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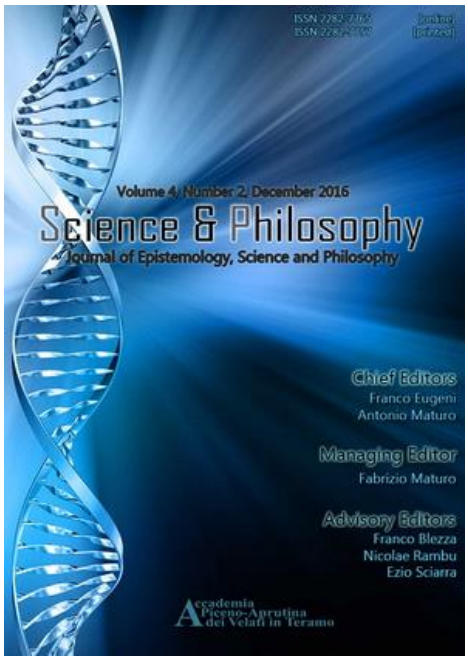

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Why is Bayesian Confirmation Theory rarely Practiced?

Robert W.P. Luk*

Abstract

Bayesian confirmation theory is a leading theory to decide the confirmation/refutation of a hypothesis based on probability calculus. While it may be much discussed in philosophy of science, is it actually practiced in terms of hypothesis testing by scientists? Since the assignment of some of the probabilities in the theory is open to debate and the risk of making the wrong decision is unknown, many scientists do not use the theory in hypothesis testing. Instead, they use alternative statistical tests that can measure the risk or the reliability in decision making, circumventing some of the theoretical problems in practice. Therefore, the theory is not very popular in hypothesis testing among scientists at present. However, there are some proponents of Bayesian hypothesis testing, and software packages are made available to accelerate utilization by scientists. Time will tell whether Bayesian confirmation theory can become both a leading theory and a widely practiced method. In addition, this theory can be used to model the (degree of) belief of scientists when testing hypotheses.
Keywords: Bayesian confirmation theory; hypothesis testing; induction problem; probability modeling.
2010 AMS subject classifications: 62F03;62F15. [1]

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1 Introduction

In the philosophy of science, Bayesian confirmation theory is one of the leading theories to decide the confirmation or refutation of a hypothesis based on probability calculus. The theory has supporters who try to rescue (e.g., [Schippers and Schurz, 2018]) it from challenges (e.g., [Chihara, 1987],[Wayne, 1995], [Shaffer, 2001], [Huber, 2005] and [Brössel and Huber, 2015]) or who try to extend (e.g., [Myrvold, 2003], [Crupi et al., 2008], [Henderson et al., 2010] and [Festa and Cevolani, 2017]) it for greater generality and applicability. Dawid [Castelvecchi, 2015] noted that it may be used to test whether string theory is science. Norton [2011] enumerated three theoretical advantages of Bayesian confirmation theory as follows:

> "First, the theory reduces the often nebulous notion of a logic of induction to a single, unambiguous calculus, the probability calculus. Second, the theory has proven to be spacious, with a remarkable ability to absorb, systematize and vindicate what elsewhere appear as independent evidential truisms. Third is its most important virtue, an assurance of consistency. The larger our compass, the more we must digest evidence of diverse form and we must do it consistently. Most accounts of evidence provide no assurance of consistency in their treatment of larger bodies of evidence."

Given many theoretical advantages of Bayesian confirmation theory, one would have expected that many scientists apply it for making decisions to accept/reject hypotheses. However, a casual sampling of scientific research articles (e.g., in Nature and Science journals) reveals that almost all such articles did not use Bayesian confirmation theory for hypothesis testing at present. Therefore, why is Bayesian confirmation theory rarely practiced by scientists for hypothesis testing?

2 The practical problem with the Bayesian confirmation theory

To confirm a theory in Bayesian confirmation theory, it is often required that the conditional probability, $P(H|E)$, of the hypothesis H happening given the evidence E should be larger than the prior probability of the hypothesis H without any evidence, i.e., $P(H|E) > P(H)$ where $P(\cdot)$ is the probability. This requirement is based on the notion that the scientist belief in the hypothesis H is revised with more degree of belief after seeing the evidence E compared with her/his initial degree of belief of hypothesis H. To calculate $P(H|E)$, it is based on the

conditional probability:

$$P(H|E) = P(E|H) \times P(H)/P(E).$$

It may not be difficult to estimate $P(E|H)$ if H is the null hypothesis. Unfortunately, H is typically not the null hypothesis in this case, so there may be difficulties to estimate $P(E|H)$. In addition, there are real problems to estimate the prior probabilities, $P(H)$ and $P(E)$ as indicated by Earman [1992] who offered three ways to deal with the problem. The first proposal is the hope that the priors 'wash out' as evidence accumulates. This is not useful for the scientists because they need to justify the priors in order to come up with a conclusion in their papers for publication. If more and more evidence accumulated adjusts the priors, then the conclusion drawn may depend on the stage of the investigation. Later work may find earlier work drawing different conclusions because the prior probabilities have changed! This is not very desirable for scientists. The second proposal is to provide rules to fix the initial degrees of belief. Earman [1992] commented that "none of the rules cooked up so far is capable of coping with the wealth of information that typically bears on the assignment of priors". So, scientists cannot rely on this proposal as there may be debate over which rules to use as well as whether the rules are suitable. The third proposal is based on plausibility argument. Again, the scientists cannot rely on such argument because this would open up for debate when they draw conclusions in their paper. Therefore, there is no remedy for the prior probability problem for scientists.

Another strategy for the scientists is to try to cancel out or embed the prior probabilities so that we do not need to estimate them. In this case, not all Bayesian confirmation measures [Fitelson, 1999] can be used to cancel out the prior probabilities. For example, Carnap's measure [Carnap, 1962] cannot cancel out the prior probabilities. On the other hand, measures forming a ratio of probability may be able to cancel out the prior probabilities. For example, Keynes [1921] is interested in the ratio $P(H|E)/P(H)$ so that one can consider the odds in favor of the hypothesis H given the evidence E is known and one does not need to estimate $P(H)$. However, one still has the problem of estimating $P(E)$ which is not trivial. One may argue that instead of comparing $P(H|E)$ and $P(H)$, we compare the conditional probabilities between two hypotheses, $H0$ and $H1$, so that $P(E)$ is canceled as follows:

$$P(H1|E)/P(H0|E) = P(E|H1)/P(E|H0) \times P(H1)/P(H0).$$

The above ratio on the immediate right of the equal sign is called the Bayse factor and the ratio on the far right is the prior ratio. If the above ratio on the left is larger than one then we have a higher degree of belief for $H1$ over $H0$. However, how can the scientists estimate $P(H0)$ and $P(H1)$? One solution is to invoke the principle of indifference so that $P(H0) = P(H1) = 0.5$ as there are two hypotheses.

However, these are the two hypotheses tested and not the total number of hypotheses that are in existence. This is the point where there is debate about how to set the prior probabilities as it is uncertain how many alternative hypotheses there are to take into account. Unfortunately, this may affect the test and the conclusion drawn by scientists. We believe that this is why Bayesian confirmation theory is not widely used because its application to drawn (scientific) conclusion is open to debate.

On the other hand, if we invoke the principle of indifference then $P(H0) = P(H1) = 1/n$ for n hypotheses. Now, since $P(H0) = P(H1)$ for whatever number of hypotheses, we have

$$P(H1|E)/P(H0|E) = P(E|H1)/P(E|H0).$$

Therefore, this ratio can be used as the basis to accept or reject hypothesis $H1$ compared with $H0$ without any prior probabilities. However, there are (at least) three problems. One problem is that it may not be easy to estimate $P(E|H1)$ because $H1$ is not the null hypothesis any more. The second problem occurs when $P(H1|E)/P(H0|E) > 1$, but $P(H1|E)/P(H2|E) < 1$. In the absence of knowing all the hypotheses, we do not know whether $H1$ is the most likely hypothesis to be accepted. Which hypothesis has the highest probability ratio is important to scientists since that hypothesis is supposed to be the leading one to be confirmed. We may assume that the state-of-the-art theory or model is published in journals or conference proceedings, and it is the leading one to form $H0$ in order to compare with the proposed theory or model forming $H1$. So, the second problem may be resolved partially. The third problem is that we still do not have any measure of the risk involved in accepting $H1$, so it is difficult to appreciate the likelihood of making an error. Although for some distributions of the underlying probabilities of the ratio, we can deduce the distribution of the ratio of probabilities. In general, we cannot deduce the distribution of the ratio for any distributions of the underlying probabilities of the ratio. Likewise, although for nested models we can assume the log-likelihood ratio (i.e., $\log[P(H1|E)/P(H0|E)]$) multiplied by two to asymptotically follow a chi-square distribution so that we can translate between the log-likelihood ratio value and the estimated p-value, in general again it is an open research problem especially for non-nested models and for small samples. Therefore, given the first and last problems Bayesian confirmation theory is not very popular among scientists.

3 Scientists' solution

To avoid the debate about the prior probabilities and to estimate the risk of the decision making, scientists tend to use a different statistical method. The idea is

to compare the performance based on a control group using classical hypothesis testing, i.e. null hypothesis significance testing (NHST) and Neyman-Pearson hypothesis testing. The null hypothesis is that the performance of the particular theory or model has no difference with that of the control group. If the performance is different from the control group statistically significantly, then the scientists can report the p-value or significance level, and claim that the null hypothesis is rejected given a particular confidence/significance level.

For NHST, the scientists can know the risk, i.e., the type-I error of incorrectly rejecting the null hypothesis. In this way, there is no need to estimate $P(E)$ or $P(H)$ while at the same time, the risk in making the wrong decision is known. Many scientists are only concerned with the type-I error because they are interested in rejecting the null hypothesis. Otherwise, if they cannot reject the null hypothesis, then they usually may not be able to publish their scientific paper as they do not have a better model or theory. Also, it is relatively difficult to estimate the type-II error for composite alternative hypothesis because there may be more than one parameter value for the distribution of the composite alternative hypothesis. In this case, it is not clear how the Bayesian confirmation theory handles such composite alternative hypothesis as there may be many prior distributions that fit the composite alternative hypothesis.

The control group that has the lowest performance is based on a random model or random guessing. This provides the lower bound performance of a model that scientific models must perform better than according to the basic principle of modeling accuracy by Luk [2017]. To establish a new scientific model, this model is compared with the old scientific model that serves as the control group. Since the old scientific model is supposed to be better than the random model or guessing, the new scientific model is expected to perform better than the random model or guessing when the new model performs better than the old scientific model statistically significantly. Therefore, when there is an established scientific model, there is no need to compare the new one with the random one. It is sufficient to compare the new model with the established one.

Scientists make use of many statistical tests that would give some idea about the risk in the decision making process so that others know about the confidence level in arriving at the acceptance or rejection of the null hypothesis. For example, scientists may use paired tests to eliminate influence of other intervening factors in the comparison. Typical paired tests include the Wilcoxon paired signed rank test and the randomization test (e.g., [Smucker et al., 2007]). For testing whether laws or principles hold in the theory, regressions may be used. Without any control group to compare, the statistical test decides whether the null hypothesis that the coefficients of the regression are zero is true or not. With some control group, some scientists may use Chi-square to compare two distinct regression models, and some scientists use the F-test to compare two nested models (i.e., one being

the special case of the other). For a probability distribution like that specified by the Zipf law, the Chi-square test can be used. All these examples show that the statistical tests only compare with the null hypothesis and the reliability or risk is about making the wrong decision to reject the null hypothesis as most of the scientific papers report performance better than that mentioned in the null hypothesis. Therefore, many scientists do not use Bayesian confirmation theory to find support for their conclusion and it does not seem to be popular among many scientists for their work.

Statistical tests are done one at a time to compare with some state-of-the-art model or theory serving as the control group. The performance of this control group is used to set the null hypothesis that there is no performance difference between the control group and the new model or the new theory under test. By showing that the null hypothesis is rejected, scientists then claim that they have a better model or theory with statistically significant results, and this is the evidence for showing that scientific progress is made. To increase the reliability, more than one experiment reported in more than one scientific paper are used to obtain statistical significance results to support that scientific progress is made. For establishing a superior theory which is applied to build various models, a random model (serving as the control group in the null hypothesis) can be used to decide whether the new theory is better than the older theory by observing the number of models of the new theory that are better than the corresponding models of the old theory (similar to showing that the theory is true in [Luk, 2018]). For the random model in the null hypothesis, we may assume that the probability that the model of the new theory will perform the same as the corresponding model of the old theory is a half. After comparing with N different models, we can estimate the p-value based on the binomial distribution, so we can decide to reject the null hypothesis or not. Hence, scientific progress can be made to advance one theory over the other by using statistical tests in this way. However, for a widely held theory, usually, the newer theory is required to perform better than the old theory for every model they generate because there are not many models for the (expensive) experiments in the course of scientific development. For example, the experiment by LIGO team demonstrating gravitational waves (e.g., see [Bunge, 2018] for a discussion) is one more experiment to the existing few (e.g., Eddington and Gravitation Probe B experiments) that support Einstein's general relativity theory over Newtonian universal gravitation theory. Note that each experiment gives rise to a new model derived from the theory so that with several experiments, there are several models that make predictions according to the same theory.

4 Practical problems with the scientists' solution

Some philosophers are knowledgeable of how scientists perform statistical tests to claim the superiority of their model or theory. For example, Bird [2018] commented that scientists perform NHST and the randomized controlled trial (RCT), so he is aware that at least some scientists (at least those he examined) do not actually use Bayesian confirmation theory in practice. He did not provide any explanation as to why Bayesian confirmation theory is not used by the scientists. Instead, he focused on explaining the replication crisis [Baker, 2016] due to the low success rate of the concerned hypothesis.

The explanation by Bird [2018] suggests that in some scientific disciplines scientists may propose many implausible hypotheses that have low success rate, in poorly understood topics where the knowledge is highly incomplete. As a result, the actual false positive rate may be alarmingly high compared with that specified by the confidence level. Consequently, many experiments in such scientific disciplines may not be able to replicate or reproduce their results. He proposed three responds to this situation: (1) do nothing and keep quiet, (2) seek high-quality hypothesis (with high success likelihood) and (3) increase the confidence level.

Apart from these responses, scientists have other options that Bird did not mention. In some scientific disciplines, instead of just one data collection, the study may perform the experiment on several (highly different) data collections. Statistical tests are performed for different data collections. If all the data collections show statistically significant results, then it suggests that the proposed models or theories are more reliably better. This requires more resources but for some disciplines, this is the norm rather than the exception. Another option is to perform some kind of replication study but with some novel twist to the theory or model to throw some light on its generality. For example, Rainville et al. [2005] do not reproduce any experiment. Instead, they invent a new experiment to validate $E = mc^2$ thereby supporting or falsifying special relativity. In addition, their experiment tries to measure the precision that the famous equation holds. Yet another option is to perform some comparison study. In this case, many hypotheses may have been proposed to explain a phenomenon and the comparison study tries to isolate which hypotheses are critical to the observation of the phenomenon. Without further resources, another option is to partition the data into subgroups and perform statistical tests of the subgroups to see if reliable significance results can be obtained for each subgroup. Finally, instead of explanatory modeling, we can perform predictive modeling as suggested by Yarkoni and Westfall [2017] for psychology studies. In this case, we can perform N-fold cross-validation of the predictive model to ascertain the validity of the superiority of the proposed model or theory. Given that there are many remedies to classical hypothesis testing, the solution using classical hypothesis testing still has some advantage over Bayesian

confirmation theory because such theory does not provide the risk or its estimate in making the wrong decision.

Another problem with classical hypothesis testing is the issue about optional stopping rule (e.g., [Mayo, 1996] and [Howson and Urbach, 2006]). In this issue, it was found that for two different sampling plans, classical hypothesis testing can result in different conclusions for some specific set of data. Theoretically, this is undesirable. In practice, this can be circumvented so that it is not an insurmountable practical problem. The idea is to use a statistical plan that is less likely to be challenged by the reviewers. Therefore, the scientists play the "diligent researcher" role when selecting the sampling plan to show that they have used a commonly accepted sampling plan to sample that does not have many controversies. Only in special circumstances, when it is not feasible to play the diligent researcher role, a more controversial sampling plan may be selected and the researcher has to provide special justifications for such sampling plan in the research article to entice the reviewers to accept the paper.

For Neyman-Pearson hypothesis testing, it is not always possible to analytically derive the distribution of the likelihood ratio even though the likelihood ratio can be defined for composite alternative hypothesis [Casella and Berger, 2002]. This means that it is not simple to relate the significance level with the likelihood ratio value for some distributions. As a result, it is not always possible to know the significance level analytically given the likelihood ratio value although there may be some practical estimation method for discrete distributions. Therefore, one cannot claim that this test can always assess the risk of the wrong decision making as the likelihood ratio may not be able to translate to the significance level. In the case that the risk cannot be assessed by Neyman-Pearson hypothesis testing, scientists can always revert back to NHST to assess the risk of making the wrong decision so that this is not a great handicap for classical hypothesis testing. Alternatively, for nested models, scientists can gather a large amount of data if that is possible. This is because due to a theorem by Wilks [1938], as the sample size approaches infinity, the log-likelihood ratio (i.e., $\log[P(H1|E)/P(H0|E)]$) multiplied by two for a nested model asymptotically follows a chi-square distribution so that an approximate statistical test can be made in practice with knowledge of the approximate risk involved in the decision making. However, for the general case, this is still an open research problem.

5 Alternative theories and models

Ideally, when a paper about a theory or a model is proposed, the paper should report a better theory or better model than existing ones by providing evidence that better predictions are made. Accompanied with better results, there should

also be some assessment of the reliability of the results and so some statistical testing should be done. Typically, the null hypothesis that there is no difference in performance is rejected. For clear cut cases, papers proposing better theories or better models should be published. However, in real life, the proposed theory or model may not always be better than existing ones. Worst still, some proposed theory or model performs with no statistical significant difference from the existing ones. Should such theory or model be published by the journal or conference proceedings?

We answer this question by recalling an example of the problem of induction proposed by Bertrand Russell [1912]. In this example problem, a chicken (or a turkey) observes that the farmer keeps feeding him every day. So, by induction, the chicken concludes that the farmer will keep feeding him in the future. Until one day, the farmer slaughters the chicken for meat. This has been a problem for the believers of induction, as induction cannot guarantee that the future will occur identically as the past. However, there are few guarantees in life. Therefore, should we just accept induction as a limitation of our ability to know? With such a drastic life or death consequence, perhaps the chicken should think twice before accepting induction. What can the chicken do?

What the chicken should do is not to be satisfied with the only conclusion that the farmer keeps feeding him in the future. The chicken should hypothesize alternative theories or models explaining why the farmer feeds chicken in general and then observe whether these alternative theories or models can provide an alternative understanding as to why the farmer keeps feeding the chicken. Based on the existing evidence, the chicken may not be able to find a better theory or model but it is important for the chicken to keep in mind alternative theories and models in order to assess what are the possible consequences. With these alternative understandings, the chicken can look for evidence to support the surviving theory or model or weed out the other theories or models.

In science, we are faced with a similar situation as the chicken. The existing theory or model may perform well but if we rely on them only, we may only find what these theory or model predict (as in the confirmation bias). Instead, we should actively seek alternative theories or models to provide an alternative understanding of the topic so that we may assess the different impact. Initially, these alternative theories or models may not be able to perform better than existing ones, but they provide an alternative understanding of the topic. Therefore, they should be published so that other scientists can find evidence to determine which theory or model should survive. If such alternative theories or models are weeded out of the publication process during the review, then other scientists cannot help to find the surviving theory. In science, proposing a new theory or model, or finding a surviving theory or model may take a life time. Therefore, it is important for papers about alternative theories and models to be published and archived so

that in the future they can be tested. Therefore, even theories and models that only perform without significant difference from the existing theory and model are worthy to be published.

If alternative theories or models are allowed to be published, will we face a deluge of them with many junk theories and models archived? Will this pollute the field making it hard for the research to find the signal from the noise? Our proposal is that not all alternative theories or models should be published. We should publish those that perform at least with no statistically significant difference from the existing theory or model. If the existing theory or model is highly effective in terms of their predictions, then this will avoid lots of theories or models getting published. Apart from this criterion, we should also demand that the author should provide an alternative understanding of the topic and give some prediction that would distinguish the proposed theory or model from the existing ones. This would give a lead to other scientists to find evidence to weed out the theories or models, thereby accelerating the process of falsifying theories or models.

Note that when the null hypothesis is about comparing with the random model or random guessing, we require the proposed model or theory to be better than the random model or random guessing because random model or guessing represents that there is no knowledge about the specific topic or issue. Therefore, if we have some (scientific) knowledge, then we should get better results than no knowledge. However, when the null hypothesis is comparing with some state-of-the-art theory or model that is known to be performing better than the random model or random guessing, we only require the proposed theory or model to be the same or better than the state-of-the art theory or model for publication. In this case, similar to the example problem, we keep a look out for an alternative theory or model that can eventually perform better than the state-of-the-art theory or model. Thus, we should allow such alternative theory or model to be published.

While the classical hypothesis testing can test theories or models that are performing similarly with no statistically significance difference, Bayesian confirmation measures may have problems testing alternative theories or models. For example, the ratio of the probabilities (i.e., $P(H1|E)/P(H0|E)$) needs to be exactly one for the alternative theory or model to be performing similarly as the existing theory or model. In practice, getting one exactly is very difficult. If we relax the requirement of getting one exactly, we need to know the distribution of the ratio of probabilities. Sometimes, it is possible to deduce the distribution of the ratio of probabilities if we know the distribution of the underlying probabilities of the ratio. However, sometimes we do not know. Likewise, for nested models and large samples, the log-likelihood ratio (multiplied by two) asymptotically follows the chi-square distribution due to Wilks' theorem so that the ratio value can be translated into a p-value, but it is still an open research problem to find the distribution for non-nested models or for small samples. Therefore, this creates a

practical problem for scientists who may not rely on using Bayesian confirmation theory.

6 Modeling scientists' decisions

Bayesian confirmation theory can be modeling the degree of belief of the scientists when testing a hypothesis rather than a practical procedure to perform decisions to accept or reject the hypothesis of an experiment. Here, we provide a sketch of how this can be done. As there is uncertainty about some of the prior probabilities, it is difficult to know the estimated conditional probability $P(H|E)$. To verify whether the ratio, $P(H|E)/P(H)$, is accurate, we can ask scientists in a survey on how much more confident they are that $P(H|E)$ is compared with $P(H)$ before and after they have read about the scientific work. Then, we have the open research issue about how to translate the confidence to the ratio, $P(H|E)/P(H)$, which is open to yet another debate (e.g., [Kaplan, 1989] and [Huber, 2005]). Even if we have an estimate of $P(H|E)/P(H)$, we have the additional difficulty to determine the p-value from the null hypothesis because we have only a single probability for one experiment. The Bayesian confirmation theory requires M experiments to decide. In this case, the null hypothesis is that $P(H|E)/P(H) =$ confidence score in the survey. Note that $P(H)$ and $P(E)$ vary for different experiments because the number of hypotheses may vary with different experiments and the nature of evidence for each experiment may be different. As a result, we need to compare the predicted ratio $P(H|E)/P(H)$ and the confidence score by a paired test so that the null hypothesis is that the $P(H|E)/P(H)$ minus the confidence score is zero. A Wilcoxon paired signed rank test can be used to obtain the p-value for instance so that the scientist can obtain the risk in making the decision to reject or accept the null hypothesis. However, to make such a decision, more than one experiment is needed, and it is not clear whether the ordinary scientists are willing to put in the extra effort in addition to controversies in setting $P(H)$ and $P(E)$ for each experiment in order to predict the ratio, $P(H|E)/P(H)$. Although we have a mechanism to confirm whether the Bayesian confirmation theory predicts the subjective degree of belief of the scientists by running this kind of statistical tests, it is unclear whether ordinary scientists will perform such task. Most likely, this is the task for the experimental philosophers or researchers on science of science [Fortunato et al., 2018] to verify whether Bayesian confirmation theory makes good prediction about the relative degree of belief of the scientists for favoring hypothesis H but this confirmation is open to debate as how to set $P(H)$ and $P(E)$ for each experiment is an open issue.

Instead of subjective probability, $P(H|E)$ and $P(H)$ can be interpreted as

objective probability. One can count the number of scientists who belief in the hypothesis H after weighing on the evidence E and before the evidence E is made available. Next, $P(E)$ can be interpreted as the proportion of scientists who can access the evidence E. In this way, we can model the scientist decision making process. Therefore, Bayesian confirmation theory can model a scientist decision making process in hypothesis testing rather than using it to do hypothesis testing.

7 Jeffreys-Lindley paradox

This paradox [Lindley, 1957] has been debated in philosophy of science ([Spanos, 2013], [Sprenger, 2013] and [Robert, 2014]) and statistics for some time. It occurs when the sample size is large. For a point value null hypothesis, as the sample size tends to infinity, the point value may approach a particular value. For very large samples, the deviations from the point value may be small for the significance level in NHST, so that one may reject the null hypothesis because of tiny deviations due to the large sample. However, for some prior probabilities, the Bayesian confirmation theory suggests that the posterior probability of the null hypothesis approaches one instead of rejecting the null hypothesis. This incompatibility between NHST and Bayesian confirmation theory is the Jeffreys-Lindley paradox.

We resolve this paradox by recalling what these probabilities are supposed to model. For NHST, the probability is modeling the chance that the data occurred with the particular value deviating from the value specified by the null hypothesis. For Bayesian confirmation theory, we are modeling the belief of the scientists in accepting/rejecting the hypothesis. These two different kinds of modeling do not necessarily imply that their probabilities have to be consistent with each other. So, there is no paradox. For NHST, the probability is about the chance of data having some particular value whereas for Bayesian confirmation theory, the probability is about the belief of the scientist. In addition, the Bayesian confirmation theory is only about modeling the degree of belief of the scientist instead of getting the exact correct degree of belief. Therefore, even if Bayesian confirmation theory says the probability is 1.0, it is only an estimate. It can actually be 0.6 instead of one. Hence, whether Bayesian confirmation theory produces a probability that is consistent with NHST is not a real practical issue. In practice, scientists follow what the data tells them assuming that the assumed distribution is appropriate as this is a decision based on evidence; they are not concerned about the modeling of their belief about the hypothesis as that would mean that they are making decisions based on the degree of belief rather than based on evidence. Therefore, this paradox does not have an impact in practice for NHST but it has a negative impact on Bayesian confirmation theory.

8 Software packages?

Another plausible reason why Bayesian hypothesis testing is less utilized than classical hypothesis testing is that software packages are available for classical hypothesis testing but no software package was available for Bayesian hypothesis testing in the past. Recently, Wagenmakers et al. [2018a] favor the use of Bayesian hypothesis testing over classical hypothesis testing and gave examples [Wagenmakers et al., 2018b] of the use of Bayesian hypothesis testing using an open source package called JASP [Wagenmakers, 2017] trying to entice psychologists to use Bayesian hypothesis testing. Less radical is Quintana and Williams [2018] who advocated the use of Bayesian hypothesis testing in conjunction with classical hypothesis testing in order to be more informative about the hypothesis testing as these two methods are thought to complement each other. Apart from JASP, Quintana and Williams noted that Bayesian hypothesis testing is also available in the 'BayesFactor' R package [Morey and Rouder, 2018].

Despite such software packages are now available, there is still the thorny issue of choosing the prior distribution or prior probabilities for Bayesian hypothesis testing. At present, Quintana and Williams [2018] suggested to perform some robust or sensitivity analysis to check whether changing the prior distribution will have a great impact on the results and the conclusion drawn. If not, the conclusion drawn would be robust to different prior distributions. Otherwise, care should be taken to interpret the results. This is, however, what a responsible scientist should do. Alternatively, an irresponsible scientist may perform prior distribution hacking similar to p-value hacking, trying to obtain the most favorable results based on finding the suitable prior distributions to reject the null hypothesis. Therefore, Bayesian hypothesis testing is not immune to abuse.

Apart from the issue about choosing the prior distribution, sometimes the prior distribution specification is vague so that it is not possible to perform the hypothesis testing. However, NHST may still be able to perform the significance test. Similarly, sometimes there may not be an alternative hypothesis apart from the negation of the null hypothesis. For example, when the alternative hypothesis is $\theta \neq \theta_o$, then it is not clear how to specify the alternative hypothesis for Bayesian hypothesis testing since the alternative hypothesis does not specify θ to take on a specific value but rather to indicate that it should not take on a specific value. In Bayesian hypothesis testing, the practical solution for this kind of problem is to specify a number of prior distributions that can satisfy this general condition (e.g., $\theta \neq \theta_o$) of the alternative hypothesis, and determine whether the results are robust to these different prior distributions. As can be seen, it is not clear whether such Bayesian hypothesis testing has real advantage over NHST when presenting results and inferences in a paper as such results or inferences may be inconclusive.

Apart from problems with the prior distributions, using the software packages

for Bayesian hypothesis testing does not directly indicate the risk that we make the wrong decisions whereas classical hypothesis testing gives us some idea based on the p-value (or significance level). The Bayes factor reported by such packages gives us the odds comparing the alternative hypothesis with the null hypothesis but this is not the same as how likely we made the wrong decision in accepting/rejecting the null hypothesis. To do this, we need to know the underlying distributions of $P(E|H)$ which cannot guarantee to derive the distributions of the Bayes factor. In addition, it is unclear what the final distribution is since the Bayes factor is multiplied by the prior ratio (which has its own distribution). Likewise, although for nested models, the log-likelihood (i.e., $\log[P(H1|E)/P(H0|E)]$) multiplied by two asymptotically follows the chi-square distribution so that we can translate the approximate likelihood ratio value (estimated by multiplying the Bayes factor with the prior ratio) to a p-value, it is still an open research problem to find the distribution in the general case especially for non-nested models and for small samples. Therefore, there is no general solution to provide the risk in accepting/rejecting the null hypothesis for Bayesian hypothesis testing.

Given these practical shortcomings, it is not clear whether Bayesian hypothesis testing can become as widely utilized as classical hypothesis testing since Bayesian has many theoretical advantages. Time will tell whether Bayesian hypothesis testing will be as popular as classical hypothesis testing, or even more popular than classical hypothesis testing or still remains obscure in practice compared with classical hypothesis testing.

