Second Summer School Portfolio
-Deliverable-

This project has received funding from the European Union's Horizon 2020 research and innovation programme under **Grant Agreement No. 952464**

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Work Package: WP2

Lead Beneficiary: West University of Timisoara (UVT or WUT)

Other contributors: UGENT and UNIMIB

Version 1

Abbreviations and Acronyms

WUT / UVT = West University of Timisoara

UGENT = Ghent University

UNIMIB = University of Milan-Bicocca

LEARN VUL

ABOUT

CONTACT

WEBSITE:
https://h2020learnvul.uvt.ro/

CONTACT:
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SECOND SUMMER SCHOOL PORTFOLIO

The Summer School portfolio includes the following chunks of materials:

I. Before summer school materials

1. Invitation (call) posted on the website
2. The announcement (call) posted by the European Association of Personality Psychology and sent to their members.
3. Selection of the third-party participants (outside UVT, UNIMIB, and UGENT)

II. During summer school materials

1. The summer school schedule (agenda)
2. The summer school participants' list
3. The summer school attendance list
4. Selection of pictures from the summer school
5. The summer school feedback form (results)

III. After summer school materials

1. Video lectures (publicly available)
2. Presentations and accompanying data (publicly available)

DISSEMINATION

All presentations and accompanying datasets are available in an Open Repository (Open Science Framework – OSF) and on our website.

Citation: Sava, F. A. (2022, October 4). LEARNVUL Project Materials. https://doi.org/10.17605/OSF.IO/P48EW

The Video Lectures are available on YouTube at the following link: https://bit.ly/learnvul2

The materials are also available on our website.

Opened applications for 1 free spot at the 2022 LEARNVUL Summer School

September 5 – September 9, 2022, in Como, Italy

The West University of Timisoara from Romania opened the call for applications as attendees at the 2022 LEARNVUL Summer School, the second summer school organized as part of the *Learning in emotionally vulnerable people* Project. The project is in collaboration with the University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT) and has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 952464 (more information at: https://h2020learnvul.uvt.ro/).

Experienced researchers from the two leading institutions of the project, the University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT), are invited to provide lectures and hands-on activities during five days of workshops between September 5th and September 9th. The Summer School activities will focus on various topics to enhance participants' research skills. Notably, after attending this school, participants will be able to: 1) Use R to conduct complex analyses on data from experimental studies, electro-dermal activities, heart rate studies, and intensive longitudinal studies; 2) Get familiar with R Markdown. Besides topics regarding statistical data analysis, there will also be discussed subjects related to the project's scope. Hence, the participants will also acquire theoretical information on: 1) Principles of learning; 2) Trends in Evaluative Conditioning and Avoidance; 3) Manuscript writing; 4) The relationship with journal editors. After the Summer School, all used materials will be made available in the LEARNVUL OSF online repository.

The applications are open to all researchers (preferably early-stage researchers) interested in the presented topics. Researchers focusing on a broader issue – personality and information processing are also welcomed, mainly if they focus on information processing that predisposes people to psychopathology (e.g., cognitive biases).

Requirements: The application consists of: (i) Curriculum Vitae; and (ii) Motivation letter.

Contact: All applications will be sent via email to florin.sava@e-uvt.ro until Aug 22, 2022, with [Summer School Application] as a subject. The confirmation response will be provided within three working days.

The organizer supports the costs related to traveling, accommodation, and meals.

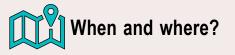**LEARNING IN EMOTIONALLY VULNERABLE PEOPLE – Summer School**

5 – 9 September 2022, Como, Italy

- Opened applications for one free spot at the Summer School -

The West University of Timisoara from Romania opened the call for applications as attendees at the 2022 LEARNVUL Summer School organized as part of the *Learning in emotionally vulnerable people* Project. The project is in collaboration with the University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT) and has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 952464 (more information at: https://h2020learnvul.uvt.ro/).
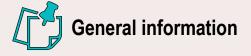
Who can apply?

The 2022 LEARNVUL Summer School is intended for mostly Ph.D. and master's students interested in empirical scientific research and topics such as statistical analysis of experimental data, principles of learning (i.e., intersecting regularities), and personality psychology (with a focus on neuroticism), and scientific writing. However, as the program covers various topics with different levels of complexity, this summer school will also fit the needs of more experienced and postdoctoral researchers who want to improve their skills and expertise in the presented topics.

When and where?

The Summer School takes place in Italy, near Lake Como, and is organized by the West University of Timisoara (WUT) in collaboration with Ghent University (UGENT) and the University of Milano-Bicocca (UNIMIB).

There will be five days of workshops between September 5th and September 9th.

All workshops will be held face-to-face in locations that will be announced later.

General information

Lecturers: Researchers from the University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT) are invited to provide lectures and hands-on activities during the five days of workshops.
Price: The costs related to traveling, accommodation, and meals are supported by the organizer.
Free seats: 1
Deadline: 22 Aug 2022

Acquired skills

The 2022 LEARNVUL Summer School activities will focus on various topics to enhance participants' research skills.

Particularly, after attending this event, participants will be able to:

a) Use R to conduct complex analyses on data from experimental studies, electrodermal activities, heart rate studies, and intensive longitudinal studies.
b) Get familiar with R Markdown.

Besides topics regarding statistical data analysis, we will also discuss topics close to the project's scope. Hence, the participants will also acquire theoretical information on:

a) Principles of learning
b) Trends in Evaluative Conditioning and Avoidance
c) Manuscript writing
d) The relationship with journal editors

The project's website has a complete version of the summer school topics and their related schedule.

After the Summer School, all materials will be available online on the LEARNVUL OSF repository.

Application

The applications are open to all researchers (preferably early-stage researchers) interested in the presented topics. Researchers focusing on a broader topic – personality and information processing are also welcomed, mainly if they focus on information processing that predisposes people to psychopathology (e.g., cognitive biases).

Requirements: The application will consist of: (i) **Curriculum Vitae**; and (ii) **Motivation letter**.
Contact: All applications will be sent via email to florin.sava@e-uvt.ro until Aug 22, 2022, with [Summer School Application] as a subject. The confirmation response will be provided within three working days.

Universitatea de Vest din Timișoara

Florin Sava <florin.sava@e-uvt.ro>

EAPP Member Mail - Announcements
1 mesaj

European Association of Personality Psychology <admin@membership.eapp.org>   29 iulie 2022, 20:08
Răspunde la: Senka Radovic <shadow.sombra.senka@gmail.com>
Către: Florin Sava <florin.sava@e-uvt.ro>

Dear EAPP Members and Affiliates,

In this week's edition of the EAPP members' news, we would like to inform you about the following:

1. **Application for 1 free spot at the 2022 LEARNVUL Summer School. September 5th – September 9th, 2022, in Como, Italy**

There is an open call for applications as attendees at the 2022 LEARNVUL Summer School as part of the *Learning in Emotionally Vulnerable People* undergoing grant (H2020) organized by three universities - West University of Timisoara (UVT), University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT). Further information about the topics covered during the summer school and on the application process are available at: https://h2020learnvul.uvt.ro/communication.html

Kind regards,

The EAPP Executive Committee

Please be aware of possible criminal activities on the internet. EAPP will never request payments other than membership fees which are requested through the membership system (Wildapricot) by means of an invoice (always received by the address admin@membership.eapp.org). For more spoofing prevention measures, go to https://eapp.org/membership/spoofing-and-phishing-prevention/
If you have any doubt on a received email, do not hesitate to contact the Assistant Manager (senka.radovic@eapp.org) or the Secretary (secretary@eapp.org).

You receive this email because you are a member of the European Association for Personality Psychology (EAPP). Click below to unsubscribe.

Unsubscribe

Universitatea de Vest
din Timișoara

Florin Sava <florin.sava@e-uvt.ro>

Summer School Application

1 mesaj

Nelson Garrido <garridonelson75@gmail.com>
Către: "florin.sava@e-uvt.ro" <florin.sava@e-uvt.ro>

20 august 2022, 14:46

Cordial greetings, gentlemen of 2022 LEARNVUL, Summer School.

I hereby respectfully submit my curriculum vitae and my letter of motivation to apply for one of the vacancies to attend the summer course offered by your prestigious institution, which will contribute to my doctoral studies.

I look forward to receiving your confirmation of receipt of my letter and requirements,

Yours faithfully,

Nelson Garrido.

2 atașamente

CV NELSON GARRIDO VENEZUELA.pdf
261K

Motivation Letter.pdf
112K

Universitatea de Vest
din Timişoara

Florin Sava <florin.sava@e-uvt.ro>

Summer School Application

1 mesaj

theo besson <theo.besson@gmail.com>
Către: florin.sava@e-uvt.ro

20 august 2022, 22:59

Dear Professor,

Please find enclose my application for the free spot of the Learn Vul summer school.

Thank you for your time and consideration,
Théo Besson

2 ataşamente

Motivation-summer-school-Besson.pdf
45K

academic-CV-Theo-Besson.pdf
138K

Universitatea de Vest din Timişoara

Florin Sava <florin.sava@e-uvt.ro>

Summer School Application

3 mesaje

Yao Wu <yao.wu@surrey.ac.uk>   22 august 2022, 13:20
Către: "florin.sava@e-uvt.ro" <florin.sava@e-uvt.ro>

Dear,

I hope this email finds you well.

I am writing this email to apply for the 2022 LEARNVUL Summer School. Please see my CV and motivation letter. Many thanks.

Best wishes,

Yao Wu

---

2 ataşamente

📄 **CV LEARNVUL Summer School_Yao Wu.pdf**
210K

📄 **Motivation Letter LEARNVUL Summer School_Yao Wu.pdf**
73K

Florin Sava <florin.sava@e-uvt.ro>   24 august 2022, 12:41
Către: Yao Wu <yao.wu@surrey.ac.uk>

Dear You Wo,

Thank you for applying for the LEARNVUL 2022 Summer School.

We received three competitive applications for a single open position.

Unfortunately your application has been unsuccessful. Whereas we indeed appreciate that some modules from the summer school are suited for your needs, we opted for another candidate whose needs where to a higher extent suited (conducting research on the some topic we are interested in).

Kind regards,
Florin Alin Sava
[Textul citat a fost ascuns]

--
Florin Alin Sava, Professor, Ph.D. in Psychology

Vice-Rector for Research, Development and Innovation
West University of Timisoara
phone: +40 256592311
mobile: +40 722510471
email: florin.sava@e-uvt.ro

Yao Wu <yao.wu@surrey.ac.uk>   24 august 2022, 13:04
Către: Florin Sava <florin.sava@e-uvt.ro>

Dear Florin,

Thank you for letting me know.

Kind regards,

Yao

[Textul citat a fost ascuns]

Universitatea de Vest
din Timișoara

Florina Huzoaica <florina.huzoaica@e-uvt.ro>

Summer School in Come
1 mesaj

Florin Sava <florin.sava@e-uvt.ro>   24 august 2022, 12:03
Către: theo.besson@gmail.com
Bcc: florina.huzoaica@e-uvt.ro

Dear Theo,

I am happy to announce to you that your application for the summer school was accepted.

Please let me know your current location (i.e., whether on Sep 4-5 you are already in Milan, or whether you need a flight ticket from Paris to Milan).

As concerning the travel arrangements from Milan to Lake Como (Como), and your accommodation in Come, we arranged in advance the following:
- you will arrive with the UNIMIB team from Milano to Como in the morning of Sep 5 and you will depart back to Milano on Sep 9;
- during your staying in Como you will have a single room at the location where the summer school, take place (Villa del Grumello, 4 nights, check in Sep 5 - Check out Sep 9) and we will cover all meals (breakfast, lunches, dinners) and coffee breaks. There is one exception, dinner on Friday 9 (not included in the program due to budgetary reasons).

Let me know if you need further info! The most urgent matter is to tell us whether you need a flight ticket or you are already in Milano on Sep 4/5.

Kind regards,
Florin

--
Florin Alin Sava, Professor, Ph.D. in Psychology
Vice-Rector for Research, Development and Innovation
West University of Timisoara
phone: +40 256592311
mobile: +40 722510471
email: florin.sava@e-uvt.ro

2022 LEARNVUL Summer School
Schedule

Day 1 (Monday, 5th of September)

Time	Topic / Activity
10.00 - 11.30	**Bayesian Analysis for experimental data** (Daniele Romano)
11.30 - 12.00	Coffee Break
12.00 – 13.30	**Conditional Processes in R: mediation, moderation, moderated mediation, between and within designs** (Marine Rougier)
13.30 - 14.30	Lunch Break
14.30 - 16.00	**R Markdown** (Giulio Costantini)
16.00 - 16.30	Coffee Break
16.30 - 18.00	**Intensive Longitudinal Studies** (Juliette Richetin)
19.00	Dinner (aperitif at Villa del Grumello)

Day 2 (Tuesday, 6th of September)

Time	Topic / Activity
09.00 - 10.30	**From lab to field studies. The Random Intercept Cross-Lagged Panel Model** (Giulio Costantini)
10.30 - 11.00	Coffee Break
11.00 - 12.30	**Dealing with Skin Conductance and Heart rate for psychophysiological measurements. Experimental designs, data pre-processing, and data analyses** (Daniele Romano)
12.30 - 13.30	Lunch Break
13.30 - 15.00	**Manuscript Writing Tips: Introduction / Discussion / Storytelling** (Jan De Houwer, Marine Rougier, and Jamie Cummins)
15.00 - 15.30	Coffee Break
15.30 - 17.00	**From writing the manuscript to contacting the journal. The relationship with editors: rebuttal and acceptance** (Marco Brambilla, Jan De Houwer, Marco Perugini)
19.00	Dinner (at Gesumin Restaurant)

Day 3 (Wednesday, 7th of September)

Time	Topic / Activity
09.00 - 10.30	**Principles of learning. Part I** (Jan De Houwer)
10.30 - 11.00	Coffee Break
11.00 - 12.30	**Principles of learning. Part II** (Jan De Houwer)
12.30 - 13.30	Lunch Break
13.30 - 15.00	**Behaviorism and ACT** (Jamie Cummins)
15.00 - 15.30	Coffee Break
15.30 - 17.00	**Future research topics (trends) in Evaluative / Avoidance Conditioning** (Jan De Houwer, Marine Rougier, and Jamie Cummins)
19.00	Dinner (pizza night at Riva Café)

Day 4 (Thursday, 8th of September)

Time	Topic / Activity
09.00 - 09.30	**Principles of learning. Wrapping up. Q & A section (**Jan De Houwer)
09.30 - 10.30	**Scientific Communication: how to disseminate results to the public (outside academia)?** (Jan De Houwer, Marine Rougier, and Jamie Cummins)
10.30 - 11.00	Coffee Break
11.00 - 11.45	**Career plan and scientific networking tips (**Jan De Houwer, Marine Rougier, and Jamie Cummins)
12.30 - 13.30	Lunch Break
15.00 – 18:00	**Outdoor activity – team building – Boat trip**
19.00	Dinner (at Il Solito Posto Restaurant)

Day 5 (Friday, 9th of September)

Time	Topic / Activity
09.00 - 10.30	**Journal Selection in various Psychology fields: (i) Personality, (ii) Social / Experimental; (iii) Clinical / Psychopathology** (Jan De Houwer and Marco Perugini)
10.30 - 11.00	Coffee Break
11.00 - 12.30	**Exercises / Individual Projects** (Feedback)
12.30 - 13.30	Lunch Break
13.30 - 15.00	**Final round-up: where to go from here? part I** (Jan De Houwer, Marco Perugini, and Florin Sava)
15.00 - 15.30	Coffee Break
15.30 - 17.00	**Final round-up: where to go from here? part II** (Jan De Houwer, Marco Perugini, and Florin Sava)
19.00	End of the summer school

All workshop activities, all coffee breaks, and lunches, as well as the dinner on Monday, Sep 5, will take place at Villa del Grumello, Via per Cernobbio 11, Como.

Please use the QRs below for the directions of the locations for the other dinners.

Tuesday, Sep 6, Gesumin

Wednesday, Sep 7, Riva Café

Thursday, Sep 8, Il Solito Posto

2022 LEARNVUL Summer School
Participants List

Affiliation	Name
University of Milan Bicocca	Marco Perugini, Professor (marco.perugini@unimib.it) Juliette Richetin, Assistant Professor (juliette.richetin@unimib.it) Cristina Zogmaister, Associate Professor (cristina.zogmaister@unimib.it) Emanuele Preti, Associate Professor (emanuele.preti@unimib.it) Rossella Di Pierro, Assistant Professor (rossella.dipierro@unimib.it) Giulio Costantini, Assistant Professor (giulio.costantini@unimib.it) Daniele Romano, Assistant Professor (daniele.romano@unimib.it) Marco Brambilla, Professor (marco.brambilla@unimib.it) Erica Casini, Post-doc (erica.casini@unimib.it) Raynae Dumpfrey (r.dumpfrey@campus.unimib.it)
Ghent University	Jan De Houwer, Professor (jan.dehouwer@ugent.be) Marine Rougier, Post-doc (marine.rougier@ugent.be) Jamie Cummins, Post-doc (jamie.cummins@ugent.be)
West University of Timisoara	Florin Alin Sava, Professor (florin.sava@e-uvt.ro) Cristina Măroiu, Post-doc (cristina.maroiu@e-uvt.ro) Luca Tisu, PhD (luca.tisu@e-uvt.ro) Cătălina Bunghez, PhD Student (catalina.bunghez@e-uvt.ro) Ștefan Marian, PhD Student (stefan.marian@e-uvt.ro) Florina Gabriela Huzoaica, PhD Student (florina.huzoaica@e-uvt.ro) Anca Lazăr, PhD Student (anca.lazar89@e-uvt.ro)
Open position	Theo Besson, Post-doc (theo.besson@gmail.com) (outgoing - Université Paris Cité, Boulogne-Billancourt, incoming – University of Milan Bicocca)

2022 LEARNVUL Summer School
Attendance List

Nr.	Name and Surname	Monday 5th of September	Tuesday 6th of September	Wednesday 7th of September	Thursday 8th of September	Friday 9th of September
1	Marco Perugini					
2	Juliette Richetin					
3	Cristina Zogmaister					
4	Emanuele Preti					
5	Rossella Di Pierro					
6	Giulio Costantini					
7	Daniele Romano					
8	Erica Casini					
9	Raynae Dumpfrey					
10	Jan De Houwer					
11	Marine Rougier					
12	Jamie Cummins					
13	Florin Alin Sava					
14	Cristina Măroiu					
15	Luca Tisu					
16	Cătălina Bunghez					
17	Florina Huzoaica					
18	Anca Lazăr					
19	Ștefan Marian					
20	Theo Besson					

GHENT UNIVERSITY

BICOCCA

Photo Documentation

2022 LEARNVUL Summer School

5-9 September

Como, Italy

2022 LEARNVUL Summer School

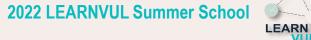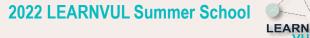# Workshop activities
(5-9 September)

Boat trip to Bellagio
(8th of September)

Boat trip to Bellagio
(8th of September)

2022 LEARNVUL Summer School - Feedback Form

	Terrible. Must be improved immediately!	Poor. Possible complaint, needs improving.	Fair. Not bad enough to merit complaining but ample room for improvement.	Good. Improvement can still be made.	Fantastic. No need for improvement!
Workshop activities					
The workshops meet my expectations.			16%	42%	42%
The structure of the program was well thought-out.		8%	16%	34%	42%
The workload during the Summer School was appropriate.			8%	25%	67%
Difficult tasks/concepts were explained in a comprehensive manner.				25%	75%
The level of instructors' involvement was suitable to the group's interests.				16%	84%
The instructors took the time to answer all the questions.				8%	92%
The participants had the opportunity to be actively involved in the activities.			16%	16%	68%
Staff and Accommodation					
The staff was well prepared.			8%	42%	50%
The staff was enthusiastic and friendly.			8%	25%	67%
The facility was appropriate for the 2022 LEARNVUL Summer School.					100%
The facility was clean and well maintained.					100%
The catering services were well-suited regarding the food and punctuality.				8%	92%

What lecture(s) did you find to be most useful for you at the 2021 Summer School?

The lectures that participants considered the most useful were the workshops on Principles of learning, Conditional Processes in R (mediation, moderation), The Random Intercept Cross-Lagged Panel Model, and R Markdown, followed by the other lectures.

What lecture(s) did you find to be least useful for you at the 2021 Summer School?

Most of the lectures were considered valuable and engaging. But, some participants pointed out that the lectures from the round tables (e.g., From writing the manuscript to contacting the journal, Manuscript Writing Tips) were not very useful to them.

The overall feedback on the workshops was a positive one.

LEARN VUL

ABOUT

The 2022 LEARNVUL Summer School was organized as part of the Learning in emotionally vulnerable people project.

This project is a collaboration with the University of Milano-Bicocca (UNIMIB) and Ghent University (UGENT) and has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 952464.

CONTACT

WEBSITE:
https://h2020learnvul.uvt.ro/

CONTACT:
Florin Alin Sava (Project Manager)

Address: Bd. Vasile Pârvan 4, Timișoara, 300223, RO

Phone: +40-(0)256-592311

E-mail: florin.sava@e-uvt.ro

WORKSHOPS

The 2022 LEARNVUL Summer School activities focused on a variety of topics meant to enhance participants' research skills.

Particularly, after attending this school, participants will be able to:

1) Use R to conduct complex analyses on data from experimental studies, electro-dermal activities, heart rate studies, and intensive longitudinal studies;
2) Get familiar with R Markdown.

Besides topics regarding statistical data analysis, there were also discussed topics close to the project's scope:

1) Principles of learning;
2) Trends in Evaluative Conditioning and Avoidance;
3) Manuscript writing;
4) The relationship with journal editors.

AFTER SUMMER SCHOOL MATERIALS

The following video lectures presented during the Summer School are publicly available on YouTube at Twinning LEARNVUL Second Summer School playlist.

Most of the presentations and accompanying data are included in the following pages (up to the end of this document).

Bayesian Analysis for experimental data	Daniele Romano
Conditional Processes in R: mediation, moderation, moderated mediation, between and within designs	Marine Rougier
R Markdown	Giulio Costantini
Intensive Longitudinal Studies	Juliette Richetin
From lab to field studies. The Random Intercept Cross-Lagged Panel Model	Giulio Costantini
Dealing with Skin Conductance and Heart rate for psychophysiological measurements. Experimental designs, data pre-processing, and data analyses	Daniele Romano
Manuscript Writing Tips: Introduction / Discussion / Storytelling	Jan De Houwer, Marine Rougier, Jamie Cummins
From writing the manuscript to contacting the journal. The relationship with editors: rebuttal and acceptance	Marco Brambilla, Jan De Houwer, Marco Perugini
Principles of learning (part I and II)	Jan De Houwer
Behaviorism and ACT	Jamie Cummins

West University of Timișoara

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

GHENT UNIVERSITY

Bayesian Analysis for experimental data

Daniele Romano

Università degli Studi di Milano-Bicocca

daniele.romano@unimib.it

How many out of 10 papers in the last year implement Bayesian Statistics?

Since last summer school, how many of you have run an analysis (Frequentist or Bayesian)?

How many did use Bayesian stat?

DALL·E – «A pragmatic scientist reflecting on philosophical problems»

AGENDA

Bayesian principles (from a pragmatic perspective)
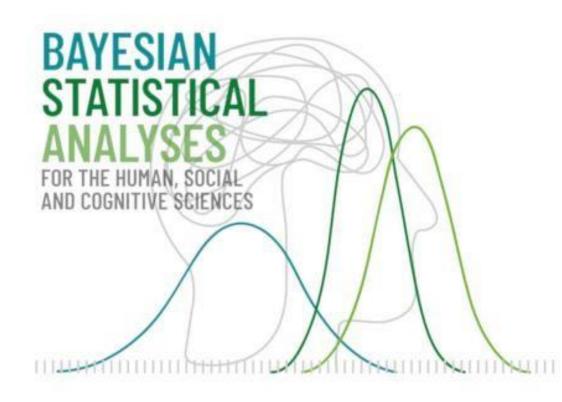
Bayes Factor trustworthiness

Bayes Factor Design Analysis

June 2023

https://sites.hss.univr.it/bayeshsc/

3rd edition

Bayesian principles

from a pragmatic perspective

Phylosophical differences

Frequentism

- **Frequentist probability**: The probability of an event is defined as the relative frequency that it assumes on a large number of tests all performed under the same conditions.

- Parameters are fixed, data distributed because of sampling

- Decisions are discrete

- Popperian's perspective: a hypothesis is true until you provide evidence to invalidate it, which is the task of science.

Bayesianism

- **Subjectivist or Bayesian probability**: probability is the measure of the degree of confidence that a coherent individual assigns to the occurrence of a given event based on his knowledge.

- Data are fixed, parameters are distributed because uncertain

- «continuos» decision

- There is no correct or wrong hypothesis; anything possible can occur according to its probability distribution based on available information and prior beliefs.

THE AIM IS TO FIND
$P(data\,|\,model)$

NO, NO! WE ARE BETTER OFF WITH
$P(model\,|\,data)$

- *Jerzy Neyman (1957): Statistics is about decision and action*

- *Ronald A. Fisher (1955): Statistics is about knowledge and rationality*

- *"Tests should only be regarded as tools which must be used with discretion and understanding, and not as instruments which in themselves give the final verdict."*
- *(Neyman, J., & Pearson, E. S. (1967). Joint statistical papers. Univ of California Press)*

- Inferential statistic is useful taking «informed» decision:

To Take the best **decision**, given the available information

E.g., «A new treatment has been proposed. Should I use it?»

What does it mean «Bayesian»

It's a set of methods originating from a single theorem (Bayes rule) which is entangled with the idea of **Conditional probability**.

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

Calculate the probability that an event occur, given the data and while considering the previous knowledge

OR

Given a set of information, that «bias» my decision, I observe data and update my believes according to the new information
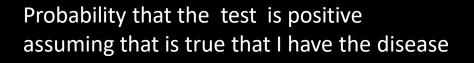
OR

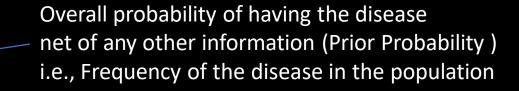How new information changes what I believe

Exists a Rare disease affecting 1‰ population.
A person is positive at the test which is correct in 99% of cases (False Positive 1%)

What's the probability that the person has the disease?

Probability that the test is positive
assuming that is true that I have the disease

Probability of actually having the disease
Given that the test is positive

Overall probability of having the disease
net of any other information (Prior Probability)
i.e., Frequency of the disease in the population

$$P(H|T) = \frac{P(T|H) * P(H)}{P(T)}$$

Probability that the test is positive

A Rare disesease 1‰ population. The test is positive. The Test is correct in 99% of cases. False positive 1%

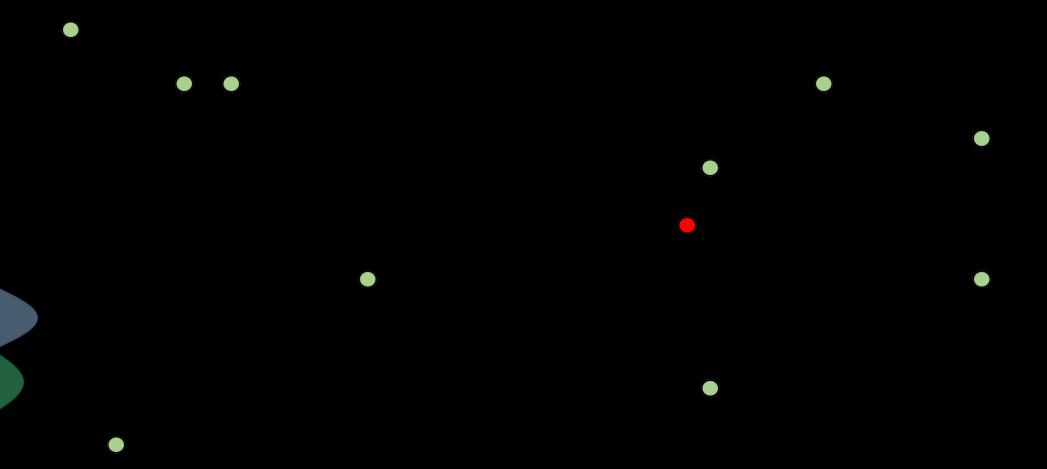1 out of 1000 actually has the disease

1% of false positive, means that 10 out of 1000 are positive to the test without having the disease
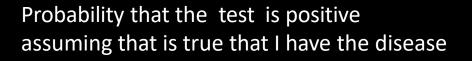
If your **test is positive**, you are one of those 11 people => 9% probability of actually having the disease

Exists a Rare disesease affecting 1‰ population.
A person is positive at the test which is correct in 99% of cases (False Positive 1%)

What's the probability that the person has the disease?

Probability that the test is positive
assuming that is true that I have the disease

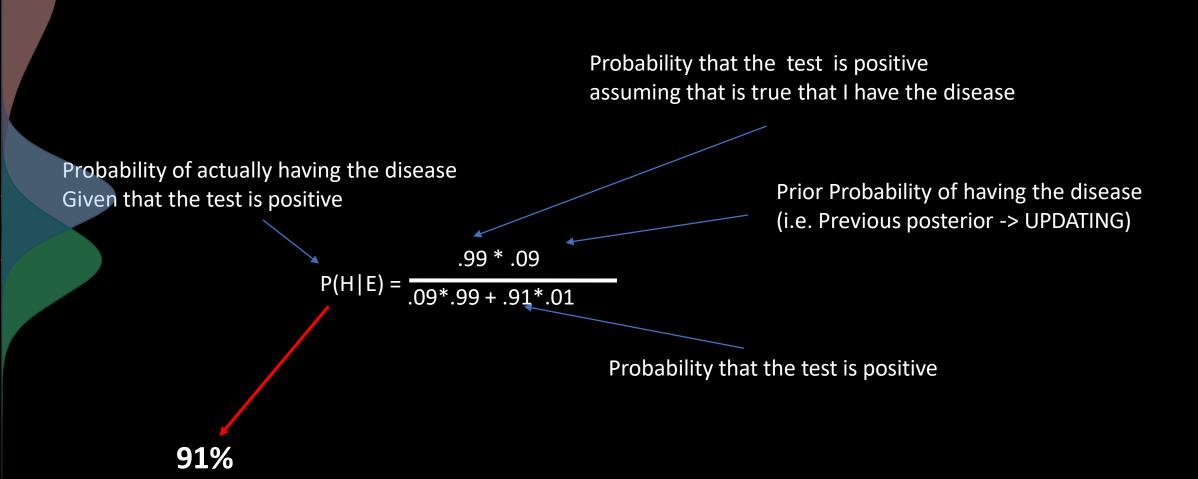Probability of actually having the disease
Given that the test is positive

Overall probability of having the disease
net of any other information (Prior Probability)
i.e., Frequency of the disease in the population

$$P(H|E) = \frac{.99 * .001}{.001*.99 + .999*.01}$$

Probability that the test is positive

9%

If you do a second (indipendent) test which is positive again

Probability that the test is positive
assuming that is true that I have the disease

Probability of actually having the disease
Given that the test is positive

Prior Probability of having the disease
(i.e. Previous posterior -> UPDATING)

$$P(H|E) = \frac{.99 * .09}{.09*.99 + .91*.01}$$

Probability that the test is positive

91%

'Truth'
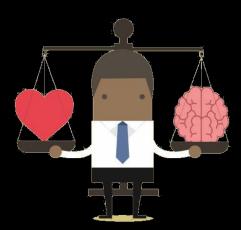(loosely speaking)

Initial beliefs

A new treatment has been proposed.
Should I use it?... Well, if it works...

Initial beliefs

It will work according to a probability distribution.
There is not a true yes or no answer

So what?!
Would you indicate the treatment or not in the end?
Pragmatically, many times we need a yes or no.

Bayesian inference & Bayes Factor

The Bayes Factor

Bayes factors describe the relative probability of data under competing positions

Bayes factors are the ratio of two marginal likelihoods.
You can imagine a marginal likelihood as a weighted sum of probability densities that
you obtain for your data under the assumption of different population parameters.
The weighting is determined by the prior distributions on parameters.

- **The Bayes factor: Weight of statistical evidence**

- $$\frac{p(M0|y)}{p(M1|y)} = \frac{p(y|M0)}{p(y|M1)} \times \frac{p(M0)}{p(M1)}$$

- Posterior odds=Bayes factor×Prior odds

- In words: "The relative probability of the data under the hypotheses is exactly the strength of the relative statistical evidence between the two hypotheses."

BF = Statistical Evidence

•"Statistical evidence" is data (in the context of a probability model) that would affect a rational person's belief regarding a statistical question of interest.

- BF will only consider relative evidence
- Beliefs will be modelled using probability distributions

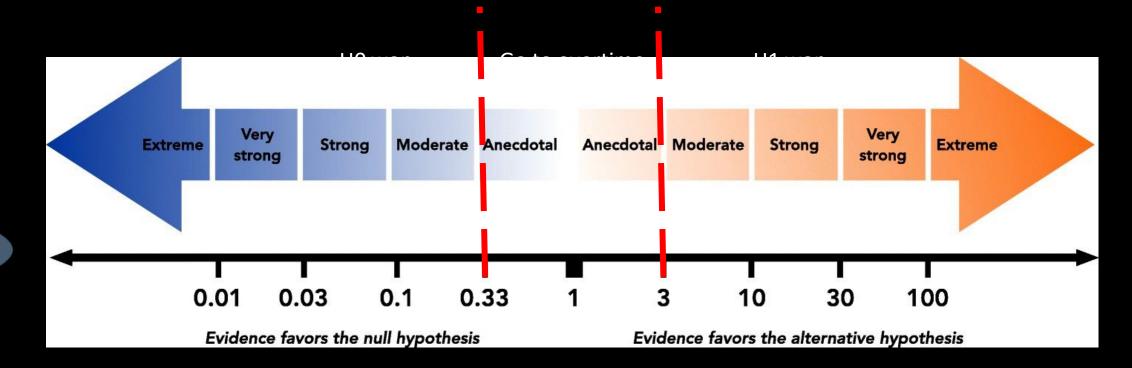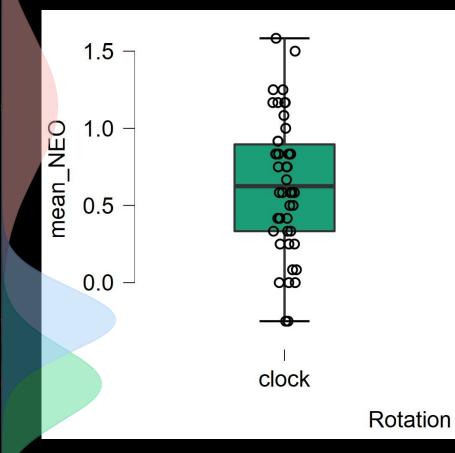•"Rationality" for our purposes is probability theory/conditionalization

Bayes Factor Standards
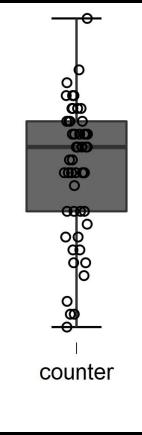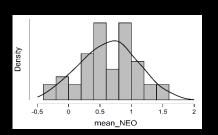
Prior: Cauchy distribution with a r scale .707

Independent Samples T-Test

	t	df	p	Cohen's d
mean_NEO	-0.534	97	0.595	-0.108

Note. Student's t-test.

Bayesian Independent Samples T-Test

	BF_{01}	error %
mean_NEO	4.151	0.033

ORIGINAL PAPER

Analysis of type I and II error rates of Bayesian and frequentist parametric and nonparametric two-sample hypothesis tests under preliminary assessment of normality

ORIGINAL PAPER
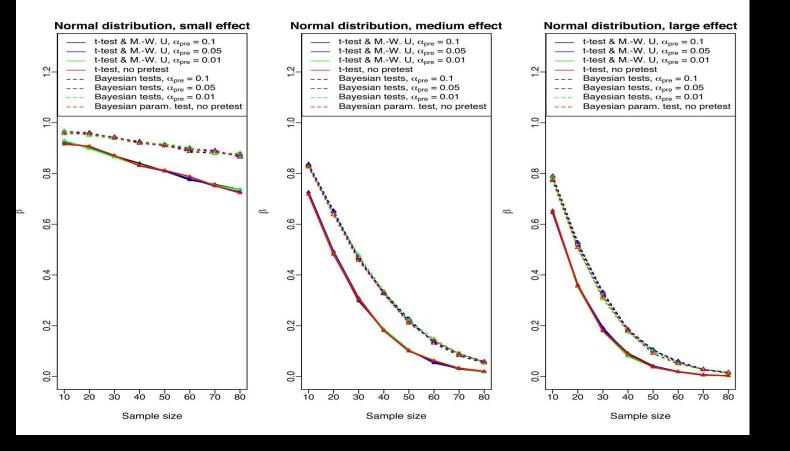
Analysis of type I and II error rates of Bayesian and frequentist parametric and nonparametric two-sample hypothesis tests under preliminary assessment of normality

Bayes Factor
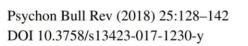
Well-designed experimental setups maximize efficiency and informativeness of the experiment. This means that they yield conclusive evidence while being efficient in terms of sample size.

Psychon Bull Rev (2018) 25:128–142
DOI 10.3758/s13423-017-1230-y

CrossMark

BRIEF REPORT

Bayes factor design analysis: Planning for compelling evidence

Felix D. Schönbrodt[1] · Eric-Jan Wagenmakers[2]

CrossMark

BRIEF REPORT

Bayes factor design analysis: Planning for compelling evidence

Felix D. Schönbrodt[1] · Eric-Jan Wagenmakers[2]

1. Which evidence strength can I expect for a specific research design?
2. Which long-term rates of misleading evidence can I expect for a specific research design?

- In a Bayesian framework, these questions can be answered using Monte-Carlo simulations:
  - assume a population with certain properties,
  - repeatedly (e.g., 10,000 times) draw random samples from this population,
  - compute the analysis for each of the samples.
  - The Bayes factor serves as a measure of evidence strength.
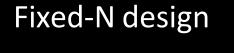
- Because BF is measured on a continuous scale, thresholds have to be introduced if a binary decision analogous to null hypothesis significance testing should be made.
- If a Bayes factor is larger than the upper boundary (e.g., larger than 3), it is regarded as compelling evidence for the alternative hypothesis;
- if a Bayes factor is smaller than the lower boundary (e.g., smaller than 1/3), it is regardedd as compelling evidence for the null hypothesis.

- Misleading evidence is defined as obtaining a Bayes factor which exceeds the wrong boundary (i.e. is smaller than the lower boundary when H1 is correct or larger than the upper boundary when H0 is correct).

- The second question can therefore be reframed as: How often do I obtain BF which exceeds the wrong boundary?

Fixed-N design
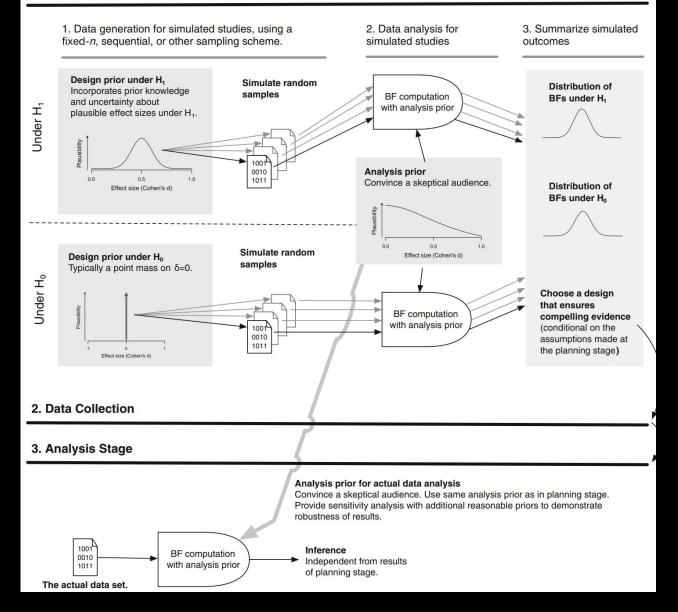
Sequential design

ShinyApp (for independent sample t-test)
R package for every other design

Conducting a Fixed-N Design BFDA

- Resemble the typical freqentist power analysis.
    - The sample size is determined before the experiment takes place.
    - Questions you can ask in this kind of design analysis include:

1.Given a specific sample size and an expected population effect size: What Bayes factors can I expect? (sort of Sensitivity Power Analysis for BF)

2.What sample size do I need to have to obtain true positive or true negative evidence with a certain probability? (a sort of a Priori Power Anlysis)

Conducting a Fixed-N Design BFDA

To answer the first question, BFDA calculate the distributions of Bayes factors for different sample sizes for the true population effect sizes.
BFDA gives information about the expected rates of false positive and false negative evidence for a certain sample size, adopting symmetric boundaries, and true population effect.

To answer the second question, BFDA gives information about the minimum sample size you need (per group) to obtain a certain evidence strength with a certain probability.
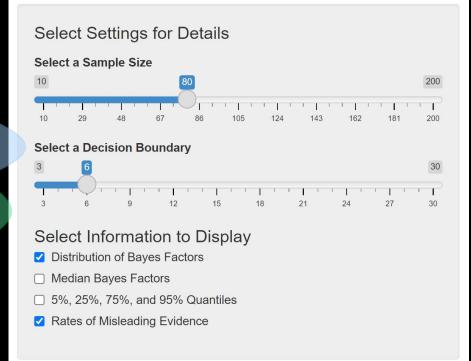
General Settings for the Fixed N Design

If your hypothesis is true: Which effect size (δ) do you expect?

0.2 | 0.3 | 1.2
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2

Part 1: What Bayes factors can I expect?

Select Settings for Details

Select a Sample Size

10 | 80 | 200
10 29 48 67 86 105 124 143 162 181 200

Select a Decision Boundary

3 | 6 | 30
3 6 9 12 15 18 21 24 27 30

Select Information to Display
☑ Distribution of Bayes Factors
☐ Median Bayes Factors
☐ 5%, 25%, 75%, and 95% Quantiles
☑ Rates of Misleading Evidence

Details of the App
BFDA for an independent-group t-test with directional hypotheses.

Monte Carlo simulations with 10,000 iterations.

Bayes factors based on a t-statistic.

The default Bayes factor was computed using the ttest.tstat function of the *BayesFactor* R package.

The null interval was set to [0;Inf]
The r scale of the default prior is "medium" (.707).

The informed prior was set to a t-distribution with a non-centrality parameter of 0.35, 3 degrees of freedom, and a scale parameter of 0.102.

https://shinyapps.org/showapp.php?app=https://shinyapps.org/apps/BFDA/&by=Angelika%20Stefan&title=BFDA%20-%20A%20Shiny%20App%20for%20Bayesian%20Design%20Analysis&shorttitle=BFDA

Prior distribtion for effect sizes under the alternative hypothesis

☑ Default: Cauchy(0, $\sqrt{2}$ / 2)

☑ Informed: t(μ = 0.35, df = 3, r = 0.102)

Rates of Misleading Evidence

	Default Prior on Effect Size	Informed Prior on Effect Size
False Positive Evidence Rates	0.007	0.024
False Negative Evidence Rates	0.027	0.029

Distribution of Default Bayes Factors (DGP: δ = 0.3)

Distribution of Default Bayes Factors (DGP: δ = 0)

Distribution of Informed Bayes Factors (DGP: δ = 0.3)

Distribution of Informed Bayes Factors (DGP: δ = 0)

Prior distribtion for effect sizes under the alternative hypothesis

☑ Default: Cauchy(0, $\sqrt{2}$ / 2)

☑ Informed: t(μ = 0.35, df = 3, r = 0.102)

Rates of Misleading Evidence

	Default Prior on Effect Size	Informed Prior on Effect Size
False Positive Evidence Rates	0.007	0.024
False Negative Evidence Rates	0.027	0.029

Distribution of Default Bayes Factors (DGP: δ = 0.3)

2.7%   69.9 %   27.4%

Distribution of Default Bayes Factors (DGP: δ = 0)

50.6 %   0.7%

Distribution of Informed Bayes Factors (DGP: δ = 0.3)

2.9%   52.5 %   44.5%

Distribution of Informed Bayes Factors (DGP: δ = 0)

50.4%   47.2 %   2.4%
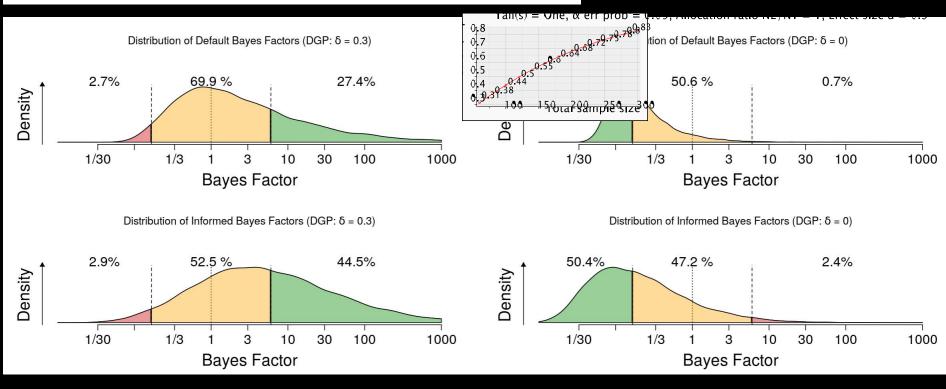
Part 2: What sample size do I need to obtain true positive or true negative evidence with a certain probability?

