# Validating alleged protective effect of Photonic Shield card on human organism during the exposure to 5G microwave radiation

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# Validating alleged protective effect of Photonic Shield card on human organism during the exposure to 5G microwave radiation

**Igor Jerman*, Jonatan Pihir*, Mateja Senica***

* Physiological Testing Department; BION, Institute for Bioelectromagnetics and New Biology, Ljubljana, Slovenia

**Abstract**:
The company PHOTONIC SHIELD LIMITED requested scientific validation of their product Photonic Shield, which allegedly protects the user from 5G microwave radiation. Validation was done via testing on human organisms following clinical research conditions. For testing, volunteer test subjects were exposed to 5G radiation while carrying a Photonic Shield card in their pocket (working (verum) or sham working (sham)).

The testing showed significant overall statistical differences (i.e., differences in p-value and Cohen's D) between the two test situations, where the test subjects were exposed to the same procedure and the same dose of 5G microwave radiation in both cases throughout the testing. Since the testing shows significant differences in the presumably shielded and unshielded situation, we conclude that the card has an effect on the human organism that compensates, at least to some extent, for the biological effects of 5G microwave radiation.

**Keywords**
Photonic Shield, physiological testing, physiological parameters, human organism, protective effect, 5G microwave radiation, clinical research conditions

** Peer reviewed article (see the reviewer’s conclusion in Appendix; the whole review is archived at the BION Institute).

# CONTENTS

# 1 INTRODUCTION

## 1.1 General

A fundamental research area at the BION Institute represents measuring the effects/influences of physically as yet undefined and unrecognized (subtle) field(s) or weak conventional fields in the resonant mode (Kernbach et al., 2013; Jerman 2021). Generally, ordinary measuring devices are not adapted to measure these fields. However, most frequently, even various unconventional devices, purportedly measuring the subtle field effects, are not yet capable of measuring this kind of field (influences) reliably enough, although the technology is steadily improving. For the most part, these fields and their effects cannot be explained by commonly accepted theoretical interpretations, even though some scientists have offered possible explanations ranging from the quantum vacuum and coherent fields to dark matter (see Kernbach 2022; Meijer et al., 2021; Jerman et al., 2009).

In more than 20 years of experimenting with various detector systems for subtle field's testing, including also electrophotography and plant germination (Berden et al.,1997; Ružič, Jerman 2002), the BION Institute developed an alternative path that makes it possible to use the *human organism* as a reliable detector of such weak or subtle influences (Jerman, Dovč, 2017). We learned how to express these detections via easily measurable general physiological effects monitored through physiological measurements (Jerman et al., 2019a, 2019b). During the development of the test system, which is based on the measurement of human physiological parameters, we tested various parameters, including HRV, skin electrical conductivity variability (VSC), and EEG. As HRV and VSC did not give us any added value, they were abandoned. However, we use EEG when testing effects primarily related to the head (as shown in the previously quoted articles) or at a specific request of the client. After all this experimentation and experiences, we can reasonably assess an alleged biological influence or non-influence emanating from products based on weak (subtle) impact. The latter may represent a stimulating factor or a protective shield against allegedly harmful environmental radiation.

## 1.2 5G network

5G is the fifth generation of wireless technology, and it is designed to provide faster speeds, lower latency, and more reliable connections than previous generations of wireless technology. 5G uses higher frequency bands than previous generations of wireless technology, which allows it to offer faster speeds and lower latency. These higher frequency bands are also known as millimeter waves (30 mm to 1 mm). 5G technology is currently being deployed in many countries around the world, and it is expected to become widely available in the coming years.

5G technology is considered safe for human use, according to the World Health Organization (WHO) and other organizations. There is no largely scientific evidence to suggest that 5G technology is harmful to the human organism (see also Bortosova et al. 2021).

However, “the available studies do not provide adequate and sufficient information for a meaningful safety assessment or for the question about non-thermal effects. There is a need for research regarding local heat developments on small surfaces, e.g., skin or the eye, and on any environmental impact” (Simkó et al., 2019). A certain number of scientists and researchers are concerned about the insufficiently tested use of high frequency GHz fields in terms of biological effects. In particular, they are concerned about possible long-term adverse effects (Havas 2019).

