



UNIVERSITÄT ZU LÜBECK
INSTITUT FÜR MULTIMEDIALE
UND INTERAKTIVE SYSTEME

Introduction to psychological micro-models of behavior and psychometric measurement methods

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Trello Board

➤ Link:

➤ <https://t1p.de/infoXpandSECRETLINK>



1

Opinion Behavior Bridges

How does Opinion influence behavior?



What is a psychological theory?

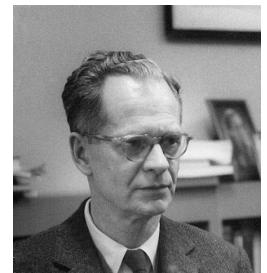
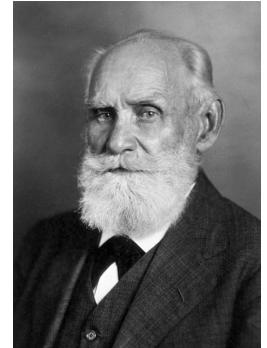
- Psychology is young field
- No Grand Unified Theory is in reach
- Theories explain aspects of the human psyche (why?)
 - Development, cognition, behavior, learning, etc.
 - Different level of detail
 - Psychophysics (Weber-Fechner)
 - Socio-Cultural Theory (Vygotsky)
- Most theories explain some data reliably
- Many theories contradict each other





Behavioristic Theories

- Plethora of theories for understanding behavior
- Behaviorism (Black-box models)
 - Classic conditioning - Stimulus response (Pavlov)
 - Reinforcement learning – Reward and punishment (Skinner)
 - Shaping and Chaining, Instinct inclination
 - Language behavior? => cognitive turn

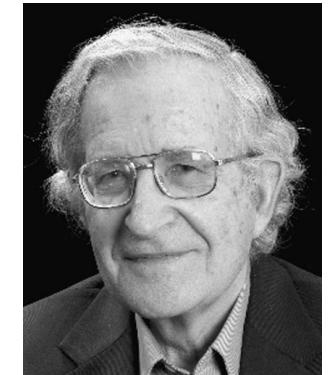




Cognitive Theories

➤ Cognitive Theories (White-box models)

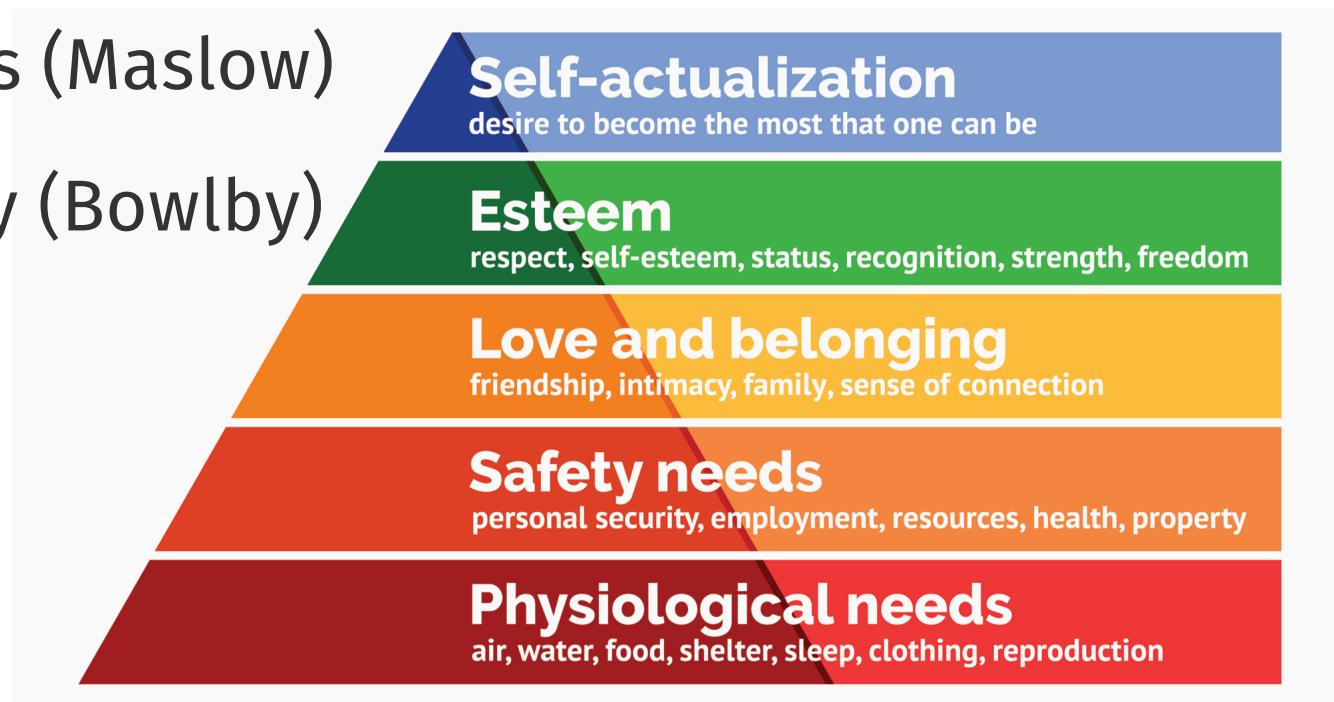
- Developmental theories – cognitive stages => constructivism (Piaget)
- Moral development – moral stages (Kohlberg)
- Language Learning – transformational-generative Grammar (Chomsky)
- Social Cognitive Theory – model learning (Bandura)
 - Personal – Behavior - Environment
 - Relatedness, self-efficacy, outcome expectations, social support
 - Implicit learning





Other (humanistic) theories

- Developmental Theory (Erikson)
- Sociocultural Theory (Vygotsky)
- Hierarchy of Needs (Maslow)
- Attachment Theory (Bowlby)
- Reactance Theory





Explaining behavior

Why do people do what they do?

