

**“It is the *disorder* of the scientific community...the intercalation of *different* patterns of argument – that is responsible for its strength and coherence”** - Peter Galison, 1997

**“ ...the very experiences children seek out ... disequilibrium.... make for a good playground”**  
- Margaret Wheatley, 1992

# **FROM PLAY FORMS TO TRADING ZONES: TOWARDS THE DEVELOPMENT OF CONTEMPORARY SCIENTIFIC THINKING**

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***BASIS OF THIS PRESENTATION:***

**THE PREMISE THAT CONTINUED SCIENTIFIC  
ADVANCEMENT REQUIRES AN INTEGRATION OF PERSPECTIVES FROM  
SCIENTISTS IN VARYING FIELDS WHO TRADITIONALLY DON'T RELATE  
TO OR INTERACT WITH OTHERS OUTSIDE THEIR OWN FOCAL AREA.**

**THE NEED FOR A “TRADING ZONE” (AS PROPOSED  
BY SCIENTIFIC HISTORIAN AND PHYSICIST  
PETER GALISON)**

***DEFINITION:* TRADING ZONE IS AN AREA WHERE TRANSDISCIPLINARY  
COMMUNICATION AND EXCHANGE CAN OCCUR,  
ENABLING THE CONNECTING OF PREVIOUSLY SEPARATE  
DISCIPLINES**

**“The boundary areas...between the disunified bits of science (Galison, in Galison & Stump, 1996, p. 13)... “  
moving boundaries around as a result of constructive border engagements? (Fuller, in Galison & Stump, p  
185)**

**THIS PRESENTATION WILL INCLUDE:**

**\* RATIONALE FOR RELATING CHILDHOOD PLAY and  
TRADING ZONES**

**\* HYPOTHESES RELATED TO PROPOSAL  
THAT ORIGINS OF ABILITY TO FUNCTION IN A TRADING ZONE ARE IN  
CHILDHOOD PLAY**

**\* RELATIONSHIPS BETWEEN CONSTRUCTIVE PLAY, SOCIODRAMATIC  
PLAY, GENDER DIFFERENCES, SCIENCE, AND TRADING ZONES**

**\* IMPLICATIONS FOR EDUCATION**

## RATIONALE

### *Current Conception of Science*

- \* **Prevailing worldviews shape scientific inquiry – shifts in these worldviews change the nature of the inquiry (e.g. Kuhn, *The Structure of Scientific Revolutions* )**
- \* **Science is *socially constructed*. Choice of problems, approaches, and who participates in ‘doing’ science is *not* objective.**
- \* **Science is *not unified* (despite seeking of “*theory of everything*”). Varied subcultures can give coherence and strength to science.**

## *Toward Scientific Advancement*

- \* For scientific advancement to occur, scientific areas of endeavor must become more integrated and interconnected, so that multiple perspectives can be brought to bear on a problem, issue or challenge**
- \* Thus scientific knowledge advancement comes when members of established and bounded disciplines can exchange ideas in a mutually understandable language and possibly reconfigure to create new combinatory disciplines – a “trading zone” as Galison has called it**
- \* “Language (was) is the linchpin of science” (Gallison, 1997, p. 793). However jargons, special terminologies, esoteric languages restrict communication and hence collaboration and innovation among different highly defined fields**

## *Relationship of Play and Scientific Advancement*

- \* The ability to let go of bounded and comfortable ways of looking at the world – or a particular entity, can be related to the experience of play in childhood, and the development of more simple to complex forms of play (play as a complex adaptive system)**
- \* Gender differences are relevant to science and scientific inquiry, e.g. ‘women’s ways of knowing’, feminist notions of science which are congruent with current conceptions of science. Towards “androcentric science”**
- \* Females are more likely to play in ways that are linguistically rich and socially interactive. This has implications for participating in “trading zone” activities.**

## HYPOTHESES

**\* Scientific advancement requires:**

**- Postformal thinking: The highest form of thought, cross-paradigmatic, integrating metasystemic understandings and principles that *may appear unrelated to the original field of the thinkers* (Lamport-Commons & Ross, 2008)**

**- Transdisciplinary or “metadisciplinary” aspects or ability to work in the ‘trading zone’**

**\* Play and childhood play experiences can be connected with scientific thinking:**

**- There is a connection between the nature of childhood play and a later career in science (e.g. suggestive from biographies of and statements from famous scientists)**

**- Scientists are more likely to have engaged in constructive play than pretend or sociodramatic play (although the relationship is not absolute)**

**- Girls are more likely than boys to engage in sociodramatic play rather than constructive play which is more preferred by boys**

**\* Because of play histories focusing on constructive play boys who become scientists are less likely to develop the connectional and relational orientations that lead to being able to function in a 'trading zone'.**

**\* Thus those who have played more sociodramatically (usually girls) may as adult scientists have much to contribute in helping science advance through being able to encourage interactive, collaborative, and connective activity in "trading zones"**

