Nordic Association for Disability and Oral Health

Pain - a bio-psycho-social perspective

- with special focus on hypnosis

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Topics

- Pain – a bio-psycho-social perspective
- Interactive dimensions of pain
- Psychosocial modulators of pain
- What is hypnosis – brief historical overview
- Modern theories of hypnosis
- Hypnotic modulation of pain
- Placebo and hypnotizability
- Pain coping and behavioral traits
- Clinical effectiveness

Classical specificity theory

The roots of the classical biomedical view on pain lie in Descartes´ mechanical model, which argues for a simple, direct relationship between the sensory stimulus of a pain receptor and the behavioral response, mediated by a neural transmission mechanism

Shortcomings of the specificity theory

- Did not sufficiently explain several pain-related phenomena, e.g.
  - The association between the severity of the tissue damage and pain perception is not linear – but often weakly correlated
  - Differences in pain ratings of soldiers wounded in battle and civilians with the same level of tissue damage
  - Phantom limb pain
  - Pain in the absence of underlying organic disease or damage
  - Placebo – nocebo responses

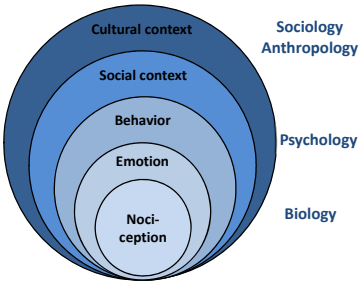
Beecher, 1946; Melzack & Wall, 1965

A bio-psycho-social view

The modern view recognizes the complexity of pain experience and the underlying mechanisms.

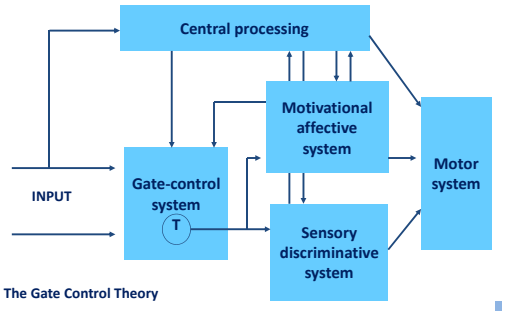
Pain is regarded as a result of complex interactions between biological, psychological, and socio-cultural factors

Pain research must therefore rely on interdisciplinary approaches.



Gate control theory

Melzack & Wall 1965



The Gate Control Theory

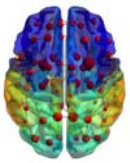
Shortcomings of the GCT

- The GCT has led to fruitful pain research
- Several details have been shown to be inaccurate
- Oversimplifications in the presentation of the neural architecture of the spinal cord and the hypothesized modulatory system
- Does not fully explain differences between various types of pain (cutaneous, visceral, muscular, neuropathic) and does not explain phantom limb pain

Melzack, 1992; Moayedi & Davis, 2013

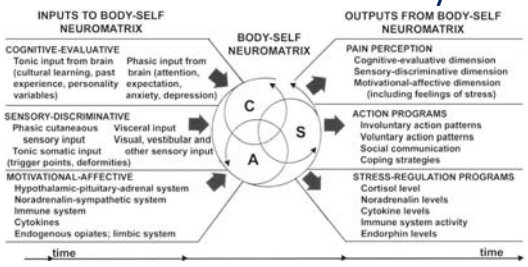
Neuromatrix theory

Melzack, 1992



- Neuromatrix is believed to be a neuronal network composing the anatomical substrate of the physical self
- The output is a ***neurosignature*** determining the perception of physical **"self"** and **"non-self"**
- The neuromatrix is thought to be (partly) genetically hard-wired: Individuals born without limbs may still experience phantom sensations
- Experience is thought to "add, delete, or strengthen existing synapses"
- *Lack of sensory feedback from amputated limbs and/or excessive firing from damaged nerves activates/alters the output pattern from the neuromatrix – and is felt as pain*
- *Pain memories (as a part of the neuromatrix) prior to amputation may play a role*

The neuromatrix theory



"Neuromatrix" a general concept not specific to pain – rather than a specific pain matrix, the evidence suggests a **multi-modal network related to the detection of salient sensory input (which includes pain – but not pain only).**

Melzack, 2001

The multidimensional definition of pain (IASP)