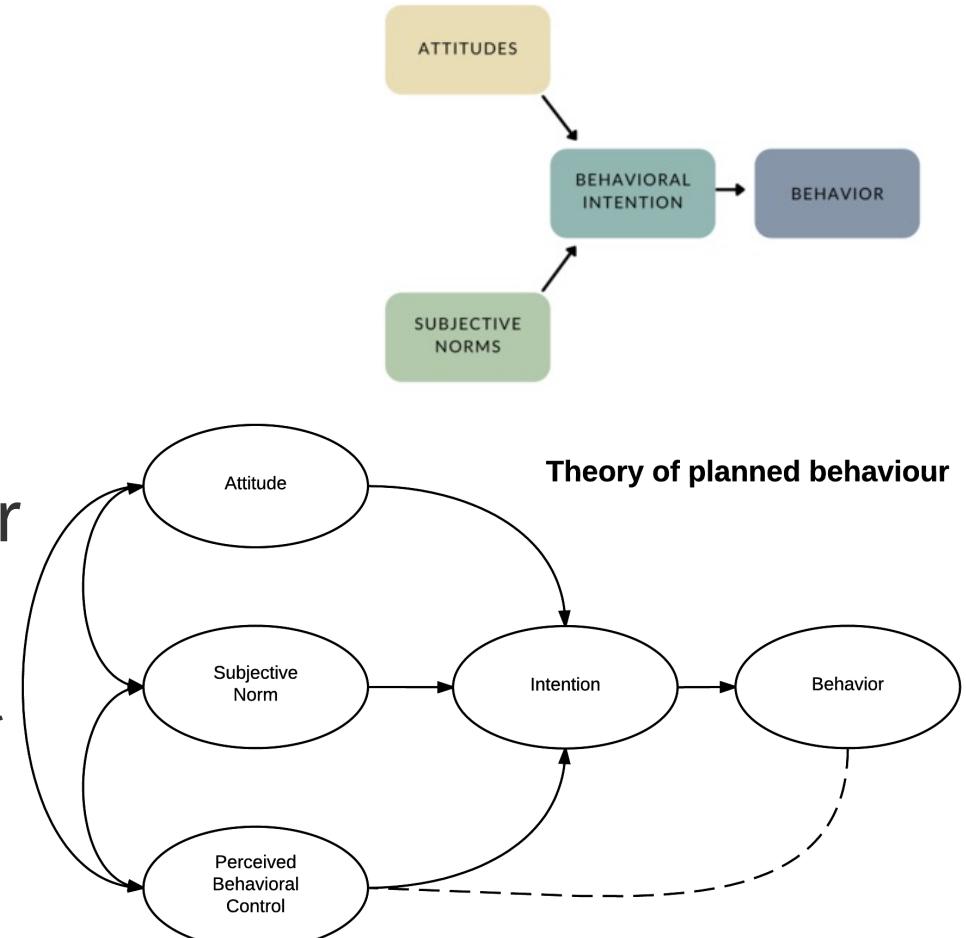
Models of behavior

➤ Theory of reasoned action (Fishbein & Ajzen)

- Attitudes (expectancy-value model)
- Subjective Norms (

➤ Theory of planned behavior (Ajzen)

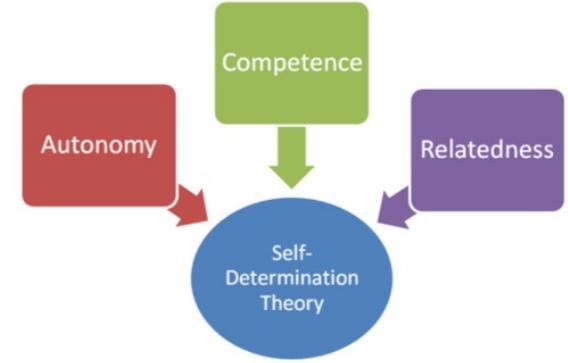
- Perceived behavioral control (attribution theory, self-efficacy)





Self-determination Theory

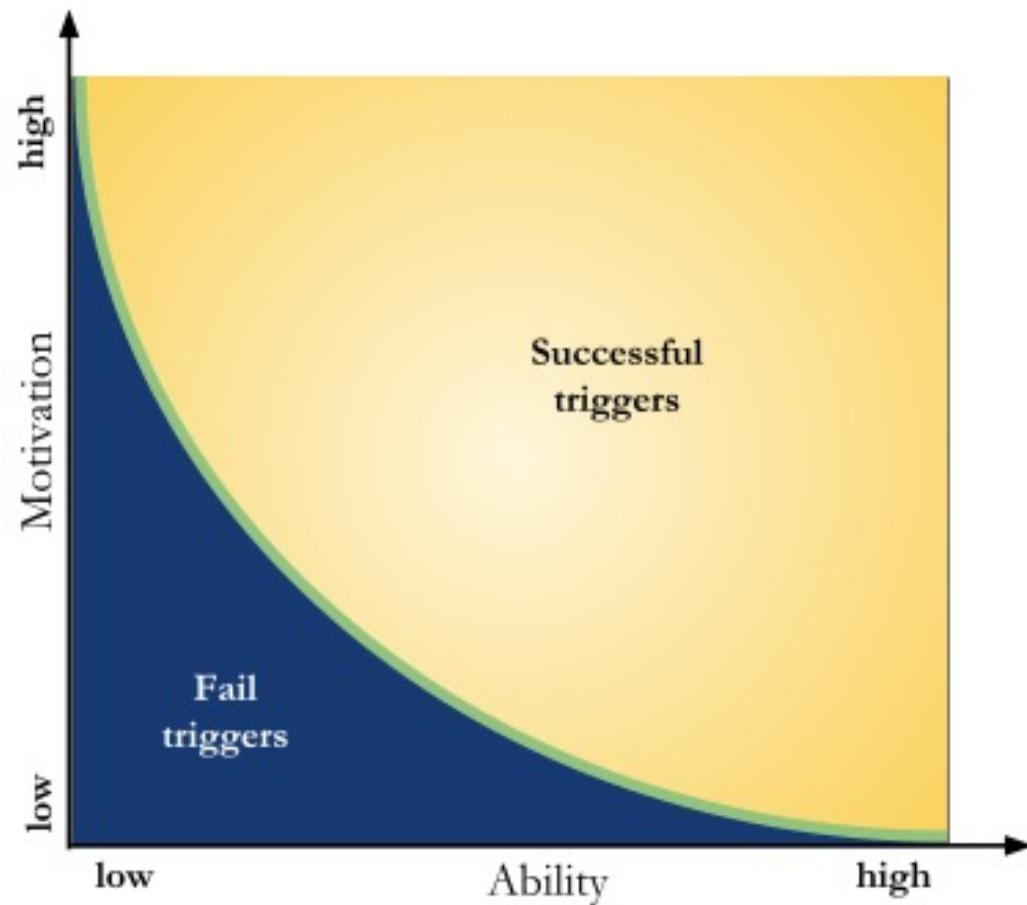
- Intrinsic and extrinsic motivation
(Deci & Ryan)
- Basic needs:
 - Autonomy
 - Competence
 - relatedness