## **TRADING ZONES are more specifically:**

- \* “Languages where people from different backgrounds can find common ground” or “exchange languages” reframing of terms from different fields so that there is one understandable discourse**
- \* “Intercalated” - “when many traditions coordinate with one another without homogenization” (or losing their identity) (Galison, 1997)**
- \* An ‘intermediary space’ where people of different disciplines can talk the same language**
- \* Places where “trading partners can hammer out a *local coordination* despite vast *global differences*” (Galison, 1997)**
- \* A “connection between place, exchange, and knowledge production”**
- \* Agreement on common goals among all participants, none dominating**

## **PLAY and ITS RELATIONSHIP TO SCIENCE (con't)**

**\* Play: A complex adaptive system, continually emergent and evolving in which simple forms blend entrain to create newer, integrated more complex forms**

**\* Play forms become more complex through entrainment, bifurcation, and phase transitions throughout the course of development.**

### **CONCEPTION OF PLAY**



### **CONCEPTION OF SCIENCE**

**“The child’s play is is the infantile form of the human ability to deal with experience by creating model situations and to master reality by experiment and planning. “ (Erikson, 1950, p. 194-5**

**The *disunity* of science – “the intercalation of different patterns of argument – that is responsible for its strength and coherence....it is by coordinating different symbolic and material actions that people create the binding culture of science” (Galison, 1997, p. 844)**

## **PLAY and ITS RELATIONSHIP TO SCIENCE**

**\* Play develops the foundation of mathematical concepts (number, measurement, pattern, computation, logical thinking, geometry, counting, pattern, relationship)**

**\* Play provides the foundation of scientific thinking (observation, exploration, curiosity, experimentation, comparison)**

***\* Albert Einstein acknowledged that his play experiences as a child were the origins of his scientific interests and thinking \****

## **PLAY FORMS**

**Play forms (play activities with specific characteristics) combine and interact with each other in the emergence of more complex play forms and play episodes.**

**Constructive play is perhaps most closely connected with physical science.**

***\* Numerous physical scientists engaged in constructive play as children \****

**Sociodramatic play is particularly significant in its apparent similarity to the scientifically oriented “trading zone”**

**CONSTRUCTIVE PLAY >-----→ BOUNDED PHYSICAL SCIENCE**

- Exploring the nature of the physical world
- Putting things together (combinatory aspects- foundation of mathematics)
- Building things
- Determining the properties of objects  
e.g. weight, size, balance, in relationship to other objects, effects of forces brought to bear on them.

- Mathematics, Physics, Chemistry

## **SOCIODRAMATIC PLAY and TRADING ZONES**

### **SOCIODRAMATIC PLAY >-----> TRADING ZONES**

**Make believe with regard to**

- \* **Role**
- \* **Object**
- \* **Situations /settings**

**Interaction among players**

**Verbalization**

**Persistence to create an episode or event**

**Linguistic – Verbal interaction**

**Thematic**

**Children adapt responses to support the theme**

**Origins in scripts –**

- Past experiences brought forth into the play frame
- **May change in interaction with others**
- Core of everyday events – child’s event knowledge, imagery and meanings (Fromberg)

**“the site – partly symbolic and partly spatial – at which the local coordination between beliefs and action takes place”**

**Language centered – seeking a commonly understood form of exchange**

**Common problem or focal area**

**“ Coordinating action and belief”**

**“ Local coordination”**

**Representational – Make believe with regard to objects**

**Representational – conveying a activity, idea, point of view**

**Playthings (objects as they are and make believe wrt objects)  
Exploration and experimentation  
Theory**

**Instrumentation  
Experimentation  
Theory**

**Fluid integration of theories flow in recurring perspectives cycle within and around the core of everyday events. Cultural contexts (Fromberg)**

**Scientific subcultures. Local coordination of**

**Boundaries fluid – are defined by players and exchange change as the play evolves**

**Exchange, place, knowledge**

**Boundaries are reconfigured in the “trading zone”**

**Phase transitions –  
Boundary release and reconfiguration**

**Occur both in sociodramatic play and trading zones**

# **HOW CAN WE ENCOURAGE DEVELOPMENT OF CAPABILITY TO FUNCTION IN A TRADING ZONE ?**

## ***IMPLICATIONS FOR EDUCATION***

### **EARLY CHILDHOOD EDUCATION**

- \* Integrate Constructive (Block and Manipulative Play) and Sociodramatic Play**
- \* Encourage more girls' participation in Block and Manipulative Play and boys' participation in sociodramatic play**
  - Put manipulative (block) and dramatic play areas in proximity (e.g. Fromberg, 2008)**
  - Extend traditional 'housekeeping' furnishings in dramatic play area to encourage multiple roles and scenarios**
  - Facilitate a variety of sociodramatic play themes**
  - Encourage Project Approach (e.g. Katz) which combines multiple play forms around a theme or purpose over time**

## **ELEMENTARY EDUCATION**

### **\* Recognize and encourage Exploratory Representational Play**

**(Wolfe, Cummins & Myers, 1998)**

**- Process of ‘shared systematic inquiry’; ‘explorations with representational and symbolic aspects’ (Advanced, more symbolically focused, form of the Project Approach**

### **\* Increase resources in, time for, and opportunities in, Art, Music and Physical Education**

**- Research evidence for increased learning, mathematical and scientific, as a result in participating in these activities**

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