Innovative Boxing Gloves Using TRIZ

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Abstract

Boxing is unique among sporting activities in that victory is obtained by inflicting on the opponent such a measure of physical injury that he is unable to continue, or which at least can be seen to be significantly greater than is received in return. In boxing, the brain is subject to violent acceleration. 'Concussion' is not a precise term but represents a spectrum of states of altered or depressed consciousness. It may be associated with small hemorrhages and axonal loss, especially if repeated. The most common form of intra-cranial hemorrhage in boxing is sub-dural hematoma. [6]

In boxing, and many contact sports involving boxing gloves and safety equipment, the general objective of the equipment is to minimize the negative effect of injury, while at the same time allowing the user to function in a capacity that is not diminished or adversely effecting by the wearing of the equipment. Elements such as timing, distance, and technique should not be compromised by bulky and heavy equipment that retards speed. It would be optimum in contact sports involving punching and striking of the head and body if the skill level of the competitor was not impacted by the equipment. The baseline reference point of ideality in this type of combat would be to create a device that maximizes protection and at the same time minimizes presence. This creates an interesting contradiction, we want safety equipment, and we don't want safety equipment.

Chronic brain injury in boxers is associated with direct effects of mechanical trauma to the brain or indirect pathological features akin to Alzheimer's disease and Parkinson's disease. Chronic brain injury is found more commonly in professional boxers. [6]

Serious injuries of the eye may occur in boxing, including injuries of the eyelids, cornea, anterior chamber, lens and retina. [6]

Injuries of the nose and ears and fractures of bones of the striking fist are common. Other injuries include disturbance of hearing and of the balance mechanisms of the ear, cranial and peripheral nerve injury and contusions of the kidney. [6]

Protective equipment in boxing may not reduce the risk of brain injury, but properly designed equipment may reduce superficial injury. [6]

Ideally, head blows should be prohibited. Otherwise, the AMA should encourage universal use of protective garb such as headgear, and thumbless, impact-absorbing gloves. [7]

Introduction

Innovation is the process of seeing things in a different way. Intuitively, people posses the predilection of striving for ideality, a state where benefits are maximized and costs and harmful effects are minimized. Through our imaginations, we are sometimes are able to creatively construct virtual perfection, achieving entitlement, the best performance level theoretically attainable, and maximizing usefulness. We don't live in a perfect world. In the course our daily endeavors we are constantly confronted with contradictions between what we have and what we want. Resolving these contradictions is the essence of problem solving.

The "Theory of Inventive Problem Solving," TRIZ, is a paradigm in which problems are deconstructed to see how the pieces fit together to form the whole through a series of process steps, an algorithm, resulting in effective and efficient solutions. TRIZ was

developed in 1946, in former Soviet Union, by Genrich Altshuller. His attempts to persuade Stalin of the benefits of TRIZ led to his imprisonment until 1954. Although TRIZ has never been officially recognized or adopted by the Russian government, it is presently used in the Russian K-12 school system.

TRIZ is praxis for producing systematic innovation by a process that is predictable, repeatable, and reliable. The strength of TRIZ focuses on patent evaluation utilizing similarities that exist in a database of more then six million already existing patents. Since 1990, TRIZ practitioners have expanded their scope beyond the geographical boundary of Russia out into the rest of the world. Today with over 50 years of combined research, TRIZ has developed into a powerful method of overcoming barriers in finding timely solutions to both simple and complex problems.

The only prerequisite for TRIZ is having a "problem you can't solve." Problem solving based on TRIZ is centered upon seeing the relationships between contradictions, both technical and physical, to improve products, services, and systems.

Description of the Algorithm for TRIZ Problem Solving

Specific Problem
↓
Identify IFR
↓
Gap Analysis (IFR –Existing System) = gap
↓
Establish ideality equation ($i = F_u / F_h$)
↓
Ideality Resources (Substance, Field, Functional, Space, Time, Informational)
↓
Contradiction → ☼
↓ (Technical Contradiction: ↑A ↓B, Physical contradiction: ↑A ↓A)