9 Conclusion

This article does not compare classical hypothesis testing with Bayesian confirmation theory as there are better suited articles for this (e.g., [Romejin, 2017]). It is also not an advocate of classical hypothesis testing as it has many unresolved statistical and philosophical issues (e.g., violation of the likelihood principle). Instead, this article is about the practical problems that explain why Bayesian confirmation theory is not practiced by scientists. Specifically, (a) Bayesian confirmation theory does not measure the reliability or risk of the decision making, (b) the assignment of probabilities to some of its (prior) probabilities may be open to debate affecting the conclusion drawn by the scientists, and (c) software package for Bayesian hypothesis was not available before whereas software package for classical hypothesis testing is widely available. Therefore, scientists use other methods to support their conclusion in scientific discourse. Specifically, scientists use classical hypothesis testing to obtain the significance level or p-value measuring the risk of rejecting the null hypothesis (based on some control group). Evidence of scientific progress is made when scientists found their theory or model obtaining

statistical significant results when they compare the performance of their model or theory with the state-of-the-art model or theory (serving as the control group in the null hypothesis) or in the absence of any model or theory a random model is used. To avoid the problem of induction, it is suggested attention should be paid not to just better theories and models but similarly performing theories and models so that the alternative theory may guide us to look for what kind of evidence to weed out the unsuccessful theory or model and the better surviving theory or model may be found in the future. While at present Bayesian confirmation theory may not be widely used by scientists to make decisions about which model or theory is better, time will tell whether it will be widely utilized due to the availability of software packages that accelerate utilization of Bayesian hypothesis testing. In addition, Bayesian confirmation theory has the advantage that it is not biased against the null hypothesis, so that scientists showing significance results based on Bayesian hypothesis testing appears to be more robust than classical hypothesis testing. However, the prior distributions of Bayesian hypothesis testing need to be examined carefully, and the classical hypothesis testing can adjust its significance level for better robustness, so that the advantage of Bayesian hypothesis testing is not that apparent. Finally, the Bayesian confirmation theory offers a probabilistic model of scientists making decisions in accepting or rejecting hypotheses.

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References

M. Baker. 1,500 scientists lift the lid on reproducibility. *Nature*, 533(7604):452–454, 2016.

A.J. Bird. Understanding the replication crisis as a base rate fallacy. *The British Journal for the Philosophy of Science*, Forthcoming(doi:10.1093/bjps/axy051), 2018.

P. Brössel and F. Huber. Bayesian confirmation: a means with no end. *The British Journal for the Philosophy of Science*, 66(4):737–749, 2015.

M. Bunge. Gravitational waves and spacetime. *Foundations of Science*, 23(2): 399–403, 2018.

R. Carnap. *Logical foundations of probability, 2nd Edition*. Chicago Univeresity Press, Chicago, 1962.

G. Casella and R. L. Berger. *Statistical inference*. Thomson Learning, University of Michigan, 2002.

D. Castelvecchi. Feuding physicists turn to philosophy for help. *Nature*, 528 (7583):446–447, 2015.

C.S. Chihara. Some problems for Bayesian confirmation theory. *The British Journal for the Philosophy of Science*, 38(4):551–560, 1987.

V. Crupi, R. Festa, and T. Mastropasqua. Bayesian confirmation by uncertain evidence: a reply to Huber [2005]. *The British Journal for the Philosophy of Science*, 59(2):201–211, 2008.

J. Earman. *Bayse or bust? A Critical Examination of Bayesian Confirmation Theory*. MIT Press, Cambridge, MA, 1992.

R. Festa and G. Cevolani. Unfolding the grammar of Bayesian confirmation: likelihood and antilikelihood principles. *Philosophy of Science*, 84(1):56–81, 2017.

B. Fitelson. The plurality of Bayesian measures of confirmation and the problem of measure sensitivity. *Philosophy of Science*, 66:S362–S378, 1999.

S. Fortunato, C. T. Bergstrom, K. Börner, J. A. Evans, D. Helbing, S. Milojević, A. M. Peterson, F. Radicchi, R. Sinatra, B. Uzzi, A. Vespignani, L. Waltman, D. Wang, and A-L. Barabási. Science of science. *Science*, 359(6379): doi:10.1126/science.aao0185, 2018.

L. Henderson, N. D. Goodman, J. B. Tenenbaum, and J. F. Woodward. The structure and dynamics of scientific theories: a hierarchical Bayesian perspective. *Philosophy of Science*, 77(2):172–200, 2010.

C. Howson and P. Urbach. *Scientific Reasoning: The Bayesian Approach*. Open Court, La Salle, 2006.

F. Huber. Subjective probabilities as basis for scientific reasoning? *The British Journal for the Philosophy of Science*, 56(1):101–116, 2005.

M. Kaplan. Bayesianism without the black box. *Philosophy of Science*, 56(1): 48–69, 1989.

J. Keynes. *A Treatise on Probability*. Macmillan, London, 1921.

D. V. Lindley. A statistical paradox. *Biometrika*, 44(1/2):187–192, 1957.

R. W. P. Luk. A theory of scientific study. *Foundations of Science*, 22(1):11–38, 2017.

R. W. P. Luk. On the implications and extensions of Luk's theory and model of scientific study. *Foundations of Science*, 23(1):103–118, 2018.

D. G. Mayo. *Error and the Growth of Experimental Knowledge*. University of Chicago, Chicago, 1996.

R. D. Morey and J. N. Rouder. *BayseFactor: computation of bayes factors for common designs*. https://CRAN.R-project.org/ package=BayesFactor, 2018.

W. C. Myrvold. A Bayesian account of the virtue of unification. *Philosophy of Science*, 70(2):399–423, 2003.

J. D. Norton. Challenges to Bayesian confirmation theory. *In Philosophy of Statistics: Volume 7 in Handbook of the Philosophy of Science*, 7:391–439, 2011.

D. S. Quintana and D. R. Williams. Bayesian alternatives for common null-hypothesis significance tests in psychiatry: a non-technical guide using JASP. *BMC Psychiatry*, 18:178–185, 2018.

S. Rainville, J. K. Thompson, E. G. Myers, J. M. Brown, M. S. Dewey, E.G. Kessler Jr, R. D. Deslattes, H. G. Börner, M. Jentschel, P. Mutti, and D. E. Pritchard. A direct test of $E = mc^2$. *Nature*, 438(22):1096–1097, 2005.

C. Robert. On the Jeffreys-Lindley paradox. *Philosophy of Science*, 81(2):216–232, 2014.

J-W. Romejin. *Philosophy of Statistics*. E.N. Zalta (ed.), https://plato.stanford.edu/archives/spr2017/entries/statistics/, 2017.

B. Russell. *The Problems of Philosophy*. Williams and Norgate, London, 1912.

M. Schippers and G. Schurz. Genuine confirmation and tacking by conjunction. *The British Journal for the Philosophy of Science*, Forthcoming (doi:10.1093/bjps/axy005), 2018.

M. J. Shaffer. Bayesian confirmation theories that incorporate idealizations. *Philosophy of Science*, 68(1):36–52, 2001.

M. D. Smucker, J. Allan, and B. Carterette. A comparison of statistical significance tests for information retrieval evaluation. *In Proceedings of the 16th ACM CIKM '07*, pages 623–632, 2007.

A. Spanos. Who should be afraid of the Jeffreys-Lindey paradox. *Philosophy of Science*, 80(1):73–93, 2013.

J. Sprenger. Testing a precise null hypothesis: the case of Lindley's paradox. *Philosophy of Science*, 80(5):733–744, 2013.

E. J. Wagenmakers. *JASP*. https://jasp-stats.org, 2017.

E. J. Wagenmakers, M. Marsman, T. Jamil, A. Ly, J. Verhagen, J. Love, R. Selker, Q.F. Gronau, M. Šmíra, S.Epskamp, D. Matzke, J. N. Rouder, and R. D. Morey. Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psyconomic Bulletin & Review*, 25(1):35–57, 2018a.

E. J. Wagenmakers, M. Marsman J. Love, A. Ly T. Jamil, J. Verhagen, R. Selker, Q. F. Gronau, D. Dropman, B. Boutin, F. Meerhoff, P. Knight, A. Raj, D-J. van Kesteren, and J. van Doorn. Bayesian inference for psychology. Part II: Example application with JASP. *Psyconomic Bulletin & Review*, 25(1):58–76, 2018b.

A. Wayne. Bayesianism and diverse evidence. *Philosophy of Science*, 62(1): 111–121, 1995.

S. S. Wilks. The large-sample distribution of the likelihood ratio for testing composite hypotheses. *Annals of Mathematical Statistics*, 9(1):60–62, 1938.

T. Yarkoni and J. Westfall. Choosing prediction over explanation in psychology: lessons from machine learning. *Perspective on Psychological Science*, 12(6): 1100–1122, 2017.

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Astroparticle physics, a constructive empiricist account♣

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Abstract

Astroparticle physics is an interdisciplinary field embracing astronomy, astrophysics and particle physics. In a recent paper on this topic, Brigitte Falkenburg (2012) defended that only scientific realism can make sense of it and that realistic beliefs constitute an indispensable methodological principle of research in this discipline. The aim of this work is to show that there exists an anti-realist alternative to this account, along the lines of what Bas van Fraassen showed in his famous book *The Scientific Image* (1980). Problems and results of astroparticle physics can be understood from an empiricist point of view too, namely that of van Fraassen's constructive empiricism, which is a more modest and metaphysics-free alternative to scientific realism. Although constructive empiricism can make sense of science no worse than scientific realism does, van Fraassen's goal is not to demonstrate that his stance is the only viable position, but just that it is not incoherent or proven false by his opponents (see Kusch 2015, 172). In this paper it will be shown that the constructive empiricist stance constitutes a legitimate alternative to scientific realism even when it gets to astroparticle physics and that it does indeed make sense of this new discipline, *pace* Falkenburg.

Keywords: Anti-Realism, Astroparticle Physics, Constructive Empiricism, Falkenburg, van Fraassen.

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1. Introduction

In her "Pragmatic Unification, Observation and Realism in Astroparticle Physics" (2012), Brigitte Falkenburg gives a historical survey of astroparticle physics, an interdisciplinary field that "*makes the bridge between astrophysics and particle physics*" (p. 327); i.e., studies elementary particles of astronomical origin and their relation to astrophysics and cosmology. Allegedly, the goal of this brand new discipline is to find a unified model of the world, such as Newton and Einstein tried to and despite the well-known incompatibility between quantum theory and general relativity.

According to Falkenburg, "*the goal of finding a unified theory of physics is associated with the belief in genuine, universal laws of nature*" (2012, 328), which is characteristic of scientific realism. As a matter of fact, Falkenburg also reckons that the whole story of astroparticle physics "*only makes sense from a point of view of scientific realism*" (p. 330). The aim of this work is to show that there exists an anti-realist alternative to her account, instead, along the lines of what Bas van Fraassen showed in his famous book *The Scientific Image* (1980).

2. A theory-laden narrative

Falkenburg's short history of astroparticle physics is manifestly theory-laden: "*Cosmic rays were discovered in the course of investigating the ionisation of the air and other gases by means of the cloud chamber and electroscopes*" (p. 328); "*A spectacular astrophysical success of cosmic ray studies was the discovery of the 3K cosmic microwave background (CMB) in 1964*" (p. 329); "*After the discovery of the W and the Z° bosons in 1983, particle physics at the accelerators has been taking place in an innovative desert*" (p. 330); etc.

Of course there is nothing wrong with that, unless one thinks that talking about ionization, CMB, bosons and the like commits her ontologically. Falkenburg seems to think it is the only way this story can be told.

The phenomenology of scientific theoretical advance may indeed be compared to the phenomenology of exploration and discovery in other fields, says van Fraassen, "*and it is also appropriate to talk in this fashion while immersed in the theoretical picture that guides the actual scientific work*" (1980, 74). But this does not mean that one cannot step back and reflect, in order to see if such a point of view on scientific activity is the only legitimate one - and if one is actually committed to believing in the existence of the entities postulated by the theories she relies on.

Admittedly, we all are "*immersed in a language which is thoroughly theory-infected, living in a world [our] ancestors of two centuries ago could not enter*" (p. 81). For instance, it may very well be the case that we have no adequate way to describe a certain box, and the role it plays in our world, except as a VHF receiver, says van Fraassen. From this, however, it does not necessarily follow that we believe that "*the concept of very high frequency electromagnetic waves corresponds to an individually identifiable element of reality. Concepts involve theories and are inconceivable without them (...). But immersion in the theoretical world-picture does not preclude 'bracketing' its ontological implications*" (*ibid.*).

Now, science is indubitably not a mere role-playing game,[1] still a scientist must not let herself be 'pushed too far' by the immersion in the world of science and by the highly-theory-laden language used in the context of the scientific practice. It is in fact possible "*even after total immersion in the world of science to (...) limit one's epistemic commitment while remaining a functioning member of the scientific community - one who is reflective, and philosophically autonomous as well*" (van Fraassen 1980, 83).[2]

A way to do that - and to avoid reifying whatever could not be defined away in a logical-positivist-like reconstruction of the language of science (see van Fraassen 1980, 44) - is by identifying a scientific theory not with a set of axioms and theorems, but rather with a class of mathematical models, as van Fraassen suggests when he defends a 'semantic approach' to theories in alternative to the so-called 'syntactic view'. Focusing on mathematics, instead of on language, makes it easier to resist hypostatization of any sort.

Accordingly, van Fraassen suggests that theories need not be true to be good, but 'only' empirically adequate, which means that all appearances (i.e. structures that can be described in experimental and measurement reports) must be isomorphic to empirical substructures of that model - that is, certain parts of the model must correctly describe (solely) the observable phenomena (see 1980, 64). Asserting a theory to be true, instead, means affirming that it

[1] "*It is not a game: these practices are part of what makes our world a coherent, useful and, even, the sometimes friendly, sometimes inimical place that it is*" (Seager 1995, 477).

[2] William Seager reckons that van Fraassen's notion of 'theoretical immersion' is too language-oriented (or theory-oriented) and might fail to explain the sense of conviction that stems from scientific practice. He prefers, in alternative, the concept of 'virtual reality': "*if we replace theoretical immersion with virtual reality, perhaps we can explain the sense of conviction without endorsing the reality of the micro-world. Conviction stems from immersion in a system of imaging devices and instrument-aided practices that project one into a plausible micro-world*" (Seager 1995, 474). Of course this substitution is perfectly tuned with constructive empiricism, the view of science that van Fraassen proposed in *The Scientific Image*: "*I argue that immersion is more analogous to entering a virtual reality than to learning a language. This metaphor assimilates instrument-based practice as well as theoretical debate and explanation, and can provide an anti-realist view of our micro-practices consonant with constructive empiricism*" (p. 459).

has a model "*which is a faithful replica, in all detail, of our world*" (van Fraassen 1980, 68-69). Now, accepting a theory as empirically adequate requires a leap of faith too, of course, since we will never know whether this is the case. "*Nevertheless there is a difference: the assertion of empirical adequacy is a great deal weaker than the assertion of truth, and the restraint to acceptance delivers us from metaphysics*" (van Fraassen 1980, 69).

This is the point of empiricism, in talks about science: it is possible to make sense of this activity without relying on metaphysics. At the end of the day, what a scientist actually observes, when she detects micro-particles, is a silver-grey line in a cloud chamber or some numerical value in a gauge.[3] According to van Fraassen's constructive empiricism, those are the appearances that must fit into a model of an empirically adequate theory. The postulated entities might fit into it or not, but we will never know.

3. What kind of realism? Van Fraassen's formulation of scientific realism and his empiricist alternative

In his *A Metaphysics for Scientific Realism* (2007), Anjan Chakravartty shrewdly notes: "*Some think there are as many versions of scientific realism as there are scientific realists. That is probably a conservative estimate! There are probably as many versions of realism as there are realists and antirealists*" (p. xii). Falkenburg invokes more than one version, in her paper: entity realism, causal realism, the belief in laws of nature, realism about the phenomena and so on. "*In the practice of physics - she writes - many facets of scientific realism coexist, and the realistic beliefs associated with them differ in being stronger or weaker*" (2012, 341).

She also adds that in astroparticle physics some strong realistic beliefs are kept and others are weakened. In this field of study, in fact,

> *a firm realism about entities, phenomena, their causes, and genuine laws of nature comes together with an instrumentalist attitude towards the models of cosmic sources and the mechanisms of emission and acceleration of cosmic rays. For example, no physicist believes that the estimation of the different contributions to the*

[3] As scientific realists admit too, of course. Here is a passage from Dudley Shapere: "*if the information comes in the radio region of the electromagnetic spectrum, or via weak interactions, it must be transformed into electromagnetic information in the visual wavelengths, or into audible clicks, or into readable printout, or the like*" (Shapere 1982, 508). Therefore, "*as constructive empiricism has it, there is nothing incoherent in the thought that we find out by inference, not observation, 'how unobservable things are'*" (Kusch 2015, 179).

> *'all particle spectrum' (...) is a true model. For obvious reasons, it is considered to be just a crude, tentative idealization (2012, 342).*

Nonetheless, Falkenburg insists that the practice of physics depends on scientific realism. "*The belief in natural kinds and genuine laws of nature is an indispensable methodological principle of research in this field*" (Falkenburg 2012, 343). Falkenburg also reckons that entity realism, causal realism and the like are all features of what can generically be called 'scientific realism' and that this entails the belief in the existence of particles, fields, forces, laws of nature, etc. In addition, she also considers that physics aims at investigating causes and that some models of astroparticles physics are taken as true. Then perhaps she agrees with van Fraassen's formulation of scientific realism: "*Science aims to give us, in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true*" (1980, 8).[4]

Van Fraassen shares with the realists the opinion that the language of science must be taken at face value. Theories are not metaphors. When a scientist talks about electrons, she means exactly those subatomic particles we all heard about. Yet, a literal interpretation of the language of science does not entail the belief that these entities exist. As a matter of fact, according to the Dutch philosopher, "*science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate*" (1980, 12) – which is exactly the statement of his anti-realist position, namely constructive empiricism.

How does a constructive empiricist reply to Falkenburg's claim that the practice of physics depends on scientific realism and that only a realist account can make sense of astroparticle physics? Note that van Fraassen thinks that his anti-realist position "*makes better sense of science, and of scientific activity, than realism does*" (1980, 73) - and without inflationary metaphysics.

In science, theory and experimentation go hand in hand. According to van Fraassen,

> *the intimately intertwined development of theory and experimentation is intelligible from an empiricist point of view. For theory construction, experimentation has a twofold significance: testing for empirical adequacy of the theory as developed so far, and filling in the blanks, that is, guiding the continuation of the construction,*

[4] Van Fraassen regards his formulation of scientific realism as quite minimal and adds that it "*can be agreed to by anyone who considers himself a scientific realist*" (1980, 8). He gets to it, in fact, after scrutinizing how important self-declared scientific realists, such as Wilfrid Sellars, Hilary Putnam and Richard Boyd, characterize this view on science. Other authors, however, criticized van Fraassen's formulation, considering it too strong (see Sicha 1992, 522-523). Yet, Falkenburg seems to invoke an even stronger version of realism, therefore she should not have any problems with van Fraassen's characterization.

> *or the completion, of the theory. Likewise, theory has a twofold role in experimentation: formulation of the questions to be answered in a systematic and compendious fashion, and as a guiding factor in the design of the experiments to answer those questions. In all this we can cogently maintain that the aim is to obtain the empirical information conveyed by the assertion that a theory is or is not empirically adequate (1980, 74).*

This applies to astroparticle physics too. Or so I argue.

4. Astroparticle physics, a constructive empiricist account

In her paper, Falkenburg puts forward a short historical survey of this discipline that aims at investigating cosmic rays in order to make the bridge from subatomic particles to cosmic sources.[5]

"*In making the bridge from subatomic particles to cosmic sources - she writes -, astroparticle physics employs (…) realistic beliefs, (…) such as causal realism and the belief in natural kinds and their properties*" (2012, 328). Not only does Falkenburg think that physicists in this field hold realist beliefs, however, but also that these constitute an indispensable methodological principle of research in astroparticle physics (see p. 343).

One might wonder how she knows that "*the physicists who discovered the cosmic rays considered them to be real entities of nature, or* natural kinds*, which have the power to cause observable phenomena in the experimental devices*" (p. 330). But even if this was the case - while, at the same time, we should not forget that important physicists in the history of this discipline were anti-realist, such as Duhem, Mach, Poincaré, Hertz (to some extent), Bohr (of course), to name just a few - does this suffice to conclude that a realist attitude

[5] Falkenburg regards the discovery of the 3K cosmic microwave background (CMB) in 1964 as a spectacular success of cosmic ray studies (see p. 329). CMB is electromagnetic radiation, however, which means that it is composed by photons. Being so, it is not completely clear whether it can legitimately be considered as part of the study of cosmic rays - all the more so since Falkenburg seems to consider them as particles in the classical sense of the word - and if there exists a general agreement, among astroparticle scientists, on including CMB in their research field. In the affirmative case, we see no reason why photons of any other energy level should not be contemplated; but then, one might wonder, are telescopic observations in *any band* of the electromagnetic spectrum part of the astroparticle-physics practice too? (I thank Dr Alberto Vecchiato, of the *Osservatorio Astrofisico di Torino*-INAF, for elucidating, in a recent e-mail message, on the matter of CMB and cosmic rays).

is necessary (or even an indispensable methodological principle of research) in astroparticle physics?[6]

Van Fraassen has shown that the answer is negative.[7] Falkenburg in fact said that cosmic rays were 'discovered' in 1964, but also remembered that CMB had been predicted by Gamow in 1948 (see p. 329). A constructive empiricist might then reply that the story of the 'discovery' of cosmic rays can be re-told, much less glamorously, as that of an observable phenomenon that simply fit the model of a pre-existing theory - note that Falkenburg admits that what is actually seen are observable phenomena in the experimental devices. What Penzias and Wilson observed was a numerical value displayed by a voltmeter that did not fit their initial prediction (model) - they did not observe 'radiation'.[8] Since the theory they were relying on appeared not to be empirically adequate, they looked for another one and found that a group at Princeton had predicted that there would be residual microwave background radiation left over from the Big Bang. Their observation fit the theory the group in Princeton was willing to test.[9]

Let's consider another case mentioned by Falkenburg. According to her, the origin of astroparticle physics might be dated back to the first years of last century, when Victor Hess measured the ionization of the air and realized that it is much stronger in the height than at the ground – something that the Italian physicist Domenico Pacini had done before, actually. She then added: "*By proving the extra-terrestrial origin of this phenomenon, Millikan identified cosmic rays as its cause*" (Falkenburg 2012, 328). Again, what Millikan actually did, a constructive empiricist might rebut, was testing the empirical adequacy of a theory about the ionization of the air (his initial intent was to disprove Hess and Kolhörster's 'discovery'); eventually, he ended up 'filling the blanks' present in it - he even coined the locution 'cosmic rays'. One just

[6] One might also wonder whether, supposing that the majority of the physicists, in any field of the discipline, exhibited realist attitudes, this would constitute an argument in support of scientific realism. It does not, in fact.

[7] He was not referring specifically to astroparticle physics, of course. But his point applies to it too, as we will see.

[8] "*The constructive empiricist will argue that the micro-world remains a mere virtual reality because there is no access to the micro-world except via the devices and practices (and theories) that project us into that world and thus no way to bring the putative micro-world into direct connection with human senses. There is no* ground truth *against which to measure our interpretations of the images delivered to us by our various instruments*" (Seager 1995, 475).

[9] Compare the following passage from *The Scientific Image*, where van Fraassen talks about Robert Millikan's famous oil drop experiment: "*in this case,* theory construction consists in experimentation*. And while it may be natural to use the terminology of discovery to report Millikan's results, the accurate way to describe it is that he was writing theory by means of his experimental apparatus. In a case such as this one,* experimentation is the continuation of theory construction by other means*. The appropriateness of the means follows from the fact that the aim is empirical adequacy*" (p. 77). The same could be said apropos of Penzias and Wilson's 'discovery'.

needs to read again van Fraassen's abovementioned passage about the intertwined development of theory and experimentation to see that Millikan's 'discovery' of cosmic rays is perfectly intelligible from an empiricist point of view too.

The same goes, of course, for this other passage from Falkenburg's short history of astroparticle physics: "*All the predictions of the standard model of particle physics were confirmed at accelerator experiments, including the recent detection of the Higgs particle at the LHC*" (2012, 329). One might reply that in this case theory dictated the formulation of the questions to be answered and acted as a guiding factor in the design of the experiments to answer those questions, while the experiments confirmed that the standard model of particle physics has not proved to be empirically inadequate so far – which is the most one can say about any theory.

The same applies to the other 'discoveries' or confirmations of predictions mentioned by Falkenburg in her paper.[10] Compare the following passage:

> *Atomic physics was developing slowly, as a theory, and at each stage, many blank spaces had to be left in the theory. Rather than fill such a blank with a conjectured answer, as hypothesis, and then testing the hypothesis, one carries out an experiment that shows* how the blank is to be filled if the theory is to be empirically adequate. *Then it is filled, and the theory construction has got one more step forward, and soon there are new consequences to be tested and* new blanks to be filled. *This is how experimentation guides the process of theory construction, while at the same time the part of the theory that has already been constructed guides the design of the experiments that will guide the continuation (van Fraassen 1980, 75).*

Van Fraassen's empiricist reconstruction of the development of atomic physics can be transposed *in toto* to astroparticle physics. Or so I argue.

In light of this, since van Fraassen's empiricist account of the intertwined development of theory and experimentation seems to be able to offer an alternative to Falkenburg's realist-biased history of astroparticle physics, then her belief that the whole story of this discipline "*only makes sense from a point of view of scientific realism*" (2012, 330) perhaps is not well-founded. Particularly, the claim that "*the belief in natural kinds and genuine laws of nature is an indispensable methodological principle of research in this field*" (p. 343) should be qualified, because astroparticle physics, as well as other

[10] And to the 'pragmatic strategies of unification' Falkenburg describes in section three of her paper as well. It is worth remembering, since Falkenburg frequently mentions the 'belief in laws of nature' - which means the belief that the same laws of physics hold inside and outside the laboratory, in every region of the universe - that this is nonunanimous among physicists – as she also admits recalling Mach's notorious instrumental attitude with respect to the concept of 'law of nature'. In *Laws and Symmetry* (1989) van Fraassen argued that "*there is no useful role for the notion of a law of nature. But there is an essentially different concept which can do some of the same work: that of symmetry*" (Morton 1993, 408). Which means that there exist an empiricist alternative to Falkenburg's 'methodological unification strategies' too.

fields of study and research, can advance even if researchers in this area maintain an 'agnostic' attitude with respect to the entities postulated by the theories that constitute the 'background knowledge' they rely on – in fact, doesn't astroparticle physicists keep an instrumentalist attitude towards the models of cosmic sources and the mechanisms of emission and acceleration of cosmic rays (see Falkenburg 2012, 342)? (And doesn't this admission clash with the claim that the belief in natural kinds and genuine laws of nature is an indispensable methodological principle of research in astroparticle physics?)

What van Fraassen maintains is that scientists have, in general, be it in physics or in any other area, a certain picture of the world in mind and it is natural and appropriate to stick to it - or immerse into it, as van Fraassen would say -, even from a linguistic point of view, while doing their job. They don't need to believe that this picture is a faithful representation of the world, however, since when it gets to unobservable entities there is no way of empirically verifying its veridicality – this means that one might think "*the world apparently works as if...*" and suspend the judgement about whether this is really the case. In other words, one can maintain an agnostic/instrumental attitude with respect to that part of the picture that allegedly represents the unobservable portion of the world and focus instead on the part that is a candidate for the direct representation of the observable phenomena.

Even in the case of a scientist with a realist creed, one can always describe her activity as a quest for empirically adequate models of the world. Whatever her opinion about what she is doing, in fact, it can always be reduced to that. Besides, this is a more 'empirically adequate' way of describing scientific activity than as a search for some kind of 'truth' – which is the reason why van Fraassen reckons that his anti-realist position "*makes better sense of science, and of scientific activity, than realism does*" (1980, 73). The rest is metaphysical surplus.

Still, van Fraassen's aim is not to deem scientific realism or anyone with realist inclinations as irrational. Scientific realism *is* a rational description of the scientific enterprise. But it is not the only possible one. Constructive empiricism is a more modest and metaphysics-free alternative, which can make sense of science no worse than scientific realism does - or even better, in van Fraassen's opinion. There is no pretention of phasing realism out: "*it is important to keep in mind that van Fraassen regards 'constructive empiricism' as one of several possible 'stances': his goal is to show that his stance is not incoherent or proven false by his opponents; his goal is not to demonstrate that it is the only viable position*" (Kusch 2015, 172).

If, on the other hand, constructive empiricism succeeds, as it does, in establishing as an alternative to scientific realism, then asserting that the whole story of astroparticle physics "*only makes sense from a point of view of scientific realism*" (Falkenburg 2012, 330) fails to do justice to van Fraassen's

view on science – and to astroparticle physics itself. Not to mention that the claim that scientific realism constitutes an indispensable methodological principle of research in this discipline (see Falkenburg 2012, 343) simply proves to be wrong.

5. On van Fraassen's 'immersion in the theoretical world-picture'

Stanislavsky method is a highly famous and influential system of dramatic training developed by the Russian actor, producer, and theoretician Konstantin Stanislavsky between the end of the 19th century and the beginning of the 20th. When an actor uses it, her onstage actions and reactions appear as if they were a part of the real world rather than a make-believe one.

Mutatis mutandis, this is analogous to what van Fraassen has in mind when he talks of "*total immersion (for practical purposes) in the theoretical world-picture*" (1980, 80). William Seager reckons that the concept of 'virtual reality' is even more adequate and writes: "*Someone engaged in what I called our micropractices cannot take the distanced standpoint recommended by CE [constructive empiricism] and continue, for without immersion the practices make no sense*" (1995, 477). This means that a scientist *must* engage in an experiment or a research *as if* the world actually corresponded to the theoretical world-picture she has in mind or to a model of the theory she wants to test, on pain of not succeeding in her job. But, again, this does not commit her ontologically (or epistemically). The scientist might actually believe that the theoretical world-picture she has in mind is a faithful representation of the real world, but she might choose to 'bracket' the ontological implications of her immersion instead – and this is a quite obvious difference with drama in the analogy above, since no actor believes that the real world is that depicted by the play she is working in.