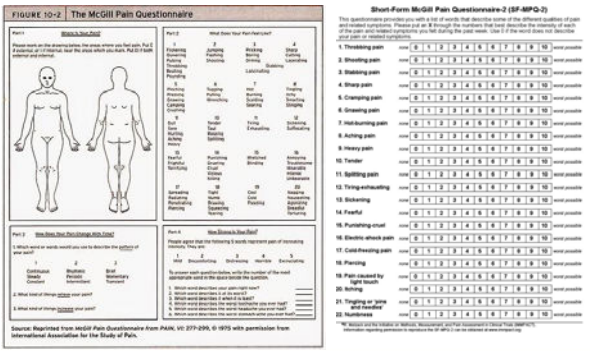
"an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"

INTERACTIVE DIMENSIONS OF PAIN

DIMENSION	ASPECTS
SENSORY-DISCRIMINATIVE	Intensity, location, quality, duration
AFFECTIVE-MOTIVATIONAL	Unpleasantness, fight-flight response
COGNITIVE-EVALUATIVE	Appraisal, cultural norms, context, cognitive state

Melzach & Casey, 1968

McGill Pain Questionnaire



Psychological modulators of pain perception

COGNITIVE PROCESSES

- Attention
- (Dis)attention
- Dissociation
- State-dependency
- Perceived control

Psychological modulators of pain perception

EMOTIONAL PROCESSES

- Active anger
- Passive anger
- Anxiety (fear of pain)
- Anxiety (pain unrelated)
- Depression
- Happiness

Psychophysiological modulators of pain perception

AROUSAL

- Relaxation
- Tension

Psychological modulators of pain perception

"PLACEBO"

- Conditioning?
- Expectation?
- Response-appropriate sensation?
- Anxiety-reduction?
- "Non-specific" inter-personal factors?
- Imagery

Psychological modulators of pain perception

PAIN COPING STRATEGIES

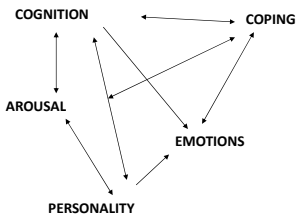
- Catastrophizing
- Re-interpretation
- Distraction
- Perceived control

Psychological modulators of pain perception

PERSONALITY TRAITS

- Locus of control
- Emotional repression
- Augmenters/reducers
- Social desirability
- Neuroticism
- Hypnotizability

interactions



EPoS

Hypnotic modulation of pain

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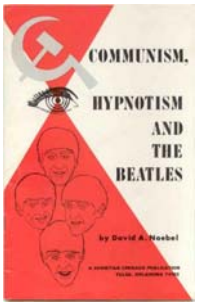
What is hypnosis?



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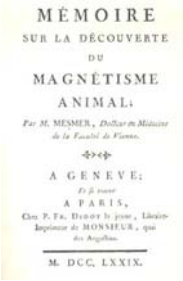
Historical debates


MÉMOIRE
SUR LA DÉCOUVERTE
DU
MAGNÉTISME
ANIMAL;
A GENEVE;
A PARIS,
M. DCC. LXXIX.

Animal magnetism (Mesmer)

Or

Imaginative involvement (Royal Commission)

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Historical debates

Psychopathological (Hysteria) (Charcot)

or

Normal phenomenon (Bernheim)

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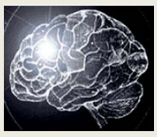
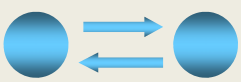
Historical debates

- State (Hilgard)
  - Psychophysiological correlates
  - High hypnotizable vs. simulator-designs
  - Etc.



- Role-taking (Spanos)
  - Expectation
  - Order of presentation designs
  - Etc.



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What is hypnosis?

Hypnotic trance is a phenomenon involving **attention** and **concentration**, which may be induced by several types of events.

Hypnosis

Religious ceremonies

Traumatic events

Intense involvement

→ **HYPNOTIC TRANCE**

Absorption
Dissociation
Suggestibility

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Principles in hypnotic communication

- Rapport
- Motivation
- Attention
- Repetition
- Positive suggestions
- Creating a "yes-set"
- Embedding
- Truisms
- Handling non-responses
- Implied directive
- Confusion
- Double bind
- Metaphors
- Direct vs indirect sugg.
- Timing and pacing
- Reversible effect
- Utilization
- Dissociative suggestions

The phenomenology of hypnosis

How do we know when someone is hypnotized?