Select Settings for Details

Select a Probability

| 0.5 | | | | | | | 0.8 | | | 0.99 |

| 0.5 | 0.55 | 0.6 | 0.65 | 0.7 | 0.75 | 0.8 | 0.85 | 0.9 | 0.95 | 0.99 |

Select a Strength of Evidence

| 3 | 6 | | | | | | | | 30 |

| 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 |

☑ Show Results Also H0 as Data Generating Process

Click here to see an explanation

t tests – Means: Difference between two independent means (two groups)
Analysis: A priori: Compute required sample size
Input: Tail(s)   =   One
          Effect size d   =   0.3
          α err prob   =   0.05
          Power (1−β err prob)   =   0.8
          Allocation ratio N2/N1   =   1
Output: Noncentrality parameter δ   =   2.5009998
          Critical t   =   1.6503932
          Df   =   276
          Sample size group 1   =   139
          Sample size group 2   =   139
          Total sample size   =   278
          Actual power   =   0.8023399

If the effect size is 0.3 and the default prior on effect size is used for analyses, you will need at least **280 observations per group** to obtain a Bayes factor **larger than 6** with a probability of **p = 0.8**.

If the effect size is 0.3 and the informed prior on effect size is used for analyses, you will need at least **220 observations per group** to obtain a Bayes factor **larger than 6** with a probability of **p = 0.8.**

If H0 is true and the default prior on effect size is used for analyses, you will need at least **460 observations per group** to obtain a Bayes factor **smaller than 1/6** with a probability of **p = 0.8**.

If H0 is true and the informed prior on effect size is used for analyses, you will need at least **240 observations per group** to obtain a Bayes factor **smaller than 1/6** with a probability of **p = 0.8.**

Sequential Design BFDA

In a Bayesian setup, it is possible to use designs with optional stopping without tampering the the rates of misleading evidence ("Sequential Designs")(Schoenbrodt, Wagenmakers, Zehetleitner, & Perugini, 2015).

The idea is to **collect data until a certain upper or lower boundary of Bayes factors is reached.**

Sequential Design BFDA

- The idea is to **collect data until a certain upper or lower boundary of Bayes factors is reached.**

- What sample sizes can I expect given a desired level of evidence and the expected effect size?

- What is the probability of misleading evidence for certain boundaries?
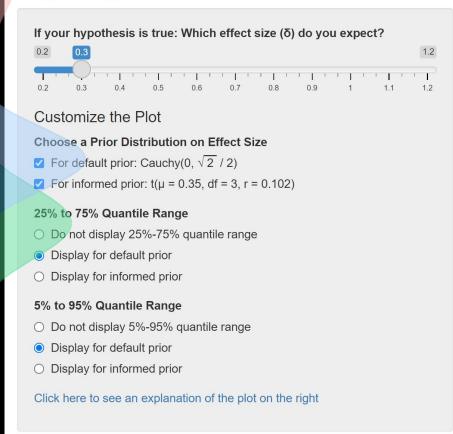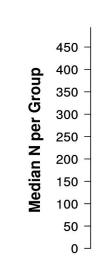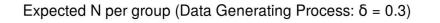
Sequential Design BFDA

1.What sample sizes can I expect given a desired level of evidence and the expected effect size?

Sequential Design BFDA

2. What is the probability of misleading evidence for certain boundaries?

Distribution of N (DGP for H1: δ = 0.3)

R code for BFDA

install_github("nicebread/BFDA", subdir="package")

https://rawgit.com/nicebread/BFDA/master/package/doc/BFDA_manual.html

Expected effect size

Type of analysis supported. Can be extended to other designs

```
BFDA.sim(
    expected.ES=0.3,
    type="t.paired", "t.between", "correlation"
        prior=list("Cauchy", list(prior.location=0, prior.scale=sqrt(2)/2)),
            list("t", list(prior.location=.35, prior.scale=.102, prior.df=3)
            list("normal", list(prior.mean=0, prior.variance=1),
    alternative="two.sided", «greater», «less»


    B= 10000,


    stepsize = 10


    boundary= Inf


    n.min=10,
    n.max=300
```

Prior specification. Others can be added (e.g., uniform -1,1 for correlation)

Directional hypothesis or not

Number of simulations (Whatchout, time consuming!!)

Number of new samples before re-running the analysis (increase to speadup simulations, but decrease precision)

Decision boudary (numeric, or Inf)

Sample size limitations

Create one simulation for the H1 and one for H0.
IT IS TIME-CONSUMING RUN THE FULL SAMPLE (e.g 10000) ONCE YOU ARE SURE OF YOUR PARAMETERS.
To try use a B=100 or even 10.

```
sim.H1 <- BFDA.sim(expected.ES=0.3,
          type="t.paired",
          prior=list("Cauchy",list(prior.location=0, prior.scale=sqrt(2)/2)),
          n.min=10,
          n.max=300,
          alternative="two.sided",
          boundary=Inf,
          B=1000,
          verbose=TRUE,
          cores=4,
          stepsize = 10)


sim.H0 <- BFDA.sim(expected.ES=0, type="t.paired",
       prior=list("Cauchy",list(prior.location=0, prior.scale=sqrt(2)/2)), n.min=10, n.max=300,
alternative="two.sided", boundary=Inf, B=1000, verbose=TRUE, cores=4, stepsize = 10)
```

How to get the output

```
> BFDA.analyze(sim.H1, design="fixed", n=20, boundary=3)
13.4% showed evidence for H1 (BF > 3)
55% were inconclusive (0.3333 < BF < 3)
31.6% showed evidence for H0 (BF < 0.3333)


>BFDA.analyze(sim.H0, design="fixed", n=20, boundary=3)
2.2% showed evidence for H1 (BF > 3)
35.2% were inconclusive (0.3333 < BF < 3)
62.6% showed evidence for H0 (BF < 0.3333)
```
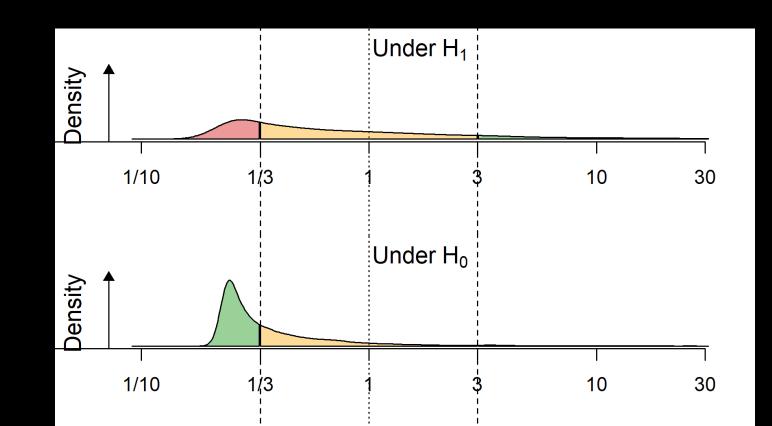
Plot the output

evDens(BFDA.H1=sim.H1, BFDA.H0=sim.H0, n=20, boundary=c(1/3, 3), xlim=c(1/11, 31))

How to get the output

> BFDA.analyze(sim.H1, design="sequential", n.min=50, n.max=100, boundary=3)
  outcome percentage
1 Studies terminating at n.max (n=100)   8%
2   Studies terminating at a boundary   92%
3   --> Terminating at H1 boundary   65.8%
4   --> Terminating at H0 boundary   26.2%

Of 8% of studies terminating at n.max (n=100):
0% showed evidence for H1 (BF > 3)
8% were inconclusive (3 > BF > 1/3)
0% showed evidence for H0 (BF < 1/3)

Average sample number (ASN) at stopping point (both boundary hits and n.max): n = 64
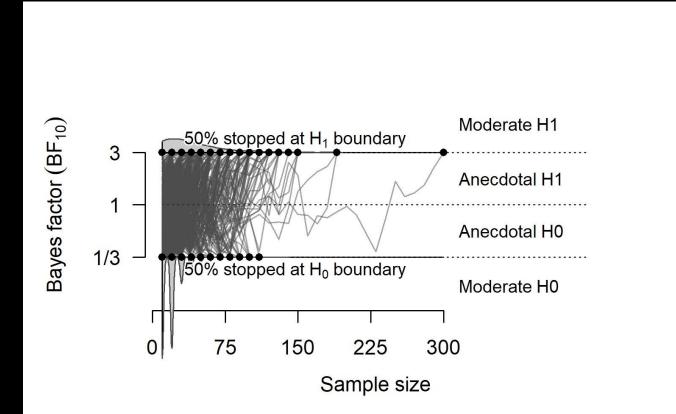
Sample number quantiles (50/80/90/95%) at stopping point:

50% 80% 90% 95%
 50 80 100 100

Plot the output

plot(sim.H1, n.min=10, boundary=c(1/3, 3), n.trajectories = 1000)
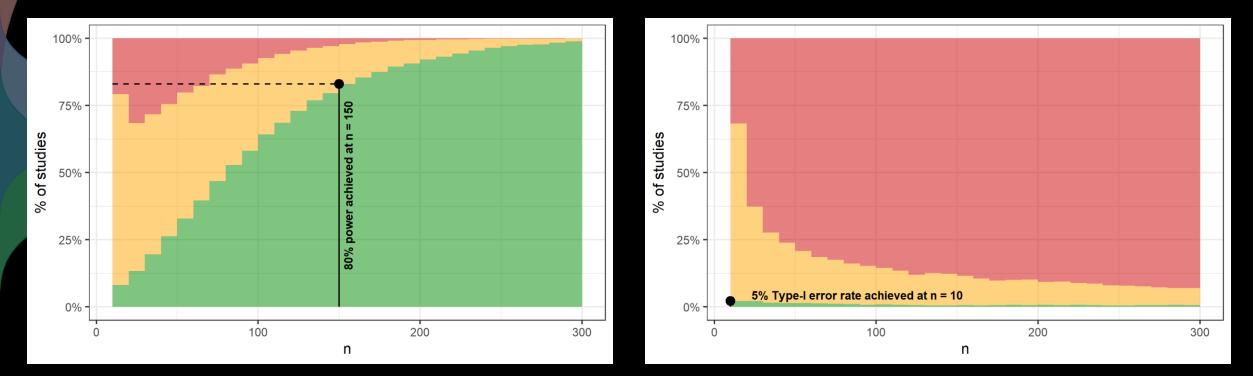
Plot the output

SSD(sim.H1, power=.80, boundary=c(1/3, 3))

A >= 80% (actual: 83%) power achieved at n = 150
This setting implies long-term rates of: 14.9% inconclusive results
and 2.1% false-negative results.

SSD(sim.H0, alpha=.05, boundary=c(1/3, 3))

A >= 5% (actual: 2.2%) long-term rate of Type-I errors is
achieved at n = 10
This setting implies long-term rates of: 66% inconclusive
results and 31.8% true-negative results.

DALL·E – «A pragmatic scientist reflecting on philosophical problems»
+
«with a new tool»

Thank you for your attention!

Mediation, Moderation, and moderated mediation

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Important references

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology, 51*(6), 1173.

Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological science, 18*(3), 233-239.

Montoya, A. K., & Hayes, A. F. (2017). Two-condition within-participant statistical mediation analysis: A path-analytic framework. *Psychological Methods, 22*(1), 6.

Muller, D., Judd, C. M., & Yzerbyt, V. Y. (2005). When moderation is mediated and mediation is moderated. *Journal of personality and social psychology, 89*(6), 852.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychological methods, 7*(4), 422.

Yzerbyt, V., Muller, D., Batailler, C., & Judd, C. M. (2018). New recommendations for testing indirect effects in mediational models: The need to report and test component paths. *Journal of Personality and Social Psychology, 115*(6), 929.

Why do we need this?
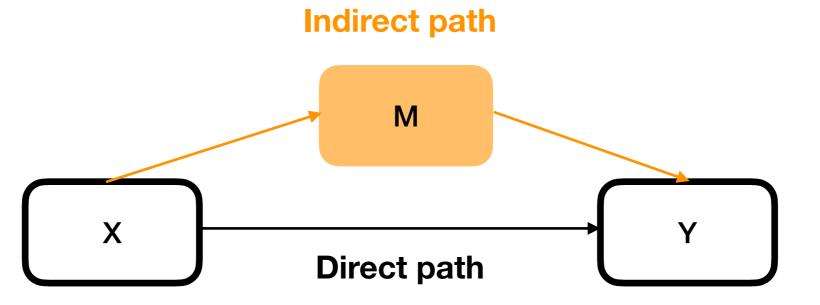
- **Mediation** & **Moderation** are very common in personality and social psychology

- Inform on the **mechanisms** & **boundary conditions** of an effect (respectively)

- « Whereas moderator variables specify **when** certain effects will hold, mediators speak to **how or why** such effects occur » (Baron & Kenny, 1986)

- Both contribute to our understanding of the effect

- Consequence: Their commonalities can be confusing

Outline

- Mediation

- Moderation

- Moderated mediation
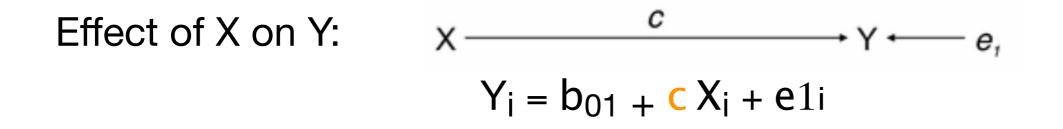
Mediation

« [a mediator] represents the generative **mechanism through which** the focal independent variable is able to influence the dependent variable of interest. » (Baron & Kenny, 1986, p. 1173)

"a given variable may be said to function as a mediator to the extent that **it accounts for** the relation between the predictor and the criterion" (Baron & Kenny, 1986, p. 1176)

Indirect path

X — **Direct path** → Y

‣ The effect of X is indirect and is **transmitted via** a mediating variable

‣ If we « **eliminate** » (i.e., neutralize) the effect of the mediating variable, we would **not observe the effect of X on Y anymore** (or strongly reduced)

Mediation

Effect of X on Y:

$$Y_i = b_{01} + c\, X_i + e1i$$

Does part of the total effect go through a third variable M?
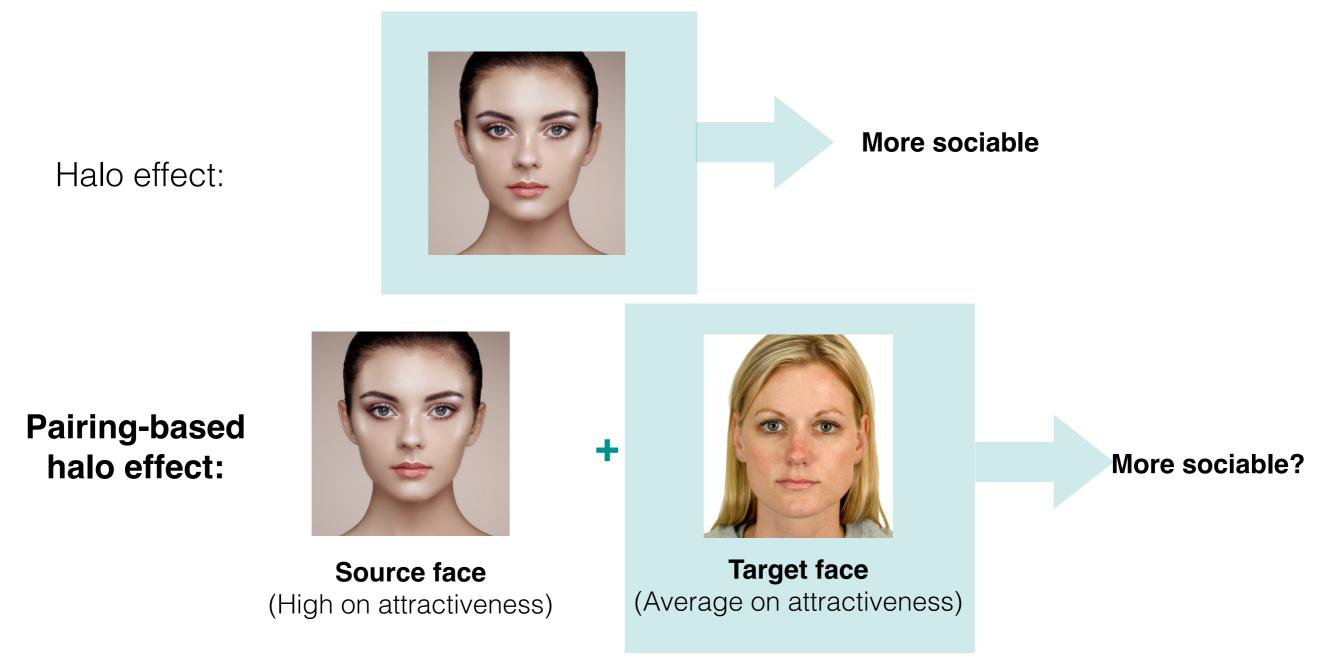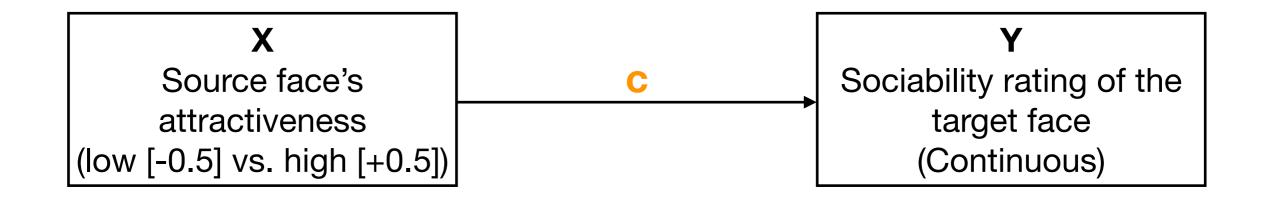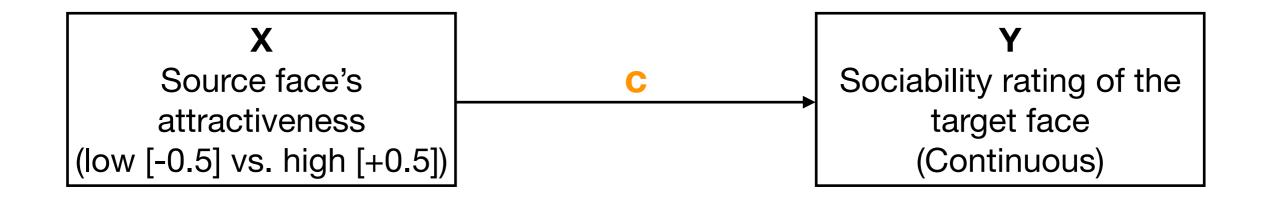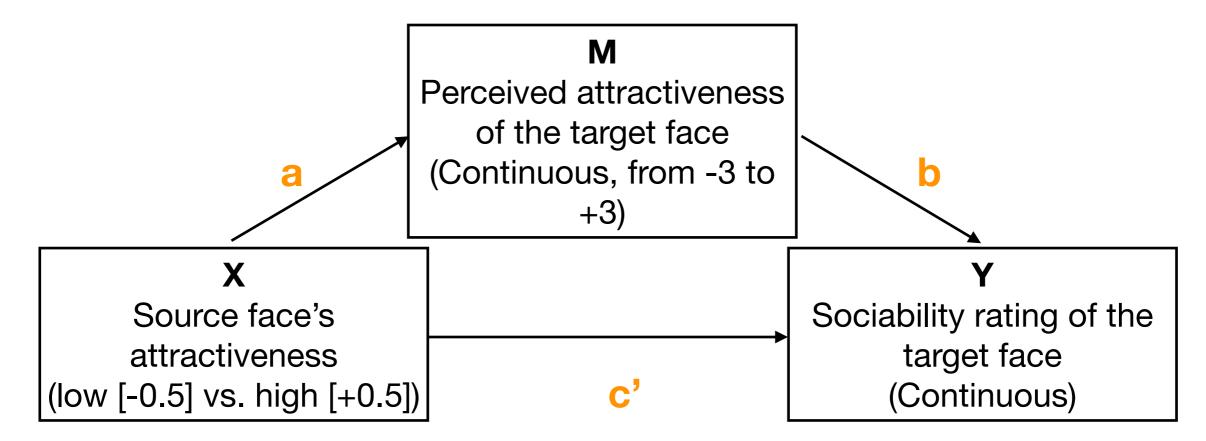
$$M_i = b_{02} + a\, X_i + e2i$$

$$Y_i = b_{03} + c'\, X_i + b M_i + e3i$$

Fundamental equation:

$$c = a*b + c'$$

Total effect

Indirect effect

Direct effect

Mediation

Illustration: Pairing-based halo effect

Halo effect:

More sociable

Pairing-based halo effect:

Source face
(High on attractiveness)

+

Target face
(Average on attractiveness)

More sociable?

X: Attractiveness of the source face (low vs. high), between-pp

Y: Sociability rating of the target face (from 0 to 5)

Mediation

X		Y
X Source face's attractiveness (low [-0.5] vs. high [+0.5])	**c** →	**Y** Sociability rating of the target face (Continuous)

$$Y_i = b_{01} + c\, X_i + e1_i$$

c = 4.67, $t(38) = 2.91$, $p < .01$.

Target faces paired with high (vs. low) attractive faces are perceived as more sociable **=> the total effect (c) is significant**

Mediation
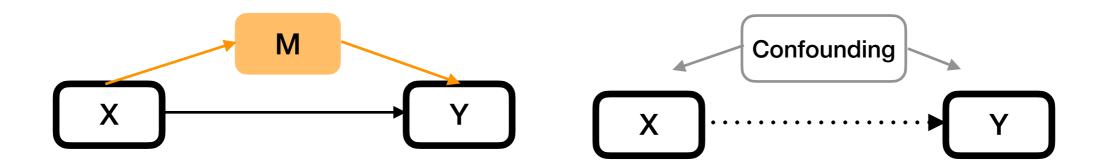
Does change in attractiveness perception of the target face mediates the effect of X on Y?

Mediation

Are we confident about X —> Y causality? (Holland, 1986)

- Is there a statistical relationship (i.e., *c*) between X and Y? **YES**

- Does X precedes Y in time? **YES**

- Is the relation between X and Y spurious (i.e., third variable)? **NO** (because participants have been randomly assigned in X conditions)

➡ **Now** we can look for the effect of a mediator

Mediation

Test of the mediation hypothesis: Baron & Kenny (1986)

$$Y_i = b_{01} + c\,X_i + e1i \qquad \text{(Eq. 1)}$$

$$M_i = b_{02} + a\,X_i + e2i \qquad \text{(Eq. 2)}$$

$$Y_i = b_{03} + c'\,X_i + bM_{i} + e3i \qquad \text{(Eq. 3)}$$
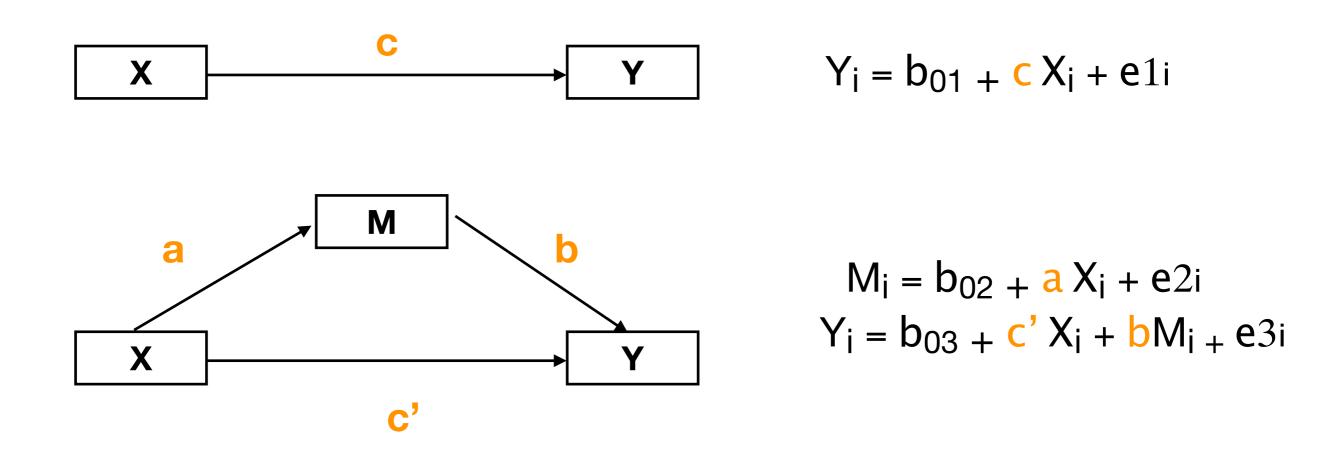
To say that M is a total mediator, 4 conditions must be fulfilled:

1) The (total) effect of X on Y is significant: **c is significant** (Eq. 1)

2) The effect of X on M is significant: **a is significant** (Eq. 2)

3) When X is controlled for, the effect of M on Y is significant: **b is significant** (Eq. 3)

4) When M is controlled for, the effect of X on Y is reduced and is not significant anymore: **c' is not significant** (Eq. 3)

When the 3 first conditions are fulfilled but the effect of X on Y (direct effect) is **only reduced** but **remains significant**, we talk about **partial mediation.**

Important: $|c| > |c'|$

Mediation
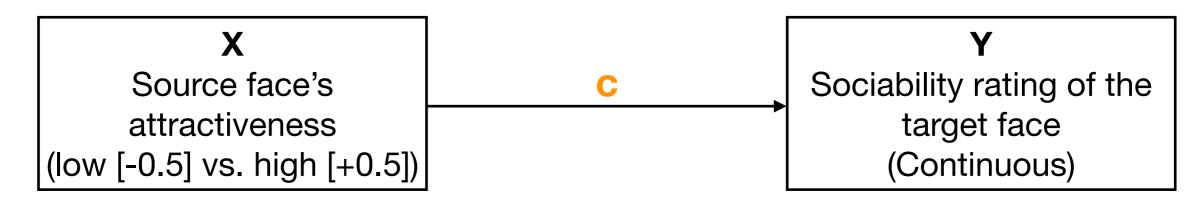
Baron & Kenny (1986) in a nutshell

$$Y_i = b_{01} + c\,X_i + e1i$$

$$M_i = b_{02} + a\,X_i + e2i$$
$$Y_i = b_{03} + c'\,X_i + bM_{i} + e3i$$

The Baron and Kenny test requires **c, a, and b** to be significant **at the same time and |c| > |c'|** descriptively

Mediation

Illustration: Pairing-based halo effect

| X
Source face's
attractiveness
(low [-0.5] vs. high [+0.5]) | **c** → | Y
Sociability rating of the
target face
(Continuous) |

$$Y_i = b_{01} + c\, X_i + e1i$$

$c = 4.67$, $t(38) = 2.91$, $p < .01$.

1) The (total) effect of X on Y is significant: **c is significant** (Eq. 1) (we already know that)

Mediation

Illustration: Pairing-based halo effect

$$M_i = b_{02} + a\,X_i + e_{2i}$$

$a = \textbf{1.92}$, $t(38) = 3.62$, $p < .01$.

$$Y_i = b_{03} + c'\,X_i + bM_i + e_{3i}$$
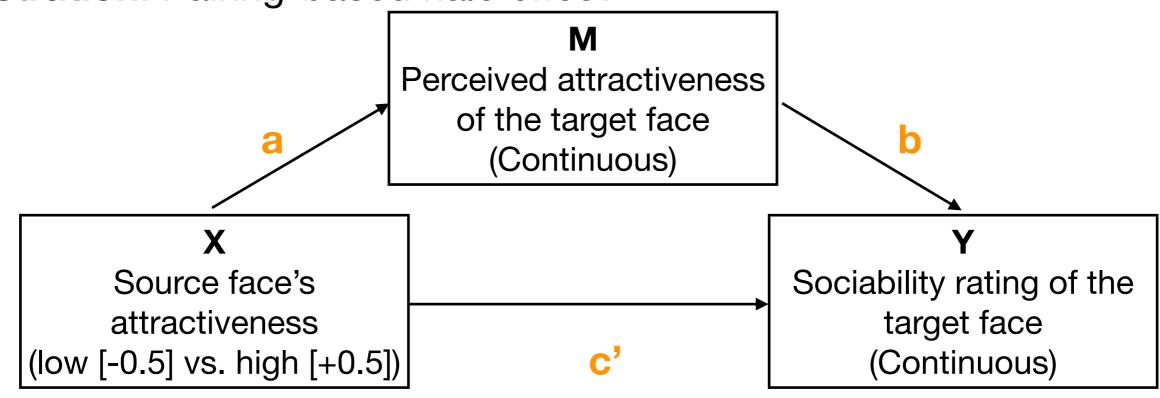
$b = \textbf{1.88}$, $t(37) = 5.80$, $p < .01$
$c' = \textbf{1.06}$, $t(37) = 0.49$, $p = .63$

2) The effect of X on M is significant: **a is significant** (Eq. 2)

3) When X is controlled for, the effect of M on Y is significant: **b is significant** (Eq. 3)

4) When M is controlled for, the effect of X on Y is reduced and is not significant anymore: **c' is not significant** (Eq. 3)

Mediation

Illustration: Pairing-based halo effect

M
Perceived attractiveness
of the target face
(Continuous)

a

b

X
Source face's
attractiveness
(low [-0.5] vs. high [+0.5])

c'

Y
Sociability rating of the
target face
(Continuous)

$$M_i = b_{02} + a\,X_i + e_{2i}$$

a = **1.92**, $t(38) = 3.62$, $p < .01$.

$$Y_i = b_{03} + c'\,X_i + b\,M_i + e_{3i}$$

Total mediation

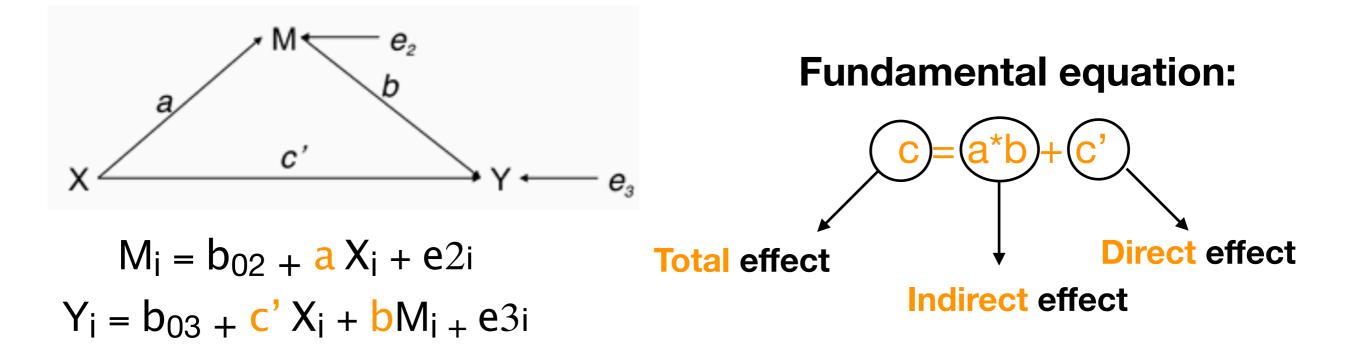b = **1.88**, $t(37) = 5.80$, $p < .01$
c' = **1.06**, $t(37) = 0.49$, $p = .63$

Mediation

Illustration: Pairing-based halo effect

$$Y_i = b_{01} + c\,X_i + e1_i$$

$c = \mathbf{4.67}$, $t(38) = 2.91$, $p < .01$.

$$M_i = b_{02} + a\,X_i + e2_i$$

$a = \mathbf{1.92}$, $t(38) = 3.62$, $p < .01$.

$$Y_i = b_{03} + c'\,X_i + b\,M_i + e3_i$$

$b = \mathbf{1.88}$, $t(37) = 5.80$, $p < .01$
$c' = \mathbf{1.06}$, $t(37) = 0.49$, $p = .63$

Fundamental equation:

$$c = a*b + c'$$

$$4.67 = (1.92 * 1.88) + 1.06$$

Total effect

Indirect effect

Direct effect

$$a*b = 3.61$$
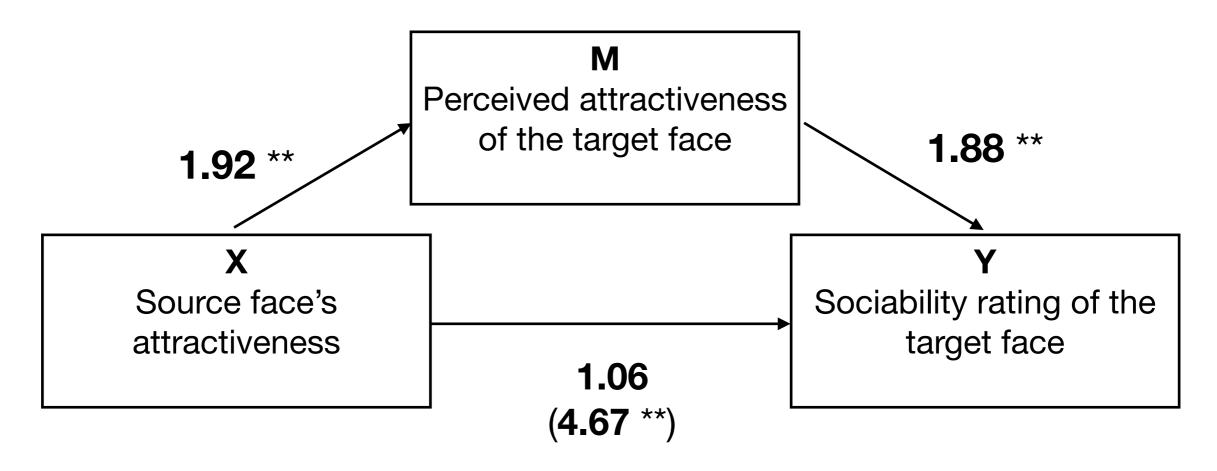
I'll come back to the test of the indirect effect (i.e., a*b)
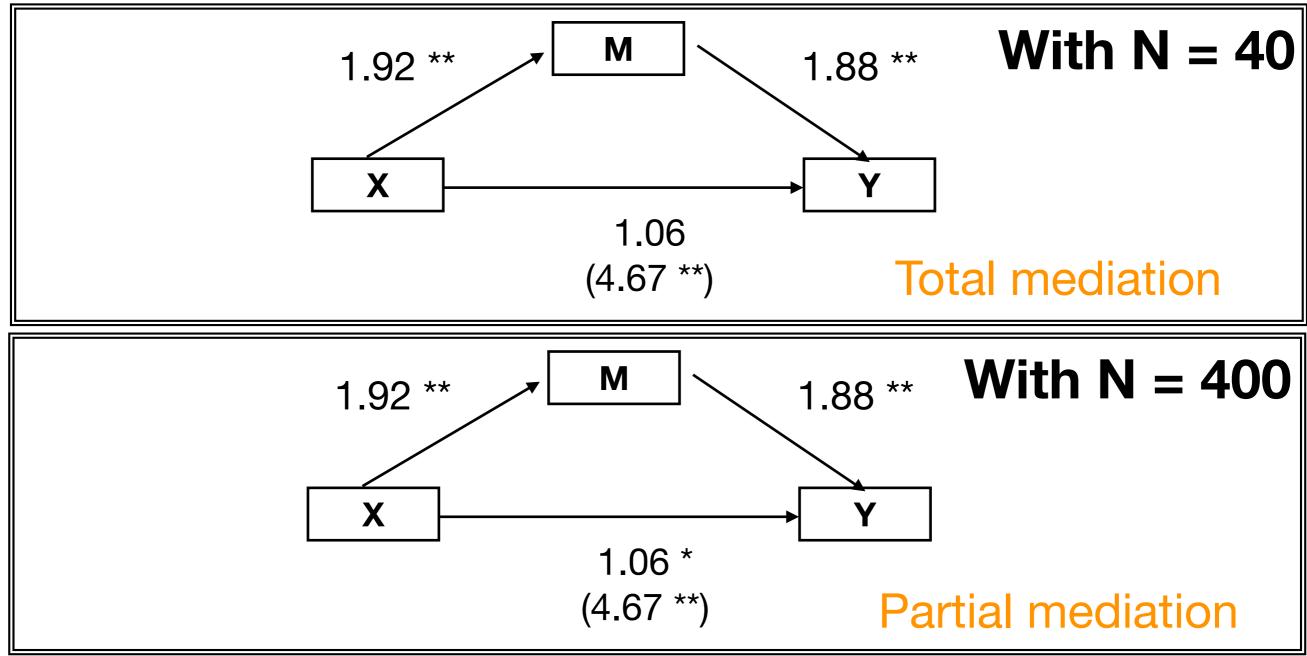
Mediation

Summary of the mediation model:

Note: we would « only » have a partial mediation if c' (1.06) had remained significant —> depends on power!

Mediation

With N = 40

1.92 ** — M — 1.88 **

X → Y

1.06
(4.67 **)

Total mediation

With N = 400

1.92 ** — M — 1.88 **

X → Y

1.06 *
(4.67 **)

Partial mediation

‣ A total mediation with 40 observations by condition **becomes "only" partial when power is increased...**

Mediation

- The difference between total and partial mediation relies only on the test of a **null hypothesis (about c')**

- **Problem**: We systematically have **less power to test c' (and c) than** to test **ab** even for effects of the same magnitude (for a demonstration see Kenny & Judd, 2014)

- We can thus **easily conclude on a total mediation**…

Therefore:

- Keep in mind that in case of a **small N, a total mediation is not very informative**

- Rely on the **proportion of total effect** that is mediated ($P_M =$ ab/c) -> continuous rather than dichotomous thinking (total vs. partial)

Mediation

Two questions regarding mediation analysis:

- How should we test for the indirect effect ab?

- Do we need to test the total effect c?

Mediation

Two questions regarding mediation analysis:

- How should we test for the indirect effect ab?
- Do we need to test the total effect c?

Mediation

How to test *ab*?
There are a dozen of different approaches for this test (Hayes, 2013)

- **Component approach**: testing *a* and *b* separately ('a and b **joint significance test**'; MacKinnon et al., 2002) as recommended by Baron and Kenny => if *a* and *b* are ***both*** significant, the *ab* product will also be significant

- **Index approach**: estimating the significance of the *ab* parameter with a single test rather than two. Multiple tests have been suggested.

Mediation

How to test *ab*?
There are a dozen of different approaches for this test (Hayes, 2013)

- **Index approach**

  - **Sobel test** (Sobel, 1982): estimating the standard error of the ab product to compute a *p*-value (but issue with normality)

$$Z_{SOBEL} = \frac{a * b}{\sqrt{b^2 * s_a^2 + a^2 * s_b^2}}$$

Mediation

How to test *ab*?
There are a dozen of different approaches for this test (Hayes, 2013)

- **Index approach**

  - **Sobel test** (Sobel, 1982): estimating the standard error of the ab product to compute a *p*-value (but issue with normality)

  - **Resampling/bootstrapping techniques** (Shrout & Bolger, 2002): non-parametric test relying on an empirically constructed confidence interval for *ab* (percentile bootstrap, bias corrected bootstrap, accelerated bias corrected bootstrap…)

  - **Monte Carlo test** (MacKinnon, Lockwood, & Williams, 2004): relies on *a* and *b* estimates (rather than on the raw data) and their SE to create a confidence interval for *ab*

Mediation

How to test *ab*?

There are a dozen of different approaches for this test (Hayes, 2013)

Which method should I use?

Mediation

Yzerbyt et al. (2018, JPSP): The Joint Significance Testing is better anyway

Type I error (falsely concluding to a mediation)

- It is often assumed there are no Type I error issues with the bootstrap approaches

- But so far, simulations when **both** α = 0 and β = 0 (a and b in the population)

  What happens if only one of them is 0?

- Because Bootstrap tests are applied to products, they could have inflated Type I errors when one path is 0 (in the population) and the other one is large

- Yzerbyt et al. simulated 10 000 samples with X, M, and Y (by varying α and β values)

Mediation

Yzerbyt et al. (2018, JPSP): The Joint Significance Testing is better anyway

	Type I error	Power
Joint significance	++	+
Monte Carlo	-	+
Percentile Bootstrap	-	+
Bias-corrected Bootstrap	- -	++
Accelerated bias-corrected Bootstrap	- -	++

Mediation

Yzerbyt et al. (2018, JPSP): The Joint Significance Testing is better anyway

> The **joint significance test** is the **only test without inflated Type I errors** and it is as **powerful** as the less biased bootstrap test (i.e., the percentile bootstrap) => also true for within-pp mediation and moderated mediation

Advantages:
- Requires basic knowledge (i.e., regression)
- Performing both a and b tests leads to a better understanding of the indirect effect (e.g., is it more proximal [|a|>|b|] or distal [|b|>|a|]?)

Disadvantage: Does not provide a single confidence interval for the indirect effect
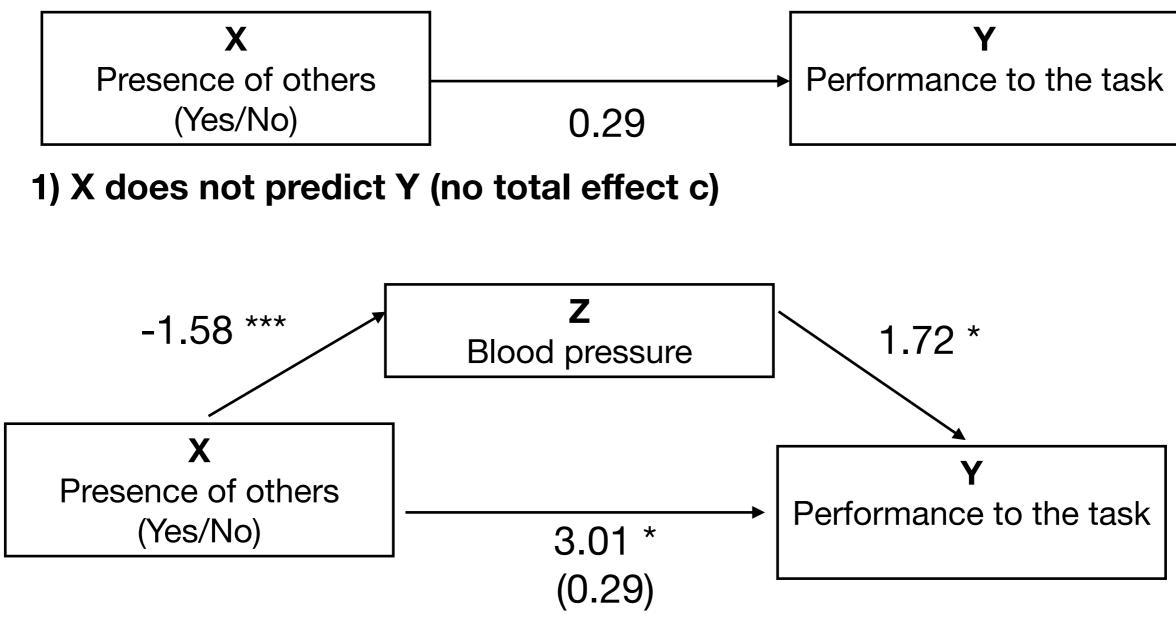
Mediation

Two questions regarding mediation analysis:

- How should we test for the indirect effect ab?
- Do we need to test the total effect c?

Mediation

Do we need to test the total effect *c*? (Judd, Yzerbyt, & Muller, 2014)

- First step before testing a mediation, as recommended by Baron and Kenny (1986)

- The test of **c often ignored** when performing a mediation with **only the ab test** (see Shrout & Bolger, 2002)

- Distinction between **indirect effect** and **mediation**: mediation is a special case of indirect effects (cf. suppression effect)

Mediation

Do we need to test the total effect *c*? (MacKinnon et al., 2000)

| X Presence of others (Yes/No) | —0.29→ | Y Performance to the task |

1) X does not predict Y (no total effect c)

| Z Blood pressure |

-1.58 ***   1.72 *

| X Presence of others (Yes/No) | —3.01 * (0.29)→ | Y Performance to the task |

2) POc (X) influences blood pressure (Z) significantly
3) Blood pressure (Z) increases perf (Y) significantly and the direct influence of POc (X) on perf (Y) becomes significant

Mediation

Do we need to test the total effect *c*? (MacKinnon et al., 2000)

Conditions 2 and 3 are met (we have an indirect ab effect) but instead of having an X-Y effect that disappears, we have an X-Y effect that becomes apparent when Z is introduced **(|c| < |c'|)** => this is a **suppression** effect

Suppression = the intervening variable, **when not controlled**, **attenuates** the X-Y effect. Happens when **ab and c' have opposite signs**.