## 1.3 Specific

### 1.3.1 The object and background of testing

The company PHOTONIC SHIELD LIMITED requested testing of an alleged protective influence on the human organism against 5G microwave radiation (from now on 5G) for the product Photonic Shield (Figure 1). In addition to the already mentioned concerns regarding 5G technology, according to some research, microwave irradiation, in general, could have harmful biological effects, at least on mitochondrial function (see Hao et al., 2015). The customer claims that the product has a protective effect against 5G radiation, not in the sense of blocking the radiation itself, but in the sense of supporting the human organism to better compensate for the radiation impact. The product should have this effect via its subtle field emission that is difficult (though not impossible) to prove physically. He wanted these claims to be validated through a thorough scientific testing.
With a methodology grounded on clinical research conditions (see Portney, 2020; Lewith et al., 2010), we tested the alleged protective influence of the Photonic Shield by exposing volunteer test subjects to 5G microwave radiation while they carried Photonic Shield product in the pocket. Several physiological parameters (see Chapter 2.5) were monitored by the appropriate measurement protocol (Giannakakis G. et al., 2022).
In the testing, the question of the possible technical (physical) protecting capacity of the card was not tackled. The testing was concentrated only on the products’ alleged influence on the human organism so that the latter gains measurable support to physiologically combat the microwave radiation burden emanating from a 5G network.

### 1.3.2 Basic hypothesis

The general working hypothesis of the research is based on the view that if there is a shielding effect of the Photonic Shield card, the shielding situation should give a similar physiological response of the body as a control situation not burdened by 5G radiation. A protective effect can therefore be stated if the protective situation and the control situation have a similar physiological response, while to 5G radiation exposed situation shows a different effect, possibly also statistically significantly different from the first two.

# 2 MATERIALS AND METHODS

## 2.1 Material (objects, devices)

Photonic Shield card (Figure 1) produced by company PHOTONIC SHIELD LIMITED. The same-size plastic cards (artifacts) were used as controls (Figure 4, right). During the tests, cards of any kind were placed in cloth bags (Figure 4). Each test person had their own verum and their own sham card.


**Figure 1:** Photonic Shield card subject to testing

For measuring physiological parameters, an 8-channel Biosignalsplux device (PLUX Wireless Biosignals S.A. ) was used.

## 2.2 Testing principles

The manufacturer's claims are validated by testing based on clinical research principles. This means that the tests are:

- *prospective* (general criteria for the efficiency of the product's influence are determined in advance);
- *with placebo effect ruled out* (test subjects don't know whether they are exposed to the product's influence or not);
- *double-blind* (even the test assistant doesn't know whether it is about the exposed situation or the control one);
- *randomized* (the decisions about the order of different situations are made randomly).

## 2.3 Situations investigated in testing

The alleged protective influence of the Photonic Shield product on the human organism was tested by measuring the physiological parameters of test subjects exposed to 5G radiation. In order to determine whether there is any protective effect of the supposedly protective product, test subjects were assigned to *three different experimental situations,* in a random order for a test subject:

- exposure to the 5G radiation from a nearby mobile phone plus Photonic Shield: subject to a presumed protective influence of the named product (*5G&Photonic Shield situation*, Figures 2 and 3),
- exposure solely to the 5G radiation from the nearby mobile phone: detecting the influence of 5G radiation; a sham working plastic artefact applied simultaneously (*5G situation*),
- no exposure: detecting the influence of background radiation with no nearby 5G radiation source (the nearby telephone switched off) and with a sham working plastic artefact (*Control situation*).

**Figure 2:** Demonstration of the test session. Photonic Shield card or the control card is placed in the right pocket (not seen in this figure, see Figure 4). The mobile phone (switched ON or OFF) is located beside the test subject's head. After placing all the sensors on the test subject, the latter sat for 35 minutes while physiological parameters were measured.

**Figure 3:** Demonstration of placed sensors during the test session.


**Figure 4:** The Photonic Shield products (left) and control cards (right). During the testing, all the cards were placed in a cloth bag so that no one knew which one was currently in use.

