Stress and Coping
—
An Economic Approach

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1. Introduction

Stress is known by everybody. At times, there are just too many demands and not enough resources. Stress has been introduced in 1936 by Selye (borrowing from physics). Stress is a disturbingly prominent topic in academic (psychological) research. "Stressbericht 2012" by Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. A lot of talk about burnout syndrome, the rise of psychological diseases in overall diseases, and more...
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    ● lot of talk about burnout syndrome
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The open issue
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- Why do economists not work on stress?
- Economic world hosts a large group of stress-inducers
  - (Biased) Technological change
  - Globalisation
  - Unemployment
  - Financial and Euro crisis
  - ... are all “good” sources of stress
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  - ... are all “good” sources of stress
- A conceptual framework is missing for economic model building
- We need to bring more psychology into economics (Rabin, 2013)
1. Introduction

The objectives
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- Provide a conceptual framework that allows to understand stressors – appraisal – stress – coping
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- Provide a conceptual framework that allows to understand stressors – appraisal – stress – coping
  - Stressors: Anything that puts demand on resources of an individual
  - Appraisal: Process of evaluating a stressor concerning its implication for well-being of a person
  - Stress: Subjective feeling resulting from current and past appraisals of stressors
  - Coping: Behaviour aimed at reducing stress

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- Provide a conceptual framework that allows to understand stressors – appraisal – stress – coping
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- Apply this framework to understand optimal reaction to stress

Beyond stressors and appraisal, understand the effect of (theory consistent) personality on coping
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  - Coping: Behaviour aimed at reducing stress

- Apply this framework to understand optimal reaction to stress
  - Which coping strategies are chosen, i.e. which reactions to stress can be observed?
  - How does stress translate into more or less aggressive coping patterns (smooth stress regulation vs. “emotional outbursts”)?
  - Beyond stressors and appraisal, understand the effect of (theory consistent) personality on coping
1. Introduction

How important are outbursts quantitatively?

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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1. Introduction

Related literature
1. Introduction

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 ...
1. Introduction

Structure of the talk
1. Introduction

Structure of the talk

2. Stress, personality and coping (the model)
3. Optimal coping
1. Introduction

Structure of the talk

2. Stress, personality and coping (the model)
3. Optimal coping
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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2. Stress, personality and coping (the model)
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   4.2 The outburst theorem
   4.3 Temporary stressors and permanent stress?
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

Stress can have many sources, some of which occur rarely (death of spouse, new job, move house ...). Rare events imply positive or negative surprises given as random variables \( g(t) \) and subjective expectation \( h(t) \) and subjective expectation \( \mu \) yielding surprise \( g(t) = h(t) - \mu \) (Bell, 1985, Loomes and Sugden, 1986). Surprises occur at a certain arrival rate (dynamic continuous time model with Poisson uncertainty). The flow of demand \( p(t) \) paired with abilities \( a(t) \) of individuals yields intensity \( p(t) / a(t) \) of stressor.
2. Stress, personality and coping

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The appraisal process
2. Stress, personality and coping

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- “... an appraisal is an evaluation of a situation in terms of its relevance for oneself, specifically one’s goals or well-being (e.g., Lazarus 1968)”
- “… appraisal as a temporal and causal antecedent to emotion (Scherer 1993b; 1999; Roseman and Smith 2001)” (all from Lewis, 2005)
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Modelling appraisal
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Modelling appraisal

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

2.2 The impact on the individual

How do emotional tension and well-being interact?

Direct channel affects well-being (utility) directly (Stress symptoms like headache, dizziness, sweating, sleeplessness ...)

Indirect channel affects labor income of the individual via a person-specific appraisal process and "cognitive load"

Both channels affect instantaneous utility $u(c(t), W(t))$
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The indirect channel of cognitive load

Stress is the result of appraisal of stressors, which can be automatic and very fast. Reactions on how to react to stressors is resource consuming ("high-level appraisals", e.g. Kalisch et al., 2006). Both processes lead to "cognitive load" (Sweller, 1988, Eysenck and Calvo, 1992, Homan, von Helversen and Rieskamp, 2013). 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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2.2 The impact on the individual

Modelling cognitive load by a mental resource constraint

An individual is endowed with a certain amount of working memory $M$ (see Smith and Kosslyn, 2007, esp. ch. 6 as a starting point). Stressors and coping use up resources of the working memory $M$.

Memory/resource constraint in the case of "stress" and "effort":

$M(W) + M(e) = M$

Higher stress levels imply cognitive load and leave less working memory for other purposes.

If effective labour input rises in effort, consumption falls in stress, $c = wl(e)$. 