(**Mediation** = the X-Y effect decreases when controlling for the intervening variable)

Mediation

Do we need to test the total effect *c*? (Judd, Yzerbyt, & Muller, 2014)

- Testing an indirect effect is different from testing a mediation

- This question requires to go back to the **very idea** of what is a mediation:
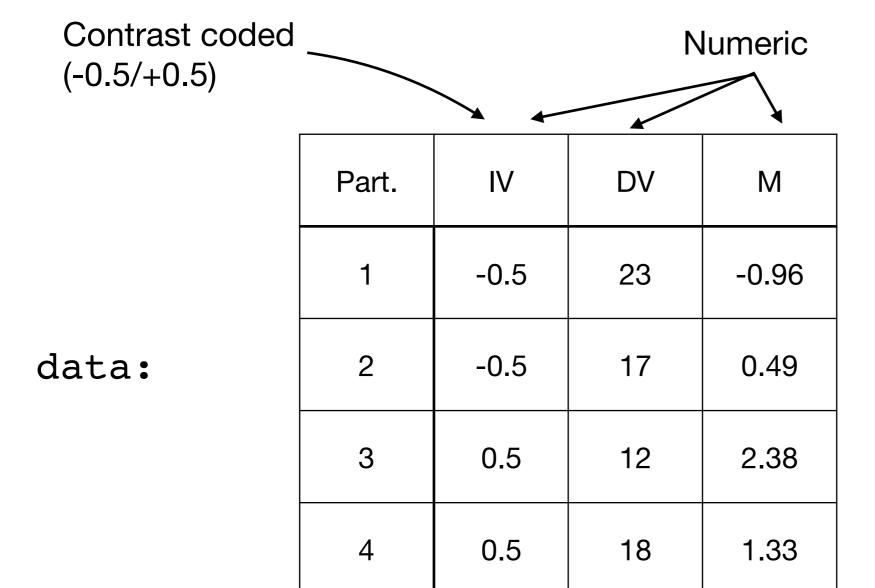
  A variable that ***accounts for*** a psychological phenomenon
  (Judd & Kenny, 1981)

- Does not make sense to account for something that does not exist

Mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

- For a simple mediation (i.e., between-pp):

```
mdt_simple(data, IV, DV, M)
```

Contrast coded (-0.5/+0.5)

Numeric

data:

Part.	IV	DV	M
1	-0.5	23	-0.96
2	-0.5	17	0.49
3	0.5	12	2.38
4	0.5	18	1.33

Mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

- For a simple mediation (i.e., between-pp):

```
model <- mdt_simple(data, IV, DV, M)
```

```
model:
```

```
====  ================  =====  ============================
Path  Point estimate       SE  APA
====  ================  =====  ============================
a                0.266  0.104  t(393) = 2.57, p = .011
b                0.120  0.012  t(391) = 10.08, p < .001
c                0.076  0.028  t(393) = 2.75, p = .006
c'               0.044  0.025  t(391) = 1.77, p = .078
====  ================  =====  ============================
```

Mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

- For a simple mediation (i.e., between-pp):

```
model <- mdt_simple(data, IV, DV, M)
```

```
add_index(model)
```
=> To have the confidence interval of the a*b term with a Monte Carlo estimation

```
- confidence interval:
  - method: Monte Carlo (5000 iterations)
  - level: 0.05
  - CI: [0.00728; 0.0583]
```

WARNING: should only be used as an addition to the Joint Significance test (i.e., test of a AND b)

Mediation

- **What about within-participants mediation?** (Montoya & Hayes, 2017)

X: Attractiveness of the source face (low vs. high), **within**-pp

Y: Sociability rating of the target face (from 0 to 5)

M: Perceived attractiveness of the target face (from -3 to +3)

Long Format

Part.	Attr_Source	Attra	Soc
1	High	2	4
1	Low	-1	3
2	High	2	2
2	Low	-3	1
3	High	3	1
3	Low	0	0

Short Format

Part.	Attra_high	Attra_low	Soc_high	Soc_low
1	2	-1	4	3
2	2	-3	2	1
3	3	0	1	0
4	1	1	3	2

Mediation

- **What about within-participants mediation?** (Montoya & Hayes, 2017)

  X: Attractiveness of the source face (low vs. high), **within**-pp

  Y: Sociability rating of the target face (from 0 to 5)

  M: Perceived attractiveness of the target face (from -3 to +3)

  'Simple' mediation (i.e., **between**-pp):

(1) $Y_i = b_{01} + c\,X_i + e1i$

(2) $M_i = b_{02} + a\,X_i + e2i$

(3) $Y_i = b_{03} + c'\,X_i + bM_i + e3i$

We have to account for the non-independence of residuals!

Mediation

- **What about within-participants mediation?** (Montoya & Hayes, 2017)

  X: Attractiveness of the source face (low vs. high), **within**-pp

  Y: Sociability rating of the target face (from 0 to 5)

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'Simple' mediation (i.e., **between**-pp):

$$(1) \quad Y_i = b_{01} + c\,X_i + e1i$$

$$(2) \quad M_i = b_{02} + a\,X_i + e2i$$

$$(3) \quad Y_i = b_{03} + c'\,X_i + b\,M_i + e3i$$

Within-pp mediation:

$$Y2_i - Y1_i = c + e1i$$

$$M2_i - M1_i = a + e2i$$

$$Y2_i - Y1_i = c' + b(M2_i - M1_i)$$
$$+ \, d[0.5(M1_i + M2_i) - 0.5(\overline{M1 + M2})] \,+\, e3i$$

Mediation

- **What about within-participants mediation?** (Montoya & Hayes, 2017)

X: Attractiveness of the source face (low vs. high), **within**-pp

Y: Sociability rating of the target face (from 0 to 5)

M: Perceived attractiveness of the target face (from -3 to +3)

Within-pp mediation:

Fundamental equation:

Total effect

Indirect effect

Direct effect

$$Y2_i - Y1_i = c + e1i$$

$$M2_i - M1_i = a + e2i$$

$$Y2_i - Y1_i = c' + b(M2_i - M1_i)$$

$$+ d[0.5(M1_i + M2_i) - 0.5(\overline{M1 + M2})] + e3i$$

Mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

`mdt_within_wide`(data, Soc_low, Soc_high, Attra_low, Attra_high)

Short Format

Part.	Attra_high	Attra_low	Soc_high	Soc_low
1	2	-1	4	3
2	2	-3	2	1
3	3	0	1	0
4	1	1	3	2
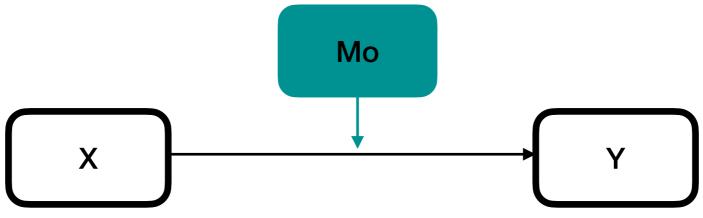
NB: for long format data, use `mdt_within`

Outline

- Mediation

- Moderation

- Moderated mediation

Moderation

« [the moderator] partitions a focal independent variable into subgroups that establish its **domains of maximal effectiveness** in regard to a given dependent variable » (Baron & Kenny, 1986, p. 1173)

=> Says whether the **direction/strength** of the effect of X on Y differs **as a function of** the modalities of Mo
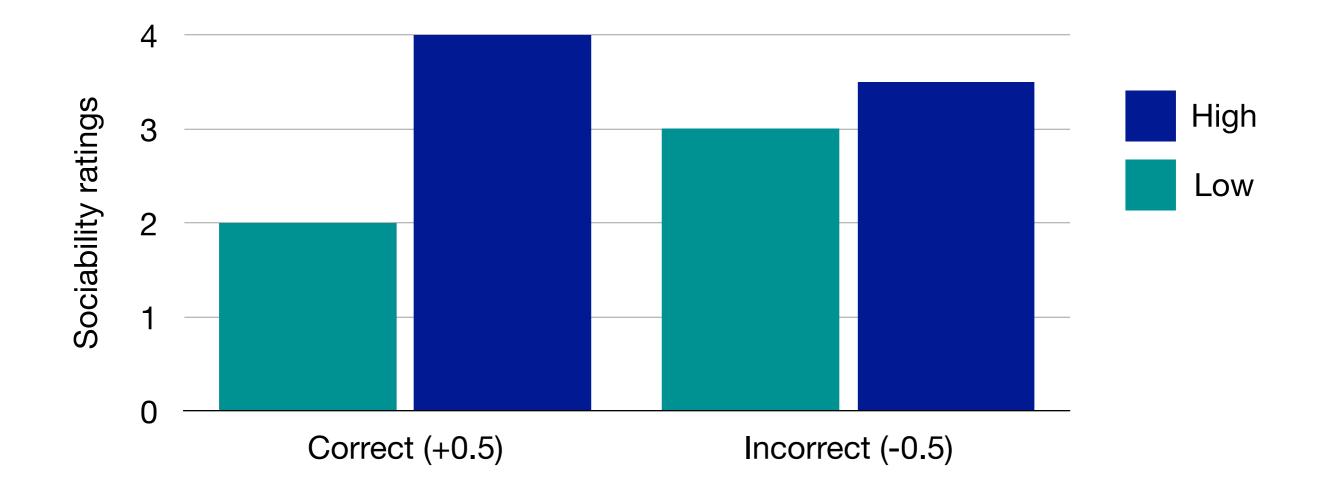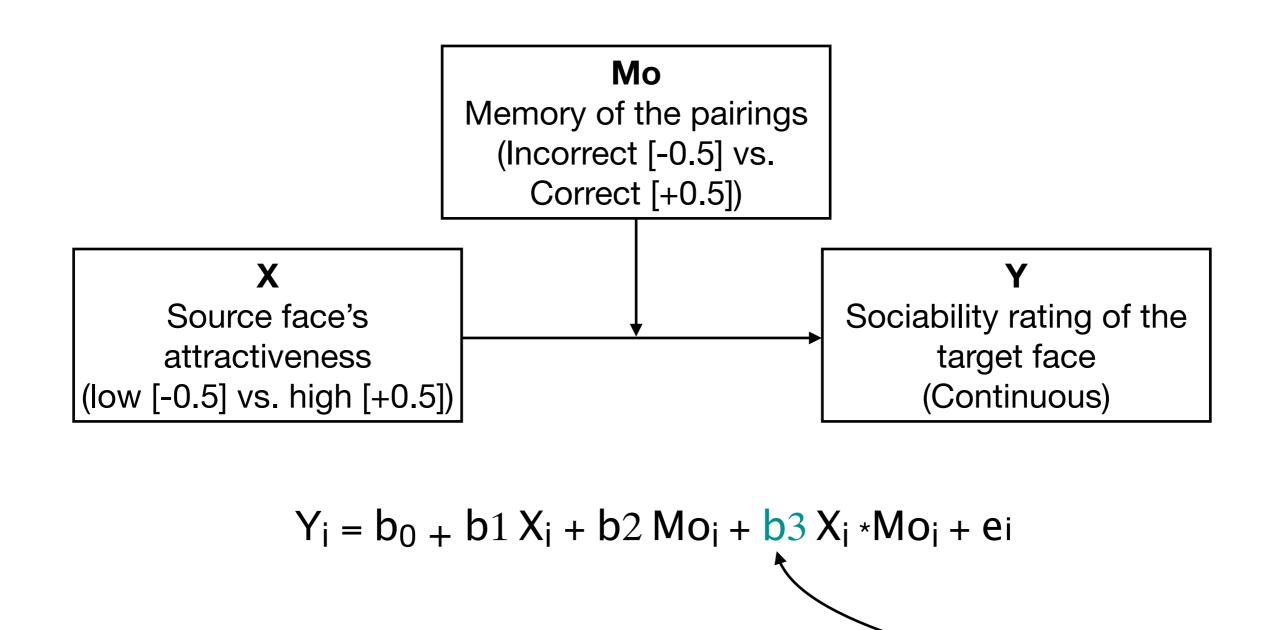
‣ Showing a moderation only requires to demonstrate that there is a **X by Mo interaction** (no need to first demonstrate an X effect on Y)

‣ The **status** of moderating variable (Mo) or main independent variable (X) only depends on the **theory**

‣ Distinction between mediating and moderating variables:

   ‣ Mediating variable: <u>accounts for</u> the relation between X and Y

   ‣ Moderating variable: <u>modifies</u> the relation between X and Y

Moderation

X: Attractiveness of the source face (low vs. high), between-pp
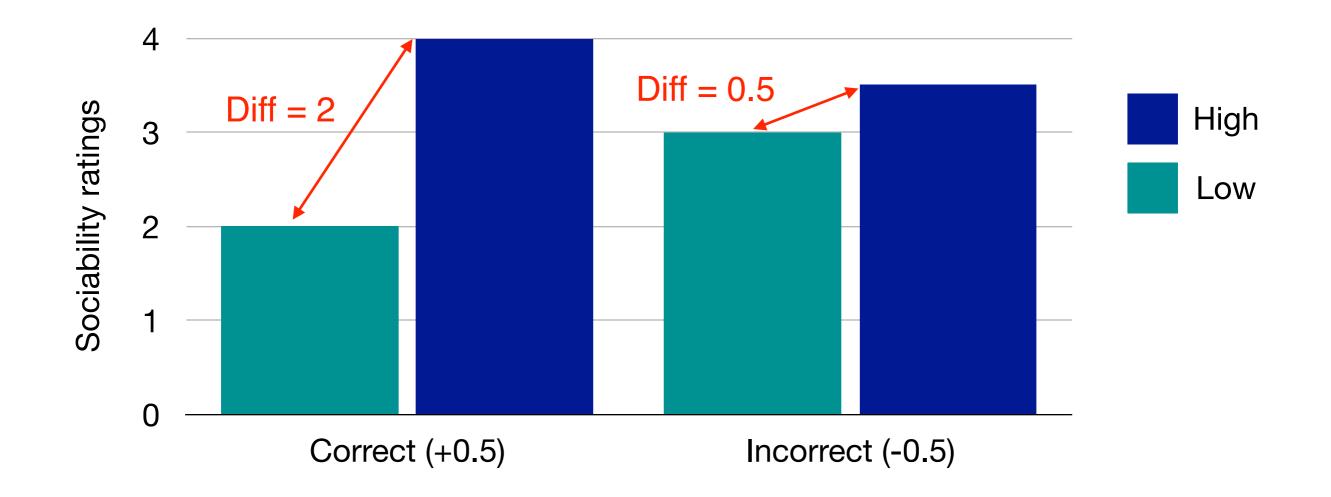
Y: Sociability rating of the target face (from 0 to 5)

Mo: Pairing memory (correct vs. incorrect), between-pp

Hypothesis: the pairing-based halo effect is larger when participants have a correct (vs. incorrect) memory of the pairings

Moderation

Mo
Memory of the pairings
(Incorrect [-0.5] vs.
Correct [+0.5])

X
Source face's
attractiveness
(low [-0.5] vs. high [+0.5])

Y
Sociability rating of the
target face
(Continuous)

$$Y_i = b_0 + b1\,X_i + b2\,Mo_i + b3\,X_i * Mo_i + e_i$$

We only need b3 to
be significant!

b_3 tells us how the X – Y relationship changes
as Mo increases by one unit

Moderation

b_3 tells us how the X – Y relationship changes as Mo increases by one unit

$b_3 = $ **1.5** (= 2-0.5): From incorrect to correct, the effect of X on Y (i.e., the mean difference) increases of 1.5

Outline

- Mediation

- Moderation

- Moderated mediation
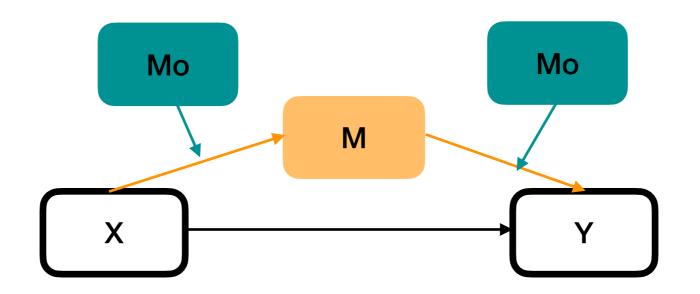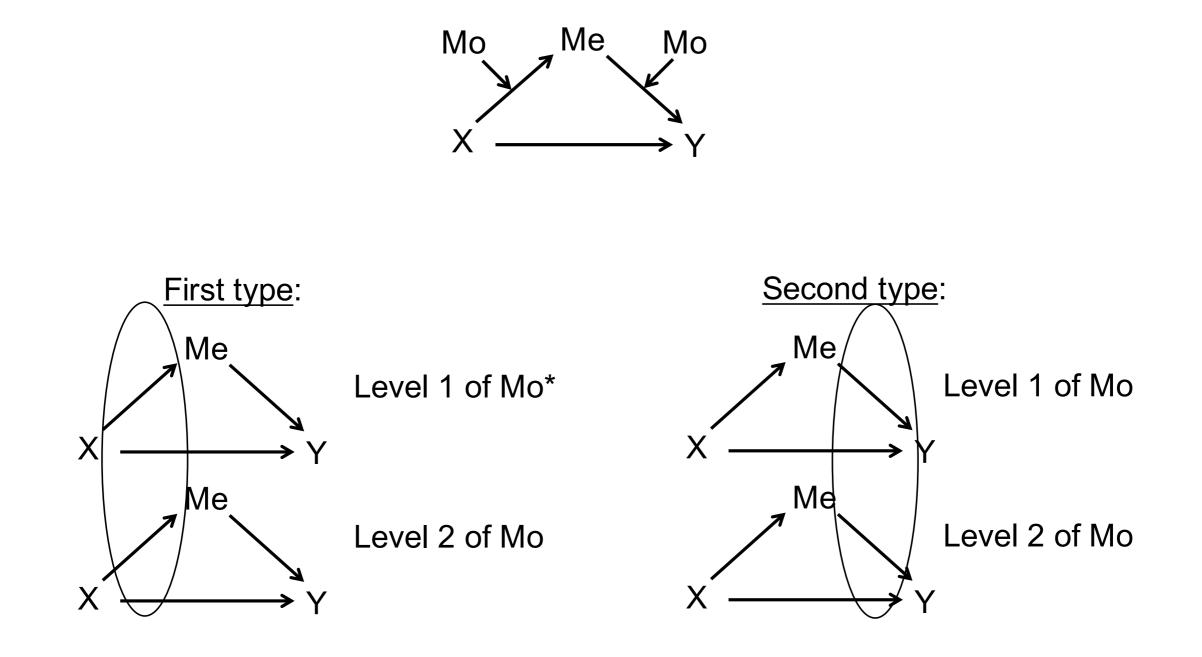
Moderated mediation

- The starting point is: X $\longrightarrow$ Y

- Then, we want to show that the mediation of this effect X $\longrightarrow$ Me $\longrightarrow$ Y differs as a function of a moderator (i.e., "Is the mediation moderated?")

  In moderated mediation, we are trying to **demonstrate that the mediational process responsible for the X to Y relationship differs (i.e., is larger/smaller) as a function of the levels of the moderator**

  => What varies as a function of the moderator is **not the magnitude of the overall effect of X on Y** but the m**ediating process that produces it**

Moderated mediation

First type:

Level 1 of Mo*

Level 2 of Mo

Second type:

Level 1 of Mo

Level 2 of Mo

* But remember Mo can be continuous

Moderated mediation

- **X** = the **independent variable** of interest (the manipulation):

Dichotomous variable experimentally **manipulated** with unit allocated randomly within conditions (e.g., coded -0.5/+0.5)

- **Mo** = the **moderator**:

Could be continuous (measured preferably before the X induction; used in mean deviated forms) or a dichotomous variable

- **Me** = the **mediator**:
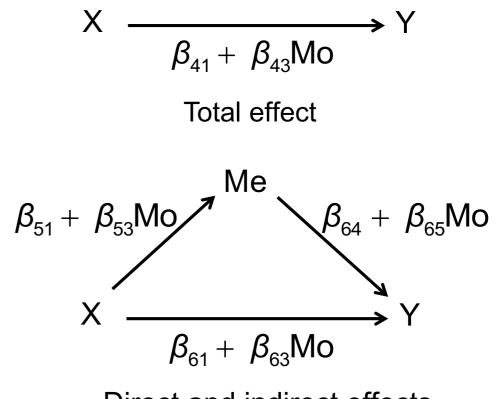
A continuous variable measured after the manipulation of X

- **Y** = the **dependent variable**:

A continuous variable measured after manipulating X and after measuring Me

Moderated mediation

- Three underlying models (Muller et al., 2005):

(1) $\quad Y_i = \beta_{40} + \beta_{41}X_i + \beta_{42}Mo_i + \beta_{43}X_i * Mo_i + \varepsilon_{4i}$

Total effect

Direct and indirect effects

(2) $\quad Me_i = \beta_{50} + \beta_{51}X_i + \beta_{52}Mo_i + \beta_{53}X_i * Mo_i + \varepsilon_{5i}$

(3) $\quad Y_i = \beta_{60} + \beta_{61}X_i + \beta_{62}Mo_i + \beta_{63}X_i * Mo_i + \beta_{64}Me_i + \beta_{65}Me_i * Mo_i + \varepsilon_{6i}$

Moderated mediation

- In order to argue for a moderated mediation, we need (Muller et al., 2005):

- An effect of X on Y: $\beta_{41} \neq 0$

- Mo doesn't moderate that effect $\beta_{43} = 0$

- The indirect effect is moderated by Mo
   Which will require: $\beta_{53} \neq 0$ and/or $\beta_{65} \neq 0$

- Moreover, these moderations must be completed by the term they are tied to. Therefore, we need:

$$\beta_{64} \neq 0 \ and \ \beta_{53} \neq 0$$

and/or

$$\beta_{51} \neq 0 \ and \ \beta_{65} \neq 0$$

Moderated mediation

$$(1) \quad Y_i = \beta_{40} + \beta_{41} X_i + \beta_{42} Mo_i + \beta_{43} X_i * Mo_i + \varepsilon_{4i}$$

$$(2) \quad Me_i = \beta_{50} + \beta_{51} X_i + \beta_{52} Mo_i + \beta_{53} X_i * Mo_i + \varepsilon_{5i}$$
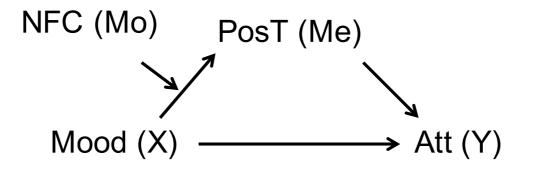
$$(3) \quad Y_i = \beta_{60} + \beta_{61} X_i + \beta_{62} Mo_i + \beta_{63} X_i * Mo_i + \beta_{64} Me_i + \beta_{65} Me_i * Mo_i + \varepsilon_{6i}$$

- **In order to argue for a prototypical moderated mediation:**
- b_{41} must be significant
- b_{43} should not be significant (only true for a prototypical MoMe)
- b_{53} and b_{64} are conjointly significant
  and/or
- b_{51} and b_{65} are conjointly significant

Moderated mediation

Illustration (Petty et al., 1993)

- Mood (X): control = -1 and positive = 1
- Need for Cognition (Mo): continuous variable centered (+ = + NFC)
- Positive thoughts (Me): continuous variable centered (+ = + pos. thoughts)
- Change in Att. (Y): continuous variable (+ = + attitude change)

- ‣ Hypothesis: positive mood favors attitude change
- ‣ Mod Med Hypothesis: the mood effect should be mediated by positive thoughts to a greater extent for high level of NFC (because mood increases positive thoughts mostly for people high in NFC)

NFC (Mo)   PosT (Me)

Mood (X) ⟶ Att (Y)

Moderated mediation

$$(1) \quad Att_i = \beta_{40} + \beta_{41}Mood_i + \beta_{42}NFC_i + \beta_{43}Mood_i * NFC_i + \varepsilon_{4i}$$

	Parameter estimates	SE	t value	P value
Intercept	1,96	1,54	1,27	0,21
MOOD	6,81	1,54	4,42	0,00
NFC	1,27	1,14	1,12	0,27
MOODNFC	-0,69	1,14	-0,61	0,54

- $b_{41} = 6.81$, there is a higher level of attitude change for participants in positive mood (at a mean level of NFC)
- This effect is not moderated by the need for cognition

Mood (X) ⟶ Att (Y)

✓ First condition is met as b_{41} is significant

Moderated mediation

$$(2) \qquad PosT_i = \beta_{50} + \beta_{51}Mood_i + \beta_{52}NFC_i + \beta_{53}Mood_i * NFC_i + \varepsilon_{5i}$$

	Parameter estimates	SE	t value	P value
Intercept	0,04	0,70	0,06	0,95
MOOD	4,34	0,70	6,22	0,00
NFC	0,77	0,51	1,50	0,14
MOODNFC	1,26	0,51	2,45	0,02

- $b_{51} = 4.34$, good mood increases positive thoughts
- $b_{53} = 1.26$, this effect gets stronger as NFC increases

NFC (Mo)
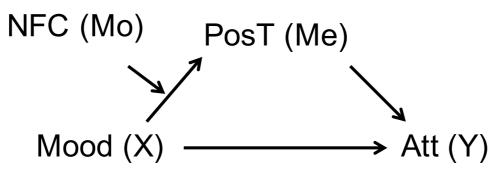
Mood (X) $\longrightarrow$ PosT (Me)

➡ b_{53} is significant, therefore, we need b_{64} to be significant as well (or b_{65} in that case but that is not the hypothesis)

Moderated mediation

(3) $\quad Att_i = \beta_{60} + \beta_{61}Mood_i + \beta_{62}NFC_i + \beta_{63}Mood_i * NFC_i + \beta_{64}PosT_i + \beta_{65}PosT_i * NFC_i + \varepsilon_{6i}$

	Parameter estimates	SE	t value	P value
Intercept	1,94	1,29	1,50	0,14
MOOD	1,48	1,55	0,96	0,34
NFC	0,36	0,97	0,37	0,72
MOODNFC	-2,17	1,03	-2,11	0,04
POS	1,25	0,19	6,61	0,00
POSNFC	-0,04	0,13	-0,28	0,78

- $b_{64} = 1.25$, the more positive thoughts participants have, the more their attitude changes
- b_{65} is non significant (so b_{51} and b_{65} are not significant at the same time)

NFC (Mo)   PosT (Me)

Mood (X) ⟶ Att (Y)
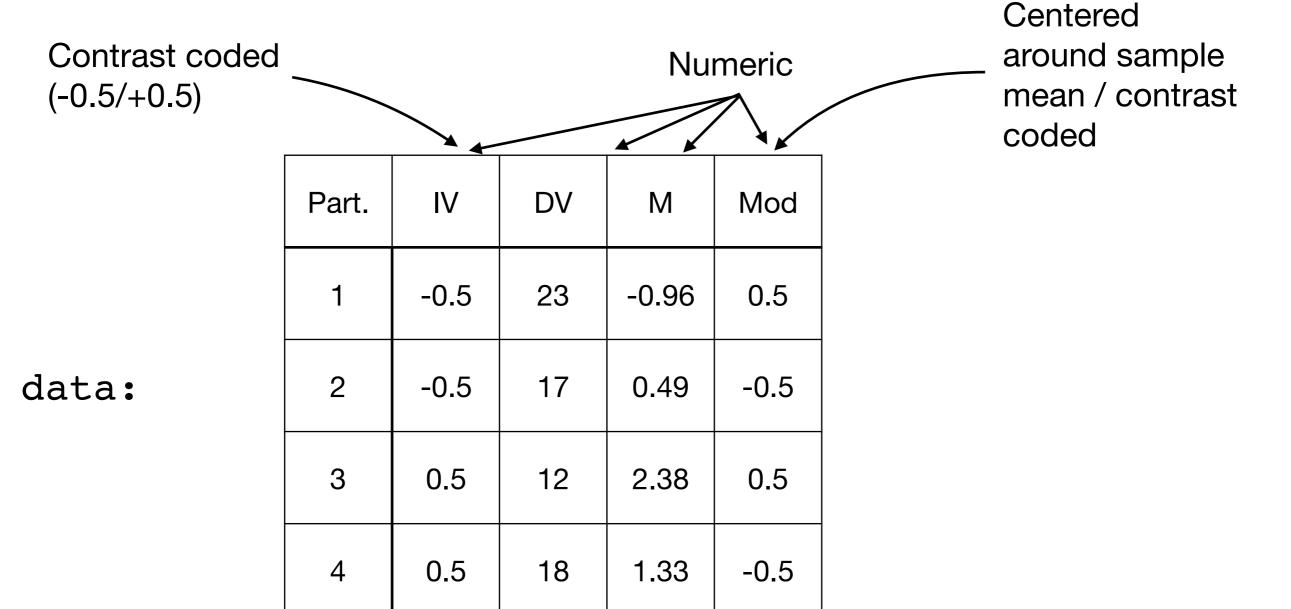
✓ The last condition is met as b_{64} is significant

Moderated mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

- For a moderated mediation (between-pp):

```
mdt_moderated(data, IV, DV, M, Mod)
```

Contrast coded
(-0.5/+0.5)

Numeric

Centered around sample mean / contrast coded

data:

Part.	IV	DV	M	Mod
1	-0.5	23	-0.96	0.5
2	-0.5	17	0.49	-0.5
3	0.5	12	2.38	0.5
4	0.5	18	1.33	-0.5

Moderated mediation

R Package 'JSMediation' (Yzerbyt et al., 2018)

- For a moderated mediation (between-pp):

```
model <- mdt_moderated(data, IV, DV, M, Mod)

model:
```

	Path	Point estimate	SE	APA
b51	a	0.185	0.159	t(390) = 1.17, p = .244
b53	a * Mod	0.485	0.318	t(390) = 1.53, p = .127
b64	b	0.261	0.037	t(388) = 7.00, p < .001
b65	b * Mod	-0.018	0.075	t(388) = 0.24, p = .814
b41	c	0.218	0.122	t(390) = 1.78, p = .075
b43	c * Mod	0.065	0.244	t(390) = 0.26, p = .792
b61	c'	0.171	0.116	t(388) = 1.48, p = .139
b63	c' * Mod	-0.059	0.231	t(388) = 0.25, p = .799

Thank you for your attention!

Exercise

Simple mediation (between-pp)

- Performing a simple task in front of mirror increases performance

  ‣ **Is this effect explained by an increase in self-consciousness?**

- *Procedure:* Half of the participants are seated in front of a hidden mirror and the other half of the participants with a mirror in front of them. Before performing the task, the researcher measures the degree of public self-consciousness using a scale from 1 to 7. Then the participants perform the task and the researcher measures their performance.

  ‣ Test the mediation hypothesis with the Baron & Kenny approach
    ‣ 1) by doing the three regression models yourself
    ‣ 2) by using the 'JSmediation' package

Exercise - Correction

Simple mediation (between-pp)

▸ **1) by doing the three regression models yourself**

- Step 1: testing of the total effect of the mirror condition on the performance

```
# Contrast code the condition variable

DF$condition_c <- -0.5 * (DF$condition == "hidden") + 0.5 *
(DF$condition == "present")
```

Exercise - Correction

Simple mediation (between-pp)

```
# Testing for the total effect c (X -> Y)

m1 <-lm(performance ~ condition_c, data = DF)
summary(m1)
confint(m1)
```

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    4.6119     0.1103  41.830   <2e-16 ***
condition_c    0.4619     0.2205   2.095   0.0399 *
---
```

```
                 2.5 %     97.5 %
(Intercept) 4.39189707 4.8319124
condition_c 0.02188939 0.9019201
```

Exercise - Correction

Simple mediation (between-pp)

- Step 2: testing of the a path (effect of the mirror condition on self-consciousness)

```
# Testing for the 'a' path (X -> M)

m2 <-lm (self_consciousness ~ condition_c, data = DF)
summary(m2)
confint(m2)
```

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.41429    0.09685  35.252  < 2e-16 ***
condition_c  0.51837    0.19370   2.676  0.00933 **


                 2.5 %     97.5 %
(Intercept) 3.2210196 3.6075519
condition_c 0.1318351 0.9048996
```

Exercise - Correction

Simple mediation (between-pp)

- Step 3: testing of the b path (effect of self-consciousness on the performance) and the direct effect c' (effect of the mirror condition on the performance)

```
# Testing for the 'b' path (M -> Y while controlling for X) and
c' path (X -> Y while controlling for M)

m3<-lm(performance ~ self_consciousness + condition_c, data = DF)
summary(m3)
confint(m3)
```

```
Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)          3.4254     0.4644   7.376  3.2e-10 ***
self_consciousness   0.3475     0.1324   2.624   0.0108 *
condition_c          0.2818     0.2224   1.267   0.2096


                        2.5 %     97.5 %
(Intercept)          2.49847530 4.3522713
self_consciousness   0.08317906 0.6118603
condition_c         -0.16215523 0.7256790
```

Exercise - Correction

Simple mediation (between-pp)

▸ **2) by using the 'JSmediation' package**

```
model <- mdt_simple(DF, condition_c, performance, self_consciousness)
model
```

Variables:

- IV: condition_c
- DV: performance
- M: self_consciousness_c

Paths:

Path	Point estimate	SE	APA
a	0.518	0.194	t(68) = 2.68, p = .009
b	0.348	0.132	t(67) = 2.62, p = .011
c	0.462	0.221	t(68) = 2.09, p = .040
c'	0.282	0.222	t(67) = 1.27, p = .210

Exercise - Correction

Simple mediation (between-pp)

▸ **2) by using the 'JSmediation' package**

```
add_index(model) # for the confidence interval of ab with
the Monte Carlo estimation
```

```
Indirect effect index:

- type: Indirect effect
- point estimate: 0.18
- confidence interval:
  - method: Monte Carlo (5000 iterations)
  - level: 0.05
  - CI: [0.0239; 0.412]
```

R Markdown

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Introduction to R markdown

Download

You can download today's slides and materials here.

https://bit.ly/3TBMbYy

Today's goals

After a short introduction to R markdown, you will learn how to generate a small report using this format.

R markdown files have a huge number of options, and I will show only very few of them. This is because:

- ► The basics are very useful and enough to achieve a lot.
- ► Most of us only use a tiny portion of all the options that Rmd offers.
- ► For the rest, there are Google and this free book by Xie & Grolemund.
- ► N.B.: You don't need to read the whole book to use R markdown, just search what you need when you need it!

R markdown

R markdown is a file format for making dynamic documents with R.

- ► Documents can contain plain text, R code, outputs, images etc.
- ► Can be html files, word files, presentations (like this one).
- ► Requires an up-to-date installation of R and of Rstudio, plus some packages.

A small example (1)

We can have slides or html/word/pdf pages in which we include a chunk of code and its output. The code below is actually run every time these slides are compiled, giving each time a different result.
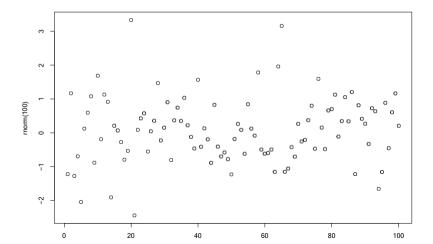
```
t.test(x = rnorm(10))
```

```
##
##  One Sample t-test
##
## data:  rnorm(10)
## t = 0.79275, df = 9, p-value = 0.4483
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.5069393  1.0539343
## sample estimates:
## mean of x
## 0.2734975
```

A small example (2)

You can also include plots

```
plot(rnorm(100))
```

Pros

Main advantages of R Markdown:

- ▸ You can share your results with people who are not R users.
- ▸ Commenting and organizing code with headings and subheadings is easier.
- ▸ You get used to make your data-analysis process transparent and reproducible.
- ▸ When new data come in or when a bug is corrected in your code, the document can be fully updated with a few clicks.
- ▸ Teaching R-related topics is easier, because all code needed is naturally embedded in the slides.
- ▸ You can render your output to Word / Powerpoint and then edit it manually.
- ▸ You focus on the content, the result is visually pleasing.
- ▸ Probability of introducing errors in reports is reduced.

Errors in reporting data?

- ► Bakker, Dijk, and Wicherts (2012) examined a sample of 281 papers and found that many p-values were inconsistently reported (e.g., incomplete statistics or p-values, incorrect p-values etc.).
- ► Nuijten et al. (2016) developed a package, statcheck, to automatically scan 250000 p-values in major psych journals, and found that half of published papers included at least one p-value that was inconsistent with its test statistic or df.
- ► A bias was found in favor of reporting lower values of p, but in general many "honest" mistakes in reporting are introduced when translating results from statistical software to research reports (papers, slides etc.).
- ► R markdown provides a way to prepare reports in which results are directly computed from data, using transparent code. We all do mistakes, but being systematic and transparent makes it easier to spot them.

Cons

- ► Compared to MS Word, Power Point or similar alternatives, is more difficult to guess the visual rendering.
- ► A WYSIWYG interface is also available, but I find it impractical (most of the times, it messes my Rmd file!).
- ► Customization is difficult, requires some html/css skills (e.g., figuring out how to customizing the first and last slide took me 1 hour). Most times, you are happy with the defaults.
- ► A tiny tiny error is enough to make your document un-knittable (but that's good, because you get used to keep only working code in your document).

Let's start!

- ► To create a new Rmd file, open Rstudio and go to File > New File > R markdown
- ► If it is the first time you use Rmd, you will need to let R install some necessary packages.
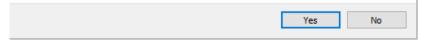
Choose the type of file you wish to create

- ► We will focus on creating a report in html, but if you have an installation of MS Word, you can also switch to a Word document later. Select Document > HTML.
- ► If you want to, later on you can also try creating a presentation: This one is created with html/ioslides, but you can also switch to MS Powerpoint.

New R Markdown	
Document	**Title:** Untitled
Presentation	**Author:** Giulio
Shiny	**Date:** 2022-09-01
From Template	☐ Use current date when rendering document
	Default Output Format:
	◉ HTML
	Recommended format for authoring (you can switch to PDF or Word output anytime).
	○ PDF

Your fist R markdown file

The new file generated includes examples of what you can do with R markdown.

- ► The top part (called YAML header) includes title, author, date, and type of output. You can edit this information (e.g., replacing "html_document" with "word_document").
- ► The parts inside back-ticks/curly brackets are R-code chunks, i.e., R code whose code and output can be shown in the document.
- ► The rest is text describing the code and output.

```
---
title: "Untitled"
author: "Giulio"
date: '2022-09-01'
output: html_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```{r cars}
summary(cars)
```
```

Knitting the file

- ► Save the file, naming it "Report.yourname.Rmd".
- ► Now, you can click *Knit* and choose how to render it, whether in html, word, or pdf.

Managing R code in Rmd files

Chunk options (1)

At the right end of each chunk, a wheel allows setting chunk options:

- ► name of the chunk (for internal use only, e.g., navigating the file)
- ► whether to run chunk's code show the output
- ► whether showing warnings and messages or not
- ► whether to use a custom size for figures

Whenever you edit a chunk's options, a code appears inside the chunk's curly brackets. You can also edit options by directly writing the appropriate code inside brackets.

Chunk options (2)

You can also set chunk options for all chunks for which an option is not explicitly specified. This can be done by expliciting the chunk option inside this command, that always appears in the first chunk.

knitr::opts_chunk$set(echo = TRUE)

Running code without rendering the file

You can also run code inside a chunk without rendering the document.

- ► To run a chunk's code, press the > symbol close to the wheel, or hit **ctrl+alt+c**
- ► To run the code of all previous chunks, press the arrow down symbol close to the wheel or hit **ctrl+alt+p**
- ► To run the subsequent chunk, press **ctrl+alt+n**
- ► To run all chunks, press **ctrl+alt+r**

Try these commands in your own document

Creating chunks

To insert a new chunk, press the +C green button on the top-right corner, or hit **ctrl+alt+i**

Create a new chunk and write any R command in it

Inline code

When writing your report, you might want to add a result directly in the text, and not inside a chunk. You can do that by including inline code in the text part, ` r *put your code here* `.

That can be sometimes difficult, because you need to round and format the numbers. In the example below, I used commands round() and format.pvalue() to adjust the number appearence.

```r
tt <- t.test(x = rnorm(10), y = rnorm(10, mean = 2), var.e
tt
```

```
##
##  Two Sample t-test
##
## data:  rnorm(10) and rnorm(10, mean = 2)
## t = -5.9643, df = 18, p-value = 1.213e-05
## alternative hypothesis: true difference in means is not
## 95 percent confidence interval:
##  -3.022304 -1.447729
```

Inline code

Replace ' with back ticks `

The result was t(`r round(tt$parameter, 3)`) = `r round(tt$statistic, 3)`, p = `r format.pval(round(tt$p.value, 3), eps = .001)`

And the result will be this

The result was t(18) = -5.964, p = < 0.001

[Formatting text](#)

Italic, bold

To write text in *italic font*, use a single underscore or asterix before and after the text. *like this*

To write text in **bold font**, use a double asterix or underscores before and after the text. **like this**

Heading levels

You can organize your report in sections with headers and sub-headers, using the # symbol.

- ► # Header 1
- ► # # Header 2
- ► . . .
- ► # # # # # # Header 6

Bullet points

You can create bullet points

- Item 1
- Item 2
  - subitem 1
  - subitem 2
- Item 3

By programming like this. Remember to leave a blank line before the first element of the list.

* Item 1

* Item 2

```
    + subitem 1

    + subitem 2
```

* Item 3

Ordered lists

You can create ordered lists

1. Item 1
2. Item 2
    a. subitem 1
    b. subitem 2
3. Item 3

By programming like this. Remember to leave a blank line before the first element of the list.

1. Item 1
2. Item 2
   + subitem 1
   + subitem 2
3. Item 3

Formulas

You can use a syntax called [MathJax,](#) a simple tutorial is available [here.](#) Essentially you put the formula inside dollar symbols and it gets formatted.

$ Y_{i,j} = \beta_{0,i} + \beta_{1,i}*X_{i,j} $

Becomes

$Y_{i,j} = \beta_{0,j} + \beta_{1,j} * X_{i,j}$

Hyperlinks

Simply put the text you wish to be clicked in square brackets, followed by parentheses including the link.

This: [Cran] (https://cran.r-project.org/)

Produces (after removing the space after the square brackets.)

This result: [Cran](https://cran.r-project.org/)

Images

You can include images using this type of syntax (without spaces)

![subtitle] (path of image){properties}

For example this code (without spaces)

![my image] (img/choice1.png){width=30%,height=30%}

Results in

References (1)

- You can also include references, using the [BibTex format.](#)
- You need to orgnize the references within a BibTex file (e.g., called references.bib), and declare it in the YAML, including for example

bibliography: references.bib

- To create the BibTex file, you can just export import references from Mendeley or Google Scholar. For example, check the references.bib file attached to this presentation.

References (2)

To call a reference in the text, you can just type the @symbol, followed by the name of the reference

@Nuijten2016

Results in

Nuijten et al. (2016)

[@Nuijten2016]

results in

(Nuijten et al. 2016)

Reference list

By default the reference list is included at the end of the file. If you want it in another position, you can use this html code

<div id="refs">

Results in this

Bakker, M, A van Dijk, and J M Wicherts. 2012. "The rules of the game called psychological science." *Perspectives on Psychological Science* 7 (6): 543–54. https://doi.org/10.1177/1745691612459060.

Nuijten, Michèle B., Chris H. J. Hartgerink, Marcel A. L. M. van Assen, Sacha Epskamp, and Jelte M. Wicherts. 2016. "The prevalence of statistical reporting errors in psychology (1985–2013)." *Behavior Research Methods* 48 (4): 1205–26. https://doi.org/10.3758/s13428-015-0664-2.

[Organizing the file](#)

Reproducibile code

Your code needs to self-sustain without your manual intervention.
In particular

- ► You cannot install or load packages by flagging them in the **Packages** menu (use package *pacman* instead).
- ► You cannot import data manually from the **import dataset** menu (use code instead)
- ► You cannot manually set your working directory from the **Session** menu (use relative referencing instead).
- ► You cannot have leftover pieces of code around, that either do not run correctly (that would prevent your file from knitting), or alter your data in unintended ways, or mess your code flow in general (if that code runs, that's even more dangerous!).

In short, your code needs to be organized and reproducible. I will teach you a few strategies that I use. You can of course use your own, as long as they work.

Installing and loading packages

At the beginning of each Rmd file, after the first chunk that includes global chunk options, I always include a chunk for managing packages. To do so, I use the R package **pacman**, which

1. checks whether packages are installed

   ► If not, they get installed

2. loads the packages

This makes your code robust to missing packages.

Create a chunk with this code at the beginning of your Rmd file. You can use chunk option "include = FALSE" to prevent the code+output from being shown (but code is still run).

```
if(!require("pacman")) install.packages("pacman")
pacman::p_load("readxl", "JSmediation")
```

Importing the data

The subsequent chunk I often have, is used to import all data. A good idea is to put your data in a folder called "data".