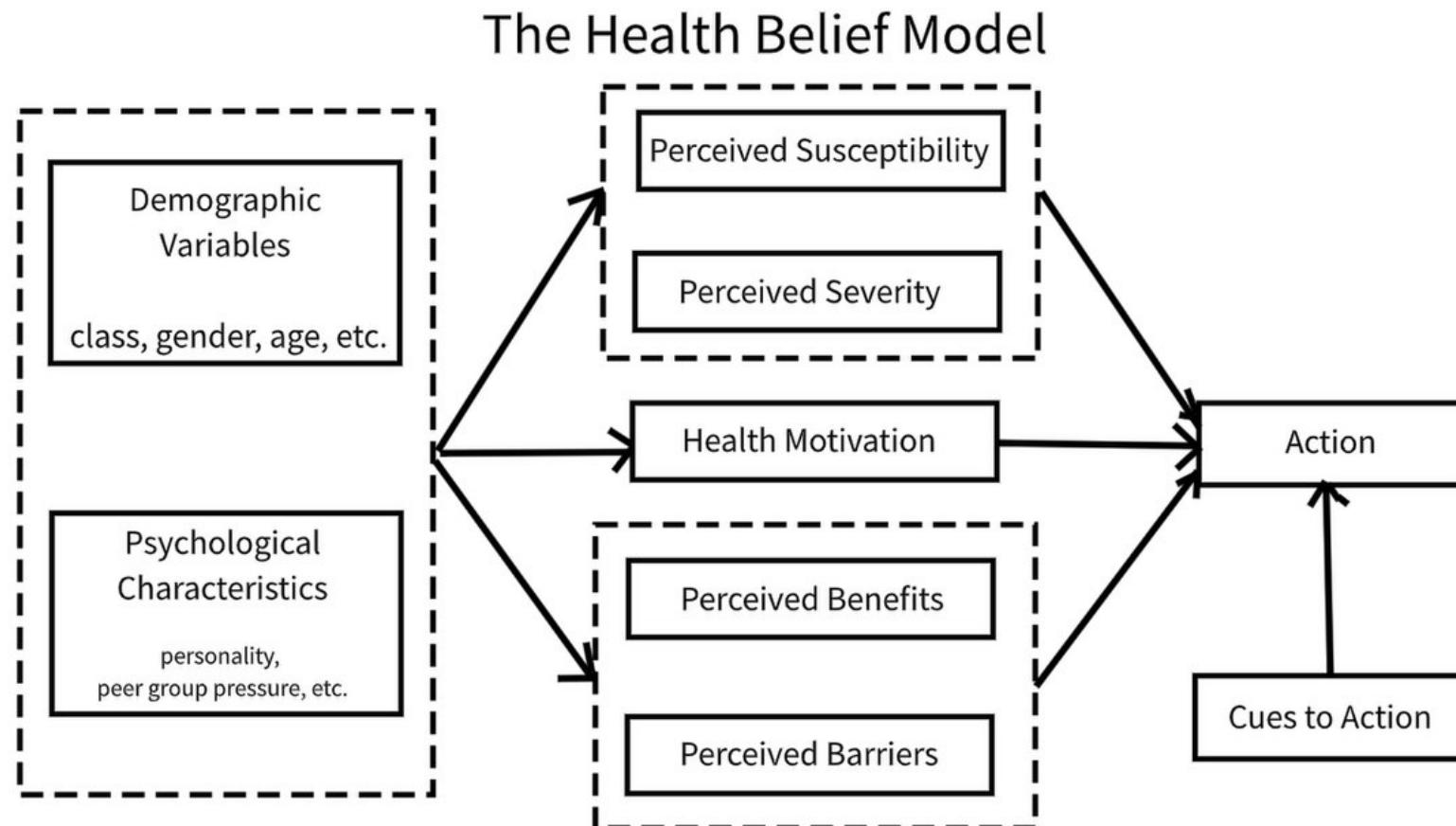


Fogg Behavior Model

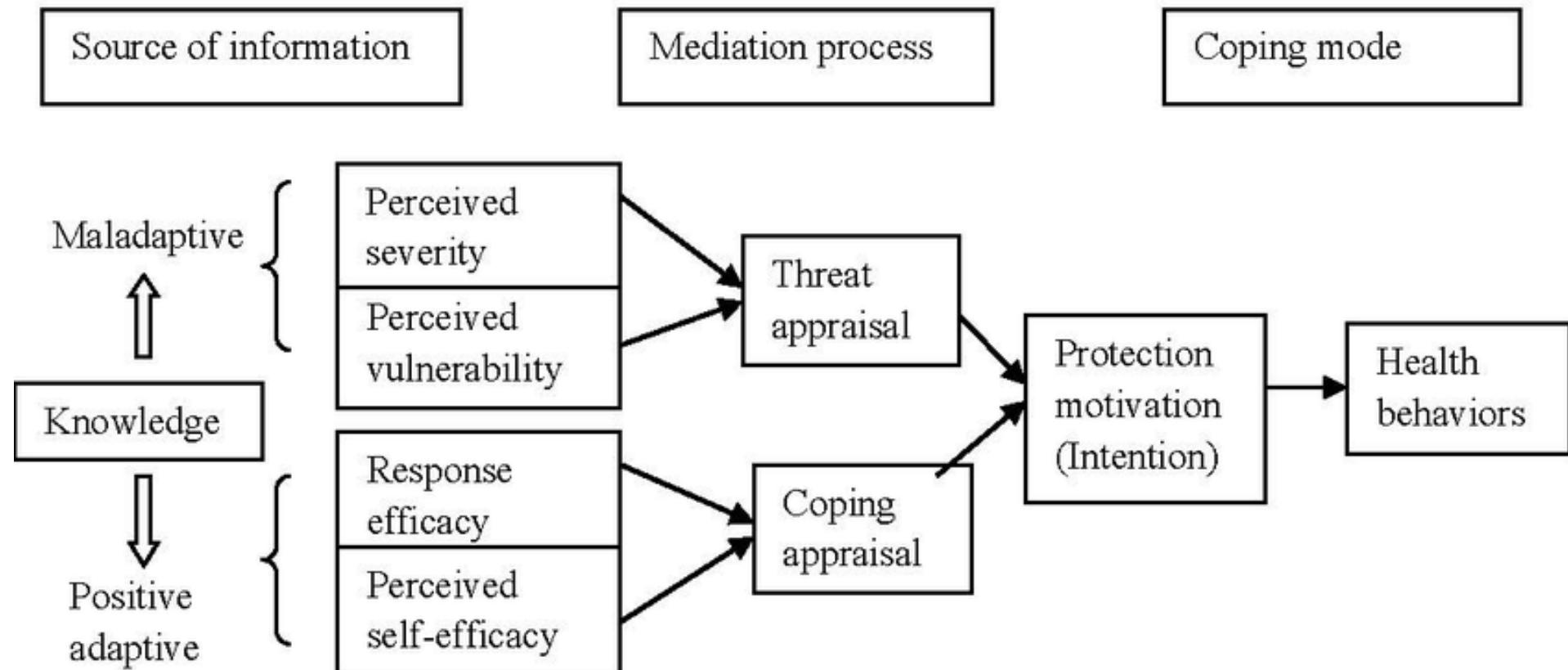
- Motivation
- Ability
- Prompt/Trigger



Health behavior theories



Protection Motivation Theory (Rogers)





Dual Process theories

- System 1 (intuitive, implicit, unconscious)
- System 2 (rational, explicit, conscious)
- Heuristics and Biases
