

Supplementary Material

1 Supplementary Material A: Epistemological sensitization text

In psychology, it is common that various studies, or different experts, result in contradictory facts. Frequently, there are one or more theories on the same topic. This phenomenon is called competing validity claims. On the one hand, competing validity claims are explicit contradictions concerning the different scientific facts made by different experts. On the other hand, the resulting inconsistency (missing cohesion) about the same phenomena can be discussed in theoretical and methodical perspectives. Competing validity claims may involve research findings, theoretical assumptions, methods, or marginal conditions of research findings, so basically involving every possible piece of scientific knowledge.

What are the reasons behind competing validity claims? Firstly, there is the possibility of revising scientific knowledge. Scientific progress always relies on the consent of the researchers in a scientific community. This consent enables scientists to extract what can be seen as “true” at a given moment and is, therefore, always preliminary. But there also exists consent for well-proven knowledge which, practically, will not be revised again. In psychology, this holds for, e.g., the knowledge about the visual perception, as well as the influence of groups on individual decisions. In comparison to this is knowledge of phenomena that is currently under investigation. That kind of knowledge may be less certain and can be revised at any time, but the acquired data provides new insight, even if contradictions arise.

Another reason for competing validity claims is different scientific data collection methods. The collected data are the result of a measurement process that holds under certain theoretical assumptions. Therefore, data are only valid with regard to theoretical assumptions of the measurement. Hence, when different studies, or different researchers, rely on different theoretical assumptions, a different interpretation of the outcomes may arise, which in turn leads to competing validity claims. A different reason for competing validity claims is related to potential problems within a study. The use of scientific methods, or the interpretation of data, is frequently bound to problems that result in insufficient or controversial data, various interpretations, or the uncertainty of the direction of causality in scientific models.

Besides these reasons, the paradigms found in a domain may constitute possible reasons for competing validity claims, as well. The paradigm of a domain not only determines the research topics but also determines the data collection methods. But what is a paradigm? The paradigm includes accepted terminologies, theoretical assumptions, empirical relations, and fundamental beliefs, norms, values, models, analogies, and metaphors. Besides, the paradigm contains rules for construction, examination, and modification of theories and hypotheses accepted by researchers.

The last reason for competing validity claims can be assigned to the difference between explanatory and interventional knowledge. Explanatory knowledge helps to clarify a specific issue by drawing on scientific theories. But having an explanation may not automatically yield a change towards the desired state. For this, interventional knowledge is needed. Explanatory and interventional knowledge only correlate indirectly. An example thereof is the relation between correlation and causality, e.g., a correlation may never be interpreted in terms of causality.

To sum up: contradictions are the foundation of the nature of science. Scientific work downright entails contradictions that can either be resolved or even lead to new contradictions. That is why it is important to acknowledge possible reasons for contradictions and to be able to evaluate which claim relies on more suitable arguments.

Please note that the number of words and the Flesch reading score in the main text refers to the German version of the sensitization text that was provided to the participants.

2 Supplementary Material B: Controversy example “Learning from pictures

Learning objectives:

- Recognize that theories have a limited range of validity
- Learn that an important goal in research is to delineate the range of validity
- Recognize that contradictions between research findings may be caused by certain boundary condition or moderator variables

Mister Holzmer works at the Department of Education Psychology at the University of Franzenheim. He designs a new teaching method (“Learning from pictures”) and evaluates its effectiveness with a sample of 120 primary school students in the second year taught by the same teacher. In comparison to a conventional teaching method, the results reveal positive effects of the new teaching method. Mister Holzmer therefore recommends teachers to use the new teaching method.

His colleague, Mister Mertes, evaluates the new teaching methods again using two samples of secondary school students between twelve and fourteen years. In a sample of 80 twelve year-old secondary students as well as in a sample of 70 fourteen year old students (all taught by the same teacher) there is no evidence of the effectiveness of the new teaching method. In both samples, the learning outcomes were not higher in comparison to a conventional teaching method. On the contrary, there are cases in which the learning outcome decreased. Mister Mertes there highly recommends not using the new teaching method.