## 2.4 Testing implementation and protocol

Tests were conducted from November 7 to November 18, 2022, at the BION Institute with 16 test subjects aged 49 to 75 (twenty females and four males). They were subjected to all three situations. Before the tests, the test subjects were instructed not to eat a big meal at least one hour before the test and not to drink coffee, alcohol, or energy drinks at least three hours before the test. The physiological parameters of each person were measured three times on three different days, every time at the same time of the day. This ruled out the effects of other factors as much as possible (e.g., the test subject could be tired after many hours of work but should be more or less at the same level of fatigue at the same time of day). Random order of both situations was applied to each test subject (the principle of randomization). Test subjects sat for 35 minutes in a comfortable wooden chair. During this time, physiological parameters were measured, as presented in Figures 2 and 3. The phone was placed near the test subject's head so that screen faced the chair (Figure 2). The Photonic Shield product (verum or sham) was placed in a cloth bag so that even the testing assistant did not know which card was currently in use (see Figure 4). The bag containing the card was placed in the right pocket of the test subject. Then the physiological measurements started. The first test assistant left the test subjects alone in the room. Immediately after, in the next room, the second assistant played a video stream on a laptop that was connected to a hotspot of a mobile phone in the testing room (tethered internet access) using a 5G network. The video stream was not played in the Control situation. The vast majority of the test subjects have long-term testing experiences involving various products and tend to be quite indifferent regarding various testing situations and the object of testing.

## 2.5 Physiological parameters

Measurements of physiological parameters by an appropriate device make it possible to monitor dynamic responses to any agent allegedly influencing the human organism in real time. By default, the following parameters were measured:

**Heart rate** (frequency of heartbeat, HR) is calculated from the electrocardiogram (ECG). Differences in heart rate speak about activities of the autonomous nervous system on its deep level in its two parts (sympathetic and parasympathetic).

**Muscle tension** (electromyogram, EMG) is measured on the right forearm. This parameter gives information about the state of the somatic system in terms of tension or relaxation. Besides muscle tension, the EMG shows any artifacts that could appear on the ECG due to arm movements.

**Skin conductance** (SC) is measured on the fingertips of the right hand, where it varies the most. Skin conductance measurements are part of lie detectors because both, sweating and blood flow affect it. Consequently, it is regulated by the sympathetic nervous system (see also Cowley et al., 2016; Boucsein, 2012). The latter is a part of the autonomous nervous system that is not under our conscious control, so we cannot regulate it just by simple intention. In general, skin conductance is higher when a person is under stress (more sweating, faster interior blood flow), but sometimes the response may be much more complex.

**Respiration rate** (RR) is calculated from thorax expansion (TE), where the latter is measured with a special extendable elastic belt. Similar to the heart rate, the respiration rate also speaks about the activities of the autonomous nervous system, only that it is under the possible partial influence of our consciousness.

**Finger temperature** (TEMP) is measured on the tip of the right-hand ring finger. The interpretation of differences in this parameter depends on the differences in skin conductance and demands thorough consideration. In ordinary cases, a higher peripheral temperature would mean a deeper relaxation.

## 2.6 Data processing

### 2.6.1 Capture and primary data analysis

After the measurement phase of the testing was over, the primary analysis of the data was performed. The largest outlier was removed so that the presented analysis of data and the outcome are based on 15 test subjects. The raw data procedure was as follows. The data with a sampling frequency of 1000 samples per second were imported into *Matlab.* Within *Matlab* the electrocardiogram (ECG) data were analyzed with the Pan-Tompkins algorithm (see Pan, Tompkins, 1985) from which the inter-beat interval (IBI) data was obtained. Heart rate was derived from IBI data. Analysis of the thorax expansion data gave us the respiration rate (RR). All data were then resampled to one-second intervals by averaging the inter-second data points.

The first five minutes of the measurements were cut since they correspond to the time needed for the test subject to calm down at the beginning of the measurements. Next, a geometric median of all test subjects was calculated for each measured physiological parameter. Two-time groups (marked as **Parts A** and **Part B**), each one 15 minutes in length, were selected. Geometric medians were then resampled so that each 15 min time window got represented in 15 steps. Afterward, the results were renormalized to an average of the first five minutes. This means the whole session was divided into two parts (A and B) and statistically evaluated for every parameter and each part separately.

