THE SANDPILE MODEL:
OPTIMAL STRESS,
COMPLEXITY, AND HORMESIS

“THE WORLD BREAKS EVERYONE; BUT, IN THE END, PEOPLE ARE STRONGER AT THE BROKEN PLACES.”

ERNEST HEMINGWAY

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HOW PATIENTS GET BETTER

INPUT FROM THE OUTSIDE
AND THE PATIENT’S CAPACITY
TO PROCESS, INTEGRATE,
AND ADAPT TO THAT INPUT

i.e., ENVIRONMENTAL INPUT
(WHICH CONSTITUTES THE DOSE)

AND THE SYSTEM’S CAPACITY
TO MANAGE THAT INPUT
(WHICH CONSTITUTES THE RESPONSE)
HOW PATIENTS GET BETTER

AN OPTIMAL DOSE OF STRESSFUL INPUT

BY TRIGGERING THE BODY’S INNATE ABILITY TO HEAL ITSELF

WILL PROVOKE “MODEST OVERCOMPENSATION” AND A STRENGTHENING AT THE BROKEN PLACES
CHALLENGE  v.  SUPPORT

CHALLENGE THE PATIENT BY DIRECTING HER ATTENTION TO WHERE SHE ISN’T OR SUPPORT THE PATIENT BY RESONATING WITH WHERE SHE IS

CHALLENGE BY WAY OF ANXIETY – PROVOKING INTERPRETIVE STATEMENTS THAT CALL INTO QUESTION HER DEFENSES OR SUPPORT BY WAY OF ANXIETY – ASSUAGING, EMPATHIC STATEMENTS THAT HONOR THOSE SELF–PROTECTIVE DEFENSES
LEVEL OF ANXIETY

IF TOO MUCH ANXIETY, PATIENT MAY “GET DEFENSIVE” AND BE UNABLE TO TAKE IN THERAPIST’S INPUT

BUT IF MORE MANAGEABLE ANXIETY, PATIENT MAY BE ABLE TO PROCESS AND INTEGRATE THERAPIST’S INPUT

AND ULTIMATELY ADAPT TO IT BY RECONSTITUTING AT A HIGHER LEVEL
POSSIBLE RESPONSES ...

IF TOO MUCH CHALLENGE / ANXIETY / STRESS, THEN TOO OVERWHELMING TO PROCESS AND INTEGRATE DEFENSIVE COLLAPSE WILL INSTEAD BE TRIGGERED

IF TOO LITTLE CHALLENGE / ANXIETY / STRESS, THEN NO IMPETUS FOR TRANSFORMATION AND GROWTH THE STATUS QUO WILL SIMPLY BE REINFORCED
OPTIMAL RESPONSE …

BUT JUST THE RIGHT AMOUNT
OF CHALLENGE / ANXIETY / STRESS

– HANS SELYE’S “OPTIMAL STRESS” –

WILL OFFER JUST THE RIGHT COMBINATION
OF CHALLENGE AND SUPPORT
NEEDED ULTIMATELY TO PROMPT
AFTER AN INITIAL (DEFENSIVE) DERAILMENT

SUBSEQUENT (ADAPTIVE) RECONSTITUTION
AT A HIGHER LEVEL
OF ORDER, COMPLEXITY, AND INTEGRATION
OPTIMIZING GROWTH POTENTIAL

CHALLENGE WHEN POSSIBLE AND SUPPORT WHEN NECESSARY TO GENERATE AN OPTIMAL LEVEL OF ANXIETY WHICH WILL THEN PROVIDE THE IMPETUS FOR EVOLUTION TO A HIGHER LEVEL OF COMPLEX ORDEREDNESS AND INTEGRATED COHERENCE
LEVELS OF COMPLEXITY

WHEN THE SYSTEM CAN PROCESS, INTEGRATE, AND ADAPT, THEN THE SYSTEM WILL PROGRESS TO A HIGHER LEVEL OF COMPLEXITY

WHEN THE SYSTEM MUST INSTEAD DEFEND, THEN THE SYSTEM WILL REGRESS TO A LOWER LEVEL OF COMPLEXITY

THE CAPACITY TO ADAPT BUT THE NEED TO DEFEND
OPEN SYSTEMS

CHAOTIC – UNDERLYING ORDEREDNESS DESPITE APPARENT RANDOMNESS

COMPLEX – INTERDEPENDENCE OF COMPONENTS

ADAPTIVE – CAPACITY TO BENEFIT FROM EXPERIENCE

NONLINEAR – UNPREDICTABLE EVOLUTION OVER TIME

DYNAMICAL – EMERGENCE OF NOVEL STRUCTURAL CONFIGURATIONS

SELF-ORGANIZING – EMERGENCE OF GLOBAL PATTERNS ARISING FROM LOCAL INTERACTIONS
THE INTRINSIC STRUCTURE OF A CHAOTIC SYSTEM IS SUCH THAT ORDER WILL ULTIMATELY EMERGE FROM CHAOS.

