The Round-Trip Fallacy

Christoph Bamberg
Ruhr-Universität Bochum

Introduction

In this essay I will explain the concept of the *Round-Trip Fallacy* and show that it is a distinct reasoning mistake. The round-trip fallacy involves inferring from the absence of evidence of an event the conclusion that there is evidence for the absence of this event. I claim that this is a widely committed and potentially hazardous mistake. First, I present Nicholas Taleb's original account of the round-trip fallacy (Taleb 2007). Then, I will develop this fallacy in such a way that it can be used as a precise tool for analysing reasoning mistakes, thereby going beyond Taleb's original formulation. I argue my account of the fallacy is distinct from Taleb's in important ways. Lastly I show how a mistake in scientific reasoning exemplifies the fallacy and I will offer a proposal for countering such shortcomings in the research process. The contribution of this work is a more precise definition of the round-trip fallacy. I think the limits of our reasoning-capacity become clearer through this inquiry into failed reasoning.

Fallacious reasoning in general

In its ideal form, reasoning can be characterized as abiding by certain constraints from logic, e.g. truth- preservation (Stenning and Van Lambalgen, 2008), updating hypotheses in light of evidence (Bradley, 2015), and neutrality with respect to non-epistemic values (see Bueter, 2015 for a discussion). On a methodological level, Popper's falsificationism, Lakatos' research programs (Lakatos 1970), Kuhn's concerns with the scientific community and other notions influence the ideal of scientific reasoning significantly (Mulkay and

Gilbert, 1981).

While these norms are part of ideal scientific reasoning, real reasoning diverges in systematic ways from this archetype. Reasons for this divergence lie within the limits of our cognitive capacities and a preference for fast and effortless processing. Loosely defined, a fallacy is a characteristic failure in reasoning ("Fallacy" (n.d.) §1.1), characteristic because the same mistakes occur in similar situations. A further aspect of fallacies is that the reasoning seems valid for the one committing the fallacy and other reasoners tricked by the fallacy (Walton, 1999).

We can use fallacies to explain mistakes in reasoning. Consider the fallacy of *affirming of the consequent* (Geis and Zwicky, 1972). Imagine somebody says that she smoked cigarettes for the last thirty years and was diagnosed with lung-cancer recently. Of course, you know that smoking may cause lung-cancer. It seems obvious that her smoking caused the lung-cancer. Yet this is not necessarily true. Maybe she tells you in the next sentence that she worked in an asbestos-factory in the same period of time, also a very likely cause of lung-cancer (Uguen et al., 2017). The conclusion that smoking caused the cancer seems valid yet the truth of the consequent (the occurrence of cancer) does not imply the truth of the antecedent (smoking cigarettes as a cause) and concluding that the antecedent is true is not warranted by the accessible information (Geis and Zwicky, 1972). Explicating the fallacy in this way makes evident that the judgement is logically invalid; fallacies can help explain mistakes in reasoning. Furthermore, such errors are more likely in similar situations. This can be helpful for building structures that counterbalance predictable non-ideal performance. The analysis of the round-trip fallacyis similarly useful for correcting reasoning.

The round-trip fallacy as described by Taleb

Nicholas Nassim Taleb identifies a reasoning mistake in his book *The Black Swan* that he calls the R*ound- Trip Fallacy* (Taleb, 2007). Taleb's description of the fallacy is brief; he explains his idea by giving examples of the fallacy. I will try to refine his idea in more precise terms in the course of this essay. He asks us to imagine someone who, having observed a limited set of data which does not include any surprising, impactful event, "would tell you, and rightly so, that there is *no evidence* of the possibility of large [impactful] events (Taleb, 2007) (italics in original)." The mistake in reasoning is:

> You are likely to confuse that statement, however, particularly if you do not pay close attention, with the statement that there is *evidence of no possible* [surprising and impactful events]. Even though it is in fact vast, the logical distance between the two assertions will seem very narrow in your mind, so that one can be easily substituted for the other. I call this confusion the round-trip fallacy, since these statements are not interchangeable (Taleb, 2007).