When Falkenburg talks about bosons, gamma rays and the like,

> *such objects have (...) passed every test for being truly in the micro-world just as they appear to be. But such tests are all internal to the virtual world itself. This is why van Fraassen can, and indeed must, say: 'when a realist gives a consciously and deliberately naive description of what happens in an experiment or observation, I do not, of course, want to dispute a single one of his assertions on its own ground' (1985, 297). Leaving aside the rhetorical tone of this remark, we can see what forces it. There is no plausible refutation of realism from within the complex and beautifully articulated virtual reality which supports the conviction that micro-objects exist, and exist as imaged. But there is a way to step back from the virtual world and understand the practices and convictions of its champions in a way that is ontologically neutral (Seager 1995, 476).*

Within the 'complex and beautifully articulated' virtual reality constituted by the theoretical world-picture, "*in which (...) theory is what guides the use of terms and the allowed inferences*" (van Fraassen 1980, 92) - and not only, as Seager remarked -, the assertion that scientific realism constitutes an indispensable methodological principle of research makes sense if interpreted *à la* Seager. As the Canadian philosopher said, someone engaged in scientific practice cannot step back and reflect while doing her job, for without a 'van Fraassian' theoretical immersion such practices make no sense. This means that, within Seager's 'virtual reality' - the realists' own ground where van Fraassen does not intend to dispute a single one of their assertions (see van Fraassen 1985, 297) -, one *must* act as a realist would do. Outside, back to the actual world, however, one can dismiss the realist bias with no further ado. Falkenburg's claim about the alleged indispensability of scientific realism as a methodological principle cannot in fact be endorsed - and does not seem to make sense - *tout court*.

6. The goal of physics

"*The goal of physics is to explain the effects from their causes*", writes Falkenburg (2012, 336). Of course this is a legitimate point of view on the aim of this important discipline, but it is no more legitimate than the constructive empiricist alternative put forward by van Fraassen, according to which the aim of science - and thus of physics too - is 'only' to give us empirically adequate theories (see 1980, 12).

According to the author of *The Scientific Image*, the problem with the realist stand is that "*an unlimited demand for explanation leads to a demand for hidden variables, which runs contrary to at least one major school of thought in twentieth-century physics*" (van Fraassen 1980, 23) - not to mention that "*as Duhem already emphasized, the very search for new and deeper empirical regularities becomes couched in theoretical language*" (p. 73).[11] Our point here, however, is not to try and underline the problems a supporter of a realist stance must cope with, but again to rebut Falkenburg's claim that

[11] As van Fraassen recalls, right at the beginning of his seminal book, "*the opposition between empiricism and realism is old, and can be introduced by illustrations from many episodes in the history of philosophy. The most graphic of these is perhaps provided by the sense of philosophical superiority the participants in the early development of modern science felt toward the Aristotelian tradition. In that tradition, the realists held that regularities in the natural phenomena must have a reason (cause, explanation), and they sought this reason in the causal properties, constituting what they called the substantial forms or natures, of the substances involved in natural processes. The nominalists, who denied the reality of these properties, were in the position of having to reject such requests for explanation*" (1980, 1).

scientific realism is the only viable position when it gets to astroparticle physics.

> *From the medieval debates, we recall the nominalist response that the basic regularities are merely brute regularities, and have no explanation. So here the antirealist must similarly say: that the observable phenomena exhibit these regularities, because of which they fit the theory, is merely a brute fact, and may or may not have an explanation in terms of unobservable facts 'behind the phenomena'- it really does not matter to the goodness of the theory, nor to our understanding of the world (van Fraassen 1980, 24).*

If one's description of scientific activity is based on the assumption that the goal of science is finding out the causes of the regularities in natural phenomena, then it comes as no surprise that she considers scientific realism as the only philosophical position able to make sense of it. But there always exists a nominalist alternative, as old as science itself. Falkenburg's assumption on the aim of physics is definitely not a conceptual truth. Constructive empiricism *is* an alternative to scientific realism, spelt out exactly in terms of the aim of science, which can make sense of this human enterprise - and therefore of astroparticle physics as well - no worse than the latter does.

7. Cosmic messengers

According to Falkenburg, "*the physicists consider cosmic rays to be messenger particles that carry information about cosmic sources and propagate this information to the earth, where it is read out by the physicists*" (2012, 336). They allegedly mediate between the cosmic sources and the detectors on earth (see p. 338). The concept of 'messenger particles', however, is not a theoretical one, but just "*an informal heuristic tool that helps to reconstruct the causal story of cosmic rays*" (*ibid.*). Still, Falkenburg adds, it "*only makes sense from a realistic point of view*" (p. 337), for it "*paves the way to more detailed theoretical explanations of cosmic rays, their causes, and their effects*" (*ibid.*).

She finds an easy parallel in Dudley Shapere's notion of observation, according to which "*observation boils down to the transfer of physical information*" (Falkenburg 2012, 338). Shapere's account, however, is admittedly theory-laden: "*what the astrophysicist (and I) have been referring to as 'observation' in the solar neutrino experiment obviously involves a great deal of inference*" (Shapere 1982, 517). It is then clear that the "*use of the term 'observation' in reference to that experiment departs from ordinary and philosophical usages which associate observation epistemically with perception*" (1982, 485), as Shapere candidly admits too.

Therefore, "*even if we were to accept the view that their usage is perfectly clear, and is misleading only to the uninitiated, the possibility would still remain that it is nevertheless not that of either the philosopher or the ordinary man*" (Shapere 1982, 488-489). This is probably the reason why Shapere's paper, although well-known and discussed in the literature, is not that influential and many if not most readers of his essay have remained unmoved.

According to Shapere, "*science is, after all, concerned with the role of observation as evidence, whereas sense-perception is notoriously untrustworthy*" (1982, 508). Not only, however, a "*survey of the solar neutrino experiment indicates that prior information plays an extensive role in determining what counts as an 'observation' in that case-as astrophysicists use that term*" (p. 505), but what works in the case of the solar neutrino might now work in general: "*I do not claim that the analysis I have given of 'observation' and its cognates as used in the context of the solar neutrino experiment necessarily applies, in all its details, to all cases of scientific use of the term*" (Shapere 1982, 512).

Shapere's account of 'observation' (insofar as it is appropriate to speak this way) is probably not even a generalization of the verb, then, but rather the description of a peculiar use of it by some astrophysicists in a specific case.[12] Admittedly, "*the astrophysicist's usage is a departure from the ordinary*" (Shapere 1982, 511), whereas 'observation' "*in philosophical discussion (...) is meant to have its common use"* (van Fraassen 1992, 18).

Then yes, Shapere's account constitutes a "*parallel to the concept of messenger particles used in astroparticle physics*" (Falkenburg 2012, 339), but this comes as no surprise either, since Shapere's essay is a case study of the detection of neutrinos allegedly coming from the core of the Sun.[13] Both Falkenburg's description of the study of cosmic rays and Shapere's paper are about very similar phenomena, in both cases described from the point of view of scientific realism and, above all, endorsing the standpoint of astrophysicists with a realist creed – or, perhaps, completely 'immersed' in the theoretical picture that guides their actual scientific work. The parallelism is no striking at all.

[12] Falkenburg considers Shapere's account of observation to be both a generalized and a naturalistic one (see her 2012, 328). Filip Buekens and F. A. Muller attribute to van Fraassen and his constructive empiricism a 'Naturalisation Thesis of Observability' instead (see Buekens & Muller 2012, 92). As it has acutely been said, the term 'naturalism' is "*one of the most ambiguous in the history of philosophy*" (Engel 2011, 191, our translation).

[13] Since this work aims at presenting a constructive empiricist alternative to Falkenburg's account of astroparticle physics, we endorse van Fraassens's distinction between 'observing' and 'detecting': "*Microscopes, cloud chambers, laser interferometers and other scientific instruments allow us to detect entities, but* detection *has to be carefully distinguished from* observation*. A look through a microscope does not allow us to observe directly a parameciu*m*; only to observe* an image *of a parameciu*m*, or to* detect *a parameciu*m" (Contessa 2006, 456). See also van Fraassen (1980, 16-17 and especially 2008, 93).

Still, it is not clear how Shapere's work can actually support Falkenburg's realist account of astroparticle physics, considering that his account of 'observation' has warmed at most only a few (realist) hearts – and that it admittedly constitutes a departure from the ordinary use of 'to observe'. Indeed, both accounts are an accurate description of some scientific practices 'as seen from the inside', endorsing the point of view of the physicists while immersed in what Seager would call a 'virtual reality' - a kind of realist *Matrix*, some might say. Their narrative is completely couched in theoretical language and describes a world where even simple acts such as 'observing' an entity depend on some background knowledge - something that the layman could not perform then.

But there exist alternatives. When Shapere writes that "*what counts as directly observed (observable), and therefore what counts as an observation, is a function of the current state of physical knowledge, and can change with changes in that knowledge*" (1982, 492, emphasis in the original), one might borrow van Fraassen's words once again and ponder: "*I imagine that he is using 'knowledge' lightly; he is referring to the account of underlying causal mechanisms implied by the accepted theories which form the background to the experimentation*" (1980, 79).[14] Even if these collateral theories are believed to be true, one can still describe the practices reported by Shapere as "*the pursuit of empirical adequacy through total immersion (for practical purposes) in the theoretical world-picture*" (van Fraassen 1980, 80) – and consider that what he calls an observation is nothing else than what van Fraassen calls detection.

The same applies to Falkenburg. Whenever she talks of 'knowledge' in her paper, even when she calls it 'well-established' or 'safe background', one might interpret it as a model (or a set of models) of a theory which has been accepted for it has not proved to be empirically inadequate so far. Some of these models are developed for one specific area but prove to be useful in other fields too or, again, are used as a guiding factor in the design of the experiments (see van Fraassen 1980, 74). "*The transfer of knowledge about particle detection went forth and back between cosmic ray studies and particle physics. In the 1950s, the knowledge was transferred from cosmic ray studies to the construction of highly sophisticated particle detectors for scattering experiments*" (Falkenburg 2012, 329).

When Shapere writes that "*what counts as an observation, is a function of the current state of physical knowledge*" (1982, 492, emphasis in the original) and Falkenburg endorses this claim, then, one might interpret it from an empiricist point of view, as meaning that a detection may or may not fit a pre-existing theoretical model. Again, as van Fraassen has pointed out, in

[14] Van Fraassen is here replying to Richard Boyd, but the same applies, *mutatis mutandis*, to Shapere's work.

experimentation theory helps formulating the questions to be answered (what counts as an observation, for instance), besides being a guiding factor in the design of the experiments to answer those questions. The experiment, on the other hand, can help 'filling the blanks' if a theory is still under construction. "*In all this we can cogently maintain that the aim is to obtain the empirical information conveyed by the assertion that a theory is or is not empirically adequate*" (van Fraassen 1980, 74).

Falkenburg also writes that "*the causal stories of cosmic rays are multi-faceted and indeed disunified*" (p. 336) and explains that different models from astroparticle physics are used to fit the so-called 'all particle spectrum', adding that "*these models give just a rough idea of what kind of cosmic sources and astrophysical processes may contribute to the energy spectrum of cosmic rays.* No physicist believes that nature really is like that" (p. 337, our emphasis)[15] - which seems particularly emblematic.

Moreover, when she develops the parallel with the position spelled out by Shapere, who was convinced that the solar neutrinos might serve to directly observe the interior of the sun, she also adds: "*As we know today, his argument failed. Shapere did not know that the information about the sun carried by the neutrinos is altered due to neutrino oscillations*" (p. 339-340). It would be too easy to remark that one might use this very argument to point to the excessive and unnecessary faith (some) scientific realists put in some theories that might just be wrong. But one might again reason in terms of the so-called 'semantic' approach and observe that Shapere was relying on a model that later proved to be empirically inadequate. Falkenburg prefers concluding that "*the nature of the messenger particles was not sufficiently known*" (p. 340). The two alternatives are legitimate. But this is exactly our point: it is not true that astroparticle physics in general, or the account of 'messenger particles' in particular, only makes sense from the point of view of scientific realism. There exist legitimate anti-realist alternatives, even when it gets to astroparticle physics. Constructive empiricism is one of them.

8. Conclusion

"*In the practice of physics (...) many facets of scientific realism coexist, and the realistic beliefs associated with them differ in being stronger or weaker*", writes Falkenburg (2012, 341). Putting aside another possible remark, that it is not typical of a realist position to admit that belief can come in degrees (see

[15] "*In astroparticle physics, the various 'astro' and 'particle' phenomena of cosmic rays are put together into the 'all particle spectrum', which collects all measurements of cosmic rays and their physical properties and represents all known radiation of extraterrestrial origin*" (Falkenburg 2012, 341).

van Fraassen 1980, 9, note 3), in this paper we have tried to show that while there might be a sense in which Falkenburg's claim can be considered true - that is, when judged from inside 'the realist *Matrix*' -, it cannot be taken as such *tout court*. An anti-realist alternative, such as the one put forward by van Fraassen in the last decades, is feasible, even for astroparticle physics.

In *The Scientific Image*, the Dutch philosopher wondered: "*is the methodology of science and experimental design intelligible on any but a realist interpretation of science?"* (p. 70) and defended that the intertwined development of theory and experimentation is perfectly intelligible from an empiricist point of view. The aim of this paper has been to show that, contrary to what Falkenburg claims, this applies to astroparticle physics as well.

In his recent "Microscopes and the Theory-Ladenness of Experience in Bas van Fraassen's Recent Work" (2015), Martin Kusch discussed van Fraassen's notorious and controversial position on the matter of observation and defended it as a viable alternative to a realist interpretation of the output of devices such as the microscope. Some of Kusch's remarks certainly apply - again, *mutatis mutandis* - to Falkenburg's defence of scientific realism as the only position able to make sense of astroparticle physics and its practices.

When she claims that "*knowledge of physical phenomena, the underlying entities, and their properties is objective and stable*" (2012, 341) or that "*the models of astroparticle physics are taken as true whenever they are based on safe background knowledge*" (p. 342), etc., one might borrow Kusch's reply to Marc Alspector-Kelly and say:

> *What is it that we know here? Does not this knowledge involve theoretical claims? And how are we to relate to them? That is, what does acceptance of the theory involve? (...) Does it merely amount to the claim that there is a regularity (invariance) between various observable phenomena brought about by the (...) system? Clearly, the scientific realist and the constructive empiricist will opt for different answers here (2015, 176-177).*

Falkenburg talks about bosons, cosmic rays, microwave background radiation and the like with ease and has every right to do so. She also thinks that "*cosmic rays and their physical properties could be established as objective, stable phenomena*" (2012, 328). One might observe, however, that her narrative "*rests upon a realist epistemology of instrumentally-aided (...) experience; that this theory has come to shape our very phenomenology of instrumentally-aided sensory experience; and that this shaping explains the strengths of resistance to the constructive empiricist's agnosticism*" (Kusch 2015, 168).

Indeed, Falkenburg's talk gives the false impression that we do not need to marshal arguments in defence of the belief that neutrinos and cosmic rays are objects or that the postulated microstructures are real (compare with Kusch

2015, 173). She even reckons that cosmic rays can be established as objective and stable phenomena, as has just been said. But whether these unobservable (to the naked eye) entities are well-behaved or not, is, for the constructive empiricist, something that we merely infer on the basis of the output of some device (compare with Kusch 2015, 176).

Compare this other passage from Kusch's paper, again directed to Alspector-Kelly:

> *He does not recognize the importance and possibility of reading the results of science in a way that is neutral with respect to the debate between scientific realist and constructive empiricist. He does not take account of the possibility that certain formulations or interpretations of scientific theories - by scientists themselves or philosophers - simply presuppose without argument the truth of scientific realism. (…) van Fraassen is entitled to demand that the scientific evidence be rendered in a neutral way, and that this neutral way is precisely the constructive-empiricist interpretation (2015, 180).*

Something very similar might be said apropos of Falkenburg's account of astroparticle physics. Her interpretation of the practices and experiments in this field *does* presuppose without argument the truth of scientific realism, as when she claims that the goal of physics is to explain the effects from their causes (see 2012, 336).[16] I have replied that this is not straightforward at all and recalled that there exist alternative points of view on science and its aim. Van Fraassen put forward an important anti-realist one a few decades ago, which rejects the scientific realists' 'unlimited demand for explanation', but sure can make sense of physics too.

Borrowing again Kusch's words, one might then say that none of Falkenburg's arguments is launched from a platform that would be neutral regarding the two opposed views (compare with Kusch 2015, 181) and that it would be more illuminating to keep neutrality, instead (see van Fraassen 2001, 155 and 2008, 109). It would be so since it could allow us to identify realist commitments as optional (see Kusch 2015, 172). Even when it gets to astroparticle physics.

Let's consider another example. Falkenburg claims that "*unifying strategies, and in particular the heuristic concept of messenger particles, demonstrate that the practice of physics depends on scientific realism*" (2012, 343). But van Fraassen had already explained that "*there seems to me no doubt that the aim of empirical adequacy already requires the successive unification of 'mini-theories' into larger ones, and that the process of unification is mainly one of correction and not of conjunction*" (1980, 87). Unifying

[16] Because of this, Kusch would probably reply that Falkenburg's argument "*presupposes the realism it seeks to establish*" (2015, 181).

strategies are perfectly intelligible from the point of view of constructive empiricism. Even when analyzing them, realist commitments are optional.

In conclusion, we can confidently say that Falkenburg's opinion that without scientific realism "*neither the problems nor the results of astroparticle physics can be understood*" (2012, 343) is not well-founded. Problems and results of astroparticle physics can be understood from an empiricist point of view too, namely from that of van Fraassen's constructive empiricism. Still, it is worth remembering that "*van Fraassen is not trying to refute the scientific realist. All he is seeking to establish is that the constructive empiricist stance is not incoherent*" (Kusch 2015, 172). It is our contention that he succeeded, even when the topic is astroparticle physics.

References

[1] Buekens, F.; Muller, F. A. (2012). Intentionality Versus Constructive Empiricism. *Erkenntnis,* 76, 91-100.

[2] Chakravartty, A. (2007). *A Metaphysics for Scientific Realism. Knowing the Unobservable*. New York: Cambridge University Press.

[3] Contessa, G. (2006). Constructive Empiricism, observability, and three kinds of ontological commitment. *Studies in History and Philosophy of Science*, 37 (3), 454-468.

[4] Discovery of cosmic background radiation. Retrieved from *http://hyperphysics.phy-astr.gsu.edu/hbase/astro/penwil.html* [accessed: september 01, 2018]

[5] Engel, D. (2011). Naturalismo Epistemológico: qual é a controvérsia, afinal? (pp. 191-205). In: *VII Semana Acadêmica do Programa de Pós-Graduação em Filosofia da PUCRS, 2011, PORTO ALEGRE RS. Semana Acadêmica do PPG em Filosofia da PUCRS, VII Edição, 2011*. Porto Alegre: EDIPUCRS.

[5] Falkenburg, B. (2012). Pragmatic unification, observation and realism in astroparticle physics. *Journal for General Philosophy of Science*, 43 (2), 327-345.

[6] Fraassen, B. C. van (1980). *The Scientific Image*. Oxford: Clarendon Press.

[7] Fraassen, B. C. van (1985). Empiricism in the Philosophy of Science. (pp. 245-308). In: P. M. Churchland & C. A. Hooker (eds.), *Images of Science. Essays on Realism and Empiricism, with a Reply from Bas C. van Fraassen*. Chicago: The University of Chicago Press.

[8] Fraassen, B. C. van (1989). *Laws and Symmetry*. Oxford: Clarendon Press.

[9] Fraassen, B. C. van (1992). From vicious circle to infinite regress, and back again. *Philosophy of Science Association Proceedings*, 2, 6-29.

[10] Fraassen, B. C. van (2008). *Scientific Representation: Paradoxes of Perspective*. Oxford: Clarendon Press.

[11] Kusch, M. (2015). Microscopes and the Theory-Ladenness of Experience in Bas van Fraassen's Recent Work. *Journal for General Philosophy of Science*, 46 (1), 167-182.

[12] Morton, A. (1993). Reviewed Work: *Laws and Symmetry*, by Bas C. van Fraassen. *The Philosophical Review*, 102 (3), 408-410.

[13] Robert Millikan coins the term 'cosmic rays'. (n.d.). Retrieved from *https://timeline.web.cern.ch/robert-millikan-coins-the-term-'cosmic-rays'* [accessed: september 01, 2018]

[14] Seager, W. (1995). Ground Truth and Virtual Reality: Hacking vs. Van Fraassen. *Philosophy of Science*, 62 (3), 459-478.

[15] Shapere, D. (1982). The Concept of Observation in Science and Philosophy. *Philosophy of Science*, 49 (4), 485-525.

[16] Sicha, J. (1992). Reviewed Work: *Images of Science. Essays on Realism and Empiricism, with a Reply from Bas C. van Fraassen* by P. M. Churchland; C. A. Hooker. *Noûs*, 26 (4), 519-525.

[17] Stanislavsky system. (May 05, 2016). In *Encyclopædia Britannica*. Retrieved from *https://www.britannica.com/art/Stanislavsky-system* [accessed: September 02, 2018]

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The measurement problem in quantum mechanics

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Abstract

In this paper, we discuss the importance of measurement in quantum mechanics and the so-called measurement problem. Any quantum system can be described as a linear combination of eigenstates of an operator representing a physical quantity; this means that the system can be in a superposition of states that corresponds to different eigenvalues, i.e., different physical outcomes, each one incompatible with the others. The measurement process converts a state of superposition (not macroscopically defined) in a well-defined state. We show that, if we describe the measurement by the standard laws of quantum mechanics, the system would preserve its state of superposition even on a macroscopic scale. Since this is not the case, we assume that a measurement does not obey to standard quantum mechanics, but to a new set of laws that form a "quantum measurement theory".

Keywords: measurement theory; quantum mechanics; reduction postulate, quantum superposition.[3]

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1 Introduction

The act of measurement is a crucial point in the scientific method. It is the process by which we collect empirical information to formulate our hypothesis and build-up our models. Moreover, any physical quantity can be named as such only when a non-ambiguous measurement procedure is (at least in theory) defined. It is fair to say that measurement is one of the cornerstones of scientific progress *in toto*.

Nonetheless, until the last century, its importance has always been taken for granted, and its definition has been somewhat naïve, along the lines of "the process done by the experimenter in the laboratory with rulers, scales and such". Then, in the XX century, quantum mechanics put the measurement process under the spotlight. The measurement serves as the bridge between the macroscopic world, that obeys the laws of classical physics, and the microscopic world, ruled by the counter-intuitive laws of quantum mechanics.

As stated by Bohr [10], "quantum mechanics occupies a very unusual place among physical theories: it contains classical mechanics as a limiting case, yet at the same time it requires this limiting case for its own formulation". If we describe a macroscopic system with the laws of quantum mechanics, we quickly come to the paradoxical conclusion that an object could be in two or more different configurations at the same time. For example, a light bulb could be on and off at the same time; a football team could win and lose the same match; an unlucky cat could be dead and alive. This contradiction is called the "measurement problem". To solve that, we assign a very peculiar role to measurement, defining a new set of rules known as the "quantum measurement theory". A quantum object, such as an electron or an atom, evolves according to quantum mechanics (i.e. the Schrödinger equation) until a measurement is performed. At this point, the processes of quantum measurement theory come into play, translating the quantum state of the system in a macroscopic consequence of the measuring apparatus. This *ad hoc* set of rules can be easily unsettling: indeed, a macroscopic object is made up of smaller parts, molecules and atoms, behaving under the laws of quantum mechanics, so why would the system as a whole behave differently? Moreover, a measurement is not an elementary process, but it can be split into simpler interactions, eventually described by quantum mechanics: can we really center a theory around a process

so weakly defined? These and many more questions bother anyone who is faced with the study of quantum physics.

2 Physical quantities as operators and the wavefunction

Classical mechanics is both descriptive and predictive: if we know the initial conditions of an object and the forces acting upon it, we can define its trajectory. Mathematical difficulties aside, we can always say where it will be after any time. To do so, the instructions to follow are straightforward: let's suppose that we have a point object of mass m, and $\boldsymbol{F}(\boldsymbol{r}, t)$ is the net force on it. Given the position and the momentum of the object at $t = 0$, we use Newton's 2nd law $\boldsymbol{F} = m\boldsymbol{a}$ to study its motion. If we are dealing only with conservative forces, so the net force that can be described as the derivative of a potential energy function $V(\boldsymbol{r}, t)$, Newton's law of motion becomes $-\nabla V = m\boldsymbol{a}$. Therefore we can calculate the trajectory of the object, namely the position $\boldsymbol{r}(t)$ and the momentum $\boldsymbol{p}(t)$.

In quantum mechanics, we cannot define these function for every t; Newton's law is replaced by the **Schrödinger equation** [9]:

$$i\hbar \frac{\partial \Psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi, \tag{2.1}$$

where i is the imaginary unit, and $\hbar$ is the Planck constant divided by 2π. In this equation, we find neither the position of the particle nor the momentum; instead, we have $\Psi(\boldsymbol{r}, t)$, called the **wavefunction**. It is a continuous complex function of time and spatial variables, and it belongs to $L^2(R^3)$, that is the set of all the square-integrable functions over the whole space. The wavefunction contains all the pieces of information quantum mechanics can offer. So how do we get them? How can we obtain from the wavefunction the physical quantities we are interested in, such as position, momentum, energy?

First of all, we assign to the wavefunction an abstract vector $|\Psi\rangle$, using Dirac notation. We then define a scalar product as follows:

$$\langle \Psi_1 | \Psi_2 \rangle = \int_{-\infty}^{+\infty} {\Psi_1}^* \Psi_2 dx \tag{2.2}$$

(it can be shown that this integral does not diverge as long as Ψ_1 and Ψ_2 are square integrable, so this product is well-defined). The set of all these abstract vectors constitutes a complete metric space, called **Hilbert space**. This is the space where the wavefunctions live.

For each dynamical quantity $Q(\boldsymbol{r}, \boldsymbol{p})$ we define an operator $\hat{Q}$ such that:

$$\langle Q \rangle = \int_{-\infty}^{+\infty} \Psi^* \left(\hat{Q}\right) \Psi d\boldsymbol{r}, \tag{2.3}$$

which we can write as a linear mapping onto the Hilbert space using Dirac notation:

$$\langle Q \rangle = \langle \Psi \left| \hat{Q} \right| \Psi \rangle. \tag{2.4}$$

This product gives the expectation value of $Q(\boldsymbol{r}, \boldsymbol{p})$ over the state represented by Ψ: that means that if we had infinitely many copies of the same system, each described by the same wavefunction, and took a measurement of $Q(\boldsymbol{r}, \boldsymbol{p})$ on each one, the average of the outcomes would be precisely $\langle Q \rangle$.

Since $\langle Q \rangle$ represents the outcome of a measurement, it must be a real number; we can write:

$$\langle \Psi \left| \hat{Q} \right| \Psi \rangle = \langle \Psi \left| \hat{Q} \right| \Psi \rangle^* = \langle \hat{Q}^\dagger \Psi | \Psi \rangle = \langle \hat{Q} \Psi | \Psi \rangle. \tag{2.5}$$

It follows that any operator that represents a physical quantity, called an **observable**, must be self-adjoint. For example, we can assign to the physical quantity "position" $\boldsymbol{r}$ the following observable:

$$\hat{\boldsymbol{r}} \equiv \boldsymbol{r},$$

therefore the expected value of position measured on the state Ψ is given by:

$$\langle \boldsymbol{r} \rangle = \int_{-\infty}^{+\infty} \Psi^* (\boldsymbol{r}) \Psi d\boldsymbol{r}. \tag{2.6}$$

3 The generalized statistical interpretation

In general, measurements made on identically prepared systems (i.e., with the same wavefunction) do not return the same result. However, a system can be in a defined state for an observable Q, in which a measurement always yields to the same outcome. In this case, the standard deviation is zero:

$$0 = \sigma_Q^2 = \langle(\hat{Q} - \langle Q\rangle)^2\rangle = \langle\Psi|(\hat{Q} - \langle Q\rangle)^2|\Psi\rangle = \langle(\hat{Q} - \langle Q\rangle)\Psi|(\hat{Q} - \langle Q\rangle)\Psi\rangle$$
$$= |(\hat{Q} - \langle Q\rangle)\Psi|^2.$$

The only vector which has norm zero is the null vector, so:

$$\big(\hat{Q} - \langle Q\rangle\big)|\Psi\rangle = 0 \qquad \Leftrightarrow \qquad \hat{Q}|\Psi\rangle = \langle Q\rangle|\Psi\rangle.$$

If $|\Psi\rangle$ is an eigenstate of $\hat{Q}$, a measurement will produce the outcome $\langle Q\rangle$ (the corresponding eigenvalue) with certainty.

We can extend this result, with the postulate known as the **generalized statistical interpretation**: if we measure the observable $\hat{Q}$ on a system described by the state $|\Psi\rangle$, we are sure to get one of the eigenvalues of $\hat{Q}$. The probability of getting a specific eigenvalue λ is equal to the square norm of the λ-component of $|\Psi\rangle$, with respect to the orthonormal basis of eigenstates of $\hat{Q}$. To ensure this postulate is meaningful, the eigenstates must generate the whole space; this is undoubtedly the case for finite-dimensional spaces, but it is not a trivial question if we are dealing with infinite-dimensional ones. We will then consider an observable a valid one only if its eigenstates fulfil this condition.