- Keith Stanovich and Tversky/Kahnemann



Questions?

- How do we utilize this knowledge in our models?
 - Structural qualitative information?
- Which theory applies to which phenomenon?
- Should we extend existing models/theories?



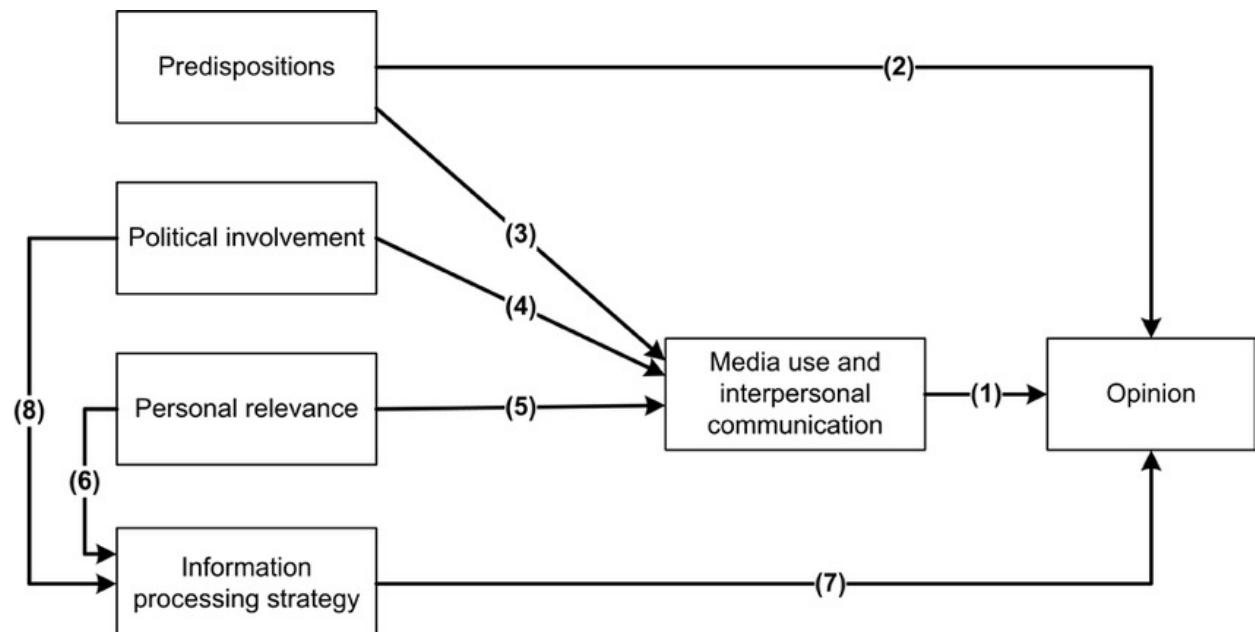
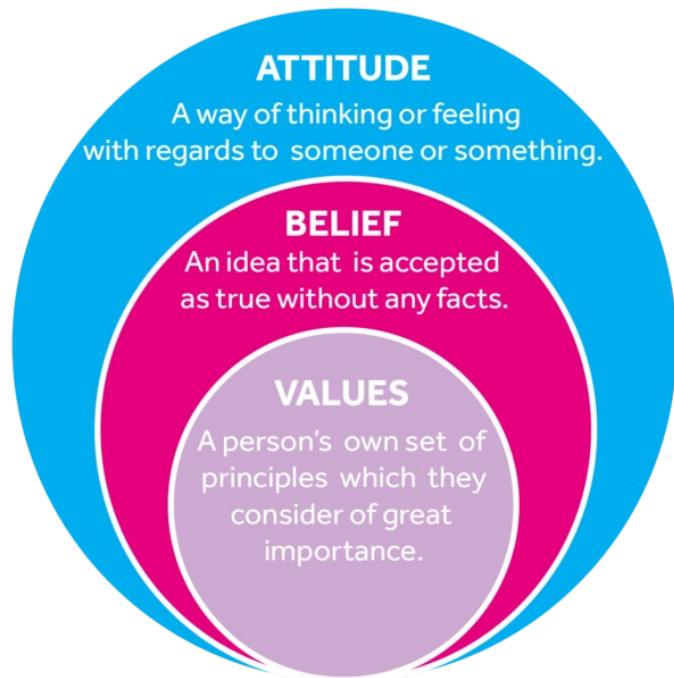
3 Theories of opinions

Why do people think what they do?



