

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

MARTHA STARK, MD

MarthaStarkMD@HMS.Harvard.edu

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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**

SELF – ORGANIZATION

**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

**THE DOSAGE OF THE STRESSOR,
THE SYSTEM'S UNDERLYING ADAPTABILITY,
AND THE "INTIMATE EDGE"
BETWEEN STRESSOR AND SYSTEM
WILL DETERMINE WHETHER THE SYSTEM
DEFENDS AND DEVOLVES
TO EVER – GREATER DISORGANIZATION**

**OR ADAPTS AND EVOLVES,
BY WAY OF A SERIES OF HEALING CYCLES,
TO EVER – MORE COMPLEX
LEVELS OF ORGANIZATION
AND DYNAMIC BALANCE**

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

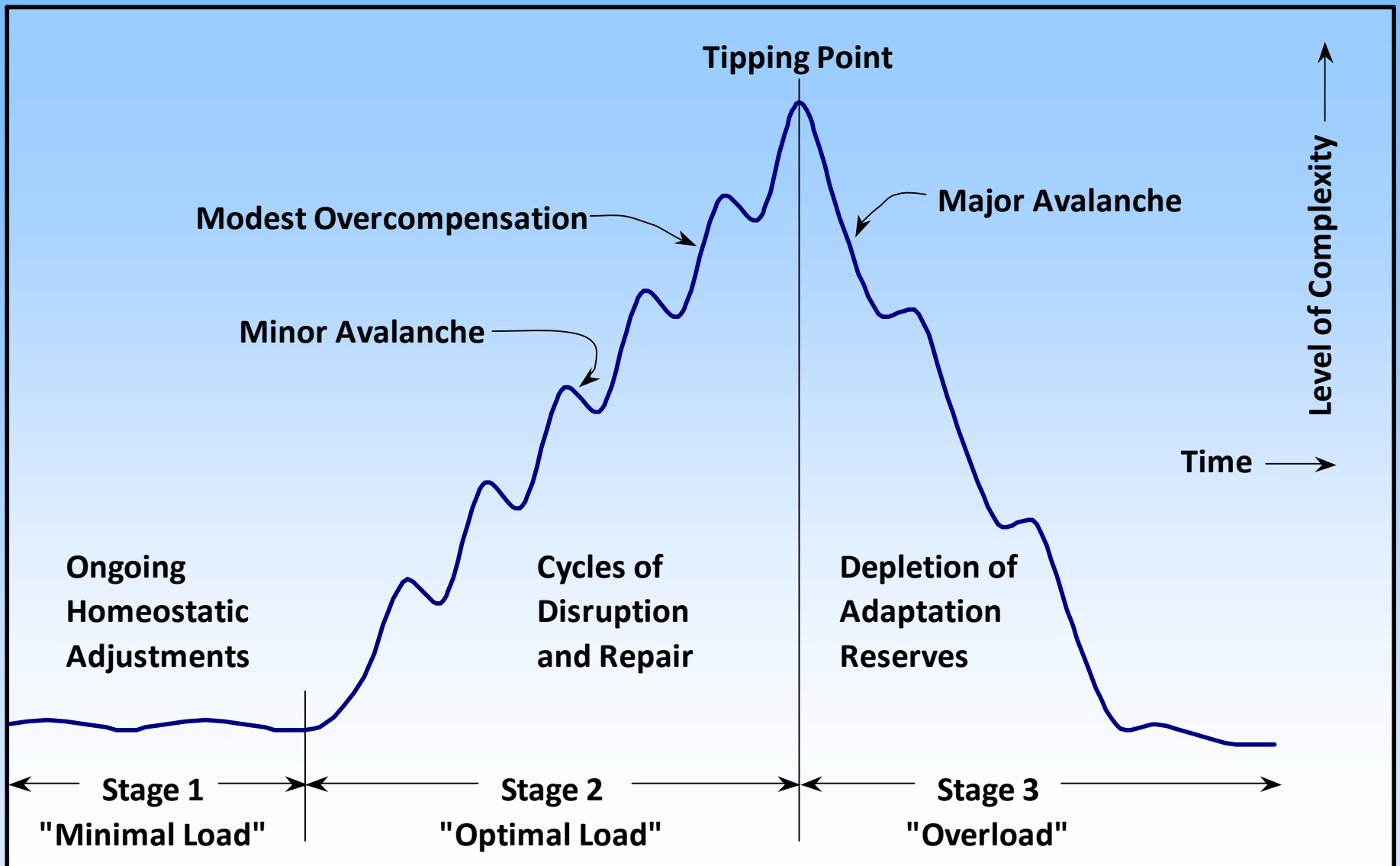
AS IT ADVANCES THROUGH CYCLES OF DEFENSIVE COLLAPSE

– A “MINOR AVALANCHE” IN CHAOS THEORY – AND ADAPTIVE RECONSTITUTION

... 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**

OPTIMAL STRESS AND HORMESIS

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