Comparison of the two studies

Mr. Holzmer’s study (primary school students):	Mr. Mertes’s study (secondary school students)
<i>Methods:</i> large sample size but small effect size; experimental design with control group	<i>Methods:</i> large sample size but small effect size; experimental design with control group
<i>Sample:</i> only primary school students in the second year	<i>Sample:</i> secondary school students between twelve and fourteen years
<i>Conclusion:</i> recommended to use the method but without regarding the target group	<i>Conclusion:</i> recommended not to use the method but without regarding the different target group in this study

Please reflect on the following questions:

- Which researcher is right and why?
- Is the teaching method recommended?

3 Supplementary Material C: Coding scheme and examples

3.1 Coding criteria

The coding criteria for the argumentation task are as follows:

0 points: The participant did not answer the task.

1 point: The participant indicates one-sided, i.e., one side of the controversial topic is correct.

2 points: The participant indicates one-sided but also indicates that there may be a second point of view, which is equally right.

3 points: The participant indicates that both points of view are correct.

4 points: The participant indicates that both points of view are correct, but there is the possibility that depending on the circumstances, one point of view may be more suited than the other.

5 points: The participant indicates that the available evidence has to be evaluated according to the given circumstances, which point of view is correct.

6. points: The same as the criterion for five points, but the participant indicates that both points of view may change according to new research.

The points assigned reflects absolutist, multiplicitist, and evaluativist beliefs as follows:

1-2 points: absolutist beliefs

3-4 points: multiplicitist beliefs

5-6 points: evaluativist beliefs

3.2 Explanatory note to the coding criteria

1 point reflects a pure absolutist belief, i.e., a one side argumentation. 2 points reflect an absolutist belief but the argumentation style provides some indication of a transition towards multiplism, e.g., it is argued that one account is right but there is a slight chance that the other is right, too. To be judged in 1 or 2 points it is important that there is no justification why the respective account is right.

3 points reflects a purely multiplist beliefs, i.e., both sides are considered as equally valid accounts. To be judged 4 points, there must be an argumentation style that provides some indication of a transition towards evaluativism, e.g., if there is a remark that it is possible to give a justification for one account.

5 points reflect an evaluativist belief, i.e., both sides are judged and there is a justification why the argument for one side is made. 6 points indicate an evaluativist belief yielding a justified choice of one side and also the expression that this may change in the light of new evidence.

Please note that the difference between absolutism and evaluativism lies in the acknowledgement of a reason why one account is to be preferred over another account.

3.3 Example “Depression scenario” and essay task

Worldwide over 350 million humans suffer from depression, which makes the disease a common and widespread illness of our time. However, the causes of depression are still unknown. The following articles want to shed light on the causes of depression.

A scientific contribution by Prof. Dr. R. Weiland

The main cause of depression is an excessive number of serotonin receptors in the brain. Those serotonin receptors, based in the brainstem, operate antagonistically to the receptors in the synaptic cleft. Once the serotonin molecules activate the receptors, the production of new serotonin is stopped. The more receptors the human brainstem has, the less the level to stop the serotonin production. To prove this, an experiment on mice was performed. The mice had a genetically modified number of serotonin receptors in the brainstem. Mice with an above-average number of serotonin receptors reacted barely or not at all to an SSRI, a drug that reduces the overall level of serotonin. But mice with a lower number of receptors showed a relatively fast effect. Due to this result, scientists concluded that humans with a higher number of serotonin receptors in the brainstem may be more likely to suffer from depression and react badly to antidepressants, e.g., in the form of SSRI.