The eigenvalues spectrum of an operator can be discrete or continue. If the spectrum is discrete, we can label the eigenvalues with a discrete index n:

$$\hat{Q}|e_n\rangle = \lambda_n|e_n\rangle, \quad \text{with } n = 1, 2, 3..,$$

where vectors $|e_n\rangle$ form an orthonormal basis of eigenvectors (the fact that $\hat{Q}$ is self-adjoint guarantees the existence of such basis, as stated by the spectral theorem). Any state $|\Psi\rangle$ can be written as:

$$|\Psi\rangle = \sum_{n=1}^{\infty} c_n|e_n\rangle. \tag{3.1}$$

The coefficients c_n are complex numbers that can be computed using the orthonormality of the basis:

$$c_n = \langle e_n|\Psi\rangle. \tag{3.2}$$

Therefore, the probability that a measurement will give a specific eigenvalue λ_n is:

$$|c_n|^2 = |\langle e_n|\Psi\rangle|^2. \tag{3.3}$$

Alternatively, if the spectrum is continuous, we label the eigenvalues with a real variable k:

$$\hat{Q}|e_k\rangle = \lambda_k|e_k\rangle, \quad \text{with} \quad -\infty < k < +\infty.$$

The eigenfunctions $|e_k\rangle$ are not normalizable, but satisfy the following, which is a sort of an orthonormality condition:

$$\langle e_k|e_l\rangle = \delta(k-l), \tag{3.4}$$

where $\delta(k-l)$ is a Dirac delta function. In this case, we can write a generic state $|\Psi\rangle$ not as a sum but as an integral:

$$|\Psi\rangle = \int_{-\infty}^{+\infty} c_k|e_k\rangle dk. \tag{3.5}$$

Similarly, we find the coefficients c_k:

$$c_k = \langle e_k|\Psi\rangle \tag{3.6}$$

and probabilities:

$$|c_k|^2 = |\langle e_k|\Psi\rangle|^2. \tag{3.7}$$

Therefore, we can write the wavefunction as a linear combination of eigenstates of a specific operator. Each one represents a possible state in which the system can be found by a measurement, with a coefficient linked to the probability that a particular state will occur. In general, a wavefunction can be written in many ways, with respect to the basis of eigenstates of several observables; those eigenstates are all and only the possible states in which the system can be found when we measure that quantity. The wavefunction mathematically expresses the concept of **quantum superposition** of states: a physical system can always be described by the sum of two or more different states, and vice-versa the sum of two or more different states is still a quantum state of the system. Quantum

superposition is a direct result of the linearity of the Schrödinger equation, which is a consequence of the principle of relativity. In Dirac's words [6]:

"The non-classical nature of the superposition process is brought out clearly if we consider the superposition of two states, A and B, such that there exists an observation which, when made on the system in state A, is certain to lead to one particular result, a say, and when made on the system in state B is certain to lead to some different result, b say. What will be the result of the observation when made on the system in the superposed state? The answer is that the result will be sometimes a and sometimes b, according to a probability law depending on the relative weights of A and B in the superposition process. It will never be different from both a and b [i.e.., either a or b]. The intermediate character of the state formed by superposition thus expresses itself through the probability of a particular result for an observation being intermediate between the corresponding probabilities for the original states, not through the result itself being intermediate between the corresponding results for the original states."

4 The measurement problem

The superposition principle states that a wavefunction can be written as a sum of states, each one representing a different physical situation. This peculiar aspect of quantum theory made possible understanding many phenomena, such as the double slit experiment: the wavefunction of the incident particle carries both the state in which the particle goes through the first slit and the state in which the particle goes through the second slit. The coexistence of two macroscopically incompatible states is what makes possible explaining this experiment, famous for being one of the first to undermine the foundations of classical physics. Even if it led to inestimable development of both theoretical and experimental physics, this approach hides an insidious complication concerning the act of measurement. If we admit the possibility of superposition of states, we occur in a series of contradictions known as the "measurement problem". Let us see in detail what it is about.

Let us suppose that we have a microscopic object, initially described by wavefunction ϕ_i. The object is monitored by a macroscopic measuring apparatus with initial wavefunction ψ_i, in order to measure a physical quantity represented by the operator $\hat{Q}$. Let α_n be the eigenstates of $\hat{Q}$:

$$\hat{Q}\alpha_n = A_n\alpha_n, \tag{4.1}$$

These functions spawn the entire wavefunction space, and we suppose that the system is initially (before any measurement) in an eigenstate of $\hat{Q}$, for example:

$$\phi_{i_1} = \alpha_1$$

or maybe:

$$\phi_{i_2} = \alpha_2.$$

At the end of the measurement process, the measured system will be described by a new wavefunction, ϕ_{f_1} or ϕ_{f_2}, depending on the initial state, and the measuring apparatus will be described by, respectively, ψ_{f_1} or ψ_{f_2}. The product of the two functions gives the wavefunction of the whole system (microscopic object + macroscopic apparatus). We can represent a measurement schematically, as follows:

$$\alpha_1; \psi_i \rightarrow \phi_{f_1}\psi_{f_1} \tag{4.2a}$$

$$\alpha_2; \psi_i \rightarrow \phi_{f_2}\psi_{f_2}. \tag{4.2b}$$

We must take into account some properties of ϕ_{f_i} and ψ_{f_i}. In order to perform a consistent and useful measure, the functions ψ_{f_i} must express that the apparatus registered an unambiguous result and produced an outcome accordingly. That means the apparatus must be in a well-defined macroscopic state, univocally linked to the value of the measured quantity, so the measurement has meaning. For instance, if the apparatus is a screen where a chemical emulsion produces a black dot when it detects a particle, the point where the screen turns black must reflect the initial state of the measured system. Therefore, we must be able to interpret the apparatus left in the state ψ_{f_i} as a result of the measured quantity, being A_i (the eigenvalue corresponding to α_i), without ambiguity. We cannot say much about ϕ_{f_1} or ϕ_{f_2}; there is no particular reason they should be linked to the initial states because the measurement can alter the system in many ways. In the above example concerning the chemical emulsion, a particle after the measurement has an entirely different wavefunction because of the collision with the screen.

This schematic analysis of a measurement is simple and straightforward; however, if the object is not initially in an eigenstate α_i of the operator $\hat{Q}$ we

have a much more complicated situation. Let us suppose that the initial wavefunction is a linear combination of eigenstates, for instance:

$$\phi_i = \frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2). \tag{4.3}$$

Because of the linearity of the Schrödinger equation, the final state will also be represented by a linear combination. Schematically, the measurement is as follows:

$$\frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2); \psi_i \rightarrow \frac{1}{\sqrt{2}}\left(\phi_{f_1}\psi_{f_1} + \phi_{f_2}\psi_{f_2}\right). \tag{4.4}$$

In the general case, in which:

$$\phi_i = \sum_n c_n \alpha_n, \tag{4.5}$$

the measurement is:

$$\phi_i; \psi_i \rightarrow \sum_n c'_n \phi_{f_n}\psi_{f_n}. \tag{4.6}$$

Unlike the previous case, where the system is in a well-defined state after the measurement (4.2), now the apparatus is left in a superposition of many states. Each state represents a different macroscopic situation, in which the apparatus produced different outcomes, like A_1 or A_2. This contradicts the obvious fact that a measurement leads to a specific result – indeed this is what we expect from a good measure. If we apply Schrödinger equation to the measurement process, as we would with any physical process consisting of elementary interactions obeying quantum mechanics, we come to a paradoxical conclusion: if the measured object is in a superposition of states, the system object + apparatus will be in a superposition of states as well, because of the linearity of the equation. To imagine a superposition of macroscopic states is such a silly thing that the most famous thought experiment about it, Schrödinger's cat, is part of popular culture.

As we can see, there is a conflict between the mere linearity of the Schrödinger equation and the basic fact that a measurement should lead to a

clear outcome. This conflict is the notorious **measurement problem** of quantum physics. It seems like a physical object behaves in two different ways, mutually exclusive. On the one hand, we have the proper dynamic evolution expected from standard quantum mechanics (i.e., the Schrödinger equation), and on the other, we have a non-linear and non-reversible process any time we make a measurement. While the former preserves the quantum superposition, the latter converts a superposition of states in a "classical" well-defined single state. The measurement seemingly does not obey Schrödinger equation, but it is governed by a distinct theory, aptly named "**quantum measurement theory**". Some authors, like Peres, doubt that such a theory is necessary since a measurement is not a primary process and is not strictly defined; moreover, a measurement is made up of simpler physical interactions that do obey quantum mechanics [11]:

"[…] there can be no quantum measurement theory—there is only quantum mechanics. Either you use quantum mechanics to describe experimental facts, or you use another theory. A measurement is not a supernatural event. It is a physical process, involving ordinary matter, and subject to the ordinary physical laws."

Still, if we apply the quantum formalism to a measurement we do not get a defined outcome. As we will see in the next paragraphs, many possible answers have been given to what a measurement theory would look like; yet no interpretation has been globally accepted or has been present without significant flaws or drawbacks. Nonetheless, their contribution is priceless, since they made "working" with quantum mechanics possible, without lingering too much on unresolved questions and not being able to do anything.

5 Measurement of the first and the second kind

We did not pose any particular condition on the final wavefunction of the apparatus (ψ_f) nor of the object (ϕ_f), except that ψ_f should be linked in some meaningful way to ϕ_i, in order to perform a consistent measurement. To find what these functions look like is the job of the measurement theory. We would like to know how the final state of the object depends on its initial state or, equivalently, how ψ_f is linked to ϕ_f. These questions are inherently connected to the question of repeated measurements: what happens if briefly after a measurement we perform a second identical one? That is, what can a measurement reveal about the function ϕ_f?

There is not a standard answer to these questions, but it strongly depends on the specific measurement procedure. For instance, in many cases the result of a hypothetical repeated measurement is trivial: if an electron collides with a screen, forming a black dot in order to measure its position, it is no more

available for a second measurement; even when a repeated measurement can be performed, it may give no useful information. We can think of the following example: measurement of momentum on a neutron can be achieved by completely stopping the neutron with a series of collisions and observing the recoil protons. The particle is available for a second measurement, but its momentum has become zero independently of ϕ_i.

Finally, there are situations where a second measurement can be made, and the final state is linked in a relevant way to the initial state. Let us consider a Wilson cloud chamber [2]: an α-particle passes through a supersaturated vapour of water, interacting with its particles with the formation of a black mark. Since the blackening is macroscopic, we can think of it as an approximate measurement of position – indeed, compared to the scale of the particle it carries an enormous uncertainty. Because of this lack of precision on the position, the uncertainty on the momentum remains small. Therefore, we can consider the measure causing essentially no perturbation to the momentum, which remains constant. For this reason, a black track of the passage of the particle forms in the chamber, made up of several consecutive position measurements. This is an example of measurement where ψ_f and ϕ_f are clearly related: the blackening of a specific macroscopic point (described by ψ_f) happens because at that moment the particle initial wavefunction ϕ_i is localized in that point. Since the measurement does not alter the motion, we can conclude that the particle wavefunction after the first blackening ϕ_f is located in the same place with the same momentum.

A measurement as above, where the final state of the system gives information to the initial state because they are directly connected, is called **measurement of the first kind**. Conversely, if the final state depends entirely on the measurement procedure and it is not linked in a significant way to the initial wavefunction we are dealing with a **measurement of the second kind**, as in the screen where an electron collides or the momentum measurement on a neutron that stops the particle. In a measurement of the second kind, the information about the initial state is lost, wiped out by the measurement. From now on we will speak mostly of measurements of the first kind, or "moral" measurements [2].

In addition to the Wilson chamber, we can think of some other practical situations that fit into the category of measurement of the first kind. Let us consider a spin-½ particle at high speed that goes through a Stern-Gerlach apparatus, a channel with one entry and two exits, in which there is a magnetic field along the z-axis. The magnetic field will deviate the particle towards one exit or the other, depending on its spin orientation. In both cases, it exits a detector is placed to indicate where the particle passes. In this apparatus, we directly measure the position, but doing so we obtain information on the spin of the particle: we perform an indirect but well-defined measurement of the third

component of the spin s_z. Since the measurement does not affect at all the measured quantity, we can reasonably assume that a second measurement on the same particle will lead to the same result – it is easy to connect a pair of Stern-Gerlach apparatus at the exits of the first and confirm this is the case. We can expand this idea by connecting N pairs of apparatus, thus building a device that performs the spin measurement N times and gets the same result every time.

Another example would be the measurement of radioactive decay. We surround a radioactive nucleus with detectors, in order to be 100% sure to detect an eventual decay. If at some point the detectors signal the nucleus is decayed, a successive measurement after the first would still show that the nucleus is indeed decayed. Vice-versa, if under inspection the nucleus is found to be non-decayed, then a second measurement made shortly afterwards will return the same outcome.

By these simple representations of real measurements, we understand by intuition and common sense that a repeated measurement should give the same result (provided that we take it after a time so small the system would not be altered by the physical interactions it is subject to). Dirac [6] held this concept in high regard, asserting it is a matter of physical continuity, a requirement for any measurement theory. While it is undoubtedly desirable, is there a formal justification to such a necessity? If we think about a measurement of position, special relativity implies that repeated measurements must yield to the same result. Otherwise, a particle would be able to travel a finite distance in zero time. In reality, if we observe a particle in a point P, a second measurement made after a time t could find the particle to be everywhere within a distance of ct from P. We should remark that an exact measurement of position causes a total uncertainty on the momentum; therefore we limit the precision of a position measurement to a range of points where we can observe the particle. Doing so, we reduce the momentum uncertainty and expect that a second measurement performed after a small enough time falls within the same range. For other observables, it is not so clear why repeated measurement should give the same result, and those arguments could be as well called “moral” [2].

6 Possible solutions to the measurement problem

The measurements of the first kind preserve information about the initial state of the system. If we want to measure the observable $\hat{Q}$ and the measured system is in the eigenstate α_1, the measurement is:

$$\alpha_1; \psi_i \rightarrow \alpha_1 \psi_f. \tag{6.1}$$

A measurement of the first kind does not alter the system, maintaining the eigenstate. As we mentioned, if the initial wavefunction is a superposition of states, for instance $\phi_i = \frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2)$, we face the measurement problem:

$$\frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2); \psi_i \rightarrow \frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2)\psi_f. \tag{6.2}$$

The most common approach to solving this problem involves postulating the existence of a **reduction of the wavefunction**. It is a process that turns a state of superposition (not macroscopically defined) into an eigenstate, whenever we make a measurement. It is irreversible and non-linear; therefore, it does not obey the Schrödinger equation. The reduction postulate states that measurements always leave the system in a well-defined state, "reducing" the wavefunction to only one of the eigenstates that constitute the superposition. Let us suppose the measurement outcome is A_2, the eigenvalue relative to α_2; the reduction of the wavefunction will result in:

$$\frac{1}{\sqrt{2}}(\alpha_1 + \alpha_2); \psi_i \rightarrow \alpha_2 \psi_{f_2}, \tag{6.3}$$

or, in general:

$$\sum_n c_n \alpha_n; \psi_i \rightarrow \alpha_k \psi_{f_k}. \tag{6.4}$$

This process is entirely different from the linear evolution predicted by "standard" quantum mechanics. Until we observe it, the system follows the expected linear evolution; when we perform a measurement, returning the outcome A_k, the wavefunction is reduced to the state α_k. When the measurement ends, the system goes back to the Schrödinger dynamics, causing it to return in a state of superposition. However, if we performed a second measurement immediately after the first one, we would undoubtedly get A_k. The reduction postulate ensures that repeated measurements yield to the same result.

Standard quantum mechanics predicts a chain of superposition: the microscopic object passes his superposition state on the macroscopic measurement apparatus, which in turn passes it on the observer's sensory organs, to his brain and so on. The reduction postulate asserts that at some point the chain breaks and the superposition is lost. How the reduction process exactly works is debated, so there are several interpretations. The most accredited hypothesis is that it happens as we pass from a microscopic object to a macroscopic one. This assumption somewhat reminds of Bohr's "complementarity" [10], that consists of refusing to assign a wavefunction to a

macroscopic system. In the same way, as Bohr does, we are posing an arbitrary cut between the microscopic and the macroscopic world. For this reason, it can not be regarded as a rigorous solution to the measurement problem, but it has shown to be an efficient practical workaround.

In Von Neumann's [12] original formulation, the reduction process instead happens at the level of the observer's "mind", that interrupts the concatenations of superposition thanks to its introspection abilities. Von Neumann's theory also presents an interactionist aspect: the observation alters the wavefunction, thus shaping the physical reality.

We should bear in mind that, if we admit the existence of a reduction process, we are stating that the wavefunction is subject to two separate evolutions: the Schrödinger dynamics and the reduction process. The strongest criticism to this interpretation is that a measurement is not a fundamental process, but it is made up of simpler interactions described by the Schrödinger equation, so it can not be regarded as a primitive notion of a theory. Moreover, what constitutes a measurement is vaguely defined, although the naïve approach [8] ("a measurement is that thing an experimenter does in the laboratory with scales, rulers, spectrometers and such") is a good starting point from a pragmatical perspective.

The reduction postulate is not the only possible solution to the measurement problem. Despite what we have said up to now, many theories assume that the superposition state (4.6) can represent a macroscopic outcome of a measurement, denying the necessity of a reduction process. In a theory pioneered by Everett [5], known as **many world interpretation**, any possible outcome of a measurement happens simultaneously in parallel universes that do not communicate with each other. When we perform a measurement, the physical reality branches, forming a parallel universe for any possible outcome. In this way, there is no need for a wavefunction reduction, since any possible state of the superposition occurs in a different world. Everett's theory has internal consistency and is supported by many authors. One of its flaws is that it fails to rigorously discriminate what should be considered a measurement and what not. Another drawback is that it is not clear how "deep" the branching of the different realities is: if we consider an observable with a continuous eigenstate spectrum, we are not able to say how distant two outcomes should be to generate two different realities.

Another remarkable theory is the Ghirardi-Rimini-Weber theory [7], also known as the **spontaneous reduction theory**. It consists of a correction on the Schrödinger equation itself, throwing in a non-linear term, which causes a process analogous to reduction. The difference is that this process, which we may call a "spontaneous reduction", does not happen when a measurement is made but can happen at any time. The probability of a spontaneous reduction is proportional to the size of the system, so it is very likely to happen for

macroscopic objects. In fact, in the macroscopic world, this probability is so big that a superposition of states cannot exist for more than an infinitesimal fraction of a second. Conversely, the occurrence of a reduction on a microscopic scale is so small that a quantum system can retain its state of superposition virtually forever. This theory has been modified many times since its formulation, mainly to take relativity into account and to fix several incongruences.

Some other theories, like **ensemble theories**, consider the superposition state with a statistical approach, as a collection of alternatives that occurs on a set of identically prepared system; the wavefunction is not suitable for describing a single system, such as a single particle, and indeed it has no physical meaning, since it does not represent a physical property of the particle but is an abstract statistical function.

Another approach is that of non-local hidden variables theories, such as the **theory of incomplete measurements** [1], postulating that there exist some hidden quantities we cannot access that regulate the measurement process. We can think of it as a realist point of view on the measurement, in contrast to the orthodox position, according to which the wavefunction is the complete information on a system.

Decoherence theories state that, when a quantum system is thermodynamically paired with the environment, it loses information; this happens because the surrounding interferes with the phase of the wavefunction causing a mixed state, a statistical mixture of pure states. That can explain the observation of the wavefunction reduction, which is an effect of the loss of coherence, while the hypothetical "universal wavefunction" (i.e., the wavefunction describing the entire universe) always remains coherent.

Recently, interpretations focused around quantum information became increasingly popular. For example, according to the **"it from bit" theory** [14], quantum mechanics describes the observer's experience of reality, but not reality itself: in this interpretation, physical reality is an effect (perhaps a consequence) of information and not the other way around.

7 Conclusions

We saw how the laws of standard quantum mechanics unavoidably lead to the measurement problem. The possible solution ideas presented above are only some of the many possible interpretations of quantum mechanics and the role of the measurement, each with its strengths and weaknesses. So far, the question is quite open. Nonetheless, it should be noted that there is no experimental way to discriminate between the interpretations. For this reason, the question seems to be rather philosophical or ontological than physical. From a scientific perspective, is it meaningful to search for an answer that we cannot empirically prove? Most importantly, such a conjecture would not be

disprovable either, because there is no way to distinguish between the alternatives.

Even if, throughout this paper, we have used the words “interpretation” and “theory” interchangeably, they really are different, if we want to be careful. The ideas presented as possible solutions to the measurement problem are indeed interpretations of the measurement theory, and not theories themselves since the prerogative of a scientific theory is that it can be disproved by empirical facts. These interpretations aim to provide a “mental picture” to explain the same consequences. They all come to the same conclusions: they agree that a wavefunction reduction (apparent or real that is) exists, the wavefunction has a statistical interpretation (whether the wavefunction itself is a real physical property or just a mathematical tool) and so on. We could say that, if a scientific theory asks “how?”, those interpretations pursue the *why*. That surely is an ontological argument, trying to point out where our perception of reality ends and where the real thing starts, if such a thing even exists.

Therefore, many do not bother much about it and gladly embrace a pragmatic instrumental position: the statistical nature of the wavefunction and the measurement outcomes are cold facts, and we do not care about why that is so. We know how to calculate probabilities from the wavefunction, we know how a wavefunction evolves, we know what to expect from a measurement, and this is everything we can hope to know. Quantum measurement theory is successful in describing the experimental result we get in the laboratory. We cannot know why, but there is no point in trying to ask this question. What we know is what we need to work with quantum mechanics properly. It is possible that in the future a new theory could entirely replace quantum mechanics, making those questions meaningless; at the end of the day, quantum theory is still the most logical description of nature we have, so we should not feel stuck but pave the way for research and progress one step at a time. As Bell said [2]:

“This progress is made in spite of the fundamental obscurity in quantum mechanics. Our theorists’ stride through that obscurity unimpeded... sleepwalking? The progress so made is immensely impressive. If it is made by sleepwalkers, is it wise to shout 'wake up'? I am not sure that it is. So I speak now in a very low voice.”

References

[1] Aerts D. (1986). A possible explanation for the probabilities of quantum mechanics, Journal of Mathematical Physics, 27.

[2] Bell J. S. (1987). Speakable and Unspeakable in Quantum Mechanics, Cambridge: Cambridge Univ. Press.

[3] Bohm D. (1952). A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden Variables' I, Phsical Review, 85.

[4] Cohen T. C., Diu B., Laloë F. (1997). Quantum Mechanics: I, Weinhaim: Wiley-VCH.

[5] De Witt B. S., Graham N. (1973). The Many-Worlds Interpretation of Quantum Mechanics, New Jersey: Princeton University Press.

[6] Dirac P. A. M. (1974). The principles of Quantum Mechanics, 2nd edition, Oxford: Clarendon Press.

[7] Ghirardi G. C., Rimini A., Weber T. (1986). Unified dynamics for microscopic and macroscopic systems, Physical Review D, 24.

[8] Griffiths D. J. (1994). Introduction to Quantum Mechanics, New Jersey: Prentice Hall.

[9] Home D., Whitaker M. A. B. (1997). A conceptual analysis of Quantum Zeno; paradox, measurement, and experiment, Annals of Physics 258, 237-285.

[10] Landau L. D., Lifshitz E. M. (1958). Quantum Mechanics. Non-Relativistic Theory, Oxford: Pergamon.

[11] Peres A. (1993). Quantum Theory: Concepts and Methods, Dordrecht: Kluwer.

[12] von Neumann J. (1955). The Mathematical Foundations of Quantum Mechanics, New Jersey: Princeton University Press.

[13] Wigner E. P. (1967). Remarks on the Mind-Body Question, Symmetries and Reflections, Indiana: Indiana University Press.

[14] Zurek W. H. (1990). Complexity, Entropy, and the Physics of Information, Massachusetts: Addison-Wesley.

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The testosterone paradox: how sex hormones shape the academic mind

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Abstract

The polarizing divide that gapes ever wider between the two main political parties in the United States is purportedly based on rational discourse about various important issues: healthcare, taxation, and national security, to name a few. However, if we delve deeper into the evolved psychological forces that shape our mindsets and culture through history, we will find that these matters are actually symptomatic of one underlying primary human motivation: Sex.

I argue that sex differences in the brain seem to shape the ideological gulf between the respective social groups each side represents. And most significantly, it is the male sex hormone testosterone that is the primary hormone affecting our sexual evolution. Not only does testosterone fuel the passion for reproduction and play a critical role in the length of human lives, but it is also an integral component to the mechanism of human civilization—its triumphs and its tragedies.

Keywords: sex hormones, cultural evolution, evolutionary psychology.[⊗]

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1. Introduction

Since the 2016 contentious presidential elections—Hillary Clinton vs Donald Trump—gender wars have been the primary contributing factor to escalating political conflict, personified in these two leading figures. Destructive forces are pitting each side against the other with profound allegations: the feminist left wing accuses Trump supporters of racism, sexism, and xenophobia, while the more characteristically masculine right wing condemns the Democrats as radical communists who hate their nation, traditions, and heritage. We are on a path toward a cultural divorce, as the heated debate is rapidly deteriorating into uncontrollable anger and even outright violent conflict. Some alarmed observers warn that we have witnessed similar periods in the course of history that led to great conflicts, such as the American Civil War and the French Revolution.

The political right in the US represents the strong, masculine personality type, which stands for what President Trump calls an "America First" vision for the world: a policy in which the interests of the American people are prioritized exclusively, protecting the nation with closed borders in addition to cultivating national identity and traditional values. This is opposed by the left wing's globalist, inclusive, and communal vision for humanity, which demands altruistic sacrifice for the universal good, favouring empathy and social bonding to achieve a global multicultural community by eliminated borders and nationalist identity. It is important to comprehend how the masculine-feminine dichotomy displays itself in cultures and to investigate the mechanisms of these deeply embedded impulses in human existence.

2. The role of sex hormones in human history

To understand the forces that drive the life cycles of human cultures and form the engine of history, it is important to look at the most fundamental building blocks of human neuroscience. Our hormones are the impetus for our history. Hormones regulate and control the way the human mind perceives the world and forms social organisations and political order accordingly. Hormones drive waves of social mood, shaping the evolution of our social life, the fluctuations of religious doctrines, cultural crusades, and sexual norms.

As *Homo sapiens*, the rational man, we have a dual nature. The mind is characterized by the faculty of reason, but humans are also social mammals, driven by animal instincts for survival, procreation, and social status. As individuals, sex is a defining feature of our personality and gender characteristics. As social animals, it also shapes our social structure, the model for the organization of our society, and plays an essential role in our biology as

sexually reproducing organisms. This dual nature of the human condition is at the core of the conflicts and the cultural storms evident in contemporary culture. Just like the ageing human body falls to disease, such as cancer, and somatic cells start to die while deadly cells multiply, weakening the body from within, so civilizations age and deteriorate precipitously when extreme ideologies arise (e.g., National Socialism) or famine or other extreme conditions challenge their homeostasis. The mental state in which people are susceptible to such ideologies of death is caused by hormones in a similar manner that hormones signal the cells of an ageing body to execute programmed death and bring to the end of an organism's life cycle.

3. Sexual and social organization

Indicative of this ageing civilization are the demographic problems facing Western societies. Birth rates are declining, population size is shrinking, and the massive Baby Boom generation of senior citizens now facing retirement will not be able to be supported by the disappearing labour force with fewer young people. Indeed, falling fertility rates are a signal for collapsing testosterone levels throughout such periods of cultural decline. These trends bring our society into a schizophrenic mode, in which the masculine and feminine sides battle one another in competition for cultural domination, rather than complementing each other in a harmonious relationship, as man and woman joined together in traditional marriage union might do. This breakdown in social and group cohesion across gender lines, in conjunction with the decline in the traditional masculine leadership role, threatens to fracture the social bonding that holds us together.

The rise of complex human societies requires shared intentionality, the cultural transmission of knowledge, and the division of labour, and these are facilitated by the mechanism of social bonding. This defining attribute of ultra-sociality in humans, connecting people into close social networks that cooperate together based on shared values, is a property that enables humanity to achieve greatness. Hence, the feminine characteristics of empathy and love are essential for the benefit of our society. However, if the structure of our social bonding is too highly empathized, too tight, it can thwart the freedom and flexibility required for the individual to exercise independent will and action by taking personal responsibility. Such a social system becomes inflexible, leading to social bondage and stagnation. In this way, the group can undermine the individual drive for creativity and rationality and block a path for objective knowledge. Therefore, we must seek a hormonal balance between the feminine side of self-sacrifice and social bonding with the masculine side of independence and rational self-interest.

4. Diminishing testosterone: an endocrine crisis

The decline in testosterone levels in the past thirty years has been documented in studies worldwide. Utilising data from long-term studies that looked at serum testosterone levels in American men between 1987 and 2005, Travison et al. reported a drop in total testosterone by 20% in those years and close to a 50% drop in free testosterone.[1] Similar studies in Denmark and Finland conclude similar decreases, with reports calling such declines "alarming," particularly from an evolutionary standpoint.[2] The Finnish population tested between 1972 and 2002 showed that men born between 1942 and 1951 had notably lower testosterone levels than men in the same age range (60 - 69) who had been tested years earlier, men born between 1913 and 1922.[3]

A further indication of collapsing testosterone levels is the array of data concerning significant decreases in semen quality. Sperm counts and semen volume between 1940 and 1990 have been shown to have lowered by 50%.[4] Another study showed that between 2001 and 2011, there was a 38% decrease in sperm quality, accounting for a 2% decline per year in men between 18 and 25 years old.[5] These levels are approaching a critical point at which conception becomes much less likely. In an overview of these concerns published in the *Wall Street Journal*, the data on declining testosterone and subsequent sperm quality has been studied from nations with "large databases and the ability to track health records," making the research longitudinal with sizable populations to assess.[6]

The causes of declines in testosterone levels and subsequent semen quality are debated in the literature. At this stage of discussion, I will forgo a review of those possible causes, as the immediate focus is the effect. The effects of declining testosterone levels include compromised fertility viability, increased

[1] T. G.Travison, et al., "The Natural History of Symptomatic Androgen Deficiency in Men: Onset, Progression, and Spontaneous Remission," *Journal of the American Geriatric Society* 56, no.5 (2008): 831–839, doi: 10.1111/j.1532-5415.2008.01679.x.

[2] A. Perheentupa, et al., "A Cohort Effect on Serum Testosterone Levels in Finnish Men," *European Journal of Endocrinology* 168 (2013): 227–233, http://www.eje-online.org/content/168/2/227.full.pdf.

[3] Ibid.

[4] E. Carleson, A. Giwercman, N. Keiding, & N. E. Skakkebaek, "Evidence for Decreasing Quality of Semen During Past 50 Years," *British Medical Journal* 305, no. 6854 (1992): 609-613. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1883354/.

[5] Anna Hodgekiss, "Sperm Quality has Declined by 38% in a Decade - and Poor Diet and Lifestyle Could be to Blame," January 21, 2013, *Daily Mail*, http://www.dailymail.co.uk/health/article-2265792/Mens-sperm-quality-declined-38-decade--poor-diet-lifestyle-blame.html.

[6] Wang, Shirley, "The Decline in Male Fertility," July 15, 2013, *The Wall Street Journal.* http://www.wsj.com/articles/SB10001424127887323394504578607641775723354.

depression and mental disorders in men, increased rates of certain types of cancer, and diminished ability to cope with the stressors of modern life.

Lower testosterone leads to lower levels of serotonin, causing anxiety and depression and the rise of violence in society. Conversely, testosterone stimulates dopamine activity in men, which fosters focus and goal orientation, feelings of well-being, and vitality. Moreover, testosterone levels correlate with what is called crystallised intelligence in men between the ages of 50 and 70 years old,[7] the same population of men whose testosterone levels have declined up to 50% between 1987 and 2005.[8] These are often very productive years in men's lives. It is the period of life when men are among the power brokers of a culture—its thought leaders in academia and religion, heads of industry, media, and politics. In those years, men are guiding their offspring and others in subsequent generations. While this is also the case for women of this age group, the data being assessed concerns males, hence the emphasis on the endocrine crisis in modern males.

