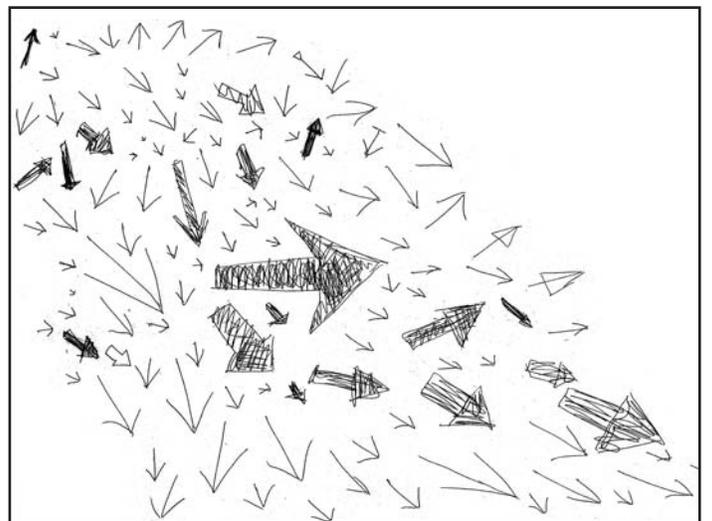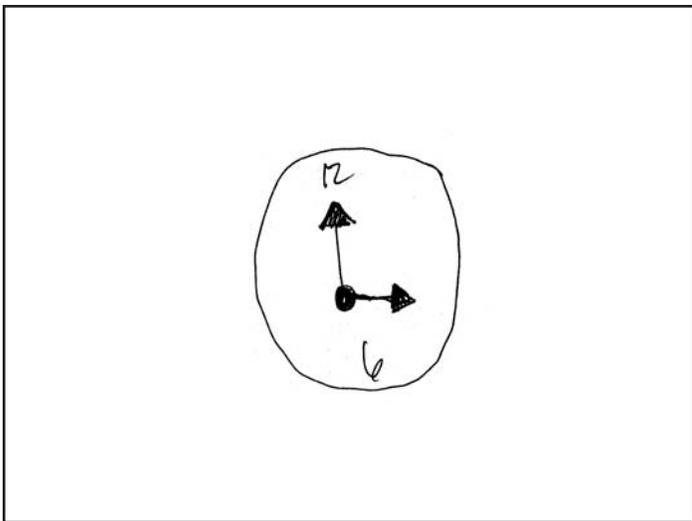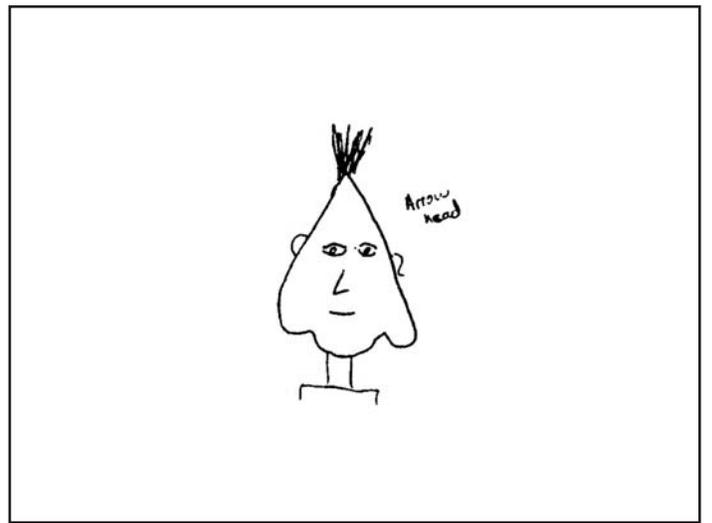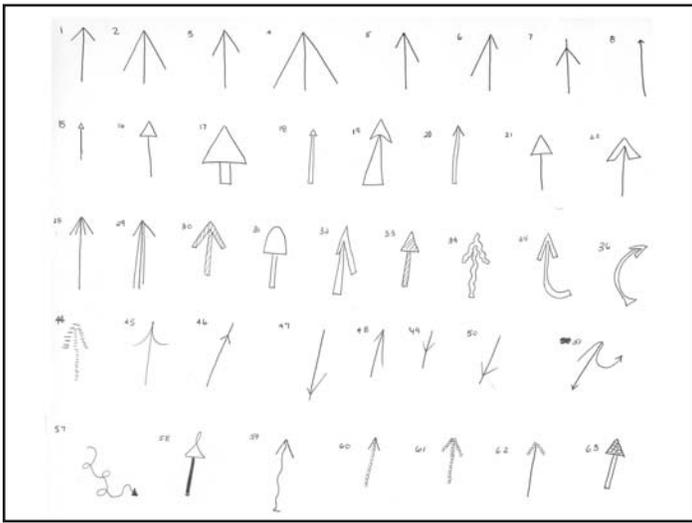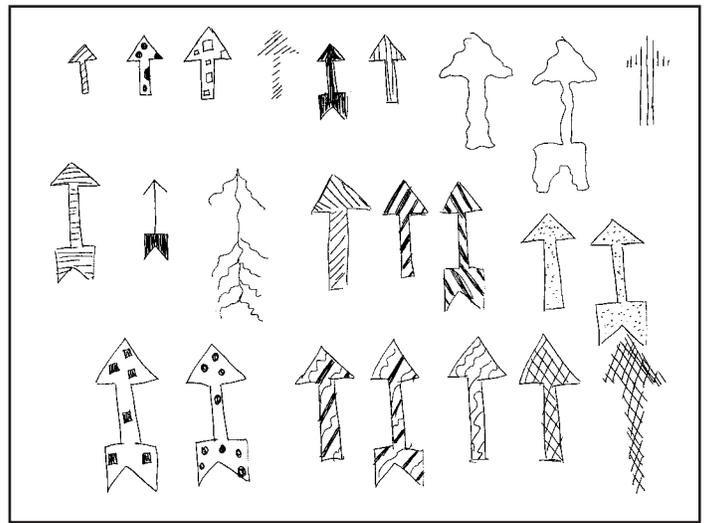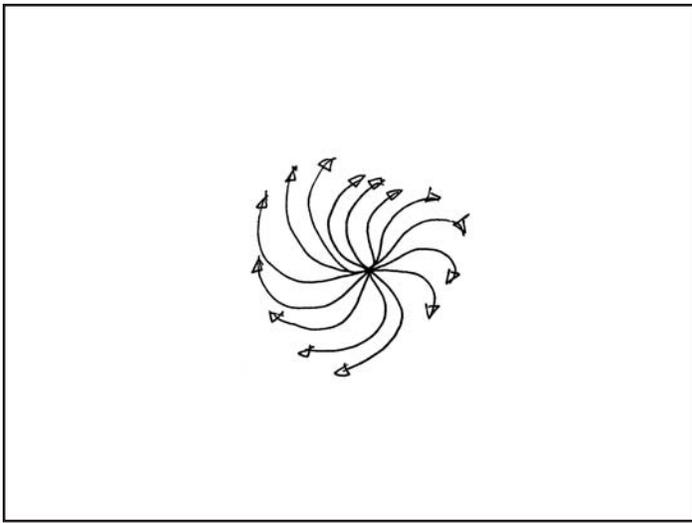
Students' comments and actions indicate that what they are thinking about is often counter-productive: they are highly preoccupied with their own ideas about creativity, and at the same time are overly sensitive to perceived limitations (not actual limits) of the project. Their inclination to try to find a single good idea – a solution to a problem – is diametrically opposed to the exploration process we want to encourage. Students start with a very different view of what is being asked for, and what it will take to come up with design alternatives at every stage of their work. By understanding their perspective, and then by teaching directly to it, we can create a firmer foundation for future work, and for a life of exploration through design.