NONLINEARITY – WHENEVER SOME CRITICAL THRESHOLD IS REACHED ERRATIC, DRAMATIC, AND SOMETIMES CATASTROPHIC TRANSITIONS FROM ONE STATE OF COMPLEXITY TO ANOTHER.
PSYCHOTHERAPY

STRESSFUL INPUT
THAT EITHER CHALLENGES OR SUPPORTS
WILL INDUCE HEALING CYCLES
OF DISRUPTION AND REPAIR

IN THE FACE OF OPTIMAL CHALLENGE,
CYCLES OF DEFENSIVE COLLAPSE
AND ADAPTIVE RECONSTITUTION
AT EVER—HIGHER LEVELS
OF PSYCHOLOGICAL COMPLEXITY

PSYCHOTHERAPY – BELATED PROCESSING
OF UNMASTERED EXPERIENCE
THE SANDPILE MODEL

PARADOXICAL IMPACT OF STRESS
ON THE LIVING SYSTEM

A DRAMATIC DEPICTION
OF THE CUMULATIVE IMPACT, OVER TIME,
OF ENVIRONMENTAL STRESSORS
ON OPEN SYSTEMS

SYSTEMS WILL REFASHION THEMSELVES
AT EVER – HIGHER LEVELS
OF COMPLEXITY AND INTEGRATION –
NOT JUST IN SPITE OF STRESSFUL INPUT
FROM THE OUTSIDE
BUT BY WAY OF THAT INPUT
THE SANDPILE MODEL

BOTH DISRUPTION AND REPAIR

NOT ONLY DO THE GRAINS OF SAND PRECIPITATE PARTIAL COLLAPSE OF THE SANDPILE BUT ALSO THEY BECOME THE MEANS BY WHICH THE SANDPILE IS ABLE TO BUILD ITSELF BACK UP

THE SYSTEM WILL THEREFORE HAVE BEEN ABLE NOT ONLY TO MANAGE THE IMPACT OF THE STRESSFUL INPUT BUT TO BENEFIT FROM THAT IMPACT
POISON v. MEDICATION

PARACELSUS – THE DIFFERENCE BETWEEN A POISON AND A MEDICATION IS THE DOSAGE THEREOF

AND, I WOULD ADD, THE SYSTEM’S CAPACITY – A FUNCTION OF ITS UNDERLYING RESILIENCE – TO PROCESS, INTEGRATE, AND ADAPT TO THE IMPACT OF THAT STRESSOR

STRESSFUL INPUT IS INHERENTLY NEITHER BAD (POISON) NOR GOOD (MEDICATION)
DEFENSE v. ADAPTATION

POISON BECOMES MEDICATION

THE THERAPEUTIC USE OF STRESS TO PROVOKE RECOVERY BY ACTIVATING THE BODY’S INNATE ABILITY TO HEAL ITSELF

WHAT DOESN’T KILL YOU MAKES YOU STRONGER

OPTIMAL CHALLENGE / OPTIMAL STRESS THE HEROINE IN OUR PIECE

THE SYSTEM’S ABILITY TO ADAPT TO STRESSFUL INPUT
STRESSFUL STUFF

EITHER A GROWTH – DISRUPTING EVENT OR A GROWTH – PROMOTING OPPORTUNITY

HOW WELL THE MINDBODYMATRIX IS ABLE TO PROCESS, INTEGRATE, AND ULTIMTELY ADAPT TO THE CUMULATIVE IMPACT, OVER TIME, OF ENVIRONMENTAL STRESSORS WILL EITHER HASTEN A COMPROMISED SYSTEM’S DETERIORATION OR SUPPORT A MORE RESILIENT SYSTEM’S EVOLUTION TOWARD INCREASING COMPLEXITY
COPING WITH STRESS

WHETHER THE PRIMARY TARGET IS MIND OR BODY

THE CRITICAL ISSUE WILL BE THE ABILITY OF THE MINDBODYMATRIX TO HANDLE STRESS THROUGH ADAPTATION

OPTIMAL STRESS – WILL PROVIDE JUST THE RIGHT THERAPEUTIC LEVERAGE TO INDUCE, AFTER INITIAL DISRUPTION, ADAPTIVE RECONSTITUTION AT EVER – HIGHER LEVELS OF COMPLEXITY, INTEGRATION, AND ADAPTIVE CAPACITY
FROM STABILITY TO COMPLEXITY ...  