- Response to ideomotor suggestions
- Perceived involuntariness
- Response-inhibition
- Changes in cognition (time-distortion etc.)
- Physiologic/behavioral correlates (eye-movements, catalepsy)
- Hallucinations (positive & negative)
- Posthypnotic amnesia
- Response to post-hypnotic suggestions
- Hypnotic analgesia
- High hypnotizable vs. simulator design

Everyday forms of hypnosis

Modern theories on hypnosis

- Dissociation theory of hypnosis (Hilgard)
  - The control of behavior is normal
  - The individual's experience – monitoring – of the behavior is impaired
- Neo-dissociation theory (Bowers)
  - Dissociated control – the underlying control of behavior is changed (executive function)

Modern theories on hypnosis

- Non-state social-psychological theory of hypnosis (TX Barber, Spanos)
  - Views hypnosis as role-taking – not as a altered dissociated state
  - Behaviors and experiences associated with hypnosis are acted out by the hypnotized individual in accordance with the social context and expectations of the hypnotic setting
  - People control their hypnotic experience by acting how they believe they are supposed to act during hypnosis
  - c.f. Martin Orne's real-simulator experiment

Modern theories on hypnosis

- Interactionist theory (Sheehan, McConkey)
  - Hypnosis depends on the qualities the individual brings to the hypnotic setting, and the ability of the hypnotist to establish the conditions that favor the persons ability to create and believe the suggested experiences
  - The hypnotic subjects are motivated and actively involved in hypnotic suggestions to develop a strong commitment to the communications of the hypnotist
  - Although they are actively involved, they still experience their response as outside their control and subjectively real

Modern theories on hypnosis

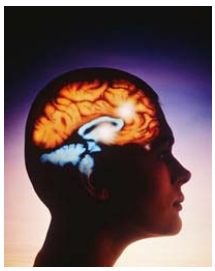
- Cold-control theory (Dienes & Perner)
  - Take offset in theories of cognition:
  - First-order and second-order states
  - Consciousness depends on our being conscious of our consciousness – e.g. I am conscious of my mental state
  - First order: e.g. imagining a cat or intending to lift my arm
  - Second order: I am aware of imagining or my intention
  - Example: blind-sight patients lack awareness of being in the mental state of seeing
  - The hypnotic experience is not compromised executive function but being without higher order consciousness of the behavior

Modern theories on hypnosis

- Discrepancy-attribution theory (Barnier & Mitchell)
  - The hypnotic experience is due to discrepancy between the cognitive process and its attribution
  - Normal: I am imagining a cat, and the resulting imagined image of a cat is attributed to that: imagination
  - Hypnosis: I am imagining a cat, but the resulting image is not attributed to the process of imagining
  - Attribution to imagination is related to the effort associated with imagination
  - The shift to a different attribution is due to the slight changes in the ease of producing images in hypnosis

Neuropsychophysiology of hypnosis

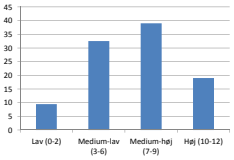
- Hypnotizability a reliable and stable personality trait measurable by tests e.g. SSHS and HGSHS
- A heritability component in hypnotizability
- Correlations between hypnotizability and absorption and ability to partition attention
- EEG-differences between highs and lows – e.g. highs generate more high theta-power

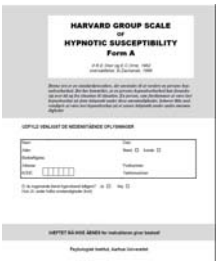


Morgan, 1973; Crawford, 1990; Lichtenberg et al. 2000; Zachariae et al. 2000

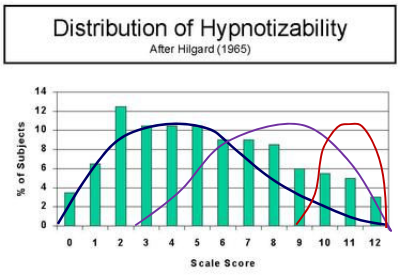
Hypnotic susceptibility

- Measured with standardized tests, e.g., The Harvard Group Scale of Hypnotic Susceptibility
- Normally distributed
- Stable over time (e.g., 25 year test-retest)





