Scheme Transfer in Science: Physical Psychology

Le Transfert de Schèmes en Science: Psychologie Physique

Main Sources

Hierarchical approach
Psychology of conscious activity

Philosophy of Consciousness
P.Ivanov
Trafford, 2009

http://unism.narod.ru

The Scheme of Scheme Transfer

The subject as universal mediation

Conscious activity as (re)production of the world:

$$\textit{object} \rightarrow \textit{subject} \rightarrow \textit{product}$$

$$\boldsymbol{O}_1 \rightarrow \boldsymbol{S}_1 \rightarrow \boldsymbol{P}_1 \qquad \boldsymbol{O}_2 \rightarrow (S_1 \rightarrow C_1 \rightarrow R_1) \rightarrow \boldsymbol{P}_2$$

$$\boldsymbol{O}_2 \rightarrow \boldsymbol{S}_2 \rightarrow \boldsymbol{P}_2 \qquad \boldsymbol{O}_2 \rightarrow (S_2 \rightarrow C_2 \rightarrow R_2) \rightarrow \boldsymbol{P}_2$$

$$\text{Ideation: } C_1 \rightarrow I_1 = (\boldsymbol{O}_1 \Rightarrow \boldsymbol{P}_1)$$

$$\boldsymbol{O}_2 \rightarrow (S_2 \rightarrow (S_1 \rightarrow I_1 \rightarrow R_1) \rightarrow R_2) \rightarrow \boldsymbol{P}_2$$

$$\boldsymbol{O}_2 \rightarrow ((S_2 \rightarrow S_1) \rightarrow I_1 \rightarrow (R_1 \rightarrow R_2)) \rightarrow \boldsymbol{P}_2$$

$$\boldsymbol{O}_2 \rightarrow (S_2' \rightarrow I_1 \rightarrow R_2')) \rightarrow \boldsymbol{P}_2$$

$$\boldsymbol{O}_2 \rightarrow \boldsymbol{S}_2' \rightarrow \boldsymbol{P}_2$$

$$O_2 \rightarrow \left(\begin{pmatrix} S_2' \\ S_2 \end{pmatrix} \rightarrow \begin{pmatrix} C_2' \\ C_2 \end{pmatrix} \rightarrow \begin{pmatrix} R_2' \\ R_2 \end{pmatrix} \right) \rightarrow \boldsymbol{P}_2$$

Typical Faults

No activity	→	Reduction to physiology
No sociality	→	No collective subject and inter-level relations
Transfer of operations	→	Pseudoscience, the form without sense
Informal transfer	→	Metaphors taken for science
Schemes instead activities	→	Psychology reduced to physics
	→	Introducing subjectivity in physics

Psychological Ideas in Physics

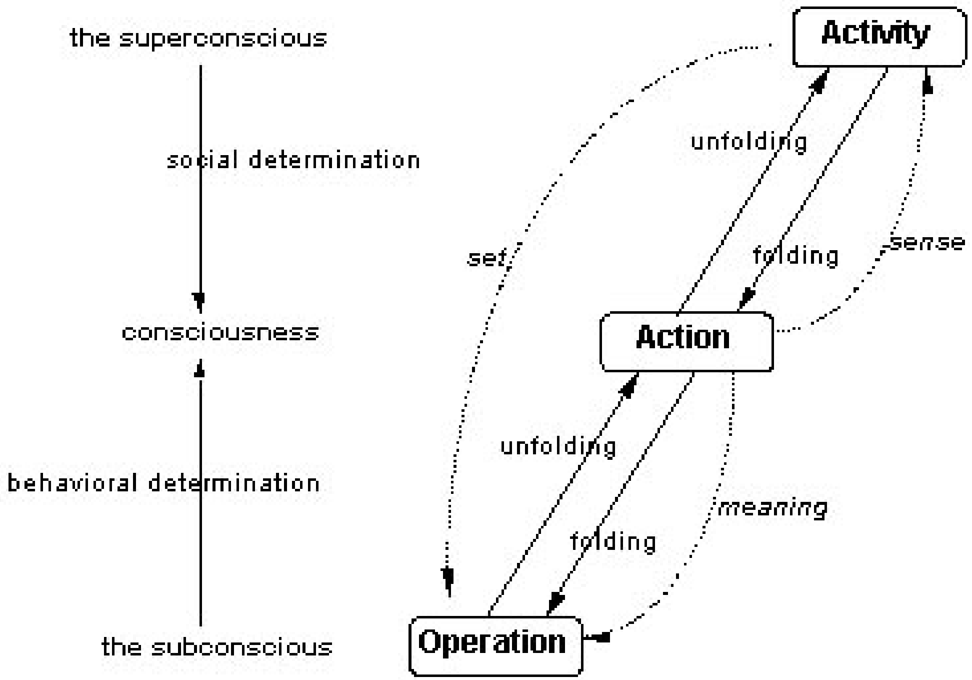
Physics as an activity → object, subject, product
Physics as a scheme of a class of activities (reflection)

