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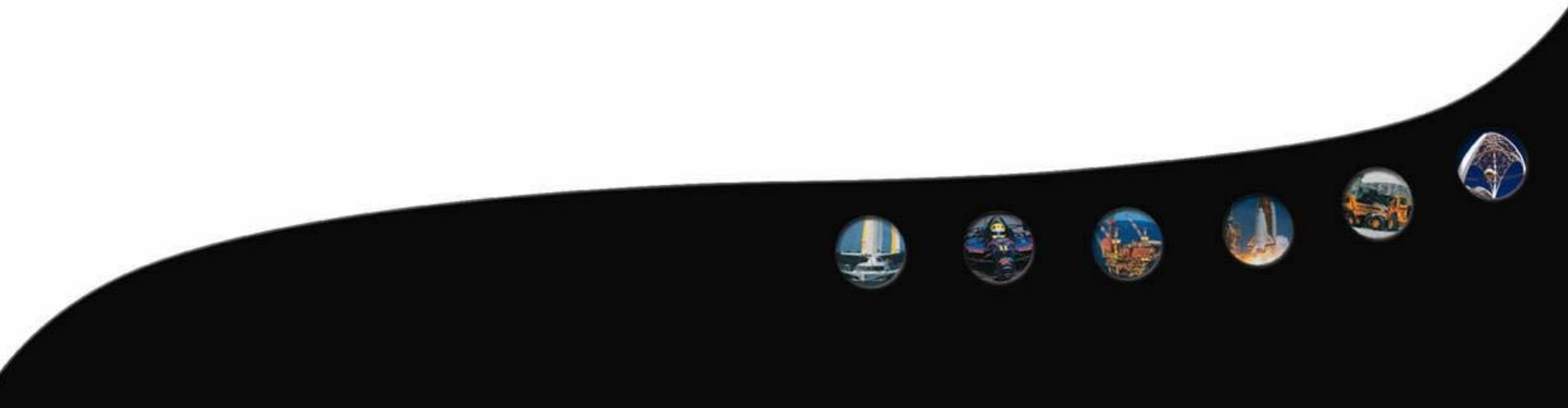
DYNAMICS OF SOCIAL SYSTEMS – ANALYSIS & DESIGN

TOM DOHERTY
TOMMY CONCEPTS dba



Dynamics of Social Systems (DSS), Analysis & Design

NAFEMS 2020, Hampton VA, 10/29/08

Tom Doherty

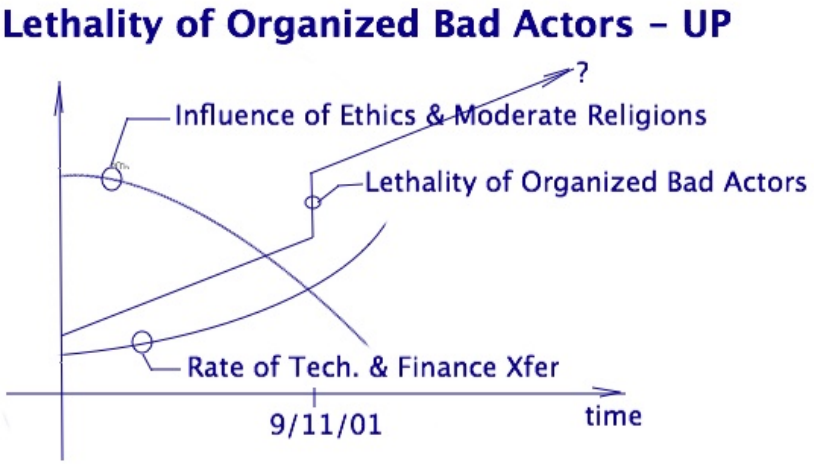
- Tommy Concepts dba
- DSS Introduction
- Analogy Between Physical & Social Systems
- Sample Dynamics Modeling Results
- Ideas on Next Steps
- Questions

Tommy Concepts dba

- Part time 1985 - 1999: SCAE Associates (biomed industry consulting, solid modeling, FEA, mechanism synthesis – analysis, Design By Simulation paradigm)
- Full time 2000 - 2002: SCAE Associates (interlocking building module patent & consumer, aeronautical, biomed consulting)
- New name 2003 – Present: Tommy Concepts dba (rehab engineering, yacht/boat design & concepts, video courseware & paper on “Dynamics of Social Systems”)
- Mission: Help Others While Having Fun
- Website / Contact: www.tommyconcepts.com