Terminology

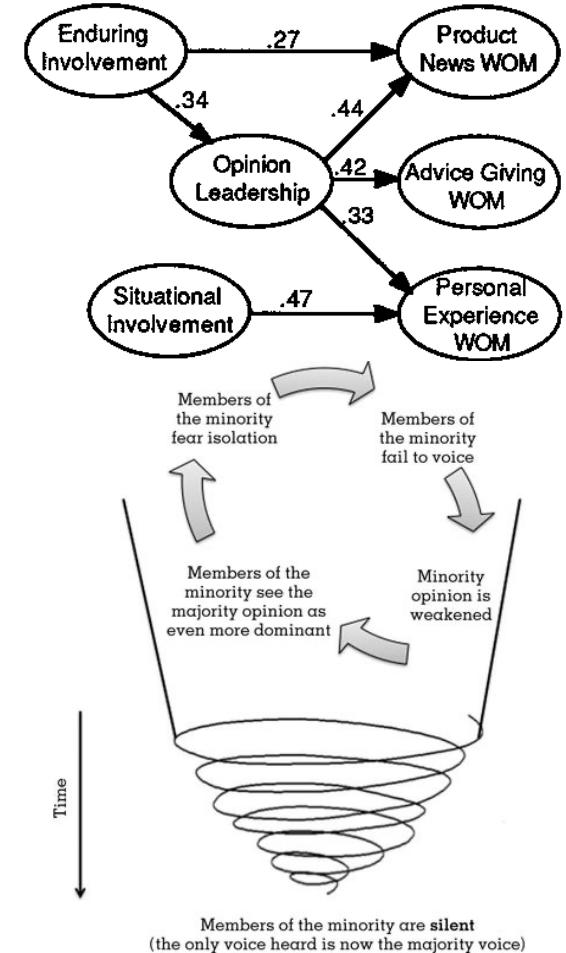
➤ Values, Belief, Attitude vs. Opinion vs. Knowledge



Theories of public opinion

- Media influences and propaganda
- Opinion leadership (Rogers & Cortano)
- Agenda-Setting Theory (McCombs)
- Spiral of silence (Noelle-Neumann)
- Opinion change by deliberation (Suiter)
- Priming (Fiske & Taylor)
- Framing (Entman)

Figure 3
Revised Opinion Leadership Model





No real bridge theories

- How does opinion influence behavior?
- Public Opinion => individual attitude

- Can we use existing models/theory? Do we need more?



From theory to model to data

Qualitative insights and quantitative predictions



From Theory to Data

- Theories as helpful, but what about data?
- How to do we get to quantitative relationships between aspects of theory?
- Example: Affective Risk in the COSMO data



Operationalization

- **Definition:** Concrete instruction on how to measure a phenomenon.
- Terms are often not clearly defined in the social sciences:
 - Index, variable, operationalization, scale, construct, dimension, indicator.

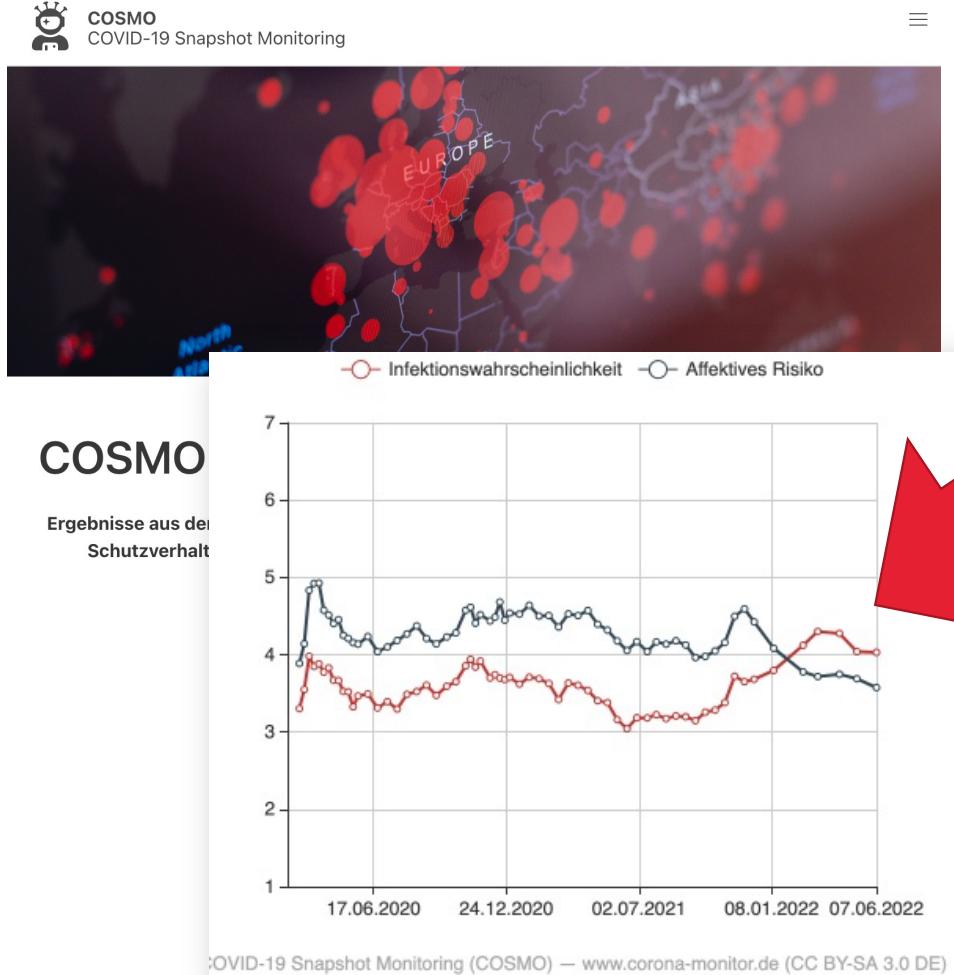


Affective Risk in COSMO Data

- Measuring „Affective Risk“
- Scale from 1 (low) – 7 (high)
 - Fear/Anxiety
„What is your level of fear regarding COVID-19?“
 - Worry
„How much do you worry about COVID-19?“
 - Pondering Covid
„How often do you think about COVID-19?“



