

Stress and Coping — An Economic Approach

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1. Introduction

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 - “It is virtually impossible today to read extensively in any of the biological or social sciences without running into the term stress” (Lazarus and Folkman, 1984)
 - Up to today, stress is a topic gaining more and more academic attention
 - Beyond research, there are stress reports (e.g. “Stressbericht 2012” by Bundesanstalt für Arbeitsschutz und Arbeitsmedizin), lot of talk about burnout syndrome, the rise of psychological diseases in overall diseases and the like ...

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 - Globalisation
 - Unemployment
 - Financial and Euro crisis
 - ... are all “good” sources of stress

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- A conceptual framework is missing for economic model building
- We need to bring more psychology into economics (Rabin, 2013)

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- Apply this framework to understand optimal reaction to stress
 - Which coping strategies are chosen, i.e. which reactions to stress can be observed?
 - Beyond stressors and appraisal, understand the effect of (theory consistent) personality on coping

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- Can (temporary) positive or negative surprises have permanent effects on stress?
- What is the role of personality in stress regulation?
- Can we quantify the model predictions joint with an estimation of personality?

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How important are outbursts quantitatively?

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- Family disputes
 - USA: 75% of couples report verbal aggression (Stets, 1990, USA, random digit dialing)
 - Germany (GSOEP with weighting factors): 44% (women) to 52% (men) report “having arguments or conflicts”
 - conflict is with partner (45%), parents (14%), children (13%), siblings (7%), hardly with colleagues or outside family
- Communication and bullying at work
 - Pressure for productivity ... leads to an increase in aggressive workplace behaviour (Baron and Neuman, 1996)
 - Is verbal aggression the precursor of more violent aggression at workplace? (Andersson and Pearson, 1999)
 - Verbal aggression is common (experienced by 1/3 of workers, Bjorkqvist et al, 1994)
- Domestic violence
 - USA: 10% of couples report physical aggression (Stets, 1990, USA)
 - much higher numbers for (biased) samples among students

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Related literature

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Related literature

- Economic literature
 - Theories of emotions
 - Optimal stopping problems
 - Stress in empirical work
 - The importance of communication in firms
- Psychological literature
 - Stress and coping
 - Appraisal theory
 - Stress and emotion regulation
- More to come during the talk ...

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Structure of the talk

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2. Stress, personality and coping (the model)
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4. Stress and coping patterns
 - 4.1 Dynamics of stress and coping
and theory consistent personality types
 - 4.2 The outburst theorem
 - 4.3 Temporary stressors and permanent stress?

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 - 4.2 The outburst theorem
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5. How to deal with outbursts?
 - 5.1 Frequency of outbursts
 - 5.2 Is postponing outbursts a good idea?
 - 5.3 The gains from psychotherapy
 - 5.4 Structurally estimating personality
6. Conclusion

2. Stress, personality and coping

2.1 The origins of stress

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Stress is usually understood to result from

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- an appraisal process (evaluation of stressors)

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Many events can be understood as stressors

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- Daily hassles and uplifts (Kanner, Coyne, Schaefer and Lazarus, 1981) captures everyday life like 'losing things', 'don't like fellow workers', 'too many obligations' ...

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- Random variable $h(t)$ and subjective expectation μ yield surprise

$$g(t) = h(t) - \mu$$

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- intensity $p(t) / a(t)$ of stressor

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Modelling appraisal

- a known function $f\left(\frac{p}{a}, \cdot\right)$ for daily hassles
- a known function $G(g(t), \cdot)$ for surprises
- both functions are specific to individual (personality)

2. Stress, personality and coping

2.2 The impact on the individual

2. Stress, personality and coping

2.2 The impact on the individual

How to model emotional tension and well-being?