TC ← ☼ → PC

↓ ← Conversion → ↓

CMT Principles ← ☼→ Separation

↓

Solution Set

↓

IFR → No → Change Perspective, Navigate

↓

Yes → Implement

Description of Some Current Products

Every Everlast boxing glove is hand-inspected in the Bronx for quality. Our professional boxing glove has been completely redesigned to conform to the shape of your fist for maximum comfort, grip, and support. A softer, more pliable top-grade leather boxing glove is now being used for extra comfort and durability. Everlast now uses a Sorbo-shock grip and a combination of three carefully chosen foams to promote metacarpal and knuckle safety without erasing your punch's power. A smooth water-resistant satin lining has been added to provide greater comfort for the hand. [1]

[1]

Everlast Traditional Youth Boxing Gloves : Designed especially to offer fit and protection for youth boxers, the Everlast® Traditional Youth boxing gloves feature full foam padding and a special Thumb-Lok™ feature.

Everlast Traditional Boxing Gloves: Everlast's Traditional boxing gloves showcase a laceless construction with dense foam padding for shock absorption. The gloves are lined with 100% cotton.


[2]

ProForce® Leatherette Boxing Gloves w/Red Palm (A Good Aerobic and Bag Glove) These multi-purpose gloves by ProForce® are ideal for martial arts, boxing, cardio and fitness workouts. Feature a pre-curved form fit design with flex grip palm. Ultra cuff wrist strap with hook and loop closure ensure a perfect fit. Thumb-lok feature offers proper form while punching. The foam core with cotton lining makes these gloves very comfortable.

[3]

Century Layered Boxing Glove: 5 layers of high quality foam covers the top of hand and thumb. All finished edges with Century name plate on back of wrist. Padded wrist with adjustable hook/ loop closure. Available in 14 or 16 oz. size.

[4]

Ringside Open-Cell foam and tricot-backed horse hair combine to form the hardest hitting glove in professional boxing. All leather construction and lace cuff provide a secure fit and offer great hand protection. Attached thumb safeguards the eyes and also helps protect the thumb as well.

[5]

Problem Description

1. Specific Problem (SP):
Design a boxing glove that is light, allowing maximum freedom of movement, and well padded, to minimize injury.

2. IFR (Imagined ultimate outcome of the problem solving process):

- Preserve useful function F_u
- Eliminate deficiencies in original system
- No ↑ in complexity

- No ↑ in harmful function F_h

3. Resources:
vinyl, rubber, cloth, plastic, cotton, nylon, foam, elastic, feathers, gel, gas, air

4. Ideality
Optimum glove would have little weight and minimize harmful impact.

5. Contradiction (TC) (GP):
↑Loss of substance ↓Harmful factors: ↑#23 ↓#29

6. Parametric Contradiction (GS):
10, 1, 34, 29

Resolving a Technical Contradiction

Algorithm for the resolution of a TC (TC: A↑ B↓)

SP → Abstraction → 39 Parameters, GP → (Contradiction Matrix) → 40 Inventive Principles, GS → Analogic thought → SS

Contradiction Matrix Result (TC)

Conceptual Definition of the Contradiction Matrix - Parametric Contradiction allows us to define our problem generically

	1 – 39 (Parameter Degrading)
1 – 39 (Parameter Improving)	Subset Principles (Analysis of similar generic problems from patent analysis)

Principle 10. Preliminary action

A. Perform, before it is needed, the required change of an object (either fully or partially).

- *Pre-pasted wall paper*
- *Sterilize all instruments needed for a surgical procedure on a sealed tray.*

B. Pre-arrange objects such that they can come into action from the most convenient place and without losing time for their delivery.
   - *Kanban arrangements in a Just-In-Time factory*
   - *Flexible manufacturing cell*

Principle 1. Segmentation

A. Divide an object into independent parts.
   - *Replace mainframe computer by personal computers.*
   - *Replace a large truck by a truck and trailer.*
   - *Use a work breakdown structure for a large project.*

B. Make an object easy to disassemble.
   - *Modular furniture*
   - *Quick disconnect joints in plumbing*

C. Increase the degree of fragmentation or segmentation.
   - *Replace solid shades with Venetian blinds.*
   - *Use powdered welding metal instead of foil or rod to get better penetration of the joint.*