```
DF <- read_excel("data/DF_Mediation.xlsx")
```

The rest of the file

The rest of the file will be a combination of what you need to do. I typically have separate chunks for

- ► cleaning data (e.g., outlier removal, creating useful variables, removing useless variables etc.)
- ► sample descriptive statistics.
- ► specific analyses.

Before each chunk, I include my comments and observations.

[Create your report](#)

Exercise (by Marine Rougier)

- ► Performing a simple task in front of a mirror increases performance.
- ► Is this effect explained by an increase in self-consciousness?
- ► Procedure: Half of the participants are seated in front of a hidden mirror and the other half with a mirror in front of them. Before performing the task, the researcher measures the degree of public self-consciousness using a scale from 1 to 7. The participants perform the task and the researcher measures their performance.

Exercise (by Marine Rougier)

1. Load packages readlx and JSmediation
2. Import the DF_Mediation data
3. Create a new variable, condition_c, which takes value -.5 if condition == "hidden" and +.50 if condition == "present".
4. Using Baron & Kenny (1986)'s approach, test whether the effect of condition_c on performance is mediated by self_consciousness, also inspecting confidence intervals for each mediation equation. You can use lm or JSmediation.
5. Bonus: Also include a reference to Baron & Kenny (1986) in the reference list, and include regression formulas for mediation in your report.

Rules of the game

Rules:

- ► The results of the exercise need to be presented in an R markdown report (you can choose whether html, word, or a presentation).
- ► Use different chunks.
- ► Make sure that your code is reproducible (see above).
- ► Choose which chunks/outputs you want to be visible and which you want to hide.
- ► Ask for help if you get stuck.
- ► If this is too hard and you are running out of time, a solution (not in R markdown) is available in the folder "solution". Use this only for emergency situations! Other solutions can also work.

Thank you for your attention!

Intensive Longitudinal studies:

Advantages & Limitations of Ambulatory Assessment

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Ambulatory Assessment
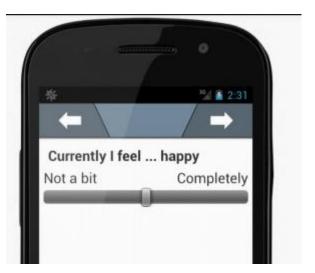
1. What is it?

2. What advantages does it have?

3. Difficulties / limitations?

4. Research designs

5. Research questions

What is Ambulatory Assessment?

Intensive longitudinal assessment of experiences and behavior „in the field"

Assessment of momentary experiences, behavior, and physiology in people's daily life

Also

- experience sampling methods (ESM)
- ecological momentary assessment (EMA)
- daily diary methods
- mobile sensing
- ambient sensing

What can be assessed?

Domains

- Momentary subjective experience
  - Perception, cognition, affect
- Behavior
  - Acts
  - movements
  - e.g., consumption
- „Objective" experiences
  - „hassles"
  - „uplifts"
- Setting
  - location
  - Presence of others
  - …
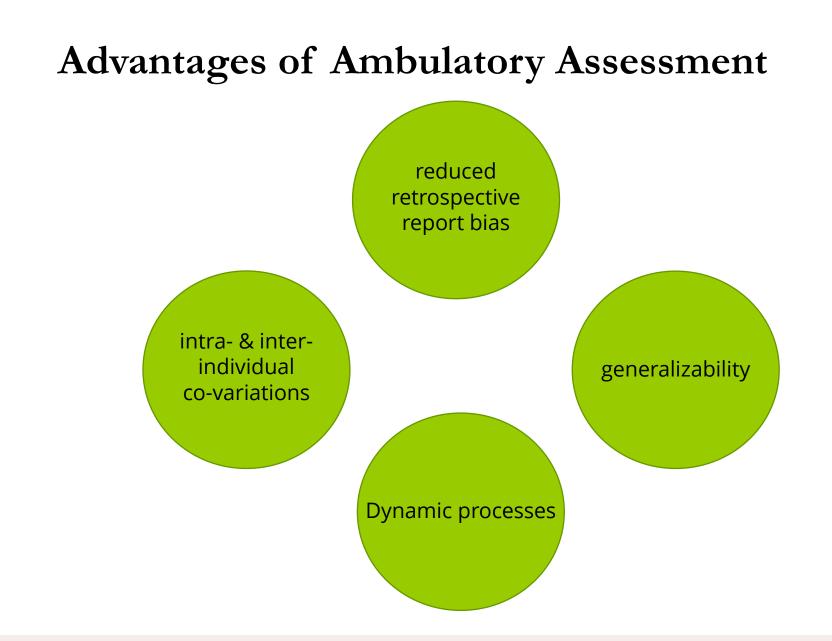
Diagnostic methods in the field

- Self-report
- Other-report
- Performance measures
- Behavioral indicators / residues
  - Recording of sounds
  - location (GPS)
  - activity (Accelerometry)
  - Use of smartphone („funf.org")
- Physiological measures

Advantages of Ambulatory Assessment

reduced retrospective report bias

intra- & inter-individual co-variations

generalizability

Dynamic processes

Avoid memory biases that affect global retrospective reports regarding long or distant time periods

Frequency estimation

During a typical day, I check my email _____ per day.

a. less than once
b. 1 – 3 times
c. 4 – 6 times
d. 7 – 9 times
e. 10 – 12 times
f. more than 12 times
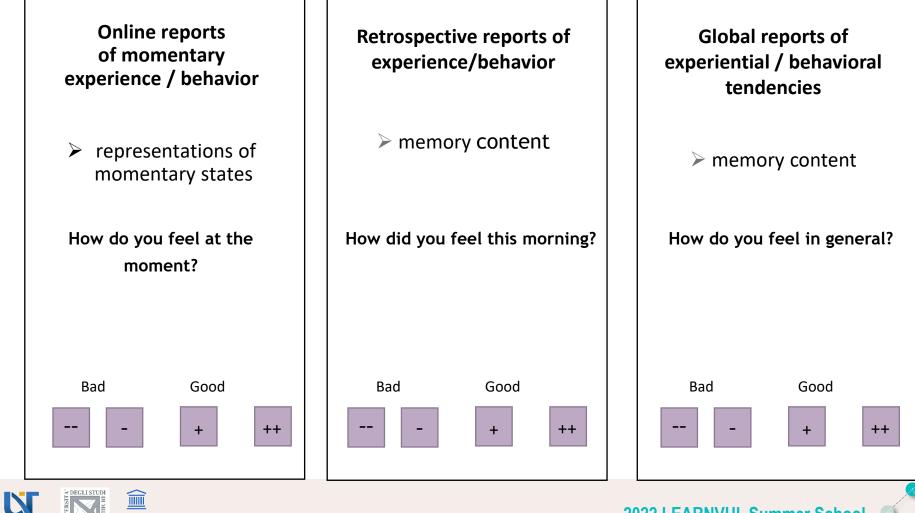
Retrospective Self-report

reduced retrospective report bias

Online reports of momentary experience / behavior	**Retrospective reports of experience/behavior**	**Global reports of experiential / behavioral tendencies**
➤ representations of momentary states	➤ memory content	➤ memory content
How do you feel at the moment?	**How did you feel this morning?**	**How do you feel in general?**
Bad　　　　Good	Bad　　　　Good	Bad　　　　Good
-- - + ++	-- - + ++	-- - + ++
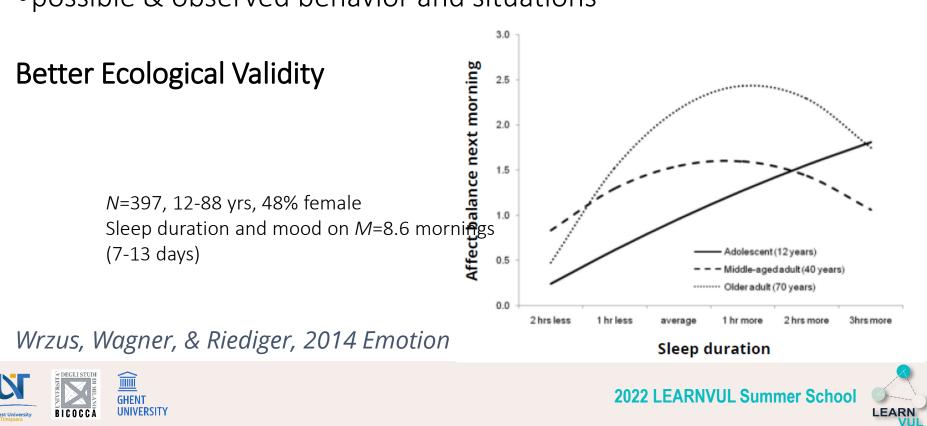
Do findings „in the lab" generalize to natural contexts?

generalizability

Better generalizability due to representativeness of
- context characteristics
- relevance of situations
- possible & observed behavior and situations

Better Ecological Validity

N=397, 12-88 yrs, 48% female
Sleep duration and mood on *M*=8.6 mornings
(7-13 days)

Wrzus, Wagner, & Riediger, 2014 Emotion
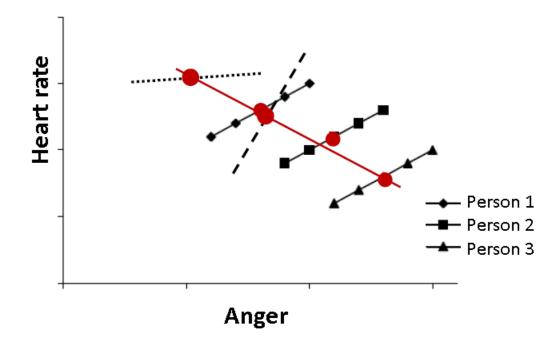
Feelings, thoughts, & behavior vary between and within persons

- Between = personality differences

- Within = processes

- Individual differences in within-person (co)variation = **personality!**

Associations within and between persons might differ

Fleeson & Gallagher, 2009; Molenaar & Campbell, 2009

How does a phenomenon change over time?

Understanding the processes underlying the temporal dynamics of emotion

How do 27 emotions last (median; Verduyn et al., 2015):
- sadness (48 hours)
- anxiety and guilt (4 hours)
- fear (1 hour)
-    shame (30 minutes)

The most studied emotion dynamics (Bailen et al., 2019 and Reitsema et al., 2019 for reviews):
- frequency with which one experiences anxiety or depression over a period of time
- average magnitude of emotion over time (intensity)
- range of fluctuations (variability)
- magnitude of these fluctuations from moment to moment (instability)
 - temporal dependency or persistence of emotion states (inertia)

Types of research questions

1. Analyses of aggregated momentary information

- ➢ Focus on interindividual differences
- ➢ Goal: reduce bias

2. Analyses of intraindividual processes

Intraindividual variability

Intraindividual change across time

Intraindividual covariation

Intraindividual time-lagged covariation

Interindividual differences in intraindividual processes

Types of research questions

The feasibility of using cellular phones to collect ecological momentary assessment data: Application to alcohol consumption

Collins, R. Lorraine; Kashdan, Todd B.; Gollnisch, Gernot.
Experimental and Clinical Psychopharmacology Vol. 11, Iss. 1, (Feb 2003): 73-78. DOI:10.1037/1064-1297.11.1.73

Be Active and Become Happy: An Ecological Momentary Assessment of Physical Activity and Mood.

Autore: Kanning, Martina[1]
Schlicht, Wolfgang[1]

Fonte: Journal of Sport & Exercise Psychology. Apr2010, Vol. 32 Issue 2, p253-261. 9p. 2 Charts.

Journal of Personality and Social Psychology
2015, Vol. 109, No. 5, 872–888
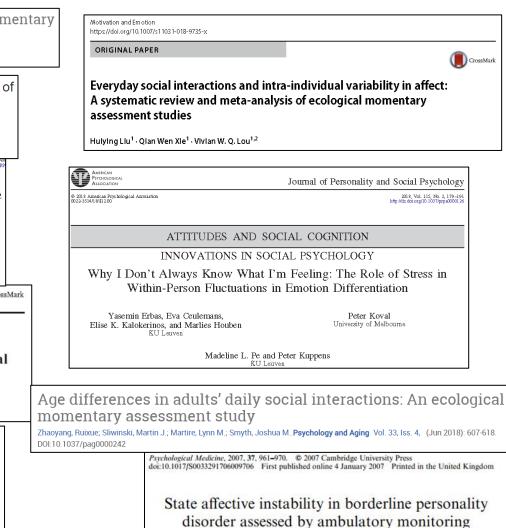
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0022-3514/15/$12.00   http://dx.doi.org/10.1037/pspp

The Independent Effects of Personality and Situations on Real-Time Expressions of Behavior and Emotion

Ryne A. Sherman
Florida Atlantic University

John F. Rauthmann
Humboldt-Universität zu Berlin

Nicolas A. Brown, David G. Serfass, and Ashley Bell Jones
Florida Atlantic University

J Abnorm Child Psychol (2017) 45:1429–1438
DOI 10.1007/s10802-016-0249-2

CrossMark

Ecological Momentary Assessment of Affective and Interpersonal Instability in Adolescent Non-Suicidal Self-Injury

Philip S. Santangelo[1] · Julian Koenig[2] · Vera Funke[2] · Peter Parzer[3] · Franz Resch[3] · Ulrich W. Ebner-Priemer[1,4] · Michael Kaess[2,3]

European Journal of Personality, Eur. J. Pers. (2018)
Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/per.2155

Interpersonal Dynamics in Personality and Personality Disorders

CHRISTOPHER J. HOPWOOD*
University of California, Davis, CA USA

Motivation and Emotion
https://doi.org/10.1007/s11031-018-9735-x

ORIGINAL PAPER

CrossMark

Everyday social interactions and intra-individual variability in affect: A systematic review and meta-analysis of ecological momentary assessment studies

Huiying Liu[1] · Qian Wen Xie[1] · Vivian W. Q. Lou[1,2]

AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Personality and Social Psychology

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2018, Vol. 115, No. 2, 179–191
http://dx.doi.org/10.1037/pspa0000126

ATTITUDES AND SOCIAL COGNITION

INNOVATIONS IN SOCIAL PSYCHOLOGY

Why I Don't Always Know What I'm Feeling: The Role of Stress in Within-Person Fluctuations in Emotion Differentiation

Yasemin Erbas, Eva Ceulemans, Elise K. Kalokerinos, and Marlies Houben
KU Leuven

Peter Koval
University of Melbourne

Madeline L. Pe and Peter Kuppens
KU Leuven

Age differences in adults' daily social interactions: An ecological momentary assessment study

Zhaoyang, Ruixue; Sliwinski, Martin J.; Martire, Lynn M.; Smyth, Joshua M..Psychology and Aging Vol. 33, Iss. 4, (Jun 2018): 607-618. DOI:10.1037/pag0000242

Psychological Medicine, 2007, 37, 961–970.   © 2007 Cambridge University Press
doi:10.1017/S0033291706009706   First published online 4 January 2007   Printed in the United Kingdom

State affective instability in borderline personality disorder assessed by ambulatory monitoring
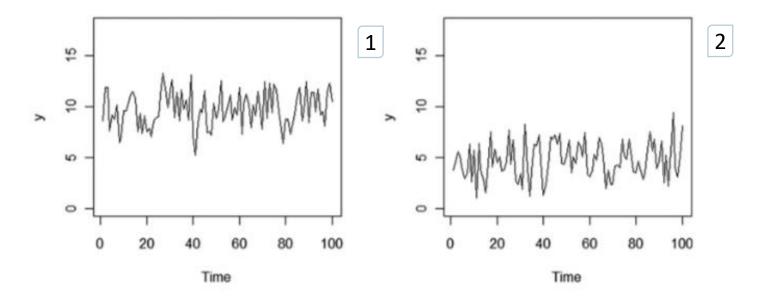
ULRICH W. EBNER-PRIEMER[1]*, JANICE KUO[2], NIKOLAUS KLEINDIENST[1], STACY S. WELCH[2], THOMAS REISCH[3], IRIS REINHARD[4], KLAUS LIEB[5], MARSHA M. LINEHAN[2] AND MARTIN BOHUS[1]

2022 LEARNVUL Summer School

Mean (General tendency)
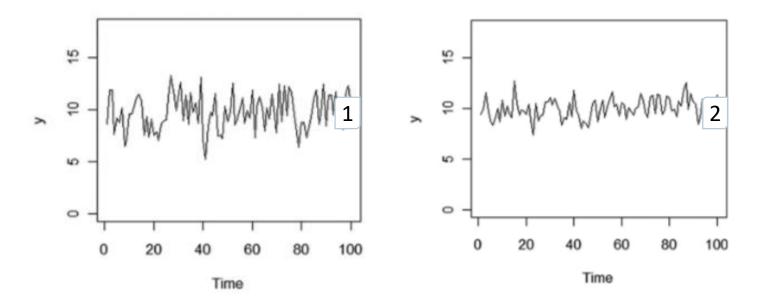
Features how people usually perceive, do, and feel

Differences in means = differences in the vertical position of the series (i.e., the equilibria or preferred states) of different individuals.

Intraindividual variability

reflects the extent to which one's **current state is different from one's mean** (Jongerling et al., 2015);

Differences in variability indicate differences in observed variances
The larger variability, the larger fluctuations over time
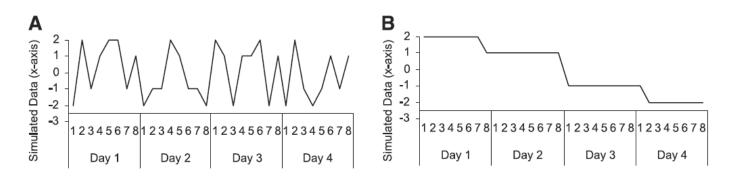
Intraindividual variability

Figure 1. Color-coded distress ratings of patients with BPD and HC over a 24 h period. Whereas each row represents a subject (BPD = Row 1–50; HC = Row 51–100), each square is a self-report, and the color denotes the level of distress: dark colors = low distress, bright colors = high distress.

Indexes of Variability:
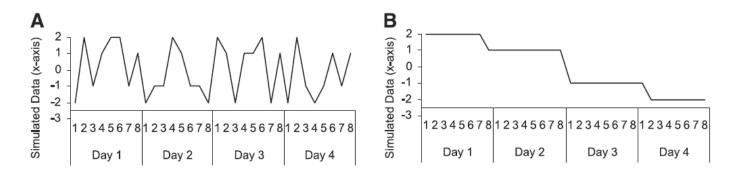
1. Simpler: *Mean Squared Successive Differences*

$$MSSD(X) = \frac{\sum_{i=2}^{n}(x_i - x_{i-1})^2}{n-1},$$

2. More elaborated: *Innovation,* also known as dynamical error in Auto-Regressive models (e.g., Jongerling, Laurenceau, & Hamaker, 2015)
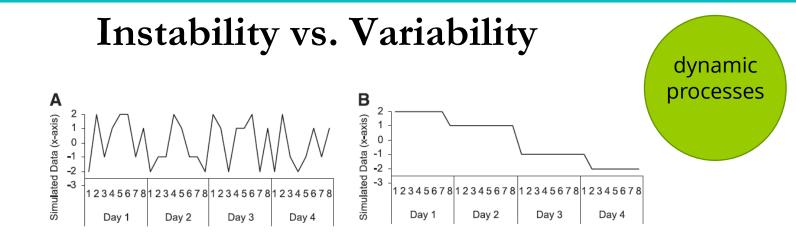
→ **Instability vs. variability**

„Variability, defined as the dispersion of scores from a central tendency, does not consider the temporal order of scores. However, one of the major components of instability is temporal dependency…" Ebner-Priemer et al. (2009, p. 196)

Instability vs. Variability

dynamic processes

instability and *variability* are not interchangeable

Variability = the dispersion of scores from a central tendency, does not consider the temporal order of scores.

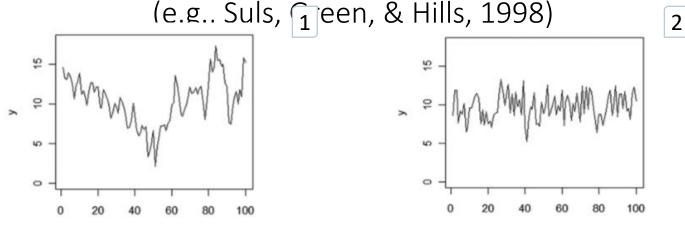One of the major components of instability is temporal dependency (Ebner-Priemer et al., 2007).

2-week vacation. You: 1st week sunshine, 2nd week rain every day. Your colleague: for the entire 2 weeks (rain, sun, rain, rain, sun, sun, rain, sun,…).

For you stable weather, for your colleague unstable.

Variability (SD) is the same for both

Several indexes for assessing (in)stability (see Ebner-Priemer et al., 2009) or multi-level models

Inertia (carry-over effects)

Reflects the extent to which **current state is predictable from prior state**
(e.g.. Suls, Green, & Hills, 1998)

1

2

Differences in inertia = differences in the pattern of fluctuations over time and in the amount of total variance.

Higher inertia = less random fluctuations over time and a wider range of fluctuations

Index of inertia in AR models: **autoregressive parameter** (e.g., Wang, Hamaker, & Bergeman, 2012) to determine whether for example how you feel at T 0 influences feelings at Time 1.
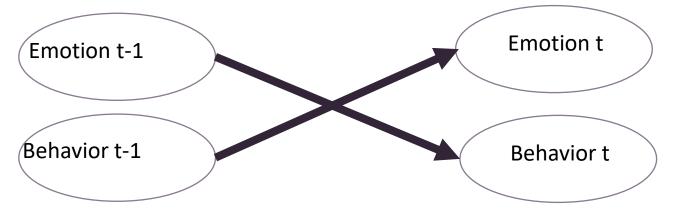
Intraindividual cross-lagged effects

Process that takes place at the within-person level between different variables across time
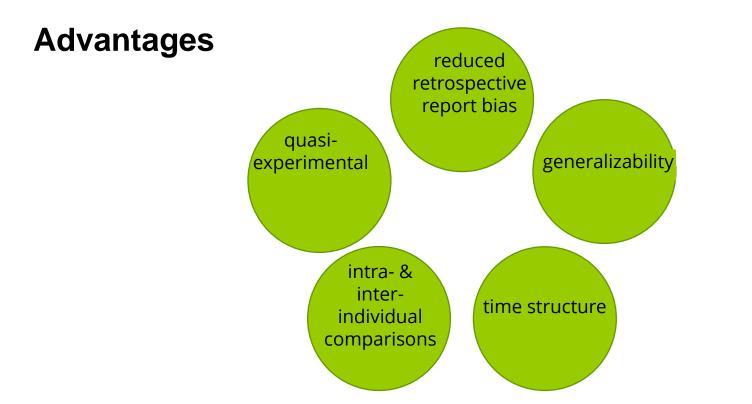
Dynamical Structural Equation Modeling (Asparouhov, Hamaker, & Muthén, 2017, 2018) a multilevel extension of AR(1) models

Advantages

- reduced retrospective report bias
- quasi-experimental
- generalizability
- intra- & inter-individual comparisons
- time structure
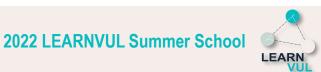
Research topics

For personality researcher:

- Antecedents and consequences of personality states
- Individual differences in within-person processes

General design issues ESM

- What assessment schedule to be used?
- Who is the population?
- What do you need to measure?

Design: signal-, time-, & event-contingent sampling

time

signal-contingent

time

time-contingent

Fixed times

Pseudo-randomized

time

Continuous
e.g., heart rate

event-contingent
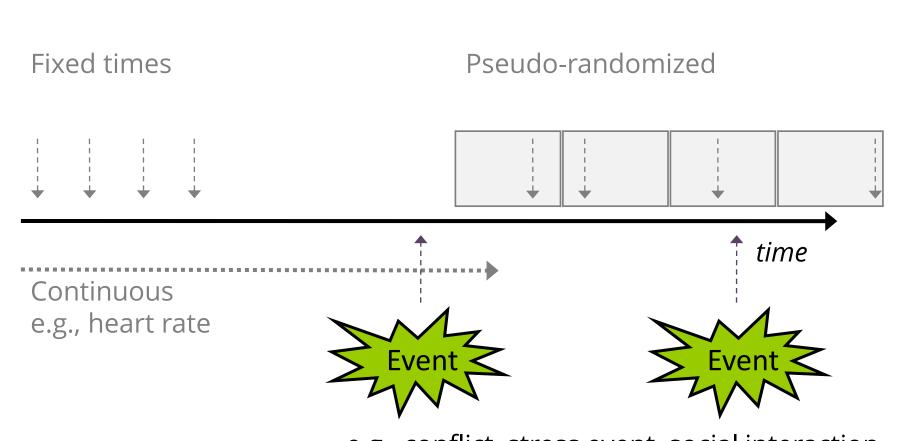
Fixed times   Pseudo-randomized

Continuous
e.g., heart rate

time

Event

Event
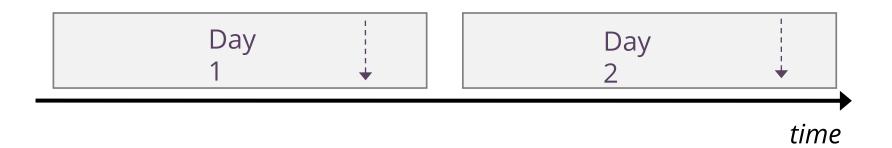
e.g., conflict, stress event, social interaction

Daily diary

Design: Interactive sampling

- Changes in continuous phenomenon trigger invitation to self-report
  - e.g. physical activity; heart rate
  - e.g. GPS / bluetooth as trigger

Assessment Schedule (summary)
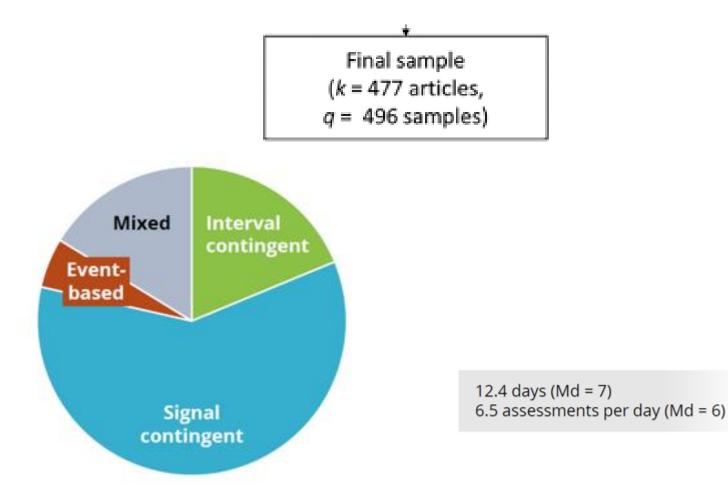
• Signal-contingent: Sample when signaled (alarm, SMS) Can be pure random schedule or stratified within a time-block.

• Time/Interval-contingent: Regular, time-based sampling scheme. E.g., pain report at the top of every hour; morning, afternoon, evening report. End of day (daily diary).

• Event-contingent: Sample based on event occurrence. E.g., record feelings after every social interaction lasting >10min.

Meta-analysis on ESM studies

Wrzus& Neubauer, 2022 Assessment

Final sample
(k = 477 articles,
q = 496 samples)

Mixed

Interval contingent

Event-based

Signal contingent

12.4 days (Md = 7)
6.5 assessments per day (Md = 6)

Which design is best?

Choice of assessment schedule depends on
Frequency and (assumed) **continuity** of phenomenon
- low frequency phenomena: event-contingent or frequent interval-contingent sampling for longer time

Characteristics and **motivation** of **sample** (reimbursement, assumed burden)
- healthy and/or highly motivated sample: more frequent assessments and longer (total) duration possible
- BUT: frequency and total duration can increase dropout

Number of assessment days & assessments per day

$r = -.18, p < .001$
95% CI [-.27,-.08]

$r = -.27, p < .001$
95% CI [-.36,-.17]

Wrzus& Neubauer, 2022 Assessment

How often should assessments occur?

Choice of assessment schedule depends on:

- **Frequency** and (assumed) **continuity** of phenomenon
  - low frequency phenomena: event-contingent or frequent interval-contingent sampling for longer time
- **Characteristics** and **motivation** of **sample**
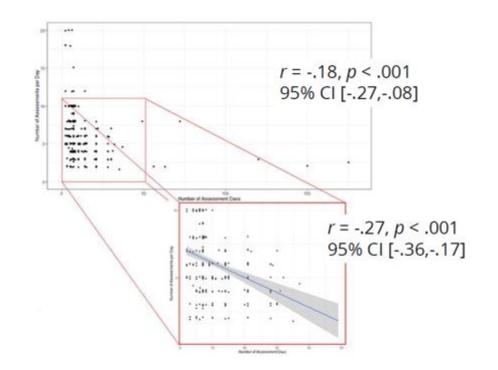 - incentives, assumed burden
  - healthy and/or highly motivated sample: more frequent assessments and longer (total) duration possible
  - BUT: frequency and total duration can increase selectivity and dropout
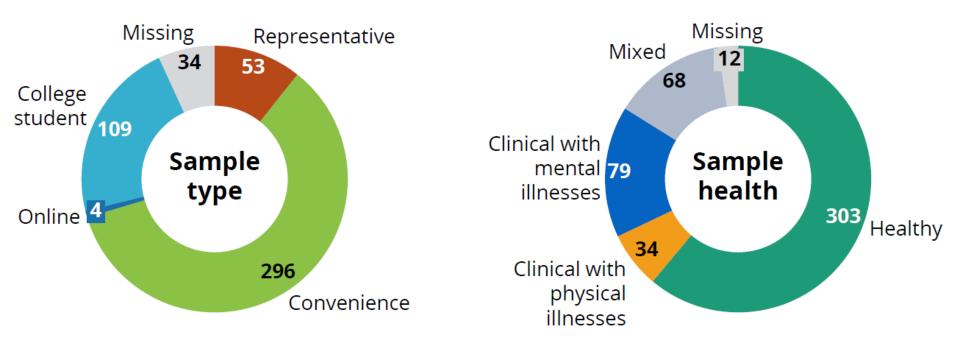
Populations/Samples

- Different technology options for different populations

- Still demographic differences in smartphone usage.

Wrzus& Neubauer, 2022 Assessment
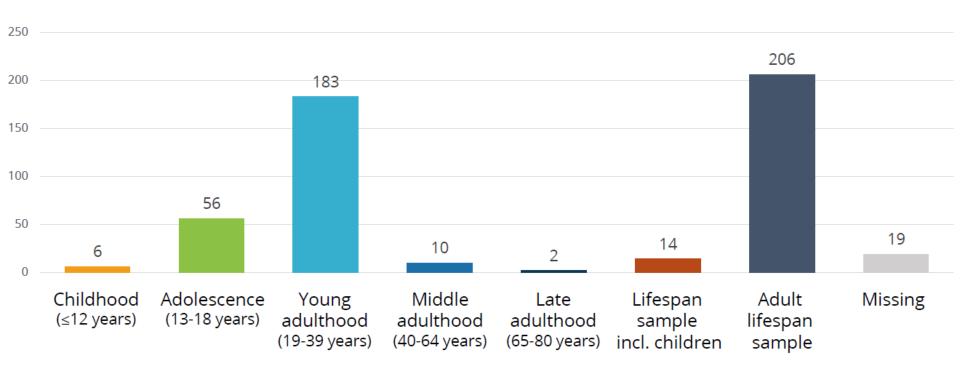
Age of samples

Wrzus& Neubauer, 2022 Assessment

What do you need to measure?

Self-Report

1. ### SMS/text-messaging using mobile phones

Works on any mobile phone (even the oldest models)
Only 160 characters or fewer
3 to 6 items max
No branching or response timing controls

2. ## Web surveys using smartphones

Works on all smartphones with Internet access
Nothing downloaded or installed on participants' own phones
Design a survey using a third party survey company (www.qualtrics.com
Requires smartphone with Internet connectivity or wifi

3. ## Smartphone resident software / apps

Specialized software that delivered surveys; highly tailorable and configurable
Apps that run on both iOS and Android

Cognitive behavior

**Is Seeking Bad Mood Cognitively Demanding?
Contra-Hedonic Orientation and Working-Memory Capacity
in Everyday Life**

Michaela Riediger and Cornelia Wrzus
Max Planck Institute (MPI) for Human Development, Berlin,
Germany

Florian Schmiedek
German Institute for International Educational Research (DIPF),
Frankfurt am Main, Germany

Gert G. Wagner
German Institute for Economic Research and MPI for Human
Development, Berlin, Germany

Ulman Lindenberger
MPI for Human Development, Berlin, Germany

N= 378 (14–84 y)
54 times in 3 weeks: current affect-regulation orientation + 2 trials of a cognitively demanding working memory task (numerical memory-updating task)

Negative correlation between contra-hedonic orientation (tendency to maintain or enhance negative feelings) and average working memory performance
momentary occurrences of contra-hedonic orientation associated with temporary declines in working memory performance within individuals

Physical activity (accelerometry)

BMC Geriatrics

RESEARCH ARTICLE   **Open Access**

Accelerometer-measured and self-reported physical activity in relation to extraversion and neuroticism: a cross-sectional analysis of two studies

Tiia Kekäläinen[1*] [ORCID], Eija K. Laakkonen[1], Antonio Terracciano[2], Tiina Savikangas[1], Matti Hyvärinen[1], Tuija H. Tammelin[3], Timo Rantalainen[1], Timo Törmäkangas[1], Urho M. Kujala[4], Markku Alen[5], Vuokko Kovanen[1], Sarianna Sipilä[1] and Katja Kokko[1]

N1 = 1098 (47–55y women) and N= 314 (70–85y women and men)
Self-reported measures extraversion and neuroticism
PA assessed with hip-worn tri-axial accelerometers and self-reported questions

In middle-aged women, neuroticism negatively associated with accelerometer-measured moderate-to-vigorous PA and SR PA
Extraversion positively associated with SR PA
No associations in older men and women

Physiology (Assessment of cardiovascular activity)

Psychological
and Psychophysiological
Ambulatory Monitoring

A Review of Hardware and Software Solutions

Ulrich W. Ebner-Priemer[1] and Thomas Kubiak[2]

European Journal of Psychological Assessment 2007; Vol. 23(4):214–226
DOI 10.1027/1015-5759.23.4.214

Published in: European Journal of Psychological Assessment, 2007, 23, 4, 206-213
which should be cited to this work

Ambulatory Assessment –
Monitoring Behavior
in Daily Life Settings

A Behavioral-Scientific Challenge for Psychology

Jochen Fahrenberg[1], Michael Myrtek[1], Kurt Pawlik[2], and Meinrad Perrez[3]

ECG, blood pressure, pulse, breathing
Information on reliability of commercial devices needed

Physiology 2

Lab and/or Field? Measuring Personality Processes and Their Social Consequences

CORNELIA WRZUS[1]* and MATTHIAS R. MEHL[2]

- Hormones   Miller et al., 2016
  Diamond et al., 2008

- Muscle activity (EMG)   Finni et al. 2014;
  Gruebler & Suzuki, 2014

- EEG, NIRS...
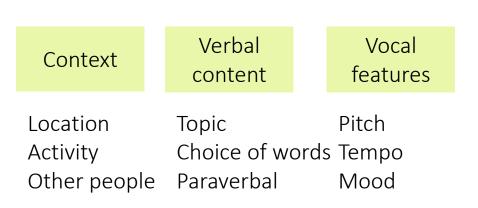
Sounds & speech

Electronically Activated Recorder
(EAR; Mehl et al., 2001)

iEAR for iPhone & Android personalized settings: start, frequency, duration, …

- Typical sampling scheme:
  30 Seconds; every 12.5 minutes

- Codable information
  - Situation/environment
  - behavior
  - conversations ("Snips")

Context	Verbal content	Vocal features
Location	Topic	Pitch
Activity	Choice of words	Tempo
Other people	Paraverbal	Mood

Sounds & speech

Preliminary evidence of diurnal rhythms in everyday behaviors associated with positive affect

Brant P. Hasler [a,*], Matthias R. Mehl [a], Richard R. Bootzin [a], Simine Vazire [b]

N=60 & N=50

wear the EAR for approximately 3 or 5 days during their waking hours

4.8 30s recordings per hour

Social Environment Coding of Sound Inventory

Personality assessment

Behavior associated with positive affect (i.e., socializing, laughing, and singing) varied according to a sinusoidal 24-h rhythm centered around participants' average waketime

And not behavior associated with negative affect (i.e., arguing and sighing)

Personality traits can moderate these rhythms (e.g., their amplitude)

Surrounding

Narrative clip
- Camera takes pictures every X seconds
- Good battery life and data storage

Thomaz, 2022

Mobile sensing

GPS ➜ Location

Bluetooth ➜ proximity to other devices

Brightness ➜ inside/outside

Temperature ➜ wheather, inside/outside

Camera ➜ Surroundings

Mood & GPS-based context (Sandstrom et al., 2016)
Better mood in social situations vs. Home vs. Work moderated by
Extraversion, Openness, A
Personality traits & smartphone usage (Chittaranjan et al., 2013; de Montjoye
et al., 2013; Montag et al., 2015)
Extraversion ➜more and longer calls
Extraversion➜less often game apps
Agreeableness➜less often mail apps
Concientiousness➜less often music player
Personality traits & sensor tracking (de Montjoye et al., 2013)
Neuroticism ➜ activity radius (based on GPS)

Technical implementation of Ambulatory Assessment
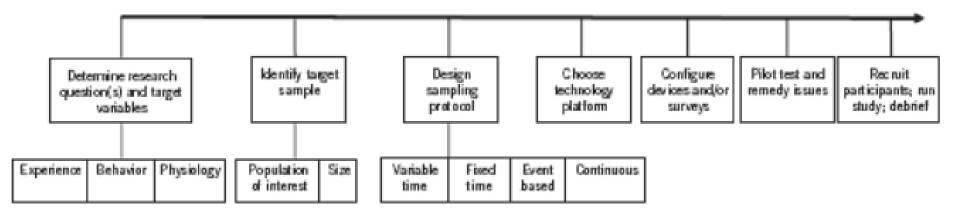
FIGURE 5.1. Key steps in designing and implementing a study of daily life.

Conner & Lehman (2012)

Survey Design

SURVEY

Depending on the software approach taken, a wide range of item types and formats can be implemented
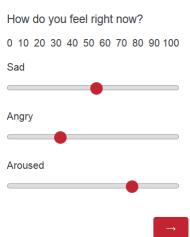
Survey Content

Mood - what aspects do you need to measure? Recommend 5, 7, or 9 point unipolar scales (*not at all* to *extremely or very*) with your choice of terms. *Right now, I feel:*

Activation

Tense
Nervous
Stressed
Upset

alert
excited
elated
happy

Unpleasant

Pleasant

Sad
Depressed
Bored
Fatigued

contented
serene
relaxed
calm

Deactivation

Positive mood: *enthusiastic, happy, relaxed*
• Negative mood: *angry, anxious, sad*
• Extraverted behaviors: *assertive, bold, talkative*

Survey Content

For scales, may need to shorten scales. At minimum, 3 top-loading items from that scale.
Example: DIAMONDS for assessing situations

For physical activity - best to measure accelerometer / steps
But if not possible: Self-reported physical activity - based on Single Item measure of physical activity (Milton, Bull & Bauman, 2009).

Survey Content

- Good to randomize order (do this if your technology allows) to minimize response set and keep things fresh.
- Can minimize number of items through "Planned missing data designs" (Silvia et al., 2014)

Table 4 Depiction of a matrix sampling design for four indicators of activated positive affect

	Happy	Enthusiastic	Excited	Energetic
Item Group 1	X	X		
Item Group 2	X		X	
Item Group 3	X			X
Item Group 4		X	X	
Item Group 5		X		X
Item Group 6			X	X

X indicates that an item was administered

Survey Length

Surveys should ideally be brief; adapt items for length, reporting interval, etc.
• Think about total burden: # items * #reports/day * # days
Very rough estimate of '*burden cap*': 20 min./day
• If sampling many times per day, or over very long periods of times, aim for fewer and shorter items in each survey
• If this isn't enough, consider supplementing with an end-of-day diary or adopting measurement burst design.

Examples of survey length

• Measuring momentary mood: 6 to 8 reports per day for a minimum of one week with <10 items at each report.

• Daily pain, activity, mood: 3 reports per day for two weeks with <30 items at each report. Morning, afternoon, evening.
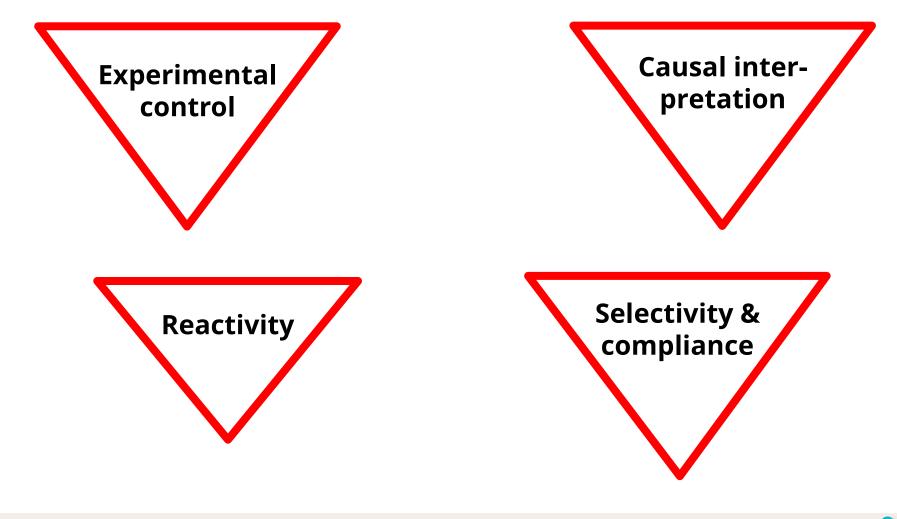
• Daily diary report of activities, food, daily stress: One report per day for one or two weeks with <60 items at each report.

Typical lengths

• ESM studies - range 3 days to 3 weeks

• Diary studies - range 1 week to 1 month

• Measurement burst designs - repeated sequences of daily measurements (Nesselroade, 1991; Sliwinski, 2008).

Difficulties / limitations
of Ambulatory Assessment

Experimental control

Causal inter-pretation

Reactivity

Selectivity & compliance

Reactivity

„systematically biasing effects of instrumentation and procedures on the validity of ones's data"
(Barta, Tennen, & Lit, 2012, p. 108)

→Changes in focal phenomenon due to assessment

→Are ambulatory assessment methods particularly reactive?

++	--
Anonymity	Participant burden
Reduced memory bias	Self-monitoring

How to prevent it?

- Reduce burden
→ See compliance

- Reduce impact of self-monitoring
- Avoid demand to change
- Ask for more than one behavior/phenomenon
- No feedback/back-button
- Record behavior after it occurred
- Randomized sampling scheme

How to detect it?

Data analyses:
- General trends over time
- Moderators of interindividual differences in trends over time
- Changes in associations overtime
- Sudden response shifts

Control group design
- Compare results in ambulatory assessment with reports of control group in retrospective questionnaires
- Reports of control group with less frequent assessment

But general problem: confound of reactivity and memory effects
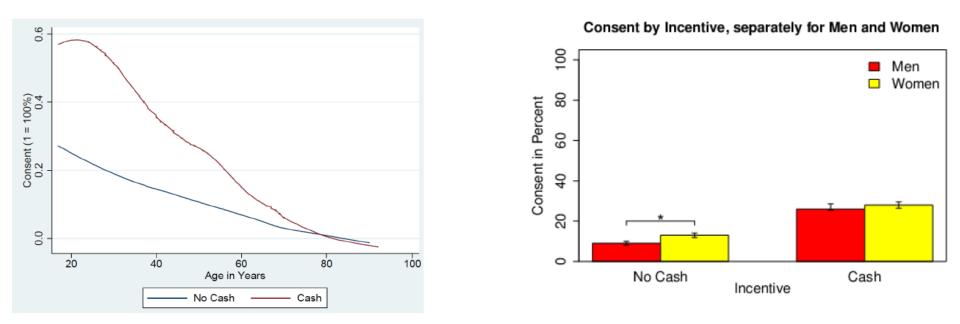
Selectivity

Participant burden and personal relevance are important

Especially **young people** and **men** more likely to participate with financial incentives

Ludwigs et al., 2019

Selectivity & compliance

Compliance

- **Scrutinize compliance (How many assessments** are answered as intended?)

❖ **Time stamp:**
  - Information on compliance (time-contingent designs)

❖ **Response windows:**
  - „enforce" timely responding (time-contingent designs)
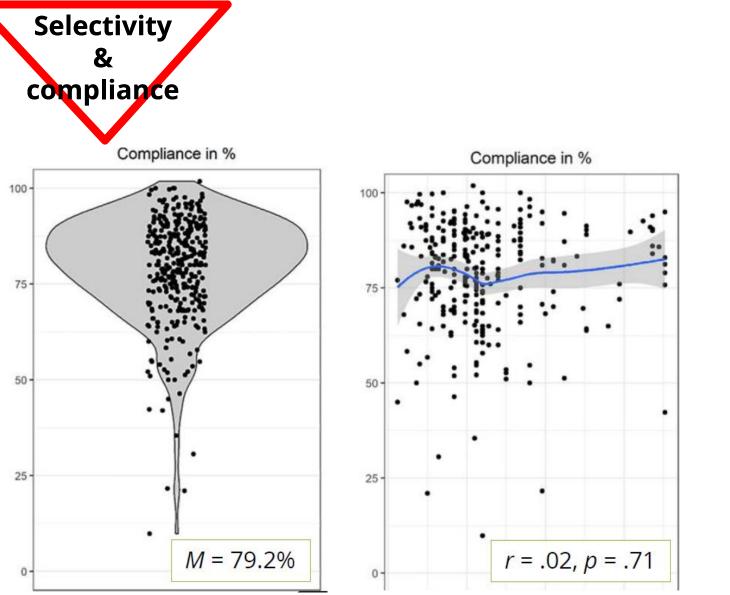
– **But for event-contingent designs?**

Couple with daily assessments:
  - Serves as reminder
  - And to assess retrospective responses

Selectivity & compliance

Compliance in %

$M = 79.2\%$

Compliance in %

$r = .02, p = .71$

Small non-linear effect of **assessments per day**
b = -.68, p= .055,
b² = .10, p= .034

Wrzus & Neubauer, 2022 Assessment

2022 LEARNVUL Summer School

How to increase Compliance?

- Research alliance
  - Introductory session
  - Hotline for technical support
  - Planned contacts(via telephone, email…)

- Be aware of intrusiveness
  - Chose optimal sampling schedule (frequency of assessment; individualized schedule)
  - Allow delayed responding
- Incentives
  - Bonus system (ethical considerations)
  - Report of results
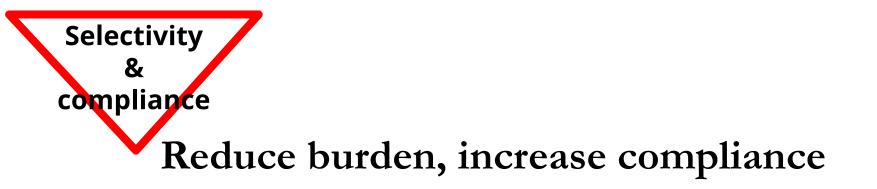
Reduce burden, increase compliance

- Limited number of items
- Simple items
- Simple response options
- Good readability
- Items known

Other Challenges & Limitations : reliability and validity

- „Context effects": Order as a source of error variance
- Fatigue; learning and memory
- Motivation to be consistent/variable
- Pilot testing!

Statistical Power

- Depends on the type of analysis, amount of between vs. within person variance, and the size of anticipated effect, among many factors (see Kreft & DeLeeuw, 2004).

- Rough guidelines - for a cross-level interaction (person factor moderating a within-person slope): need minimum of 30 people with 30 observations; 60 people with 25 observations; 150 people with 5 observations (Kreft & DeLeeuw, 2004).

In ESM studies, aim for *minimum* of 50 people x 42 time points = 2,100 total observations.
In diary studies, aim for *minimum* of 100 people x 7 time points = 700 total observations.
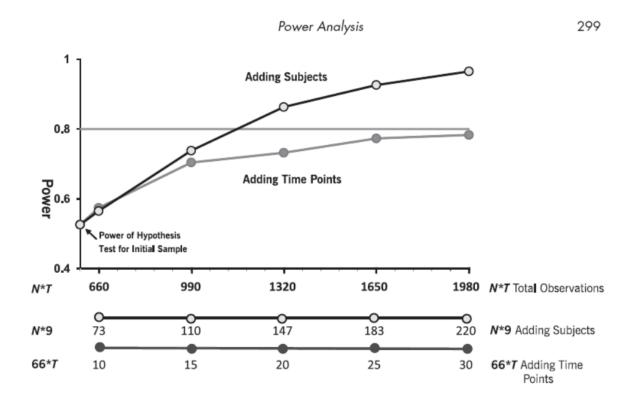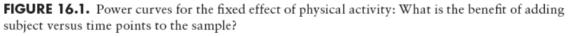
Statistical Power

To increase power, better to add people than observations

Power Analysis   299

FIGURE 16.1. Power curves for the fixed effect of physical activity: What is the benefit of adding subject versus time points to the sample?

from Bolger, Stadler, & Laurenceau (2012)

Data Cleaning

- Do not underestimate how long this will take.
- Double replies (especially with texting); understanding missing data; matching IDs with surveys for programmes that do not do this automatically.
- Good to keep a "Issues List" google docs or word document describing any issues to expect in data (e.g., participant 115's phone died halfway through the study so they started using a different phone number, etc).

Reliability

• Need a more sophisticated approach for measuring reliability; cannot use regular Cronbach's alpha because it fails to account
for dependency in observations.

• Two approaches

1. Mixed approach using a 3-level multilevel model using HLM (Nezlek, 2012; Ch 20 in *Handbook*)
2. Variance Components approach based on Generalizable Theory (GT) in SPSS or SAS (Shrout & Lane, 2012; *Psychometrics.* Ch 17 in *Handbook*)

Data Analysis

- Start descriptively. Get to know your data.
- Learn multilevel modeling to take full advantage of the data
Great introduction by Hayes (2006)
Another good introduction by Nezlek (2012). Ch. 20 In *Handbook*

Summary on Ambulatory Assessment

1. What is it?

  ➤ Intensive longitudinal assessment of momentary experience & behavior, in every-day life

2. What advantages does it have?

  ➤ Ecologic validity, otherwise unaccessible information, avoid memory biases

3. Difficulties / limitations?

  ➤ No solution to all problems; selectivity; compliance; reactivity

4. Research designs

  ➤ Event- & time-contingent; interactive

5. Research questions

  ➤ inter- & intraindividual variability

  ➤ dynamic processes

TAMLIN CONNER CHRISTENSEN, LISA FELDMAN BARRETT, ELIZA BLISS-MOREAU, KIRSTEN LEBO and CYNTHIA KASCHUB

A PRACTICAL GUIDE TO EXPERIENCE-SAMPLING PROCEDURES

Handbook of Research Methods for Studying Daily Life

edited by
Matthias R. Mehl
Tamlin S. Conner

Experience Sampling Method
Measuring the Quality of Everyday Life

Joel M. HEKTNER Jennifer A. SCHMIDT Mihaly CSIKSZENTMIHALYI
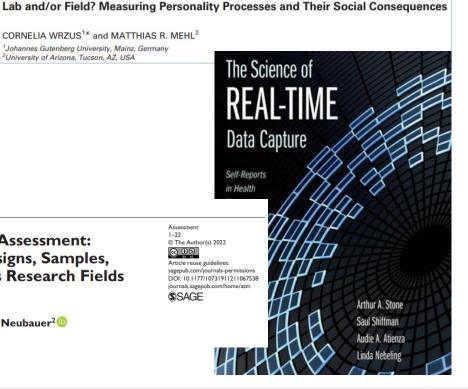
DAVID A. ELLIS

SMARTPHONES WITHIN PSYCHOLOGICAL SCIENCE

DIARY METHODS: Capturing Life as it is Lived

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Lab and/or Field? Measuring Personality Processes and Their Social Consequences

CORNELIA WRZUS[1]* and MATTHIAS R. MEHL[2]
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The Science of **REAL-TIME** Data Capture

Self-Reports in Health

Arthur A. Stone
Saul Shiffman
Audie A. Atienza
Linda Nebeling

Original Research Article

Ecological Momentary Assessment: A Meta-Analysis on Designs, Samples, and Compliance Across Research Fields

Cornelia Wrzus[1] and **Andreas B. Neubauer[2]**

Ecological Momentary Intervention

APPLIED PSYCHOLOGY: HEALTH AND WELL-BEING, 2018, *10* (2), 236–253
doi:10.1111/aphw.12128

Stopping the Train of Thought: A Pilot Study Using an Ecological Momentary Intervention with Twice-Daily Exposure to Natural versus Urban Scenes to Lower Stress and Rumination

Femke Beute* and Yvonne A.W. de Kort

Addictive Behaviors
Volume 78, March 2018, Pages 30-35

ELSEVIER

An ecological momentary intervention for smoking cessation: The associations of just-in-time, tailored messages with lapse risk factors

Emily T. Hébert [a] [⊠], Elise M. Stevens [a], Summer G. Frank [a], Darla E. Kendzor [a, b], David W. Wetter [d], Michael J. Zvolensky [c], Julia D. Buckner [e], Michael S. Businelle [a, b]

JMIR MHEALTH AND UHEALTH   Wright et al

Original Paper

Mobile Phone-Based Ecological Momentary Intervention to Reduce Young Adults' Alcohol Use in the Event: A Three-Armed Randomized Controlled Trial

Cassandra Wright[1,2], PhD; Paul M Dietze[1,2], PhD; Paul A Agius[1,2,3], MSc; Emmanuel Kuntsche[4,5,6], PhD; Michael Livingston[7,8], PhD; Oliver C Black[2], PhD; Robin Room[7,9], PhD; Margaret Hellard[1,2], PhD; Megan SC Lim[1,2], PhD

What about Neuroticism & Anxiety?

Heightened false alarms of conditioned threat predict longitudinal increases in GAD and SAD symptoms over the first year of college

Christopher Hunt, Ryan Fleig, Brandon Almy, Shmuel Lissek

1st-year college students (N=175) completed a fear conditioning task in semester 1 and measures of generalized anxiety disorder (GAD) and social anxiety disorder (SAD) symptoms in semesters 1 and 2

Higher anxiety to safe cues resembling danger during semester 1 predicted increased symptoms of GAD by semester 2
Higher anxiety to safe cues resembling and not resembling danger in semester 1 predicted greater SAD symptoms by semester 2
Semester 2 SAD symptoms were also predicted by higher threat expectancy to low probability threat cues in semester 1

What about Evaluative Conditioning?

Developmental Psychobiology WILEY

RESEARCH ARTICLE

Learning to like triangles: A longitudinal investigation of evaluative conditioning in infancy

Frances L. Doyle[1,2] | Louis Klein[1,3] | Lindsay J. Kemp[1] | Caroline Moul[1] |
Jenny L. Richmond[4] | Valsamma Eapen[3,5] | Paul J. Frick[6] | Eva R. Kimonis[4] |
David J. Hawes[1] | Mike E. Le Pelley[4] | Divya Mehta[7] | Mark R. Dadds[1]

Infants (N = 319) EC paradigm pairing neutral stimuli (triangular and square shapes) with affective stimuli (angry and happy faces) conducted at 7 and 14 months old.
At both time points, learning through evaluative conditioning was not present.
But presence of individual differences moderating effect

No empirical studies really studying EC in longitudinal studies

N & EC over time?

Is EC a stable phenomenon?
Is N or Anxiety variation linked to variations in EC effects?
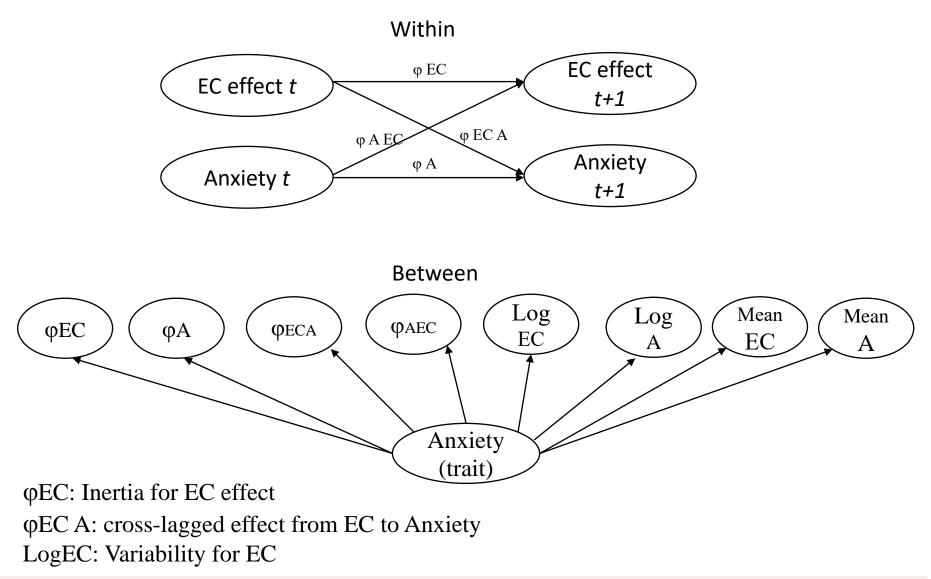
Study
D1: baseline measures of N (trait)
D2-D11: EC procedure + CS evaluation + Anxiety and
Intolerance to uncertainty assessment (state)
D12: self-report behavioral measures
N ≈ 180

N & EC over time?

Within

Between

φEC: Inertia for EC effect
φEC A: cross-lagged effect from EC to Anxiety
LogEC: Variability for EC

Thank you for your attention!

From lab to field studies.
The Random Intercept Cross-Lagged Panel Model

Giulio Costantini

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[Introduction to the RICLPM](#)

Different types of relationships among the same variables (1)

We are often used to think about the relationship between two variables as a simple one. E.g., if X increases, Y can either increase, decrease, or not change.

However, if you observe the same variables across multiple clusters (typically individuals) and multiple times, the same two variables can display multiple types of relationships.

E.g., X is "typing speed" (words per minute), and Y is "% of typos". How are they related?

e.g.,(Hamaker, 2012, Epskamp et al., 2018, Costantini et al., 2019)

Different types of relationships among the same variables (2)

Types of relationships that we can estimate with longitudinal data over multiple individuals.

1. **between-person level**. They are negatively related: Those who are able to type faster, also make fewer typos (e.g., you vs. your grandparents).
2. **within-person contemporaneous level**. They are positively related: In situations in which one types faster than the usual, one makes more typos (e.g., you at home vs. during an exam with time pressure).
3. **within-person cross-lagged level (3-hour lag)**. They are not related: If one types faster than usual, this should not affect the number of errors that one will make at the subsequent time-point.

Longitudinal (panel) data

- ► Experiments use random assignment for establishing an effect of X (e.g., anxiety) on Y = (e.g., EC effect), thus excluding spurious relationships (e.g., $Y \to X$ or $X \leftarrow Z \to Y$).

- ► Sometimes, experiments are unfeasible. Other times, they would not preserve ecological validity (e.g., is anxiety induced in the lab the same as anxiety occurring in everyday life?)

- ► Longitudinal/panel data (X and Y observed at times $t1$, $t2$, ..., tn) allow taking into account temporal order of events.

- ► One might be tempted to use a simple correlation analysis between X_t and Y_{t+1}. However, this would not exclude for instance the effect of a confounder, e.g., $X_t \leftarrow Z \to Y_t \to Y_{t+1}$. You also need to control for autoregressive effects, $Y_t \to Y_{t+1}$.
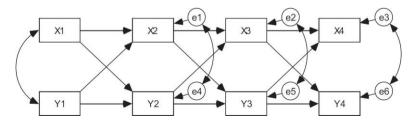
- ► The Cross-Lagged Panel Model (CLPM) does exactly this. By comparing the relative strength of $X_t \to Y_{t+1}$ vs. $Y_t \to X_{t+1}$, one han have hints regarding causal predominance (e.g., see Kenny, 1975).

Cross-lagged panel model (CLPM)

The CLPM includes

- **within-person autoregressive effects.** $X_t \rightarrow X_{t+1}$ (i.e., same as cross-lagged effects, but on the same variable)
- **within-person cross-lagged effects.** $X_t \rightarrow Y_{t+1}$ and $Y_t \rightarrow X_{t+1}$
- **within-person contemporaneous effects.**
  - At $t1$, they are estimated on exogenous variables $X_{t1} \leftrightarrow Y_{t1}$.
  - At $t2, ..., tn$, they are estimated on residuals of lagged effects, $e_{Xt+1} \leftrightarrow e_{Yt+1}$

Is anything missing?

Assumptions

- At least **Two waves** (= just-identified model - i.e., no fit indices). More waves are better.
- **GLM assumptions** (i.e., linearity, normality, etc.)
- **Synchronicity**. X_t and Y_t are measured at the same time (retrospective reports?).
- **Stationarity**. The phenomenon does not change over time.

Issues with the CLPM
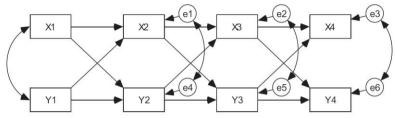
What if the variables involved have also trait-like properties?
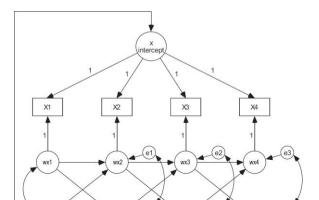
- ► The CLPM takes into accounts traits as autoregressive effects, i.e., influences between subsequent states.
- ► Modeling trait stability as an autoregressive effect implies only the stability of the grand-mean, the one across all persons and times (stationarity assumption).
- ► Individual trait levels (e.g., rank-order stability) wanes progressively over time, until none is left. Is this a plausible model of traits and trait stability?
- ► In the Whole Trait Theory model of personality (Fleeson & Jayawickreme, 2015), *traits* are (relatively) stable mean levels of a person's characteristics, and *states* are temporary deviations from those mean levels.
  - ► John is typically more extravert than Anna, but today Anna is at a party and thus displays more extraversion than John, who is at home.
  - ► Anna types faster than John (ability trait), but today John is at an exam and types faster than Anna, who is just taking notes.

RICLPM
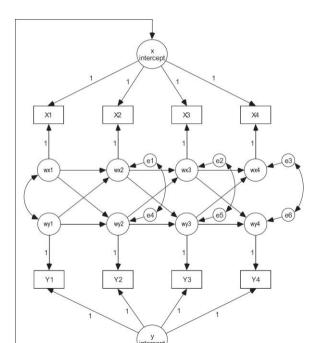
- ► The RICLPM was introduced by [Hamaker et al. (2015)](#) as an improvement over the cross-lagged panel model.
- ► The RICLPM includes a random intercept for each variable (i.e., a factor with all $\lambda = 1$), representing the subject's mean on each variable over time.
- ► This strategy is close to fitting a CLPM on within-person centered variables, i.e., after removing the trait. However, it has two important advantages
  - ► Within-person effects (auto-regressive, cross-lagged and contemporaneous) are estimated separately from between-person effects.
  - ► Estimates of between-person effects are available (i.e., correlations among random intercepts), whereas they are missing in the CLPM.
- ► The CLPM is nested under the RICLPM, thus they can be compared using a chi-square test.
- ► **Three or more** waves are needed to fit it.

RICLPM

RICLPM

Estimating a RICLPM in lavaan

We will use data made freely available by [Jeroen Mulder and Ellen Hamaker](#) in the companion website of their [2021 paper](#) introducing extensions of the RICLPM. This tutorial is slightly adapted from their website, which also includes many more extensions. I strongly advise to check the website and the papers by [Hamaker (2015)](#) and [Mulder & Hamaker (2021)](#) if you are interested.

RICLPM in lavaan

Lavaan

The most time-consuming part is to specify the "model" in lavaan language. This requires creating is a long textual variable, in which each line indicates a relationship between some of the variables.

Different types of relationships correspond to different symbols

- ▶ $=\sim$ for factor loadings: Factor $=\sim X_1 + X_2 + X_3$.
- ▶ $\sim$ for regressions: $Y \sim X$, or also (quicker option) $Y_2 + X_2 \sim X_1 + Y_1$, to indicate separate regressions in which each of the variable at the left of the $\sim$ is predicted by each variable on the right.
- ▶ $\sim\sim$ for covariances: $X_1 \sim\sim Y_1$
- ▶ A number before a coefficient indicates that the coefficient is not estimated, but constrained to that value. E.g., Factor $=\sim 1 * X_1 + 1 * X_2 + 1 * X_3$ constrains loadings to 1.

Fitting a RICLPM in four steps

1. Load packages, import data
2. Specify random intercepts (between-person/trait part of variables)
3. Specify within-person variation from the random intercepts (within-person/state part of variables).
4. Specify lagged effects involving states (auto-regressive and cross-lagged regressions)
5. Specify covariances at the between-person and within-person contemporaneous levels.

0. Import data

We can import data directly from GitHub. We have five observations of two variables, $X1, ..., X5$ and $Y1, ..., Y5$ These are simulated data, but you can imagine that they represent X = anxiety and Y = EC effect

