
Is the 100-Car-Study a 1000-Answers-Study?

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The claim of the study

Naturalistic data are produced because

- Drivers were given no special instruction
- No experimenter was present
- Instrumentation was unobtrusive
- Majority drove their own vehicles

„The naturalistic approach fills out a void in our existing driving safety research methods. Specifically, it provides much greater information regarding the pre-crash and crash events... Furthermore, the data provides **much greater external validity** relative to the larger context of driving...”

„[Other methods] are not well suited **to explain the combination of factors leading to an adverse driving event.**”

Points to discuss

Empirical science has two major working fields

Description: representing the world by data within a conceptual framework

Do naturalistic studies have better data?

Explanation: investigating relationships between antecedent conditions and effects

Do naturalistic studies give better explanations?

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How naturalistic is NATURALISM?

Each reproduction of the world is

- at least a selection and
- In arts mostly more „natural“ than its original

The same holds true for naturalistic observation:

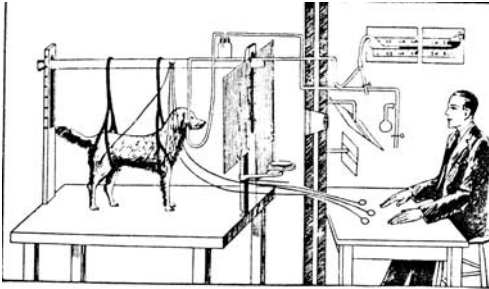
- It is a selection out of the world and
- Is compressed into a „typical“ category

Therefore, naturalistic observation **is not true per se**, but is like other methods a representation of the world, selected and controlled by the researcher



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Are there non-naturalistic observations?



Classical conditioning - Pavlov's dog

„Mind reading“ – Berkeley Lab



Observations of the outer world are always „naturalistic“ – what else?

The problem lies in the measurement issue: are there interactions between the observed object and the methodological access?

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Naturalistic is not a new data quality

Therefore, „naturalistic“ cannot mean

- True or
- Real

But may be characterized by a more or less withdrawal of the researcher with the result of

- A mostly uncontrolled environment where the behavior under study is shown (the „field“ feature)
- **Waiting for, instead of provoking behavior**

Therefore, data from a „naturalistic study“

- are like other methods designed by a researcher and
- have to meet the same criteria (validity) like other methods

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External validity

The study claims to have greater external validity. The meaning of external validity in this case:

To which extent reflect the data

- Of 100 selected drivers
- In an instrumented vehicle
- In the environment of Virginia
- And

the driving behavior in general?

Three main endangerments of external validity

- Researcher influence: selection of subjects, research design...
- Obstrusiveness
- Self-selection

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Obstrusiveness

Be D the difference between the true value and the measured one. The obstrusiveness is the part of D which is caused by the fact of measurement itself. It is a systematic error (bias) which can be

- Qualitative: subjects show qualitative different behavior (e.g. social desirable) or
- Quantitative: less or more

When being observed.

It would be difficult to investigate the variable „picking one's nose" in the lab by direct observation.



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Effects of Accident Data Loggers (ADL)



Year	Where	Number	Results
1994-95	EU-Project SAMOVAR	341	-28%
1997-98	Police Berlin	380	With ADL -8% Without +13%
1998	BAST – young drivers	2494 with 2067 manyears, 41.9 Mio km	No reduction in accidents, but 23.1% less violations
1999	Rotterdam	100	With ADL -27%
2000	Bavaria Emergency	ALL	Significant reduction

The authors claim that drivers feel themselves not observed – some questions remain...

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Self-selection



The main advantage of observational studies is **to wait for, not to produce behavior**. At the same time, this is the main disadvantage of the method.

Suppose, a behavior is caused by the influence of a person and by the influence of a given situation.