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- Both channels affect instantaneous utility $u(c(t), W(t))$

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The indirect channel of cognitive load

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- Reflections on how to react to stressors is resource consuming (“high-level appraisals”, e.g. Kalisch et al., 2006)

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- Cognitive load stands for all the thoughts and worries, constructive or not, related to stressors and strategies on how to best react to stressors

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Modelling cognitive load by a mental resource constraint

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- An individual is endowed with a certain amount of working memory M (see Smith and Kosslyn, 2007, esp. ch. 6 as a starting point)

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- If effective labour input rises in effort, consumption falls in stress,
 $c = w/(e)$

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2.3 Strategies for coping with tension

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- Frequent strategies: problem solving, support seeking, ... , emotional expression, aggression, ... , wishful thinking, worry
- Categories
 - functional vs. dysfunctional approaches
 - problem-focused vs. emotion-focused (Lazarus and Folkman, 1984)
 - automatic vs. controlled processes (e.g. Conner-Smith et al. 2000, Skinner and Zimmer-Gembeck, 2007)

2. Stress, personality and coping

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 - talking to a friend, a colleague, a therapist
 - reduces tension by “sorting things out”, i.e. by rationalizing events

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 - individuals feel overwhelmed by stressors
 - emotional tension rises to much, they “can’t help” but explode
 - individuals start crying, shout at others, call other people names
 - relatively short event
 - outburst reduces tension by a fixed amount Δ

$$W(\tau) = W(\tau_-) - \Delta$$

2. Stress, personality and coping

2.4 Formal modelling (functional forms)

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- Emotional tension $W(t)$ is a state variable

$$dW(t) = \left\{ \phi \frac{p}{a} W(t) - \delta_0 W(t) - \delta_1 m(t) \right\} dt - \chi [h(t) - \mu] dq(t)$$

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2. Stress, personality and coping

2.4 Formal modelling (functional forms)

- Emotional tension $W(t)$ is a state variable

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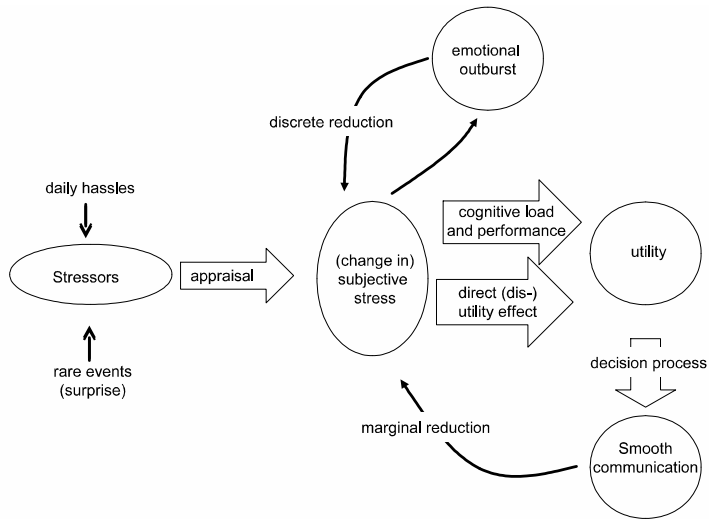
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- “Outburst technology”

$$W(t) = W(t_-) - \Delta$$

2. Stress, personality and coping

2.4 Formal modelling



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Formal structure

- Optimal stopping problem with exogenous stopping

$$E_t \int_t^\infty e^{-\rho[\tau-t]} [u(c(\tau), W(\tau)) - v(m(\tau))] d\tau - \sum_{i=1}^n e^{-\rho[\tau_i-t]} v^M$$

- Choosing a path $\{m(\tau)\}_t^\infty$ anticipating outbursts at \bar{W} and taking constraints on $W(t)$ into account

3. Optimal coping

3.2 Optimal coping style

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Properties of the closed-form solution

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Properties of the closed-form solution

- Optimal coping level

$$m = \left(\frac{\delta_1 v^M}{v_0 \Delta} \frac{1}{1 + \zeta} \right)^{1/\zeta}$$

- Assume convex cost function $v(m)$ for smooth coping, i.e. $\zeta > 0$

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 - increases in v^M – reflecting costs of emotional outburst
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- Amount of talking is independent of current tension level $W(t)$