This endocrine crisis affects the worldview of a culture: declining testosterone, which links to depleted serotonin and diminished dopamine, creates a mindset more prone to passivity and fear and violence. Such weakened psychological vitality makes entire populations susceptible to group-think, to a herd mentality, and to manipulation by controlling forces. As noted above, though empathy is an important quality in humans, if the feminine, empathizing mind is not balanced by the masculine systemizing mind, the drive for individual excellence in society is muted, at times even entirely squelched. Therefore, looking back through history, it can be postulated that when cultures are suppressed by tyrants—including the tyranny of the crowd—when creativity and ingenuity and prosperity are supplanted by fear and reserve and paucity, it is very likely that this is the effect of declined testosterone levels.

5. The endocrine crisis in academia

The current period of conflict provides scientists with the incredible opportunity to examine our political strife from a broader social-science perspective to evaluate the inherent forces that drive social conflict and transformation. This would require an integration of the natural sciences—primarily biology and neuroscience—with the humanities in order to reach a more comprehensive understanding of our mind-body connection and how evolved sexual reproductive strategies drive the organization of our society,

[7] Johannes Schroots, "On the Dynamics of Active Aging," *Current Gerontology and Geriatrics Research* (2012): http://www.hindawi.com/journals/cggr/2012/818564/.

[8] Carleson et al.

culture, and political ideologies accordingly. There are highly respected thinkers who have endeavoured some aspects of such a project, such as a biologist E.O. Wilson and psychologist Jonathan Haidt; yet they, like others, only go so far in their investigations. The academic culture that underpins the social environment in which researchers work and publish creates a feedback loop with the culture. The very lens through which we see the world affects our perceptions of the world and therefore how we organise socially: what gets researched and what doesn't, what kinds of art and entertainment are produced, what journalists report, and thereby what the public comprehends as "truth." The decline in testosterone evidenced throughout the past few decades is concurrent with an academic culture that is increasingly hostile to the principles of open discourse and exhaustive investigation.

Unfortunately, although the public tends to think of academic science as purely empirical and objective, we are biologically designed to operate under self-imposed and socially induced restraints, even regarding our core belief system and ideology. Our very human nature as social animals that form cohesive social groups for survival often prohibits individual scientists from pursuing an independent course of inquiry that contradicts the mainstream line of thinking. This is not different from the kinds of accusations and persecution that can lead to excommunication when heresy is detected in religious groups. As social mood declines, humans cannot overcome the increased feelings of irrationality. They come to distrust their own minds and the world around them and become reduced to instinctual, animalistic, group behaviour on par with other mammals and even social insects, such as ants and bees.

The view of man as both an independent and a rational being tends to coincide with a culture in which a rise in testosterone levels raises our feelings of self-esteem, our internal locus of control, and an optimistic, rational view of human nature. During the period between the 1950s and 2000, there was a rationalist view of man in both psychology and the social sciences, and an individualistic view that regarded man as an autonomous unit, in which the mind of the individual is not part of overly subject to social group pressure. This view, referred to as *methodological individualism*, also reigned supreme in the study of biological evolution, in which the individual was considered the unit of selection. However, the cycles of history are fractured into sub-cycles of different degrees, and within this overall positive trend in a social mood, there were sub-periods of decline, primarily during the recession of the 1970s. During this period of negative social mood, in 1978 social scientist Herbert Simon received a Noble Prize in economics for his work on bounded rationality, his concept that our rationality is limited during decision making, constrained by our finite mind and time resources.

The mainstream view of individual selection in biology, along with reason and atheism versus religion, were represented by evolutionist Richards

Dawkins, who published the *Selfish Gene* in 1976. Dawkins presented his thesis that genes are the unit of selection in individuals, in a similar fashion that *memes*, a term he coined for ideas that spread through human society, are the unit of selection in human cultures. The contrast between the overall positive trend in social mood post-WWII until 2000 and the negative sub-degree trend during the 1970s is evident in Dawkins' overall approach. While he championed reason, individualism, and science, on the one hand, his newly introduced concept of memes, on the other hand, challenged pure reason and free will, because the meme associates human cognition with the biologically determined mechanism of social groups.

During the 1970s, some other dissenting voices to the individualistic paradigm emerged, but they were few and usually silenced by the majority. One such scientist was Harvard biologist E.O. Wilson, who published his book *Sociobiology* in 1975, discussing humans as social organisms like ants or naked mole-rats—a concept that was not well received at the time. Another dissenting academic to the individualistic view was the evolutionary biologist David Sloan Wilson who promoted the view of multilevel selection, rather than the individual as the sole unit of selection. This determines that evolution operates on the level of individuals within groups, but also in group selection—groups as a whole system competing against other groups for survival, resources, and propagation of itself.

The societal decline in testosterone and other "happy chemicals" in our brains since its peak around the year 2000 has resulted in the effect of a decline in social mood. Our collective mind feels depressed and disillusioned with reason, perceiving ourselves too fragile and incompetent to deal with the challenges presented by the times. Jonathan Haidt presented his own model of *social intuitionism* in 2001, in which moral positions and judgments are primarily intuitive. They are only rationalized, justified, or otherwise explained after the fact, and are taken mainly to influence other people to form cohesive coalitions in the social dynamics of group behaviour.[9] The idea that the faculty of reason only follows our intuition diverged from the prevailing rationalist model of morality, such as of Lawrence Kohlberg's stage theory of moral reasoning, which was the accepted model in prior decades.

Since the social mood has declined, both individualism and reason have suffered severe blows in our collective consciousness and view of human nature. Currently, the view of man as a rational, independent being is attacked from every side, similarly to how Locke's rationalist view of man during the eighteenth century Age of Reason was subsequently attacked by Hume and Rousseau. Locke believed in the *blank slate hypothesis*, which states that the human mind is born with no innate ideas, thus validating the optimistic view

[9] Jonathan Haidt, *The Righteous Mind: Why Good People Are Divided by Politics and Religion* (New York: Pantheon, 2012), Kindle edition, 913.

of man as a rational being who possesses the absolute power of free will. The opposite view, called *innate ideas*, binds our brains—and our fates—to biological factors, which are associated with the limitations of the material world and animalistic impulses as the basis of behaviour.

6. The radical triumvirate

There are no ideological forces more destructive to the benevolent view of man advocated by the Enlightenment than the unholy trinity of feminism, Marxism, and Eco-feminism. It seems that with the decline in testosterone, which is responsible for creating dominance hierarchies and social order, this triumvirate seeks to demolish a rationalist world order by bringing anarchy and chaos to the social system. Established social structures grounded in the biology of the sexes, such as the heterosexual family, gender differentiation, and the sexual division of labour, are attacked in by the progressive vanguard of contemporary academia and media as irrelevant, primitive, and anachronistic, controlled by a "patriarchy" that defies the laws of human progress with outdated traditions. Yet, these powers are blind to the irony that Camille Paglia calls a "delusion" when she writes, "Sexual freedom, sexual liberation—a modern delusion. We are hierarchical animals. Sweep one hierarchy away, and another will take its place, perhaps less palatable than the first.[10]

The prevailing elite ideology of feminism and cultural Marxism views the human personality as a subjective social construct that has no objective biological basis. It is, for example, in complete denial of the role testosterone has in creating the biology of sexual differentiation in the human brain. Moreover, the Marxist-feminists adhere to aspects of Darwinian evolution that attack the biblical view of mankind as a dominant being, created in the image of a transcendent God, above all other animals and above physical nature itself. Hence, by advancing their *version* of the evolutionary worldview, they seek to reduce the status of man to simply another animal, residing on earth and limited to the material world. In the socialist, utopian, egalitarian version of evolution, evolutionary psychology has no place. The idea that our brains evolved through adaptations to ancestral, environmental conditions clashes with the ideology that there are no innate genders, racial differences, or superior cultures or religions; and this is accomplished particularly by attacking Western culture as having a superiority complex.

Marxist feminism, thereby, is similar to the Platonic dualistic worldview that regards its ideals of an egalitarian, utopian, communal society as products

[10] Camille Paglia, *Art and Decadence from Nefertiti to Emily Dickinson* (Yale Nota Bene, 2001), 4.

of the mind, not impeded by the limitations of the body. Any mention of biological factors that result in gender and race differences are strictly prohibited in this intellectual atmosphere; in fact, increasingly they are punished. Jonathan Haidt describes the phenomenon of such insular thinking and how it generates a kind of group trance, in which "moral claims come to feel as objectively true as the claims of physics and math."[11] Likewise, Steven Pinker critiques the feminist lockdown on the scientific inquiry about sexual difference in the human brain:

> *At some point in the history of the modern women's movement, the belief that men and women are psychologically indistinguishable became sacred. The reasons are understandable: Women really had been held back by bogus claims of essential differences. Now anyone who so much as raises the question of innate sex differences is seen as "not getting it" when it comes to equality between the sexes. The tragedy is that this mentality of taboo needlessly puts a laudable cause on a collision course with the findings of science and the spirit of free inquiry.* [12]

This aversion to academic freedom in science is an enormously troubling characteristic of the current culture, and its effects are already broad reaching. In failing to publish much new research on the societal decline of testosterone, the highly feminized academic establishment ignores research, for example, that indicates the loss of masculine development among adolescent boys, who should have experienced puberty with rising male hormones levels. Young men between the ages of eighteen and twenty-four in the UK report that even the term "masculine" has negative implications. Only 28% of the men polled self-reported as "feeling masculine," and only 2% identified as "completely masculine." This stands in contrast with men over sixty-five, 56% of whom reported feeling completely masculine.[13] In concert with their propaganda campaign over the past decades to vilify masculinity in general, feminist academics ignore or suppress research that supports positive aspects of testosterone. A German study indicates the correlation between higher testosterone and a higher incident of honesty in the ninety-one male participants. Co-researcher Dr Armin Falk suggested that the significantly

[11] Stephen L. Petranek, "American History Interviews Psychologist Jonathan Haidt," August 1, 2012, HistoryNet, http://www.historynet.com/american-history-interviews-psychologist-jonathan-haidt.htm.

[12] Steven Pinker, "Sex Ed," *New Republic*, February 14, 2005, https://newrepublic.com/article/68044/sex-ed.

[13] Virginia Hale, "YouGov Poll: Only Two Percent of Men Aged 18-24 Feel Masculine," Breitbart London, May 20, 2016, http://www.breitbart.com/london/2016/05/20/yougov-masculine-poll/.

higher incident of pro-social behaviour (i.e., honesty) in those men treated with testosterone might be due to "increased pride and the need to develop a positive self-image in participants."[14] While this outcome is hardly news to people who understand the very positive benefits of robust testosterone, what's alarming is that the study results are reported as surprising and contrary to some long-held canon regarding the anti-social behaviour of higher testosterone—as if that is a truth that certain newer studies are only now refuting. In fact, what this depicts is the bias inherent for decades in most research concerning testosterone, and that is a direct result of the encroaching Marxist-feminist ideology that has come to grip the research community.

As the triune influence of feminism, Marxism, and Eco-feminism has saturated the thought leaders of our society, perhaps no one consequence is more stunning than the swiftly growing phenomenon of gender identity politics in all manner of "transgenderism." Perception and politics have driven science and contorted public opinion into not only tolerance or acceptance of gender variation but enthusiastic promotion thereof. Camille Paglia is very straightforward in criticising the current "transgender mania" and in recognising it as a characteristic of a culture's late phases.[15] Bringing her broad historical knowledge to bear, she explains that she has seen this cycle before; and what she describes is clearly the phase of cultural decline caused by falling testosterone levels:

> *I found in my study that history is cyclic, and everywhere in the world, you find this pattern in ancient times: that as a culture begins to decline, you have an efflorescence of transgender phenomena. That is a symptom of cultural collapse.*[16]

Moreover, Paglia calls the "wildly inflated claims" of transgenderism propaganda.[17] The lies promoted to reinforce this mania include the anti-biological idea that sexual reassignment surgery and therapy can actually change the cellular DNA coded with a person's sex.

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[14] Christine Hsu, "Is Testosterone the New Truth Serum? Male Sex Hormone Found to Promote Honesty in Men?"
October 10, 2012, Medical Daily, http://www.medicaldaily.com/testosterone-new-truth-serum-male-sex-hormone-found-promote-honesty-men-243038.

[15] Sam Dorman, "Paglia: 'Transgender Mania' is a Symptom of West's Cultural Collapse," CNS News, November 3, 2015, http://cnsnews.com/news/article/sam-dorman/camille-paglia-transgender-mania-symptom-cultural-collapse.

[16] Ibid.

[17] Ibid.

7. Conclusion

The terrible irony we find ourselves in is simply this: The condition of diminished testosterone creates the societal mood and perceptions that resist a comprehensive investigation into conditions caused by the diminished testosterone. The more persuaded people are by the propaganda, the more intractable they are, unwilling and unable to see objective truth. The clarion call in the wake of the Holocaust has been "never forget," but if we don't understand a situation, we cannot remember—or rightly remember—what led to it or what exacerbated it, and therefore we are stymied in how to cure or prevent it.

References

T. G.Travison, et al., "The Natural History of Symptomatic Androgen Deficiency in Men: Onset, Progression, and Spontaneous Remission," Journal of the American Geriatric Society 56, no.5 (2008): 831–839, doi: 10.1111/j.1532-5415.2008.01679.x.

A. Perheentupa, et al., "A Cohort Effect on Serum Testosterone Levels in Finnish Men," European Journal of Endocrinology 168 (2013): 227–233, http://www.eje-online.org/content/168/2/227.full.pdf.

Ibid.

E. Carleson, A. Giwercman, N. Keiding, & N. E. Skakkebaek, "Evidence for Decreasing Quality of Semen During Past 50 Years," British Medical Journal 305, no. 6854 (1992): 609-613. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1883354/.

Anna Hodgekiss, "Sperm Quality has Declined by 38% in a Decade - and Poor Diet and Lifestyle Could be to Blame," January 21, 2013, Daily Mail, http://www.dailymail.co.uk/health/article-2265792/Mens-sperm-quality-declined-38-decade--poor-diet-lifestyle-blame.html.

Wang, Shirley, "The Decline in Male Fertility," July 15, 2013, The Wall Street Journal. http://www.wsj.com/articles/SB10001424127887323394504578607641775723354.

Johannes Schroots, "On the Dynamics of Active Aging," Current Gerontology and Geriatrics Research (2012): http://www.hindawi.com/journals/cggr/2012/818564/.

Carleson et al.

Jonathan Haidt, The Righteous Mind: Why Good People Are Divided by Politics and Religion (New York: Pantheon, 2012), Kindle edition, 913.

Camille Paglia, Art and Decadence from Nefertiti to Emily Dickinson (Yale Nota Bene, 2001), 4.

Stephen L. Petranek, "American History Interviews Psychologist Jonathan Haidt," August 1, 2012, HistoryNet, http://www.historynet.com/american-history-interviews-psychologist-jonathan-haidt.htm.

Steven Pinker, "Sex Ed," New Republic, February 14, 2005, https://newrepublic.com/article/68044/sex-ed.

Virginia Hale, "YouGov Poll: Only Two Percent of Men Aged 18-24 Feel Masculine," Breitbart London, May 20, 2016, http://www.breitbart.com/london/2016/05/20/yougov-masculine-poll/.

Christine Hsu, "Is Testosterone the New Truth Serum? Male Sex Hormone Found to Promote Honesty in Men?"

October 10, 2012, Medical Daily, http://www.medicaldaily.com/testosterone-new-truth-serum-male-sex-hormone-found-promote-honesty-men-243038.

Sam Dorman, "Paglia: 'Transgender Mania' is a Symptom of West's Cultural Collapse," CNS News, November 3, 2015, http://cnsnews.com/news/article/sam-dorman/camille-paglia-transgender-mania-symptom-cultural-collapse.

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Milestones in the Journey of Phenomenology: From Socrates to Kant

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Abstract

Phenomenology is linked to ancient philosophers as its roots can be traced from the Socratic era. Various other philosophers have also contributed to developing this field. As Socrates' 'scepticism', Plato's 'idealism', Aristotle's 'realism', Locke's 'epistemology', Hume's 'positivism', and Kant's 'existentialism' are all of the respective concepts which provided the very fundamentals of phenomenology. After these great philosophers, others have also played their significant role as milestones in this journey. In this work, researchers have reviewed the contributions of prominent phenomenologists in historical order. The respective researchers have analysed the difference and contrast between the approaches of different thinkers. Based on the review of selected thinkers by applying the method of relational analysis, researchers have concluded that with the time phenomenology has also evolved and became more empirical as well as dialectic.

Keywords: milestones; phenomenology; relational analysis; Socrates; Kant.§

1. Introduction

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Society is full of phenomena, and the way of exploring this phenomenon is known as phenomenology. In which, one considers the things like experience or perceive them to be contrary to the facts or reality. The inception of phenomenology can be seen back in the times of three Greek philosophers, who made tremendous history, Socrates, his brilliant student Plato and Plato's best student, Aristotle.

Phenomenology is a school of thought that emphasises a focus on people's subjective experiences and interpretations of the world. That is, the phenomenologist wants to understand how the world appears to others. The phenomenological inquiry is only concerned with 'possible' human experiences - not with experiences that are presumed to be universal or shared by all humans irrespective of time, culture, gender, or other circumstances. Also, it is important to remember that the phenomenological determination of meaning is itself always indeterminate, tentative, incomplete, inclined to question assumptions by returning again and again to the lived experience.

Phenomenology strives to clarify the abilities of individuals and rediscover the phenomena that exist. In areas like physics and chemistry, it is highly appropriate in a broad variety of circumstances. But, we have tended to apply the phenomenological model also to the social sciences, where it surely fits some phenomena as well as situations and not others. Partly, as a result, have ended up creating a lot of organisational systems that are not very functional in terms of their ability to meet the respective human needs.

The objectives of this paper are: to trace the origin of phenomenology; to examine the basic concepts in phenomenology from Socrates to Kant; and finally, to analyse the theoretical development in phenomenology from Socrates to Kant.

2. Methodology

In this article, researchers have conducted a constructive analysis of the historical literature related to the field of phenomenology which is derived from philosophy by using the technique of relational analysis that refers to go into the past by investigating the association between the thoughts perceived.

It is the type of content analysis which is, "the method of exploration for making replicable and substantial deductions from writings (or other important matter) to the connections of their utilisation" (Krippendorff, 2004, p. 18). The researchers selected the present content from secondary sources.

3. Socratic Skepticism

Socrates (469-399 B.C) was one of the most influential Greek thinkers and is often considered as the father of western philosophy. He focused on how to acquire knowledge, which is the very fundamental of phenomenology. Besides this, 'Socratic scepticism' which is considered as a powerful tool to find out the truth by cross-questioning. It is also known as 'Socratic dialectic' and 'Socratic ignorance' which means that everybody thinks that his point of view is correct and he is the wisest one and extracts the meaning of things that have no reason behind their very existence. This is the attitude that a person learns by the traditional knowledge in which things have been occurring for several times in the same way. There is a dire need to change it, and it is only possible when a person continuously thinks and understands again and again about things that are going on around him. All the events and incidents are like an abstract picture on a canvas that is showing something else, and its meaning is something else. A person has to ponder upon, to understand the real meaning that is hidden in the picture.

In the same manner, when a person experiences something, there might be a chance of having different reality that he cannot see even after having experienced. But, there is a need to understand the real meaning of that event, and it can only be possible by the serious consideration of a person. An individual tries to evaluate the reasoning behind whatever he understood and experienced and he must focus on the common aspects of reasoning. Phenomenology requires to go beyond the perception of people and investigate the reality or truth, which is also known as the meaning behind words (Ballard, 1965).

4. Plato's Idealism

Plato (427-347 B.C), who was the student of Socrates and founder of the academy in Athens, known as a classical Greek philosopher, introduced the domain of ideas which can also be extracted from Socrates thinking. But, he also presented the contradictory view. Socrates focused the meanings behind the words, while Plato focused on 'pure meaning'. The meaning behind the words focuses on those meanings that are beyond the perception of an individual and known as reality. Along with it, he also emphasised on universality, which is concerned with collectivity, or we can say the truth for all rather than only for the individual.

According to Thomas Sheehan (2017), who translated Plato's work, The Allegory of the Cave, while, pure meaning have ambiguity because every human has a different ability to perceive things. It usually happens that the same words or the same events are perceived differently by different

people, and every person has its interpretation of the same phenomenon. In fact, everybody has its reasoning regarding the phenomenon as he stated in The Allegory of the Cave which refers that the perception of people can be closer to reality, but the reality is still hidden which is not easy to approach for an individual.

Although, Platonic theory presented the dualistic world's view which pointed out that things, as they appear on the floor, are not to be true and it is merely their momentary appearance. In fact, intuition plays a vital role in phenomenology. It would not be wrong to say that phenomenology is a body and intuition is its soul. Because, intuition is an extrasensory thing or we can say it is the sixth sense of a person which unconsciously provides not only a treasure of knowledge, but a real picture of events and this intuition also comes from Plato's 'schau', i.e. the way of seeing things.

He proposed Platonic idealism, and it is a perfect condition which is unapproachable for a normal human being. But, this perfection is reflected when a person classifies things as good or bad and make an ordered world. That means every human being has some perfection in it, and he can overcome his and others' problems through his positivity and universal reasoning.

5. Aristotle's Realism

Aristotle (384-322 B.C), who was taught by Plato, is also known as a classical Greek philosopher. He argued that there is no other domain, but the only thing is reality as its properties can be seen in real objects that reflect in nature as either good or bad. These abstract truths are known as realism, which refers to the reality surrounding a human being. But, reality has some aspects, which cannot be perceived at once but can be assessed by more and more consideration. To get access to the real phenomenon, he propounded the concept of 'being'. He explained the meaning of being, by explaining the sense of the Greek verb 'to be'. It was also phenomenologically related to different concepts, as he also evaluated the reasons for animal existence (Long, 2007).

6. Locke's Epistemology

John Locke (1632-1704), an English philosopher, is known as the father of liberalism. He emphasised on epistemology, which refers to the theory of knowledge which can justify the objective world and this knowledge is based on probability as well as ideas. Every idea which is perceived by a person reflects the fundamental qualities of a particular object. He propounded that whatever a person understands about an object is known as an idea, and these ideas are a picture of whatever is going on in a person's mind.

These ideas are the construction of its own (related to the idea of Socrates 'learned ignorance') and in beginning human's knowledge revolved around these ideas. The human mind perceives things immediately in the light of preexisting knowledge that the mind already has and starts finding out reasons based on this acquired knowledge. This reasoning is based on the agreement of a preexisting and immediately acquired knowledge (Dunbar, 2011).

If both ideas agree with each other, it develops the perception of a person, and a person does not only gets stuck at this knowledge, he takes it as the truth. But, this reasoning is based on a personal judgment, i.e. unanswered and unsatisfactory. If these ideas do not agree with each other, they have a collision due to the presence of intuition because intuitive knowledge is somehow flawless as it has a satisfying, answerable as well as strong reasoning. Thus, Hume's thinking of knowledge is based on the probability of agreement or disagreement of ideas, but it is conclusive (Schmitt, 2014).

7. Hume's Positivism

David Hume (1711-1776), a Scottish philosopher, best known for the system of radical philosophy, inferred that the human mind is dominated by the imagination which represents the early idea or image about something it reflects. The thought process of a human being is irrational and biased, and this imagination varies from person to person, as every person has its way of thinking and perceiving things.

The important aspects of this imagination are; a human's mind and its social setting. An individual's mind perceives things according to his social setup, but it has the ability of reasoning and also can replace irrational and biased thoughts or imagination by using intuition and universal reasoning. For this purpose, Hume linked objects and ideas like Aristotle. The first one is taken as a cause, and other is taken as an effect to understand the reason (Internet Encyclopedia of Philosophy).

He claims that by making the relationship between cause and effect, genuine reasoning can be possible, and this reasoning is a great source of knowledge, and he referred to it as 'epistemology'. This kind of reasoning helps us to understand others' state and feelings in which they perceive something and the situation in which problem would occur. Not only this, the future condition can also be predicted from this acquired knowledge.

The existing perception of the mind is usually traditionally learned (as described above by Socrates and Locke), and it becomes a part of a human's consciousness. It is also known as knowledge acquired by senses that shape a human's actions. But, it may not be a knowledge of truth and

has chances of being wrong, because it is not considered as scientific knowledge and it can also be one's perception. The knowledge acquired by reasoning, i.e. after making the relationship between objects is based on observation, and it is a knowledge that establishes its basis on the very presence of evidence. Thus, it has a probability of being true due to the undeniable facts (Schmitt, 2014).

Hume's belief of 'matter of facts' is also referred to as the 'correct' knowledge that is based on evidence. He just assumed the cause and effect relationship, but he believed that both are separate and without the presence of an evidence a relationship is not possible to prove any phenomenon or experience.

Thus, according to Hume's viewpoint, the 'matter of fact' which refers to the existence of things is based on probability. These all beliefs are irrational, and it is also known as 'scepticism' because here, the confirmation of objects by a person is done by his previous knowledge, but contrary to this view (Fodor, 2005).

8. Kant' Existentialism and Transcendental Idealism

Immanuel Kant (1724-1804), a German philosopher, is often considered as the central figure of modern philosophy. He suggested that knowledge regarding objects possessed by a person is confirmed by the experience of that particular object. He opposed the views of Hume that existing knowledge of a person confirms this experience of objects. In its simplest sense, Kant rejected the 'scepticism' presented by Hume.

One of the very reasons behind this rejection is to create a distinction between prior knowledge and posteriori knowledge. Prior knowledge refers to the preexisting knowledge of a person that is based on pure reasoning. While, posteriori knowledge refers to the knowledge a person acquires after getting an experience of an object, the knowledge that has empirical evidence.

Kant also amalgamated rational as well as empirical knowledge and raised a question on epistemology, which refers to the probability and justification of objective and provides universal knowledge (Watkins, 2014). He argued how a subject has infinite knowledge of objective, however, the subject is finite itself. The answer to this question can be found in Platonism; the dualistic view of understanding a phenomenon, i.e. one is external - which is full of sensation, while, the other is full of consciousness, i.e. internal.

Both views are contrary to each other, and these are also reciprocal ways to obtain knowledge. A person gets knowledge first whatever he can see apparently. After that, this obtained knowledge clashes with the knowledge a person already possesses. Then, an individual's mind detects this collision

which resulted due to the clash of knowledge and this sage is actually what scholars state as reasoning. The respective reasoning is based on empirical evidence and scientific knowledge can provide infinite knowledge which is also universal.

He also compared the prehistoric view of objective knowledge with the modern view of epistemology, which is also known as 'new ways of ideas'. It is an assumed statement which shows a causal relationship between things and an individual's knowledge regarding those things. It is also known as 'representationalism', which is not only rational as well as empirical. From this relationship, the subject draws a conclusive statement based on his assumption, but this statement is cognitively justified (Dickerson, 2011).

Kant shifted the paradigm from 'theocentric' which considered God as the main feature of human existence and perceive things from the god's perspective to 'anthropocentric' which refers that god's attributes exist in the actions that are performed by the people and environment. Anthropocentrism is also known as 'existentialism'.

It is impossible for a human being to see things according to God's perspective because a human being has a finite vision of things. Humans could only perceive things as they appear and it is based on the subject's perception and usually, the subject cannot go into the depth of such complex phenomenon. Because, most of the time the reality of the phenomenon is obscure for the subject (Rockmore, 2011).

The perception of a person is based on the intuitive idea that he gets from his experiences. According to his experiences, he develops the reasoning regarding these things and categorize them according to the nature of an intuitive idea. It was actually that 'Copernican turn' for which Kant used the term, 'transcendental idealism', i.e. to perceive things as we understand. But, the probability of something being true is 'priori cognition', and this view of Kant became a primary source of 'constructivism', although he did not use this term himself. But, this is the way to construct things through 'pure reasoning' that is based on personal experiences (Boyle, 2013).

Phenomenologists	**Concepts**	**Followers**
Socrates	*Socrates Skepticism / Socrates Dialectic /Socrates Ignorance*	Pyrrho, Timon, Arcesilaus, Carneades, Aenesidemus, Sextus Empiricus
Plato	*Idealism*	Kant, Hegel, Fichte, Wilhelm, Schelling, Schopenhauer
Aristotle	*Realism*	Cicero, Theophrastus, Eudemus, Diodorus, Erymneus, Alexander, Arito, Lyco, Strato, Dicaearchus
John Locke	*Epistemology*	Hume, Kant, Reid, Stewart
David Hume	*Positivism*	Simon, Pierre, Laplace, Comte, Husserl, Kuhn, Popper, Quine
Immanuel Kant	*Existentialism*	Sartre, Kierkegaard, Nietzsche, Husserl, Heidegger, Ponty
Immanuel Kant	*Transcendental Idealism*	Berkeley, Hume, Descartes, Leibniz, Schopenhauer, Hegel

9. Analysis

The essence of phenomenology can be seen in many philosophers' views because primarily it is derived from philosophy. It is apparently new, but a longtime is involved behind its very origination. Phenomenology is incepted from Socrates' 'dialectic' - to acquire knowledge by cross-questioning as well as Socrates' 'view of ignorance' that everybody has its perspective to judge things and he considers his judgment as not only the best but true.

The same view is reflected in Plato's 'schau' - the way of judging things, but he added intuition to find out the truth. In platonic theory, where he presented the dualistic world's view that one is 'ideal', which is unapproachable and the other is 'real' that we can see. But, he explained that the ideal one is reflected in the real one.

However, Aristotle argued that there is only one condition which is known as real, but some realities are in an abstract form which can be found in contemplation, the knowledge which we consider as the soul of phenomenology. Locke presented it with the new approach, called 'epistemology' - the theory of knowledge, which reflects the intuition role discussed by Plato.

While, Hume determines the cause and effect relationship in epistemology to find out the truth, named as scepticism. He believed that without evidence relationship between cause and effect could not be proven. But, Kant disagreed on this view and stated that a causal relationship could be proved by the assumed statement which he called 'representationalism' or 'modern epistemology' afterwards.

10. Conclusions

Phenomenology is a production of a long period of reflection which includes several classical and modern philosophers, and this is the very reason that the essence of phenomenology can be found in many philosophers' views because primarily it is derived from philosophy.