Principle 34. Discarding and recovering

A. Make portions of an object that have fulfilled their functions go away (discard by dissolving, evaporating, etc.) or modify these directly during operation.
   - *Use a dissolving capsule for medicine.*
   - *Sprinkle water on cornstarch-based packaging and watch it reduce its volume by more than 1000X!*
   - *Ice structures: use water ice or carbon dioxide (dry ice) to make a template for a rammed earth structure, such as a temporary dam. Fill with earth, then, let the ice melt or sublime to leave the final structure.*

B. Conversely, restore consumable parts of an object directly in operation.
   - *Self-sharpening lawn mower blades*
   - *Automobile engines that give themselves a "tune up" while running (the ones that say "100,000 miles between tune ups")*

Principle 29. Pneumatics and hydraulics

A. Use gas and liquid parts of an object instead of solid parts (e.g. inflatable, filled with liquids, air cushion, hydrostatic, hydro-reactive).
   - *Comfortable shoe sole inserts filled with gel*
   - *Store energy from decelerating a vehicle in a hydraulic system, then use the stored energy to accelerate later.*

Solution Set (SS):
Glove should be small and air cushioned.

Separation Principles (PC)

Algorithm for the resolution of a PC (PC: A↑ A↓)

SP →Abstraction → Identify bi-polarity (GP) → Use separation principles (GS) → Analogic Thought → SS

Parameters of Separation Principles

1. Time - Using time as a factor to separate the bi-polarity
2. Space - Using space as a factor to separate the bi-polarity
3. Scale - Using scale as a factor to separate the bi-polarity
4. Condition - Using condition as a factor to separate the bi-polarity

Boxing Gloves

Separation in time: we want boxing gloves at impact (A↑); we don't want boxing gloves prior to impact (A↓)
Separation in space: we want a glove with substance; we don't want a glove with substance
Separation in scale: we want the cushioning power of a large glove; we want the motion of a small glove
Separation upon condition: large users more padding and smaller users less padding

Solution Set (SS):
Glove should be small and be without substance.

Inventive Principles

Contradiction Solution Route	Inventive Principles
	Boxing Gloves
Separation In Space	1
Separation In Time	10, 29, 34
Satisfy Contradiction	
Alternative Ways	1