4. Stress and coping patterns

4.1 Dynamics of stress and coping and personality

4. Stress and coping patterns

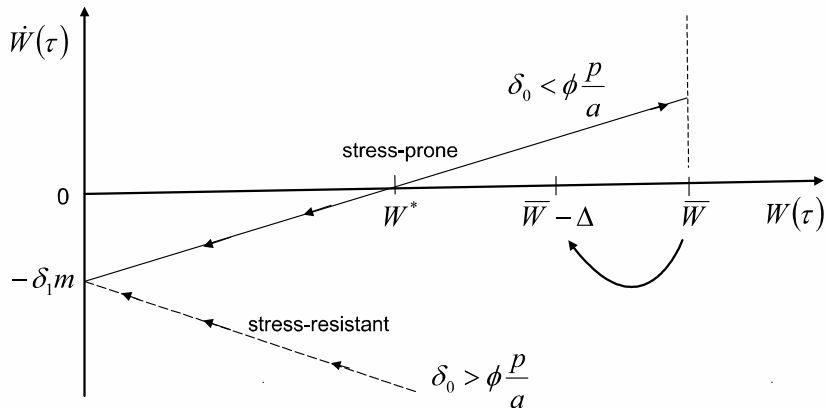
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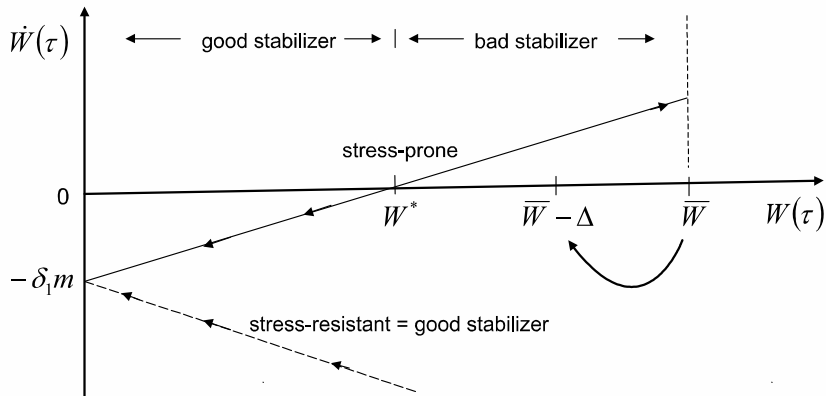


$$\dot{W}(t) = \Phi W(t) - \delta_1 m, \quad \Phi \equiv \phi \frac{p}{a} - \delta_0 \text{ "growth rate of stress"}$$

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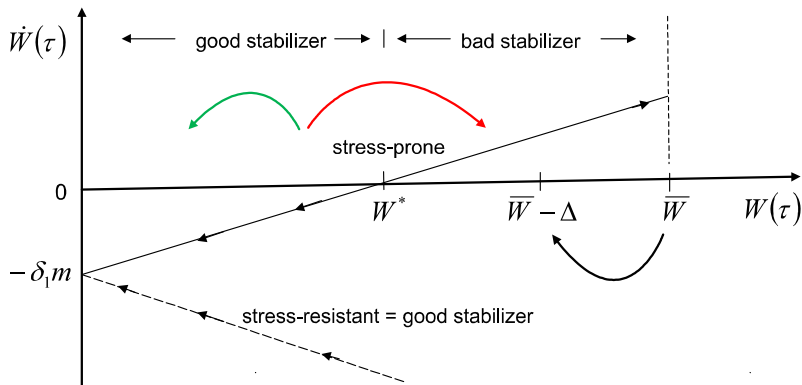
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- Of interest also for psychology: “one intriguing puzzle is why people use one emotion regulation strategy rather than another” (Gross, 2008, p. 505)

