Improvisational Design of Engineering Alternatives (IDEA)

The Theory

The mechanism of humor and innovation are both very similar, in that they are both based on divergent thought. Arthur Koestler has discussed the equivalence of humor and innovation extensively,[1] and Edward de Bono likens the incongruity basis of humor to the lateral thinking required for innovation.[2] Figure 1 illustrates the similarity between the inherent incongruity of humor and the divergent thinking resulting from the same incongruity associated with creativity and innovation.

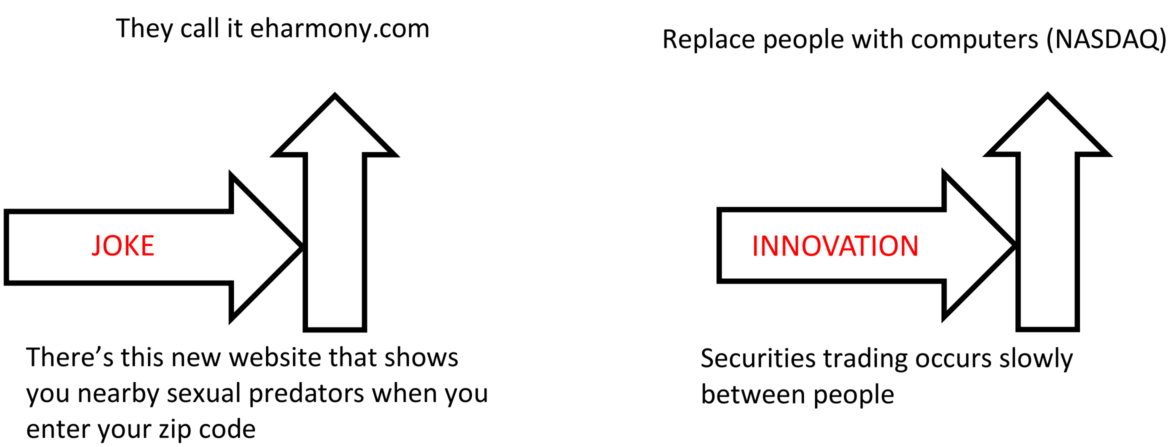

FIGURE 1. Schematic of the incongruity in both humor and innovation. The joke is provided courtesy of comedian Nikki Glaser.[3]

Technical innovation is the product of two collaborative processes: (i) design, and (ii) creativity. While technical personnel, such as scientists and engineers, have developed numerous protocols to facilitate design, there is concern that they are lacking in creativity. A 2007 study that compared music majors to engineers found that while music majors were more artistically creative than engineers, there was not a statistical difference in scientific creativity between the two groups.[4] Technical people can be just as creative as artists, but they are trained to think using deductive and rational processes which can dampen their natural creativity. Engineering design protocols help organize the important conflicts between design variables (i.e.faster vehicles require heavier engines, which in turn slow down the vehicle). However, to circumvent the inherent conflict in these variables an innovative designer must be able to explore new alternatives, and that requires creativity.

To identify such design alternatives, a drastically different approach is needed that is orthogonal to the traditional approach to the problem as seen in Figure 1. In hindsight, both the orthogonal nature and the creativity of the new alternative is obvious. However, uncovering these alternatives requires divergent thinking that systematically moves away from the traditional design approaches. Divergent thinking helps move past the cognitive barrier that constrains traditional brainstorming to the region of idea space near the traditional approaches. This can be illustrated in Figure 2. The vertical axis in Figure 2 is the infeasibility of a particular idea, and moving to a region of infeasibility is required to traverse the cognitive barriers and find unique and creative designs that are both feasible and far from the traditional design in idea space. Humorous improvisation exercises provide the means to sample this infeasible space through divergent thinking. Other approaches to divergent thinking have been suggested including liberal doses of Jägermeister, but that usually ends with you face down in the gutter with a large incision where your left kidney used to be.

Our approach to sampling idea space is analogous to the sampling of the conformation of molecules where the vertical axis in Figure 2 is energy, and the horizontal axis is molecular conformation. The goal of computer simulation is to find the low energy structures of the molecules. For highly entangled polymer molecules, molecular dynamics (MD) does not change the conformation from their initial state, and MD is the molecular equivalent of traditional brainstorming. To overcome the significant energy barrier between the initial conformational state and find the low energy molecular conformation (or the feasible idea in idea space) stochastic perturbations are used to generate random conformational changes, some of which may be of very high energy (high infeasibility in idea space). Monte Carlo models generate these random changes, and our model analogously uses humor to generate such random changes in idea space.[5]

While humorous improvisation has been used for decades in generating creative ideas for business and marketing applications, it has not been effectively applied to innovation in technical fields. Popular approaches, such as those described in “Innovation at the speed of Laughter,” by John Sweeny work well for business applications, but they are not effective in technical areas.[6] Unlike business innovation, technical innovation occurs in an idea space that is shaped differently. As seen in Figure 2, the distance between the infeasible idea space and