Measuring hypnotizability



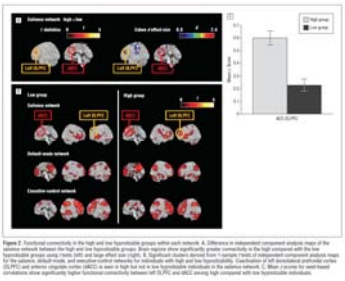
And "virtuoso" hypnotizables

Neuropsychophysiology of hypnosis

- Highs show greater hemispheric specificity/ assymmetry than lows
- Highs have higher preference for right-hemispheric activity
- Hypnosis associated with increased cerebral metabolism in certain brain regions
- Hypnotizability associated with increased frontal lobe activity and highs have more effective and flexible attentional and inhibitory (dis-attentional) systems
- Highs more able to suppress or enhance event-related brain potentials

Crawford, 1989; Gruzelier, 1999; De Benedittis & Longostreui, 1988; Zachariae & Bjerring, 1994

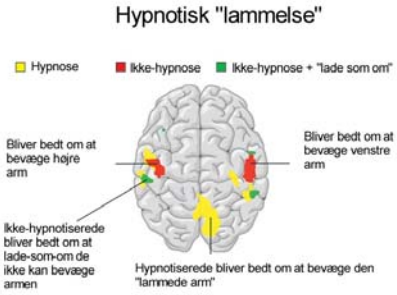
Neurobiology of hypnosis



- Stronger associations between areas in the brain related to the ability of focused attention in high than low hypnotizable individuals.

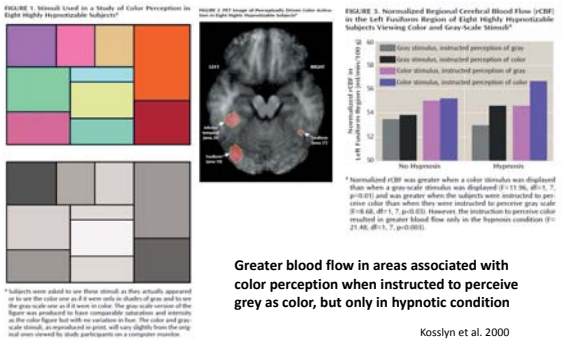
Hoeft et al. 2012.

Neurobiology of hypnosis



Cojan et al. 2009

Neurobiology of hypnosis



Greater blood flow in areas associated with color perception when instructed to perceive grey as color, but only in hypnotic condition

Kosslyn et al. 2000

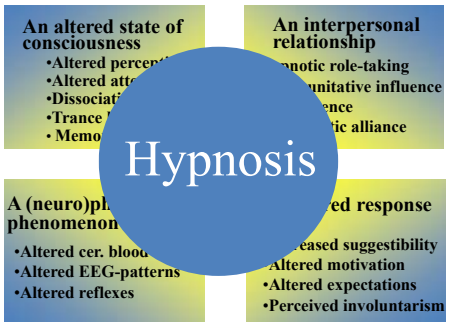
Neurobiology of hypnosis

- Taken together, the evidence suggests
  - That hypnosis is supported by neural activity that allows for
    - highly focused attention
    - Ability to manipulate sensory input
    - Reduction in self-consciousness
  - Involves intense cognitive activity that is experienced as effortless
  - May be a developed ability to alter attention, inhibit arousal, reduce conflict monitoring in response to threats (stress management)