It is apparently new, but a longtime is involved behind its very origination. It is noticeable that with time, the concept of phenomenology has been constructively evolving; in a sense that it has become more calculative.

References

[1] Ballard, E. G. (1965). *Socratic Ignorance*. Netherlands: Springer. doi: 10.1007/978-94-011-9432-7

[2] Boyle, N. (2013). *The Impact of Idealism: The Legacy of Post-Kantian German Thought Volume 1, Philosophy and Natural Sciences.* Cambridge: Cambridge University Press.

[3] Dickerson, A. B. (2011). *Kant on Representation and Objectivity.* Cambridge: Cambridge University Press.

[4] Dunbar, R. (2005). *The Human Story: A New History of Mankind's Evolution.* London: Faber.

[5] Fodor, J. A. (2005). *Hume Variations.* Oxford: Clarendon Press.

[6] Internet Encyclopedia of Philosophy - A Peer Reviewed Academic Resource. Retrieved from http://www.iep.utm.edu/hume-ima/

[7] Krippendorff, K. (2004). *Content Analysis: An Introduction to its Methodology* (2nd ed.). Thousand Oaks, California: Sage.

[8] Long, C. P. (2007). "Aristotle's Phenomenology of Form". *Epoche: A Journal for the History of Philosophy, 11*(2), 435-448.

[9] Plato (2017). *The Allegory of the Cave.* (T. Sheehan, Trans.). ISBN: 9781520847726 (Original work published 380 BC).

[10] Rockmore, T. (2011). *Kant and Phenomenology.* Chicago, Ill.: University of Chicago Press.

[11] Schmitt, F. F. (2014). *Hume's Epistemology in the Treatise: A Veritistic Interpretation.* Oxford: Oxford University Press.

[12] Watkins, J. W. (2014). *Science and Scepticism.* Princeton, NJ: Princeton University Press.

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The feminine question as social inequality: a historical overview

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Abstract

In this work, I refer to many sources because this theme is complex, and it is useful to follow tracks already well used by other authors who ventured with these themes.
The gender report is a report on equality. No company will ever be expected to be right if it does not foresee inclusive actions rather than exclusionary.
The social constructions of the same company will have to contend with a reality of reference that embraces all the universes and respects the personal values. Everything, therefore, aimed at the growth of society as a non-arithmetic group of people who, with their history and their characteristics, increase the collective share capital.
Keywords: Person/Persons, gender equality, female issue, violences.[ǂ]

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1. The feminine question as social inequality

First of all, it is necessary to mention a theme that underlies the same "female question": social inequality. The difference in treatment represents it, today we would say a difference of opportunity, present in society on a social basis and with characteristics of injustice. For example, age, ethnicity, race, religious group, geographic area or gender. Social arenas are built around them socially. They are, therefore, social constructions as the result of sociocultural processes, artificially constructed, that put the individuals of a given category in a condition of inferiority, marginalisation and exclusion. To be given by the Industrial Revolution onwards, a vision of the social world more inclusive and awareness, by the excluded, more significant, has come. In Fact, the feminine consciousness, concerning itself and of the other sex, has made a historical path that equates to some conceptual firm points: subordination, parity, distinction, reciprocity.

At the first stage, that of subordination corresponds alleged inferiority of the woman on a social basis. The Protestant theologian Karl Barth wrote that throughout the Greek-Christian civilization, with regard to the relationship between man and woman, one has always witnessed a secular subordination of the functional type of woman, i.e. concerning the social roles of the two sexes.

A key to reading can mean that the best thought of the West has always recognised the substantive equality of men and women but has never given life to similar behavioural styles. Moreover, the conceptual equality man-woman was based on the Greek principle of the common rationality of all the men as aristotelically rational animals and the Christian principle of the anthropological triangulation spirit-mind-body. This, of course, does not exclude massive prejudices against the woman who make think more of a conception of the inferiority of principle than of true functional subordination.

Things do not change in the Christian era if it is true that women are recognized both the spirit and rationality while remaining strong prejudices of inferiority and the examples would be many as Tertullian and St. Thomas, just to name a few. Therefore, the woman to achieve certain legal equality had to first conquer a conceptual parity, that is, an equal anthropological identity in absolute with the man. This effort has been achieved through scientific knowledge that has gone to dispel the prejudices inherent in the classical age.

Indeed, it was believed that to generate was only the man and that the woman was the container; Science has shown the complementarity between man and woman. Also, paradoxically, it was believed that the woman was a man missed. The exact opposite is true: The man is a woman lacking because the biological *plafond* of the species is all feminine: all the embryos begin to develop as females, and only at the sixth week of gestation the fetuses begin their differentiation.

The second phase, that of parity, bursts between the Nineteenth and the early Twentieth century, where the first feminism fights for an abstract and legal parity, risking to lose sight of the specific feminine identity. The fight for the Equality of civil rights (vote, treatment at work, childcare services...) saw its fruits in the West only after a century of struggles and at the end of the Second World War.

Already in the German ideology of the years '40 of the Nineteenth century peeps the demand for the emancipation of women working in industrial factories. Marx and Engels take a stand in favour of the workers who fight for the recognition of their rights. They support the thesis that the first division of labour is the one that exists between man and woman in the procreation of children. "*The main thoroughgoing for the liberalisation of women would be to support the struggles for the labour movement, aimed at overcoming the capitalist concept of private property, including the masculine concept of the woman's property. It is clear that the emancipation of women and their equal to man are and remain impossible until the woman is excluded from social and productive work and will remain confined to the scope of private domestic work. The emancipation will be possible only when the woman can participate in the productive work and the domestic one the commitments only in part*".

During the Industrial Revolution and the formation of the Nation States, the English women, forced to carry out exhausting shifts of work in the industrial establishments (cotton mills, spinning mills, weaving laboratories and knitwear of cities like London, Bristol, Cardiff, Liverpool), begin to organize to reclaim their rights.

In the second half of the Nineteenth century, John Stuard Mill (a British philosopher and economist, a supporter of the theories of liberalism and utilitarianism) was sensitised by his wife Harriet Taylor to the issue of defending women's rights. Between 1865 and 1868 he was at the same time university lecturer in Scotland and deputy in the Parliament of London. As a member of the House of Commons, he posed the question of the need to regulate with specific laws the rights of women: the right to vote, a reasonable working time, protection in family law, protection of mother workers. In 1869 he published a book: The Subjection of women = The Servanthood of females, in which he claimed equality of the sexes in family law and universal suffrage for all citizens, males and females. In the essay, he argues that the subjection of the woman does not arise from natural inferiority but from an act of strength of the male human race that turns her physical weakness into servitude. The resulting condition, endorsed by law, spread by tradition and prejudice, is contrary to the equality of rights that governs liberal civilisation: there can be no freedom if half of mankind is excluded from it. What people generally experience is not the true nature of

women, but femininity which has been manifested in the condition of sexual subordination. The first means of enslavement is the family. Emancipation enriches the whole species: gender equality, the ability to coexist between free and equal beings, peer education and equal opportunities will increase the intellectual and moral qualities of the entire human race. To achieve equality, it is necessary to give women, not only the right to vote, but also a new sort of family law, centred on the legal equality of the two spouses, the separation of goods and the Institute of divorce. The liberation of women will also improve the men who, once and for all, stop feeling superior only because they are males. This will end the last remaining legal slavery after the abolitionism of "negro slavery" in the United States of America.

In the third phase, that of the distinction, the feminists go in search of their specific identity, that is, of a feminine way of being person, distinct from the masculine one.

The need to "measure" the extent of emancipation and the affirmation of their identity could also be included in this area. It comes to the aid the concept of "rights of citizenship", of the English sociologist Thomas Marshall (1950) by which one measures that set of civil, political and social rights which are incumbent on the individuals as citizens assuming that, even Within the same political system, citizens do not enjoy equal rights.

The last phase, that of reciprocity, is actuating through functional correlation, whereby the human person is realized through the overcoming of the phase of complementarity.

Ultimately, the factors capable of freeing women from a condition of subordination are implied in assumptions about the origins of inequality, and, to a reasonable extent, are already present in the descriptions of the phenomenon. We can try, however, to summarise them. On the one hand, we have the cultural matrices, on the other the material roots. The construction of roles can be perceived as compulsion (Zincone, 1978) as it is possible to grasp the non-natural and unique character of social relations, values and beliefs. The rooting of disciplines such as cultural anthropology, psychology or psychoanalysis-apart from the conformism of individual studies in the field of gender-has offered an essential tool for self-reflection on social roles and identities. Liberal ideologies, trusting in the individual capacities, and the democratic ones, based on the principle of equality, have provided-beyond their specific strengthening of gender discrimination-significant goals to women's movements. Olympe de Gouges, author of the *Déclaration des Droits des femmes et des citoyennes*, is a victim but also a daughter of the French Revolution. Similarly, the book of Mary Wollstonecraft, *Vindication of the rights of Woman*, published in 1792, ranks, albeit in polemical form, within Democratic thought. Feminism can nourish itself of the liberal and Democratic incoherencies, and then of those socialistic ones.

Always subject to cultural factors, the processes of secularisation reduce the weight of the social doctrine of the Church, long imbued with a traditional vision of feminine nature and gender roles. More Generally, modernisation processes are supportive of women's empowerment. And Here we move to the material roots of emancipation. Although not immediately, industrial production allows the woman to perceive an income and brings her out of the family environment. The same role of women in industrial family business management creates a contradiction between assumed responsibilities and rights absent (Tilly, 1992).

Another vital element of liberation is knowledge of contraceptive techniques. This will not only reduce the number of pregnancies but will restrict the reproduction period. These factors, which we can define as exogenous to the political systems, are accompanied By important endogenous factors: favourable public policies and feminist movements. Naturally, the exogenous and endogenous factors are strongly connected, just as the link between pro-women public policies and the presence of feminist organisations and movements is tight. For example, free and compulsory education also for women and the opening of all grades and types of higher education qualify the female workforce and make it more convenient for women to get out of the family, offer themselves on the market, become Economically autonomous (Del Boca, 1988). They also make available women, potential frameworks for feminist organisations and politics in general. Public policies can, therefore, be observed both as the outcome and as the thrust of change.

Anthropology has tried to trace the origins of female subordination. The history of the family and the work questioned itself on the capacity of the industrialisation to break the family-work unit and to release, therefore, the women as individuals. The history of political thought and the institutions discussed critically how theories and legal experiences, both liberal and democratic, treated women. Philosophy and psychology have thought about the fundamentals, risks and promises of feminine identity. Sociology, economics and Politology have tried to understand the shapes and reasons for the vertical and horizontal segmentation of female activity. More or less nourished by these reflections, public policies have moved and continue to operate.

2. Gender issues: a first approach

According to estimates by the World Health Organization, on the planet over one-third of women have undergone or is undergoing physical or sexual violence, mostly by the partner. The survey conducted on a sample

of 42,000 female subjects showed that one in three women, 33% of the total, in a period between 15 and sixty years of age underwent physical or sexual violence. In Italy, the data are aligned with the European ones. 31.5% of women claimed to have suffered some form of male or female sexual violence, about 6,788,000 women; 16.1% underwent stalking, about 3,466,000 women. 10% of women interviewed claim to have personally known sexual assault before 16 years of age. The partners, current or former, commit the most severe acts of violence: the rapes in 62.7% of the cases. The data of the female massacre are not exaggerated: only in 2014 in Italy were killed 152 women; of these 117 have been killed in the family environment.

In the first nine months of 2018, the number of women killed has only fallen by three units (from 97 cases of the same period of 2017 to 94), but-explains the police-only in 32 cases you can properly talk about femicide, cases in which a woman is killed because of the pro The first kind. In all, in 2016, 149 women were killed in 2017 the number stopped at 123

In the period January-August 2018, there were 8,414 cases of stalking, compared with 9,905 in the same period of 2017 (with a decrease of 15.05%). The reports of alleged perpetrators of this offence have increased, with a + 4.49% (9,351 total) compared to the same period last year (8,949). Besides, the subjects for stalking increased by 23%, passing from 672 to 827 individuals. Of these, only 19% committed the same crime again after being warned.

A theme, polysyllabic, which already from the seventies begins to become a subject debated in the first human sciences... At least in the West... As a result of the clamours that came from the other side of the ocean. The concept is proposed during the seventies and in recent decades has not ceased to be the subject of debates and controversies. We must, however, assume that, the cultural climate within which the concept is formed, is strongly marked by the movements of the beginning of the sixties, by their request for discussion of the economic and political system, by the fight against social inequalities, the racial-sexual discriminations that have as objective that of reaching a subversion of the dominant economic and social paradigms.

If we retrace the history of everything that has been analyzed around this theme, we can only refer to some scholars, Ann Oakley (an English sociologist) and Joan Scott (American historian), as well as the American anthropologist Gayle Rubin, (though To be honest we must also include the scholar Robert Stoller – who had published in 1968 an essay entitled Sex and Gender...-and who worked with Harold Garfinkel (one of the key characters of the school of Ethnomethodology and American sociology in general).... it distinguished the gender identity, understood as a profound psychological expression of the person, from the biological sex).

In 1972, Oakley refers, in some of its works, to a new society, highlighting the possible overcoming of the differences between the sexes: in its optics,

these differences express the social conditioning that, depending on the contexts, build the male and female gender roles, giving female roles a reproductive function. It is easy to see here that there is no explicit reference to the strategic question of the power relations underlying the gender-gender binomial.

And we also refer to the American anthropologist Rubin, who makes an analysis of the structure of kinship in patriarchal contexts; through this analysis, she laid the foundations for an understanding of the relationship of power based on sex, somehow overcoming the approach linked to those who are sexual roles. In fact, through the concept of sex-gender system, Rubin's work offers a reflection on the forms of domination of men on women capable of going beyond the approaches in the key of patriarchy, because as an expression of male power, it ends with to propose an identification between what is biological-natural and what is cultural, at the end justing the regime of social inequality between men and women.

It is proposed, therefore, to put at the centre of its speculations a broader reflection on the dynamics of the social life linked to sexuality. And the same anthropologist makes explicit references to Marx, Freud, Levi-Strauss, and insists that the concept of sex/gender system, although built in reference to archaic social contexts, is primarily designed to shed light on practices through which sexuality and human reproduction become a founding moment, in the sense social, modern contexts. The consequence, however, would be that the oppression of women is not considered inevitable, as it happens in the perspective founded on patriarchy (patriarchy that, aggravating the biological differences between the sexes, comes in this way To create the genre), but a simple (by way of saying) historical datum.

Therefore it is possible in principle to abolish the system of social inequalities that is based on it, in summary the concept of gender, proposed by this scholar, refers to a system that is a social, economic and psychological whole through which is going to substantiate the male power over the bodies and existences of women.

To highlight precisely this explicit reference, that link that binds gender and system of power, it will be the task of Joan Scott that at the end of the the 80s will give a further impulse to this debate, widening the perspective of the gender studies which were to incorporate institutions such as the labour market, education political system, to get to look at and analyze the power relationships that are the basis of the definition of sexual difference, without making the opposition between men and women the core of gender analysis; in fact, he writes, man and woman are at the same time empty and superabundant categories. Empty because they have no definitive meaning;

Superabundant because they continue to contain alternative, negated or suppressed definitions internally.

Ultimately, gender is a primary factor in the manifestation of power relations; inside or through which power is drawn up. Through this way new forms of culture, social and institutional are built, and through this way the relationships of subordinate force between masculine gender and feminine gender are opened that our [Western] cultures, coming to a sort of elaboration of the cognitive process of gender and gender and its forms of power within this scheme, try now to overcome. Firstly, stating that gender is gender are social and cultural constructions, our culture seeks not to consider them as equivalent. On the contrary, the awareness of their historically produced character makes it possible to question the dichotomic approach (on the one hand sex, from another part of the genus) as well as to emphasise how biology and society jointly combine to model and influencing human actions and relationships.

Then it becomes essential to reason on the differences-inequalities dichotomy, within this phenomenon, in terms of the order of kind. Therefore, as Cesarean says, consider the genus as a social configuration that governs not only the relationships but also the daily practices, indissolubly linked to the dynamics of producing power as much of differences as of inequalities, it makes it possible to call into question those perspectives that reason on gender mainly in terms of opposing sexual roles.

Following the social transformations, the sudden changes in structuring and restructuring of society operated by globalization phenomena, to try to counter the idea of an organization of social relations that is based on gender inequality, we have to oppose the consideration that these inequalities are not the inevitable social and political result of gender differences. On the contrary, (Cfr. V. Cesareo, in R. Cipriani, edited by, 2019), it is the gender differences, which constitute the product of these inequalities, since the sexual categorizations (like social constructions), which vary according to the times of the places, and the differences which are recall, are in fact used to offer forms of justification to the existing inequalities. So an argument about the relationship between gender and forms of power is once again as indispensable.

We could give the first vision talking about the power of men as collective on women as a collective; but also of some of some men on other men, and some women on other women: these forms of power that mingle with class differences, ethnic differences, age-generation differences, differences in sexual orientation via saying, They build a network of inequalities that become palpable in everyday life. Then gender inequalities, which are closely intertwined with everyday life, become legitimated, and this does not mean

that they should be justified, not only by common sense but also by the functioning of the institutions.

All this gives the departure to the last part of my reasoning: in the system of practices that produces and reproduces a hierarchical division of the social world, by virtue of which the differences between men and women, elaborated culturally, are transformed into asymmetries and social inequalities, the genre is theme typed through a relational dimension and through an idea of open system to the constant reworking and redefinition of the company. What comes out of it?

It follows a vision of the cultural representations associated to the feminine gender, but (and this is the novelty) also of those associated with the masculine: for men as for women become fundamental points the social contexts within which they live and enter in a relationship. That's why using gender as a synonym for the female condition is misleading. Because socialization, openness to other ways of thinking and understanding life become important if one has respect first and foremost (and this is a strong idea of the Christian religion, for example).

And that is why it is also a common opinion that the processes of social/cultural change have influenced or invested even the masculinity and their hierarchies, at least in part to change the order of gender.

And here we take back the initial provocation... because the subject of violence, respect for women, family as core founding society, belong to us as westerners, as laymen... and as Christians... and they mark a watershed (it is not said that it is insuperable if there is common accordo....but the agreement must first be on the respect of the person).

In fact, violence against women that does not mention diminishing is probably the most striking aspect of these transformations. Because it constitutes one of the significant indicators of the inability of a party, of course, I refer to a minority part of the male world, to metabolise these transformations.

At this point we can try to identify albeit briefly at least two main attempts to explain the male violence on women: the first linked to the patriarchal order, where the lower the female status in relation to the male, higher it will be the presence of physical and sexual violence against women put in place by men; therefore, the gender inequalities in economic terms, contribute to foster a strongly hierarchized gender order and the violence against them would be nothing more than the expression of the daily reaffirmation of this order; the other, linked to the contemporary dynamics of the relations of power between the genres, highlights the inability of a part of the male world to welcome, and therefore to accept, and therefore to respect, and also to share choices of freedom, practices of autonomy, which contribute to the female biographical construction.

And this is why violence, not only of a physical nature but also of a psychological nature, made up of denied rights, transmitted fears, fueled by a chauvinistic culture that legitimises it as a form of expression of the self, linked to ancestral forms of culture that are they accept without any critical form or without any revision mediation, blessed by sometimes transcendental systems, mainly affecting women who try to break free. Very often, this happens in the relationships of a couple where intimate relationships become the privileged arena, unfortunately, the irrational unbecoming of male violence, and I repeat not necessarily physical.

3. Suggestions for a conclusion

How can we conclude?

From this historical overview, through the many sources cited and consulted, we could begin to give answers perhaps assuming that we should produce forms of destructuring the concept of gender, forms that are capable of recognising and enhancing differences and thus transforming them into positive actions against discrimination. To do this, we must go beyond the dichotomic contrast of specifically masculine traits and specifically feminine traits. One of the ways towards gender equality could be to countless in social life, in the world of work, in political representation, in that educational, throughout the social arena, gender and to focus more on the similarities between genres than their diversity.

The political action of emancipation can, therefore, be interpreted as the dismantling of three processes: imprisonment in the family, exclusion from work, the submission with violence. The first is the expropriation of procreation, closure in the family and subordination within it. The second is to exclude from a series of activities and subordination in others. The third consists of the dissemination of practices of harassment and sexual assault and of physical ministrations.

The breakdown of the first block includes the legalization of the use and advertising of contraceptive methods, the decriminalization of abortion and the last decision on this point entrusted to women, greater equality between spouses with regard to the rights of children and the common heritage, equality with regard to the fixing of the domicile and the possibility of divorce and separation. The breakdown of the second block includes the end of prohibitions or quotas regarding access to various grades and types of education, professions and trades. In this block, the policies of quotas reserved for women and those of equal pay are also inserted. The third bloc should include the first attempts to penalise carnal violence within marriage, stricter

judicial practices against rapists, public funding of housing-shelters for battered wives and their children.

The persistent discrepancy between form and substance of the process of emancipation, between rights and social positions has been tried to remedy, especially from the seventies onwards, with various legal instruments: the reserve of posts, an extension of the concept of equality wage, the prohibition of discrimination. The reserve of seats or quota system has been introduced in both higher education and public administration, especially in the United States, and with the autonomous decision by parties and trade unions in Europe as well. A resolution of the European Parliament (1988, no 2169) called on political organisations to set aside posts for women in governing bodies and lists. However, It has found political resistances because it seems to clash with principles of equity and with consolidated interests, and has aroused legal perplexity because it seems to oppose the principle of citizen equality in the face of the law. With the local electoral reform (Law No. 81 of March 25, 1993) in Italy, it was introduced the obligation not to put in the lists more than 2/3 of the same sex candidates, but in the subsequent elections, the law is not, in fact, applied. Equally uncertain was the success of anti-discrimination strategies. According to the principle of non-discrimination, it is not sufficient for a career to be formally open to women, that employers should not favour the recruitment of men. In the seventies, many western countries introduced laws aimed at avoiding discrimination in recruitment and careers: This is, among other things, a large part of the social legislation of the European Community (Guadagnini and Porro, 1988), for other verses very slender. In Italy, two norms (Law No. 125 of 4 April 1991, positive actions for gender equality in work, and Law No. 215 of 25 February 1992, positive actions for female entrepreneurship) sought to force entrepreneurs and public actors to take action. In the United States, the prohibition of discriminating is guaranteed by title VII of the Civil Right Act.

The courts, however, still seem to be inspired-at best-to liberal culture, according to which, today as yesterday, the public sphere of law must record what civil society produces "spontaneously". This has meant, for example, that in about half of the cases raised in the United States, between 1972 and 1989, the judges accepted the position of employers who motivated the poor presence of women in key positions with the lack of interest of women to get those positions. On the contrary, and even before this date, the courts had accepted the thesis of the "futility" on black minorities, of the usefulness of applying for prestige positions when one knows not to succeed: we would say the argument of discouragement of groups discriminated against (Schulz, 1992). From this hypothesis comes the obligation of the employer to be active to counteract the discouragement

of minorities. This line denies or wants to bypass evidence and that is that women offer themselves in a different way on the job market. It is what he also observed Norris (1987) on the political market: the obstacle to equality is not so much from the discrimination of those who select candidates, either from the voters, or from the offer or, better, the scarcity of women's offerings. These considerations well propose to reorganise the social, working and political life to make it compatible with the functions of reproduction and care (Zincone, 1985; Hernes, 1985).

From here comes the idea of sober politics, a society that is friendly to women. These beliefs are rooted in the practical proposals for “laws on time”, which concern both the coordination between working hours and schedules of services and shops, and the cycles of life and the possibility of a less rigid scan of the phases in which we study , you work, you devote time to the family. An objective emancipation budget must take into account an extraordinary acquisition of rights and a less extraordinary, but conspicuous, acquisition of social positions on the part of women in the last century. It is rather on the sexual and physical violence that the steps forward appear scat. Moreover, the reconstruction here made of the female emancipation draws its optimism from a heavy omission: that of many countries of the Third World. At the beginning of 1993, for the first time, a western democracy, Austria, grants political asylum to a Muslim woman because in the country of origin she is denied, for her sex, elementary rights. It is possible that the denial of women's rights at the international level and the persistent use of sexual, physical and verbal violence against women in our democracies become crucial political issues. There may be a serious commitment to reorganising our companies to make them compatible with reproductive and nursing activities. It's possible, but it's uncertain. From this uncertain possibility depends on the future of the process of empowerment of women, but also passes from a new vision: avoid considering the set of norms aimed at protecting the workers as protection norms to get to propose actions and processes Socio-cultural targets instead of equality, which propose to open women all careers to offer equal opportunities. In this way equality itself will be opposed to the idea of protection and will impose the waiver of differentiated protection given by the greater physical fragility and the more significant family commitment of women, opening the path to the new socio-cultural paradigm.

And if we go back to our deep and ancient roots, the persistence between gender differences in public life and private life can then become a battle fought and won.

References

Al-Hibri, A., Capitalism is an advanced stage of patriarchy: but Marxism is not feminism, in The unhappy marriage of Marxism and feminism (a cura di L. Sargent), London 1981.

Atkinson, T.-G., Metaphysical cannibalism, in Amazon odyssey (a cura di T.-G. Atkinson), New York 1974.

Cesareo V., in, Manuale di Sociologia, a cura di Cipriani R. Maggioli Edizioni, Rimini, 2018

Cipriani R. (a cura di), Manuale di Sociologia, Maggioli Edizioni, Rimini, 2018

Del Boca, D., Women in a changing workplace: the case of Italy, in Defeminization of the labor force (a cura di J. Jenson), Oxford 1988.

Del Boca, D., Fornengo, G., La segregazione occupazionale, in "Politiche del lavoro", 1992, VII, 19, pp. 113-128.

Galoppini, A. M., Il lungo viaggio verso la parità: i diritti civili e politici delle donne dall'Unità ad oggi, Bologna 1980.

Gherardini B., A domanda risponde. In dialogo con Karl Barth sulle sue “Domande a Roma”, Casa Mariana Editrice, Frigento, 2011

Guadagnini, M., Porro, G., Normativa internazionale e comunitaria sulla parità uomo-donna, Torino 1988.

Hernes, H. M., Women in the corporate system, in Unfinished democracy di E. H. Haavio-Mannila e altri, London 1985.

Hernes, H. M., L'organizzazione della vita quotidiana e il lavoro di servizio, in Time to care: politiche del tempo e diritti quotidiani (a cura di L. Balbo), Milano 1987.

Marshall, T. H., Citizenship and social class, Cambridge 1950 (tr. it.: Cittadinanza e classe sociale, Torino 1976).

Norris, P., Politics and sexual equality, Boulder, Colo., 1987.

Schulz, V., Women 'before' the law, in Feminists theorize the political (a cura di J. Butler e J. W. Scott), New York-London 1992.

Tilly, L., Genere ed industrializzazione: nuove prospettive, in Operaie, serve, maestre, impiegate (a cura di P. Nava), Torino 1992.

Tilly, L., Scott, J. W., Women, work, and family, New York 1978.

Zincone, G., Costruzione e costrizione, in "Biblioteca della libertà", 1978, XIII, n. monografico a cura di G. Zincone, Un mondo di donne, pp. 5-87.

Zincone, G., Gruppi sociali e sistemi politici: il caso donne, Milano 1985.

Zincone, G., Cittadinanza e partecipazione: strategie di inclusione, in "Biblioteca della libertà", 1989, XXIV, pp. 85-110.

Zincone, G., Da sudditi a cittadini, Bologna 1992.

Zincone, G., Emancipazione femminile, Alfabeto Treccani, Roma, 2014.

Sitography

Dizionario delle Scienze Sociali online.

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Towards a contact pedagogy: community theatre experience in a municipality of earthquake zone (Per una pedagogia del con-tatto: un percorso di teatro di comunità in un comune del cratere sismico)

Fiorella Paone[∂]

Abstract

The work aims to comprehend, share and "build memory" around an educational practice experienced in a municipality of the earthquake zone of Abruzzo, therefore, in a context of social crisis by means the storytelling of a social and community theatre experience (Bruner, 1956). The focus is more specifically on the nexus between the artistic and pedagogical work and the potentialities of a functional development of the community which spreads out, in a perspective of applicativity. The educationalist, as educational process and relationship professional, can offer his/her specific contribution to such above mentioned processes in attempt to recover and/or strengthen both individual and common well-being.

Keywords: social and community theatre, pedagogy, differences, storytelling, educational process, applicativity, contact.[ł]

Sunto

Attraverso la narrazione (Bruner, 1956) di un'esperienza di teatro di comunità realizzata in Abruzzo si vuole comprendere, condividere e "fare memoria" di una pratica educativa sperimentata in un comune del cratere

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sismico, dunque, in un contesto di crisi e fragilità sociale. Nello specifico, si vuole mettere a fuoco il nesso fra lavoro artistico e pedagogico e le potenzialità di sviluppo funzionale delle comunità che da esso si dipanano in una prospettiva di applicatività (Blezza, 2018). Il pedagogista, in qualità di professionista del processo formativo e della relazione educativa, può dare un contributo specifico a tali processi nella direzione di un recupero e/o di un rafforzamento del benessere dei singoli e dei gruppi.
Parole chiave: teatro di comunità, pedagogia, differenze, narrazione, processo formativo e trasformativo, applicatività, con-tatto

1. I presupposti analitici: *dall'ultima pagina alla prima*

"Dopo l'ultima pagina viene la prima: questa premessa, che potrebbe essere la conclusione del libro, ne è l'inizio" (Barba, 1996: 13). Così Eugenio Barba apre la sua riflessione in occasione dei trent'anni dell'Odin Teatret, cominciando a tracciare le traiettorie che hanno delineato la sua pratica teatrale.

Prendo umilmente a prestito queste parole perché chiariscono con un efficace metafora il senso del tentativo che mi accingo a intraprendere dopo aver partecipato, in qualità di collaboratrice e pedagogista, all'esperienza de *La Pulce d'acqua dolce, Festival di arti in natura - 2018*, svoltosi, nella sua seconda edizione, nei giorni 5, 6, 7, 8 e 9 Settembre a Montorio al Vomano (Teramo)[1]. Il senso, cioè, del tentativo di avviare un processo metariflessivo sull'esperienza vissuta che, come suggerisce Gibbs (1988), descriva e analizzi quello che è accaduto e le sensazioni che hanno accompagnato il percorso, indaghi i perché di ciò di cui si è fatto esperienza e metta a fuoco punti di forza e debolezza dell'intervento.