```r
# packages
if(!require("pacman")) install.packages("pacman")
pacman::p_load("lavaan", "semPlot", "dplyr")

# data
dat <- read.table("https://raw.githubusercontent.com/Jeroe
                  col.names = c("x1", "x2", "x3", "x4", "x

# if you have to write it manually, you can use the shorte
dat <- read.table("https://bit.ly/3qarvJN",
                  col.names = c("x1", "x2", "x3", "x4", "x
```

0. Data must be in wide format
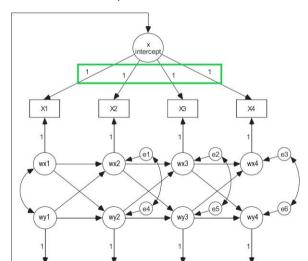
Data must be in wide format: Each line represents a participant and each variable represents the observation of a variable for that participant in a certain timepoint.

```
head(dat)
```

```
##           x1        x2        x3        x4        x5
## 1  0.146118  0.101487  0.293875  0.179214  0.101160 -0.0
## 2  0.199538  0.174609  0.245947  0.311929  0.345243  0.4
## 3 -0.236111  0.186394 -0.150179 -0.280665 -0.294195 -0.0
## 4  0.418547  0.010475  0.087123  0.202448  0.190860  0.3
## 5  0.257057  0.274397  0.173706  0.144743  0.149408  0.6
## 6  0.757936  0.161540 -0.056032 -0.020761  0.188245  0.0
##         y4        y5
## 1 0.053864 -0.060264
## 2 0.246816  0.281764
## 3 0.525106  0.171506
## 4 0.518664  0.322222
## 5 0.700347  0.502234
```

1. Random intercepts

Random intercepts represent the subject's mean on each variable over time. In this case, we have two variables and five observations for each variable ($x_1, ..., x_5$ and $y_1, ..., y_5$), thus we have two factors and five indicators, with all $\lambda = 1$.
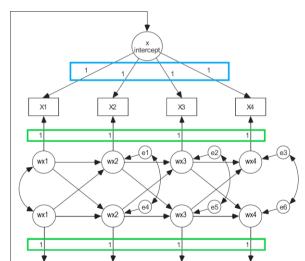
1. Random intercepts in lavaan

They are factors, and thus need to be specified with symbol =~
The ones multiplied before each indicator have the effect of constraining the loadings to 1.

The resulting RI_x and RI_y represent an average score (since all $\lambda = 1$) of each subject in each variable over time, thus a proxy of the stable/trait portion of the variable.

```
RICLPM <-'
  RIx =~ 1*x1 + 1*x2 + 1*x3 + 1*x4 + 1*x5
  RIy =~ 1*y1 + 1*y2 + 1*y3 + 1*y4 + 1*y5
'
```

2. within-person components

The within-person components represent the residual of each observed variable with respect to the random intercept, i.e., within-person centered variables, or, conceptually, the state variation from the stable trait level.
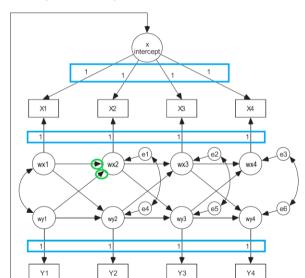
2. within-person components

They are also factors, and their values are also constrained to 1, but this time each "factor" only has one indicator.

```
RICLPM <-'
 # ...
 # text to include after the previous part of the model

  wx1 =~ 1*x1
  wx2 =~ 1*x2
  wx3 =~ 1*x3
  wx4 =~ 1*x4
  wx5 =~ 1*x5
  wy1 =~ 1*y1
  wy2 =~ 1*y2
  wy3 =~ 1*y3
  wy4 =~ 1*y4
  wy5 =~ 1*y5
'
```

3.Lagged effects

All within-person centered variables at time 2 are predicted by
those at Time1, Time3 is predicted by Time 2 and so on. Time 1
is not predicted by other variables .

3. Lagged effects in lavaan

These are regressions involving the within-person centered variables, and they can be specified with the ~symbol.
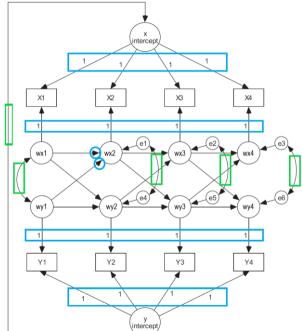
```
RICLPM <-'
 # ...
 # text to include after the previous part of the model

  wx2 + wy2 ~ wx1 + wy1
  wx3 + wy3 ~ wx2 + wy2
  wx4 + wy4 ~ wx3 + wy3
  wx5 + wy5 ~ wx4 + wy4
'
```

4. Covariances/correlations (1)

There are three types of covariances (which can be later standardized as correlations):

- ► Those involving between-person effects
- ► Those involving within-person variables at Time1 (typically not that interesting)
- ► Those involving within-person variables at other times (contemporaneous effects, estimated after controlling for lagged effects).

4. Covariances/correlations (2)

4. Covariances/correlations (3)

Why considering mainly contemporaneous covariances/correlations on residuals of lagged effects, and not those at Time 1?

Autoregressive and cross-lagged effects are generally more interesting and powerful than contemporaneous ones: Predicting what will happen in the future from information from the past is generally more interesting than predicting what happens to a variable at the same time you observe predictors.

Why are contemporaneous correlations interesting, if we are interested in how phenomena unfold over time?

The possibility of lagged predictions depends on the temporal resolution. What if a process happens in seconds and you can only sample variables at intervals of several hours? The associations will (mostly) show up as contemporaneous ones (see e.g., Epskamp (2018))

4. Correlations in lavaan

Correlations can be specified via the symbol ~~

```
RICLPM <-'
 # ...
 # text to include after the previous part of the model

  # Contemporaneous covariance at Time 1.
  wx1 ~~ wy1 # Covariance

  # Contemporaneous covariances (at Times 2, 3, 4, and 5)
  wx2 ~~ wy2
  wx3 ~~ wy3
  wx4 ~~ wy4
  wx5 ~~ wy5

  # between-person correlations
  RIx ~~ RIx
  RIy ~~ RIy
  RIx ~~ RIy
```

One last step

Lavaan requires to manually specify that the model also includes variances for within-person centered variables. A variance is just a correlation (~~) of a variable with itself.

These include variances for each Time 1 observation, and residual variances for Time 2, 3, 4, 5 observations.

```
RICLPM <-'
 # ...
 # text to include after the previous part of the model

  wx1 ~~ wx1 # Variances
  wy1 ~~ wy1
  wx2 ~~ wx2 # Residual variances
  wy2 ~~ wy2
  wx3 ~~ wx3
  wy3 ~~ wy3
  wx4 ~~ wx4
  wy4 ~~ wy4
```

Fitting the model

If you need to refresh lavaan, you can check [this page](#)

```
RICLPM.fit <- lavaan(RICLPM, # the model
                     data = dat, # the data
                     missing = 'ML', # how you treat missi
                     meanstructure = TRUE, # whether you w
                     # but also mean levels of variables
                     int.ov.free = TRUE # whether to estim
                     )
```

Interpreting the results

Extracting the results

Using command summary, you can get all parameter estimates and fit indices.

```
summary(RICLPM.fit, standardized = TRUE, fit = TRUE)
```

Convergence and fit measures

The chi-square test is not significantly different from zero. This is not surprising, since the data are simulated from a RICLPM.

```
lavaan 0.6-11 ended normally after 115 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        44

  Number of observations                          1189
  Number of missing patterns                         1

Model Test User Model:

  Test statistic                                25.806
  Degrees of freedom                                21
  P-value (Chi-square)                           0.214
```

Fit indices

You get indices such as CFI, TLI, RMSEA, SRMR, Information criteria

```
User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    0.998
  Tucker-Lewis Index (TLI)                       0.997

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)                531.750
  Loglikelihood unrestricted model (H1)        544.652

  Akaike (AIC)                                -975.499
  Bayesian (BIC)                              -751.941
  Sample-size adjusted Bayesian (BIC)         -891.701

Root Mean Square Error of Approximation:

  RMSEA                                          0.014
  90 Percent confidence interval - lower         0.000
  90 Percent confidence interval - upper         0.030
  P-value RMSEA <= 0.05                           1.000

Standardized Root Mean Square Residual:

  SRMR                                           0.014
```

Parameter estimates - loadings (1)

Loadings are not very interesting in this case, since they are fixed.

```
Latent Variables:
                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  RIx =~
    x1               1.000                               0.096    0.390
    x2               1.000                               0.096    0.473
    x3               1.000                               0.096    0.475
    x4               1.000                               0.096    0.461
    x5               1.000                               0.096    0.465
  RIy =~
    y1               1.000                               0.178    0.569
    y2               1.000                               0.178    0.558
    y3               1.000                               0.178    0.535
    y4               1.000                               0.178    0.525
    y5               1.000                               0.178    0.533
```

Parameter estimates - loadings (2)

Loadings are not very interesting in this case, since they are fixed.

```
Latent Variables:
                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all

  wx1 =~
    x1               1.000                               0.227    0.921
  wx2 =~
    x2               1.000                               0.179    0.881
  wx3 =~
    x3               1.000                               0.178    0.880
  wx4 =~
    x4               1.000                               0.185    0.887
  wx5 =~
    x5               1.000                               0.183    0.885
  wy1 =~
    y1               1.000                               0.257    0.822
  wy2 =~
    y2               1.000                               0.265    0.830
  wy3 =~
    y3               1.000                               0.281    0.845
  wy4 =~
    y4               1.000                               0.288    0.851
  wy5 =~
    y5               1.000                               0.282    0.846
```

Autoregressive and cross-lagged effects

Here we can examine both autoregressive and cross-lagged effects.

```
Regressions:
                  Estimate  Std.Err  z-value  P(>|z|)  Std.lv  Std.all
  wx2 ~
    wx1             0.232    0.028    8.314    0.000    0.294    0.294
    wy1             0.009    0.026    0.329    0.742    0.012    0.012
  wy2 ~
    wx1             0.174    0.045    3.888    0.000    0.149    0.149
    wy1             0.004    0.046    0.092    0.927    0.004    0.004
  wx3 ~
    wx2             0.241    0.037    6.509    0.000    0.242    0.242
    wy2             0.026    0.024    1.082    0.279    0.039    0.039
  wy3 ~
    wx2             0.156    0.054    2.871    0.004    0.099    0.099
    wy2             0.262    0.039    6.747    0.000    0.247    0.247
  wx4 ~
    wx3             0.279    0.038    7.267    0.000    0.269    0.269
    wy3             0.010    0.023    0.431    0.666    0.015    0.015
  wy4 ~
    wx3             0.185    0.055    3.367    0.001    0.114    0.114
    wy3             0.296    0.035    8.362    0.000    0.288    0.288
  wx5 ~
    wx4             0.290    0.035    8.244    0.000    0.293    0.293
    wy4            -0.004    0.022   -0.186    0.852   -0.006   -0.006
  wy5 ~
    wx4             0.124    0.048    2.612    0.009    0.082    0.082
    wy4             0.392    0.031   12.644    0.000    0.400    0.400
```

Autoregressive effects of X

X has always a significant autoregressive effect, indicating some
stability of within-person centered fluctuations over time. If you
tend to have higher level of X than usual at Time t, you are also
likely to have higher level of X at Time $t + 1$.

Regressions:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
wx2 ~						
wx1	0.232	0.028	8.314	0.000	0.294	0.294
wy1	0.009	0.026	0.329	0.742	0.012	0.012
wy2 ~						
wx1	0.174	0.045	3.888	0.000	0.149	0.149
wy1	0.004	0.046	0.092	0.927	0.004	0.004
wx3 ~						
wx2	0.241	0.037	6.509	0.000	0.242	0.242
wy2	0.026	0.024	1.082	0.279	0.039	0.039
wy3 ~						
wx2	0.156	0.054	2.871	0.004	0.099	0.099
wy2	0.262	0.039	6.747	0.000	0.247	0.247
wx4 ~						
wx3	0.279	0.038	7.267	0.000	0.269	0.269
wy3	0.010	0.023	0.431	0.666	0.015	0.015
wy4 ~						
wx3	0.185	0.055	3.367	0.001	0.114	0.114
wy3	0.296	0.035	8.362	0.000	0.288	0.288
wx5 ~						
wx4	0.290	0.035	8.244	0.000	0.293	0.293
wy4	-0.004	0.022	-0.186	0.852	-0.006	-0.006
wy5 ~						
wx4	0.124	0.048	2.612	0.009	0.082	0.082
wy4	0.392	0.031	12.644	0.000	0.400	0.400

Autoregressive effects of Y

Y has a significant autoregressive effect at all timepoints but
$Y_t 1 \rightarrow Y_t 2$

```
Regressions:
                   Estimate  Std.Err  z-value  P(>|z|)  Std.lv  Std.all
  wx2 ~
    wx1              0.232    0.028    8.314    0.000    0.294   0.294
    wy1              0.009    0.026    0.329    0.742    0.012   0.012
  wy2 ~
    wx1              0.174    0.045    3.888    0.000    0.149   0.149
    wy1              0.004    0.046    0.092    0.927    0.004   0.004
  wx3 ~
    wx2              0.241    0.037    6.509    0.000    0.242   0.242
    wy2              0.026    0.024    1.082    0.279    0.039   0.039
  wy3 ~
    wx2              0.156    0.054    2.871    0.004    0.099   0.099
    wy2              0.262    0.039    6.747    0.000    0.247   0.247
  wx4 ~
    wx3              0.279    0.038    7.267    0.000    0.269   0.269
    wy3              0.010    0.023    0.431    0.666    0.015   0.015
  wy4 ~
    wx3              0.185    0.055    3.367    0.001    0.114   0.114
    wy3              0.296    0.035    8.362    0.000    0.288   0.288
  wx5 ~
    wx4              0.290    0.035    8.244    0.000    0.293   0.293
    wy4             -0.004    0.022   -0.186    0.852   -0.006  -0.006
  wy5 ~
    wx4              0.124    0.048    2.612    0.009    0.082   0.082
    wy4              0.392    0.031   12.644    0.000    0.400   0.400
```

Cross-laggede effects X -> Y

X positively predicts Y at subsequent timepoints.

```
Regressions:
                    Estimate  Std.Err  z-value  P(>|z|)  Std.lv   Std.all
  wx2 ~
    wx1               0.232    0.028    8.314    0.000    0.294    0.294
    wy1               0.009    0.026    0.329    0.742    0.012    0.012
  wy2 ~
    wx1               0.174    0.045    3.888    0.000    0.149    0.149
    wy1               0.004    0.046    0.092    0.927    0.004    0.004
  wx3 ~
    wx2               0.241    0.037    6.509    0.000    0.242    0.242
    wy2               0.026    0.024    1.082    0.279    0.039    0.039
  wy3 ~
    wx2               0.156    0.054    2.871    0.004    0.099    0.099
    wy2               0.262    0.039    6.747    0.000    0.247    0.247
  wx4 ~
    wx3               0.279    0.038    7.267    0.000    0.269    0.269
    wy3               0.010    0.023    0.431    0.666    0.015    0.015
  wy4 ~
    wx3               0.185    0.055    3.367    0.001    0.114    0.114
    wy3               0.296    0.035    8.362    0.000    0.288    0.288
  wx5 ~
    wx4               0.290    0.035    8.244    0.000    0.293    0.293
    wy4              -0.004    0.022   -0.186    0.852   -0.006   -0.006
  wy5 ~
    wx4               0.124    0.048    2.612    0.009    0.082    0.082
    wy4               0.392    0.031   12.644    0.000    0.400    0.400
```

Cross-laggede effects Y -> X

Y never significantly predicts X at subsequent timepoints.

```
Regressions:
                Estimate  Std.Err  z-value  P(>|z|)  Std.lv  Std.all
  wx2 ~
    wx1          0.232    0.028    8.314    0.000    0.294   0.294
    wy1          0.009    0.026    0.329    0.742    0.012   0.012
  wy2 ~
    wx1          0.174    0.045    3.888    0.000    0.149   0.149
    wy1          0.004    0.046    0.092    0.927    0.004   0.004
  wx3 ~
    wx2          0.241    0.037    6.509    0.000    0.242   0.242
    wy2          0.026    0.024    1.082    0.279    0.039   0.039
  wy3 ~
    wx2          0.156    0.054    2.871    0.004    0.099   0.099
    wy2          0.262    0.039    6.747    0.000    0.247   0.247
  wx4 ~
    wx3          0.279    0.038    7.267    0.000    0.269   0.269
    wy3          0.010    0.023    0.431    0.666    0.015   0.015
  wy4 ~
    wx3          0.185    0.055    3.367    0.001    0.114   0.114
    wy3          0.296    0.035    8.362    0.000    0.288   0.288
  wx5 ~
    wx4          0.290    0.035    8.244    0.000    0.293   0.293
    wy4         -0.004    0.022   -0.186    0.852   -0.006  -0.006
  wy5 ~
    wx4          0.124    0.048    2.612    0.009    0.082   0.082
    wy4          0.392    0.031   12.644    0.000    0.400   0.400
```

Contemporaneous correlations

X and Y also show positive contemporaneous correlations, indicating that if someone has higher levels of X than usual, one will also likely have higher level of Y than usual at the same timepoint.

```
Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  wx1 ~~
    wy1               0.021    0.002    9.372    0.000    0.364    0.364
 .wx2 ~~
   .wy2               0.009    0.002    5.168    0.000    0.196    0.196
 .wx3 ~~
   .wy3               0.013    0.002    7.837    0.000    0.274    0.274
 .wx4 ~~
   .wy4               0.013    0.002    8.177    0.000    0.277    0.277
 .wx5 ~~
   .wy5               0.007    0.001    4.916    0.000    0.160    0.160
  RIx ~~
    RIy               0.010    0.001    7.992    0.000    0.587    0.587
```

Between-person correlations

X and Y also show a positive between-person correlation, indicating that individuals who have typically higher values of X also have higher values of Y.

Covariances:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
wx1 ~~						
wy1	0.021	0.002	9.372	0.000	0.364	0.364
.wx2 ~~						
.wy2	0.009	0.002	5.168	0.000	0.196	0.196
.wx3 ~~						
.wy3	0.013	0.002	7.837	0.000	0.274	0.274
.wx4 ~~						
.wy4	0.013	0.002	8.177	0.000	0.277	0.277
.wx5 ~~						
.wy5	0.007	0.001	4.916	0.000	0.160	0.160
RIx ~~						
RIy	0.010	0.001	7.992	0.000	0.587	0.587

Now you

- ► Fit a CLPM using the same data. Tip: you only need to remove some parts from the RICLPM model.
- ► Compare the fit of the two RICLPM and CLPM, using the command anova(model1, model2). Which model fits the data better?
- ► Do cross-lagged relationships between X and Y change? If so, why do you think that this happened?

Solution (1)

```
CLPM <- '
  # Random intercepts are removed
  # RIx =~ 1*x1 + 1*x2 + 1*x3 + 1*x4 + 1*x5
  # RIy =~ 1*y1 + 1*y2 + 1*y3 + 1*y4 + 1*y5

  # within-person components can be retained
  wx1 =~ 1*x1
  wx2 =~ 1*x2
  wx3 =~ 1*x3
  wx4 =~ 1*x4
  wx5 =~ 1*x5
  wy1 =~ 1*y1
  wy2 =~ 1*y2
  wy3 =~ 1*y3
  wy4 =~ 1*y4
  wy5 =~ 1*y5

'
```

Solution (2)

```
CLPM <- '
  # ... insert this after the first part of the model

  # Lagged regressions are retained
  wx2 + wy2 ~ wx1 + wy1
  wx3 + wy3 ~ wx2 + wy2
  wx4 + wy4 ~ wx3 + wy3
  wx5 + wy5 ~ wx4 + wy4

  # Contemporaneous covariance at Time 1 is retained
  wx1 ~~ wy1 # Covariance

  # Contemporaneous covariances (at Times 2, 3, 4, and 5)
  wx2 ~~ wy2
  wx3 ~~ wy3
  wx4 ~~ wy4
  wx5 ~~ wy5
'
```

Solution (3)

```
CLPM <- '
  # ... insert this after the first part of the model

  # between-person covariances are removed
  # RIx ~~ RIx
  # RIy ~~ RIy
  # RIx ~~ RIy

  # (Residual) variances are retained
  wx1 ~~ wx1 # Variances
  wy1 ~~ wy1
  wx2 ~~ wx2 # Residual variances
  wy2 ~~ wy2
  wx3 ~~ wx3
  wy3 ~~ wy3
  wx4 ~~ wx4
  wy4 ~~ wy4
  wx5 ~~ wx5
```

Solution (4)

Code for fitting the lavaan model is the same, but with different model and output names.

```
CLPM.fit <- lavaan(CLPM, # the model
                   data = dat, # the data
                   missing = 'ML',  # how you treat missi
                   meanstructure = TRUE, # whether you w
                   int.ov.free = TRUE # whether to estim
                   )
```

Solution (5)

Unsurprisingly, the RICLPM fits the data better. Remember that data are simulated from the RICLPM!

```
anova(CLPM.fit, RICLPM.fit)

## Chi-Squared Difference Test
##
##             Df     AIC     BIC  Chisq Chisq diff Df dif
## RICLPM.fit  21 -975.50 -751.94  25.806
## CLPM.fit    24 -805.08 -596.76 202.225      176.42
## ---
## Signif. codes:  0 '**' 0.001 '*' 0.01 '*' 0.05 '.' 0.
```

Solution (6)