### 2.6.2 Statistical analysis and evaluation

To check for the difference between all three test situations, the Friedman test was used to detect differences in treatments across multiple test attempts. Levene's test was used for equality of variances to check if there were any significant differences in data variability among all three situations. To check for the difference between both test situations, the Wilcoxon signed-rank paired test was used. The results of all statistical tests were corrected with the Holm-Bonferroni correction for multiple comparisons[1]. The

[1] Holm-Bonferroni correction is a method used to adjust the p-values of statistical tests in order to control the familywise error rate (FWER), which is the probability of making at least one false discovery (also known as a type I error) among all the statistical tests performed. This correction is used when multiple statistical tests are performed simultaneously on the same data set – a in our case, and the risk of making a false discovery increases as the number of tests increases.

results are estimated as significant if the p-value after the correction is below 0.05. If the p-value is between 0.05 and 0.1 and the absolute value of Cohen's D is above 0.5, then the result is considered to be significant as well. To decide if the influence of the tested card has an impact on human physiology in the presence of microwave radiation from a mobile phone, the outcome of the testing should have at least two statistically significant differences between the control and the protected (5G&Photonic Shield) situation on one side and the unprotected (5G) situation on the other side (after Holm-Bonferroni correction) in Parts A and B.

# 3 RESULTS WITH DISCUSSION

## 3.1 Overall statistical differences in physiological parameters

An overview of the Friedman test results demonstrates that there are statistically significant differences between the three experimental situations for all measured parameters except for respiration rate (RR) and finger temperature (TEMP) in Part A (Table 1a). The Levene test (Table 1b) shows significant differences in variability for the skin conductance (SC), finger temperature (TEMP) and in Part A heart rate (HR) and muscle tension (EMG). Additional comparisons between different combinations of situations were made in the post hoc tests (Wilcoxon signed-rank paired test), which revealed statistically significant and highly significant differences between medians in *Control vs. 5G* comparison and mostly in Part B in 5G&Photonic Shield vs. 5G comparisons (see Table 2).

**Table 1a:** Summary of the Friedman test corrected with Holm-Bonferroni correction for multiple comparisons (p-values). Values written in grey represent statistically insignificant differences between two experimental situations ($p > 0.05$), values written in magenta denote a trend, and values written normally represent statistically significant differences between at least two of the three different experimental situations ($0.001 < p < 0.05$), and the values written in bold a highly significant statistical difference ($p < 0.001$). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

| | HR | EMG | SC | RR | TEMP |
|---|---|---|---|---|---|
| Part A | 0.012 | 0.046 | 0.051 | 0.189 | 0.170 |
| Part B | **0.000** | 0.018 | **0.000** | **0.000** | **0.000** |

**Table 1b**: Levene test with Holm-Bonferroni correction. Marks are the same as in Table 1a.

| | HR | EMG | SC | RR | TEMP |
|---|---|---|---|---|---|
| Part A | 0.005 | 0.048 | 0.002 | 0.451 | 0.005 |
| Part B | 0.577 | 0.527 | **0.000** | 0.454 | 0.011 |

**Table 2**: Summary of Wilcoxon signed-rank post hoc test corrected with Holm-Bonferroni correction for multiple comparisons. Values written in grey represent statistically insignificant differences between the two experiment situations ($p > 0.05$), and values written normally represent statistically significant differences between the two compared experiment situations ($0.001 < p < 0.05$ or $0.05 < p < 0.1$ with absolute Cohen's D above 0.5), and the values written in bold a highly significant statistical difference ($p < 0.001$). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

| Comparison | Time | HR | EMG | SC | RR | TEMP |
|---|---|---|---|---|---|---|
| Control vs. 5G | Part A | 0.032 | 0.086 | 0.096 | 0.096 | 0.062 |
| | Part B | **0.001** | 0.086 | **0.001** | **0.001** | 0.014 |
| 5G&Photonic Shield vs. 5G | Part A | 1.000 | 0.032 | 0.240 | 0.219 | 0.240 |
| | Part B | 1.000 | **0.001** | 0.006 | **0.001** | **0.001** |
| 5G&Photonic Shield vs. Control | Part A | 0.023 | 0.750 | 0.026 | 1.000 | 1.000 |
| | Part B | **0.001** | 0.603 | 0.005 | 1.000 | 0.003 |

## 3.2 More detailed results per parameters

In the following, boxplot graphs are presented for each measured parameter belonging to all three situations and two measurement parts. The line inside the boxplot represents the median of normalized (to the first five minutes) average values so that all parameters may be directly compared.

