

Mathematics About People in Psychotherapy & Conflicts

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Why Use Mathematics?

Words.

Reasoning in words can be very difficult.

Equations.

We can encode these social mechanisms into equations and use mathematics to determine the logical consequences of these mechanisms.

The model that we encode in the equations can be too simple, or wrong, but the math guarantees that the conclusions we draw from them are the logically accurate consequences of our assumptions.

Therapist-Client

$$\frac{dx}{dt} = m_1x + b_1 + f_1(y,x)$$

$$\frac{dy}{dt} = m_2y + b_2 + f_2(x,y)$$

x = emotional state of the therapist

y = emotional state of the client

Rate of change of the state of therapist and client
 $dx/dt, dy/dt$

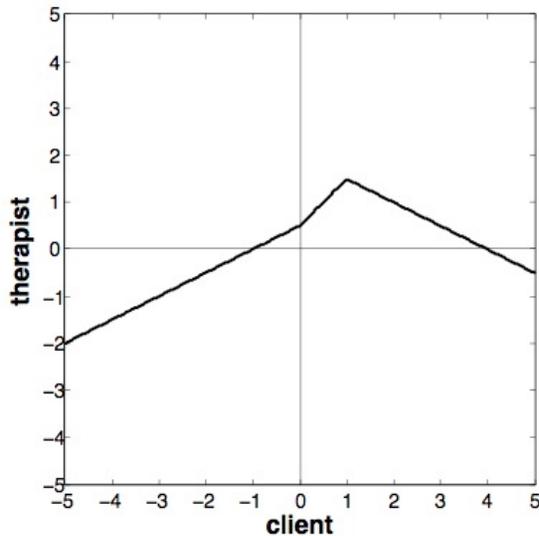
is proportional to

1. m_1x and m_2y : their “inertia” to change ($m_1, m_2 < 0$)
2. b_1 and b_2 : the effect of their “uninfluenced” states
3. $f_1(y,x)$: the “influence” of the client on the therapist
 $f_2(x,y)$: the “influence” of the therapist on the client