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See pages 6-9 for notes and an selection of student responses to the exercise. (Images are sometimes cropped and are not intended to represent complete works.)

Notes

[1] Leo Tolstoy, "On Teaching the Rudiments," in *Tolstoy on Education,* Leo Wiener, ed. Chicago and London: University of Chicago Press, 1967. (As quoted in Donald Schön, *The Reflective Practitioner.* Basic Books, 1983, p. 66)

[2] Classroom conversation, Yale University School of Art, 1981

[3] James Adams, *Conceptual Blockbusting: a Guide to Better Ideas.* Reading: Addison-Wesley Publishing Co., 1986 (3rd edition). Adams discusses Edward de Bono's concept of vertical and lateral thinking (p. 34) and throughout his book introduces specific methods for idea generation. There are a great number of books that have popularized these creative techniques. Adam frequently cites:
Robert McKim, *Experiences in Visual Thinking.*
Koberg and Bagnall, *Universal Traveler, a Soft Systems Guide to Creativity, Problem Solving, and the Process of Reaching Goals*
as well as a number of primary sources on the study of creativity.

[4] John Chris Jones, *Design Methods.* New York: Van Nostrand Reinhold, 1992 (2nd edition)

[5] Neuhart, Neuhart, and Eames, *Eames Design: the Work of the Office of Charles and Ray Eames.* New York, Harry N. Abrams, Inc., 1989

[6] Cahier de Georges Braque, Paris, 1947 (as quoted in Paul Rand, *Paul Rand: a Designers' Art.* New Haven: Yale University Press, 1985, p. 189)

[7] Adams, p. 24-25. (In this brain teaser you are asked to connect nine dots, arranged in a 3x3 dot square, using no more than four straight lines and without lifting your pencil from the paper. The only way to do this is to go outside the implied boundary created by the 3x3 square of dots, and most people have difficulty breaking through that imaginary constraint.)

[8] Steven Pinker, *The Language Instinct.* New York: HarperPerennial, 1995, p. 156

ARROW SHIRT

100 Different Arrows

Scare crow