	S1	S2	S3	...	
P1		x			Σ
P2	x				Σ
P3		x	x	x	Σ
P4					Σ
...	x			x	Σ
Pn		x	x		Σ
	Σ	Σ	Σ	Σ	$\Sigma \Sigma$

Row totals depend on different situations, column totals on different persons

The description of a behavior in different situations is based on data from different drivers. The driver can decide whether he will run into a given situation or not – self-selection

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From measurements to events



Data are indexed three-fold: $X(p,v,t)$

- Person p
- Variable v
- Time t

Defining an event e on variable v and aggregating for frequency of e results in a new variable

- $X(-,v,-)$

The statistic X is only meaningful if

- the occurrence of event e is independent from person p and time t or
- Event e may happen with same probability to each person p at each time t

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Evidently this is not the case for all critical events



Table RO.5. Number and percentage of drivers involved in multiple events.

Number of Crashes	Percentage of Drivers	Number of Near-crashes	Percentage of Drivers	Number of Incidents	Percentage of Drivers
0	64.5%	0	16.8%	0	7.5%
1	21.5%	1	7.5%	1-5	9.3%
2	6.5%	2-4	27.1%	6-10	3.7%
3	3.7%	5-8	27.1%	11-15	0.9%
4	3.7%	9-12	3.7%	16-20	3.7%
More than 4	0.0%	13-24	13.1%	21-25	5.6%
		25-50	2.8%	26-30	4.7%
		More than 50	1.9%	31-40	8.4%
				41-50	7.5%
				51-100	16.8%
				101-150	16.8%
				151-200	11.2%
More than 200	3.7%				

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The real advantage



Therefore, like for all observational methods, the 100-Car-Study find its limitations

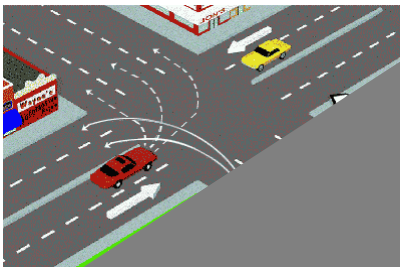
- in the unknown obstrusiveness of the method
- In the self-selection of driving situations and

But: what is the real advantage of the 100-Car-Study?

Example: Does phoning influence the accepted time gap during a left turn?

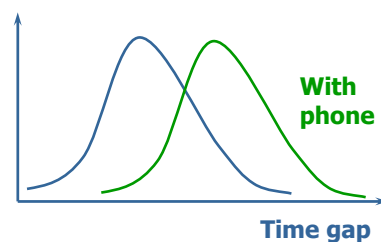
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Traditional observation results



Left turn at a crossroad with oncoming traffic
Parameter: accepted time gap
Method: Video analysis

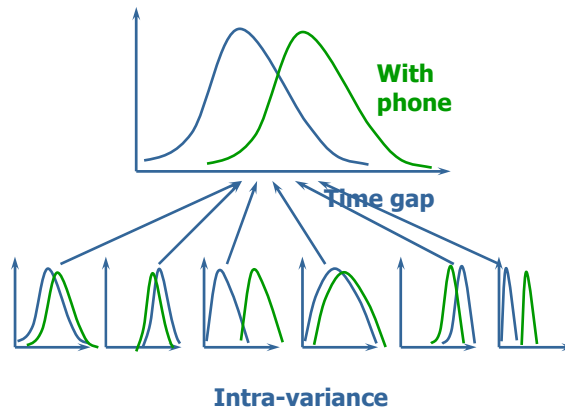
Distribution of observations



Independent observations

We have no chance to prove whether the effect is valid for each driver

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The longitudinal character of the 100-Car-Study gives the opportunity to prove the effect for each driver separately

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What is really new?

The new issue of the 100-Car-Study is the mass of individual data – allowing the researcher to evaluate the data on an individual base.

It is now possible to separate interindividual from intraindividual variance – a real progress for all kind of activities

Additionally:

Despite the huge amount of data, the study has only 100 degrees of freedom. The unit of observation is the individual driver.