DSS Introduction

- International Conflicts -> Appear to Last Forever
- Global Tech. & Finance Transfer Rates -> Increasing
- Ethics & Moderate Religions -> Declining Influence
- Theory of Modern City –> In Jeopardy



DSS Introduction

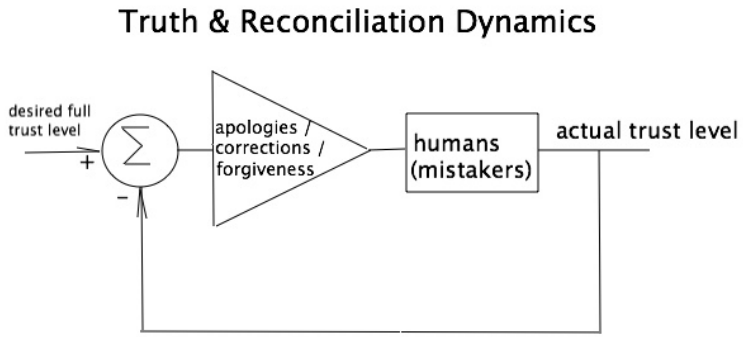
- Persistent High Crime Levels (continued K-12 & college “Columbine Effect”, Known Bad Locales, Domestic Violence)
- Persistent High Levels of Relationship Flops (bullying, spiralling fights, one and two way forever grudges, splits, past friends become enemies, etc.)
- Mysterious Marketing / Attraction Dynamics
- Slow Social Change Processes (directional conflicts not resolved quickly)

DSS Introduction
Augmenting "Wisdom of Ages"

Biblical Conflict Resolution Methods:

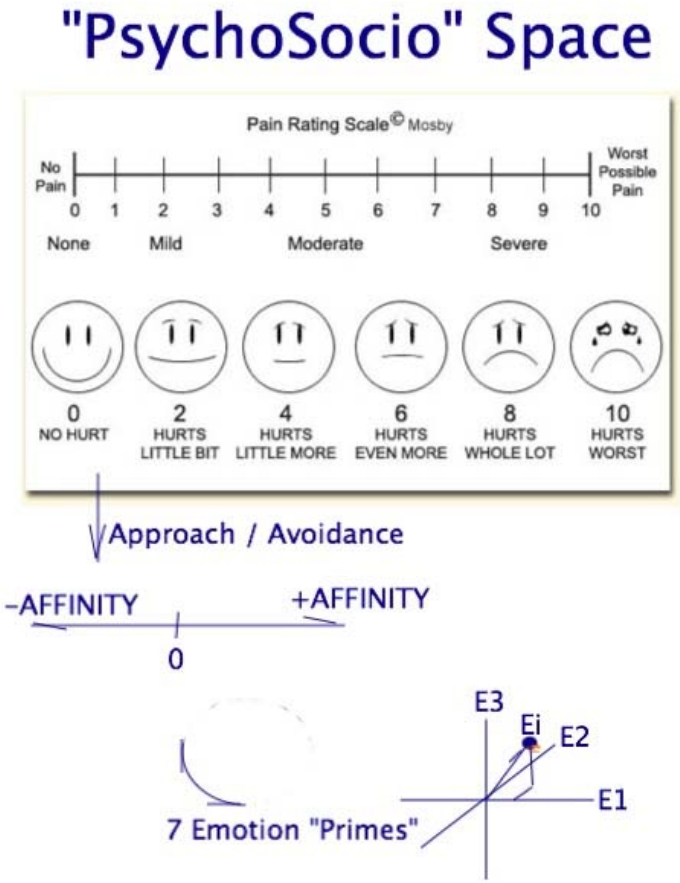
- **Prevention** (avoid strife, only fools quarrel)
- **Fix Yourself First** (speck in friend's eye yet log in yours)
- **Legal Escalation Route** (1/1 dialogue, arbitration, courts)
- **Forgiveness Route** (seek apology / correction --> forgive)