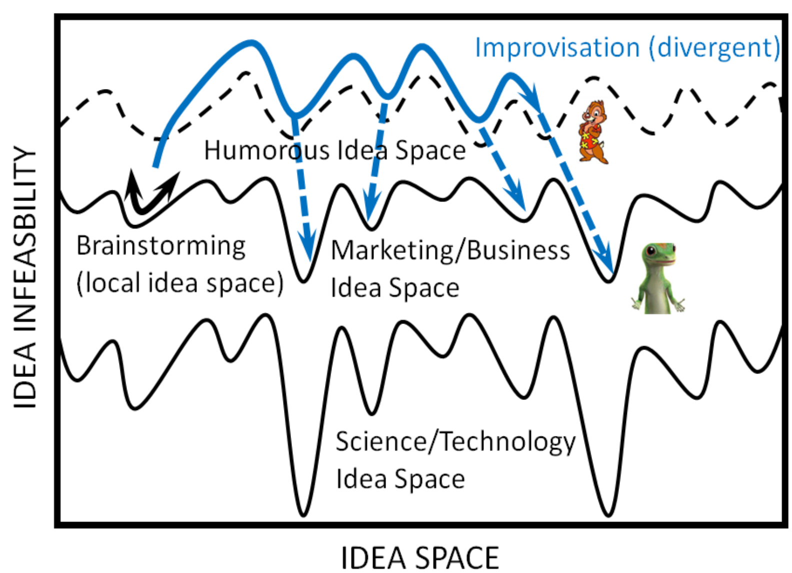

FIGURE 2. Idea infeasibility vs. hypothetical idea space. Brainstorming fails to leave local minima, but humor traverses infeasible (humorous) idea space to find unique ideas. A talking animal in an improvisation may lead to a marketing idea like the Geico Gecko®.

potentially useful ideas in business is relatively small. For example, a humorous improvisation that involves role-playing as a talking animal is sufficient to inspire a marketing campaign similar to the talking Gecko that is spokesman for the Geico auto insurance company. The approach of Sweeney and others simply collect these divergent ideas, but this single step is insufficient for technical innovation. Technical ideas are constrained by numerous physical laws and limitations which make the vertical distance in Figure 2 between the divergent ideas from improvisation space and technical idea space very large. This means that additional steps must be added to the divergent humorous improvisation step to satisfy physical constraints such as the laws of thermodynamics, mass and energy balances, and physical limits on transport processes and material properties associated with technical designs. These additional steps required to move toward technical idea space are discussed below.

The Practice

While humorous improvisation provides an effective exercise in divergent thinking, it requires additional refinements to move toward more feasible solutions in technical idea space. In addition to the initial (i) divergent step, we utilize two additional steps consisting of (ii) a convergent step and (iii) an emergent step as seen in Figure 3. Preliminary results indicate this three-step process does improve technical creativity.[7]

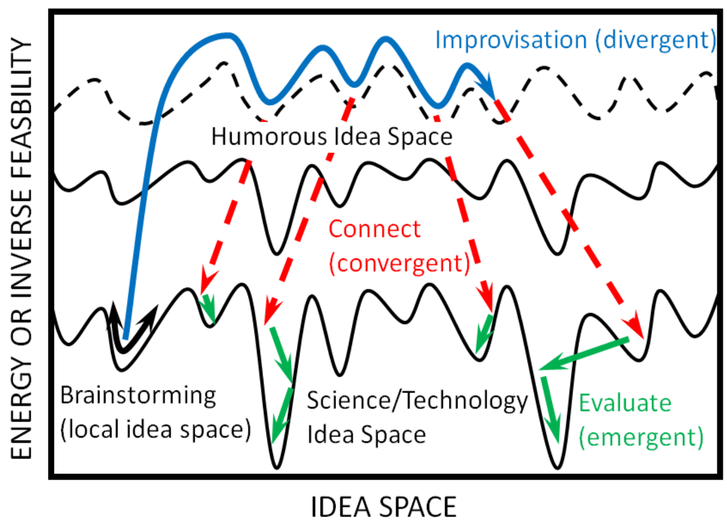

FIGURE 3. Schematic of the improvisation based technical innovation process which includes (i) a divergent humorous improvisation process to access random ideas by traversing infeasible idea space, (ii) a convergent parallel process that uses the infeasible ideas to generate technical design ideas, and (iii) an emergent process to fine-tune the solution.

A typical application of this method begins with some improvisational warm-up exercises that get people in the mood for the divergent thinking. These warm-up exercises should also set the humorous tone for this creativity exercise. While humor provides the creative energy to overcome cognitive barriers, it also improves the participants' mental proclivity for creation by increasing endorphin concentration.[8] Improvisation is dominated by two basic principles: (i) don't think, and (ii) "Yes and." Not thinking is what creates the divergent ideas that are utterly crazy and would not otherwise occur in a traditional brainstorming session. "Yes and," describes the response of one improviser when presented with an idea (the offer) from another improviser. The idea should be accepted without rejection or contradiction so as to increase the breadth of idea space sampled and to encourage even more creative contributions.