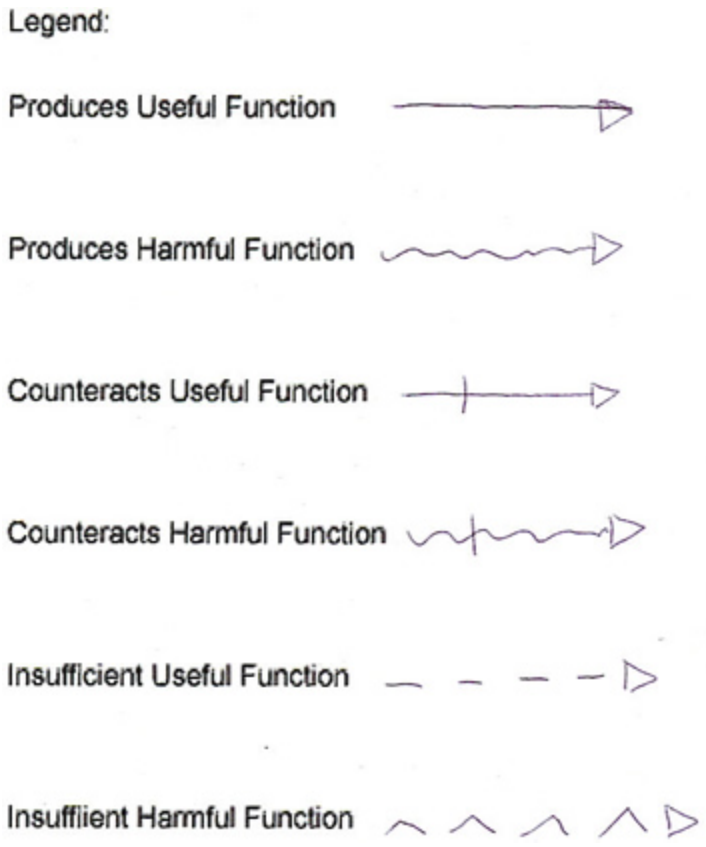
TRIZ Tools Used to Analyze the Problem

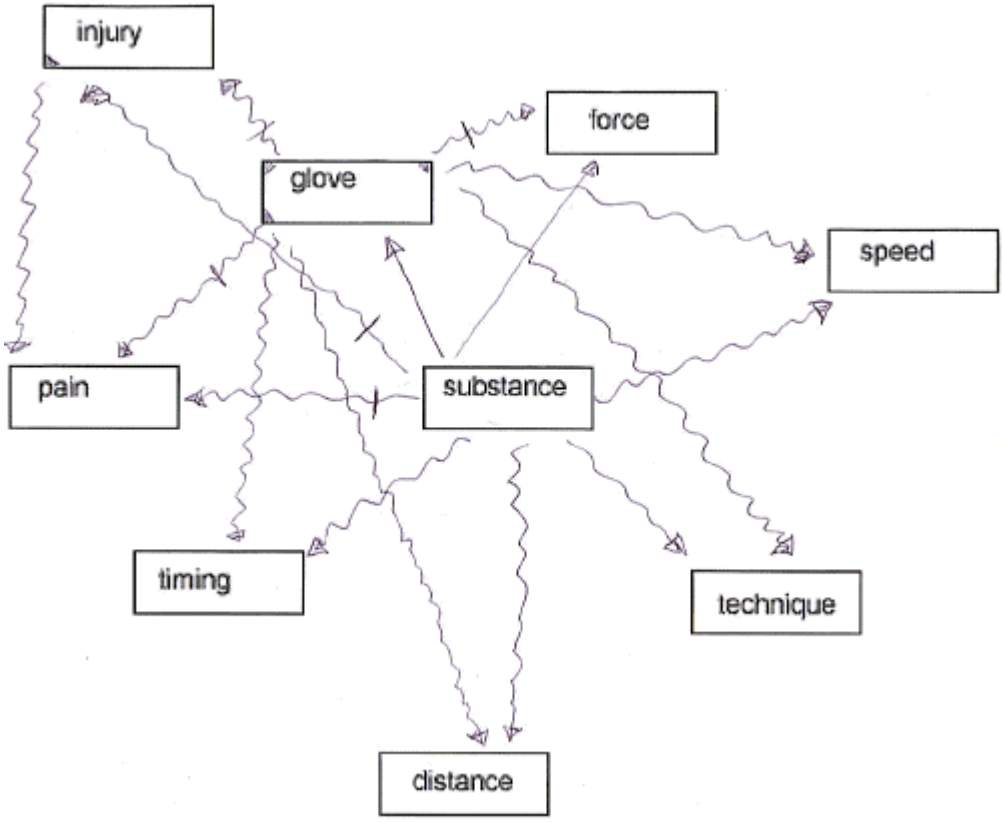
Function Modeling

Function Modeling can be used to determine elements that produce a useful or harmful function.
Function Modeling can be used to determine elements that counteract a useful or harmful function.

Four Control Questions of Function Modeling

1. Does the selection function produce another function?
2. Does the selected function counteract another function?
3. Is the selected function produced by another function?
4. Is the selected function counteracted upon another function?




injury
force
glove
speed
pain
substance
timing
technique
distance

Functions (of glove)

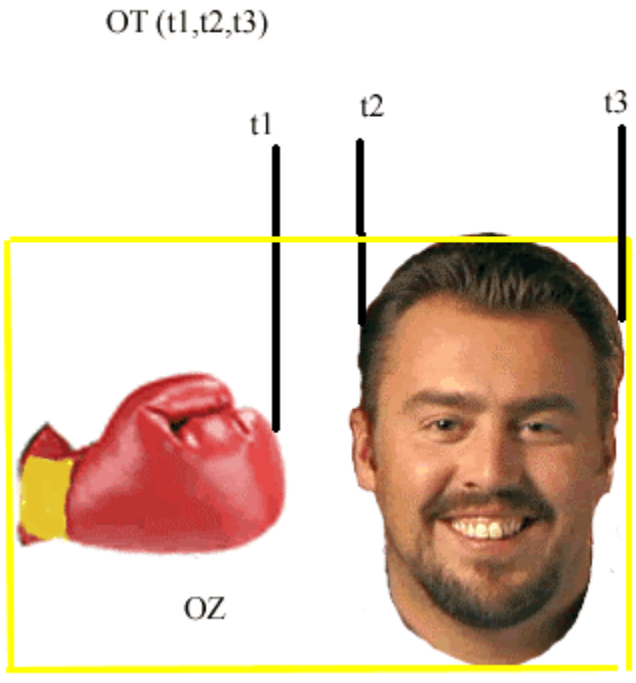
Glove is a useful function.