```
summary(CLPM.fit, standardized = TRUE)
```

```
## lavaan 0.6-12 ended normally after 112 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        41
##
##   Number of observations                          1189
##   Number of missing patterns                         1
##
## Model Test User Model:
##
##   Test statistic                               202.225
##   Degrees of freedom                                24
##   P-value (Chi-square)                           0.000
##
## Parameter Estimates:
```

Solution (7)

Now, cross-lagged effects of both $X \to Y$ and $Y \to X$ are present. If trait stability is not correctly accounted for, it can distort estimates of other effects!

Regressions:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
wx2 ~						
wx1	0.321	0.023	13.743	0.000	0.392	0.392
wy1	0.061	0.019	3.269	0.001	0.093	0.093
wy2 ~						
wx1	0.151	0.038	3.965	0.000	0.117	0.117
wy1	0.325	0.030	10.684	0.000	0.314	0.314
wx3 ~						
wx2	0.388	0.028	13.991	0.000	0.389	0.389
wy2	0.055	0.017	3.135	0.002	0.087	0.087
wy3 ~						
wx2	0.200	0.043	4.605	0.000	0.122	0.122
wy2	0.466	0.027	17.015	0.000	0.451	0.451
wx4 ~						
wx3	0.414	0.029	14.368	0.000	0.403	0.403
wy3	0.047	0.018	2.666	0.008	0.075	0.075
wy4 ~						
wx3	0.197	0.044	4.438	0.000	0.118	0.118
wy3	0.481	0.027	17.746	0.000	0.470	0.470
wx5 ~						
wx4	0.423	0.028	15.120	0.000	0.425	0.425
wy4	0.025	0.017	1.450	0.147	0.041	0.041
wy5 ~						
wx4	0.153	0.040	3.795	0.000	0.096	0.096
wy4	0.537	0.025	21.691	0.000	0.549	0.549

Some final remarks

Extensions

Mulder & Hamaker (2021) have proposed several extensions, that can be very useful:

- ► Including other between-person variables as predictors or outcomes.
- ► Multi-group version of the RICLPM.
- ► Including multiple indicators for X and Y.

Other straightforward extensions:

- ► Including three or more variables.
- ► Constraining relationships to be equal at different timepoints. This simplifies the model a lot in terms of number of parameter that one needs to estimate.

An open discussion

Some have criticized the RICLPM and supported the CLPM instead.

- ► Ludtke & Robitzsch (2021), A critique of the Random Intercept Cross-Lagged Panel Model, preprint
- ► Orth et al. (2021). Testing Prospective Effects in Longitudinal Research: Comparing Seven Competing Cross-Lagged Models. JPSP.

Others support the RICLPM

- ► Uli Shimmack (2022), Why Most Cross-Lagged Models Are False, blog post
- ► Richard Lucas (2022), It's time to abandon the CLPM, preprint

I think that the RICLPM is clearly a better model when traits are involved. What convinces me the most (more than simulations) is that the RICLPM offers a more plausible model of trait-like phenomena, in line with current (and convincing) views of personality (Fleeson & Jayawickrome, 2015)

Acknowledgements

Most of this presentation is based on the wonderful page by Jeroen Mulder and Ellen Hamaker.

https://jeroendmulder.github.io/RI-CLPM/index.html
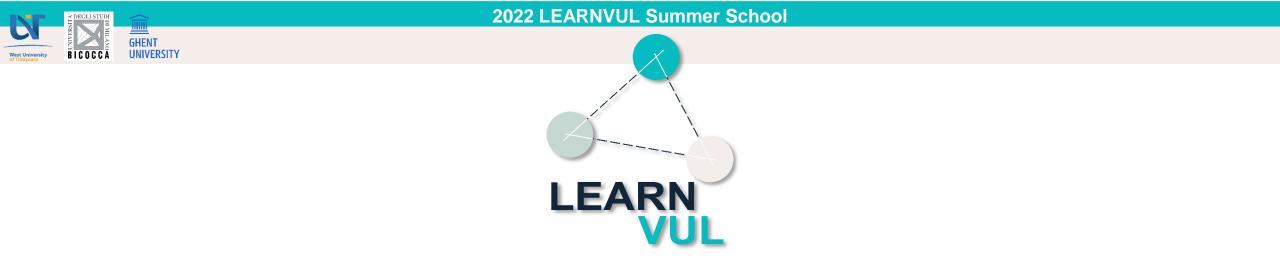
Thank you for your attention!

Dealing with Skin Conductance and Heart rate for psychophysiological measurements.
Experimental designs, data pre-processing, and data analyses

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What is a psychophysiological measure

- Definition: Psychophysiological measures are **physiological responses of human body to psychological manipulations**

Why psychophisiological mesurments

Objectivity: By means of objectivity it's possible to make assessments that do not depend on the user's will.

Multidimensionality: Multidimensional measures are able to provide different faces of user state.

Unobtrusiveness: Although psychophysiological measures require the placement of electrodes on the body, they don't directly interfere with user tasks like "secondary task measures".

Implicitness: psychophysiological measures do not require the measurement of overt performance

Continuity and Responsiveness: Psychophysiological measures are continuous signals and therefore they can be used in real-time. They allow researchers to examine both short-term (phasic) and long-term (tonic) bodily reactions.

Why not

Special Equipment: Psychophysiological signals are measured by using special equipments and these equipments may be costly. The selection and correct placement of them are crucial to acquire noise free data.

Data Acquisition and Interpretation: Psychophysiological measures are mostly weak electrical signals and may be highly susceptible to noise. They are very vulnerable to confounding factors like ambient lightning (pupil dilation), power grid (ERP), and body movement (ECG).
Data interpretation is another problem because of a large amount of hard-to-analyze data.

Unnaturalness: Electrodes are attached to user by cables and this causes the user movements to be constrained and break the naturalness of the interaction

Which measure?

| Measures	Diagnosticity & Sensitivity	Strengths & Weaknesses
Event Related Brain Potentials (ERP)	• The P300 component is sensitive to variations in mental workload [5]. • ERP has a high temporal precision and sensitive to phasic and stimulus or response-related changes.	• ERP is sensitive to electrical fields produced by other physiological systems such as heart, eyes and muscles.
Electroencephalography (EEG)	• EEG is able to determine low or high perceptual and cognitive processes [2]. It can also be used to monitor the state of alertness and task engagement [5, 19]. • It has a high temporal precision and sensitive to phasic and tonic changes [3, 5].	• Very sensitive to biological and electrostatic artifacts as well as hardware related interferences (electrodes) and it's not very suitable for user experience evaluation [2].
Electro Dermal Activity (EDA)/Galvanic Skin Response (GSR)	• GSR is linearly correlated with arousal [2]. It's also a measure of stress [1] and frustrations [4]. • Its temporal sensitivity is poor, only tonic changes [3, 4, 5]	• Less sensitive to noise and less ambiguous than facial muscle (facial EMG) and heart activity (ECG) [3].
Cardiovascular Measures/Heart Rate (HR) and Heart Rate Variability (HRV)	• HR is sensitive to cognitive demands, time restrictions or uncertainty [19]. It's also sensitive to attention and correlated with arousal [1] • HRV is used as a measure of mental workload [1]. It also is used for assessing the positive or negative valence of an experience [2].	• Because the heart and circulatory system is regulated by many different bodily processes, interpreting the signal's relevance to the game context can be challenging [3].
Blood Pressure (BP)	• BP tends to increase under conditions of active coping and patterns of ECG and BP may be used to differentiate between humans in a state of challenge and a state of threat [19]	• It may be used in the evaluation of critical system interfaces and the design of computer games.
Electromyogram (EMG)	• EMG is a good indicator of motor preparation for movements [19]. • Facial EMG is able to identify emotional valence [1].	• EMG is sensitive to noise such that bad contact between skin and electrodes and confounding sources of muscle activity, speaking and other social communication [1].
Eye Movements (fixations, saccades, gaze and blinks)	• Eye blink rates and duration yield meaningful information about task demands and level of fatigue [19]. • Eye gaze is a direct measure of cognitive interest [9].	• It's a good metric for interface evaluation and usability testing.
Pupil Diameter	• Pupil dilation is corralled with mental workload [2]. • It's an index of global changes in information processing [5]. • It also responds to emotional valance [19].	• Hard to apply in practical context because eye reacts to different light conditions, which almost impossible to anticipate and difficult to calculate outside of the controlled environments [2].
Respiration	• It's a measure of task demands [19]. It's also used for negative valance and arousal [1].	• Respiration changes affect EDA and cardiac measures. This change can be controlled using appropriate preparation and analysis steps within a well controlled setting [1].
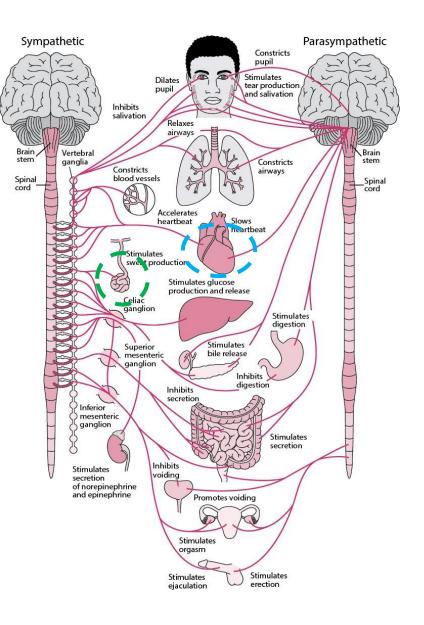
Dirican, A. C., & Göktürk, M. (2011). Psychophysiological measures of human cognitive states applied in human computer interaction. *Procedia Computer Science*, *3*, 1361-1367.

Autonomous nervous System

Activation or deactivation
of the autonomous
nervous system:
AROUSAL RESPONSE.

Skin Conductance (SC)

Disclamer

I tried to create a BRAND-FREE presentation, but keep in mind that every physiological measure is intrinsically entangled with its specific brand production.
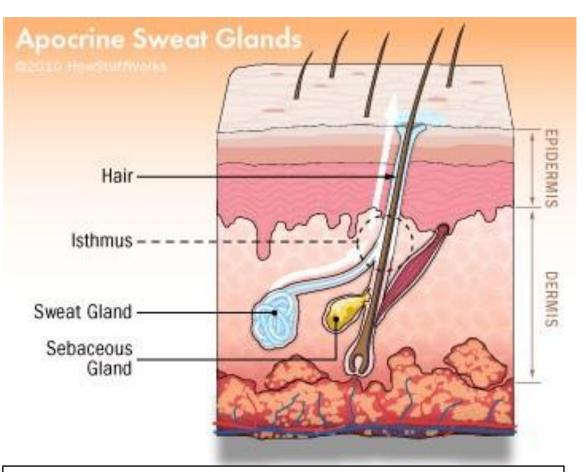
What is it

•A momentary change in the electrical potential of the skin that can be evoked by a wide variety of stimuli generated internally or applied externally to the body (Deltombe et al. 1998).

•Under normal conditions, whenever the skin's sympathetic nervous system is activated, the sweat glands fill up, the skin's resistance is reduced and consequently skin conductance increases (Edelberg, 1967; Christie, 1981).

Apocrine Sweat Glands
@2010 HowStuffWorks

Hair

Isthmus

Sweat Gland

Sebaceous Gland

EPIDERMIS

DERMIS

ALERT!! Skin Conductance Response (SCR) = Galvanic Skin Response (GSR) = Sympatetyc Skin Response (SSR) = Electrodermal Activity (EDA)
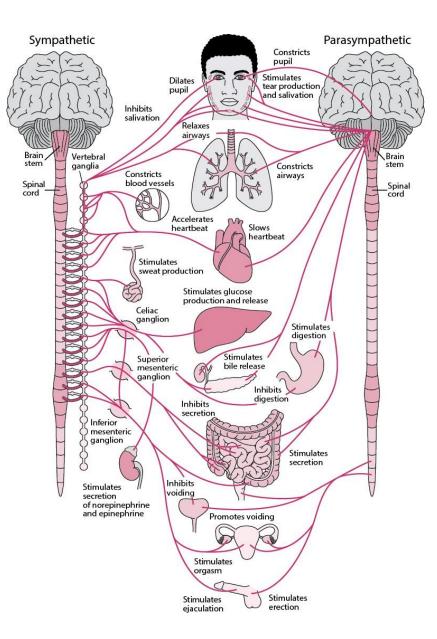
Neurophysiological mechanisms

•Electrodermal responses are automatic responses mediated by the sympathetic division of the autonomic nervous system

•The autonomic nervous system is that part of the peripheral nervous system that regulates the visceral functions of the body and is made up of a network of fibers and cells widely distributed in the body

•The autonomic nervous system innervates three types of tissue: glands, smooth muscle, and heart muscle. More precisely, it innervates the secretory glands, heart and blood vessels.
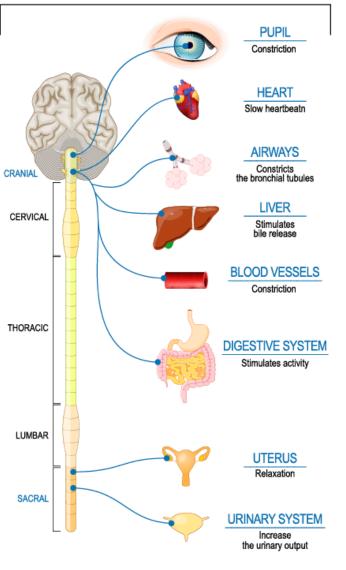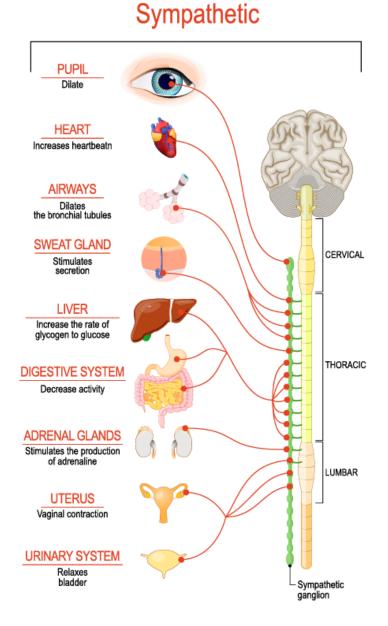
The **parasympathetic** system is responsible for stimulation of "rest-and-digest" or "feed and breed", activities that occur when the body is at rest, especially after eating, including sexual arousal, salivation, lacrimation (tears), urination, digestion, and defecation.

The **sympathetic** division organizes the involuntary responses that prepare for situations of maximum effort, flight reactions and alertness.

The first observation about the existence of a relationship between psychological factors and electrodermal phenomena was attributed to Romain Vigouroux (1879)

The afferent conduction time is short and mediated by large diameter myelinated fibers.
The overall latency is determined primarily by central stimulus processing time and efferent transmission.

- **LESIONAL STUDY (Tranel and Damasio 1994; 1989)**
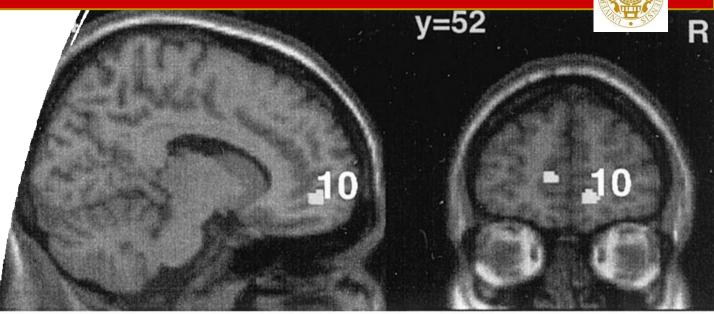
The generation of a normal SCR is impaired in the case of a damaged dorsomedial frontal region associated with damage to the anterior cingulate gyrus and dorsolateral prefrontal regions.
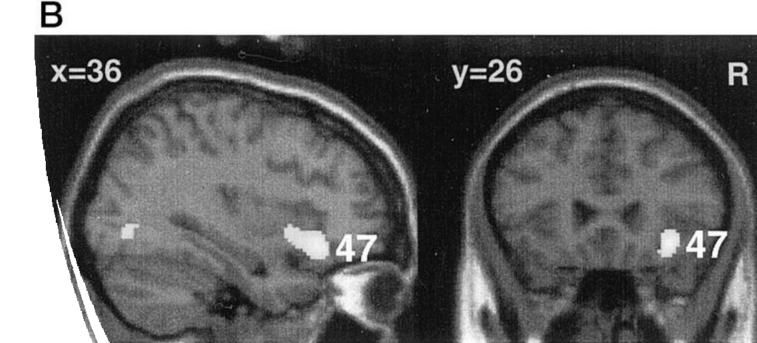
Extensive injuries to the inferior parietal lobe and anterior cingulate cortex can also cause similar consequences

- **fMRI STUDY (Critchley, Elliot, Mathias and Dolan 2000)**
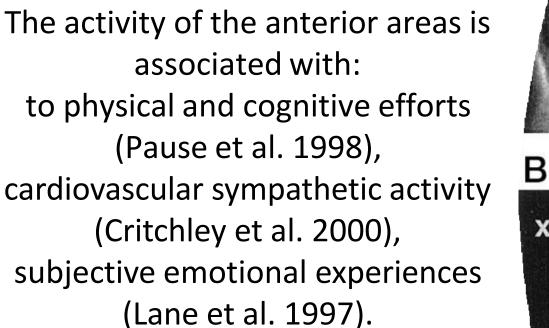
The genesis of the SCR is associated with prefrontal areas, while extra-striated areas and the inferior parietal lobe would have an attentional orientation role.

The same areas are also correlated with cardiovascular sympathetic activation (Critchley et al., 2000; Oppenheimer et al. 1992).

The activity of the anterior areas is associated with:
to physical and cognitive efforts (Pause et al. 1998),
cardiovascular sympathetic activity (Critchley et al. 2000),
subjective emotional experiences (Lane et al. 1997).
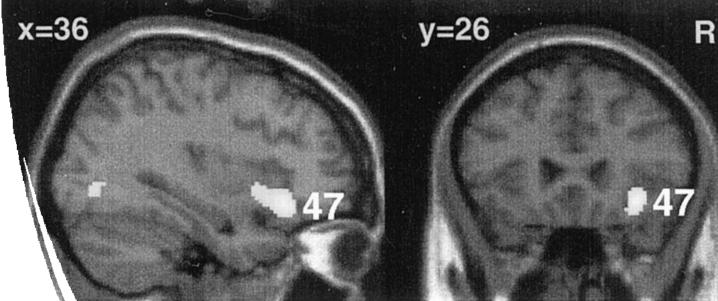
- Pavlov (1927) described a generalized state of excitement which can be elicited by an unexpected exogenous stimulus.

•Sokolov (1960) initially redefined this state of arousal as a manifestation of a more generalized orientation response (OR) and later (1975) extended the concept to also include a more focal orientation response, of which the skin conductance response is the main component (Boucsein, 1992).

- Jung (1904) considered the SCR as an index of mental processes.

•From his word association experiments, it emerged that all mental events - thoughts, ideas, fantasies - could be explored electrophysiologically, without the need for a verbal reference.

Attraction for the possibility of using this method to verify the statements of witnesses in trial contexts (Neumann & Blanton, 1970).

Electrodermal responses were considered as "Lie detector" of the Guilty Knowledge Test (Lykken, 1959,1974,1979)
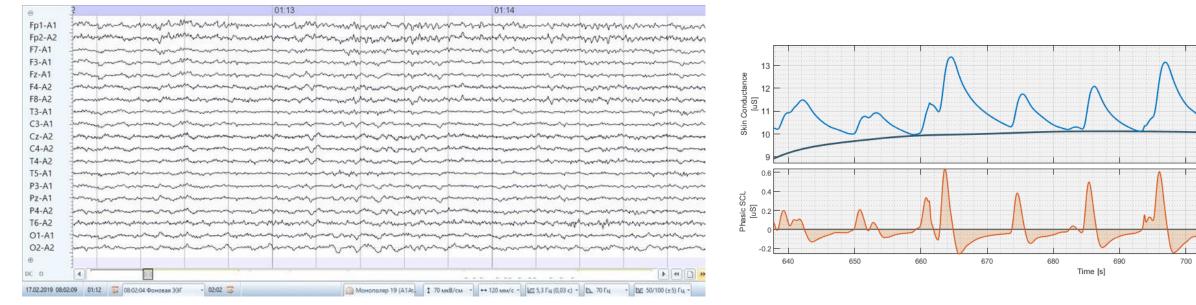
Psychogalvanic responses, on a morphological level, are represented by simple curves: generally biphasic or triphasic, less frequently monophasic.

EEG Signal

EDA Signal
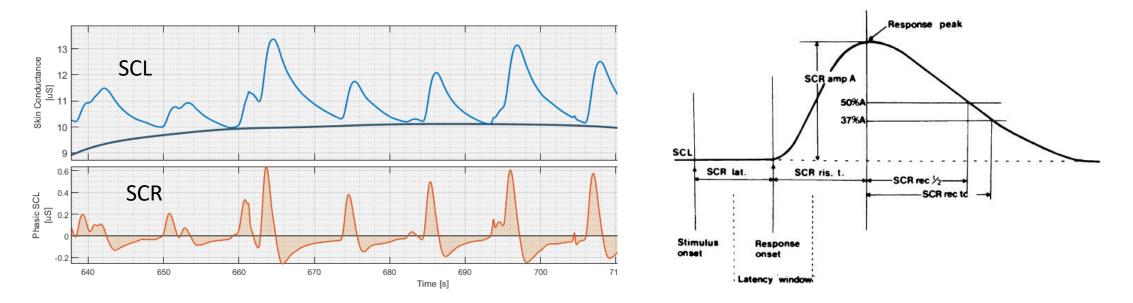
typically it is decomposed into 2 types of waves:

the tone: relatively constant which would reflect the individual's general state of activation (SCL)

the phase: more influenced by events and able to represent event-related fluctuations (SCR)

Each SCR is charachterised by several potential parameters (amplitude, latency, slope, polarity,…).

Better Safe than Sorry Tips

Large intra- e inter-individual **Variability**

Either for the latency (1-3 sec), and the amplitude (3,1 +/- 1,8 mV), **even at rest** (Elie e Guiheneuc 1990)

Quick **Habituation** to constant stimuli

Significant reduction of SCR in 15-20 minutes at constant situation (Levinson e Edelberg 1985; Baba et al. 1988; Elie e Guiheneuc 1990)

Bodily **temperature** (Deltombe 1998)

- Latency is negatively correlated to bodily temperature
- Amplitude is positively correlated to temperature

Age dependent (Drory e Korczyn 1993)

Age progressively reduces the amplitude of the SCR from 60 years old.

Intraday Fluctuations.
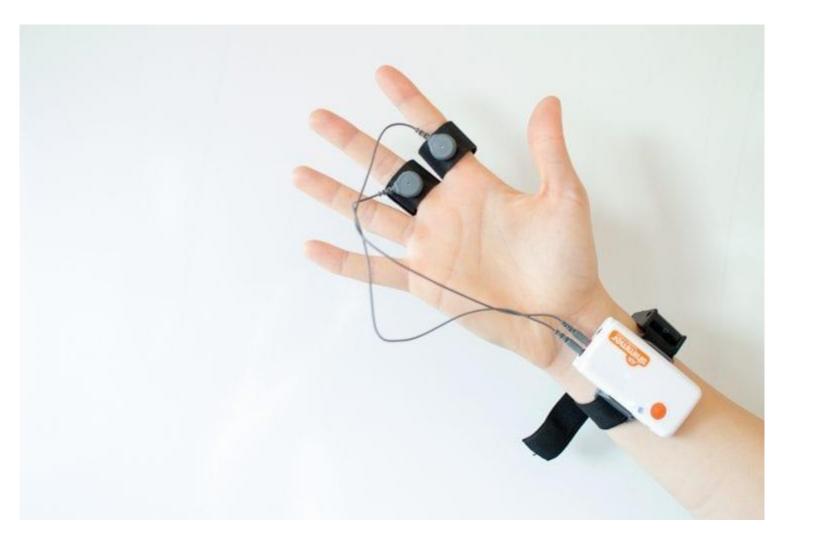
Heterogeneous results.
In general, the tonic level of conductance tends to increase in the early morning, early afternoon and evening while decreasing in the second half of the afternoon and at night (Waller, 1919; Ueno, 1929; Venables, Christie, 1973).
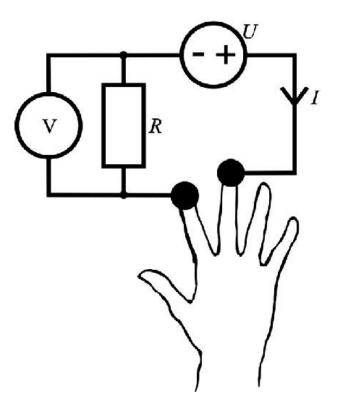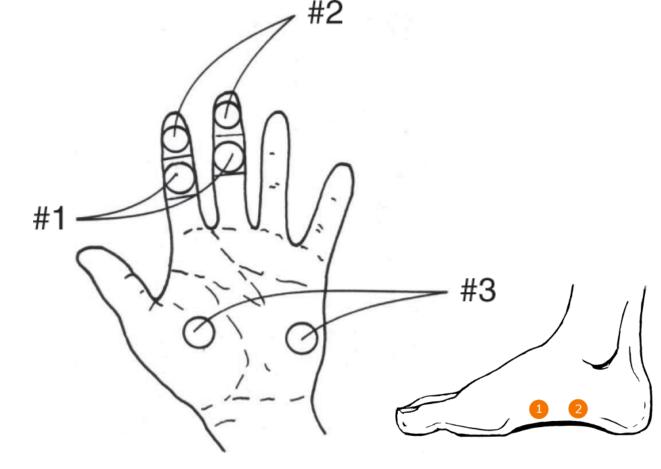
How to record it

Electrodes Placements

Hands

Feet

Means and SEs for the three responsiveness measures, the mean skin conductance level (SCL), the number of skin conductance responses per minute (SCRs) and the sum of skin conductance response amplitudes per minute (S-AMPL), for each of the 16 positions. The positions are sorted on the mean SCL.

Position	SCL [µS]		SCRs [1/min]		S-AMPL [µS/min]	
	M	SE	M	SE	M	SE
Forehead	8.72	0.72	2.97	0.54	0.32	0.07
Foot (instep)	8.50	0.88	4.88	0.76	0.92	0.18
Finger	6.50	0.53	3.80	0.64	0.53	0.13
Shoulders	5.96	0.94	2.41	0.69	0.43	0.12
Neck	5.38	0.84	1.57	0.42	0.19	0.07
Abdomen	5.15	0.91	1.26	0.63	0.29	0.14
Calf (sock)	4.70	0.95	1.63	0.47	0.28	0.09
Wrist (vertical)	4.65	0.73	2.10	0.62	0.44	0.15
Buttock	4.33	0.59	0.98	0.35	0.19	0.07
Wrist (distal)	4.23	0.89	1.43	0.42	0.31	0.11
Chest	4.20	0.69	1.57	0.50	0.35	0.10
Wrist (central)	4.18	0.72	1.77	0.57	0.44	0.14
Thighbone	3.72	0.58	0.90	0.33	0.18	0.07
Arm	3.04	0.52	0.62	0.23	0.13	0.05
Back	2.18	0.60	1.21	0.43	0.26	0.09
Armpit	1.61	0.34	0.71	0.27	0.10	0.05

Use Isotonic gel to improve Signal to noise ratio, clean the site before placement

Amplifiers

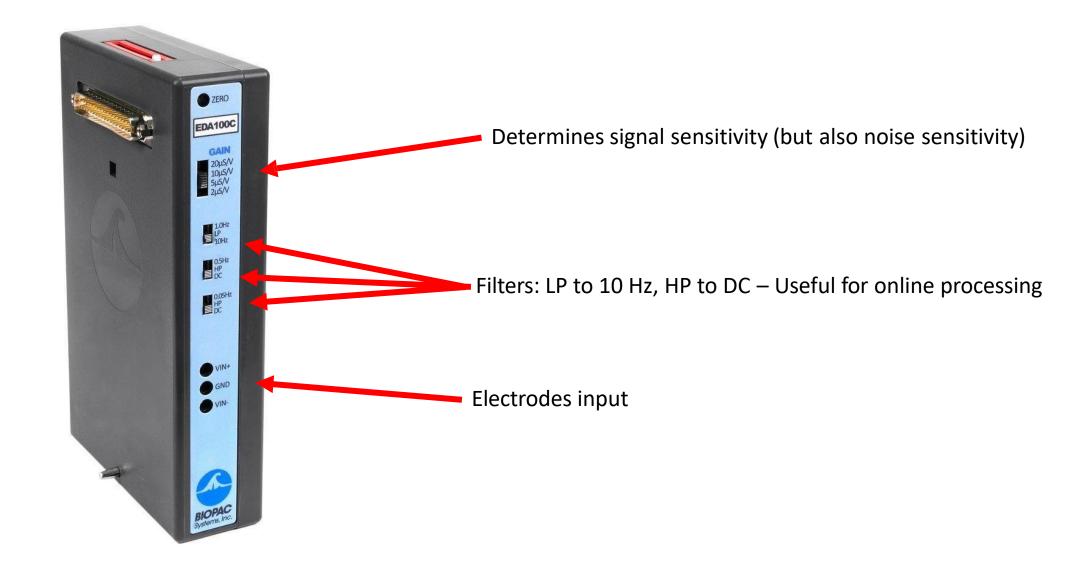Many brands from less than 500€ up to 10k €

What changes:
- gain power (sensitivity)
- Analogic filtering
- Software support
- Sampling rate I/O digital conversion

For biofeedback go for the cheapest
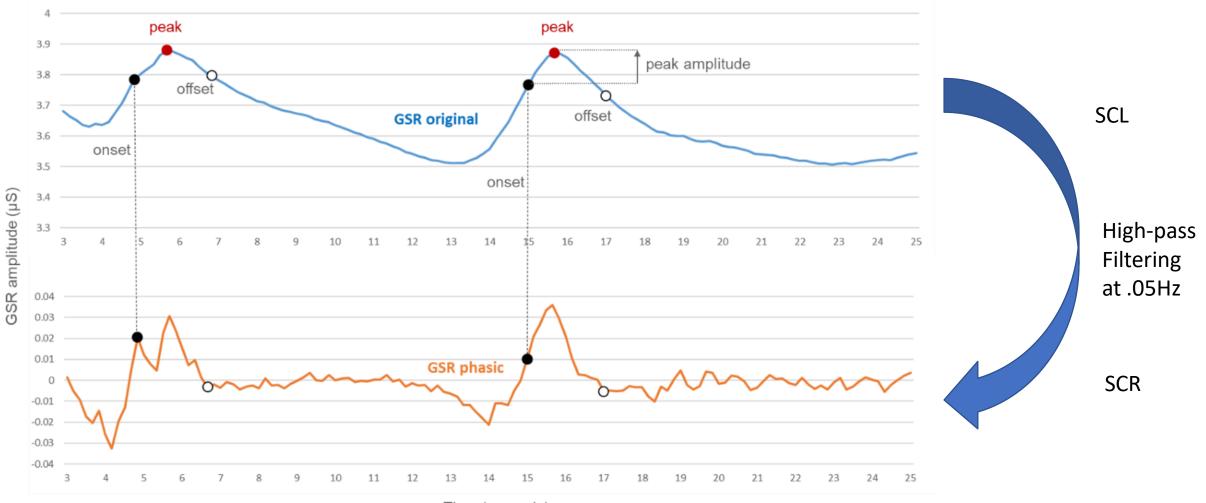For event related research gain power can be decisive and sampling rate must be of at least 10 Hz

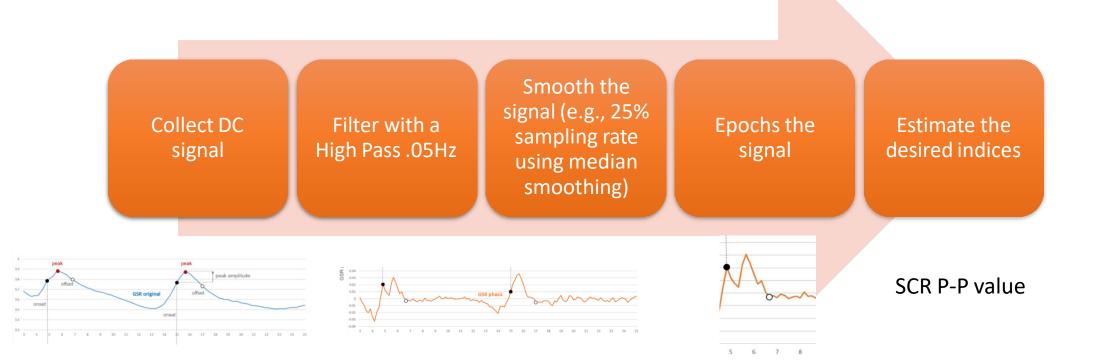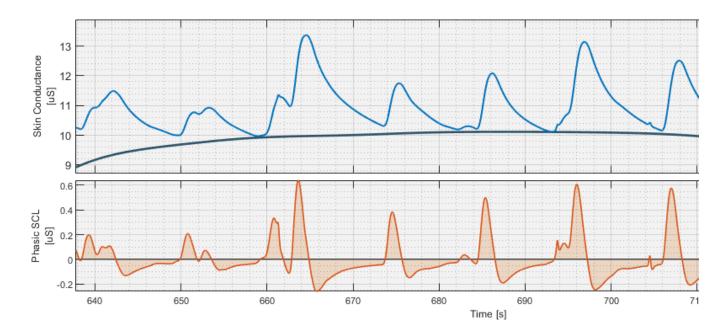# Parameters to set (not always available)

Determines signal sensitivity (but also noise sensitivity)

Filters: LP to 10 Hz, HP to DC – Useful for online processing

Electrodes input

From Tonic to phasic

Pre-processing

| Collect DC signal | Filter with a High Pass .05Hz | Smooth the signal (e.g., 25% sampling rate using median smoothing) | Epochs the signal | Estimate the desired indices |

SCR P-P value

Indices

Measure	Definition
Skin conductance level (SCL)	Tonic level of electrical activity of skin
Skin conductance response (SCR)	Phasic change in electrical conductivity of skin
Non-specific SCRs (NS-SCRs)	SCRs occurring in the absence of identifiable eliciting stimuli
Frequency of NS-SCRs	Rate of NS-SCRs occurring in the absence of identifiable stimuli

Not suggested

Peak-to-Peak (or Peak to base)

Useful in long exposures (e.g., >1min)
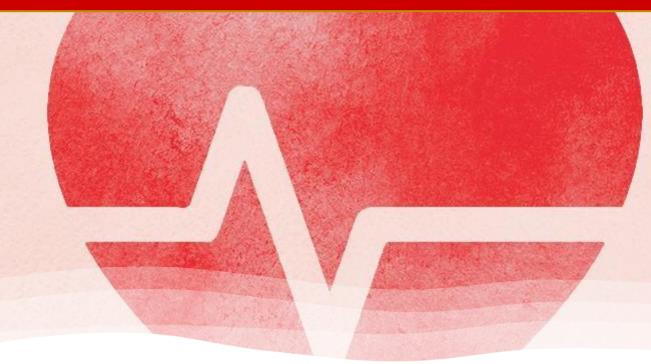
Thumb rule for a good SCR experiment

- Prepare the participant (iso-gel, skin temperature, scrubbing)
- Decent timing for triggering, not needed super perfect within 1 sec is ok.
- Check to have an appropriate sampling rate.
- Moderate number of trials, consider checking habituation problem
- Separate trials of at least 5 sec, better 10 (or more) for event-related tasks
- Variate stimuli to reduce habituation
- Collect SCL, filter off-line (keep 1 min empty at the beginning).
- Collect data around the same period of the year and of the day. Or consider this in your randomisation or sampling design.
- Within-subject experiment are MUUUUCH better
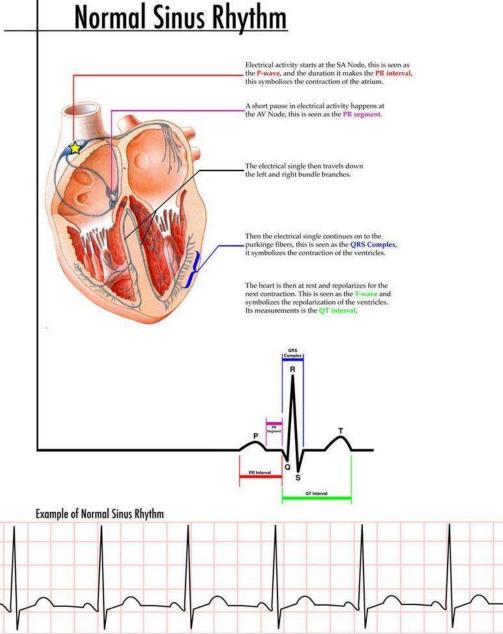
HR
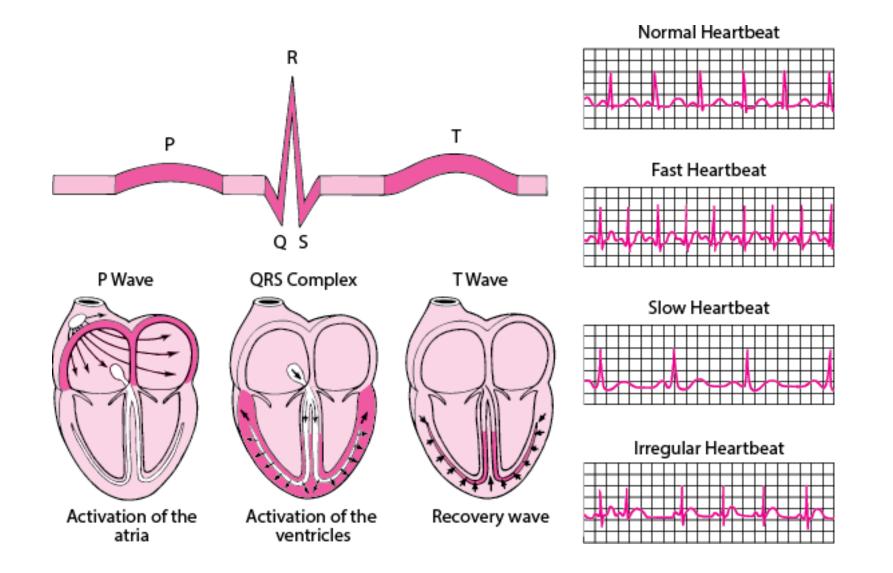
A heart beat

A heart beat may be detected through a variety of measurements. Most commonly it is detected via ECG—measurements of the changes in the voltage across the chest. ECG spikes indicate when the electrical events leading to a contraction of the heart muscle occur.
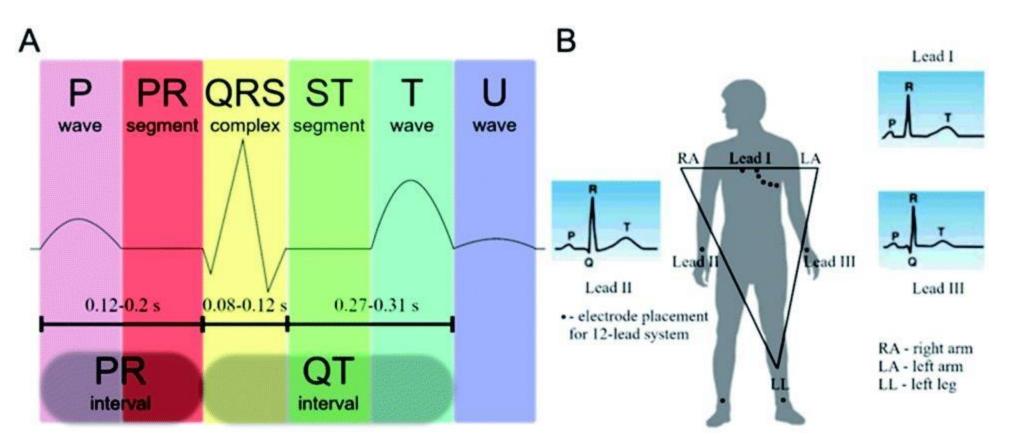

Normal Sinus Rhythm

Electrical activity starts at the SA Node, this is seen as the P-wave, and the duration it makes the PR interval, this symbolizes the contraction of the atrium.

A short pause in electrical activity happens at the AV Node, this is seen as the PR segment.

The electrical single then travels down the left and right bundle branches.

Then the electrical single continues on to the purkinge fibers, this is seen as the QRS Complex, it symbolizes the contraction of the ventricles.

The heart is then at rest and repolarizes for the next contraction. This is seen as the T-wave and symbolizes the repolarization of the ventricles. Its measurements is the QT interval.

Example of Normal Sinus Rhythm

How to record HR

Parameters to set (not always available)

- Costs and principles the same of GSR:
- Gain to balance signal sensitivity with noise
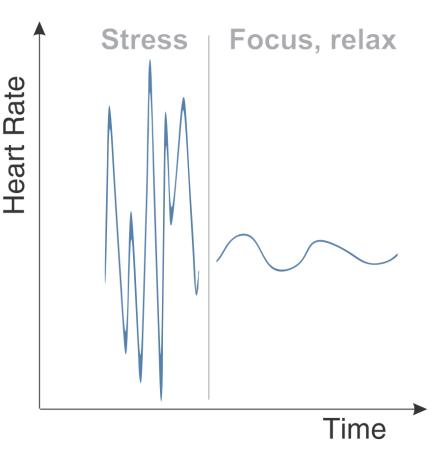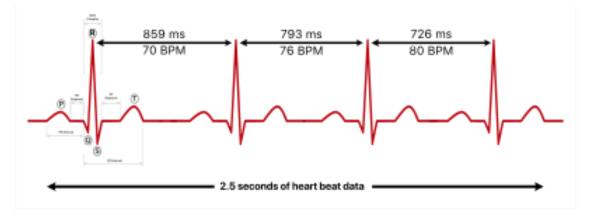- Filters apllicable off-line, filter-out the less signal possible

HR indices

Heart Beat Frequency (Bpm)
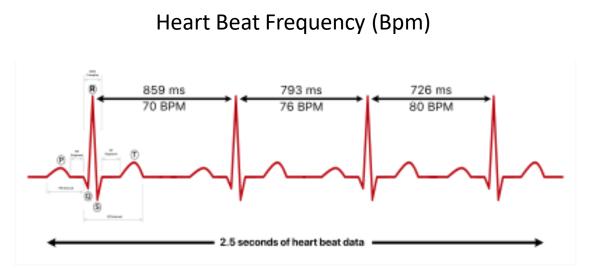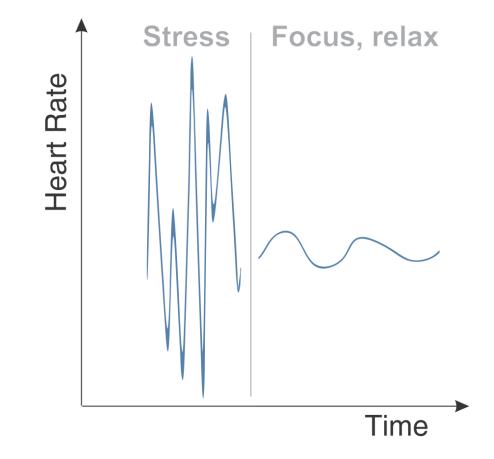

Heart Rate Variability

HR indices

Heart Beat Frequency (Bpm)

R-R distance to derivate HR frequency

HR indices

Transformation of the variability of the R-R interval variability in frequency power.

Different frequencies are associated with sympathetic or vagal activations.

Thus from HRV we can have indices of specific subsystems activations of the ANS and its eventual unbalance.

Heart Rate Variability

Shaffer, F., & Ginsberg, J. P. (2017). An Overview of Heart Rate Variability Metrics and Norms. Frontiers in public health, 5, 258. https://doi.org/10.3389/fpubh.2017.00258.

ULF Band

The ultra-low-frequency (ULF) band (≤0.003 Hz) requires a recording period of at least 24 h. Circadian rhythms may be the primary driver of this rhythm. Core body temperature, metabolism, and the renin–angiotensin system operate over a long time period and may also contribute to these frequencies. There is disagreement about the contribution by the PNS and SNS to this band.

VLF Band

The VLF band (0.0033–0.04 Hz) requires a recording period of at least 5 min, but may be best monitored over 24 h.

Low VLF power has been shown to be associated with arrhythmic death and PTSD.

The heart's intrinsic nervous system appears to contribute to the VLF rhythm and the SNS influences the amplitude and frequency of its oscillations.

PNS activity may contribute to VLF power since parasympathetic blockade almost completely abolishes it. In contrast, sympathetic blockade does not affect VLF power and VLF activity is seen in tetraplegics, whose SNS innervation of the heart and lungs is disrupted.

Experimental evidence suggests that the heart intrinsically generates the VLF rhythm and efferent SNS activity due to physical activity and stress responses modulates its amplitude and frequency.

Shaffer, F., & Ginsberg, J. P. (2017). An overview of heart rate variability metrics and norms. *Frontiers in public health*, 258.

LF Band

The LF band (0.04–0.15 Hz) is typically recorded over a minimum 2 min period ([12](#)).
LF power may be produced by both the PNS and SNS, primarily by the PNS ([66](#)). The SNS does not appear to produce rhythms much above 0.1 Hz, while the parasympathetic system can be observed to affect heart rhythms down to 0.05 Hz (20 s rhythm).

HF Band

The HF or respiratory band (0.15–0.40 Hz) is conventionally recorded over a minimum 1 min period.
The HF band reflects parasympathetic activity and is called the respiratory band because it corresponds to the HR variations related to the respiratory cycle.
Total vagal blockage virtually eliminates HF oscillations and reduces power in the LF range.
HF band power may increase at night and decrease during the day.
Lower HF power is correlated with stress, panic, anxiety, or worry.

A. **Record good ECG data**

1. **Hardware Setup—**ECG100C amplifier settings:

   i. Gain:1000

   ii. Mode: NORM

   iii. LPN Filter: 35Hz LPN ON

   iv. HP Filter: 0.5Hz HP ON

2. **Software Setup**

   i. Set the acquisition sample rate to 1000 Hz (MP menu > Set Up Data Acquisition > Length/Rate)

      - *"The sampling rate must be properly chosen. A low sampling rate may produce a jitter in the estimation of the R-wave fiducial point, which alters the spectrum considerably. The optimal range is 250 to 500 Hz or perhaps even higher"*—Guidelines: HRV

3. **Subject Preparation**

   i. If the subject has to move to perform a task, place the electrodes away from the limbs being used. The cleanest ECG signals will come from the chest, but this might not always be convenient for subjects.

   ii. Always prepare the electrode site by removing dead skin using an ELPAD and cotton swabs with water.

   iii. Apply gel to the electrodes (even for disposable ones, when they look dry) but not so much as to spread and prevent it from sticking well.

   iv. To help prevent movement artifacts, use tape to attach the electrode leads to the skin as well. Making a loop with the electrode lead cable under the tape will reduce the chance of dislodging the electrode due to a sudden pull.

   v. **Wait** at least 5 minutes before recording so that the gel can be absorbed into the skin. This will reduce the impedance.
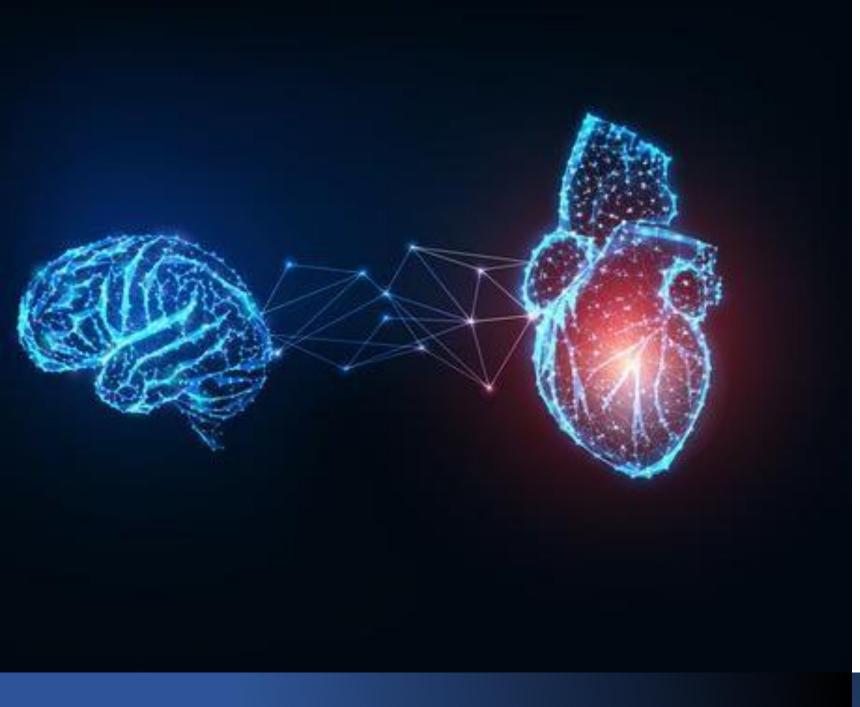
Drawbacks of HR

Useless in stimulus-evoked responses: guidelines suggest a 5 min epoch minimum.

Better if breath rhythm is controlled (adding complexity to data collection)

Conclusions

Psychophysiological measures are useful to access unmediated responses of subjects arousal

Consider specific needs to design proper experiments

Relatively easy to use and reads, but ask for experienced supervision the first few times you use it.

Learn to read the signal also without softwares (artifact detection, quality and sensitivity of signal)

Relatively cheap (the most expensive setup can go up to 15k €, but you can have a reasonable facility with around 5 k €)

Thank you for your attention!

Manuscript Writing Tips:
Introduction / Discussion / Storytelling

Jan De Houwer, Marine Rougier, and Jamie Cummins

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marine.rougier@ugent.be

jamie.cummins@ugent.be

I. Before writing the manuscript

Think about who your audience is and which journal you would like to submit to. Different journals allow different formats of papers, so you need to have an idea of the journal before you can start writing. It is good to think about this even when running the studies (e.g., whether an extra study would strengthen a paper or not).

Write preregistrations in such a way that you can re-use them for your paper.

I. Before writing the manuscript

R-scripts and code needs to be clear so that you are sure you correctly report what you did and why you found it.

Prepare an outline/storyline. This needs to reflect a logical progression in arguments, in which each argument or idea is stated in one sentence. If it is difficult to formulate an argument in one sentence, often this means that there are multiple arguments in this idea that need to be separated.

II. While writing the manuscript

Be prepared to "kill you children": Sometimes you must delete ideas, paragraphs, sentences, … in the service of the overall quality of your paper.

It is better to have a paper that is imperfect but submitted than to continue to aim for the perfect paper. Reviewers will always have comments.

Mimic other papers: each research domain has its own jargon and ways of formulating ideas. Read other papers and imitate the style of those paper. But of course, don't copy from paper (plagiarism). To avoid plagiarism, never write with another paper next to you.

II. While writing the manuscript

Method and results sections are good places to start or to return to when you are stuck.

Writing is storytelling: try to write an engaging story that readers enjoy to read but without becoming prosaic (scientific language must also be neutral and objective)

II. While writing the manuscript

Less is more. You'll find that it is always possible to reduce the length of your paper by about 1/3 if you try. Shorter papers are easier for the reader, so try to be as succinct as possible and remove all that is not strictly necessary.

Simple language suffices. Don't use overly complex words. Have mercy on your reader.

Always re-read your text from the perspective of the reader: It might be clear for you but it might not be clear for readers.

Consult books on academic writing (e.g., https://www.apa.org/pubs/books/4441024)

II. While writing the manuscript

Some find it helpful to write everyday. Like other skills, you need to acquire writing skills.

Some can get into "the zone" of writing but it takes time to get there. For these people it is good to reserve longer periods of time in which you can work on a paper.

Stop if you are stuck. Take a break rather than continue to try.

Ask for help: get feedback from your co-authors.

III. After writing the manuscript

A manuscript is not the end product of research. More and more it is seen as a living document that is an advertisement of the data and that can change (via links).

Some prefer to put preprints on the web (e.g., PsychArchives, ResearchGate) before submitting. This can generate useful feedback but some worry about older versions that continue to have their own life after newer versions have been made.

Let papers "ripe" a bit. Often you have a fresh look at a paper one or two weeks after writing it.

Thank you for your attention!

From Writing the Manuscript to Contacting the Journal
The Relationship with Editors: Rebuttal and Acceptance

Marco Brambilla

Università degli Studi di Milano-Bicocca

marco.brambilla@unimib.it
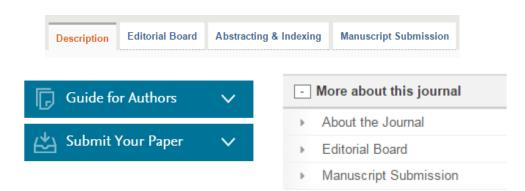
Submitting your paper

Types of papers published

- Full article
- Brief/Short/Flash Report
- Review
- Meta-analysis
- Commentary

Journal characteristics

- Aims and scope of the journal (Mission statement)
- Audience
- Reputation: Impact factor
- Editorial Board
- Time to publication
- Authors fees
- Ethical standards (open data, supplementary materials, ethics committee)

Submitting your paper

Review Process

- Submission (generally through journal platform)
- Acknowledgement generally within 48 hours
- Editor

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                                    ┌──────────┐
                                    │  Editor  │
                                    └──────────┘
             ┌───────────────────────┬──────────────────────┐
             ▼                       ▼                      ▼
      ┌────────────┐          ┌────────────┐         ┌────────────┐
      │  Associate │          │  Associate │         │  Associate │
      │   Editor   │          │   Editor   │         │   Editor   │
      └────────────┘          └────────────┘         └────────────┘
        ┌──────────┐
        ▼          ▼
  ┌────────────┐ ┌────────────┐
  │ Consulting │ │  Ad Hoc    │
  │  Editors   │ │ Reviewers  │
  └────────────┘ └────────────┘
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Review Process: types of Peer Review

- **Double Blind**: Article is de-identified
- **Single Blind**: Reviewer knows identity of authors. Authors do not know who the reviewers are
- **Open**: Open identities - Disclosure of author and reviewers names to one another at any point during the peer review

Submitting your paper

Cover Letter

- A cover letter should be:
    - Always be written….not writing a cover letter is a missed opportunity
    - Never be just a brief note….Never be a long letter
    - Short letter that includes the key information of the manuscript

Dear Editor, I am pleased to submit to your attention the manuscript entitled "Morality and Intergroup Behaviour: Threats to Safety and Group Image Trigger Responses To Outgroup and Ingroup Members", which I would like to submit for publication in the Journal of Experimental Social Psychology.

The current manuscript presents three different studies on the distinctive role of morality (vs. sociability and competence) in predicting perceived threat and behavioural tendencies. The studies presented in the present manuscript have been carried out in accordance with the Ethical Standards of the APA.