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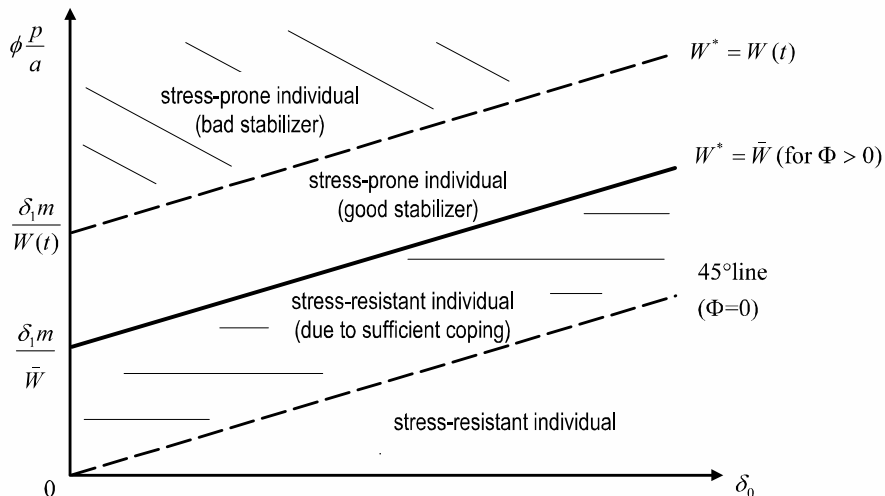
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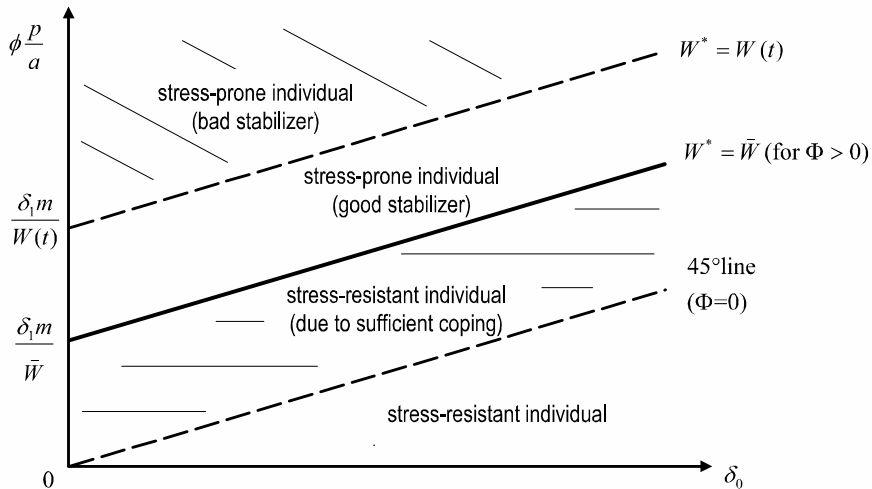
- What are conditions under which “emotional outbursts” occur?
- Of interest also for psychology: “one intriguing puzzle is why people use one emotion regulation strategy rather than another” (Gross, 2008, p. 505)
- Would outbursts ever occur in a world *without surprises* – and thereby in a predictable way?
- Or would the individual exclusively employ the smooth coping channel to reduce tension?

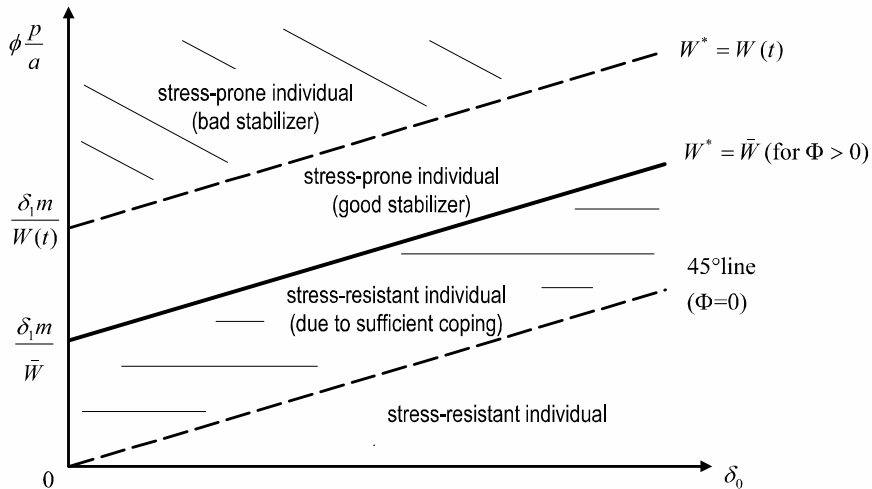
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Findings