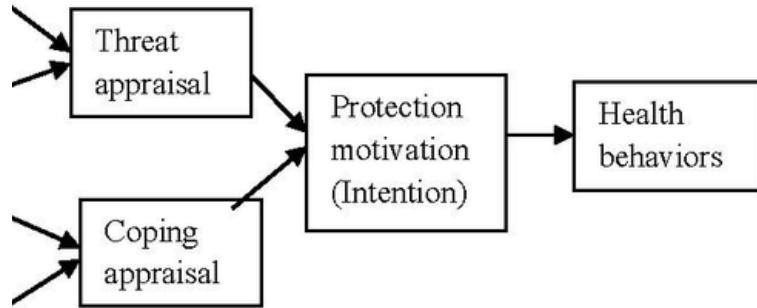
COSMO example data



A	B	C	D	E	F	G	H	I	J	K	L
1	2020-03-03	3.799	3.975	3.887	973	3.216	3.390	3.303			
2	2020-03-10	4.054	4.228	4.141	966	3.463	3.636	3.550			
3	2020-03-17	4.749	4.915	4.832	1015	3.892	4.069	3.980			
4	2020-03-24	4.847	4.996	4.922	1113	3.763	3.935	3.849			
5	2020-03-31	4.843	5.009	4.926	1028	3.797	3.968	3.882			
6	2020-04-07	4.490	4.660	4.575	1022	3.687	3.863	3.775			
7	2020-04-14	4.430	4.596	4.513	1032	3.741	3.918	3.829			
8	2020-04-21	4.319	4.486	4.403	1006	3.574	3.765	3.669			
9	2020-04-28	4.369	4.538	4.454	1018	3.576	3.756	3.666			
10	2020-05-05	4.167	4.333	4.250	1007	3.439	3.612	3.525			
11	2020-05-12	4.126	4.295	4.211	1013	3.434	3.607	3.520			
12	2020-05-19	4.068	4.245	4.156	972	3.235	3.417	3.326			
13	2020-05-26	4.046	4.227	4.136	925	3.375	3.557	3.466			
14	2020-06-09	4.147	4.324	4.235	955	3.405	3.579	3.492			
15	2020-06-23	3.953	4.124	4.039	993	3.224	3.399	3.311			
16	2020-07-07	4.011	4.190	4.100	1010	3.306	3.480	3.393			
17	2020-07-21	4.099	4.268	4.183	1001	3.215	3.381	3.298			
18	2020-08-04	4.182	4.355	4.269	999	3.400	3.573	3.486			
19	2020-08-18	4.285	4.462	4.373	957	3.433	3.614	3.524			
20	2020-09-01	4.120	4.290	4.210	984	3.522	3.689	3.606			
21	2020-09-15	4.052	4.140	4.052	1013	3.389	3.560	3.475			

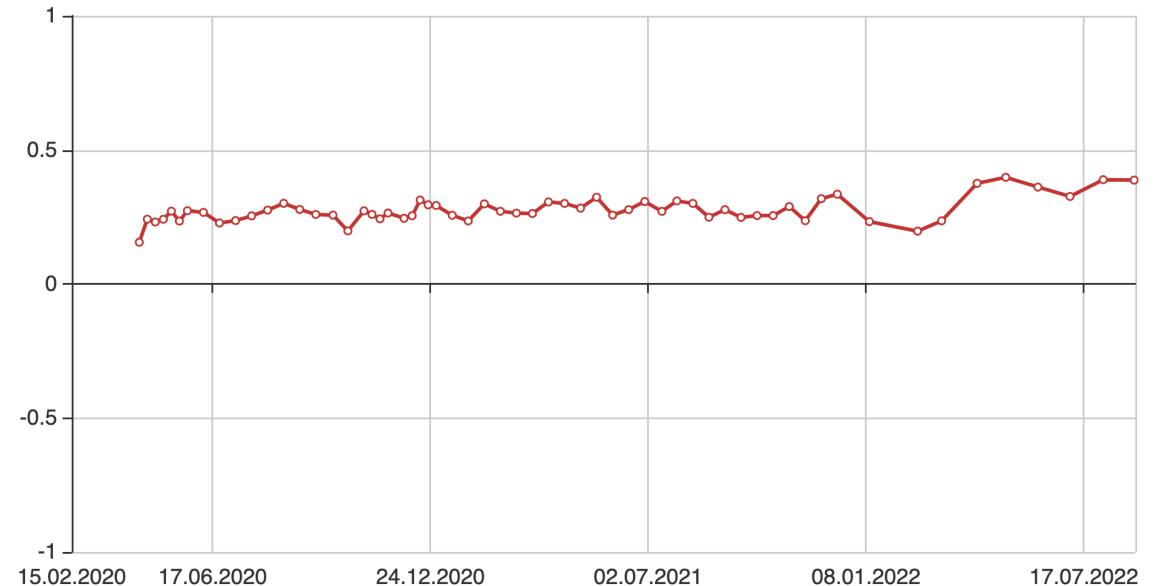
<https://projekte.uni-erfurt.de/cosmo2020/web/explorer/>

Risk and Protection (Mask wearing)



Protection Motivation Theory

Korrelation: Affektives Risiko und Atemschutzmaske tragen



Hinweis: Korrelationen erlauben keinen Schluss auf ursächliche Zusammenhänge
COVID-19 Snapshot Monitoring (COSMO) — www.corona-monitor.de (CC BY-SA 3.0 DE)



How to use such insights in modeling?

➤ Qualitative insights from survey data

- Non-numerical insights, descriptive
- Should lead to modeling ideas/questions/hypotheses
 - "Does affective risk perception depend on case numbers?"
 - "Does affective risk lead to more protective behavior?"