A scientific contribution by Prof. Dr. W. Zimmer

Sleep deficits can cause depression. Weariness may influence the coping of stress as well as social interaction. Furthermore, judgment and concentration are affected. Hereto, 16.000 adolescents and their parents were interviewed. Data was collected regarding symptoms of depression and suicidal ideation in association with sleep deficits. The statistical analysis concluded that the respondents who go to bed early have far less risk of suffering from depression. 24 percent of adolescents who are used to go to bed past midnight suffer more frequently from depression. Suicidal ideation was about 20 percent higher in comparison to the adolescents who are used to go to bed at about 10 pm. Regarding the sleeping schedule, 54 percent of the parents stated that their children have to be in bed by 10 pm on a school night, while 21 percent stated 11 pm and 25 percent stated (later than) midnight. Bedtime and depression correlate according to the information given by the adolescents. The risk of depression was 71 percent for all those who regularly sleep less than five hours per night in comparison to eight-hour-sleepers. Suicidal ideation occurred 48 percent more.

The participants received the following essay task

“In both texts, the cause for a depression disease, either in the form of the number of serotonin receptors or due to sleep deficits, was discussed. Comment on this controversy and explain your conclusion.”

3.4 Coding criteria examples

The following table B1 provides examples for phrases that indicate a category from the scoring scheme criteria of the argumentation task (depression scenario).

Points	Examples	Epistemological belief level
1	<ul style="list-style-type: none">- I think that only the serotonin level has something to do with depression.- In my opinion, a sleep deficit is the only cause of depression.- Prof. Weiland is right.	Absolutist
2	<ul style="list-style-type: none">- I think that the serotonin explanation is right, but perhaps sleep may also have to do with depression.- In my opinion, a sleep deficit is the main cause of depression, but other biological factors may also play a role.- Prof. Weiland is right, but it may be that Prof. Zimmer may provide an account for depression.	
3	<ul style="list-style-type: none">- In my view, both the serotonin receptor account as well as the sleep deficit hypothesis are equally good explanations.- Both the serotonin receptor hypothesis and the sleep deficit hypothesis explain the occurrence of depression.- The sleep deficit and the serotonin level are the opinions of these two researchers.	Multiplicist
4	<ul style="list-style-type: none">- In my view, both the serotonin account as well as the sleep deficit hypothesis are equal good explanation but there may be circumstances in which one view gains more importance.- Both the serotonin hypothesis and the sleep deficit hypothesis explain the occurrence of depression, except for certain factors in which either the serotonin or sleep deficit is more important.- The sleep deficit and the serotonin level are the opinions of these two researchers, but who knows, sometimes one thing counts more than the other thing.	

Points	Examples	Epistemological belief level
5	<ul style="list-style-type: none"> - I think it depends on the diagnosis, for instance, when patients have sleep deficit and the serotonin level and the number of receptors is normal, then this may be the more appropriate explanation. - When a patient has indeed more serotonin receptors and a normal to above normal serotonin level, then this is a better explanation especially, when there is no sleep deficit. - Depending on the circumstances, either the sleep deficit or serotonin level theory may be a more appropriate explanation. A diagnosis if there is a sleep deficit or an abnormally high level of receptors may reveal which theory fits better. 	Evaluativist
6	<ul style="list-style-type: none"> - I think it depends on the diagnosis, for instance, when patients have sleep deficit and the serotonin level and the number of receptors is normal, then this may be the more appropriate explanation but future research may provide even better theories of depression. - When a patient has indeed more serotonin receptors and a normal to above normal serotonin level, then this is a better explanation, especially when there is no sleep deficit. Still, perhaps more research is needed to fully uncover what is going in the etiopathogenesis of depression. - Depending on the circumstances, either the sleep deficit or serotonin level theory may be a more appropriate explanation. A diagnosis if there is a sleep deficit or an abnormally high level of receptors may reveal which theory fits better. On the other hand, I think future research will give a more detailed account of depression. 	

4 Further materials

All other materials not provided in this supplement are available in German on request from the corresponding author.