Note that Taleb's reference to evidence of "no *possible*" events is likely an unintended error. The examples Taleb gives to illustrate the round trip fallacy do not refer to "impossibility" or imply that the unobserved event is "impossible." If a patient receives a negative result for a cancer-screening, the doctor may infer – mistakenly – that there is evidence of the absence of cancer in the patient's tissue – thus the round-trip fallacy – but it is hardly likely that the doctor would infer that it is *impossible* for the patient to have cancer. After all, cancer is still *conceivable*, the screening doesn't show it is an *analytical truth* that the patient is cancer-free.

Refining the account

Although Taleb's description sparks interest, it lacks precision. Taleb's description of the fallacy stays on an intuitive level and does not make explicit why the fallacy is a fallacy in the first place. The reader of his account therefore left with the intuition that "something seems wrong" about the described reasoning and may feel a sense of unease. We need to explain the idea that "these two statements are not interchangeable (Taleb, 2007)." Statistical terminology lends itself well to this task since the core of the fallacious reasoning is an unjustified inductive inference. Three main elements of the round-trip fallacy can **be** derived from Taleb's account in *The Black*

Swan:

> There is absence of evidence of a particular event x.
> There is evidence of absence of this particular event x.
> Absence of evidence of x → evidence of absence of x.

Consider a draw of observations from a set which may contain a particular event x. Let's assume there is a chance bigger than zero that you do not observe x in your draw. The first statement says you do not have evidence that x is in the set, since you have not observed it and the second statement means that one may be able to rule out the observation of event x in the set of events. The third element of the round-trip fallacy expresses the conflation of the general claim with the observational statement. This conflation of observation with the general claim is decisive. Someone observes absence of event x, believes that this implies that this is evidence for no event x and draws the conclusion that there is evidence for the absence of x. Now the question arises whether this belief, that the one statement can be inferred from the other, is justified. That is, can "no evidence of x" be exchanged with "evidence of no x"? If the second statement was entailed by the first, the inference to the second statement would be warranted. This is a decisive question that Taleb skips over. Moreover, he fails to delineate when the inference is justified and when it is not.

He mentions that there is a vast *logical distance* between the two statements though they may seem close to each other – the warrant for inferring from the first to the second statement is weak. "Evidence of no x" is not entailed by "no evidence of x," that is, there is no valid deductive inference from one to the other statement. Additionally, one may make an inductive inference from "no evidence of x" to "evidence of no x" but it comes with high inductive uncertainty, and whatever basis it has depends on what set of events we draw the observations from. A toy example may help illustrate the point. Take an idealized draw from an urn which either contains 100 balls of all the same color (e.g. 100 blue balls) or of two different colors equally distributed (e.g. 50 blue and 50 red). You do know these two possibilities but not which set-up is the case. If you draw 49 blue balls, you observe "no evidence of red balls." You cannot claim that you have evidence that there are no red balls yet it is very likely that there are only blue balls in the urn. Thus, the inductive inference to the claim there are only blue balls in the urn is well supported by the empirical evidence however it is not necessitated by it. In this example, the inferential basis for inferring from "no evidence of x" to "evidence of no x" is strong. Now suppose you observe 51 draws of blue balls and know the two possible set-ups of the urn, you could say with certainty that the urn only holds blue balls and that you have evidence of the absence of red balls. In this case the absence of red balls and the knowledge about the urn allows the inference that there are no red balls in the urn. Yet in the real world we usually do not have such information and more importantly, the assumed distributions from which such events are drawn are less idealized and more unpredictable.

Surely, justified inductive inferences have to be distinguished from cases where the round-trip fallacy can arise. The fallacy can occur when the observations you are trying to generalize from are not representative enough to support the generalization. This can be the case when the number of observations on a set of events is too small relative to the size of the. Claiming that there are only blue balls in the urn after having observed 10 blue balls is misjudging the distance between these 10 observations and the claim that there is evidence for the generalization that there are only such balls. Furthermore, the fallacy can occur when the events one observes do not follow a discernible pattern or cannot be assumed to be distributed amongst a Gaussian, uniform-distribution, or any other such well-known statistical distribution. You can find yourself in such a situation when you don't know that the events **do not (!)** fit a Gaussian distribution or that there are many more possible observations. Also,

one might willfully disregard missing evidence or the lack of uniformness of events one is concerned with. In such cases, the difference between "absence of evidence of x" and "evidence of absence of x" is overlooked.