“MINIMAL LOAD” – THE INITIAL STAGE DURING WHICH THE SYSTEM’S HOMEOSTATIC MECHANISMS WILL ALLOW IT TO PRESERVE ITS STATUS QUO

“OPTIMAL LOAD” – A COMPENSATORY STAGE DURING WHICH THE SYSTEM’S UNDERLYING RESILIENCE WILL ENABLE IT TO EVOLVE TO EVER – HIGHER LEVELS OF COMPLEXITY AS IT ADVANCES THROUGH CYCLES OF DEFENSIVE COLLAPSE – A “MINOR AVALANCHE” IN CHAOS THEORY – AND ADAPTIVE RECONSTITUTION,

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... TO CHAOS

“OVERLOAD” – THE TERMINAL STAGE OF DECOMPENSATION DURING WHICH THE OVERBURDENED SYSTEM WILL SUSTAIN CATASTROPHIC COLLAPSE – A “MAJOR AVALANCHE” IN CHAOS THEORY – AND DEVOLVE TO A MUCH LOWER LEVEL OF COMPLEXITY

WHEN A CRITICAL THRESHOLD HAS BEEN REACHED A TIPPING POINT A SATURATION POINT A POINT OF TOXIC ACCUMULATION
Nonlinear Evolution of the Sandpile Over Time

Martha Stark (2011)
EVOLUTION OF CHAOTIC SYSTEMS

FROM MINIMAL LOAD
THROUGH OPTIMAL LOAD TO OVERLOAD

FROM MINIMAL STRESS
THROUGH OPTIMAL STRESS TO TRAUMATIC STRESS

FROM UNADAPTED
THROUGH ADAPTED TO MALADAPTED

FROM UNCOMPENSATED
THROUGH MODESTLY OVERCOMPENSATED
TO DECOMPENSATED

FROM HOMEOSTASIS
THROUGH ALLOSTASIS TO DYSHOMEOSTASIS
EVOLUTION OF LIVING SYSTEMS

FROM STABILITY
THROUGH INCREASING COMPLEXITY
TO CHAOS

BY VIRTUE OF THE FACT
THAT LIVING SYSTEMS ARE
OPEN
COMPLEX ADAPTIVE
NONLINEAR DYNAMICAL
SELF – ORGANIZING
AND CHAOTIC

JUST LIKE THE SANDPILE
THE HORMETIC EFFECT

THE ALMOST UNIVERSAL BIPHASIC DOSE–RESPONSE CURVE CHARACTERIZED BY LOW–DOSE STIMULATION SECONDARY TO EITHER MODEST OVERCOMPENSATION TO DISRUPTION IN HOMEOSTASIS OR DIRECT STIMULATION AND HIGHER–DOSE INHIBITION
MODEST OVERCOMPENSATION

BUT IF MODEST OVERCOMPENSATION TO AN EARLIER DISRUPTION IS POSITED AS A PRIMARY CAUSE OF LOW–DOSE STIMULATION, THEN DON’T OUR EXPERIMENTS NEED TO FACTOR IN THE ELEMENT OF TIME?

DON’T OUR STUDIES NEED TO TRACK HOW INDIVIDUAL SUBJECTS WILL RESPOND, OVER TIME, TO THE CUMULATIVE IMPACT OF STRESSFUL INPUT?
EVOLUTION OF A SANDPILE

... TO CONCEPTUALIZE THE COMPLEX – AND PARADOXICAL – RESPONSIVENESS OF PATIENTS TO THE MYRIAD OF ENVIRONMENTAL STRESSORS TO WHICH THEY ARE BEING CONTINUOUSLY EXPOSED

THE HORMETIC EFFECT WOULD THEN BE REPRESENTED AS A COMPLEX SERIES OF NONMONOTONIC CURVES MARKED BY MULTIPLE TRANSITION POINTS
EXCESS STRESS WILL CAUSE MENTAL AND PHYSICAL DISTRESS AND, AS TIME PASSES, DYSHOMEOSTASIS AND CHRONIC ILLNESS.

BUT MY HYPOTHESIS IS THAT LESS STRESS, IF WELL ENOUGH PROCESSED, WILL PROVIDE THE IMPETUS FOR HEALING AND WELLNESS, AND A STRENGTHENING AT THE BROKEN PLACES – ‘CAUSE OF HORMESIS

Martha Stark (2011) – Dedicated to Ed Calabrese