➤ Such outcomes can be integrated into models

- Both in equation-based models (as dampening/increasing terms) and agent-based models as agent-properties



Interplay Between Risk Perception, Behavior, and COVID-19 Spread

Philipp Dönges^{1†}, Joel Wagner^{1†}, Sebastian Contreras^{1,2†}, Emil N. Iftekhar^{1†}, Simon Bauer¹,
Sebastian B. Mohr¹, Jonas Dehning¹, André Calero Valdez³, Mirjam Kretzschmar⁴,
Michael Mäs⁵, Kai Nagel⁶ and Viola Priesemann^{1,7*}

➤ Exploratory modeling

- Does adding this mechanisms explain more features of the data than a simpler model?



Numerical Anchors missing

- How much does an „affective risk“ of 5.5 lead to mask wearing?
- How to utilize these data to inform agents?
Automatically?
- Experiments still needed (WP1/WP3)



Psychological Measurement



Classical test theory (CTT)

➤ Axioms of CTT:

- Existence: measurement can infer the "true value".
- Linkage: Measurement errors are random.
- Independence: Measurement error and "true values" are uncorrelated.

➤ Only one-dimensional measurement (vs. conjoint/discreet choice)

	stimme völlig zu	stimme zu	stimme eher zu	stimme eher nicht zu	stimme nicht zu	stimme gar nicht zu
"Ich kann ziemlich viele der technischen Probleme, mit denen ich konfrontiert werde, allein lösen."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"Technische Geräte sind oft undurchschaubar und schwer zu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Operationalization

- **Definition:** Concrete instruction on how to measure a phenomenon.
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Easy to operationalize

- **Age:** e.g., open question with text response
- **Gender:** single choice: Male, female, other
- **Job Status:** Single choice: In training, employee, employer
- **Experience with care in private environment:** Single choice: little, medium, much



Hard(er) to operationalize

- Technology Self-Efficacy (Kontrollüberzeugung im Umgang mit Technik) Beier 2003).
 - "Subjective extent to which a technical problem solution can be attributed to one's own behavior."
 - The "perceived" is there by definition.
- Inappropriate: "How high is your TSE?"
- Likert scale as a standard attitude measurement tool.
 - According to Rensis Likert
 - Important: Likert scales are always multiple items!

	stimme völlig zu	stimme zu	stimme eher zu	stimme eher nicht zu	stimme nicht zu	stimme gar nicht zu
"Ich kann ziemlich viele der technischen Probleme, mit denen ich konfrontiert werde, allein lösen."	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
"Technische Geräte sind oft undurchschaubar und schwer zu	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



How people respond to surveys



- Errors can occur at any step of the process
 - The middle steps can be skipped
- Typical response biases:
 - Consent bias, social desirability, third party presence, sponsorship effects, etc.



Reflective Self-Disclosure

➤ Measure latent variables

- Latent variable is a construct or factor.
- Examples: opinions, intelligence, memory, emotions, etc.

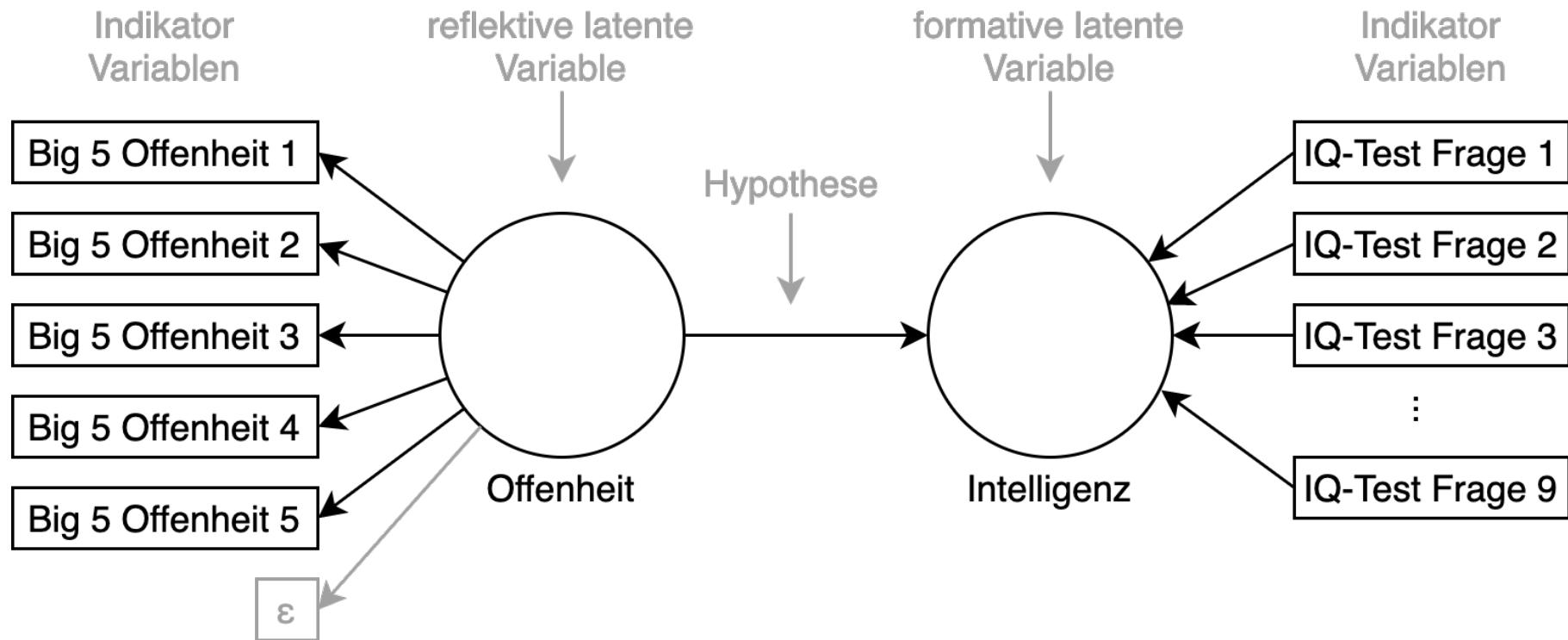
➤ Not an actual entity, not really "tangible".