FIGURE 4. Researcher Lew Lefton leading a humorous improvisation at a 2009 American Society of Engineering Education Meeting while Pete Ludovice records both impromptu and technical ideas for design. This session lead to the design of a barbeque that compressed meat while cooking to remove fat (dubbed pushed pork, instead of pulled pork).

Before actually engaging in an improvisation exercise (typically called games), the technical design challenge to be addressed should be outlined as specifically as possible. If there are conflicts between design variables, these should also be outlined. There are many methods to outline such design variable conflicts, and one useful method is the TRIZ approach which specifically determines these design variable conflicts.[9] During each improvisation exercise, a facilitator and the rest of the participants that are not engaged in the particular improvisation should be writing down any and all silly thoughts or ideas generated from the improvisation. Sweeney and others will capture these ideas as potential candidates for creative designs, but such an approach, by itself, is not effective for technical innovation as discussed above. The initial divergent ideas are used immediately to inspire another idea related to the design challenge at hand that is more constrained by the relevant design variables. This is done in practice by writing ideas down on a two column list where one column is the original divergent idea and the second column is an idea relevant to the design challenge that is inspired by this idea as seen in Figure 4. Very often participants may be unable to use the initial divergent idea to inspire a potential idea that is loosely related to the technical challenge.

The ideas recorded by during the second convergent stage are then examined by the entire group as a whole and evaluated for their feasibility in addressing the design challenge. This discussion should include all the ideas from the entire groups to take advantage of the wider cognitive band-width of the group. The ideas resulting from this third emergent stage will also take advantage of a group improvisational dynamic as described by Sawyer.[10] It is these ideas that are derived from the emergent phase group discussion that represent potential designs. In summary, this method can be summarized by the following steps:

1. Carry out an improvisation scene or game with a subset of the group, while the remainder of the group writes down any word or phrase that is said or inspired by the divergent action of the improvisation.

2. Immediately or shortly thereafter (during the improvisation session) mentally imagine the divergent word or phrase in the context of the technical challenge and write down any additional (convergent) idea that comes to mind. This is usually done in a column adjacent to the divergent ideas.

3. Re-examine the convergent ideas with the group and refine these so feasible potential solutions to the technical challenge emerge from the group interaction.

The interplay between the three steps of the process are illustrated in an example from workshop carried out in a 2009 product design class in the School of Chemical & Biomolecular Engineering at Georgia Tech. One group wished to design a deodorizer system for athletic shoes.[7] This was an example of a very diffuse design challenge that did not have specific design variable conflicts. An improvisation exercise produced a sophomoric bathroom humor joke that produced the idea of “Reed Diffusers,” because one of the participant’s spouses had placed reservoirs of scented oils in their home’s bathrooms with natural reeds that used capillary action to distribute the scent. This inspired the convergent idea of using capillary channels in the deodorizer system. The emergent discussion produced the idea of installing capillary channels in a shoe insole to distribute a deodorizer throughout the show. One should note the tenuous connection between the divergent and convergent ideas. Here the convergent idea was simply a technological approach that is commonly used, but may or may not useful. While some thinking is involved in the convergent step, it should simply be a free association of the design challenge with the original divergent idea. This sometimes leads to a blur of the interface between divergent and convergent ideas, but this is completely acceptable.

Improvisation

Improvisation (typically called improv despite your spell-checker’s efforts to change it to improve) is, broadly speaking, any performance which is made up on the spot. When your best friend comes back to get you at the gas station with some barely plausible story about a fire truck, they were doing improv. In reality, they probably just forgot you were with them so they left. Always tell someone before you go to the bathroom.

For our discussion here, "improv" will mean improv comedy (as opposed to improvised jazz or improvised dramatic theater). An improv comedy performance consists of actors telling one or more stories on stage, without a script, and hopefully making you laugh. The art form traces its roots back to the 16th century and the travelling players of the Italtian Commedia dell'arte. In the mid-20th century it re-emerged as a teaching tool for theater students, spearheaded by Viola Spolin. Many improv games began as formal exercises to help actors establish strong characterizations and be prepared for anything that may happen in a live performance. It soon became clear, that these improv games were entertaining to watch, and by the 1960s and later, improv was established as a full-fledged performance art with companies around the world. In recent years, many have realized that the techniques which improvisers use on stage, have tremendous value as skills in the real world, for both personal and business activities. This has launched a fast growing field which can be broadly described as applied improvisation. Applied Humor Associates is the leading company in the use of applied improvisation for technical innovation.

If you want to learn some of the techniques which are used in basic improv, the best choice is to take a class from an experienced improv instructor. If you have access to the Internet, such classes are easy to find with your favor search engine. If you don't have access to the Internet, consider getting a new phone. If you're too cheap to pay for classes, you can still get an idea of how to do improv using your trusty web browser. Try http://improvencyclopedia.org as a starting point or take a look at some of the following books.

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