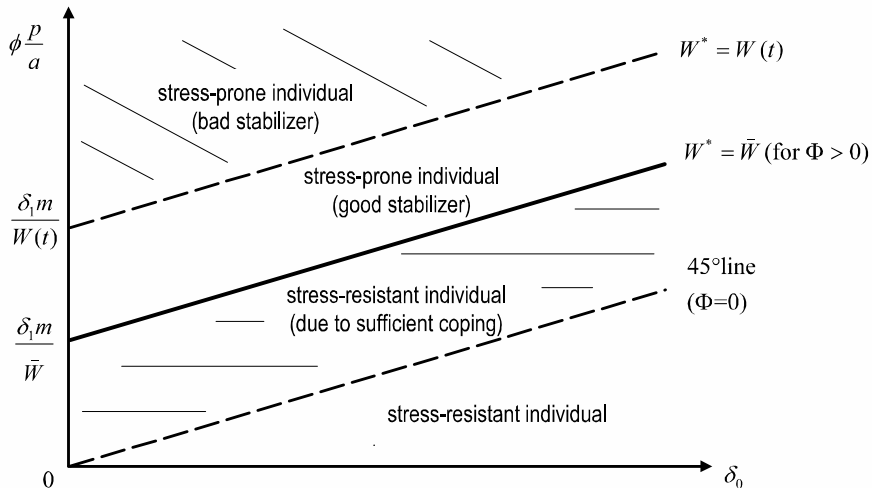






δ_0 – autonomous stress-reduction potential

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$\Phi = \phi p/a - \delta_0$ – growth rate of stress

W^* – threshold level (beyond which stress rises)

\bar{W} – tolerance level (beyond which outbursts)

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- Does a surprise have a transitory or permanent effect on stress?
 - Imagine a big clash in the department, can this have permanent effects?
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- We can understand all this by returning to distinction between stress-prone and stress-resistant individual

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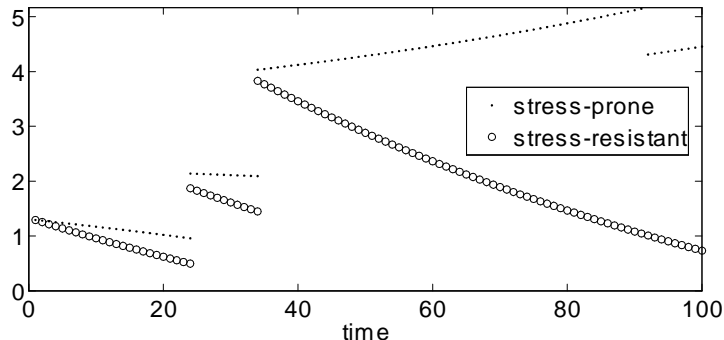
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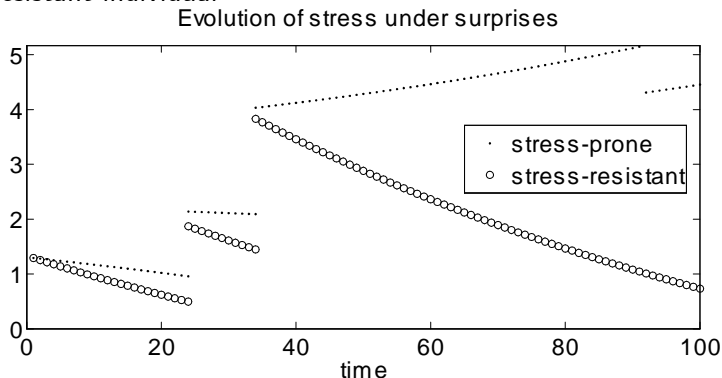
Evolution of stress under surprises



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The evolution of stress after negative surprises for a stress-prone and a stress-resistant individual



- Identical sequence of shocks pushes
 - stress-prone individual to outburst while
 - stress-resistant individual stays calm (remains a good stabilizer)

4. Stress and coping patterns

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Can a single negative event have a permanent effect on an individual?

- No: if we look at stress-resistant individual
- Yes: if we look at stress-prone individual
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- Crucial difference between stress-resistant and stress-prone individual here as well

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What about positive events?

- Crucial difference between stress-resistant and stress-prone individual here as well
- Stress-prone individual can permanently reduce stress level by a unique positive event

5. How to deal with outbursts?

5.1 The frequency of outbursts

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How often do outbursts occur?

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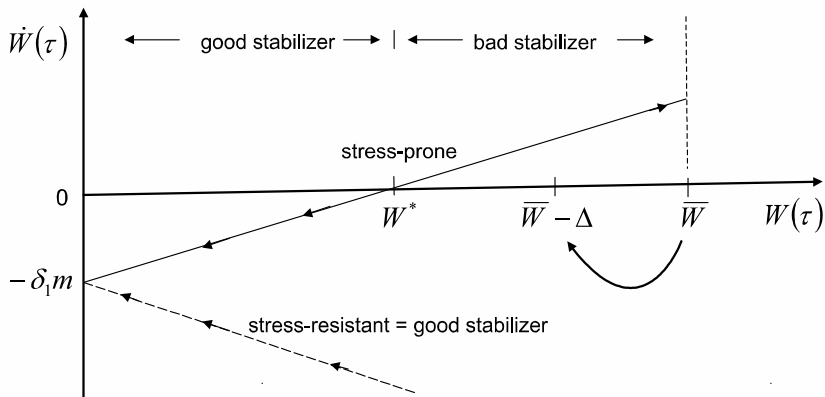
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How often do outbursts occur?