Glove is a harmful function.

	Functions	Elements
Useful	Minimize Injury Minimize Pain Reduces Force Decrease Force	Protect The Participant
Harmful	Alters Distance Change Timing Decrease Speed Compromise Technique	Changes Distance Changes Timing Compromises Technique

Operational Time and Operational Zone

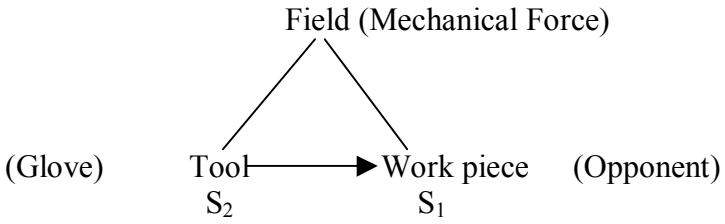
Operational Time – is the time before or after the occurrence of the operation.
Operational Zone – is the physical locality where the operation is taking place.



Su-Field Modeling

Basic Algorithm

1. Identify S_1, S_2, and F
2. Compile and Identify SU-Filed Model
3. Select Standard Solution
4. Develop a concept



TRIZ Summary

TRIZ is used to systematically reduce creativity and innovation to a set of principles and algorithms which reduces the problem solving process to a predictable, reliable, and repeatable process. Using TRIZ Methodologies creativity can be taught. Through the use of TRIZ problem solving becomes systematic because it is based on empirical observation. TRIZ is practical, there are a number of steps and tools for each step that can be easily followed to get to a final result.

Conclusion

The benefits of using TRIZ to drive development lies in the reduction of trial-and-error analysis, the elimination of tradeoff (compromise), formulating ideal resolution of a problems solution space, the identifying of existing system and gap to idealness, and the development of a positive filter for evaluating problems and solutions.

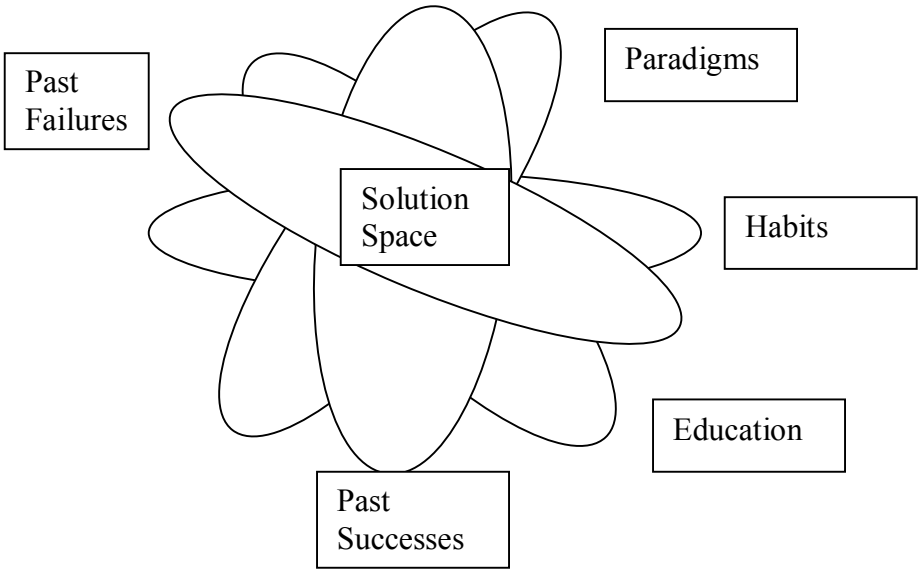
TRIZ solutions exist outside solution space and outside bias ovals by eliminating the limitations of psychological and emotional methodologies of creativity and innovation.

$y = f(x)$ transfer function

Where input variables (preventing repeatability, predictability, and reliability) are:

x_1 = limited knowledge base
x_2 = bias, prejudice
x_3 = ability to communicate
x_4 = other

Outside solution space and outside bias ovals



RESOURCES

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2.http://www.dunhamssports.com/product/index.jsp?productId=966809&cp=710957.1190233&parentPage=family, visited July 16, 2004.
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