We hope that you will find this piece of work interesting and look forward to your editorial comments.
Sincerely yours,

Submitting your paper

Cover Letter

Dear Editor,

On behalf of the co-authors, I am pleased to submit the manuscript entitled "Not just about faces in context: Face-context relation moderates the impact of contextual threat on facial trustworthiness" for review in Personality and Social Psychology Bulletin.

In four experiments (three pre-registered), we provided novel insights for research on face-context integration and attribution of trustworthiness. Prior studies showed that the threat conveyed by a contextual scene determines the extent to which the person presented in that scene deserves to be trusted. Here we questioned what processes lie behind such an effect. We showed that the attribution of facial trustworthiness due to contextual threat depended on the nature of the relationship used by the perceiver to encode face-context links. In Experiment 1a-1c, we found face-context integration on the attribution of trustworthiness to be stronger when threatening contexts were potentially attributable to human actions. Experiment 2 pushed further on this idea and showed that manipulating the nature of face-context relationship (i.e., the face presented as either the victim or the perpetrator in the threatening scene) produced changes in face-context integration. This work speaks for the importance of considering relational processes when it comes to explain how contextual threat can bias our response to facial stimuli.

These experiments have neither been submitted for publication nor have they been published elsewhere. In conducting the reported research, the ethical guidelines for the American Psychological Association were followed, and the research was conducted following approval by the Institutional Review Board. The rights of the participants were protected throughout the experiments. The authors have no conflicts of interest.

Submitting your paper

Cover Letter: Ethics

The studies reported in this paper were approved by the Ethics Committee at the University of Milano-Bicocca, and written informed consent was obtained from all participants.

Cover Letter: Open Science

All the materials, data and analyses codes are available on Open Science Framework. The relevant link is provided in the manuscript. Moreover, we provide the links referring to the pre-registered protocols of the studies.

Cover Letter: Conflict of interests

I would like to take this opportunity to mention a possible conflict of interest. Professor XX and his team are working on the same topic, but have a different theoretical approach. Therefore, please do not send our paper to anyone in that group, as they will not give an unbiased opinion.

Dr. XX is very familiar with the topic and so is very well qualified to review my paper. I have no personal connection with her, although we have met during a conference and we discussed about my paper.

Submitting your paper

Cover Letter: Suggesting Associate Editors and Reviewers

As for the associate editor for the work, we are happy to recommend XX, and XX given their expertise on XX. However, we are happy with whatever associate editor may be assigned to the paper.

We would like to suggest the following reviewers, who span various areas of expertise across the psychological sciences and none of whom we have previously collaborated with.

Submitting your paper

Editorial Decision

- Reject
  - Submit elsewhere
  - Collect new data/ re-write some sections of the manuscript/new analyses

- Major Revision

- Accept Pending Minor Revision

Submitting your paper

Editorial Decision: Reject

Dear Dr. XX,

I have now received two expert reviews of your manuscript.
As you can read in their comments below, the reviewers believe this paper is focused on an interesting issue. However, they also highlight serious concerns. These concerns align quite closely with my own reactions to the manuscript. Though I see value in this work, I believe the limitations outweigh the strengths. Thus, I am declining the opportunity to publish this work in PSPB. Below I elaborate on the reasons for this decision.

Dear Dr. XX,

Thank you for your submission to Cognition and Emotion. I have now had your submission reviewed by three experts and conducted my own independent evaluation of the project. As you can see from the reviews themselves, there was considerable enthusiasm for the topic and, potentially, for the methodology. There was, however, some diversity of opinion regarding the submitted manuscript and some serious concerns regarding the substantiveness and coherency of the findings, the underlying theory, and aspects of the study methodology. Based on the results of the external review process, with regret I must inform you that your paper did not receive a sufficiently high priority score to be considered further for publication in Cognition and Emotion

Submitting your paper

Editorial Decision: Major Revision

Dear Dr. XX,

Thank you for submitting your manuscript to the European Journal of Social Psychology. I have received two reviews of the paper from colleagues with highly relevant expertise in the field of your studies. Please find their feedback below. I have also read your paper independently.

The reviewers and I found a number of positive aspects in the research. The research question is interesting and innovative and the results are surprising. All in all, work has the potential to make a substantial contribution.

But reviewers also express concerns that, taken together, suggest that the present version of this manuscript is not suitable for publication in EJSP. My own reading of your manuscript confirms this assessment. Below, I will list the issues that prevent publication of the manuscript in its current form. If you are willing to revise the manuscript along the lines I have outlined below, I would be more than happy to receive a revised version of your manuscript. The revision I ask for needs to include additional data, because you are partly drawing conclusions based on comparisons between studies (for details see below), which is certainly not ideal.

Submitting your paper

Editorial Decision: Major Revision

Dear Dr. XX,

Thank you for submitting XX to the Journal of Nonverbal Behavior. Unfortunately I will not be able to accept your paper for the journal, due to a pile-up of methodological and interpretational difficulties, but I would be willing to entertain a major revision. The problems that the reviewers and I see are serious, however, so I cannot give you any estimate of the chances of an ultimate acceptance.

Some of the reviewers' comments were exactly like mine, while others were novel. So, there are many issues for you to consider. The topic is fundamentally good, and there is no doubt about the care you went to with coding and analysis. It is with methodological design issues and interpretations that we find fault.

Submitting your paper

Editorial Decision: Accept Pending Minor Revision

Dear Dr. XX,

I have received three reviews from researchers active in the study of the two dimensions of person judgement. Of course, I also read the paper carefully myself.

The reviewers and I agree that you have produced a very competent report of research relevant to the readership of EJSP. I want to commend you especially for the clear and engaging writing in the manuscript. It was a pleasure to read it. As I detail below, I have some conceptual and analysis concerns. As a result, I am unable to accept the current manuscript in its present form. However, if you are willing to address the concrete concerns raised by me and the reviewers, I would like to invite you to submit a revision of this paper.

The revision will not be sent out for full review. I would like to receive it within 90 days. This brief window is indicative of the fact that the requested revisions are quite straightforward.

Submitting your paper

Re-submission:

- Submit a new manuscript with a cover letter in which you describe in detail all the changes you made and how you addressed the issues raised by the reviewers.

Dear Dr. Vernon,

My co-authors and I would like to thank your staff and the reviewers for your feedback on our manuscript recently submitted to Personality and Individual Differences. After considering the helpful suggestions and comments of the reviewers, we are pleased to now resubmit a revised version of the work that accords with the input that we received. We enumerate the changes that we have made in the pages below.

Sincerely,

Nick Rule
University of Toronto

Submitting your paper

Re-submission:

- Answer completely
- Answer Humbly
- Answer Objectly

> **Reviewer 1:** *Although the authors go into quite a bit of detail on explicit measures of prejudice, they could more clearly describe the implicit measure of prejudice (IAT) in the Methods section.*
>
> **Reply:** We are grateful for this feedback and have now included additional information about the IAT in the Method section, particularly regarding the specific modifications that were made for the present work. Please see page 10 of the revised manuscript.

Submitting your paper

Re-submission:

Editor: *Do you have any measurements of how the partner (confederate) behaved during the initial phase where they exchanged stories and during the synchrony task? This is of concern because the confederate was not blind to which story they wrote, and this could have influenced their behavior, and therefore have been a confounding or biasing element in the synchrony data.*

Reply: We agree with the editor that this issue is extremely relevant. To address this point, we included a "supplementary analysis" section in the manuscript (page 14).

In particular, we conducted additional analyses to ascertain that the confederate performed the movements implied in the synchrony task in the same way across the experimental conditions. To this aim, we asked two independent judges, blind to the experimental conditions, to watch the videos and to indicate the extent to which the confederate appeared hostile, rude, and happy (reverse-scored), during the synchrony task. The judges provided their answers using four-point scales ranging from 1 (not at all) to 4 (extremely). We computed a global index (alpha .69) that was submitted to a 2 (Dimension: honesty vs. friendliness) ×2 (Valence: negative vs. positive) ANOVA. We did not find a main effect of dimension, $F(1, 75) = .47$, $p = .50$, $\eta^2 = .006$, or a main effect of valence, $F(1, 75) = 1.49$, $p = .22$, $\eta^2 = .02$, or the interaction effect, $F(1, 75) = .78$, $p = .38$, $\eta^2 = .01$. We further asked the two independent judges to indicate the extent to which the confederate appeared as helping the participant in the synchrony task and the extent to which the confederate had an avoidant attitude during the synchrony task. On these two different items, we carried out a 2 (Dimension: honesty vs. friendliness) ×2 (Valence: negative vs. positive) ANOVA. We did not find any significant results, $Fs(1,75) < 1.49$, $ps > .38$, confirming thus that the confederate performed the synchrony task in the same way in the various experimental conditions. We think that this additional analysis improved substantially the paper and we thank the editor for asking us to be more precise about this issue in the manuscript.

Submitting your paper

Re-submission:

Reviewer 1: The authors should probably discuss the replication issue briefly in the introduction. This discussion helps build the case for the importance of the current work (i.e., here is another project showing the impact of embodiment, which makes the idea/theory seem more real).

Reply: We agree with the reviewer that the replication issue is truly relevant for our discipline. We would prefer not to enter in the debate about replicability, especially in the introduction section. In fact, despite its relevance, a theoretical discussion about the 'reality' of embodiment effects goes beyond the aims of the present research.

Submitting your paper

Re-submission:

We agree with the referee that ____, but…

The referee is right to point out ____, yet…

In accordance with the referees' wishes, we have now changed this sentence to____.

Although we agree with the referee that…

It is true that____, but…

We acknowledge that our manuscript might have been ____, but…

Williams H. How to reply to referees' comments when submitting manuscripts for publication. *I Am Acad Dermatol* 2004; 51:79-83.

Submitting your paper

Avoid:

- Blame reviewers for misunderstanding, instead clarify where necessary

- Whine about how hard the revisions were or why you really need this publication

- Get defensive or take the process personally

Instead:
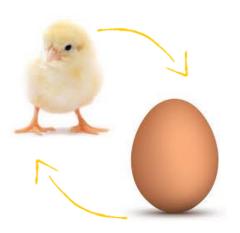
- Your tone should be positive and upbeat

- your focus should be on what you have done to consider each suggestion

Selecting the right journal

**Which comes first:
The journal or the paper?**

Where could we publish?

Selecting the right journal
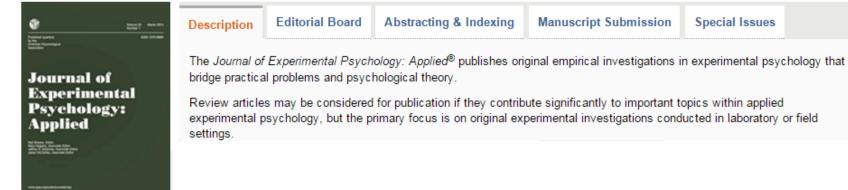
DESCRIPTION

Cognition is an international journal that publishes theoretical and experimental papers on the study of the mind. It covers a wide variety of subjects concerning all the different aspects of **cognition**, ranging from biological and experimental studies to formal analysis. Contributions from the fields of **psychology**, **neuroscience**, **linguistics**, **computer science**, **mathematics**, **ethology** and **philosophy** are welcome in this journal provided that they have some bearing on the functioning of the mind. In addition, the journal serves as a forum for discussion of social and political aspects of cognitive science.

ISSN: 0010-0277

Description	**Editorial Board**	**Abstracting & Indexing**	**Manuscript Submission**	**Special Issues**

The *Journal of Experimental Psychology: Applied*® publishes original empirical investigations in experimental psychology that bridge practical problems and psychological theory.

Review articles may be considered for publication if they contribute significantly to important topics within applied experimental psychology, but the primary focus is on original experimental investigations conducted in laboratory or field settings.

Aims and Scope

Sex Roles: A Journal of Research is a global, multidisciplinary, scholarly, social and behavioral science journal with a feminist perspective. It publishes original research reports as well as original theoretical papers and conceptual review articles that explore how gender organizes people's lives and their surrounding worlds, including gender identities, belief systems, representations, interactions, relations, organizations, institutions, and statuses.

Selecting the right journal

Reputation: Impact Factor

- The impact factor is a measure reflecting the yearly average number of citations to recent articles published in that journal

- In any given year, the impact factor of a journal is the number of citations, received in

2008 impact factor = A/B.

where:

A = the number of times that all items published in that journal in 2006 and 2007 were cited by indexed publications during 2008.

B = the total number of "citable items" published by that journal in 2006 and 2007. ("Citable items" for this calculation are usually articles, reviews, proceedings, or notes; not editorials or letters to the editor).

impact factors are calculated yearly and listed in the Journal Citation Report (Web of Science)

- It is a proxy for the relative importance of a journal within its field (<u>not for the importance of a specific paper</u>)

- Journals with high IF are those in which it is typically more difficult to publish (the greater the impact factor, the higher the rejection rate)

Selecting the right journal

Reputation: Impact Factor

- Be realistic: Don't aim too high – Don't aim too low

- IF has not an absolute meaning and it should be contextualized in the scientific field

- Examples:
  Psychology 56.20 (Psychological Science in the Public Interest)
  Medicine   286.130 (Cancer Journal for Clinicians)

- Within the same field:
  Social Psychology   16.16 (Personality and Social Psychology Review)
  Educational Psychology   8.20   (Educational Psychologist)
  Experimental Psychology   24.48 (Trends in Cognitive Sciences)

Selecting the right journal

Reputation: Impact Factor

- To compare journals from different fields you may use rank statistic. Journals are ranked within each field and split into quartiles:

    Q1: top 25%

    Q2: 26-50%

    Q3: 51-75%

    Q4: 76-100%

Selecting the right journal
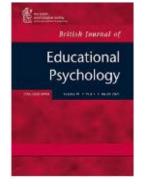
Reputation: Impact Factor

8.46 – Q1 – Social Psychology
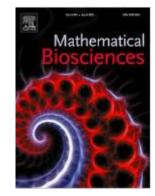
6.83 – Q1 –Educational Psychology

3.93 – Q2 – Social Psychology
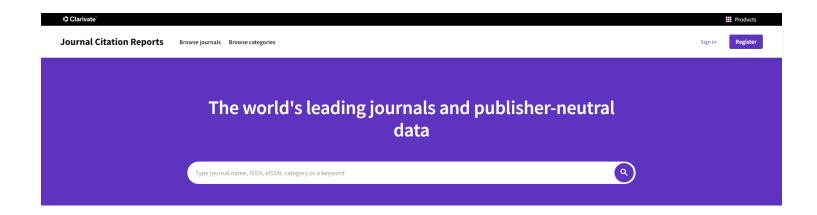
3.93 – Q1 – Biology

Selecting the right journal

Reputation: Impact Factor

Thank you for your attention!

The Psychology of Learning: A brief overview

Jan De Houwer

Ghent University
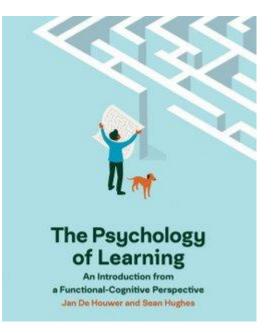
Jan.DeHouwer@ugent.be

De Houwer, J., & Hughes, S. (2020). The psychology of learning: An introduction from a functional-cognitive perspective. The MIT Press. [CC-BY-SA]

- pdf on www.psychologyoflearning.be

- Chapter 0 is foundation

The Psychology of Learning

An Introduction from a Functional-Cognitive Perspective

Jan De Houwer and Sean Hughes

INTRODUCTORY CHAPTER:

WHAT IS LEARNING AND HOW CAN ONE STUDY LEARNING?

0.1. What is learning?

0.1.1. Learning as ontogenetic adaptation

- Evolution (Darwin): Phylogenetic adaptation (adaptation to environment over generations, e.g., giraffe's neck, African-South American migration)

- Learning: Ontogenetic adaptation (adaptation during the life of one organism).

Learning = observable changes in the behaviour of a particular organism during its life as a result of regularities in the environment

= ESSENTIAL within psychology
 (like evolutionary theory is essential for biology)

0.1.2. Difficulties in applying the definition of learning

"Learning = observable changes in the behavior of a particular organism during the organism's life as the result of regularities in the environment"

environment is cause => is not an observation but a hypothesis about causes of behavior

(e.g. grip reflex) + see also "traffic death".

Learning = effect of environment (more specifically, regularity in environment) on behavior

0.2. Types of learning

0.2.1 Types of regularities / patterns in the environment

Regularity = anything more than 1 event at 1 moment in time (De Houwer et al., 2013)

- in the occurrence of 1 stimulus (e.g., food)

- in the occurrence of 2 stimuli (e.g., food on certain tree)

- in the occurrence of behaviors and stimuli (e.g., food when you shake the tree)

0.2.2. Types of learning

Traditionally 3 types:

- effects of a regularity in the occurrence of 1 stimulus (e.g., repeated bang => reduction in response)

    = effects of non-contingent stimulus presentations

- effects of a regularity in the occurrence of 2 stimuli (e.g., relation bell-food => salivation to bell)

    = classical conditioning

- effects of a regularity in occurrence of behaviour and stimuli (e.g., link pushing-food=> pushing more often)

    = operant conditioning

- Complex learning = joint effect of multiple regularities

2 types of complex learning based on distinction between standard and meta-regularities

=> standard regularity: only individual stimuli and responses as elements (e.g., tone-shock)

=> meta-regularity: at least one regularity as an element

0.2.3. Difficulties in determining type of learning

Distinction based on what is assumed to be the cause of change in behavior

- e.g. Pavlov's dog:

Behaviour: increase in salivation when hearing bell

* possible causes:

- repeatedly offering food

- BELL-FOOD

=> CONFOUNDS of different regularities so experimental research with controls is needed

Distinction procedure vs effect

Procedure = that which a researcher does: offering stimuli and observing behavior

e.g. Classical conditioning procedure

Effect = impact of regularity on behavior
(not directly observable)
e.g. Classical conditioning as an effect

0.3. A functional-cognitive framework for the Psychology of Learning

Two approaches in the psychology of learning that differ in their objectives

- Functional approach

$$B = f (Er)$$

- Cognitive approach: Mental processes that influence behavior

0.3.1. Functional approach

0.3.1.1. Environment as moderator of learning

Learning (impact of Er on B) depends on / is moderated by characteristics of the environment

e.g.: Effect of "pushing lever – food" depends on how long the rat has not eaten.

Aim: To discover moderators of learning: What aspects of the environment determine the impact of Er on B?

= functional knowledge (knowledge about the "B = f(Er)" function)

Method: Manipulating elements of the procedure

Each learning procedure includes 5 elements:
- Stimuli and behaviors that constitute the regularity

   e.g. bell-food; light-shock; lever-food, ...
- An observed behavior

   e.g., salivation, skin conductance, frequency of pushing, ...
- An organism

      e.g. human, rat, fruit fly, plant, ...
- Wider context

      e.g. other tasks, local, past, ...
- Nature of the regularity

   e.g. number of times presented, duration of presentations, ...

0.3.1.2. Abstract Functional Knowledge

Abstraction = simplification: focus on one aspect and ignore the rest / "make abstraction of" some aspects

E.g. abstraction in terms of geometric shape or colour

- Functional learning: abstraction in terms of role / function

  eg. Pavlov's dog: bell, food, salivation

  => salivation is interesting for physiologist

  => but learning psychologist focus (also) on general principle (classical conditioning: CS-US => CR)

  CS: bell, tone, dog, ...

  US: food, shock, bite, ...

  CR: salivation, skin conductance, anxiety, ...

e.g. Skinner's Rat: Rat pushes the lever when the light is on because food will follow.

=> interesting for study of eating behaviour

=> but learning psychologist focus (also) on the general principle (operant conditioning: Sd: R-Sr => R)

Sd: light, tone, beverage dispenser, ...

R: push the lever, walk away, pay, ...

Sr: food, shock stops, soda, ...

= abstraction in terms of role / function

=> Abstract concepts allow functional knowledge to be extended to new situations

= Analytic-abstractive functional approach

(in short: functional approach)
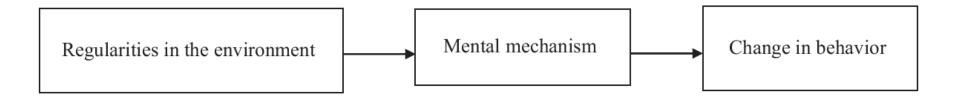
= as abstract as possible but as specific as necessary (also knowledge about moderators; e.g., differences between animal species)

0.3.1.3 Why this approach?

- Predict based on observed environment

- Influencing on the basis of interventions in the environment

e.g: Facebook, psychotherapy, Mumbai (VIDEO)

= applications (see Chapter 5)

0.3.2. Cognitive approach

How can regularities in the environment influence behaviour? Via which mental mechanism?

e.g. Classical conditioning via formation of associations between representations in memory

= MENTAL PROCESS STATEMENT

= MEDIATION (necessary intermediate step)
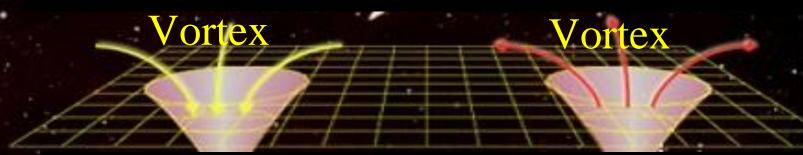
=> Why go looking for mechanisms?

- Offers a "true explanation" of learning rather than "merely" describing learning

- Knowledge about the mechanism can lead to better predicting and influencing (e.g., petrol - car)

  (see next slide)

=> But finding mental mechanisms is not easy!

- Mental = information = not physical

- Can be derived only from functional knowledge (knowledge of impact of environment on behavior)

Psychological Space-Time Continuum

Cognitive Vortex

Functional Vortex

BOX 0.3: Latent learning (Tolman & Honzik, 1930)

    Day 1: Maze without food

    Day 2: Maze with food

       => faster food retrieval on day 2 if maze without food
         on day 1

- For functional psychologist: Not specially

   B-day2 = f (Er-day1) = functional cause

- For cognitive psychologist: Crucial

   There should be immediate cause on day 2

   The only possibility is knowledge of the maze

BOX 0.4 : Behaviorism and the "cognitive revolution".
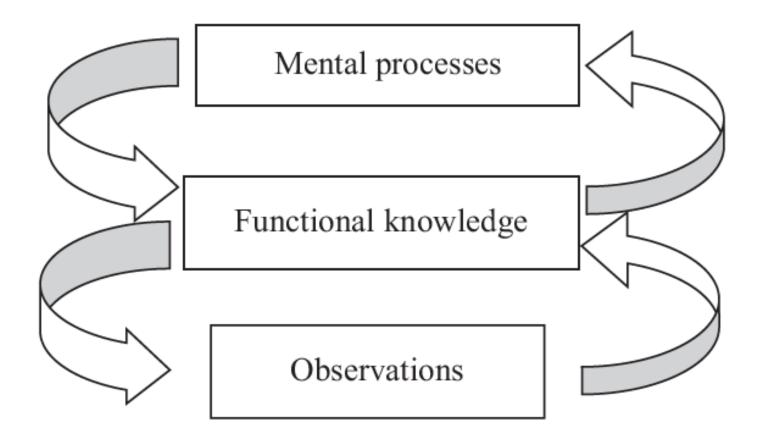
0.3.3. Relation functional - cognitive psychology

Table 0.1

The concepts that need to be explained (explanandum) and the concepts used to explain (explanans) in the functional and cognitive approaches to the psychology of learning

	Explanandum (*Concept that must be explained*)	Explanans (*Concept used to explain*)
Functional	Behavior (e.g., salivation)	Regularities in the environment (e.g., pairings of bell and food)
Cognitive	Learning (e.g., classical conditioning)	Mental processes (e.g., association formation)

Mental processes

Functional knowledge

Observations

Separate EFFECT vs. MENTAL PROCESS

e.g.. Confusing classical conditioning as an effect with mental process (e.g., forming associations)

0.4. Structure of the course

1. Five chapters (in addition to introductory chapter):

- Chapter I: Effects of non-contingent incentive provision
- Chapter II: Classical Conditioning
- Chapter III: Operant conditioning
- Chapter IV: Complex forms of learning
- Chapter V: Applied learning psychology

2. Structure of each chapter: both approaches

- Functional knowledge

- Mental process theories

3. What not?

   - other determinants of behaviour (e.g. genes)

   - neuroscience (and connectionism)

BASIC VISION: Learning psychology as a lens to understand behaviour

Chapter I
EFFECTS OF REGULARITIES IN THE PRESENCE OF A SINGLE STIMULUS

I.1. Functional knowledge

I.1.1. Nature of the stimuli
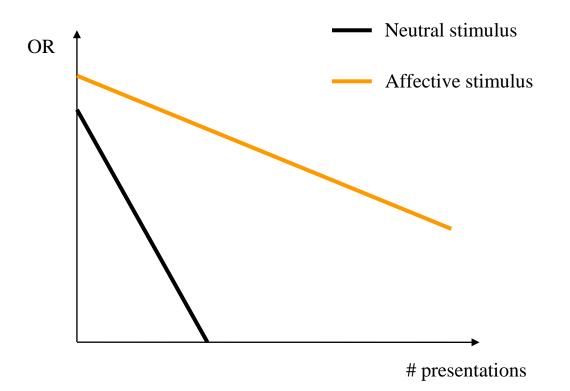
   1) general: sounds, visual stimuli, ... (e.g., habituation as effect: VIDEO)
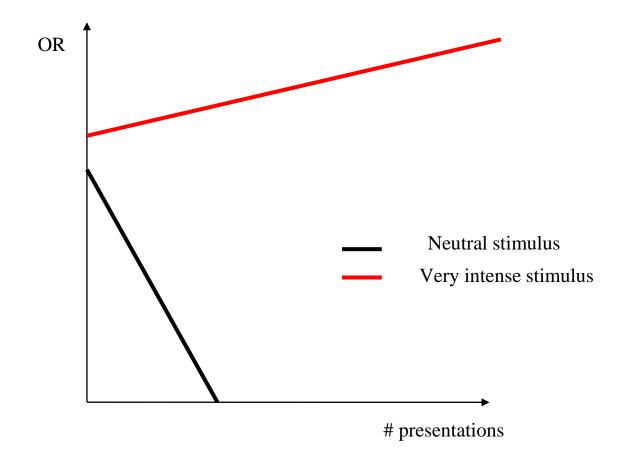
   2) yet impact of nature of stimuli:

   - on *speed of effect*: habituation slower for "significant" stimuli

   e.g. affective vs neutral images

   e.g. anxious cry of a peer: faster recovery after habituation (biological significance)

OR

Neutral stimulus
Very intense stimulus

presentations

I.1.2. Nature of behavior
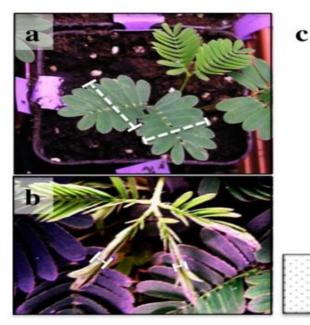
1) general: changes in intensity of response, liking, responses of spiders, slowing down classical conditioning, ...
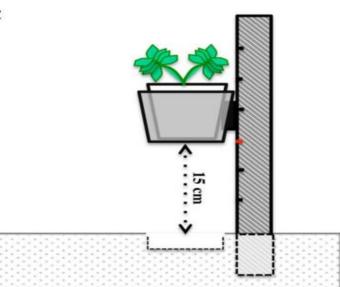
2) in lab usually change Orientation Response (OR)
   - different components: increase in skin conductance, decrease in heart rate, EEG
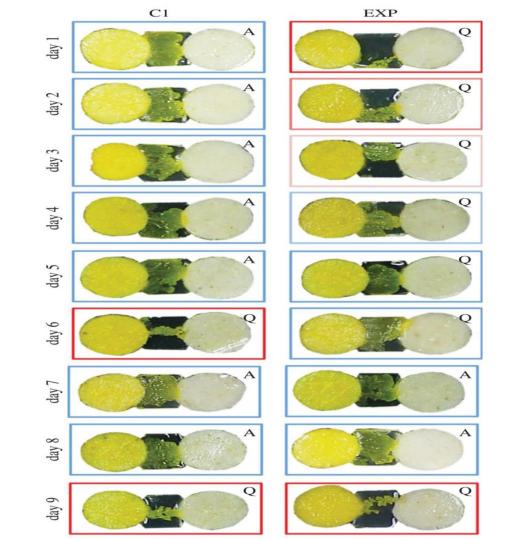
   - habituation rate differs from component to component (e.g., heart rate faster than skin conductance)

I.1.3. Nature of the organism

- General (influence on all kinds of organisms)

- but may modulate effect nature of stimuli and nature of behavior (e.g., biological relevance)

	C1	EXP
day 1	A	Q
day 2	A	Q
day 3	A	Q
day 4	A	Q
day 5	A	Q
day 6	Q	Q
day 7	A	A
day 8	A	A
day 9	Q	Q

I.1.4. Broader context

- little examined

- 1 example: Diverting attention helps habituation (e.g., loud bang during concentration test)

I.1.5. Characteristics of non-contingent presentations
= Impact how stimuli are presented
I.1.5.1. *The nature of the non-contingent stimulus presentation* (key statistical features):
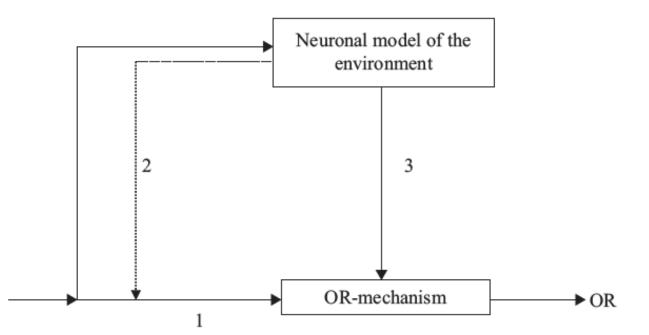
e.g. number of presentations counts and not only the first one

I.2. Process theories

I.2.1. Habitution OR: Sokolov and Bradley

1. Model of Sokolov (1975)
   (a) assumptions

2. Bradley's model (2009)

(a) assumptions

- OR depends not only on novelty but also significance

- repeated presentations have more impact on novelty than on significance

- some OR components depend more on novelty, some more on significance

(b) Explanation of functional knowledge

- nature of stimuli: less effect of presentations on significance, thus slower habituation to significant stimuli

- nature of behavior: less effect of presentation on significance, thus slower habituation for significance components (e.g., skin conductance)

- interaction nature stimulus x nature behavior

I.2.2. Opponent process theory: Solomon

=> Effects of non-contingent stimulus presentations on reactions and counterreactions (dynamics of affect)

1. Functional knowledge that the model seeks to explain:

Repeated presentations of stimuli weaken the reaction and strengthen the counterreaction (e.g. smoking, jogging)
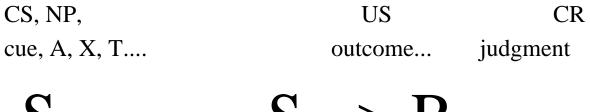
=> studies in lab with dogs

CHAPTER II.
CLASSICAL CONDITIONING

THE EFFECTS OF
REGULARITIES IN THE PRESENCE OF TWO
STIMULI

II.0: Some basic terms and procedures

II.0.1. Basic terms

CS, NP,	US	CR
cue, A, X, T....	outcome...	judgment

$$S \text{-------} S => R$$

- tone - food - salivation

- light - shock - GSR

- cause - effect - judgement

- predictor - event - judgment

- photo - photo - evaluation

…
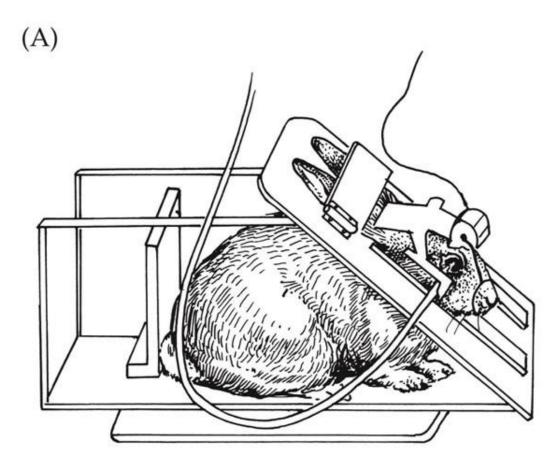
II.0.2. Procedures

1. Pavlov:
   - food (US) => salivation (UR)
   - buzzer(CS) - food(US)
      => CS elicits salivation (CR)
   => rarely used (impractical)

2. Eye Blink Reflex
   - air puff in eye(US) => blink reflex(UR)
   - tone (CS) - air puff (US)
      => CS elicits blinking
   - more convenient because automated procedure

(A)

3. Fear Conditioning

      - Shock (US) => pain

      - Figure (CS) - shock (US)

=> CS evokes fear (CR) < > UR

=> different indices of index fear

       ° skin conductance

       ° suppression

II.1. Functional knowledge

What aspects of procedure moderate CC (the effect of regularities between stimuli on behavior)?
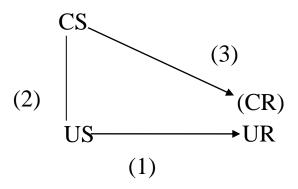
II.1.1. Nature of the stimuli

II.1.1.1. Classical cond is general phenomenon

I.1.1.2. The influence of the characteristics of the CS, US, and the relationship between the CS and US

- salience (intensity, relevance) CS and US

- intrinsic relationships: INTERACTION CS x US

II.1.1.3. The impact of the nature of the US on the nature of the CR

- appetitive US => appetitive CR (e.g., salivation)
  aversive US => defensive CR (e.g., freezing)
  !!! but CR may differ from UR; e.g., anxiety, drugs;
  see also VIDEO conditioned suppression!!!