Ed è per rimanere con i piedi ben piantati all'interno di questo processo che credo sia importante fare sì che l'*ultima pagina* si ricongiunga alla *prima*, invitandomi a ripercorrere il cammino fatto da una nuova posizione, illuminandolo della rinnovata consapevolezza acquista. Una consapevolezza che si volge al passato per esplorare i dettagli che durante il percorso erano sfuggiti e nutrirsi degli stimoli che si erano trascurati e, contemporaneamente, si apre al futuro, pronta a mettersi in discussione, modificarsi e evolvere.

Il senso del mio tentativo di riflessione pedagogica attraverso la narrazione dell'esperienza condivisa del Festival è, dunque e innanzitutto, quello di

1 Il Festival è prodotto dall'Associazione di promozione sociale *Tric-Trac* (http://www.trictracteatro.it) e gode del sostegno e del partenariato del Comune di Montorio al Vomano, del B.I.M., dell'Istituto Comprensivo di Montorio – Crognaleto, del Liceo Artistico *F.A. Grue* di Castelli e di diversi sponsor privati, nonché della collaborazione con il gruppo territoriale di *Nati per Leggere* di Montorio al Vomano-Teramo-Castelnuovo, di *Ubik dischi e libri* e dell'*EquiClub Vomano*.

rinnovare costantemente il desiderio di ricerca, sperimentazione e studio nell'ambito del teatro in educazione, nutrendo di nuovi stimoli e energie un percorso che non può che avere una forma a spirale, capace di tenere insieme, con un invisibile filo, passato e presente in un processo che torna sui suoi passi per evolvere ed andare avanti.

Un percorso fatto di dubbio sistematico, esplorazione e scoperta, desiderio e impegno; un percorso in cui per andare avanti occorre volgersi a ciò che si è già vissuto, in cui, come dice Grotwski, ogni volta che scopro qualcosa ho la sensazione che sia ciò che ricordo. Le scoperte sono dentro di noi, e bisogna fare un viaggio all'indietro per arrivare fino a esse (Grotwski, 1988: 168).

Ha, inoltre, il senso di puntualizzare e mettere a fuoco una riflessione sul nesso fra l'esperienza artistica e il lavoro pedagogico, sostanziando il piano della mediazione e individuando la via dell'*applicatività* necessaria a superare lo sterile dualismo fra il livello teoretico e quello dell'operatività[2]. E sono le ragioni e i processi che sottendono il suddetto nesso che approfondisco in questo lavoro pedagogico che sceglie la via della narrazione per comprendere, rileggere e riferire dell'esperienza personale e collettiva del Festival, per rintracciarne le caratteristiche essenziali e farne emergere il senso più profondo, senza ridurne la complessità e annullarne la specificità e l'unicità (Blezza, 2018: 178). Una narrazione da intendere come momento di allontanamento dallo scorrere degli eventi che mi permette, in qualità di ricercatrice esperta in educazione, ma anche di persona coinvolta dai fatti, di collocarmi al di fuori di essi per mettere a fuoco le emozioni, i contenuti e le dinamiche in azione nella comunità interessata dalle iniziative del Festival.

Un lavoro di riflessione e analisi che, prendendo a prestito e declinando nel campo del teatro pedagogico e di comunità alcuni concetti del filosofo del linguaggio Tordov (1965), rilegge il processo teatrale e i suoi esiti spettacolari in termini narratologici, considerandoli, quindi, come *storia* e *discorso* allo stesso tempo. Come *storia* in quanto il lavoro teatrale in oggetto si basa sull'intreccio e l'interazione fra avvenimenti e persone, ma anche come *discorso* perché da un lato vi è un gruppo di narratori e attori che mettono in scena la *storia* a partire dal proprio punti di vista e dall'altro un gruppo di spettatori che partecipa allo spettacolo conoscendo e reinterpretando gli avvenimenti raccontati a partire dal modo in cui li si è voluti far conoscere, al di là dei fatti in quanto tali.

2 Quantomai opportune e chiare sono le parole di Blezza a questo proposito:*Il pedagogista è un professionista "di mezzo" e della mediazione, che partecipa sia del piano della teoria che di quello della prassi, ma opera su un terzo piano intermedio a essi, che è quello applicativo, del suo esercizio professionale. Questo esercizio professionale pedagogico può tener conto di qualunque teoria, e di qualunque prassi, di qualunque principio o dovere o valore e di qualunque fatto o comportamento o modo d' essere: ma è da lì che vede cominciare il suo specifico.* (Blezza, 2018: 127)

La contaminazione fra *storia* e *discorso* nel lavoro teatrale testimonia dell'imprescindibilità della condivisione e del contatto con l'altro per dare vita e senso alle parole attraverso un processo di negoziazione che definisca l'identità dei singoli e della comunità. Quella che qui più ci interessa del lavoro teatrale realizzato durante l'esperienza del Festival (considerato innanzitutto come processo e, poi, anche come prodotto) è, infatti, la sua funzione pragmatica. Ci interessa, cioè, lo studio della relazione fra segni e interpreti, una relazione che è alla base del processo semiotico e che, come vedremo, nasce dalla dimensione estetica per allargarsi sino ad abbracciare un profondo significato pedagogico, sociale e politico.

A questo proposito, i presupposti concettuali per approfondire il nesso fra dimensione artistica e pedagogica sono ancora una volta offerti dall'analisi che Tordov (1970) costruisce sul tema del *fantastico.* Declinando, infatti, in ambito teatrale la sua concezione di *esitazione,* emerge che lo sguardo dell'attore e dello spettatore sugli eventi e il tentativo di dar loro un nome (realtà oppure visione folle o soprannaturale) passino proprio attraverso un tempo sospeso che apre al possibile e evoca l'altrove; passino, cioè, attraverso l'*esitazione.* Un'*esitazione* che se rimane nell'ambito della spiegazione razionale scivola nella categoria dello *strano*, e che se si sposta nell'ambito della spiegazione soprannaturale scivola nella categoria del *meraviglioso*. Quello che qui ci interessa è, comunque, il tempo dell'*esitazione* che è zona liminale tra lo *strano* e il *meraviglioso. Esitazione* che, dal punto di vista semantico, costruisce una situazione di sospensione che è precondizione da una parte del processo artistico di metamorfosi e trasformazione, di rottura del limite, di superamento delle barriere del già noto, dall'altra del lavoro pedagogico di orientamento e crescita, quindi di evoluzione dei singoli e delle comunità in un'ottica di benessere. L'*esitazione*, dunque, riguarda il rapporto tra uomo e mondo in una prospettiva che rende possibile il depotenziamento di uno sguardo pandeterministico su di sé e sul contesto. L'*esitazione* dell'attore e dello spettatore difronte al testo teatrale, che è parola, corpo e azione, permette la trasgressione della legge e l'immaginazione di un altrove, suscitando una reazione che permette di comunicare al di là del normale modo di comunicare. Inteso in questo senso il discorso teatrale attiva un processo emozionale che rimescola equilibri e disegna nuovi significati, aprendo un inedito spazio per l'incontro dell'*Io* e del *Tu,* un incontro fondamentale in ogni relazione educativa. In questo spazio relazionale, infatti, può entrare il pedagogista che, come *educatore emozionale* (Buccolo: 2013), dunque, come professionista dello sviluppo educativo, può, anche al di là del lavoro con l'infanzia, promuovere percorsi formativi di crescita e *coscientizzazione* (Freire, 1968) dei singoli e delle comunità. Come sostiene Artaud, infatti (1938): *dal punto di vista umano l'azione del teatro come quella della peste è benefica, perché spingendo gli uomini a vedersi quali sono fa*

cadere la maschera, mette a nudo la menzogna, la rilassatezza, la bassezza e l'ipocrisia.

In quest'ottica, le dimensioni artistica e pedagogica si alleano: la prima per aprire uno spazio che *informa* dell'esistenza di altri mondi possibili e per *dar* loro *forma,* la seconda per offrire gli strumenti concettuali, critici e applicativi per *orientarsi* nell'universo della possibilità e *orientare* le proprie scelte in senso etico, ossia nella direzione del miglioramento del benessere personale e collettivo. Con le parole di Buccolo, infatti, si può sostenere che (2008): *il teatro può essere utile per la pedagogia. Può essere considerato come lo specchio che amplifica e deforma la realtà individuale e collettiva, ma anche come luogo della ragione e dell'utopia, del gioco e della finzione, della parola e del gesto: insomma della più alta comunicazione.*

A partire da tali presupposti che mi offrono le chiavi concettuali per interpretare l'esperienza, mi accingo a narrare[3] il Festival *La pulce d'acqua dolce*, un percorso personale e collettivo, umano e professionale ancora in itinere.

2. L'ultima pagina: "La Pulce d'acqua dolce, Festival di Arti in Natura"

Guardando all'esperienza de *La Pulce d'acqua dolce, Festival di arti in natura,* posso affermare che l'edizione 2018 si pone e raggiunge l'obiettivo di creare un contatto fra l'*Io* e il *Tu,* avviando un processo di dialogo intergenerazionale e interculturale nella comunità di Montorio al Vomano, città nella quale si realizzano tutte le attività del suddetto Festival.

Le azioni, le modalità e i risultati raggiunti saranno a breve presentati sinteticamente, ma intanto ci sembra importante specificare che *comunità, immaginazione, trasformazione* e *contaminazione* sono i concetti chiave che guidano il lavoro artistico dalla fase di ideazione sino a quella di realizzazione. Prima di approfondire tali concetti e aprire una riflessione sul significato che essi hanno per le persone coinvolte, però, è opportuno presentare sinteticamente il Festival, descrivendo i tratti fondamentali che lo contraddistinguono.

3 Con le parole di Eco, "narrare" vuol qui dire *dare forma al disordin*e delle esperienze (Eco, 1994: 51) per rendere trasmissibile quanto vissuto.

Il Festival, giunto quest'anno alla sua seconda edizione, nasce da un'idea di Alessia Martegiani[4] e Valentina Nibid[5], che ne hanno curato la direzione artistica. Le due artiste intuiscono sin da subito l'importanza di aprire la loro proposta alla collaborazione di altre personalità impegnate in campo artistico, sociale e pedagogico in modo da integrare le differenti competenze e dare più forza alla proposta del Festival. Il collettivo che si costituisce è così formato da professionisti provenienti da differenti aree disciplinare[6] che spaziano dal teatro alla musica, dalla ricerca pedagogica a quella biologica, dall'educazione allo yoga, dalla letteratura alla fotografia.

Nelle intenzioni di questo variegato gruppo di lavoro il Festival muove dal desiderio di dare voce, attraverso l'arte, al bisogno di comunità, di ascolto, e di bellezza fondamentali per la cura di un territorio, come quello di Montorio al Vomano, che sta attraversando un momento di grande fragilità dovuto agli eventi sismici del 2016 - 2017 e alla temuta esondazione del lago di Campotosto che hanno provocato gravi danni alle abitazioni, un conseguente spopolamento del centro storico e il trasferimento di molti cittadini nei limitrofi comuni della costa.

Il Festival si presenta, con le parole della Dott.ssa Nibid: *come un'occasione di incontro in uno spazio performativo ricco di suggestioni e simbologie, dove l'arte diviene veicolo capace di accompagnare un sano recupero del patrimonio di luoghi e tradizioni della comunità alla ricerca del benessere individuale e collettivo*.

Del resto, già Jacques Copeau (1931) ci ha insegnato che: *non nasce teatro laddove la vita è piena, dove si è soddisfatti. Il teatro nasce dove ci sono delle ferite, dove ci sono dei vuoti, delle differenze, ossia nella società frantumata*

4 Studiosa e didatta della voce da oltre vent'anni, ha insegnato in diverse accademie, fra le quali l' Accademia Musicale Pescarese, Cotto Lab di Ascoli Piceno, Scuola Civica Ritucci Chinni di Vasto. Attualmente è docente di canto jazz ai corsi Propedeutici e Accademici del Conservatorio G. Braga di Teramo. Svolge attività concertistica internazionale e tiene workshop sull'improvvisazione vocale e sul linguaggio jazzistico, sui ritmi brasiliani e sul repertorio della grande canzone d'autore.

5 Attrice, clown e formatrice, è laureata in S*toria e Pratiche delle Arti, della Musica e dello Spettacolo* dell'*Università dell'Aquila* e si è formata come operatrice di *teatro sociale e di comunità* presso l'*SCT Centre* di Torino. Partecipa a numerosi progetti e spettacoli presso festival, scuole, case-famiglia, ospedali, centri diurni psichiatrici, carceri, case di cura dal 2002 al 2009 all'interno dell'associazione culturale Brucaliffo e dal 2010 all'interno dell'associazione di promozione sociale Tric-Trac per la quale dirige lo spazio creativo *Il Bugigattolo* e il festival di arti in natura, *La Pulce d'Acqua Dolce.*

6 Più nello specifico, oltre alle direttrici artistiche Valentina Nibid (teatro) e Alessia Martegiani (canto) sono coinvolti nei lavori del Festival: Mariagiorgia Ulbar (poesia), Chiara Druda (pittura e scultura), Davide Grotta (musica e suoni), Michela Ardente (yoga), Erika Di Silvestre (educazione e divulgazione scientifica) e la sottoscritta, Fiorella Paone (teatro d'infanzia e ricerca pedagogica).

dispersa… È lì che qualcuno ha bisogno di stare ad ascoltare qualcosa che qualcun altro ha da dire a lui[7].

Il Festival vuole, dunque, essere un momento di confronto, di crescita e di festa capace di evocare un sentimento di appartenenza collettivo e di mettere in moto un desiderio di costruzione di un progetto comune. A questo scopo, il Festival, sia nell'edizione 2017 che 2018, presenta un calendario di appuntamenti che, sebbene diversificati, hanno il racconto della *vita quotidiana*[8] del territorio con i suoi luoghi e tradizioni come elemento di contatto e unione dei percorsi realizzati attraverso i diversi linguaggi artistici.

In particolare, e per l'anno 2018[9], il calendario del Festival prevede tre sezioni[10].

La prima sezione accoglie appuntamenti di teatro, musica e divulgazioni scientifiche per adulti e bambini/e aperte a tutti gli interessati, coinvolti in momenti di lettura ad alta voce, laboratori scientifico-espressivi di educazione ambientale, passeggiate coi pony, classi di pratica yoga, concerti, presentazioni di libri, spettacoli teatrali e incontri divulgativi. Questa sezione si apre con una Tavola Rotonda di incontro fra gli artisti coinvolti e presentazione della proposta a tutta la cittadinanza interessata che ho personalmente l'onore di presentare e coordinare.

La seconda sezione prevede una Residenza Artistica, dal titolo *La Voce del Fiume,* laboratorio intensivo tra teatro e musica, che si realizza attraverso cinque giorni di laboratorio in natura alla ricerca del potere evocativo del suono e del gesto, della capacità trasformativa dell'immaginazione. Il gruppo dei *Residenti Artisti,* formato da giovani provenienti da tutta Italia, lavora a partire dagli stimoli offerti dal territorio di Montorio al Vomano e dalla sua comunità. Il lavoro dei *Residenti Artisti*, infatti, si fonda su due direttrici fondamentali.

Da una parte, vi è il lavoro di mimesi che attraverso la poesia, il gesto e la voce ha come suo focus il fiume Vomano. Come sostengono la Dott.ssa Nibid e la Dott.ssa Martegiani, infatti: *il fiume con il suo scorrere dalla montagna al mare rappresenta la possibilità della trasformazione e l'unione di territori lontani. L'acqua, inoltre, sia come elemento naturale che metaforico, evoca la*

7 Il brano è tratto dal "manifesto" politico culturale di Jacques Copeau, il quale vede l'impegno dell'attore orientato a percorsi pedagogici di educazione alla cittadinanza e alla partecipazione democratica attivati dall'incontro fra la potenza simbolica della finzione teatrale e i bisogni della vita quotidiana.

8 Del resto, già Goffman ha ribadito l'importanza di studiare la *vita quotidiana* e le sue dinamiche per arrivare a una definizione delle differenti situazioni sociali e, nel far questo, ha adoperato la metafora teatrale (Goffman, 1959)

9 Si sceglie di occuparsi più da vicino dell'edizione 2018 del Festival in quanto si ritiene che questa sia un'edizione più matura e più interessante in termini analitici. Tale edizione, infatti, è più vicina ai miei interessi di pedagogista in quanto realizza in modo più efficace rispetto alla prima l'obiettivo di avvicinare il lavoro artistico a quello pedagogico e di comunità.

10 Il Programma completo de *La Pulce d'acqua dolce, Daphnia 2018* è consultabile al seguente link: http://www.trictracteatro.it/la-pulce-dacqua-dolce-daphnia-2018/

possibilità della nascita e del nutrimento della vita, è spazio intimo e suggestivo che apre alla contemplazione e alla introspezione, è condizione necessaria per una cittadinanza che ha bisogno di incontrarsi, di creare comunità, di ricordare insieme le sue origini, di narrare la sua storia, di trovare il suo canto e godere insieme della bellezza.

Dall'altra parte, vi è l'incontro con un gruppo di cittadini di Montorio e con le loro storie, condivise attraverso il percorso di teatro di comunità[11] denominato *La Città Nascosta*[12], durante il quale l'intreccio fra i ricordi narrati dai partecipanti fa emergere la mappa affettiva di Montorio al Vomano, avviando un virtuoso processo di consapevolezza, crescita e vitalità che nutre e vivifica il contributo di tutti e di ciascuno. La condivisione delle proprie storie da parte dei partecipanti de *La Città Nascosta* con i *Residenti Artisti* genera uno sguardo originale sul territorio, uno sguardo nato dal contributo di tutti i partecipanti al percorso, uno sguardo che diviene collettivo e capace di valorizzare l'esperienza di tutti in un approccio intergenerazionale e interculturale.

La terza e ultima sezione del Festival consiste nella realizzazione di un evento spettacolare, intitolato *ESONDAZIONI, Lo spettacolo portato dal fiume ...*[13], che è costruito come un viaggio, non solo metaforico, tra strade e immagini attraverso una performance itinerante tra musica, teatro, cibo e danze che trasforma, come in un antico rito, la parata di attori e spettatori fra le vie del centro storico cittadino in una festa.

Lo spettacolo nasce dal suddetto incontro fra i *Residenti Artisti* e il gruppo partecipante al laboratorio *La Città Nascosta,* che insieme propongono agli spettatori la propria visione di Montorio al Vomano. Una visione che si basa sull'attenzione e la cura di sé e dell'altro, sull'incontro empatico e sulla capacità

11 La presenza di uno spazio specifico dedicato al teatro di comunità, che è la novità dell'edizione 2018 del Festival, si basa sulla convinzione che questa metodologia sia particolarmente adatta ad un contesto sociale che sta attraversando un momento di potente dispersione e sradicamento a causa dei citati eventi sismici. Il teatro di comunità si muove, infatti, in una dimensione trasformativa atta a promuovere processi di cambiamento sociale che hanno come scopo primo il *benessere* individuale e collettivo. A partire dalla riscoperta e valorizzazione di risorse e competenze già esistenti tende a rendere visibile l'invisibile, a costruire un'utopia di rinascita, creando la speranza di altri mondi possibili attraverso la pratica dell'arte e della bellezza.

12 Il percorso teatrale denominato *La Città Nascosta* è realizzato nei mesi di luglio e agosto 2018 in preparazione del Festival. Il gruppo di partecipanti, composto da cittadini italiani, albanesi e kosovari di differenti età, genere e background socioculturali, ha lavorato sulla memoria dei luoghi e sul loro valore simbolico ed emozionale. Il collettivo all'interno del quale si sviluppa il percorso di ricerca teatrale condivide una visione di c*ittà nascosta* come, per seguitare ad usare una metafora delle *Città Invisibili,* di: *una città infelice (che) può contenere, magari solo per un istante, una città felice; le città future sono già contenute nelle presenti come insetti nella crisalide*. Per rimanere nell'ambito delle *Città Invisibili* il collettivo condivide anche l'urgenza di *cercare e saper riconoscere chi e che cosa, in mezzo all'inferno, inferno non è, e farlo durare, dargli spazio* (Calvino, 1972).

13 Per la regia di Valentina Nibid.

di *in-tendersi* (Scaramuzzo, 2005) al di là delle barriere culturali e sociali dovute a pregiudizi reciproci. Usando la categoria d'analisi dell'*in-tendersi*, si può sostenere che è proprio lo sforzo di *tendersi verso l'interiorità dell'altro,* attivato dal processo artistico e creativo, ossia da un processo di educazione poetica (Scaramuzzo, 2013), che rende possibile un incontro autentico e una relazione efficacie[14]. Un *in-tendersi* che spinge a uscire dalla solitudine dell'individualismo e a trovare conforto nell'altro senza rinunciare al *sé*, bensì arricchendolo. Da questo *in-tendersi* nasce una narrazione comune e feconda perché basata su una forte capacità di transcodificazione, quindi di rappresentazione e condivisione dei propri vissuti. Nei termini di Tordov, la suddetta narrazione è *storia*, dunque, capace di mettere in contatto e interazione persone e avvenimenti, ed è anche *discorso*, quindi, capace di tenere insieme l'*Io* e il *Tu,* di far convivere e incontrare i loro reciproci punti di vista, di generare legami e attivare un dialogo basato sulla partecipazione emotiva, l'ascolto attivo e il rispetto dell'altro. Questa narrazione, riscoperta e utilizzata da coloro che partecipano al percorso teatrale, porta a mettersi in gioco in un contesto di finzione, quale quello drammatico, attraverso un atto mimetico[15] e di immedesimazione nell'altro da sé, aprendo, così, alla possibilità di un autentico incontro. L'esperienza artistica vissuta, infatti, ha fatto sì che si innescassero nuove relazioni e si mettessero in comune le diverse abilità, promuovendo un'esperienza artistica viva e feconda, capace di contribuire alla ricostruzione dell'identità sociale e di stimolare "il risveglio" della comunità[16].

La numerosa partecipazione[17] della cittadinanza montoriese e dei comuni limitrofi all'evento, inoltre, è testimonianza del riconoscimento di un bisogno di confronto, è affermazione di una forte urgenza di condivisione e riscoperta di sé

14 A questo proposito Scaramuzzo scrive (2005): *non possiamo intenderci (...) se ascoltando non faccio un movimento verso il mondo che è nell'altro. (...) L'atto di intendere non è un atto del conoscere, ma un atto del volere: un atto d'amore.*

15 A tal riguardo Scaramuzzo (2011) parla di *mimopaideia*, ossia di un'azione formativa ed educativa che insiste sul concetto di *mimesis* e sul suo esercizio per comprendersi e comprendere l'altro al fine di costruire relazioni funzionali al benessere.

16 Nel corso dello spettacolo *Esondazioni,* evento conclusivo del Festival, gli attori ripetono spesso la battuta: *e poi ci siamo addormentati*. Si vuole, infatti, sottolineare che la comunità di Montorio ha attraversato un periodo in cui la vitalità delle relazioni sociali e le capacità di incontro e dialogo sono entrate in crisi, per l'appunto *si addormentano*. Attraverso l'incontro con l'altro mediato dal linguaggio artistico si tenta, quindi, di svegliare la comunità montoriese. Lo spettacolo *Esondazioni* si apre, infatti, con le seguenti battute che introducono al senso di quanto sin qui sostenuto: *il fiume gorgheggia, è ora di pescare. Tiriamo su le reti del sonno e del dolore. Quello che non si vede bisogna ridestare. Il pozzo parla piano, respira, canta e chiama. Montorio è quasi pronta, ancora è sonnolenta, dal pozzo caccia storie confuse e sbriciolate che cercano una forma, di essere svegliate, scomposte e ri-sensate. Bisogna fare piano, prestare orecchie e gambe, per ascoltare i sogni, per farli camminare! Prego entrate signori, fate piano, destate lento il sonno, con cura e con amore.*

17 All'evento finale hanno partecipato circa 400 persone. Le curatrici, inoltre, stimano che al Festival hanno partecipato più di 1.000 persone.

e del proprio contesto in quanto, come sostiene Boal, *il teatro è l'arte di vedere noi stessi*. È, inoltre, dimostrazione di un intenso desiderio di rinascita come comunità di cui nel seguito del lavoro cercherò di definire i contorni, nell'ottica di mettere maggiormente a fuoco il nesso fra lavoro artistico e pedagogico.

3. La prima pagina: intuizioni che disegnano costellazioni

Tornerò, ora, come anticipato, alla *prima pagina* di quest'ultimo mio impegno nell'ambito del teatro di comunità, condividendo, di seguito le riflessioni preliminari all'avvio del Festival.

Penso sia importante, infatti, quando si vuole parlare ad altri della propria esperienza, in questo caso di un'esperienza artistica, risalire a quella che definisco l'*idea originaria*, ossia l'insight che ha messo in moto il processo. Spesso si tratta di una molteplicità di intuizioni, ma guardando bene si scopre che esse appartengo ad un'unica visione, disegnano una vera e propria costellazione. E non è un caso questo riferimento alle stelle, che sono state e potrebbero ancora essere, più o meno metaforicamente, punto di riferimento per orientarci in ogni momento di crisi e trasformazione, non solo per ritrovare i sentieri già battuti, ma anche per scoprire nuove rotte.

In questo senso, continuando ad utilizzare l'appena citata metafora, la pedagogia è per me capacità di leggere le stelle ed ha la funzione di orientare, illuminare e far scoprire ciò che rimane in ombra sia del sé che del contesto.

Questo declinarsi al plurale della *prima pagina* della storia del Festival, oramai circa tre anni fa, è influenzato e arricchito dal fatto che quello della *Pulce d'acqua dolce* è, come già spiegato, un lavoro curato da un collettivo di professionisti ognuno con la sua specificità e la sua storia personale e professionale[18]. Intuizioni differenti, quindi, provenienti da storie e itinerari differenti, che si scoprono vicini, seppur senza perdere la propria specificità e identità. Differenze che divengono nutrienti le une per le altre e portano ad un maggiore riconoscimento dell'*Io* e del *Tu.* L'incontro e la ricombinazione delle differenze sono, d'altronde, alla base della genesi del processo teatrale. Come, infatti, dice il già citato Copeau, il teatro (in Cruciani, 2006: 207): *nasce quando all'interno di un gruppo sociale delle persone* diverse *rendono possibile un'attività di riconoscimento. L'estraneità è la molla del teatro.* Attività di riconoscimento che può essere orientata e formalizzata a partire dall'alleanza fra arte e pedagogia, che facilita la costruzione di un piano di mediazione capace di favorire il contatto e individuare il senso dei percorsi personali e collettivi.

A partire dalla consapevolezza di un'essenziale natura plurale di quella che ho precedentemente definito *idea originaria* e nel muovermi alla ricerca del

18 Cfr. nota n. 8

seme da cui essa è germogliata, la memoria trova il suo primo aggancio nei giorni del terremoto e del post terremoto del 2016. Giorni di cui i residenti di Montorio al Vomano conservano una memoria di tristezza, paura, dolore, impotenza. Giorni in cui molti si sono sentiti soli; giorni per molti congelati nell'attesa di qualcosa di indefinito; giorni in cui si è vissuta una sensazione di sospensione che, distruggendo materialmente ed anche metaforicamente le routine della vita quotidiana, hanno lasciato una profonda sensazione di vuoto e spaesamento sia nelle persone direttamente colpite dal sisma e dalle sue conseguenze, sia in tutti coloro che, come la sottoscritta, gli erano vicini.

Questo evento e queste sensazioni sono alla base dell'idea originaria che ha spinto a mettere in moto il percorso artistico del Festival.

L'arte offre, infatti, l'opportunità di non rassegnarsi e rimanere inermi difronte ad un'aspettativa di rinascita che sembra allontanarsi ad ogni passo, ma di entrare in uno spazio comune che è innanzitutto spazio di desiderio e relazione. Una relazione che non si costruisce solo fra gli artisti, ma con tutta la comunità che ha il desiderio ed il coraggio di entrare nel gioco di un incontro dialettico capace di rendere viva la memoria e attiva e partecipata la speranza di una vita migliore.

A questo proposito mi vengono in mente le parole di Danilo Dolci (1970:3): *Se l'occhio non si esercita, non vede. / Se la pelle non tocca, non sa. / Se l'uomo non immagina, si spegne. /(….*)

Ebbene l'arte è anche questo; è lente per vedere, è modalità di contatto, è visione di un altrove possibile. E non è solo questo. Se vissuta seriamente e se orientata in termini pedagogici, è un modo di costruire il mondo a partire dal dialogo fra le diverse singolarità, superando da un lato tendenze omogeneizzanti che appiattiscono le differenze e dall'altro posizioni tese a demonizzare le suddette differenze costruendo nemici ideali che non fanno che creare divisioni artificiali all'interno della comunità stessa.

Le parole conclusive dello spettacolo *Esondazioni* fanno risuonare proprio questo desiderio di contaminazione, incontro e integrazione: *questo e' il nostro augurio di farci tutti fiumi, di farci attraversare, di scorrere e mutare. Unire tutti i pezzi e farli dialogare, scomporli e ricomporli per dare un nuovo senso al mondo e alle persone! Torniamo alla bellezza di immagini e parole! Contaminazione...lunga vita alla vita che si mescola!*

L'arte diviene augurio e tentativo concreto di costruzione di un mondo fatto di intrecci fra narrazioni di un tempo antico e di un tempo presente e disegna, come frutto di un lavoro collettivo, la mappa di un territorio che emerge dall'abbandono, dalla dimenticanza, dall'incuria e dall'oblio per divenire vita. L'esperienza artistica disegna un mondo che rimane aperto e in divenire, un mondo fatto di tutti i mondi di coloro che lo attraversano e contribuiscono a costruirlo. Un mondo che, attraverso un linguaggio poetico ed evocativo, ha la capacità di testimoniare la profonda umanità di un territorio, rintracciandone il

senso. Un senso che ha un valore interno, risuonando in modo personale in ognuno, e esterno, mettendo in moto azioni comuni e vivificanti.

La dimensione etica è, dunque, al centro dell'esperienza artistica intesa come opportunità educativa per costruire e condividere occasioni di senso ricche di bellezza che siano stimolo e modello per tutta la cittadinanza coinvolta. Questa concezione di arte ha, quindi, un proprio intrinseco ed immediato valore pedagogico, per almeno due ordini di ragioni. Da una parte, infatti e come anticipato in apertura di questo lavoro, fornisce punti di riferimento, indicando ad ognuno possibili strade per partecipare a situazioni di bellezza che sostengano il benessere; dall'altra parte fa vivere, in un contesto metaforico, concrete esperienze di un "mondo diverso", rafforzando e appagando l'ambizione a goderne e esserne coinvolto in una prospettiva che è insieme, culturale, sociale e politica. Essa, infatti, stimola la curiosità intellettuale, rafforza il senso di appartenenza che porta alla cura del "noi", e aiuta, con un'espressione di Arrigoni (2011), a "restare umani"[19] in un'ottica di responsabilità e cittadinanza attiva.