➤ Two forms of the latent variable

- **Formative** measurement: how one measures the latent variable determines its content.
 - E.g., "intelligence is what the intelligence test measures"
- **Reflective** measurement: social science tests and empirical forms of inquiry as indicators of something "behind it"

Structural model

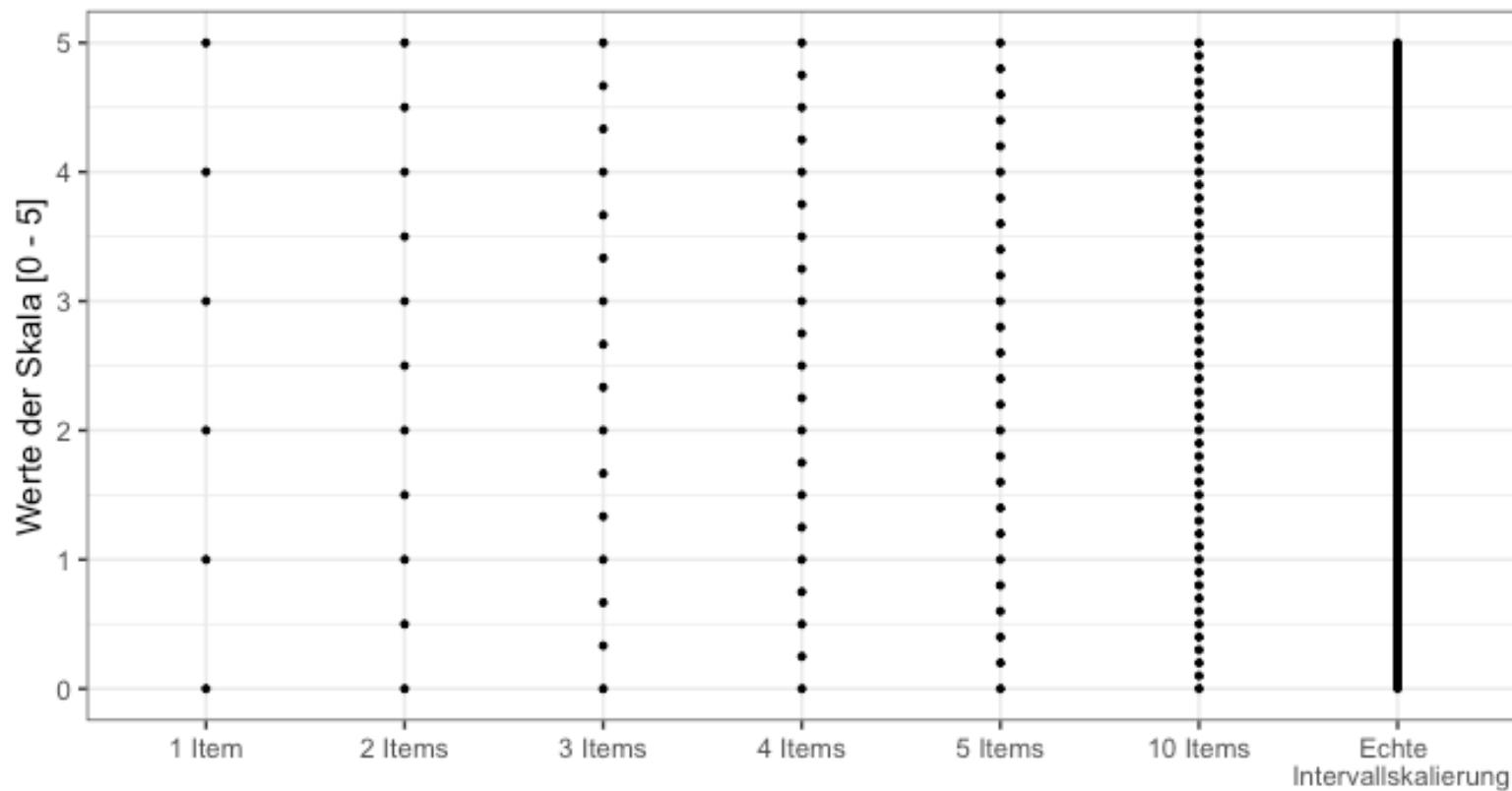
➤ How does openness affect a person's intelligence?





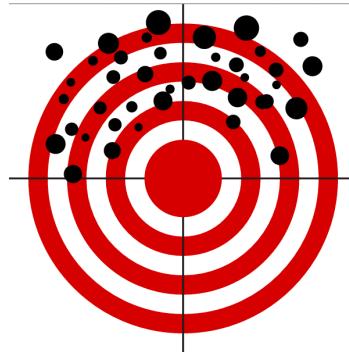
Pseudo-Interval Scales

- By increasing the number of items, we increase measurement resolution.

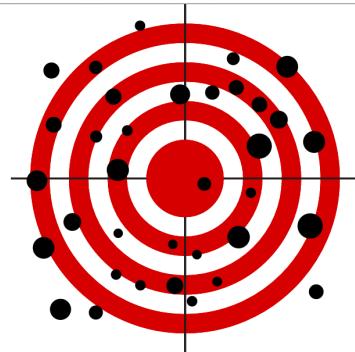




Scale Validity & Reliability



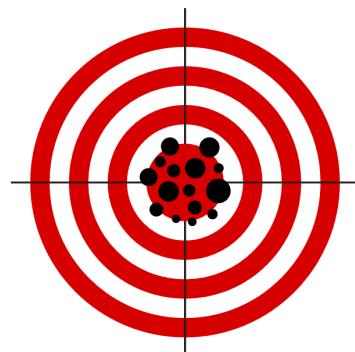
Unreliable & Unvalid



Unreliable, But Valid



Reliable, Not Valid



Both Reliable & Valid

➤ **Validity** - "Are we measuring the right thing?"

- Content validity
- Visual validity ("Augenscheininvalidität")
- Construct validity
- Criterion validity

➤ **Reliability** - "Are we measuring reliably?"

- Test-retest, parallel-test, split-half

➤ **Internal consistency:**

- Cronbach's alpha, Omega-Value, Factor-Structure

Normal Distributions everywhere



- Social Scientists often assume normally distributed data
 - Frequentist methodology (NHST)
 - Normally distributed errors
 - Normally distributed variables

- Reasonable:
 - Normal distributions are results of additive processes
 - Multiple sources of differentiation that add up to explain differences in human beings



Questions

- What should we measure and how frequently to inform our models?
- Reflective or formative measurement?
- Changes over time?



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