Spiegel, 2008

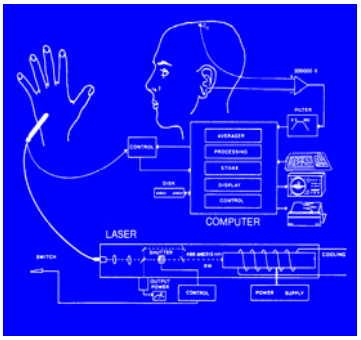
The Domain of Hypnosis

Hilgard, 1973

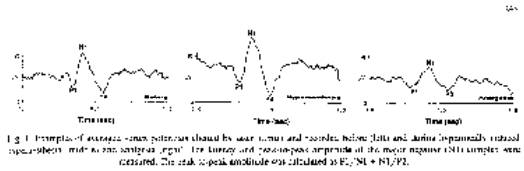


Hypnotic modulation of sensory pain perception

Experimental setup

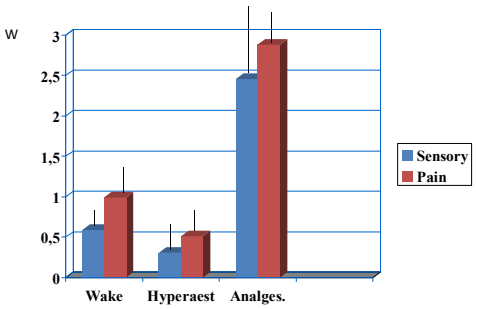


Argon laser evoked brain potentials during the waking condition, hypnotic hyperaesthesia, and hypnotic analgesia.



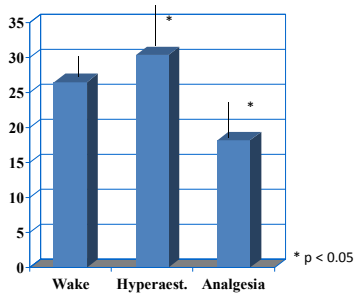
Arendt-Nielsen, Zachariae, Bjerring, 1990

Sensory and pain thresholds during the conditions of waking, hypnotic hyperaesthesia, and hypnotic analgesia



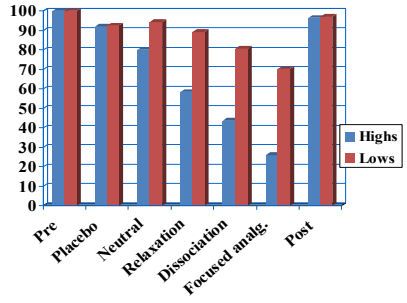
Arendt-Nielsen, Zachariae, Bjerring, 1990

Amplitude of evoked potentials (µV)



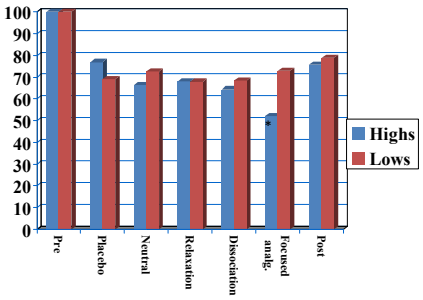
Arendt-Nielsen, Zachariae, Bjerring, 1990

Sensory pain ratings (% of baseline)



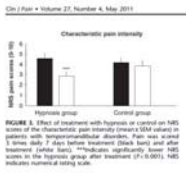
Zachariae, Bjerring, 1994

Amplitudes of pain-related brain potentials



Hypnotic analgesia

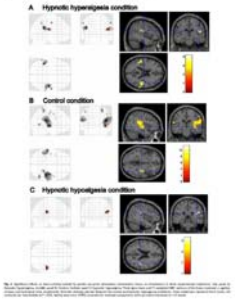
- Patients with temporomandibular disorder



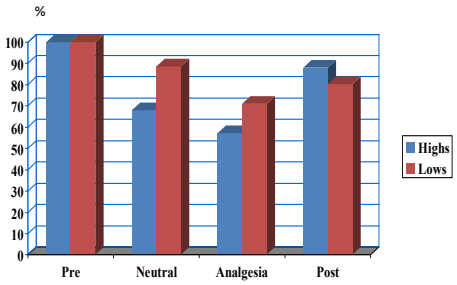
Abrahamsen, Baad-Hansen, Zachariae, Svensson, 2011

Abrahamsen, Dietz, Lodahl, Roepsdorff, Zachariae, Østergaard, Svensson, 2010

- MRi: Hypnotically induced hyper- and hypoanalgesia during experimentally induced pain (pin prick: left mental nerve)



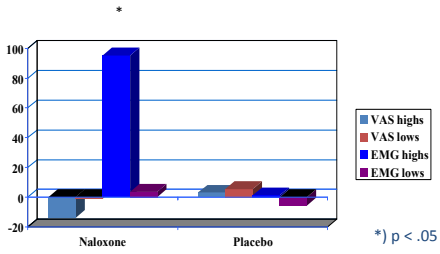
Nociceptive reflexes (%)