4. Considerazioni conclusive

Se il lavoro dell'artista è, dunque, quello di mettere in moto il desiderio e portare una testimonianza di un altrove possibile, quello del pedagogista può essere quello di inserirsi in questo processo facilitando, attraverso gli opportuni strumenti di dialogo e orientamento, il con- tatto con quegli aspetti di sé e del contesto che si individuano come significativi in un'ottica di coscientizzazione, valorizzazione e/o trasformazione evolutiva.

Si può dire che la pedagogia può aiutare a mettere a fuoco la dimensione etica e formativa dell'esperienza artistica personale e collettiva, quindi, in relazione ai diversi contesti e obiettivi, può fornire i criteri che aiutano a orientarla nella direzione di un rafforzamento del benessere di una comunità. L'arte, come strumento di rappresentazione, narrazione e drammatizzazione della realtà dei singoli e delle comunità, può, dunque, essere via privilegiata da percorrere per esercitare una *pedagogia del con-tatto*, ossia una pedagogia tesa a creare occasioni di relazione e contaminazione fra l'*Io* e il *Tu*, costruendo un *Noi* basato sul prendersi cura, sul dialogo e sul rispetto delle reciproche differenze in un'ottica di crescita del benessere personale e collettivo.

In questo senso, sono significativamente le parole che gli artisti del Festival utilizzano per invitare a scoprire la c*ittà felice*[20] nascosta a Montorio al Vomano: *seguiteci nel viaggio della città nascosta che ha voglia di tornare, riprendere le*

19 Tale concezione che vede i percorsi artistici come occasione di bellezza è stata precedentemente approfondita (Paone, 2016).

20 Cfr. nota 14

storie per poterle mescolare e dare nuovo senso a ordine e parole, un senso tutto nostro di cura, ascolto e amore[21].

Come pedagogista, mi sento di chiudere questa riflessione raccogliendo e facendo mio l'invito alla *cura,* all'*ascolto* e all'*amore* come capisaldi della relazione empatica, base di ogni processo formativo, e come punti di riferimento per l'esercizio di una autentica pedagogia del con-tatto.

Bibliografia

Arrigoni V., (2011), *Gaza. Restiamo Umani,* Manifestolibri, Milano.

Artaud A., (1938), *Le Théâtre et son double*, Gallimard, Paris.

Barba E., (1993), *La Canoa di Carta,* Il Mulino Bologna.

Barba E., (1996), *Teatro. Solitudine, mestiere, rivolta*, Ubulibri, Milano.

Blezza F., (2018), *Pedagogia Professionale, Che cos'è, quali strumenti impiega e come si esercita*, Libreriauniversitaria, Padova.

Boal A., (1985), *Teatro do Oprimido e Outras Poéticas Políticas*, Civilização Brasileira, São Paulo.

Bruner J., (1956), *A Study of Thinking*, John Wiley & sons, New York, 1956. trad. it. *Il pensiero. Strategie e categorie*, Armando, Roma.

Buccolo M., (2008), *La formazione va in scena:" La progettazione dei processi formativi attraverso la metodologia del teatro d'impresa"*, Laterza, Bari.

Buccolo M., (2013), *L'educatore emozionale. Percorsi di alfabetizzazione emotiva per l'infanzia,* FrancoAngeli, Milano.

Calvino I., (1972), *Le città invisibili,* Einaudi, Torino.

Copeau J., (1931), *Souvenirs du Vieux Colombier*, Les Nouvelles Editions Latines, Paris; trad. it. (1962), *Ricordi del Vieux Colombier*, a cura di A. Nacci, Il Saggiatore, Milano.

Cruciani F., (2006), Registi, pedagoghi e comunità teatrali nel Novecento, Editoria & Spettacolo, Napoli.

Dolci D., (1990), *Il limone lunare*, Laterza, Bari.

Eco U., (1994), *Sei passeggiate nei boschi narrativi*, Bompiani, Milano.

Freire P., (1968), tr. it (1971), La *pedagogia degli oppressi*, Mondadori, Milano.

Freire P., (1992), tr. it. (2011), *Pedagogia della speranza*, EGA Edizione, Gruppo Abele, Torino.

21 Parole tratte dal già citato spettacolo *Esondazioni*.

Gibbs G., (1988), Learning by doing*:* A guide to teaching and learning methods, Paperback, London*.*

Grotowski J., (1988), Il Performer*, in Teatro e Storia III, n.4: 163-169.*

Parisi Presicce P., (2017), *Impalcature. Teorie e pratiche della narratività*, Mimesis, Milano.

Scaramuzzo G., (2005), *In-tendere. L'umana sophia di Pirandello,* Anicia, Roma.

Scaramuzzo G., (2011), *Mimopaideia. Buone pratiche per una pedagogia dell'espressione,* Anicia, Roma.

Scaramuzzo G., (2013), *Educazione poetica. Dalla «Poetica» di Aristotele alla poetica dell'educare,* Anicia, Roma.

Goffman E., (1959), *The Presentation of Self in Everyday Life,* Random House. New York.

Paone F., (2016), *Se si insegnasse la bellezza alla gente.,* in Associazione Mila Donna Ambiente, *Premio alla Bellezza,* Tracce, Pescara: 117 – 122

Tordov T., (1965)*, Théorie de la littérature*, Seuil, Paris.

Tordov T., (1970), *Introduction à la littérature fantastiquem*, Seuil, Paris.

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Statistics for a Football Coach

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Abstract

This work presents a Decision-Making Model referring to the forecasts about the Football World Cup in Brazil (2014). This work aims to demonstrate how it is possible to approach young students to the study of Mathematics through evoking themes that are congenial to them and able to arouse their interest.

Keywords: Football World Cup, Motivation, Statistical Analysis, Regression line, Didactics, Students. [ł]

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1. Introduction

Football represents one of the most followed social phenomena at every level (F. Casolaro, 2014). The statistical analysis tells us that "being a footballer" is the first aspiration of the majority of boys!

Along with this aspiration, a strong passion for sports journalism is spreading, even among the youngest (of both sexes), therefore they are inclined to consider events with a much more critical eye. In particular, in the years in which the World Cup finals take place, the events are also followed by those who are not football fans because, through the media, the event has access to every house.

World Cup 2014: Italy, against any forecast, comes out in the first round with 3 points! Was it a case or was the statistical analysis in the forecasts wrong?

Immediately, in the various comments of technicians, experts, journalists and columnists, on the debacle of our National Team, only the responsibilities of CT Prandelli were read out and they were connected to serious errors in the tactical approach (F. Casolaro 2014). However, it is important to consider the technical resources available to Prandelli in the Serie A (2013/2014) in which 68% of the footballers in the first teams were foreign players and most of the remaining 32% were in the middle-low ranking teams.

If we do not consider the six footballers of Juventus (Buffon, Barzagli, Bonucci, Chiellini, Pirlo and Marchisio, arrived at that World Cup worn out by the efforts of three competitions – Serie A, Champion's League, Italian Cup -), the majority of 17 other players were playing in the mid-table teams, and were therefore considered, at the time of the facts, unfit to participate in the most important competitions for club teams. Below is an indication of the club teams in which the other 17 members of the Italian team (at the Brazilian World Cup) played:

- AS Roma, a team ranked second in the Serie A 2013/2014, provided only De Rossi, as 8/11 of the first team were foreigners: the other three were Totti and De Sanctis (respectively 38 and 37 years old) and Florenzi (23) who was considered too young;
- SSC Napoli, that in that league (in which it ranked third) had the first team composed almost exclusively by foreign players, provided only Insigne;
- AS Fiorentina, ranked fourth, had only three Italian in the first team. Of these the only Aquilani was called by Prandelli to join the Italian team;
- FC Inter, fifth place, had no Italian players in the first team.

From the sixth place onwards we find the other players: Cassano, Paletta and Parolo from Parma, sixth place; Darmian, Cerci and Immobile from Torino, that ranked seventh; De Sciglio, Abate and Balotelli from Milan, that ranked eighth; Candreva from Lazio (ninth); Perin from Genoa (fourteenth).

To these must be added Sirigu, Verratti and Thiago Motta who were playing abroad in Paris S. Germain, and therefore did not have the opportunity to compete in the Serie A.

It is legitimate to ask, at this point, if another coach could have done more. To answer the question, we will use a simple linear regression model.

2. The independent variable x: motivation, skills and experience of footballers

The World Cup is the competition that every child, every soccer lover would like to play and is, at the same time, the great goal of the overpaid professionals of the footballing universe.

The World Cup is, therefore, an event in which the motivations are extremely important and can combine in a holistic system, giving rise to sometimes extraordinary results that disavow the predictions of the best experts.

What we intend to do with our model is to provide guidelines based on pragmatic reasoning, totally unrelated to the magic of 11 men who, by throwing their hearts beyond the obstacle, exceed their limits. We will keep ourselves within those limits with an exception that we will clarify later.

The result achieved by a National Team in a World Cup obviously depends on the skill of the players that make up the team. A good indicator of players' abilities may be the number of appearances collected by them in international club events (Champion's League, Europe League, Copa Libertadores etc.).

The higher the attendance in these competitions, the greater the players' abilities and the habit of the same to face high-level competitions like a World Cup will presumably be.

Using the data provided by the "Soccerway" website, we have identified, for each player of the different National Teams, the number of appearances in the most important international club competitions in the four football seasons that preceded the World Cup in Brazil (2014):

- Champion's League (CHL) and Europe League (EUL) for Europe;
- Copa Libertadores (COL) and South American National Cup (CNS) for South America;
- Caf Champion's League (CCL) for Africa;
- AFC Champion's League (ACL) for Asia;
- Concacaf Champion's League (CCC) for North and Central America.

The appearances, however, must be appropriately weighted: an appearance in the European Champion's League must be worth more than an appearance in the Europe League or in the CONCACAF (North and Central American Champions Cup). This is because depending on the events the value of the

participating teams changes. Below are our evaluations concerning the importance of the events and their weight in the model we have built:

- An appearance in the Champion's League (CHL) will be worth 1 point;
- An appearance in the Europe League (EUL) will be worth 0.7 points;
- The Copa Libertadores (COL) is the South American Champion's League. An appearance in this competition will be worth 0.8 points (0.2 less than the Champions League, as the strongest South American players play in Europe);
- The South American National Cup (CNS) is the equivalent of the Europe League in South America; an appearance in this cup will be worth 0.56 points;
- The AFC Champion's League (ACL) is the most important international club competition in the Asian Continent. An appearance in this event will be worth 0.3 points. In the 2013 edition, Guangzhou Evergrande won the competition: its coach was Marcello Lippi who in 2006 won the World Cup with Italy;
- The Concacaf Champion's League (CCC) is the equivalent of the Europe League for clubs in Central and North America. The CAF Champion's League (CCL) is the African Champions League. An appearance in these competitions will be worth 0.3 points.

With the assigned weights, we geometrically structure our model.

Imagine we have, in a National Team, players with a total number of appearances in the listed competitions as follows: 40 Champion's League (weight 1), 50 Europa League (weight 0,7), 30 Copa Libertadores (weight 0,8).

Step 1 - We multiply the appearances for the weights and we carry out the sum of the products 40x1 + 50x0,7 + 30x0,8 = 99.

Step 2 - We divide the value of the sum (99) by 23 (number of players of each National Team): $\frac{99}{23} = 4{,}3$.

What we have achieved is the Average of the weighted appearances of the national players in the most important international club events. In our model, it indicates the strength of the team and the result achieved by the National Team in the World Cup is made to depend on it. It is the independent variable and is indicated with the letter x (M. Squillante et. al 2016).

3. The dependent variable y: the score obtained by the National Teams in the World Cup

Each team is assigned a score based on the results obtained in the competition:

- 3 points for victory in the regular time;
- 1 point for a tie in the regular time;
- 1 point for victory in extra time;

- 0.3 points for a tie in extra time;
- 0 for defeat;
- 0.2 points for victory on penalties.

Points are reduced to one third for the final for the third and fourth place.

Thus, a National Team that has passed the group with 6 points and has been eliminated in the round of 16 on penalties will be assigned a score calculated as follows:

6 + 1 (tie in the regular time of the round of 16) + 0,3 (tie in the extra time of the round of 16) = 7,3.

This score is our dependent variable and will be indicated with the letter y.

Let us briefly summarize the course of the 30 National Teams in the 2014 World Cup:

- Holland: Overcame the group with 9 points. Overcame the round of 16 in the regular time and won the quarter-finals on penalties. It was eliminated in the semi-finals on penalties. Won the final for the third/fourth place in the regular time;
- Belgium: Overcame the group with 9 points. Overcame the round of 16 after extra time. It was eliminated in the quarterfinals in the regular time;
- Switzerland: Overcame the group with 6 points. It was eliminated in the round of 16 after extra time;
- Germany: Overcame the group with 7 points. Overcame the round of 16 after extra time. Overcame the quarterfinals in the regular time. Won the semifinals in the regular time. Won the final after extra time;
- Russia: Was eliminated in the group with 2 points;
- Bosnia: Was eliminated in the group with 3 points;
- England: Was eliminated in the group with 1 point;
- Greece: Overcame the group with 4 points. Was eliminated in the round of 16 after penalties;
- Croatia: Was eliminated in the group with 3 points;
- Portugal: Was eliminated in the group with 4 points;
- France: Overcame the group with 7 points. Overcame the round of 16 in the regular time. Was eliminated in the quarterfinals in the regular time;
- Brazil: Overcame the group with 7 points. It won the round of 16 after penalties. Overcame the quarterfinals in the regular time. Was eliminated in the semifinals in the regular time. Lost the third/fourth final in the regular time;
- Argentina: Overcame the group with 9 points. Overcame the round of 16 after extra time. Won the quarter-finals in the regular time. Overcame the semi-finals after penalties. Lost the final after extra time;
- Colombia: Won the group with 9 points. It won the round of 16 in the regular time. Was eliminated in the quarterfinals in the regular time;
- Chile: Overcame the group with 6 points. Was eliminated in the round of 16 after penalties;

- Ecuador: Was eliminated in the group with 4 points;
- Mexico: Won the group with 7 points. Was eliminated in the round of 16 in the regular time;
- Uruguay: Overcame the group with 6 points. Was eliminated in the second round in the regular time;
- Honduras: Was eliminated in the group with 0 points;
- United States: It overcame the round with 4 points. Was eliminated in the round of 16 after extra time;
- Costa Rica: Won the group with 7 points. It won the round of 16 after penalties. Was eliminated in the quarters after penalties;
- Ivory Coast: Was eliminated in the group with 3 points;
- Nigeria: Overcame the group with 4 points. Was eliminated in the round of 16 in the regular time;
- Cameroon: Was eliminated in the group with 0 points;
- Algeria: Overcame the group with 4 points. Was eliminated in the round of 16 after extra time;
- Ghana: Was eliminated in the group with 1 point;
- Japan: Was eliminated in the group with 1 point;
- Iran: Was eliminated in the group with 1 point;
- South Korea: Was eliminated in the group with 1 point;
- Australia: Was eliminated in the group with 0 points.

4. From the set of observations to the regression line

Table 1 shows, for each of the 30 National Teams, the scores assigned to the teams, the players' appearances in the most important international club competitions and the Average of weighted appearances:

National Team	Score (y)	Appearances	Average of weighted appearances (x)
HOLLAND	15,8	CHL=167; EUL=199	13,32
BELGIUM	11	CHL=255; EUL=224	17,9
SWITZERLAND	7	CHL=184; EUL=166	13,05
GERMANY	17	CHL=546; EUL=105	26,93
RUSSIA	2	CHL=169; EUL=207	13,65
BOSNIA	3	CHL=61; EUL=141; ACL=7	7,03
ENGLAND	1	CHL=226; EUL=94	12,7
GREECE	5,3	CHL=162; EUL=133	11,09
CROATIA	3	CHL=273; EUL=159	16,7
PORTUGAL	4	CHL=282; EUL=250	19,87
FRANCE	10	CHL=316; EUL=110	17,087
BRAZIL	11,5	CHL = 370; EUL=96; COL=162; CNS = 13	24,96
ARGENTINA	16,5	CHL = 260; EUL = 131; COL = 96; CNS =18; CCC = 24	19,38
COLOMBIA	12	CHL= 74; EUL= 115; COL= 111; CNS=41	11,57
CHILE	7,3	CHL= 71; EUL= 90; COL =151; CNS= 155	14,85
ECUADOR	4	CHL = 36; EUL =31; COL = 206; CNS = 149; ACL =14; CCC=54	14,19
MEXICO	7	CHL =37; EUL = 38; COL = 77; CCC = 111	6,89
URUGUAY	6	CHL = 117; EUL = 189; COL = 41; CNS = 17; ACL = 6	12,76
HONDURAS	0	CHL =36; EUL = 18; CCC = 112	3,57
UNITED STATES	5	CHL = 19; EUL = 80; CCC = 72	4,2
COSTA RICA	9,8	CHL = 39; EUL = 82; CCC = 88	5,34
IVORY COAST	3	CHL = 104; EUL = 147; CCL = 6	9,07
NIGERIA	4	CHL = 81; EUL = 53; CCL = 5	5,2
CAMEROON	0	CHL= 176; EUL =97; CCL = 8	10,71
ALGERIA	5	CHL 38; EUL = 62; CCL = 13; ACL = 21	3,98
GHANA	1	CHL = 138; EUL =81; CCL=3; ACL=12	8,66
JAPAN	1	CHL = 58; EUL = 72; ACL = 98	5,99
IRAN	1	ACL = 217; CCC = 1; EUL =7	3,056
SOUTH COREA	1	CHL = 24; EUL = 19; ACL = 167	3,8
AUSTRALIA	0	CHL = 11; EUL = 13; ACL = 97	2,14

Table 1. The scores assigned to the 30 National Teams, the players' appearances in the major international club competitions and the Average of weighted appearances.

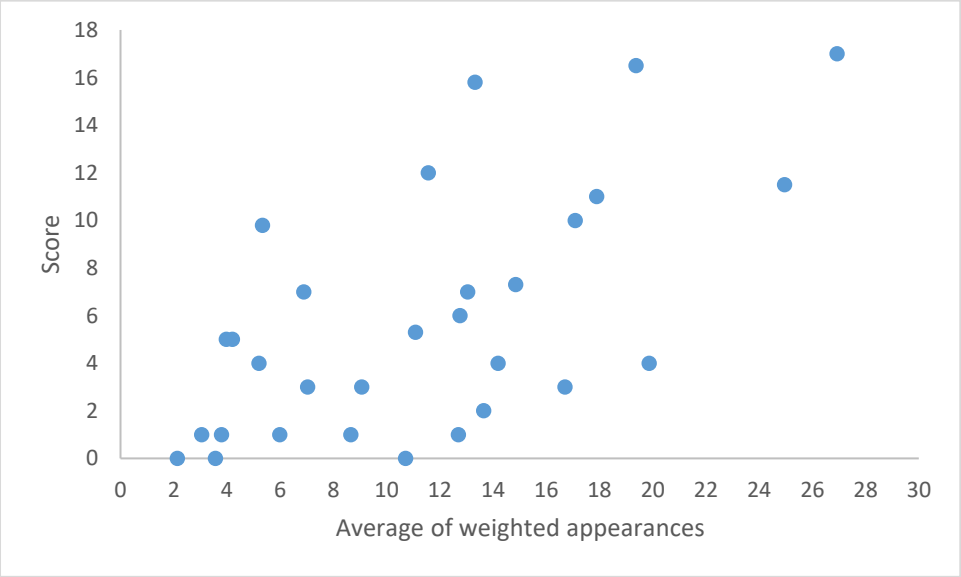
From the observations we have eliminated Spain which appeared in Brazil as the defending champion. From the 2002 World Cup to the 2014 World Cup three times out of four the defending champion team was eliminated in the first round: France in Korea and Japan (2002), Italy in South Africa (2010), and Spain in Brazil (2014). At these must be added Germany presented at the World Championship played in Russia in 2018 as World Champion: it was eliminated in the first round.

The trend of the motivational variable is, therefore, in this case, and limited to this aspect, easily predictable and it is even more so for the Spain which in addition to the 2010 World Cup had won the European Championships of 2008 and 2012.

Reported in a system of Cartesian axes, the set of observations takes the form of a point cloud: the dispersion diagram (figure 1). Each point represents one of the 30 National Teams: the abscissa is the Average of weighted appearances, the ordinate is the score obtained.

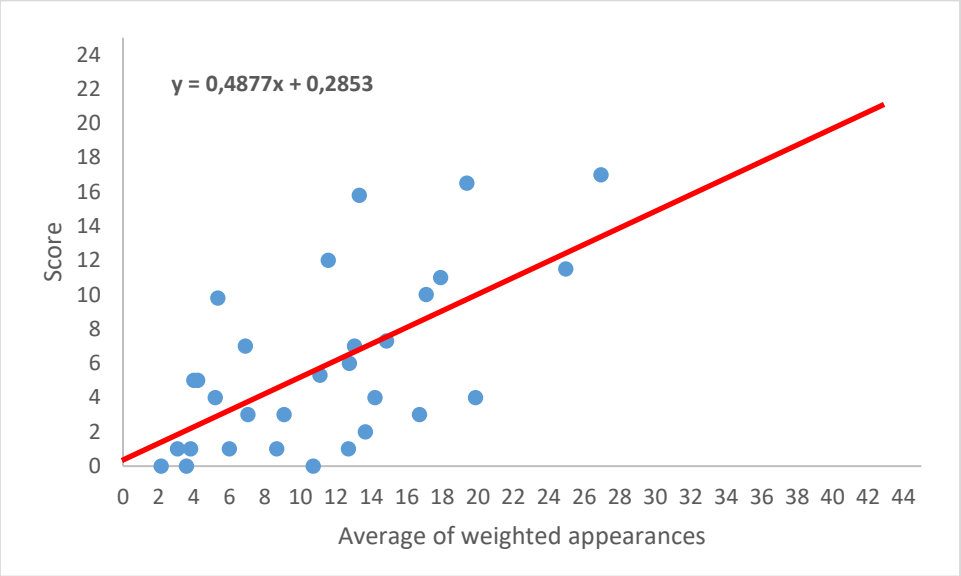
The diagram is a photograph of what actually happened:

Figure 1: Dispersion Diagram



Our regression line has equation: $y = 0{,}28 + 0{,}48x$.

Figure 2: The regression line



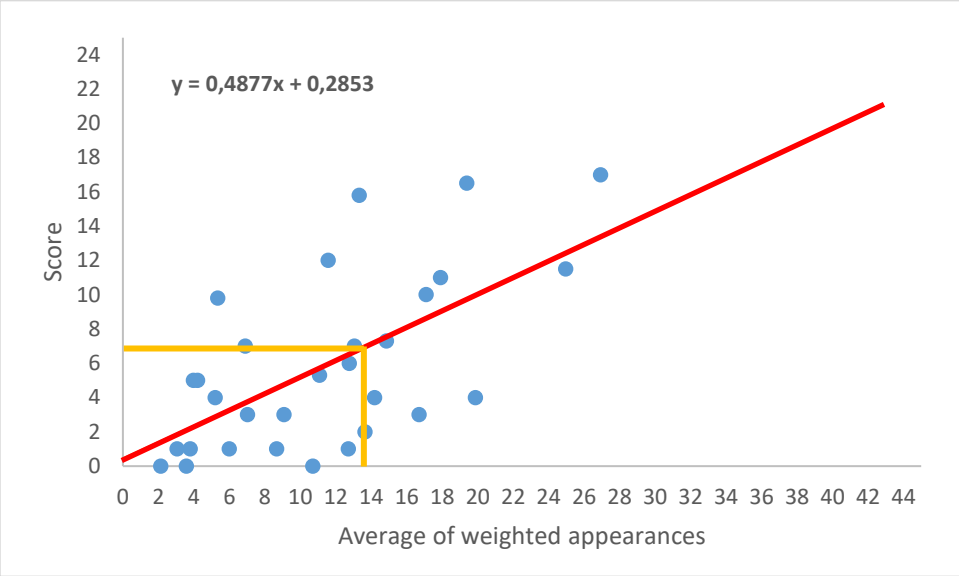
The regression line (figure 2) is the one that best interpolates the points of the dispersion diagram. It is the one that minimizes the sum of the squares of the distances of the points from the line (F. Casolaro, A. Fontana 2018).

The maximum score attainable by a National Team is 21 (victory of all matches in the regular time). The score will be obtained, according to our line, by a team with an x (Average of weighted appearances) of 42,5. With an x equal to or greater than 42,5 the score obtained will always be 21. The x can never take negative values. The angular coefficient of 0,49 indicates that for an increase in the Average of weighted appearances of 1 there is a growth of the score of 0,49. The vertical intercept of 0,28 indicates that a National Team with the Average of weighted appearances in major events for Club of 0 in our model reaches a score of 0,28 points.

At this point, by inserting the value of the Italian National Team (13,65) in the equation of the line, we calculate the score that according to our model it should have obtained (figure 3):

$$y = 0{,}28 + (0{,}48)(13{,}65) \Longrightarrow y = 6{,}94$$

Figure 3: The case of Italy



So Italy should have obtained a score of 7 (rounded up). This score is associated with combinations of different results, certainly better than those obtained by our National Team, but which in no case go beyond a complicated landing in the quarter-finals.

Only in one circumstance, the Azzurri could have overcome the quarter of finals, but this case turns out to be so fortunate and daring that we believe it is right, considering also the rounding up, to exclude it.

It may be useful to consider the score reached by the National Teams that had an Average of weighted appearances similar to that of Italy. Next to Holland (x = 13,32) which reached a truly remarkable result being eliminated in the semifinals on penalties and then beating Brazil in the final for 3rd / 4th place (y = 15.8) and to Russia (x = 13,65) which instead was surprisingly eliminated in the groups with 2 points (y = 2) we find Switzerland (x = 13,05) which exceeded the groups with 7 points and then was eliminated in the round of 16 from Argentina in the regular time (y = 7). The score of Switzerland is exactly the same as the one that, in our model, should have reached Italy and wanting to make an arithmetic average of the scores of the three National Teams, the score obtained is 8.2, so very close to the 7 estimated by us for the National Prandelli Team.

The choice of the line as a function is completely discretionary.

The line is the simplest and most intuitive model and it is, above all for this reason, the most used in educational applications. It is not absolutely certain, however, that it is the best to approximate the link between the variables taken into consideration in our analysis (A. Maturo, R.M. Contini 2010).

The coefficient of determination:

$$R^2 = \frac{\sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} = 0{,}4$$

in our opinion, indicates a good adaptation of the linear function to the observed data.

5. Conclusions

As can be seen, the results of the statistical analysis differ only insignificantly from the opinion expressed in the introduction, according to which Italy could not have done more.

With reference to the motivational aspect it is not superfluous to underline how, in continuity with the results of the World Cups from 2002 to 2014 where on three occasions out of four the defending champion team had been eliminated in the first round, also in the 2018 event, after the one taken into consideration in the analysis, Germany (winning team in 2014 and one of the favorites in the World Cup in Russia) was eliminated in the group stage.

As clarified in the work, the pragmatism of our model limits the consideration of the motivations to this single aspect that results however fundamental in the attainment of our statistical result; therefore we consider it appropriate to add sociological reasons among the pre-requisites of the decision analysis. (F. Casolaro, L. Paladino 2012).

And the social and psychological aspects were fundamental in the presentation of the model in some conferences concerning the teaching of Mathematics: 4° Convegno Nazionale *La Matematica nel 1° Ciclo: aspetti didattici, sociologici e interdisciplinary* Chieti, 06-09 aprile 2016 Università di Chieti-Pescara; X edizione Convegno di Geometria *Giochi matematici per la scuola premio "Aldo Morelli"*, Castellammare di Stabia 20-22 maggio 2016; 10° Convegno di matematica, Montesarchio 12 e 13 maggio 2017, Auditorium "E. De Filippo" Liceo "E. Fermi"- Ambito BN5.

Also, the rhetorical implications that are always identified in sporting events were fundamental in attracting the attention of students and teachers. While the students were fascinated by the possibility of using Mathematics for the analysis of interesting phenomena and integral parts of their passions, the teachers saw in the study the possibility of presenting even complex topics through more engaging tools.

Model improvements are achievable by considering other independent variables on the basis of which to determine the National Team's score value. This could be made to depend, for example, not only on the Average of weighted appearances in international Club events but also on the results achieved by the National Teams in the most recent events (we could consider the previous World Cup or the last Continental cup to which the team has taken part). However, it would end up in the field of multi-varied regression with all the complications related to a study of this type. Having the model purely didactic aims and not being oriented to the elaboration of a statistic with forecasting purposes, improvements of this type should be made only later and following a discussion activity that actively involves the students who, once learned the rudiments of bivariate regression, could subsequently approach multivariate analysis.

References

[1] F. Casolaro (2014). "Prandelli non poteva fare di più", Il Crotonese 12-08-2014: "I numeri non aiutano l'Italia".

[2] F. Casolaro (2014). "La Matematica del calcio: un corso made in Sannio", Il Mattino 18-06-2014

[3] F. Casolaro, L. Paladino (2012). "Didactics of Statistics in Sociology" - First International Conference on Recent Trends in Social Sciences: Qualitative Theories and Quantitative Models (RTSS) - Iaşi (Romania), 23-25 September, 2012.

[4] M. Squillante et. al, (2016). "The Logic of Probability: A Trip through Uncertainty". Science & Philosophy - Vol. 4(2), 2016,

[5] Mirray R. Spiegel (1994). "Statistica - 975 problemi risolti". Ed. McGraw-Hill.

[6] A. Maturo, R.M. Contini (2010), "Statistical and mathematical models for the analysis of educational processes in the intercultural school", WCLTA-2010 CAIRO, Procedia Social and Behavioral Sciences, 9, (2010).

[7] F. Casolaro, A. Fontana (2018). "I pre-requisiti essenziali per lo studio della Probabilità e della Statistica" – Quaderni dell'APAV n. 2 - 2018, pag. 45-52.

[8] F. Casolaro (2018). "Un approccio didattico all'insegnamento della Statistica" - Quaderni dell'APAV n. 2 - 2018.

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