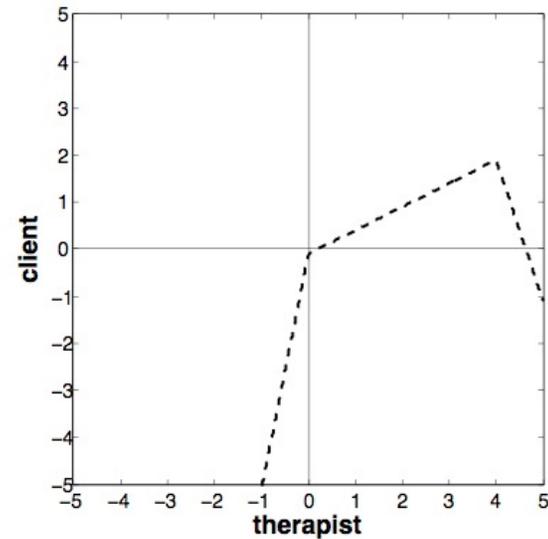
Therapist-Client

Influence Functions

How the
Therapist
responds
the **Client**

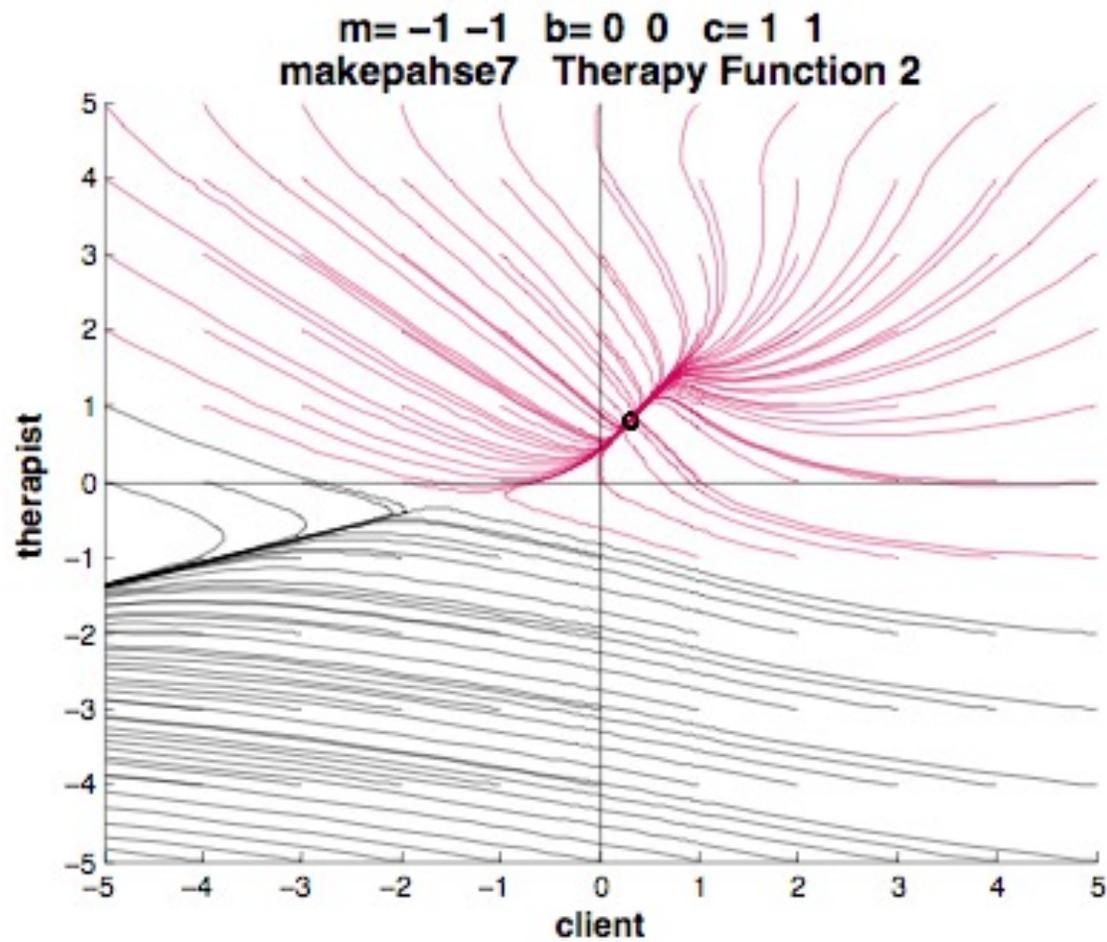


How the
Client
responds the
Therapist



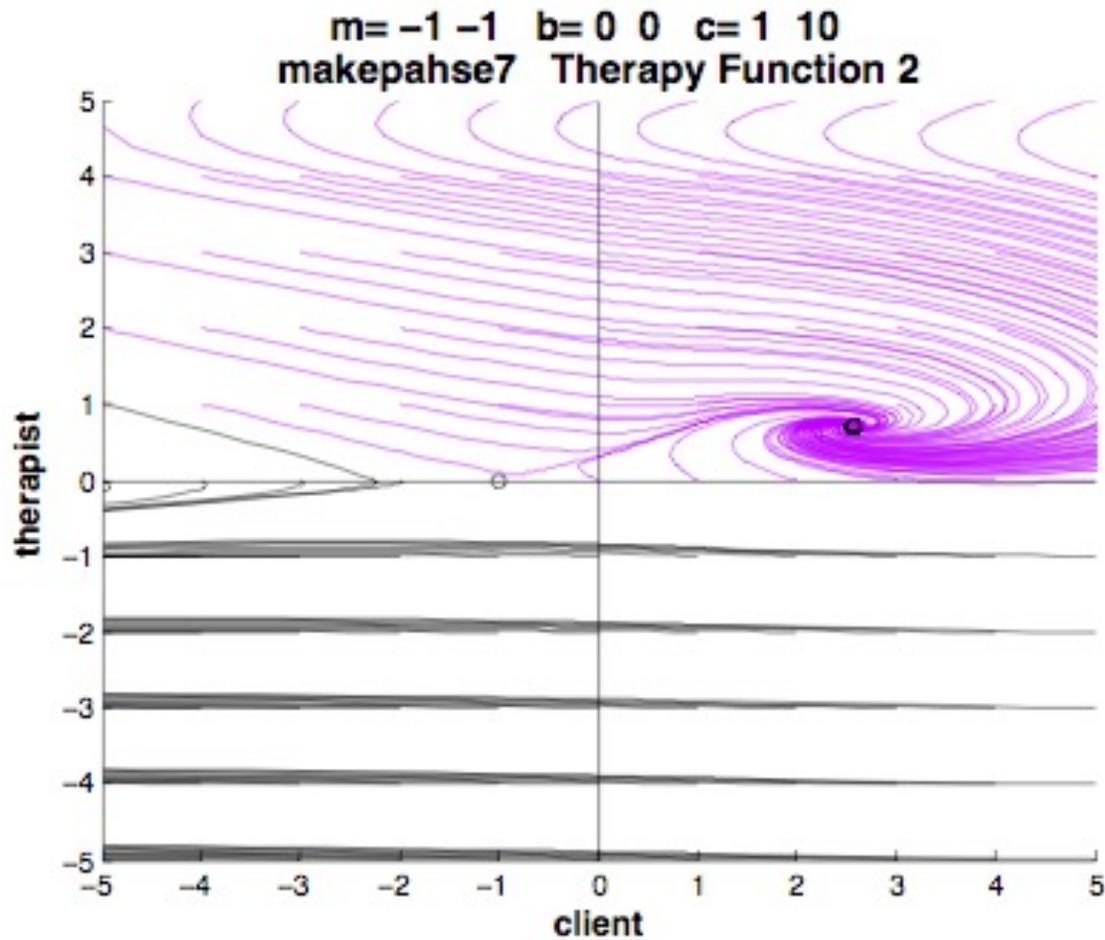
Therapist-Client

Base Case



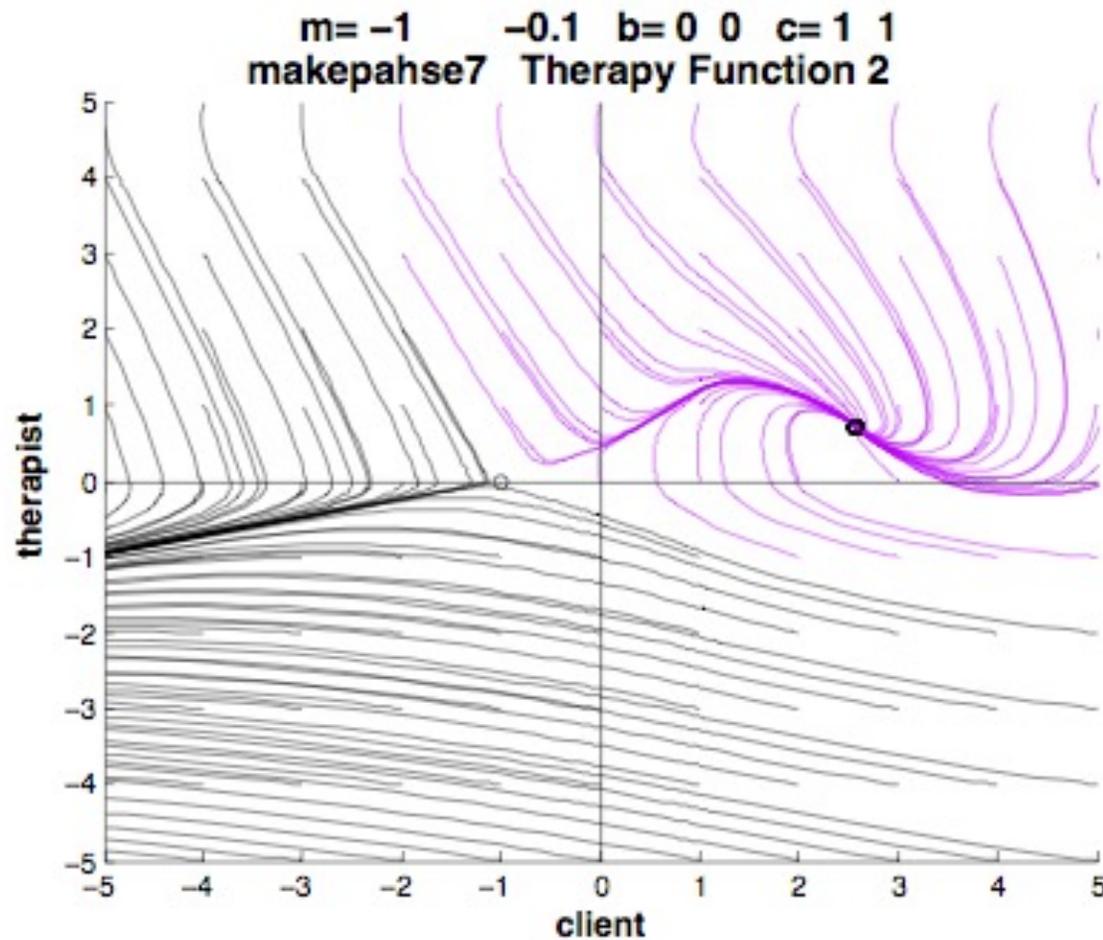
Therapist-Client

Client Responds STRONGLY to Therapist



Therapist-Client

Client is LESS Dependent on the Past



Therapist-Client

SUMMARY OF RESULTS