Attempts to introduce the subject into physics:
- interference with the quantum observer
- identification of entropy with (negative) information

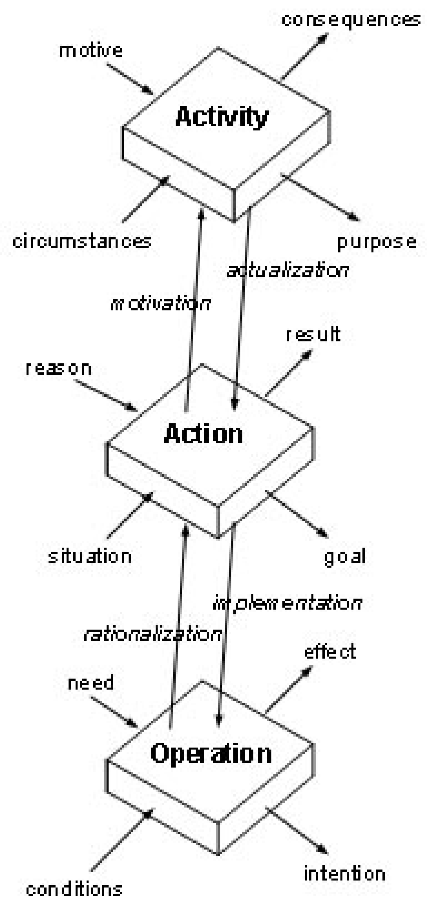
Observer in physics ≠ human observer
- classical observer, relativistic observer, quantum observer

Physical idealization of the subject:
- reference frame as an idealization of observer
- asymptotic conditions as a model of quantum observer
- statistical constructs representing experimental layout

Hierarchical Activity



A. N. Leontiev (1903–1979)

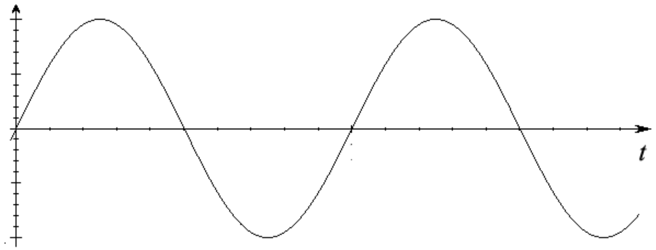


The Scheme of Newtonian Mechanics

t	time variable
$\boldsymbol{x}(t)$	position of a material point
$\boldsymbol{v} = d\boldsymbol{x}/dt$	velocity
$\boldsymbol{a} = d\boldsymbol{v}/dt$	acceleration
m	mass
$\boldsymbol{p} = m\boldsymbol{v}$	momentum
$d\boldsymbol{p}/dt = \boldsymbol{F}(t, \boldsymbol{x}, \boldsymbol{v})$	force
	equation of motion (Newton's 2nd law)
$m\boldsymbol{a} = \boldsymbol{F}$	
$K = m\boldsymbol{v}^2/2$	kinetic energy
$U(\boldsymbol{x})$	potential energy
$E = m\boldsymbol{v}^2/2 + U(\boldsymbol{x})$	total energy