- stress level change exponentially in time τ

$$W(\tau) = (W(t) - W^*) e^{\Phi[\tau-t]} + W^*$$

- growth rate of stress is $\Phi \equiv \phi \frac{p}{a} - \delta_0$ (measures also (in)stability of an individual)

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- growth rate of stress is $\Phi \equiv \phi_a^p - \delta_0$ (measures also (in)stability of an individual)
- The frequency of outbursts is $T^{-1} = \Phi / \ln \frac{\bar{W} - W^*}{\bar{W} - \Delta - W^*}$ and
 - rises in the growth rate of stress Φ
 - rises in the tolerance level \bar{W}
 - falls in (the endogenous) threshold level W^*
 - falls or rises in Δ

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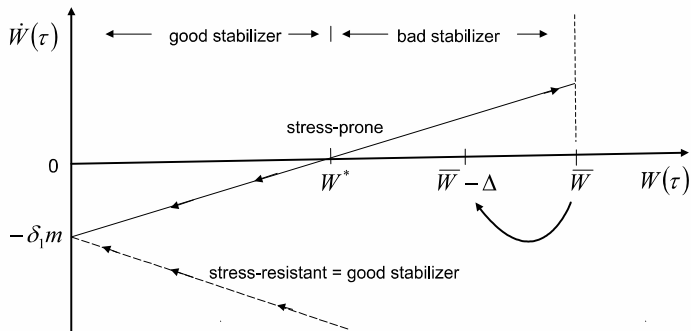
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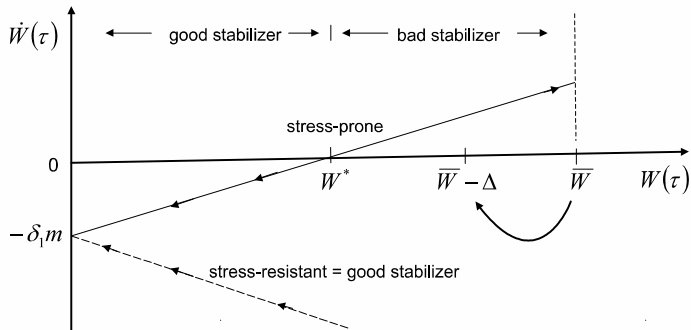


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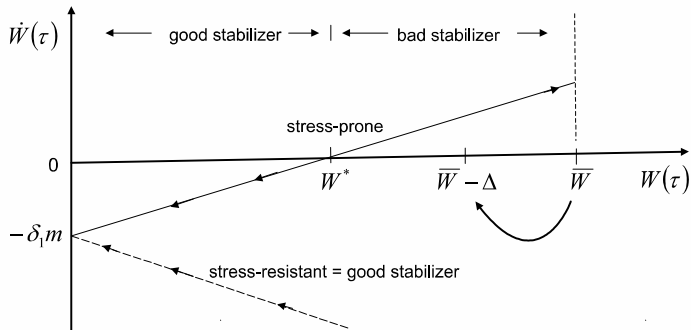
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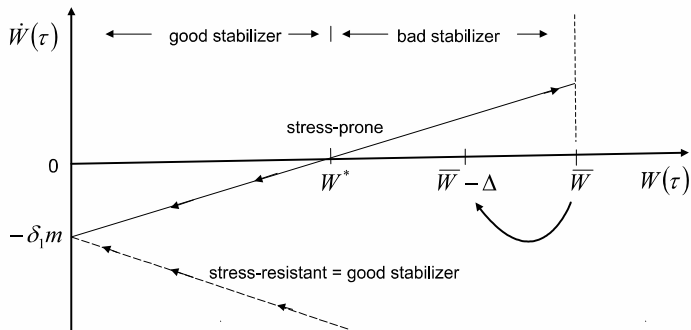
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- The setup (a world without surprises)