From this discussion it may have become apparent that a critical cause of the round-trip fallacy is poor understanding of statistics. A key claim of *The Black Swan* is that the social world we move around in is too often falsely perceived, by experts and lay-people alike, as containing regularities, e.g. following a Gaussian distribution, when in reality it is quite unpredictable and volatile (Taleb, 2007). Thus, even though my account of the round-trip fallacy goes well beyond Taleb's initial formulation, it still stays true to his general claim. The round-trip fallacy is one manifestation of how mischaracterization and oversimplification of our reality arises out of a misconception of statistical representativeness and likelihood-distributions. An integral aspect of fallacies is that those who commit the fallacy are not aware of the mistake and the drawn inference appears valid (Walton, 1999). This aspect seems to be present in the round-trip fallacy since the misconception of the distance between the two central statements makes the inference seem valid.

In sum, then, the round-trip fallacy is committed when one makes a mistaken inductive inference from the absence of evidence of x to the conclusion that there is evidence of the absence of x. I have described how this fallacy arises and what statistical notions it is based upon. It may seem as if the round-trip fallacy is just a variant of other types of fallacious generalization. I will consider this possibility in the next section.

Examples of reasoning mistakes through the round-trip fallacy

The pervasiveness of the round-trip fallacy can be seen in diverse examples. I will look at examples from science, medical practice and reasoning in the financial sector. A scientific example is the search for extraterrestrial life.

Projects such as the Voyager program, the Hubble Space Telescope and other international space programs yield much information about the make-up of other solar-systems (Swain et al., 2008). So far, no evidence for extraterrestrial life has been found through these programs. To conclude that this is evidence of the absence of extraterrestrial life would be an instance of the round-trip fallacy. Especially since space is vast and only a fraction of it was ever observed, the logical distance between "no evidence of extraterrestrial life" and "evidence of no extraterrestrial life" is vast and inferring the second from the first statement is not supported by the premise. Here it may seem unlikely that one would commit the round-trip fallacy since the logical distance between the two statements is quite apparent and the inferential basis for such an inference is obviously weak. In the next example this distance is subtler. In order to assess whether a patient has cancer or not, a sample of tissue is usually taken to be tested for cancerous cells. The doctor attempts to take a sample as representative as possible. If the test is negative, the doctor did not observe evidence for cancer. If she claims, based on the negative test and without considering further tests, that she has evidence that the patient does not have cancer, she is committing the round-trip fallacy (Taleb, 2007). The absence of cancerous cells is not proof that there is no cancer in the body. Yet at first glance this may seem as a valid medical assessment. The third example shows that the round-trip fallacy is commonly committed, even by experts. An example from economics is the financial crash associated with the dot-com bubble burst. If you look at the stock market-valuation of internet and technology companies in the U.S.A. between 1995 and March 2000, you would see a steady increase in their value and "no evidence of a crash." One might draw the inference that this is "evidence of no crash" for the future. But that would show overconfidence in the resilience of the stock-market, falsely based on the reassuring good performance ofthe last few years. Such reasoning is an instance of the round-trip fallacy because the distance

between "no evidence of a crash" and "evidence of no crash" is vast logically. Furthermore, the burst of the bubble on March 10, 2000 shows that drawing this inference can have dire consequences. The 2008 financial crisis, caused by a mortage-bubble, the "Great Crash" of 1929 and other such crashes show that this is a reoccurring phenomenon (Ferguson, 2008). In part this is due to the fact that investors look at the absence of a crash in the last years and the rising performance of their shares and then reason to the conclusion that the market will continue to develop like this in the future or at least for now. Yet they miss the fact that their observation alone does not warrant this inference. The round-trip fallacy can be found in the reasoning of doctors, investors and lay-people alike and does not seem restricted to a particular domain of reasoning.

These examples show that the round-trip fallacy can arise in a variety of situations, sciences and with varying impact. I will now give a more in-depth account of research on lead-poisoning to show that scientists committed the round-trip fallacy when searching for the dose-effect relation for lead. Lead is a highly toxic heavy metal affecting virtually all organs and especially the developing nervous system (Mushak, 2011). Thus, it is important to know the relation of lead-dosage to health risk for children. Scientists and policy makers are interested in finding out the threshold of lead concentration above which negative health effects can be observed.