```
        CS
          \
           \        (3)
    (2)  |   \
         |    \
         |     → (CR)
        US ─────────→ UR
             (1)
```

- change in US:
*valence US: US evaluation (e.g., make food bad)
*Type of US: counter-conditioning: CS-shock then CS-food

US revaluation effect:

Faze 1:

bell (CS) - food (US)

=> the bell afterwards elicits salivation

Faze 2:

food - nausea

=> food becomes aversive

Test:

bell (CS)
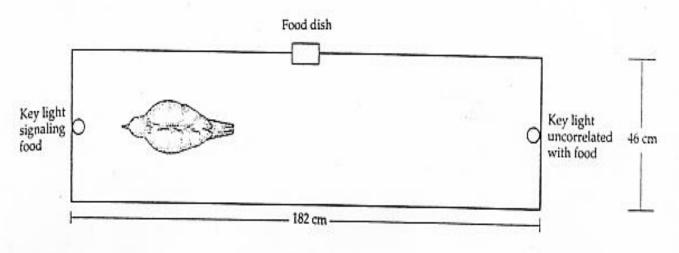
=> bell doesn't elicit salivation anymore

Counter-conditioning effect:

Faze 1:
    bell (CS) - food (US)

        => the bell afterwards elicits salivation

Faze 2:
    bell (CS) - shock (US)

        => the bell does not elicit salivation
    anymore

II.1.2. The nature of the observed behaviour

II.1.2.1. Influences on involuntary and random behavior

- autoshaping:

   light - food => change in pecking (see VIDEO)

- dysfunctional / not instrumental (light as food? => see VIDEOs)

Food dish

Key light
signaling
food

Key light
uncorrelated
with food

46 cm

182 cm

II.1.2.2. Three types of behaviour
   - **preparatory** / consummatory responses:
   prepare for US (but not always useful)
   eg. Pavlov's dog, phobias

- contingency judgments:

eg. Food allergy
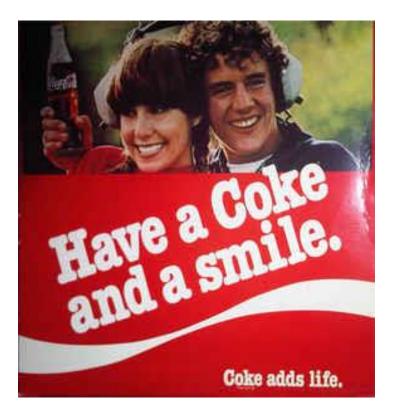
"Mr. X. eats strawberries (CS) and gets allergy (US)"

=> judgement on strawberry allergy link (CR)
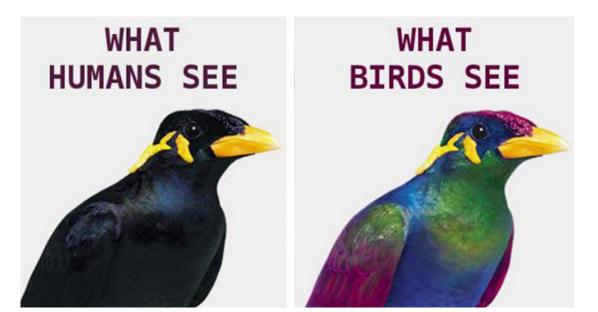
- **evaluative** conditioning

    eg. Photo, taste-taste

II.1.3. The properties of the organism
- general (humans to worms) VIDEO
  but each in its own way: convergent evolution

- but nature of the organism determines which
  contingencies are (quickly) learned (e.g.,
  mammals: taste-fear; birds: color-fear)

II.1.4. The influence of the broader context

Broader context = other events in the environment
  (e.g., other regularities)

- secondary task: weakened CC
- Focus on CS-US link: strengthened CC

Interim conclusion: CC very general but is modulated by nature stimuli, nature behavior, nature organism, and broader context

II.1.5. (Change in) characteristics of CS-US relationship

CC procedure = present a certain CS-US regularity in a
  certain way

  => What do you mean by "regularity"?
  => In what way?

II.1.5.1. The nature of the spatio-temporal relationship.
(a) Contingency is more important than contiguity

- contiguity:
    * occur together in time and space
    * Associationism / Pavlov (physiological)

- contingency
    * co-occurrence and non-co-occurrence
                        = co-variation
    * logical or statistical connection

(b) Conditional contingency is more important than contingency

- Evidence that it is not only contingency that counts: cue competition
    *Overshadowing:
        °AX+ vs. X+
        °silience

    *Blocking
        °A+ and AX+ vs. only AX+
        °A " blocks learning " about X-US

    => contingency is not enough: redundancy matters
        °example rebranding: Package + Brandname

(c) Indirect relationships

- Higher-order conditioning

Phase 1: light - shock

Faze 2: tone - light

= higher (second) order relationship

- Sensory preconditioning

Faze 1: Tone - light

Phase 2: light - shock

= higher (second) order relationship

II.1.5. (Changes in) characteristics of the CS-US relationship:
II.1.5.1. The nature of the spatio-temporal regularity
    (a) Contingency is more important than contiguity
    (b) Conditional contingency is more important than contingency
    (c) Indirect relationships

II.1.5.2. Changes in the nature of the regularity between two stimuli
    (a) No regularity - regularity
    (b) Regularity - no regularity
    (c) Regulartiy depends on context

II.1.5.3. Way of implementing of the regularity

II.1.5.2. Changes in the nature of the regularity in the presence of two stimuli

(a) No regularity followed by regularity

- CSpreexposure effect:
    *effect = CC slower than first CS only
                        Phase 1: CS only (e.g., tone)
                        Phase 2: CS-US
    *also (sometimes) with people: e.g. dentist, chemo
    functional analysis: describe in terms of known moderators of CC
                        ° salience CS (habituation)
                        ° contingency (CS only, CS-US)

- US-preexposure effect:
  - *effect = CC slower than before US only
    - Faze 1: US only (e.g., shock)
    - Faze 2: CS-US
  - *functional analysis
    - ° salience US (habituation)
    - ° contingency
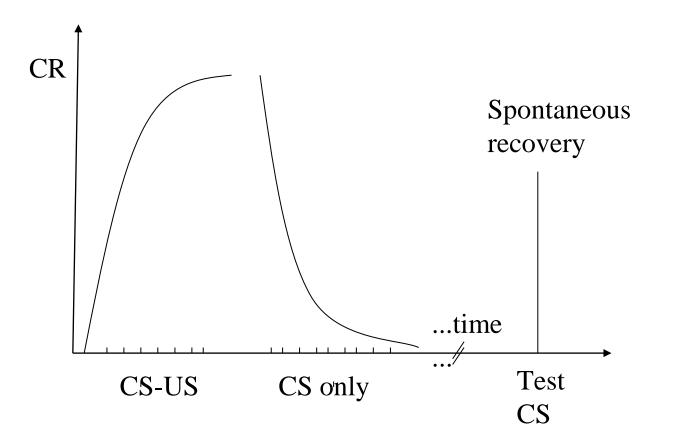
- Change contingency: Learning absence of regularity?
  - * Phase 1: $\Delta P = 0$ Phase: $\Delta P > 0$

(b) regularity - no regularity
- CS post-exposure effect = EXTINCTION

CR

Spontaneous recovery

...time

...

CS-US   CS only   Test CS

(c) The presence or absence of contextual cues

- example

light: tone-shock (switch: radio-sound)

no light: tone only (radio-no sound)

- 2 functional analyses

* occasion setting: light indicates when tone
-shock regularity is present

* compound: "Light + Tone" = shock

"Tone" = no shock

II.2. Mental process theories

"Learning" = Impact regularities in environment on behavior

Functional approach = **describe learning (**when does it occur: moderation)

=> provides explanations for behavior in terms of environment

Cognitive approach = **explain learning** in terms of mental processes (mediation)

=> must explain why learning sometimes occurs and sometimes not
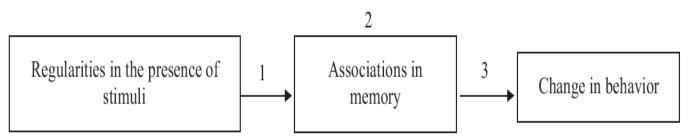
=> evaluation based on heuristic and predictive function

Two types of process explanations of classical conditioning:

1. Associative models:
S-R
S-S
2. Propositional models

II.2.1. Associative models

Common element: Associations mediates effect of regularity on behavior

Points of difference:
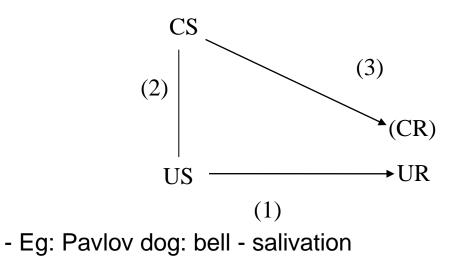
- which elements in association: S-R or S-S

- conditions under which associations are formed and influence behavior (see 2 arrows)

II.2.1.1. S-R models

(a) Core of S-R models

- association S (representation CS) and R (representation UR) due to co-occurrence CS-UR

(=> contiguity CS-UR is necessary and sufficient)

- explanation CR: activation CS results in activation UR via 'spreading of activation'.

- Eg: Pavlov dog: bell - salivation

=> S-R models fail to account for important procedural knowledge and thus have limited heuristic value (but are still popular; Rescorla, 1988; De Houwer, 2021).

=> BUT: Under certain conditions CC does conform to predictions S-R

e.g., no US-revaluation effect
for [2nd] order cond:
B-US, A-B, US revaluation
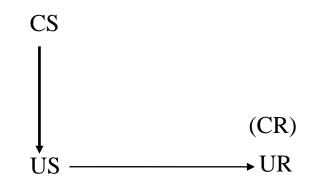
II.2.1.2. S-S models

(a) Core: CS-US relationship leads to association S (representation CS) and S (representation US) under appropriate cognitive conditions

- CR = activation CS results in activation (thinking about) US and then UR occurs
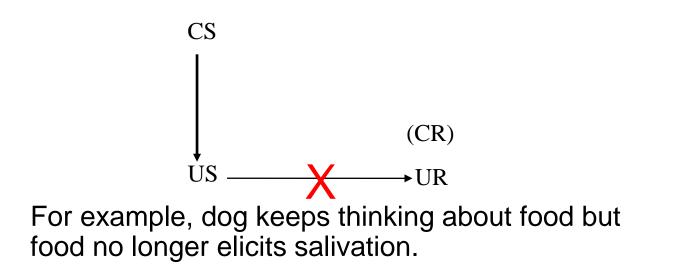
(e.g., bell => thinking about food => salivation)

CS

(CR)

US ——————————→ UR
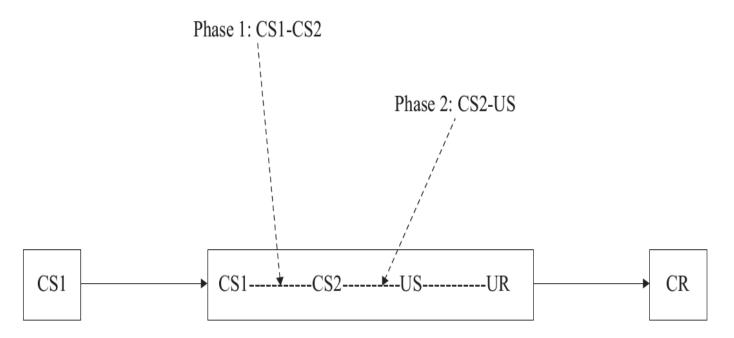
b) General evaluation S-S models:

- US revaluation

*S-S: US revaluation has impact because CR depends on US activation

CS

$\downarrow$

(CR)

US ———— X ————→ UR

For example, dog keeps thinking about food but food no longer elicits salivation.
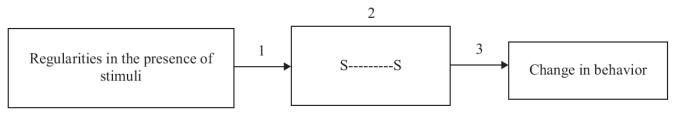
- impact of broader context (secondary tasks): attention

- indirect relations: sensory pre-conditioning

But still problems...

- Why CR different from UR? Expectations?

- Why is "awareness" of CS-US regularity
  necessary?
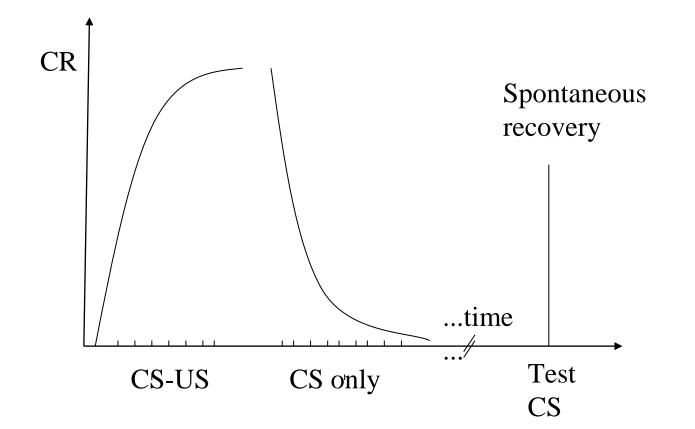
- Basic idea Rescorla-Wagner model:

1) More "learning" (change asso strength) as US presence/absence is unexpected: **Prediction error**
2) S-S association
3) direct translation asso strength to behavior

- Formalization with 1 CS: $\Delta V_A = \alpha_A \beta (\lambda - V_A)$
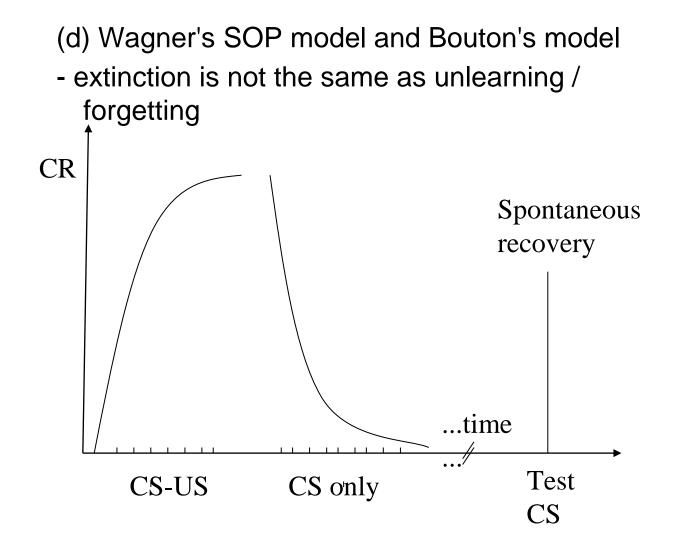
Prediction = asso strength = V_A
Prediction error = $(\lambda - V_A)$

CR

Spontaneous
recovery

...time

...

CS-US   CS only   Test
CS
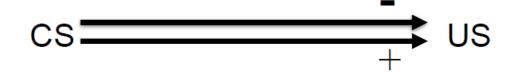
- Formalization with 2 CSs

   (a) formula (e.g., on AX+ trials)

$$\Delta V_A = \alpha_A\, \beta\, (\lambda - {}_{V_{AX}})$$

$$\Delta V_x = \alpha_x\, \beta\, (\lambda - {}_{V_{AX}})$$

V_{AX}= sum of asso strength all cues (A and X).

    = Expectation based on all available cues
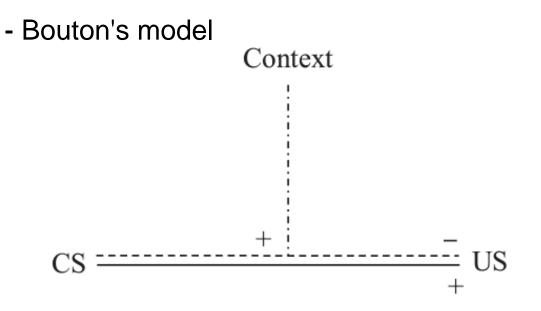
   (b) example: blocking

     - A+: $V_A \sim \lambda$

     - AX+: $V_{AX} = V_A + V_X = \lambda + 0 = \lambda$

$$\Rightarrow \Delta V_x = \alpha_x \beta (\lambda - V_{AX}) = 0$$

(d) Wagner's SOP model and Bouton's model
- extinction is not the same as unlearning / forgetting

CR

Spontaneous recovery

...time

CS-US   CS only   Test CS

- SOP model Wagner (1981)
  * exitatory and inhibitory association

$$\text{CS} \xrightarrow{\quad - \quad} \text{US}$$
$$\text{CS} \xrightarrow{\quad + \quad} \text{US}$$
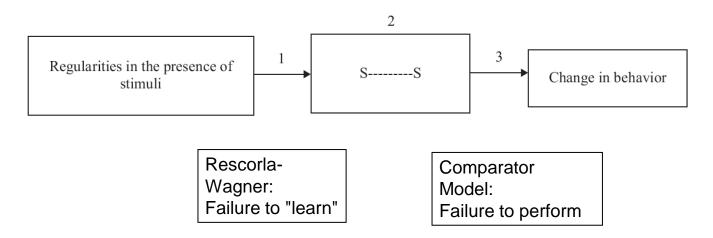
  * if attention to CS then increase
        exitatory: unexpected presence US
        inhibitory: unexpected absence US

- Bouton's model

Context

CS ======== + ‖ — US
                    +

=> not forgetting but "learning" that CS is sometimes (in certain contexts) not followed by the US.

(e) Miller's comparator model

- only contiguity counts for asso formation

=> AX+: X-US relation always "learned"

- performance depends on comparison of X-US strength and A-US strength

=> reaction to X less if before or after AX+ also A+

| Regularities in the presence of stimuli | → 1 | S---------S | → 3 | Change in behavior |

2

| Rescorla-Wagner: Failure to "learn" | | Comparator Model: Failure to perform |
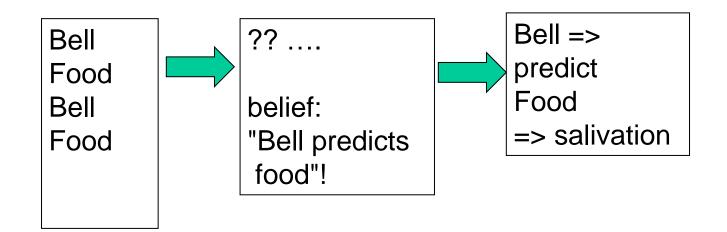
II.2.2. Propositional models
II.2.2.1. Core

- proposition = statement about reality
    * truth value (belief) <> association
    * info about nature of relationship
   (e.g., substance in blood=cause or consequence of illness)

- Formation of propositions is non-automatic (e.g., awareness and attention required)
  ==> PROBLEM SOLVING: Generate and evaluate hypotheses based on all the knowledge you have
  = *constructive process (like perception, memory...)*

e.g. Pavlov's dog:

Bell
Food
Bell
Food

→

?? ….

belief:
"Bell predicts
 food"!

→

Bell =>
predict
Food
=> salivation

See VIDEO about belief violation in dogs

CHAPTER III:
OPERANT CONDITIONING:

THE EFFECT OF REGULARITIES IN THE PRESENCE OF STIMULI AND BEHAVIOR

III.0. SOME BASIC TERMS AND PROCEDURES

III.0.1. Basic terms

OC = effect of regularities in the presence of stimuli and
behavior

III.0.1.1. The three terms contingency

Sd: R - Sr

Example: Light: push lever - food
(but not limited to Skinnerbox)

(a) Sd: discriminant stimuli

- **descriptive/procedural**: discriminates between R-Sr and R-no situations => can be 1 stimulus, series of stimuli, or class of stimuli (e.g., red objects: color is unit/criterion delimiting class)

- **functional**: Sd has impact on behavior due to the fact that it indicates the R-Sr relation

  eg. Sd: R-Sr / noSd: R-noSr

  => R more frequent after Sd than without Sd

  = Sd FUNCTION (role it has)

  => functional stimulus class: class of stimuli that functions as Sd (e.g., red objects)

b) Sr: result / reinforcer

- **descriptive/procedural**: Outcome of behaviour

=> can refer to one stimulus (food chunks) but also to a series of stimuli (10 chunks, 1 per minute) or class of stimuli (e.g., red chunks)

- **functional**: Sr has impact on behavior because of the R-Sr relation

= Sr FUNCTION (role it has)
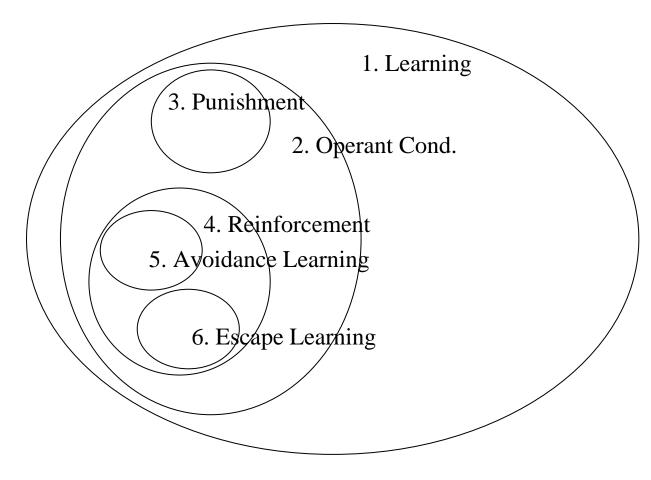
(c) R: operant behaviour

- **descriptive/procedural**: behaviour that has an impact on the environment = operation

  $\Rightarrow$ can refer to a single behaviour (pushing a handle) but also to a series of behaviours (entering a code)

  $\Rightarrow$ Always class of behavior (response class; e.g., pushing handle) delineated by unit of behavior (= criterion)

  Example: lever downward distance; force of pressure; imitation of a species, new behavior => can be complex!

- **functional**: behavior that depends on R-Sr relationship

  = operant class (e.g., imitative behavior)

III.0.1.2 Types of operant conditioning

1. Learning

3. Punishment

2. Operant Cond.

4. Reinforcement

5. Avoidance Learning

6. Escape Learning

Claim that change in behavior = type of learning is
    HYPOTHESIS that needs to be supported

Example. Child stops naughty behavior after being scolded
    => punishment: R-Sr relationship is cause of
    behavioral change
    => alternative explanation: reaction to scolding
        (= 1 stimulus at 1 moment so not learning)

<u>III.0.2. Procedures</u>

III.0.2.1. Separate trials method

    (a) Thorndike puzzle box (see figure)

           => cat in the box - pulling the loop -fish

           => every time again (separate trials)

    (b) Maze

           => start position - search - food

           => start again every time
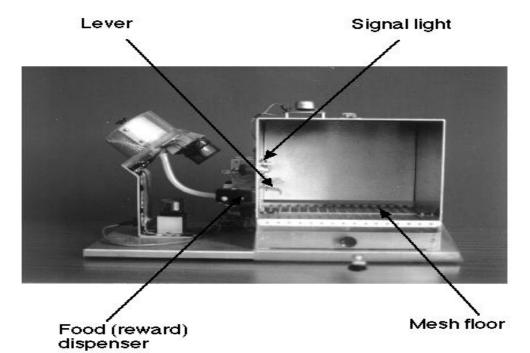
= time consuming + only speed as AV

III.0.1.2. Free-operating method

a) Skinner: maze with automatic return of animal to start = efficient + frequency as AV

=> see video + youtube

(b) Skinner box: free to set conduct

Lever   Signal light

Food (reward) dispenser   Mesh floor

III.1. Functional knowledge

III.1.1. Nature of the stimuli

III.1.1.1. OC is general:

- Different (classes of) stimuli / events

  Sd (light, local, ...)

  [R (lever push, silence, ...)]

  Sr (food, appreciation, ...)

- Illustration: Sensory reinforcement

  => R (e.g., pushing a lever) to get stimulation (e.g., train driving around; repetitive behavior autism)

III.1.1.2. Impact properties Sd, Sr, R-Sr relationship, and Sd-R relationship on the EXTENT of conditioning

(a) (change in) intensity Sd, Sr:

      * Better learning as more intense, more relevant

      * Change intensity: Punishment more effective if direct intense Sr (vb., rats - shock; traffic fine) => what is moral?

(b) R-Sr (see role of intrinsic relationship = interaction):

*Sevenster: Sticleback
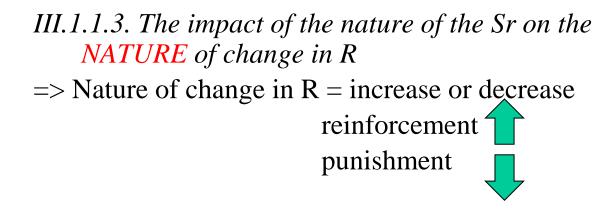
=> faster learning of swimming through ring if it is followed by appearance of female than by male

=> faster learning of biting a bar if it is followed by male than by female

* avoidance learning (behavior reduces likelihood of aversive US)

=> flights very fast (e.g., one way box)

=> pushing the lever very slowly

III.1.1.3. The impact of the nature of the Sr on the
   NATURE of change in R

=> Nature of change in R = increase or decrease

                     reinforcement ⬆

                     punishment   ⬇

(a) Which Sr function as reinforcers?"
   Sr is reinforcing if it leads to an increase in behavior
   * reinforcer ≠ reward
      => reward implies explanation of why something
         functions as reinforcer (= mental level) whereas
         reinforcer = functional level (function)

III.1.2. Nature of the observed behaviour

III.1.2.1. Influence on voluntary and involuntary behaviour?

- indirectly (through voluntary behavior)

=> example: heartbeat - money

- directly (without voluntary behavior)

=> Miller: Heartbeat – brain stimulation (curare)

=> difficult to replicate

=> biofeedback: control of autonomy

reactions via (pos.) feedback about those

reactions (e.g., blood pressure,

ADHD, brain   activity): but " really "

indirectly?

III.1.2.2. Nature of change in behavior

   (a) various aspects of existing behavior

         * frequency

         * strength

         * creativity

         * speed

         => unit of behavior is crucial

               R = operative CLASS

               WHAT is being reinforced (what is the unit)?:

                 E.g. New ways of pressing vs. pressing

                 E.g. Press intermittently vs. pressing

b) creating new behaviour: Shaping

       * often sequence is new (e.g., lever pressing)

              => see youtube video

       * also completely new behaviour via systematic changes in the unit of behaviour

III.1.3. Characteristics of organism

- general: rats, humans, fruit flies (genes)
- intrinsic relationships: genes may be important

III.1.4. Influence of the broader context

III.1.4.1. Other Sd:R-Sr relations

- each behaviour is a choice: also outcomes of other behaviour are important
- DRO: reinforce behaviors that are incompatible with undesirable behaviors (e.g., mutation vs. sitting still)
- DOE: unique outcomes have more impact
    => way to improve learning

III.1.4.2. Sr establishing operations

=> Context influences how Sr functions as a reinforcer ("motivation")

Example. Food deprivation: establishes Sr function

<u>II.1.2. Key aspects of the Operant Conditioning (OC) procedure</u>

OC procedure = Specific Sd: Present R-Sr relation in certain way

=> What do we mean by 'relation'? = core property

=> How to present and measure? = boundary condition

II.1.2.1. The nature of the relation.

(a) **Contingency is more important than contiguity**

    - <u>degree of</u> contingency R-Sr: p(Sr/R) - p(Sr/~R)

        e.g. Hammond (1980):

        * no effect if p(Sr/R) - p(Sr/~R) = 0

        effect if p(Sr/R) - p(Sr/~R) = 0.05

Overview: Impact core properties (i.e., nature of relation).

(a) Contingency

(b) Conditional contingency

(c) **Schedules of reinforcement**

Continuous reinforcement: R always followed by Sr

Partial reinforcement: R sometimes followed by Sr

- four types of partial reinforcement

- Influence of reinforcement schedules on choice behavior

    * Choice: If two behaviors are possible, which behavior does one choose?

    => Answer learning psychology: depends on Sr following behavior and schedules relating behaviors to Sr

Overview III.1.2. Core aspects of OC procedure:

III.1.2.1. Nature of the relation:

    (a) contingency more important than contiguity

    (b) conditional contingency
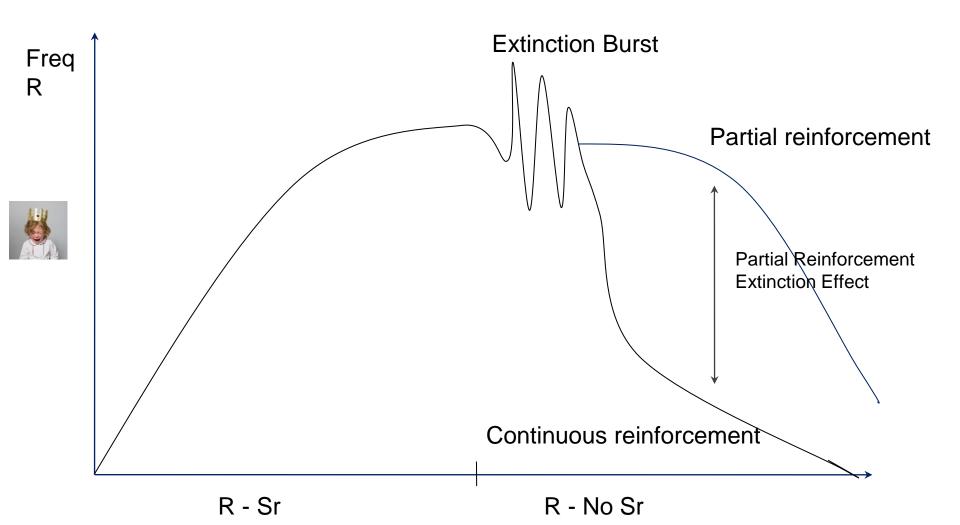
    (c) schedules of reinforcement

    (d) indirect relations

III.1.2.2. Changes in the nature of the relation

    (a) no relation followed by relation

    (b) relation followed by no relation

    (c) context dependent

Relationship depends on context

- Sd: discriminates between situations in which R-Sr relationship differs

- Different functions

                        * indicates *when* R followed by Sr (yes/no)

                        * indicates *the schedule*

- Research on STIMULUS CONTROL

       * behavior only adaptive as stimulus control

       * question: when does stimulus control occur?

        (nature Sd, R, R-Sr relationship, organism ...)

        => we only discuss different forms of stimulus control
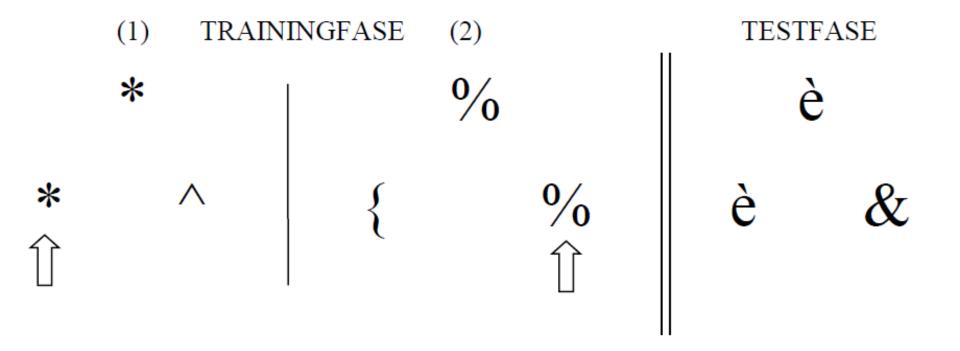
Control by one discrete stimulus

=> ***non-relational responding***

E.g. procedure: if light (Sd): then pressing button (R) will be followed by money (Sr)

e.g. effect: frequency of button presses increases when the light is on (behaviour under control of the light)
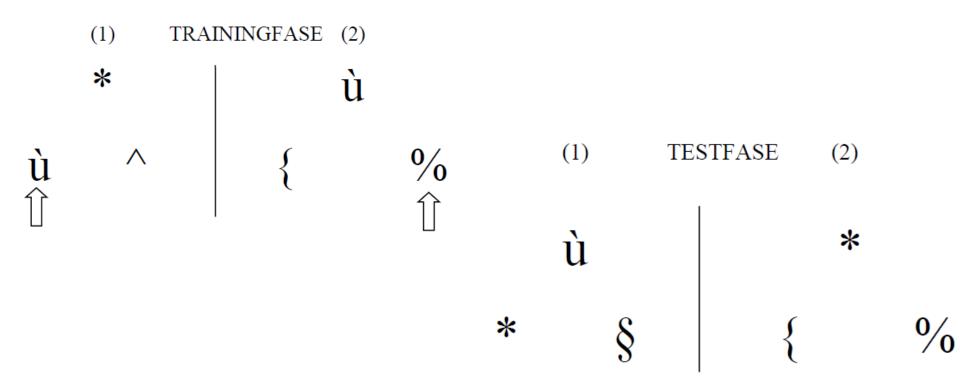
Control by non-arbitrary relation between two stimuli

=> leads to **non-arbitrary relational responding** (e.g., equal, different, greater than, ...).

Control by arbitrary relationship between stimuli

=> leads to **arbitrary applicable relational responding**: *as if* there is a certain relation

=> first evidence: stimulus equivalence

III.2 Process theories

Objective: To explain procedural knowledge about OC

Two types:

    1. Associative models:
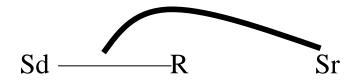
                *S-R

                *R - Sr, Sd - Sr

    2. Propositional models

III.2.1.1. S-R models

(a) The core of S-R models
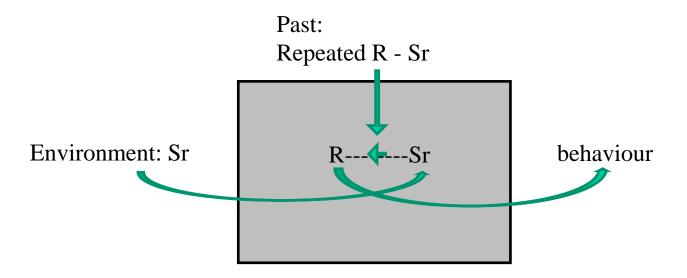
1. Not learning about Sr, but because of Sr

Sd ————————R   Sr

2. Why?: Try to avoid R-Sr (teleological) explanation
   because " real " causes of behavior must be present
   here and now => only Sd can be cause of R (Sr is there
   only after R)

   = mechanistic S-R view (contiguous causation vs.
   functional causation)

R-Sr model without Sd
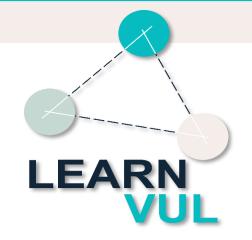
Past:
Repeated R - Sr

Environment: Sr   R---◄----Sr   behaviour

Thank you for your attention!

Behaviourism and ACT

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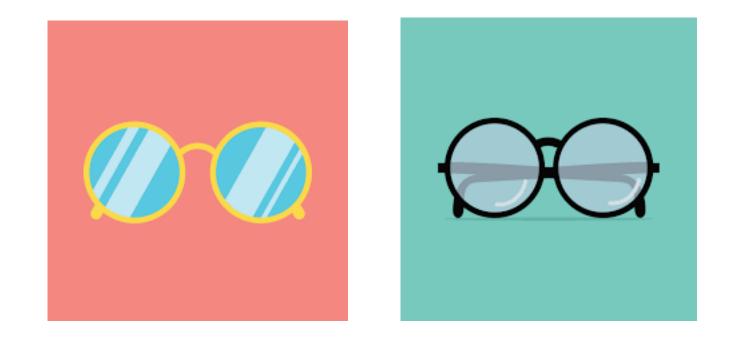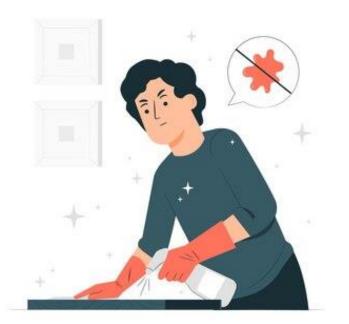
Overview

- The cognitive lens
- The behaviourist lens
  - Naming != explaining
- Skinner was innocent! (But not perfect)
- Behaviourism and language
  - Relational Frame Theory & The Simpsons
- Acceptance and Commitment Therapy
  - Lemons, suffering, and the anxiety monster

How We View the World Matters

Question…

A 16-year-old boy (Joris) learns that vomiting is an involuntary response to illness. He hears a story on the news about a young man who choked on vomit during his sleep and died. He becomes obsessed with getting ill and vomiting. He avoids anyone who appears to be sick at school. His friends wonder why he isn't talking to them. Joris carries hand sanitizer everywhere he goes, and avoids public restrooms. He won't touch food that he thinks might be contaminated by germs, and avoids restaurants he used to enjoy with his family. He is diagnosed with an Obsessive Compulsive Disorder.

What assumptions are you making about OCD, Joris, and his behaviour? In other words:

- What should we study here?
- How should we do so?
- Why do we think this?

Question…

Pre-analytic assumptions?

- There is a "mind" somewhere "inside" of us comprised of mental mechanisms.

- Mental mechanisms (e.g., attention, memory, and stereotypes) are hypothetical machines composed of parts, relationships, and operating conditions.

- These mechanisms mediate between environment (input) & behaviour (output).

Purpose of Scientist / Clinician?

- Construct and validate a model of the mental machine (its parts; how they connect to one another; conditions under which they work).

- Understanding how the mental machine works we can change the machine and then change behaviour. Mental machine is the *unit of analysis*.

"*I rarely leave the house because if I do then I'll become contaminated, get sick and vomit...*"

Purpose of Scientist / Clinician

Figure out what faulty belief is made up of; how it connects to other beliefs; and how it can be changed (via cognitive restructuring or reappraisal) to alter behaviour.

Unit of analysis: 1st faulty belief 2nd behaviour.

Behaviourism

Pre-analytic assumptions?

- People are defined in terms of what they *do* (Behaviour) not what they *are* ("Extrovert") or *have* ("Depression")

- Behaviour is an action which takes place in a context ('act-in-context').

- To change behaviour we need to identify how the past and present context triggers and maintains it (i.e., how behaviour is *functionally related* to the environment).

Purpose of Scientist / Clinician?

- To predict-and-influence behaviour with *precision*, *scope*, and *depth*. To help ourselves and others to create rich, full, and meaningful lives.

- Unit of analysis: the act-in-context

Naming isn't Explaining!
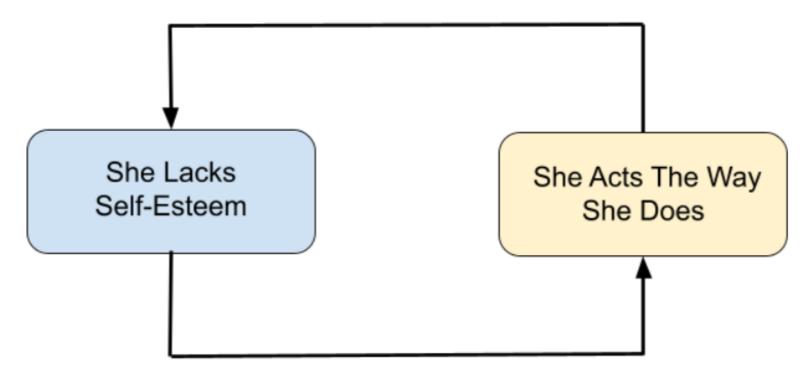
Naming has its benefits. But also comes with it's costs...

"I've never been someone who feels comfortable in big groups. If I see someone I know when I'm out in town I start

Question: If you said "we can look at her behaviour" then what is it that causes these behaviours?

esteem. *If I could get more self-esteem I know my life would be way easier..."*

Circular Reasoning

Why Does Marieke Act The Way She Does?

She Lacks
Self-Esteem

She Acts The Way
She Does

How Do We Know Marieke Lacks Self-Esteem?

- Not necessarily. Think of **phlogiston, the id/ego/superego**, "vibes", **impetus, 4 humors, etc.**
- But all of these things *feel like* they are real. And this is because they are related to things we *do.*

- Memory vs. remembering, attention vs. attending, belief vs. believing

- The behaviourist acknowledges these (private) actions, but does not assume their cause is internal
    - Rejection of hypothetical constructs as root cause

Behaviorism is not the science of human behavior; it is the philosophy of that science. Some of the questions it asks are these: Is such a science really possible? Can it account for every aspect of human behavior? What methods can it use? Are its laws as valid as those of physics and biology? Will it lead to a technology, and if so, what role will it play in human affairs? Particularly important is its bearing on earlier treatments of the same subject. Human behavior is the most familiar feature of the world in which people live, and more must have been said about it than about any other thing; how much of what has been said is worth saving?

Some of these questions will eventually be answered by the success or failure of scientific and technological enterprises, but current issues are raised, and provisional answers are needed now. A great many intelligent people believe that answers have already been found and that they are all unpromising. Here, for example, are some of the things commonly said about behaviorism or the science of behavior. They are all, I believe, wrong.

1. It ignores consciousness, feelings, and states of mind.
2. It neglects innate endowment and argues that all behavior is acquired during the lifetime of the individual.
3. It formulates behavior simply as a set of responses to stimuli, thus representing a person as an automaton, robot, puppet, or machine.
4. It does not attempt to account for cognitive processes.
5. It has no place for intention or purpose.
6. It cannot explain creative achievements—in art, for example, or in music, literature, science, or mathematics.
7. It assigns no role to a self or sense of self.
8. It is necessarily superficial and cannot deal with the depths of the mind or personality.
9. It limits itself to the prediction and control of behavior and misses the essential nature or being of man.
10. It works with animals, particularly with white rats, but not with people, and its picture of human behavior is therefore confined to those features which human beings share with animals.
11. Its achievements under laboratory control cannot be duplicated in daily life, and what it has to say about human behavior in the world at large is therefore unsupported metascience.
12. It is oversimplified and naïve and its facts are either trivial or already well known.
13. It is scientistic rather than scientific. It merely emulates the sciences.
14. Its technological achievements could have come about through the use of common sense.
15. If its contentions are valid, they must apply to the behavioral scientist himself, and what he says is therefore only what he has been conditioned to say and cannot be true.
16. It dehumanizes man; it is reductionistic and destroys man *qua* man.
17. It is concerned only with general principles and therefore neglects the uniqueness of the individual.
18. It is necessarily antidemocratic because the relation between experimenter and subject is manipulative, and its results can therefore be used by dictators but not by men of good will.
19. It regards abstract ideas such as morality or justice as fictions.
20. It is indifferent to the warmth and richness of human life, and it is incompatible with the creation and enjoyment of art, music, and literature and with love for one's fellow men.

These contentions represent, I believe, an extraordinary misunderstanding of the achievements and significance of a scientific enterprise. How can it be explained? The early history of the movement may have caused trouble. The first explicit behaviorist was John B. Watson, who in

Don't Behaviourists Reject Internal Events?

No!

- There are a lot of flavours of behaviourism.

  - Methodological behaviourism
  - Radical behaviourism

- Radical behaviourism:

  - Acknowledges privates experiences, states, and events
  - It simply does not attribute these things as the root cause of behaviour
  - Root cause: environment!

The Behaviourist Lens

Root cause of behaviour -> environment!

Assumes history of learning (antecedents and consequences) impacts how people respond to current environment

Interventions should therefore be situated in the environment: change history of learning = change behaviour

Uses *behavioural principles* like reinforcement, punishment, extinction

Criteria for truth: prediction and influence of behaviour

Don't Behaviourists Reject Internal Events?

Example:

In the presence of a particular teacher, a child cries when they are presented with work to do. When they do this, the teacher removes the work from their desk.

"Cognitive explanation": the child doesn't like doing work, believes that crying will express how they're feeling and the teacher will react to this, etc.

Environment -> mental mechanism -> behaviour

Solution: change the child's beliefs about the teacher's behaviour

Don't Behaviourists Reject Internal Events?

Example:

In the presence of a particular teacher, a child cries when they are presented with work to do. When they do this, the teacher removes the work from their desk.

"Behaviourist explanation": in the presence of work (an aversive stimulus), the child has learned that crying reliably leads to an escape from this context

Antecedent -> Behaviour -> Consequence

Solution: change the antecedent and/or consequence; differentially reinforce alternative behaviours

An example: Growth Mindset

Behaviourists have (many) tools

Functional analyses

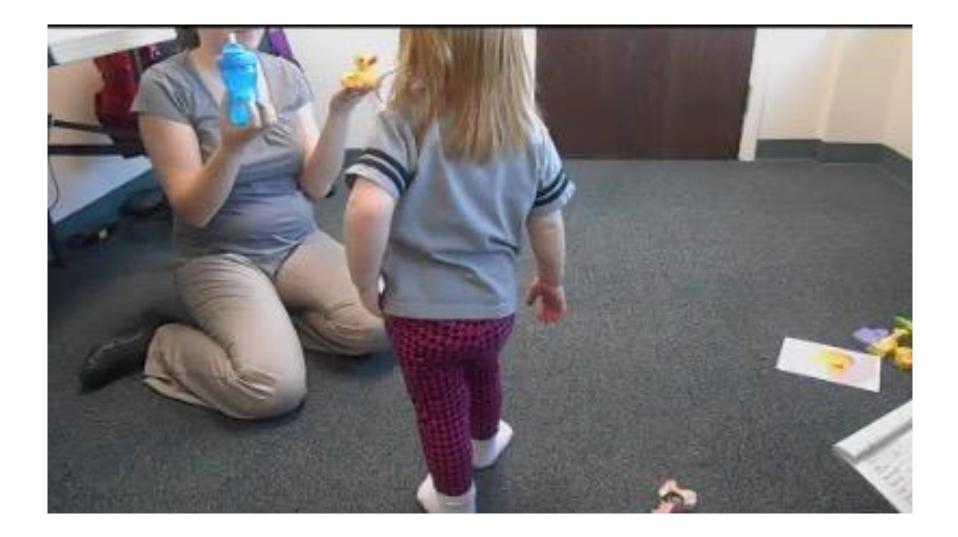Differential reinforcement of alternative behaviour

Token economies

Celeration charts/precision teaching interventions

Multiple exemplar training

Mand/tact/intraverbal/echoic training

...and many, many others

Behaviourism and Language/Cognition

Radical behaviourism was at a bit of a crossroads

Chomsky mischaracterised much of RB as MB in his famous review of Skinner's book Verbal Behaviour

But he did have one point: Skinner's account could not explain the *generativity of language*

It could explain the initial ways in which specific words acquired their meaning

But not the ways in which never-before-experienced words could acquire meaning and control behaviour

Learning via direct experience vs. learning indirectly

In operant and respondent conditioning changes in behaviour occur as a result of direct experience of contingencies

But for human beings, changes in behaviour also occur without direct experience of contingencies

e.g., an online shopper making a choice between products after reading product reviews

The online shopper does not experience the products directly, yet their choices are as though they have interacted with the products

This takes us into the realm of verbal behaviour

Behaviourism and Language/Cognition

Along came….stimulus equivalence theory!

NO PETS
ALLOWED

The arbitrariness of equivalence responding

Important to note: in the previous example, the relation between the stimuli is arbitrary
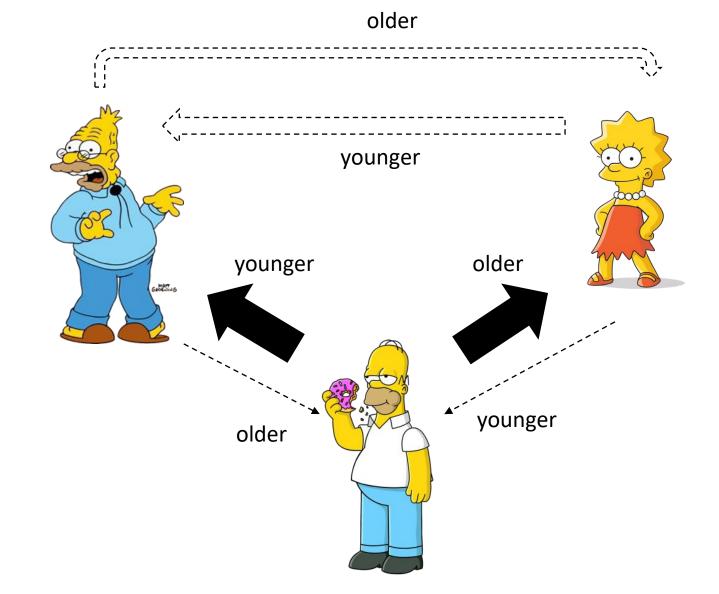
What do we mean by that?

The coordination of the symbols is not based on physical similarity (e.g., that they are the same colour and other shapes are different colours)
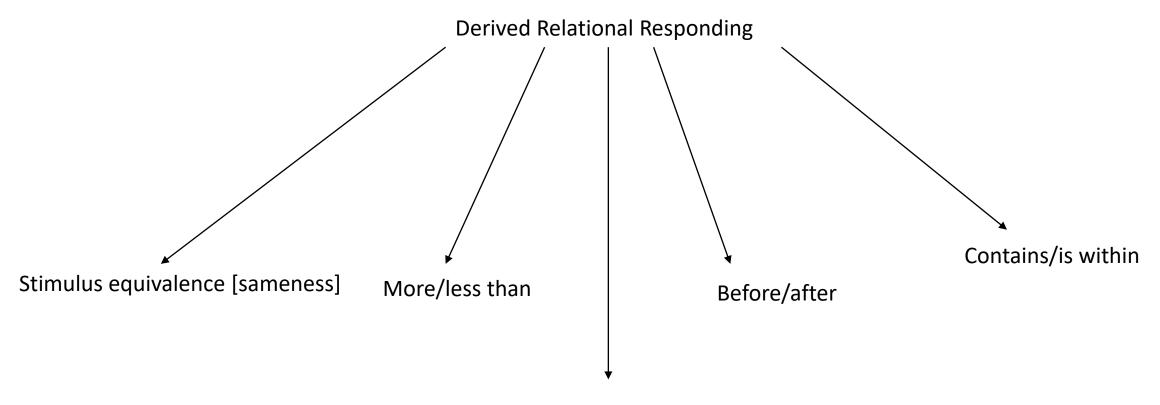
The coordination is purely arbitrary. It is particularly this *arbitrary* stimulus equivalence that animals cannot do

Behaviourism and Language/Cognition

Along came….stimulus equivalence theory!

Then along came….Relational Frame Theory!

Behaviourism and Language/Cognition

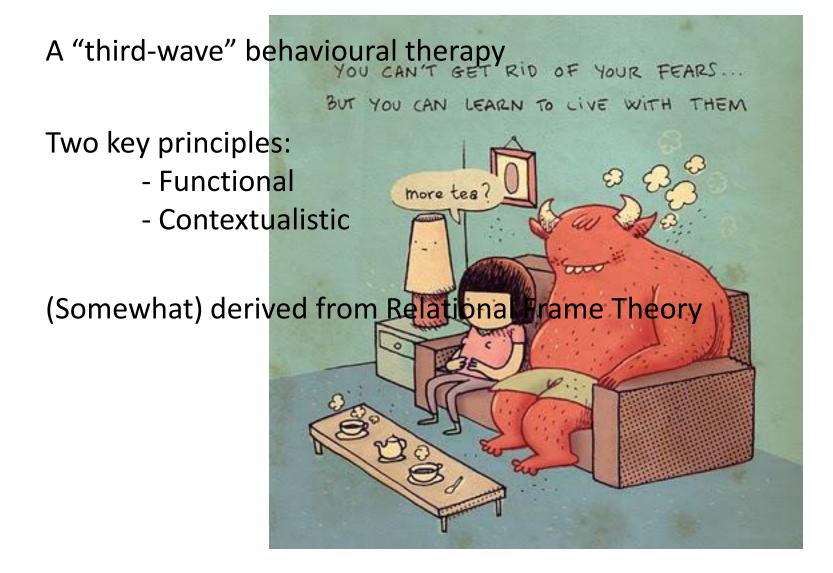Remember: none of these explanations invoke internal mechanisms!

Derived relational responding is an operant – something people *do* – not something people *have*

As cognitive psychologists, you might be inclined to ask "but what are the mechanisms that facilitate this ability"?

This is a valid question for the cognitive psychologist - but it is not a question for the behaviourist!

For the behaviourist: DRR *is* the mechanism by which the environment impacts behaviour

Acceptance and Commitment Therapy

A "third-wave" behavioural therapy

Two key principles:
      - Functional
      - Contextualistic

(Somewhat) derived from Relational Frame Theory

Behaviourism and ACT

[listen intently to the sound of my voice]

Even though you are not directly having contact with that lemon, through DRR you likely have some evoked responses (e.g., salivation)

In the same way, the function of many stimuli in our lives can be dramatically transformed by DRR

The Dark Side of Language

1. Life during COVID was very difficult, but I got through it by telling myself "at least it's not a war."

2. If I lose weight, I'll be a good person. If I'm a good person, I can't be a bad mother.

3. Good things happen to good people. Horrible things have happened to me. How will I ever find love?

4. Winning this tournament will be my greatest achievement.
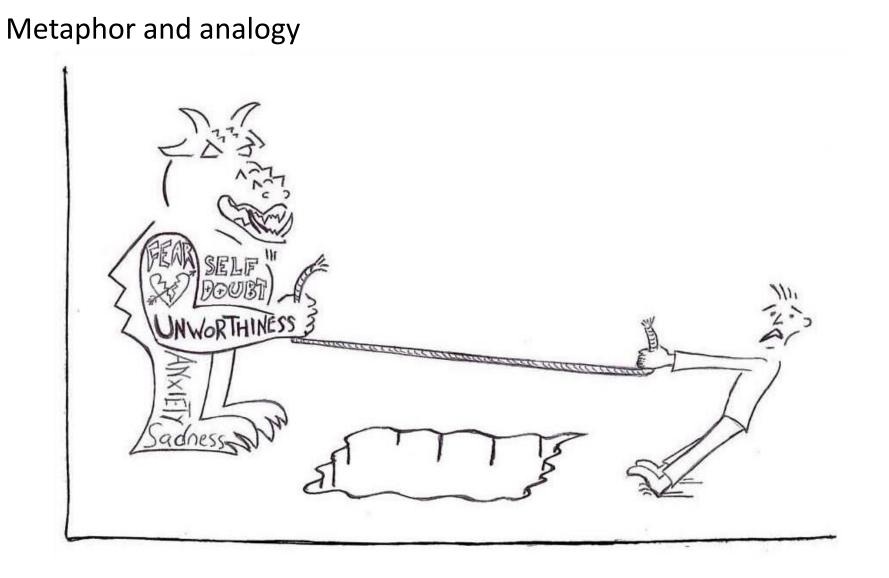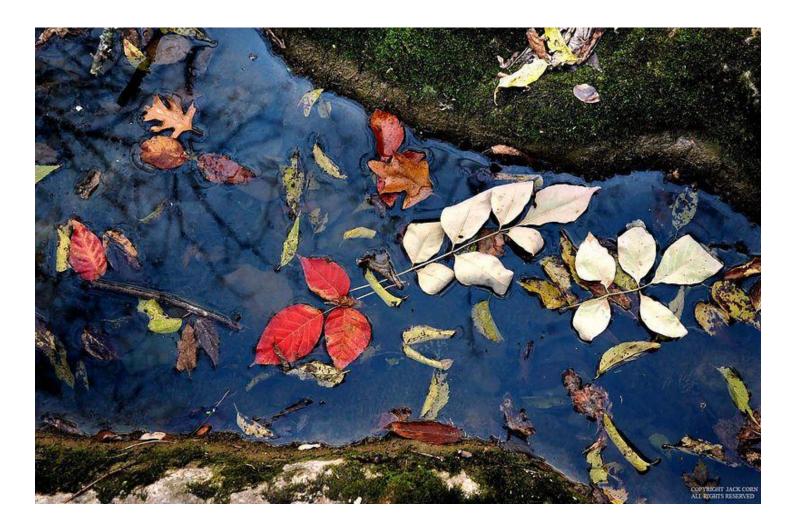
The CBT viewpoint

The ACT viewpoint

The ACT viewpoint: Some Techniques

Cognitive de-fusion

The ACT viewpoint: Some Techniques

Acceptance

ACCEPTANCE

IT'S RAINING

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I don't like rain.
It makes me gloomy.
I wanted it to be sunny
and head to the beach.
Why is it raining ?

Yup

@speakinggrey

The ACT viewpoint: Some Techniques

Metaphor and analogy

The ACT viewpoint: Some Techniques

Self-as-context

So…does ACT work?

Like every other therapy: hard to say

There is a wealth of evidence for behavioural principles

There is a wealth of evidence for derived relational responding

There is some evidence for ACT's effectiveness for some things (depression, anxiety)

There is less evidence for ACT's effectiveness for others

So…does ACT work?

A fully radical behaviourist view recognises the limits of clinical intervention on individuals

As an individual we should accept pain, but as a society we should not

So...does ACT work?

I'm a psychologist – and I believe we've been told devastating lies about mental health

Sanah Ahsan

Society's understanding of mental health issues locates the problem inside the person – and ignores the politics of their distress

Summary

- Naming is not explaining
- Radical behaviourism is not methodological behaviourism
- RFT extends the behavioural account of language
- ACT harnesses the RFT conception of language
- The logic of therapy should not preclude striving for better material conditions

Thank you for your attention!