- What happens when \bar{W} rises?
 - sounds good: outburst at least comes later
 - but what about: “let it out”, “do not bottle your anger up inside”, “air-cleaning quarrels” (Bushman, Baumeister and Phillips, 2001)

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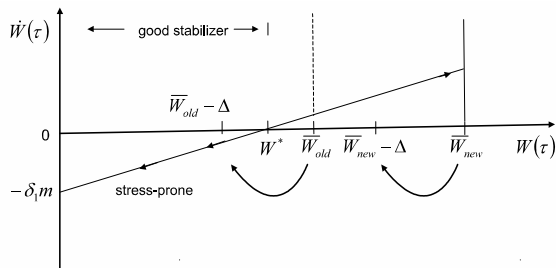
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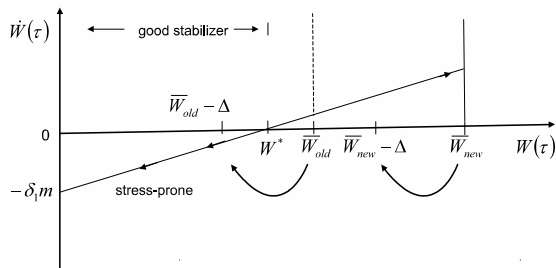


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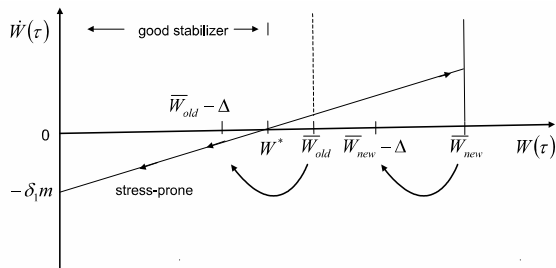
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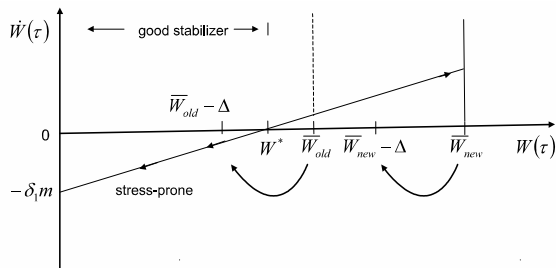
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- While higher outburst level \bar{W} postpones next outburst ...
- ... higher \bar{W} might also make the permanent stress-reduction effect obsolete
- The individual might be caught in an outburst cycle

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5.3 The gains from psychotherapy

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- What is the objective of psychotherapy?
 - Change certain types of behaviour (display emotional outbursts) ...
 - Make people happier – increase their subjective feeling of life satisfaction ...

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 - Make people happier – increase their subjective feeling of life satisfaction ...
 - ... by adjusting personality parameters of the individual (as a short-cut to a more deeper learning and re-evaluation/-appraisal process)
- How can this be achieved?
 - See the outburst theorem for the first objective
 - Look at the value function (given a parameter restriction) for the second

$$J(W) = \Lambda_0 - \frac{v^M}{\Delta} W$$

where

$$\rho\Lambda_0 = vwM - v_0m^{1+\zeta} + \frac{v^M}{\Delta} \left[\delta_1 m + \lambda\chi \left[E^h h - \mu \right] \right]$$

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- **Corollary I** (building on value function theorem): A therapy increases subjective well-being $J(W)$ of the individual if
 - the individual's productivity δ_1 in coping m rises
 - the individual becomes emotionally more *stable* (χ falls) conditional on the individual being on average *negatively* surprised
 - the individual becomes more *emotional* (χ rises) conditional on the individual being on average *positively* surprised,
 - the individual reduces her expectations with respect to surprises (μ falls) as this makes her more often positively surprised

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 - the individual succeeds in reacting less emotional (lower ϕ) to daily hassles
 - the individual manages to improve her autonomous stress reduction potential (increase δ_0)
- What is optimal personality?
 - Make an individual more emotional (increase χ) but
 - let her expect less (decrease μ)

5. How to deal with outbursts?

5.4 Structurally estimating personality

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- The model provides theory-consistent personality parameters
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 - δ_0 and δ_1 capture how quickly an individual can reduce stress
 - χ measures how strongly an individual reacts to surprises
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- Quantified versions of these parameters (or versions of it) are usually
 - obtained by factor analysis of answers to questionnaires (think of “Big 5 literature”) and therefore
 - hard to link to precise theoretical predictions