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The second claim is to explain the combination of factors leading to an adverse driving event

Explanation means

$$p \rightarrow q$$

to prove whether p is a sufficient and necessary precondition of q

The method in Volume 3 of the study report: Define adverse event and search for antecedents

$$(p \rightarrow q) \wedge q \rightarrow p$$

Assumption
- find effect
look for cause

Ex ante procedure: MODUS PONENS as base of all experimental methods

If $p \rightarrow q$ and p is given then q will follow

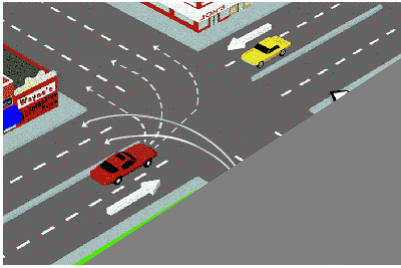
p	q	$p \rightarrow q$	$p \rightarrow q \wedge p$	$p \rightarrow q \wedge p \rightarrow q$
W	W	W	W	W
W	F	F	F	W
F	W	W	F	W
F	F	W	F	W

Ex post procedure: Rationale in 100-Car-Study – no tautology

If $p \rightarrow q$ and q is given then p was the antecedent

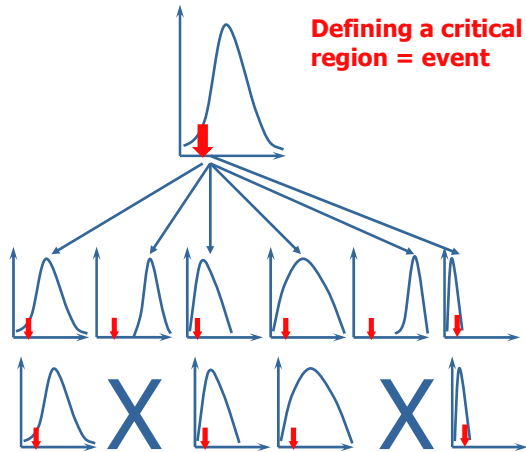
p	q	$p \rightarrow q$	$p \rightarrow q \wedge q$	$p \rightarrow q \wedge q \rightarrow p$
W	W	W	W	W
W	F	F	F	W
F	W	W	W	F
F	F	W	F	W

The 100-Car-procedure



Left turn at a crossroad with oncoming traffic

Parameter: accepted time gap



Results in a selection of drivers

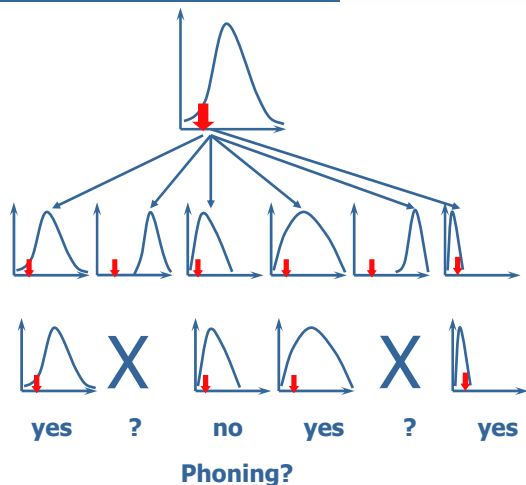
The effect of event definition:
Reduced sample of drivers

The next step of the evaluation:
We observed x critical incidences. In how many cases the driver had a phone call?

Result:

In y% the drivers had a phone call.

What does that mean?



In fact: nothing. It is impossible to prove an implication $p \rightarrow q$ by looking for the antecedents of q

Result



The study is not more naturalistic than many others – its main advantage is its longitudinal character and the opportunity to prove effects on an intraindividual base – e.g. **driver typologies and especially learning histories**.

The impressive body of data can be used for descriptive purposes, especially to estimate the size and importance of safety problems –e.g. **what should be done next?**

The benefit of more and more extended „naturalistic studies“ will be asymptotic – greetings from GAUSS and his normal distribution

Especially if parameters are correlated, multidimensional distributions will result with very small numbers of extreme values (e.g. a crossroad **and** phoning **and** oncoming traffic)

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Result



The data can only in part be used for explanatory purposes. Processes of self-selection and the conclusions from effect to cause **forbid causal interpretations of the results**. This essentially is true if data acquisition is event-triggered.

Therefore, the associations found in the material must be seen als heuristic – with studies like this one **we will have better questions**

Only explanatory methods (experiment) reveal the causes of behavior and are therefore suited to develop adequate countermeasures – **you cannot substitute brain by data**.

Testing these countermeasures with „naturalistic studies“ will be too time and cost consuming and should better done in carefully designed experiments with deliberately chosen samples.

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Thank you