Observational studies and case studies of children exposed to lead in their environment accumulated between 1920 and 1940 (Rabin, 1989). The studied toddlers and young infants ingested the lead paint of their cribs, toys and children's rooms and suffered from severe symptoms of Plumbism such as vomiting, abdominal pain, irritation, anemia, lack of muscular coordination, peripheral motor paralysis, etc. (Byers and Lord, 1943). The mounting evidence led the American Centers for Disease Control and Prevention (CDC) to issue a policy statement which categorized blood lead levels above 60µg/dL as requiring medical intervention (Centers for Disease Control and Prevention (2005)). This threshold was subsequently lowered in light of more accurate testing to a level of 10 µg/dL (*ibid.*). It may look like an example of good scientific practice resulting in vital policy decisions. Yet the scientific community seems to have missed more subtle effects of lead-poisoning (Lamphear, 2005). This failure is an example of the round-trip fallacy. The evidence that was considered by the scientists included children with visible symptoms of lead-poisoning but there were no subjects with low levels of lead in their blood since this does not cause the symptoms the scientists were screening for (Sciarillo et al., 1992). The fallacy plays out in the following way. First, the observation is made that *there is no evidence that low levels of lead cause harm*. Infer from that *there is evidence low levels of lead do not cause harm.* As a result of this wrong inference a threshold is postulated below which lead is not supposed to be harmful which is exactly what the CDC's guidelines did. For instance, Lamphear et al. (2005) found more subtle effects of low levels of lead by analyzing effects on IQ measurements of subjects with lead-levels below 10 µg/dL. They did not find any "safe" level of lead when considering the more elusive effects on intelligence.

The occurrence of the fallacy is partly due to the sampling of the studies. Since the researchers included only subjects with certain physical symptoms, the sample was not representative of all symptoms associated with lead exposure. The toxic effects of lead are multifarious, the investigating scientists came from different backgrounds and consequently the research lacked coordination (Mushak, 2011). This facilitated susceptibility to the round-trip fallacy. This example shows that the scientific community may commit the round-trip fallacy and that taking note of this mistake helps explaining the reasoning by the scientists.

A proposal to counter the round-trip fallacy

The mistakes committed in the research might have been avoided if the scientific community had implemented the right procedures. I will consider a proposal by Hugh Lacey regarding approaches to hypotheses and whether his notion can counter the round-trip fallacy (Lacey, 2005). *Holding*, *adopting* and *endorsing* are three attitudes one can take to a theory (*ibid.*). I claim that researchers on Plumbism unjustifiably *held* the belief that there are low-levels of lead without harm while they would have been more justified in seriously *endorsing* this belief. *Holding* a proposition means treating it as "belonging to the stock of established scientific knowledge (*ibid.*)." You are only justified in *holding* a proposition if all lines of research that could falsify the proposition have been exhaustively examined, that is, all objections have been answered. The scientists researching lead poisoning failed this test because they did not consider children with different, more subtle symptoms. If they had, they would have found an effect of lead-poisoning at levels below the assumed threshold. When the regulatory body, the CDC, issued a policy statement proposing this threshold, the claim that low levels of lead have no effect was held at that time but was unjustified. Lacey acknowledges that in some cases one must proceed even though not all aspects of a topic have been reviewed (*ibid.*). In that case, *Endorsing* the proposition is the correct attitude, that is, one should treat it "as being supported by evidence that is sufficiently strong that the legitimacy of courses of action [...] informed by it, should not be challenged on the ground that [the proposition] has insufficient empirical support (*ibid.*)." Furthermore, a proposition may be seriously endorsed only if it was based on *inclusive research,* that is research by scientists representing the different ethical and social values of a democratic society, and is tested against the strongest available evidence. If the CDC had adopted the approach of seriously endorsing the threshold-claim, they might have added some cautionary remarks or qualifiers such as “it is likely that below 10 μg/dL no harm should be expected.” The scientists would have looked for effects of lower levels earlier had the threshold not been set thus confidently. Lacey’s different approach could have countered the effects of the round-trip fallacy. Establishing resistance against holding or endorsing an idea can prevent mistaken reasoning.