Significant effects of both condition ($p < .01$) and hypnotic susceptibility. ($p < .05$)

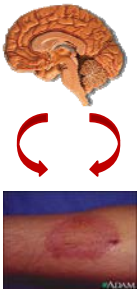
Zachariae, et al. 1998

Percent change of pain intensity and reflexes during conditions of analgesia with naloxone and with saline compared to analgesia without injection



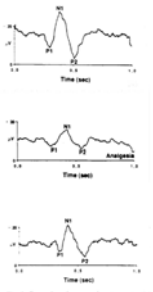
*) $p < .05$

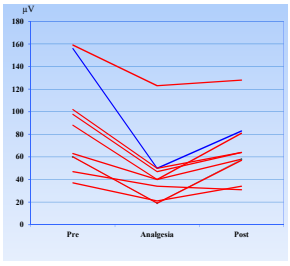
Hypnotic analgesia, pain-related brain potentials, and histamine flare reaction during hypnotic analgesia



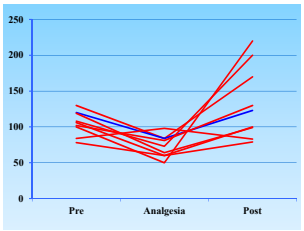
- Lesions of the sensory nerves are associated with reduced histamine flare reaction and unilateral remission of psoriasis (Lynn, 1988; Farber, 1990)
- Local analgesics associated with reduced histamine flare reaction (Bjerring & Arendt-Nielsen, 1990)
- Ten high hypnotizable subjects had argon laser induced pain-related brain potentials and histamine flare reactions measured during:
  - A pre-hypnotic baseline
  - During suggestions to experience hypnotic analgesia
  - After hypnosis

Pain-related brain potentials





Ratio between histamine flare reactions in the analgesic and the control arm



100 = 1:1

Hypnotically induced inflammation

- Hypnotists claim that they are able to induce inflammatory skin reactions by asking patients to imagine that they have been burned by a cigarette (Ullman, 1947)
- In a study, nurses were given suggestions in hypnosis that they were burned by boiling fat while frying bacon. One woman responded and told that she had once had a similar experience (Johnson & Barber, 1976)

Hypnotically induced inflammation

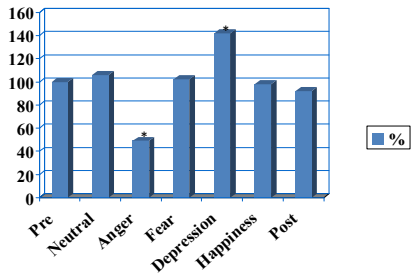
En tv-producer (LS-O), der tidligere havde haft en forbrænding på hånden, fik fremkaldt en rødmen i den samme hånd i hypnose ved at genkalde sig situationen (Zachariae, DR2, 2013)

EEG

EPoS

Emotions and pain

Pain-evoked brain potentials during hypnotically induced emotions



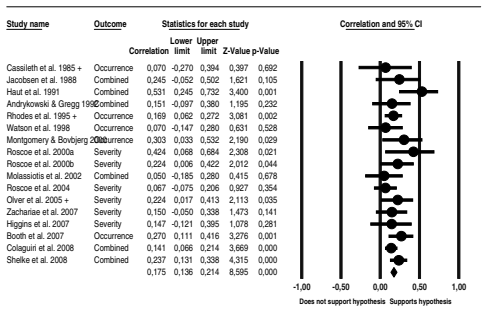
*) p < .05

Zachariae, et al. 1991

Placebo and hypnosis

Placebo

- Proposed placebo mechanisms
  - Conditioning
  - Expectancy (e.g., "priming")
  - "Response-appropriate sensation"
  - Reduction of anxiety/tension
  - "Non-specific" inter-personal factors

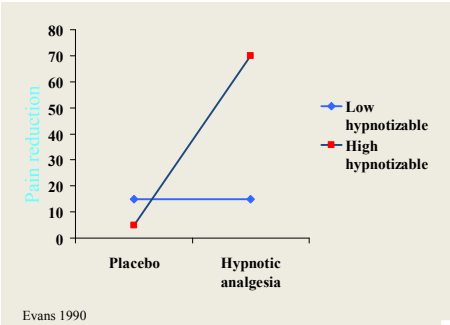


Colagiuri & Zachariae: Patient Expectancy and post-chemotherapy nausea – a meta-analysis 2010

Hypnosis and placebo

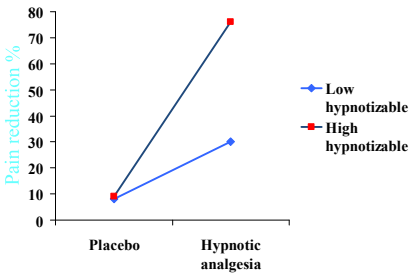
- Is the placebo response related to suggestibility?
- Are high hypnotizables better placebo-responders?