Harmonic Oscillator

$$m\boldsymbol{a} = -\omega^2 \ (\boldsymbol{x}-\boldsymbol{x}_0)$$
$$\boldsymbol{x} = \boldsymbol{x}_0 + \boldsymbol{A} \cos(\omega t + \varphi)$$



In general :

$$\boldsymbol{x}(t) = \boldsymbol{x}_0 + \sum \boldsymbol{A}_k \cos(\omega_k t)$$

Fourier transform:

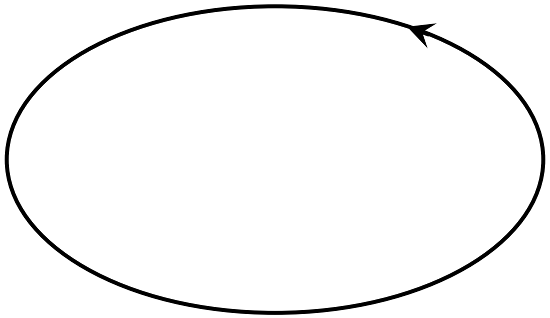
$$f(x) = \int_{-\infty}^{+\infty} d\nu \ \exp(2\pi i x \nu) f(\nu)$$

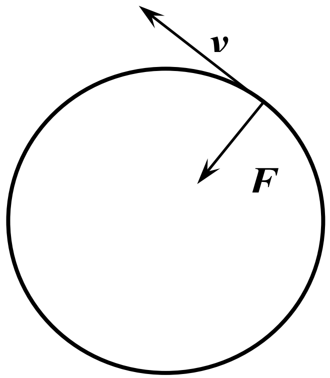
$K = m\boldsymbol{v}^2/2$

$U = m\omega^2(\boldsymbol{x}-\boldsymbol{x}_0)^2/2$ like kinetic energy, with $\boldsymbol{v} \to \omega(\boldsymbol{x}-\boldsymbol{x}_0)$

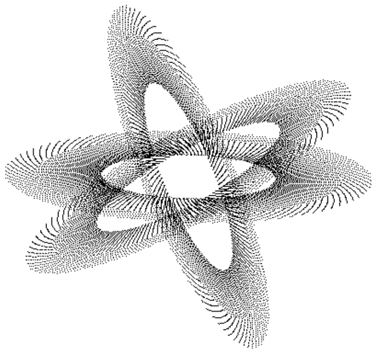
Harmonic Oscillator (cont.)

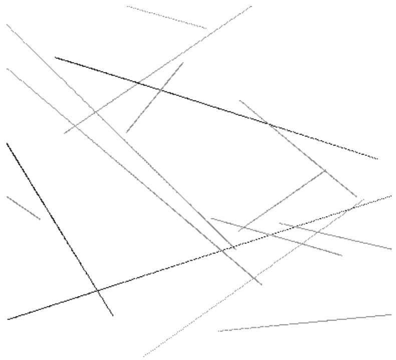
2D oscillator :

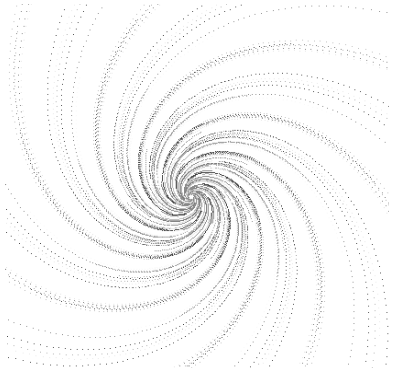




Visible shapes of linear 2D oscillators :