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2.3 Strategies for coping with tension

- Emotion-focused (not problem-focused) and automatic vs. controlled processes
  - Controlled process: talking to a friend, a colleague, a therapist (reduces tension by "sorting things out", i.e. by rationalizing events)
  - Practice some (endurance) sport
  - Take a break and enjoy leisure

- Stress reduces gradually due to depreciation function

- Automatic process: emotional outbursts
  - 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

\[
\delta(m(t), \cdot) = \Delta W(\tau) = W(\tau) - \Delta K
\]

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2. Stress, personality and coping

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2. Stress, personality and coping

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- **automatic process – emotional outbursts**
2. Stress, personality and coping

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Emotion-focused (not problem-focused) and automatic vs. controlled processes

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  - outburst reduces tension by a fixed amount $\Delta$

\[
W(\tau) = W(\tau_-) - \Delta
\]
2. Stress, personality and coping

2.4 Formal modelling (functional forms)

Emotional tension

\[ \text{Emotional tension} \]

\[ W(t) \text{ is a state variable} \]

\[ dW(t) = n \phi p a W(t) \delta_0 W(t) \delta_1 m(t) dt \]

\[ + \chi \left[ h(t) \mu \right] dq(t) \]

Deterministic part displays stressors \( p \) and ability \( a \), both are exogenous and fixed. \( \phi \) as appraisal parameter of stressor, \( \delta_0 \) as autonomous stress reduction ability, \( m(t) \) that leads to smooth reduction of tension given productivity.

Stochastic part displays surprises \( h(t) \mu \), exogenous and random in level. Appraisal of surprises captured by \( \chi \). Poisson process \( q(t) \) with exogenous arrival rate.

"Outburst technology"
2. Stress, personality and coping

2.4 Formal modelling (functional forms)

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

$$dW(t) = \left\{ \frac{P}{a}W(t) - \delta_0 W(t) - \delta_1 m(t) \right\} dt$$

$$-\chi [h(t) - \mu] dq(t)$$

Deterministic part displays stressors $p$ and ability $a$, both are exogenous and fixed

$\phi$ as appraisal parameter of stressor

$\delta_0$ as autonomous stress reduction ability

Coping $m(t)$ that leads to smooth reduction of tension given productivity

Stochastic part displays surprises $h(t)$, exogenous and random in level

Appraisal of surprises captured by Poisson process $q(t)$ with exogenous arrival rate

"Outburst technology" $W(t)$
2. Stress, personality and coping

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

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  - coping $m(t)$ that leads to
  - smooth reduction of tension given productivity $\delta_1$
2. Stress, personality and coping

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- Stochastic part displays
  - surprises $h(t) - \mu$, exogenous and random in level
  - appraisal of surprises captured by $\chi$
  - Poisson process $q(t)$ with exogenous arrival rate
2. Stress, personality and coping

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

\begin{align*}
    dW(t) &= \left\{ \frac{\phi_p}{a} W(t) - \delta_0 W(t) - \delta_1 m(t) \right\} dt \\
    &\quad - \chi [h(t) - \mu] dq(t)
\end{align*}

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- “Outburst technology”

\begin{equation*}
    W(t) = W(t_-) - \Delta
\end{equation*}
2. Stress, personality and coping

2.4 Formal modelling
3. Optimal coping
3. Optimal coping

How does an individual behave?

- Individual chooses smooth coping $m(t)$ ...
- ... taking outbursts into account
- Outbursts occur automatically when tolerance level $\bar{W}$ is hit
3. Optimal coping

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Formal structure
3. Optimal coping

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Formal structure

- Optimal stopping problem with exogenous stopping

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

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

Closed form solution (under mild parameter restriction)

- Optimal constant coping level

$$m = \left( \frac{\delta_1 v^M}{\nu_0} \frac{1}{\Delta} \frac{1}{1 + \zeta} \right)^{1/\zeta}$$
4. Stress and coping patterns

4.1 Dynamics of stress and coping and personality

\[ \dot{W}(t) = \Phi W(t) \delta_1 \]

\[ \Phi = \phi_p a \delta_0 \]

"growth rate of stress"

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4. Stress and coping patterns

4.1 Dynamics of stress and coping and personality

- How does stress translate into more or less aggressive coping patterns (in a world *without* surprises)?
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- How does stress translate into more or less aggressive coping patterns (in a world *without* surprises)?

\[ \dot{W}(t) = \Phi W(t) - \delta_1 m, \quad \Phi \equiv \phi \frac{p}{a} - \delta_0 \]  

"growth rate of stress"
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4.1 Dynamics of stress and coping and personality

- How does stress translate into more or less aggressive coping patterns (in a world *with* surprises)?
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- How does stress translate into more or less aggressive coping patterns (in a world with surprises)?

\[
dW(t) = \Phi W(t) - \delta_1 m \, dt - \chi [h(t) - \mu] \, dq(t)
\]
4. Stress and coping patterns

4.2 The outburst theorem

Questions

What are the conditions under which "emotional outbursts" occur?