Hypnosis and placebo



Evans 1990

Hypnosis and placebo



Zachariae et al. 1994

EPoS

Pain coping and behavioral traits

Coping Strategies questionnaire

Rosenstiehl & Keefe, 1983; Swartzman et al. 1994

- **Distraction**
  - *I think about pleasant previous experiences*
- **Ignoring sensations**
  - *I tell myself that my pain must not stop me from doing what I need to do*
- **Reinterpretation**
  - *I pretend that the pain is not a part of me*
- **Catastrophizing**
  - *I feel that I cannot cope any longer*
- **Prayer and hope**
  - *I put my trust in God*

Pain catastrophizing

When I'm in pain …

1. I worry all the time about whether the pain will end.
2. I feel I can't go on.
3. It's terrible and I think it's never going to get any better.
4. It's awful and I feel that it overwhelms me.
5. I feel I can't stand it anymore.
6. I become afraid that the pain will get worse.
7. I keep thinking of other painful events.
8. I anxiously want the pain to go away.
9. I can't seem to keep it out of my mind.
10. I keep thinking about how much it hurts.
11. I keep thinking about how badly I want the pain to stop.
12. There's nothing I can do to reduce the intensity of the pain.
13. I wonder whether something serious may happen.

Dimensions:
Helplessness
Rumination
Intrusive thoughts

Pain catastrophizing

- Pain catastrophizing associated with pain intensity and unpleasantness in clinical (chronic tension-type headache) and healthy samples (students) – even when adjusting for depression and trait-anxiety

Kjøgx H, Zachariae R, Pheiffer-Jensen M, Kasch H, Svensson P, Jensen TS, Vase L. Pain frequency moderates the relationship between pain catastrophizing and pain. Frontiers in Psychology, 2014.

- Hypnotic suggestions for high and low pain catastrophizing associated with changes in clinical (chronic tension-type headache) and experimentally induced pain (intramuscular infusion of hypertonic saline)

Kjøgx H, Kasch H, Zachariae R, Svensson P, Jensen TS, Vase L. Experimental manipulations of pain catastrophizing influence pain levels in chronic pain patients and healthy volunteers (submitted manuscript)

Behavioral traits

- Locus of control
- Alexithymia
- Emotional repression
- Augmenting/reducing
- Social desirability
- Neuroticism (negative affectivity)
- Somato-sensory amplification
- Monitoring/blunting
- Hypnotizability

Somato-sensory amplification

Somatosensory Amplification Scale

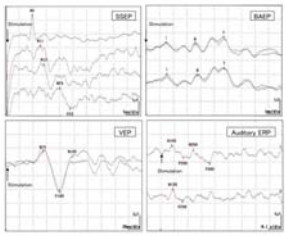
1. When someone else coughs, it makes me cough too
2. I can't stand smoke, smog, or pollutants in the air
3. I am often aware of various things happening within my body
4. When I bruise myself, it stays noticeable for a long time
5. Sudden loud noises really bother me
6. I can sometimes hear my pulse or my heartbeat throbbing in my ear
7. I hate to be too hot or too cold
8. I am quick to sense the hunger contractions in my stomach
9. Even something minor, like an insect bite or a splinter, really bothers me
10. I have a low tolerance for pain

Total

Barsky, 1992

Somato-sensory amplification

- Studies suggests that individuals high on SSA process somatosensory stimuli differently than individuals low in SSA



Nakao & Barsky, 2007

Coping with threatening health-related information – *two strategies*

- **"MONITORING"**
  - High degree of attention towards bodily sensations and stimuli from the environment (hypervigilance)
  - High level of need for perceived control
  - High level of need for detailed information
- **"BLUNTING"**
  - Perceives sensations and stimuli as potentially threatening
  - Copes by suppressing unpleasant thoughts and emotions
  - Have limited needs for information about diagnosis and treatment

Miller, 1995

Coping with threatening health-related information – *two strategies*

- Example
  - In a stratified, randomized study, patients received either limited or extensive information prior to a surgical procedure.
  - Monitors, who received limited information, and blunters, who received extensive information, reported more post-surgical pain and experienced more complications than the remaining patients.