Signal Flow Chart for Trust Maintenance:



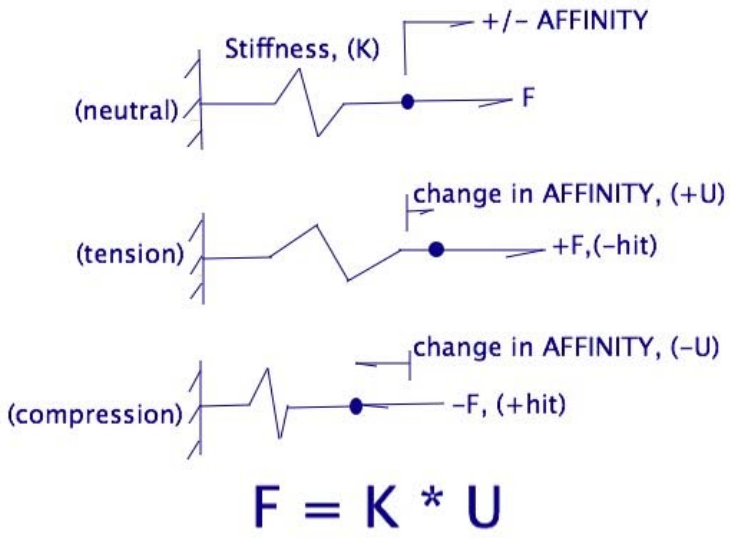
Analogy Between Physical & Social Systems
Defining the AFFINITY scale...

- Facial expression
  Mosby's pain rating scale (a good starting point) for individuals or groups (social "***units***")
- Conflict - attraction dynamics are described by a point on the "***AFFINITY*** scale" for each unit
- AFFINITY toward "the object" is a cognitive thought that influences and is influenced by 7 prime emotions



Analogy Between Physical & Social Systems
Mental spring (K), force (F), & displacement (U)

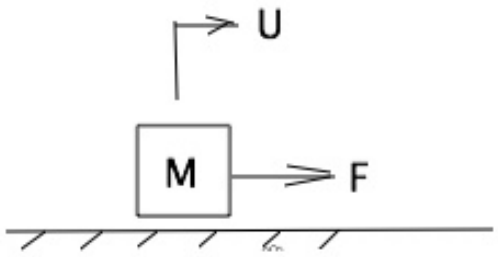
- Mental spring idealization is a device in the unit's mind that stores potential energy of applied emotio-mental forces.
- Gifts, services, love, mercy, beauty, “+value” things are “- hit” forces.
- Thefts, contract violations, injustices, physical strikes, “-value” things are “+ hit” forces.



Analogy Between Physical & Social Systems
Mental mass

- Mental mass idealization is a device that stores kinetic energy of applied emotio-mental forces.
- Mental “inertial” device enables internal time delay in recognizing new force step changes, natural frequencies, etc.

Visualization of Idealized Mass Element

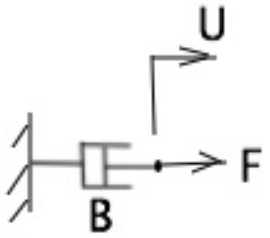


$$F = M * A$$

Analogy Between Physical & Social Systems
Mental damper

- Damper dissipates mental energy from +/- “rate of change of AFFINITY” (V)
- Examples:
  - Distractions
    - Music, art, humor...
    - “- value distracts”
  - Perception changes
  - Third party involve
  - Forgiveness