1. The member of the dyad that is most responsive to the other achieves the most positive state. The successful strategy of a low reactivity therapist, developed intuitively over many years, may have a basis in the most simple dynamics of how dyads interact.
2. Under most circumstances, both the client and therapist will necessarily go through up and down emotional swings, before reaching their final steady states.
3. A therapist starting from a positive emotional state can direct an initially negative or positive client to a positive emotional state.
4. A therapist starting from a negative emotional state is never good for the client.
5. Increasing the influence of the other person yields the same final result as responding more weakly to your own previous emotional state.

Conflict Model

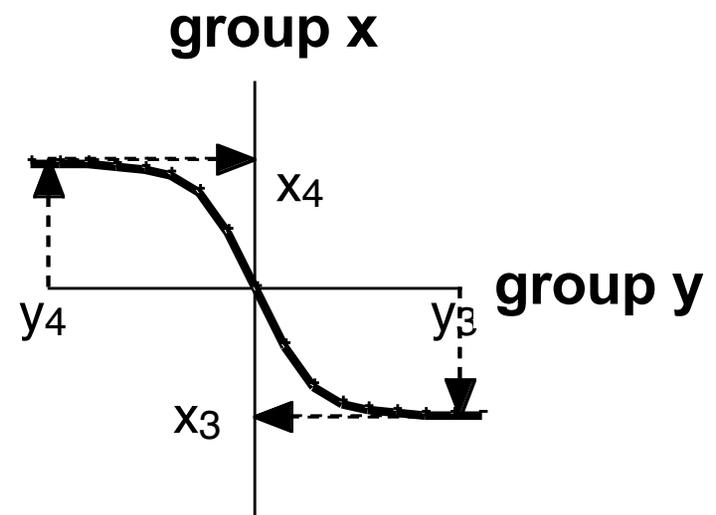
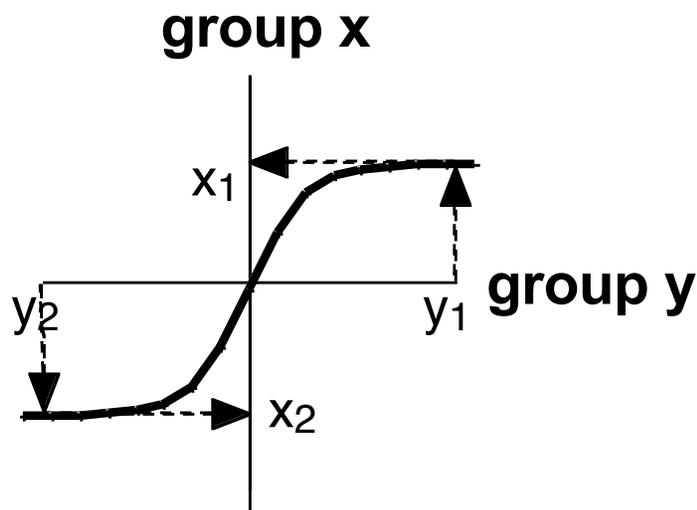
Influence Function: $f_1(y,x) = c_1 \tanh(y) = c_1 [(e^y - e^{-y}) / (e^y + e^{-y})]$