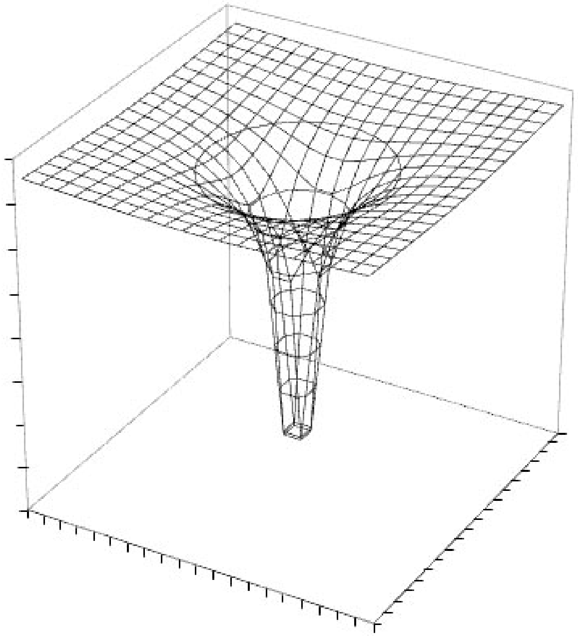
Singular Potentials

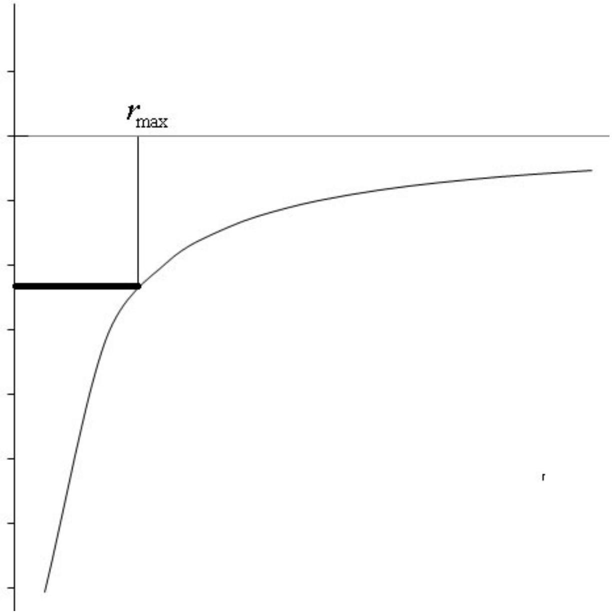
Coulomb potential:
classical gravity, electrostatics

$$U = -\frac{k}{r}$$

Coulomb force:

$$F = -\frac{2k}{r^2} \cdot \left(\frac{\boldsymbol{r}}{r}\right)$$



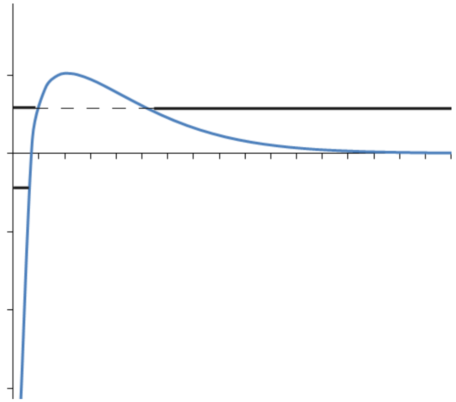


Singular Potentials (cont.)

Screened Coulomb potential (potential barrier):

$$U = -\frac{k}{r}\left(1 - \lambda e^{-\alpha r}\right)$$

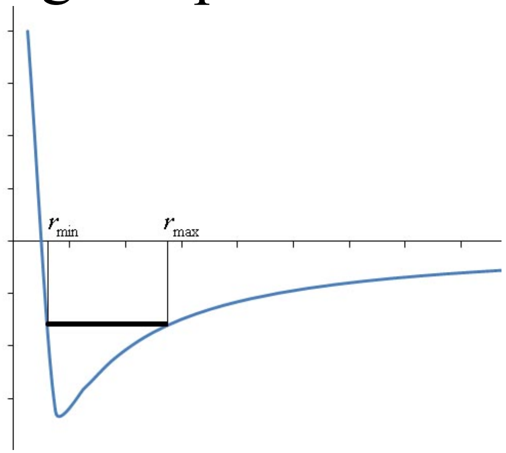
atomic forces,
collective effects



Coulomb attraction with short-range repulsion:

$$U = -\frac{k}{r} + \frac{\alpha}{r^3}$$

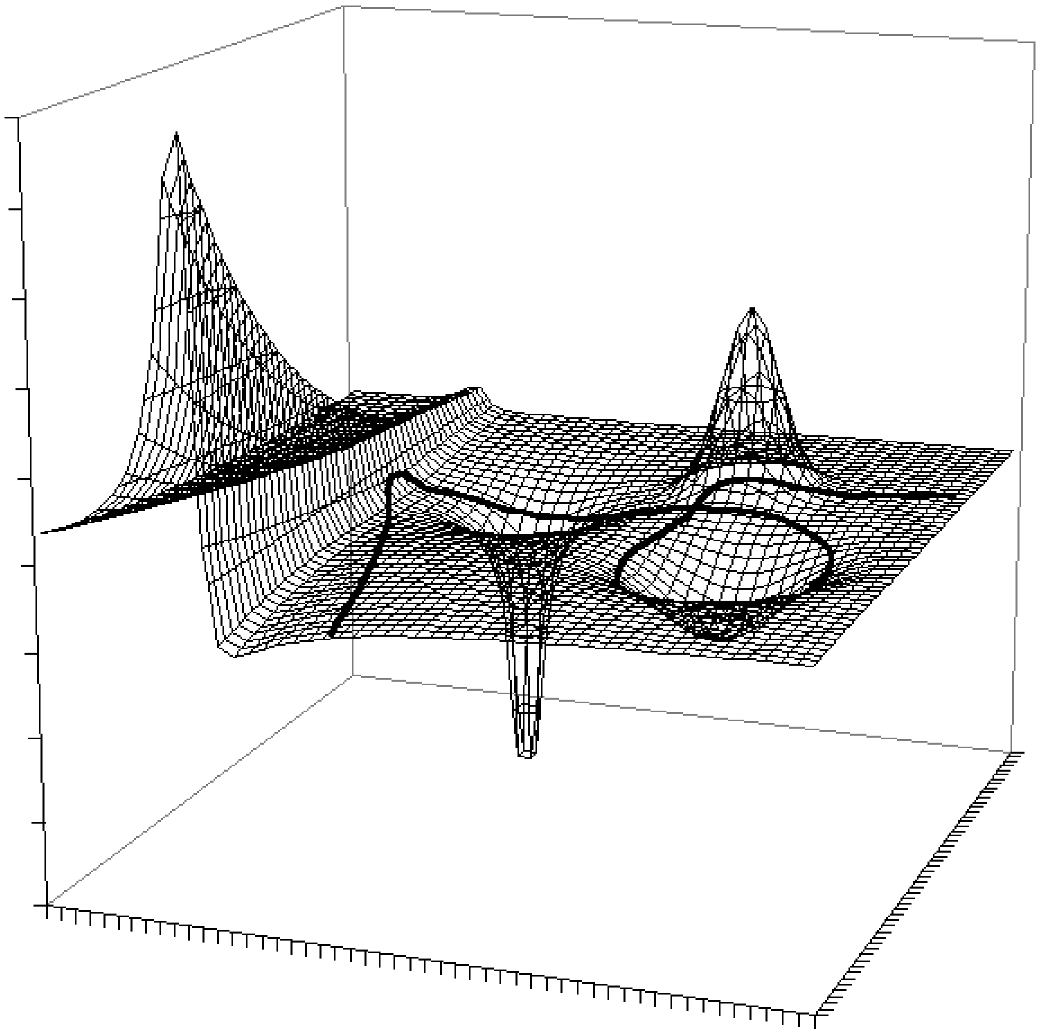
molecular forces,
nuclear forces



Mechanics of Motivation

t	(inner) time
$\boldsymbol{X} = \{\boldsymbol{x}\}$	motivation space
$\boldsymbol{x}(t)$	activity, a trajectory in the motivation space
$\boldsymbol{v} = d\boldsymbol{x}/dt$	rate of activity
$\boldsymbol{a} = d\boldsymbol{v}/dt$	affects
m	inertness
$\boldsymbol{p} = m\boldsymbol{v}$	psychological momentum
$\boldsymbol{F}(t, \boldsymbol{x}, \boldsymbol{v})$	sensibility
$\boldsymbol{F} = d\boldsymbol{p}/dt = m\boldsymbol{a}$	the equation of motion
$\boldsymbol{E} = m\boldsymbol{v}^2/2 + U(\boldsymbol{x})$	resource of the activity

Motion in the Inner Space



Temperaments

Temperament: strength, mobility, and balance