Miller, 1995

EPoS

Take-home message

- Pain is a **multidimensional** phenomenon including sensory, cognitive, and affective processes
- Pain is influenced by **coping**, e.g. pain catastrophizing
- Individual differences in pain responses may be related to **behavioral traits**, e.g., somato-sensory amplification, hypnotizability
- Self-reported pain perception and neurobiological pain correlates can be modulated by communicative **intervention** strategies, e.g., placebo, hypnosis
- Pain is a **bio-psycho-social** phenomenon and clinicians should focus on all dimensions when treating pain

Clinical effectiveness of hypnosis

Both volunteers and patients experience significant pain relief from hypnotic analgesia

Significant effect on effect size (Cohen´s d) of hypnotizability:

High = 1.22

Medium = 0.64

Low = 0.10

Effect size conventions (Cohen 1988):

Large = 0.8

Medium = 0.5

Small = 0.2

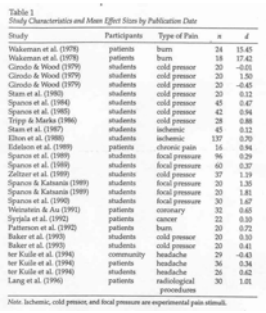


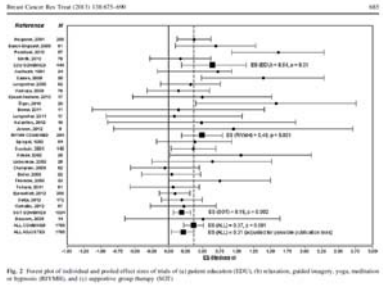
Table 1
Study Characteristics and Mean Effect Sizes by Publication Date

Study	Participants	Type of Pain	n	d
Wakeman et al. (1978)	patients	burn	24	15.45
Wakeman et al. (1978)	patients	burn	18	17.42
Girodo & Wood (1979)	students	cold pressor	20	−0.01
Girodo & Wood (1979)	students	cold pressor	20	1.50
Girodo & Wood (1979)	students	cold pressor	20	−0.45
Stam et al. (1983)	students	cold pressor	20	0.12
Spanos et al. (1984)	students	cold pressor	45	0.47
Spanos et al. (1985)	students	cold pressor	42	0.94
Tripp & Marks (1986)	students	cold pressor	28	0.88
Stam et al. (1987)	students	ischemic	45	0.12
Elton et al. (1988)	students	ischemic	137	0.70
Edelacin et al. (1989)	patients	chronic pain	16	0.94
Spanos et al. (1989)	students	focal pressure	96	0.29
Spanos et al. (1989)	students	focal pressure	60	0.37
Zeltzer et al. (1989)	students	cold pressor	37	1.19
Spanos & Katsanis (1989)	students	focal pressure	20	1.35
Spanos & Katsanis (1989)	students	focal pressure	20	1.81
Spanos et al. (1990)	students	focal pressure	30	1.67
Weinstein & Au (1991)	patients	coronary	32	0.65
Syrjala et al. (1992)	patients	cancer	22	0.10
Patterson et al. (1992)	patients	burn	20	0.72
Baker et al. (1993)	students	cold pressor	20	0.10
Baker et al. (1993)	students	cold pressor	20	0.41
ter Kuile et al. (1994)	community	headache	29	−0.43
ter Kuile et al. (1994)	patients	headache	36	0.34
ter Kuile et al. (1994)	students	headache	26	0.62
Lang et al. (1996)	patients	radiological procedures	30	1.01

Note. Ischemic, cold pressor, and focal pressure are experimental pain stimuli.

Montgomery et al. 2000

Psychological intervention in chronic pain



Johannsen, Farver, Beck, Zachariae (2013) The efficacy of psychological intervention for pain in breast cancer patients and survivors: a systematic review and meta-analysis.

Pain maintenance