Conclusion

In this essay I considered the role of fallacies for explaining reasoning-processes. The round-trip fallacy was singled out as a distinct mistake in our reasoning. I took Taleb’s description of the reasoning mistake as a basis for precisely defining the fallacy as inferring the statement “*there is evidence of no x*.”from the statement “*there is no evidence of x*.” Contrary to appearances, this inference is not justified because the basis for moving from the first to the second statement is too weak in all but the most simplified cases, such as the example of drawing from an urn of red and blue balls as described earlier. The round-trip fallacy can occur in many different domains and especially in scientific inquiry. Within a well-structured scientific community, the resultsof the round-trip fallacy can be contained. I considered a proposal by Hugh Lacey for structuring scientific inquiry. If we understand the logical error at the core of the fallacy, we can learn how to adjust our institutions and environment to minimze the occurrence of this error.

Bibliography

Bradley, R. (2015). *A Critical Introduction to Formal Epistemology.* Bloomsbury Critical Introductions. doi:10.5040/9781474217781.

Bueter, A. (2015). “The Irreducibility of Value-Freedom to Theory Assessment” *Studies in History and Philosophy of Science Part A*, 49: 18-26.

Byers, R. K., & Lord, E. E. (1943). “Late effects of Lead Poisoning on Mental Development.” *American Journal of Diseases of Children,* 66 (5): 471-494.

Centers for Disease Control and Prevention. (2005). *Preventing Lead Poisoning in Young Children*. Atlanta: CDC.

Fallacy (n.d.). In *Oxford English Dictionaries.* Retrieved from https://en.oxforddictionaries.com/definition/fallacy

Ferguson, N. (2008). *The Ascent of Money: A Financial History of the World* Penguin.

Geis, M. L., & Zwicky, A. M. (1971). *On Invited Inferences.* Linguistic Inquiry, 2 (4): 561-566.

Lacey, H. (2015). “‘Holding' and ‘Endorsing' Claims in the Course of Scientific Activities.” *Studies in History and Philosophy of Science Part A*, 53: 89-95.

Lakatos, I. (1970). “Falsification and the Methodology of Scientific Research Programmes.” *Criticism and the Growth of Knowledge,* 4, 91-196.

Lamphear, B. P. (2005). “Low Level Environmental Lead Exposure and Children’s Intellectual Function: an International Pooled Analysis.” *Environmental Health Perspectives,* 113:7.

Mulkay, M., & Gilbert, G. N. (1981). “Putting Philosophy to Work: Karl Popper's Influence on Scientific Practice.” *Philosophy of the Social Sciences*, 11 (3): 389-407.

Mushak, P. (2011). “Lead and Public Health: Science, Risk and Regulation” *Science, Risk and Regulation*, 10. Elsevier.

Rabin, R. (1989). “Warnings Unheeded: a History of Child Lead Poisoning” *American Journal of Public Health*, 79 (12): 1668-1674.

Sciarillo, W. G., Alexander, G., & Farrell, K. P. (1992). ‘Lead Exposure and Child Behavior.” *American Journal of Public Health*, 82 (10): 1356-1360.

Stenning, K.; van Lambalgen, M. (2008). *Human Reasoning and Cognitive Science.* MIT Press

Swain, M. R., Vasisht, G., & Tinetti, G. (2008). "The Presence of Methane in the Atmosphere of an Extrasolar Planet” *Nature*, 452 (7185): 329.

Taleb, N. N. (2007). *The Black Swan: The Impact of the Highly Improbable Vol. 2.* Random House.

Uguen, M., Dewitte, J. D., Marcorelles, P., Loddé, B., Pougnet, R., Saliou, P., & Uguen, A. (2017). “Asbestos-related Lung Cancers: A Retrospective Clinical and Pathological Study.” *Molecular and Clinical Oncology,* 7 (1): 135-139.

Walton, D. N. (1990). “Ignoring Qualifications (secundum quid) as a Subfallacy of Hasty Generalization.” *Logique et Analyse*, 33 (129/130): 113-154.

Walton, D. (1999). “Rethinking the Fallacy of Hasty Generalization” *Argumentation*, 13 (2): 161-182.