sanguine, choleric, phlegmatic, melancholic

$$\boldsymbol{F} = m\boldsymbol{a}$$

strong temperament = high sensitivity (F)

high mobility = low inertia (m)

low balance = higher affectedness (a)

individual constants vs. dynamic variables

circular motion: m, F, a are constant

elliptical motion: variation within a limited range

periodic and quasi-periodic motion

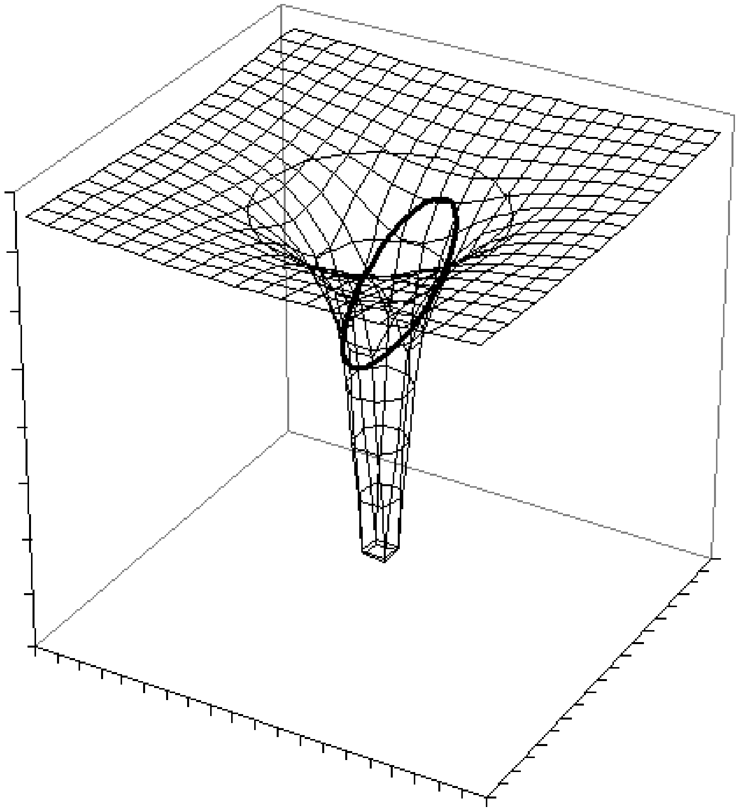
regular activities vs. developing activities

averaging and statistics

temperaments in the adiabatic limit

Neurosis Potential

Neurosis: inaccessibility of an area in the motivation space
Outer constraints or singularities of the potential energy



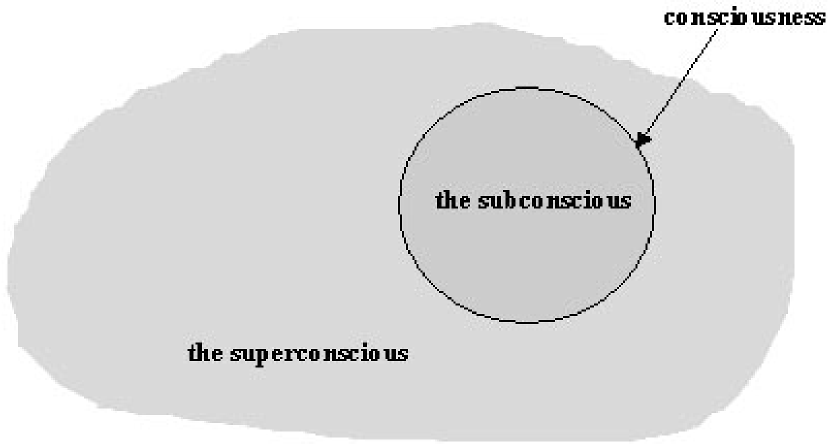
Motion around the neurotic motive, approaching it regularly, but never coming to the point