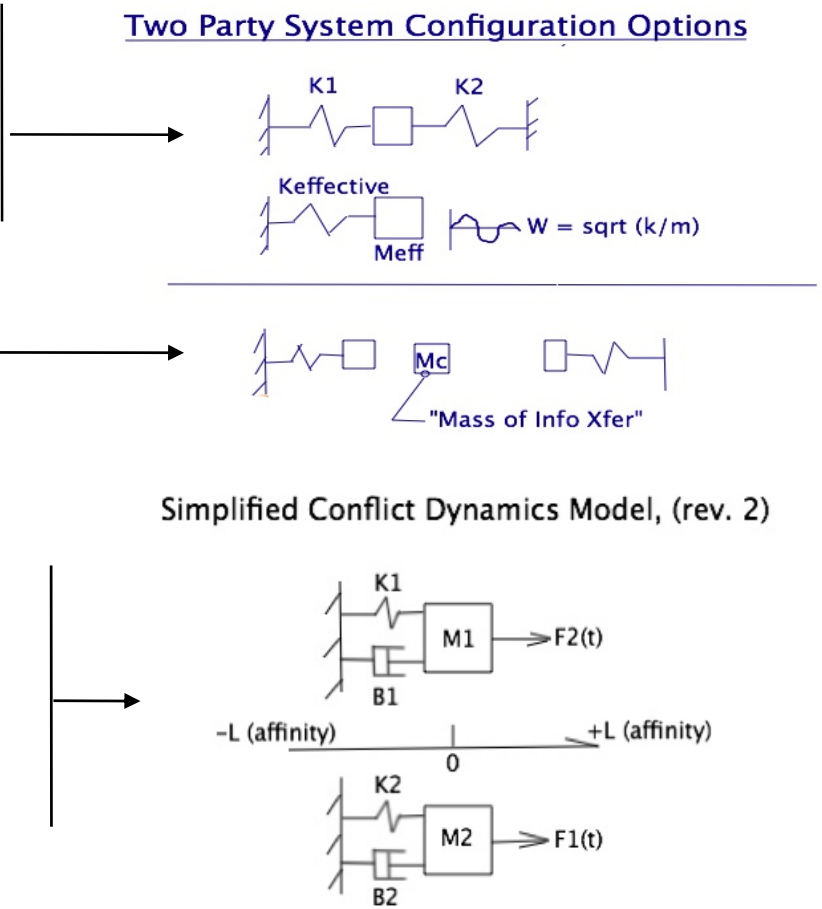
Visualization of Idealized Damping Element



$F = B * V$

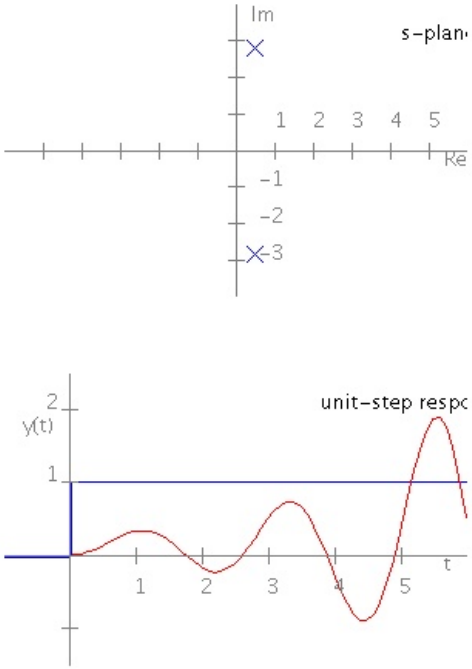
Analogy Between Physical & Social Systems
Two Party System Configurations

- Simplest model has one “effective spring” and one “effective mass”
- More advanced approaches may benefit from a “Mass of Info.” element
- Two decoupled 2nd order spring mass damper systems is a good first step model configuration

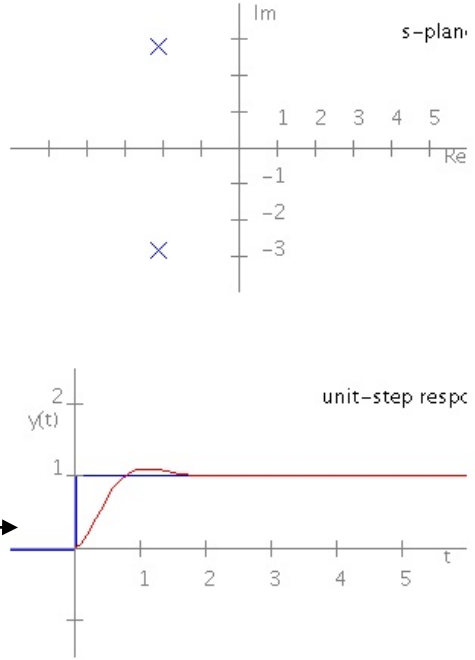


Analogy Between Physical & Social Systems
Design of "Good Vibe" Systems

Methods exist to ***DESIGN*** systems with "good" dynamics: (eg. prefer stiffer & lighter systems to keep natural frequencies high & choose "just right" damping levels.)