Based on fundamentals of the model, who will display outbursts under which circumstances?

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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Findings

\[ W^* = W(t) \]

\[ W^* = \bar{W} \text{ (for } \Phi > 0 \text{)} \]

45° line (\( \Phi = 0 \))
δ₀ – autonomous stress-reduction potential
φp/a – appraisal φ of intensity p/a of stressors (daily hassles)
Φ = φp/a − δ₀ – growth rate of stress
W* – threshold level (beyond which stress rises)
¯W – tolerance level (beyond which outbursts)
4. Stress and coping patterns

4.3 Can surprises have permanent effect on stress?

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

4.3 Can surprises have permanent effect on stress?

The evolution of stress after negative surprises for a stress-prone and a stress-resistant individual
4. Stress and coping patterns

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

Evolution of stress under surprises

- stress-prone
- stress-resistant

Identical sequence of shocks pushes stress-prone individual to outburst while stress-resistant individual stays calm (remains a good stabilizer)
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The evolution of stress after negative surprises for a stress-prone and a stress-resistant individual

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4. Stress and coping patterns
4.3 Can surprises have permanent effect on stress?

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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4. Stress and coping patterns
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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?
5. How to deal with outbursts?

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How often do outbursts occur?

- We consider a bad stabilizer (in a world without surprises)
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How often do outbursts occur?

- stress level change exponentially in time $\tau$

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

- growth rate of stress is $\Phi \equiv \phi \frac{p}{a} - \delta_0$ (measures also (in)stability of an individual)
5. How to deal with outbursts?

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- 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 $\Phi$
  - rises in the tolerance level $\bar{W}$
  - falls in (the endogenous) threshold level $W^*$
  - falls or rises in $\Delta$
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5.2 Should outbursts be suppressed?

Should outbursts be suppressed by increasing the tolerance level $W$?

The setup (a world without surprises)

What happens when $W$ 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)

Klaus Wälde (Johannes-Gutenberg University Mainz and CESifo)

Stress and Coping

April 2016
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![Diagram](image)
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- It might actually *not* be such a good idea!
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![Graph showing the relationship between $W(\tau)$ and $\tilde{W}$ with arrows indicating the impact of $\Delta$ and $-\delta m$.]

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Stress and Coping

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- ... higher $\tilde{W}$ might also make the permanent stress-reduction effect obsolete

- The individual might be caught in an outburst cycle
5. How to deal with outbursts?

5.3 The gains from psychotherapy

What is the objective of psychotherapy?
- Change certain types of behaviour (display emotional outbursts)...
- 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 the parameter restriction) for the second

\[ J(W) = \Lambda_0 v_M \Delta W \]

where

\[ \rho \Lambda_0 = \nu_w \Lambda_0 m^1 + \zeta + v_M \Delta h \delta_1 m + \lambda \chi E h \mu ii K \]

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**Corollary 1** (building on value function theorem): A therapy increases subjective well-being $J(W)$ of the individual if
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- **Corollary 1** (building on value function theorem): A therapy increases subjective well-being $J(W)$ of the individual if
  - the individual’s productivity $\delta_1$ in coping $m$ rises
  - the individual becomes emotionally more stable ($\chi$ falls) conditional on the individual being on average negatively surprised
  - the individual becomes more emotional ($\chi$ rises) conditional on the individual being on average positively surprised,
  - the individual reduces her expectations with respect to surprises ($\mu$ falls) as this makes her more often positively surprised
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- **Corollary II**: A therapy allows an individual to keep its level of subjective well-being despite a rise in the intensity of stressors if
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- the individual succeeds in reacting less emotional (lower $\phi$) to daily hassles
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- What is optimal personality?
  - Make an individual more emotional (increase $\chi$) but
  - let her expect less (decrease $\mu$)
6. Conclusion

Background

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).
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- Stress falls steadily over time for stress-resistant individuals ("good stabilizers")
- Stress can rise or fall for stress-prone individuals ("good stabilizers" or "bad stabilizers")
- Bad stabilizers eventually hit the tolerance level $\bar{V}$ and outburst occurs (or outburst cycles)
  - cost and benefits of smooth coping
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Prevalence of outbursts (outburst theorem)

- personality: stress-prone vs. stress-resistant individuals
- appraisal type $\phi$, situation $p$, ability $a$ and autonomous stress-reduction potential $\delta_0$
6. Conclusion

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
- A negative temporary shock can induce permanent outburst cycles for a stress-prone individual
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Is suppressing outbursts a good idea?

- Yes: outburst comes later
- No: Increasing the tolerance level $\bar{W}$ might lead to outburst cycles
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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!
Thank you!