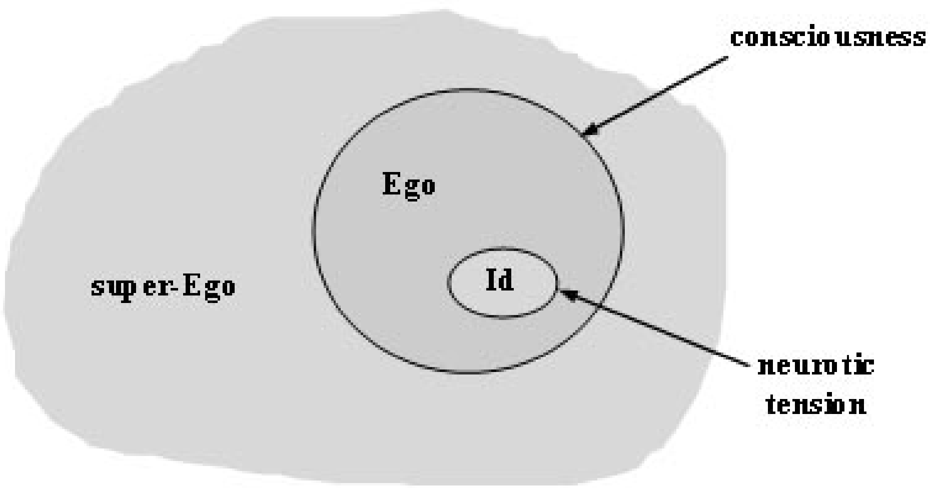
Force towards the singularity aggravates the situation

Soothing: circular motion
Remedy: increasing energy

Extended Mechanical Models

Continuous medium
Personality as an area in the motivation space





A model of neurosis
Topological singularity

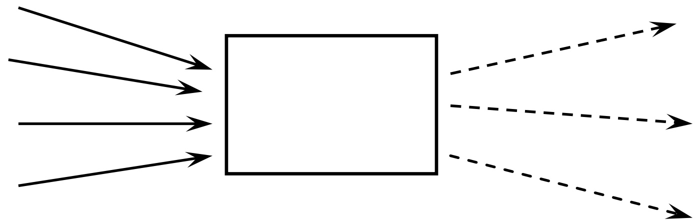
Cannot be removed by contraction

Higher dimensions (diversification of activity)

Quantum Mechanical Models

The scattering scheme:

projectile → target → outgoing particles



Ivliyev 1988: corresponds to the typical experimental setup
Inner dynamics and asymptotic conditions
Projective techniques
Interference and resonances
Statistical relevance

Koren 1984: experiments with a modulating activity

Physical Psychology vs. Psychophysics

Psychophysics:

physical measurements on an individual
physical action → physical outcome
the specificity of reaction attributed to psychology

Physical psychology:

psychologically relevant stimuli
psychological reactions
physical model reinterpreted in psychological terms
allows for collective subject

Applicability: scalable phenomena
weak nonlinearity
cultural stabilization

Conclusions

- It is possible to use any activity as a scheme for another activity, and inversely, thus making the both hierarchical
- Scheme transfer requires reinterpretation of the source notions in terms of the target science
- Even simple formal models can provide useful insight in the hidden regularities of the target science
- Realistic scheme transfer implies mutual influence of the source and target methods resulting in various hybrid schemes
- Scheme transfer potentially produces new sciences, like physical psychology