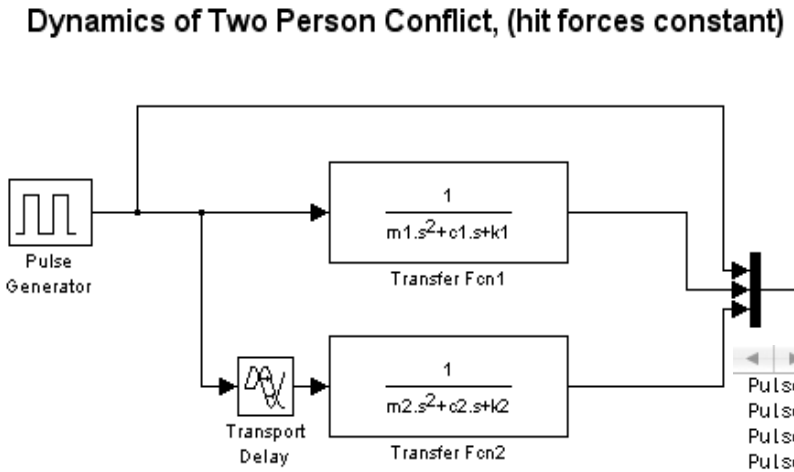
- Inadequate or negative damping (B) leads to unstable dynamics
- "Just right" damping (zeta ~ 0.7) gives fast stable response to sudden loads



(results from S-plane utility by Brian Woo - Johns Hopkins Univ. website)

Sample Dynamics Modeling Results
Matlab / Simulink implementation

- Each unit is a 2nd order system
- One unit “hits” first, after delay the 2nd unit “hits” back, & so forth
- “Eye for an Eye” constant magnitude responses by both
- Standard dynamics terms used



Model Sketch

Model File

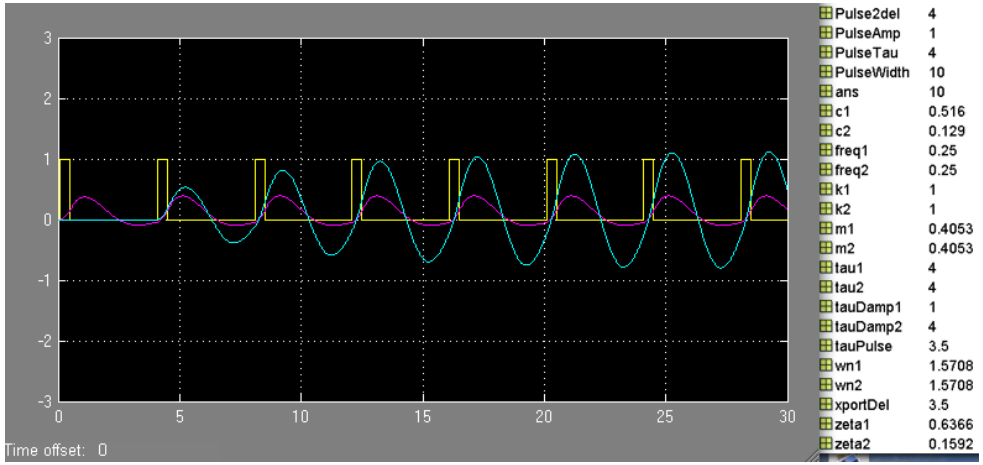
```
dss_setup.m:1
PulseTau   = 4
PulseAmp   = 1
PulseWidth = 10
Pulse2del  = PulseTau

k1         = 1
tau1       = 4
tauDamp1   = 1
freq1      = 1/tau1
wn1        = 2*pi*freq1
m1         = k1/wn1^2
zeta1      = 1/(tauDamp1*wn1)
c1         = 2*zeta1*m1

k2         = 1
tau2       = 4
tauDamp2   = 16
freq2      = 1/tau2
wn2        = 2*pi*freq2
m2         = k2/wn2^2
zeta2      = 1/(tauDamp2*wn2)
c2         = 2*zeta2*m2
```