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- Structural estimation of personality would
 - allow to quantify personality parameters from the model and thereby improve the interpretation of “factors” and their (almost arbitrary) names
 - build on linear simultaneous equation models with latent factors as explanatory variables (see e.g. Heckman et al., 2006, Conti et al., 2014, Piatek, 2010, provides an introduction)
 - extend these analyses by using the model prediction of the density $g(W|\Theta_i, X, \sigma)$ of stress W which is conditional on latent personality factors Θ_i , covariates X and model parameters σ

5. How to deal with outbursts?

5.4 Structurally estimating personality

- In Piatek (2010) notation, these models look like

$$W_i = g(Y_i^*, \sigma),$$

$$Y_i^* = X_i\beta + \alpha\Theta_i + \varepsilon_i, \text{ where}$$

- W_i is a vector of measures for stress for individual i
- $g(\cdot)$ is a non-linear “link function”
- Y_i^* is the latent outcome (empirically represented by the vector of answers to the questions in a questionnaire)
- σ are the parameters of the model (which are not latent personality factors, i.e. $\sigma = (\rho, \nu_0, \zeta, \kappa, \nu, \alpha)$)
- the second equation explains latent outcomes by covariates X (like p , a and w), latent personality factors Θ_i (which are given by ϕ , δ_0 , δ_1 , χ and μ), factor loadings α and the error term ε_i

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- The conditional density in the likelihood function depends on
 - latent outcomes Y^* and on
 - all model parameters $(\beta, \alpha, \sigma, \psi_\varepsilon)$ where ψ_ε are the parameters of the regression error ε_i

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- With a structural component, a statistical model would (probably ...) look like

$$W_i \sim h(W|\Theta_i, X, \sigma)$$
$$Y_i^* = X_i\beta + \alpha\Theta_i + \varepsilon_i$$

where, in addition to notation from above,

- $h(W|\Theta_i, X, \sigma)$ is the endogenous (closed-form expression of the) density of stress and where
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- this density is conditional the latent personality factors Θ_i , covariates X and model parameters σ
- Extension / difference of structural approach
 - Link function $g(\cdot)$ is replaced by an endogenous model-density
 - Conditional densities in likelihood functions need to be adjusted accordingly

6. Conclusion

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Background

- Stress is a feeling that everybody experiences (at least) every now and then

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- Stress is a feeling that everybody experiences (at least) every now and then
- Stress induces various coping styles
- This paper looked at smooth coping and emotional outbursts
 - Smooth coping stands for controlled and cognitive approach to emotion regulation
 - Emotional outbursts stand for more impulsive, costless and fast approach
 - Emotional outbursts tend to be socially harmful (in contrast to constructive smooth coping)

6. Conclusion

Dynamics of stress and coping

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Dynamics of stress and coping

- Determinants of smooth coping
 - cost and benefits of smooth coping
 - cost and benefits of outbursts

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 - personality: stress-prone vs. stress-resistant individuals and on
 - appraisal type ϕ , situation p , ability a and autonomous stress-reduction potential δ_0

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 - personality: stress-prone vs. stress-resistant individuals and on
 - appraisal type ϕ , situation p , ability a and autonomous stress-reduction potential δ_0
- Do temporary shocks have permanent effects?
 - Personality matters a lot
 - Reducing stressors temporarily removes symptoms (high stress, frequent outbursts) ...
 - ... and can permanently reduce stress for stress-prone individual
 - Shocks can permanently push (stress-prone) individual to outburst cycles

6. Conclusion

How to deal with outbursts?

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How to deal with outbursts?

- Frequency of outbursts: Growth rate of stress Φ

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 - Permanent effects achievable via personality changes
 - Reappraisal of daily hassles and life-time events
 - Don't expect too much and be emotional!

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- Increasing the tolerance level \bar{W} might lead to outburst cycles
- The gains from psychotherapy
 - Permanent effects achievable via personality changes
 - Reappraisal of daily hassles and life-time events
 - Don't expect too much and be emotional!
- Framework to structurally estimate personality
 - Big advance over Big 5 literature
 - Methodological challenge for econometricians :-)

Thank you!