$c_1 > 0$, positive
coordination
do the **SAME**

$c_1 < 0$, negative
de-synchronization
do the **OPPOSITE**

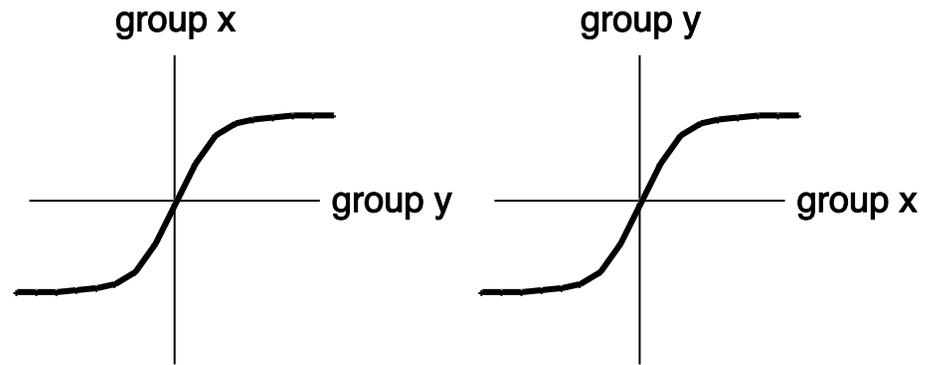
group y **happy** -> group x **happy**
group y **unhappy** -> group x **unhappy**

group y **happy** -> group x **unhappy**
group y **unhappy** -> group x **happy**

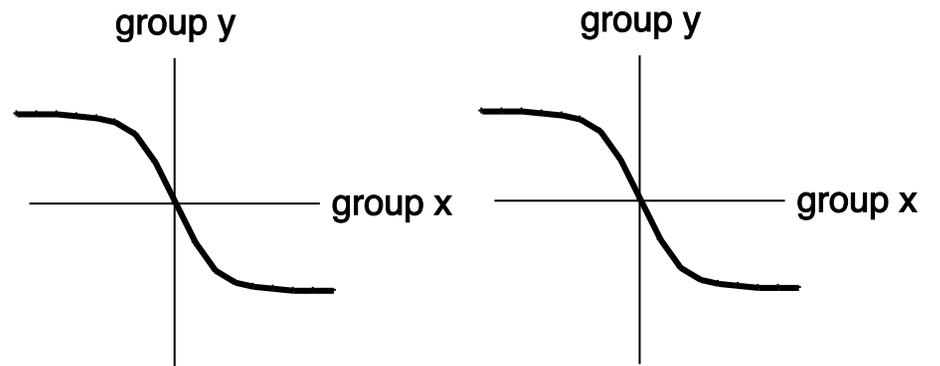


Cases

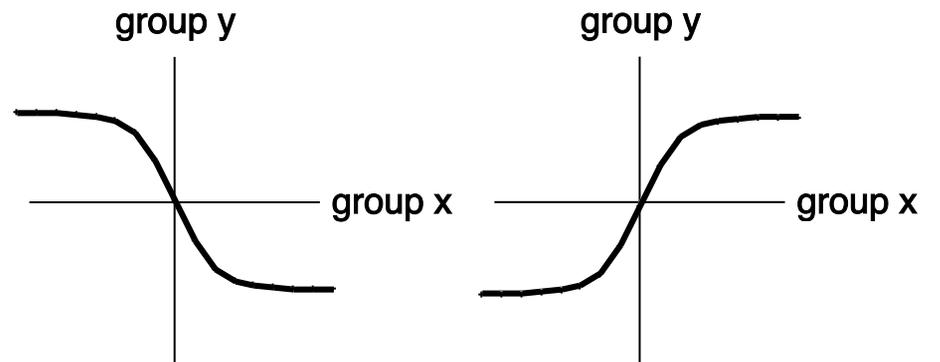
SAME - SAME



OPPOSITE - OPPOSITE



OPPOSITE - SAME



Conflict Model

SUMMARY OF RESULTS

1. There is NOT a proportional effect.
2. Everything is DIFFERENT above a THRESHOLD (which is equal to the inertia to change).
3. SMALL differences can produce LARGE effects over LONG times.
4. ONE group does need NOT change the feedback of the other group to change the dynamics and therefore the result of the conflict.
5. ONE group ALONE can CHANGE the OUTCOME by temporarily switching to a different feedback strategy.

Lessons: From All 3 Models

- **This type of model can be applied to many different types of behavior.**
- **It can give us insights on behavior that can then be tested using observations or experiments.**
- **Different influence functions can yield very different types of behaviors.**
- **Time dependent changes in parameters lead to very interesting results.**