Sample Dynamics Modeling Results
Influence of damping

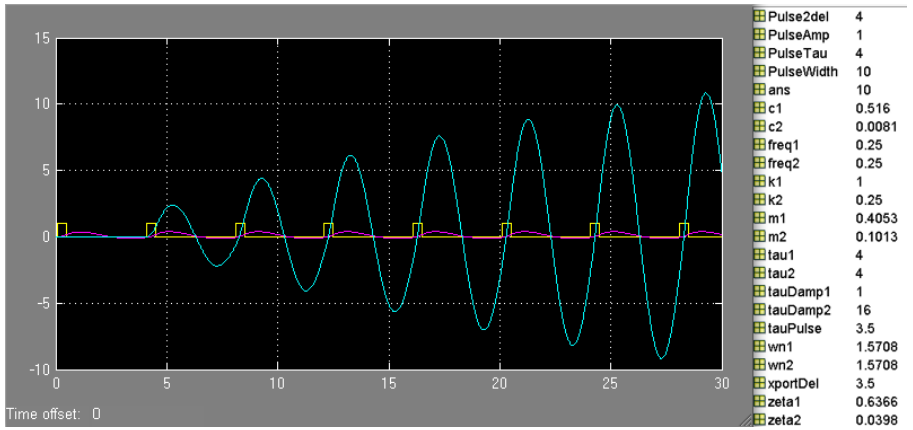
- Model Run 2
- Parameters K & M same for both units
- Damping B of unit 1 is 4X that of unit 2
- Unit 2's “AFFINITY” swings to same magnitude hit are larger



Loading Pulse, AFFINITY1, & AFFINITY2 vs. Time

Sample Dynamics Modeling Results
Stability differences between "units"

- Model Run 5
- Well damped, stiffer, and heavier "Unit 1" has more stable response to same load pulse magnitude
- Note: damping differences much larger than stiffness & mass differences



Parameter ratios between Unit 1 & Unit 2 are:

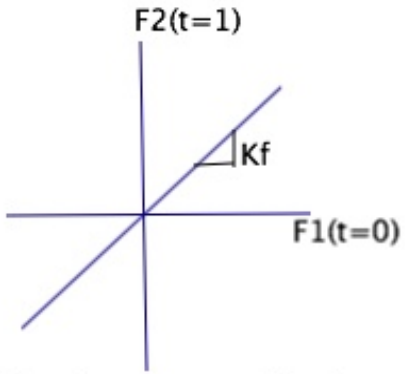
K1/K2 = 4X
M1/M2 = 4X
B1/B2 = 64X, (zeta1/zeta2 = 16X, zeta1 = 0.64, zeta2 = 0.04)

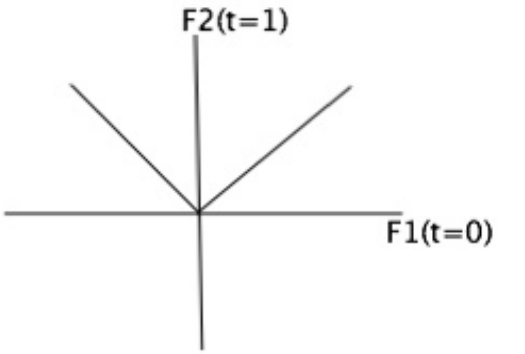
Ideas on Next Steps
"Response Choice" investigations

- Initial "eye for eye" modeling used response choice of "Kf = 1" per this diagram
- Alternative response choice curves (eg. "turn the cheek" or "love always"), should be investigated

"Response Choice Curves"

Person 2's response Options to Person 1's force application:





1) Kf = 1, (eye for eye – proportional response)
2) Kf = 0, (turn other cheek – zero response)
3) Kf = –1, (contrarian response)
4) Kf = nonlinear, (love always response)

Ideas on Next Steps
Theory, modeling, experimental

- Theory:
  - Adaptive Response Curves
  - 7d Emotional Space
  - Adaptive K-B-M properties
  - Load coupling
  - Nth order groups
- Modeling:
  - Investigate Influence of Various “Response Choice Curves”
  - Develop models to help K-B-M measurements
- Experimental:
  - Develop method to measure K-B-M of individuals and groups.
  - Develop test - model reality checking

Questions?

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