Figure 5, presenting the normalized heart rate, shows that the 5G situation had an invigorating effect on the vegetative system. Since there are no differences between 5G&Photonic Shield and 5G situations, this parameter, does not demonstrate a protective effect of the Photonic Shield card on the human organism.

Muscle tension (EMG, Figure 6) clearly displays a protective effect in both parts since the 5G&Photonic Shield values are on the same side and very similar to the Control situation. Both situations are also statistically significantly different from the 5G situation. The latter shows an invigorating effect on muscle tension parameter.

For skin conductance (SC) in Part B, we can again see support for the protective effect of the Photonic Shield card (Figure 7). Again, as for muscle tension, 5G&Photonic Shield and the Control values are on the same side against the 5G. The latter shows again an invigorating effect in both parts in relation to the Control situation.

In Figure 8, which displays the respiration rate (RR), the overall outcome in both parts is very similar to muscle tension: the 5G situation shows an invigorating effect while the 5G&Photonic Shield and the Control situations are on the same side. In Part B, the 5G&Photonic Shield situation shows a high statistically significant difference from the 5G burdened situation. Again, it speaks in favor of a protective effect and reliably supports the working hypothesis.

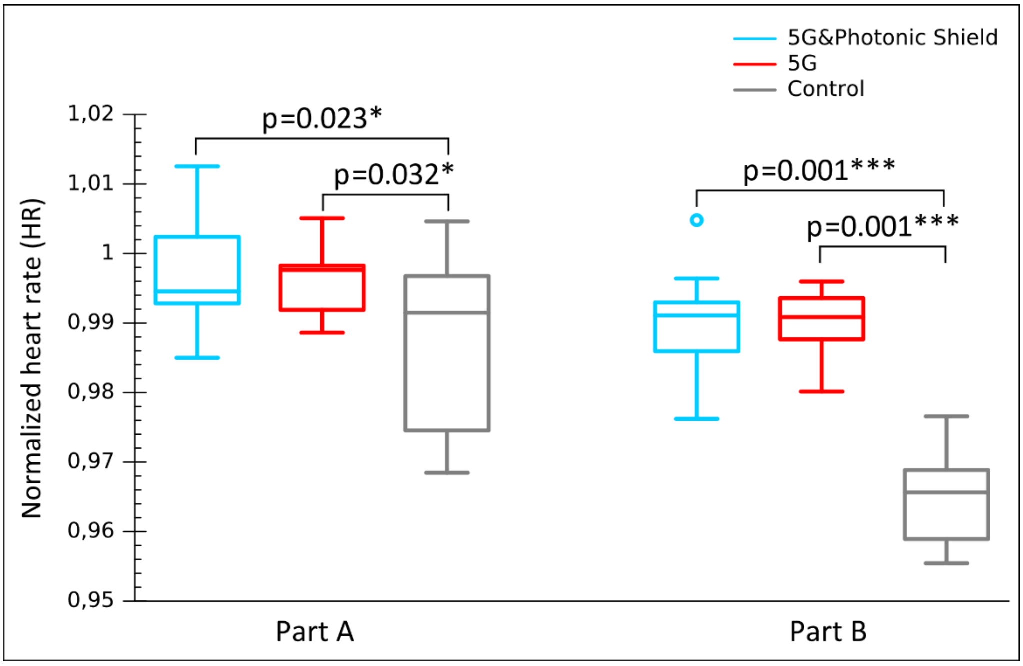


**Figure 5:** Normalized heart rate (HR) from the test subjects during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 15 test subjects. The single asterisk (*) marks a statistically significant difference between the two compared situations with $p < 0.05$. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

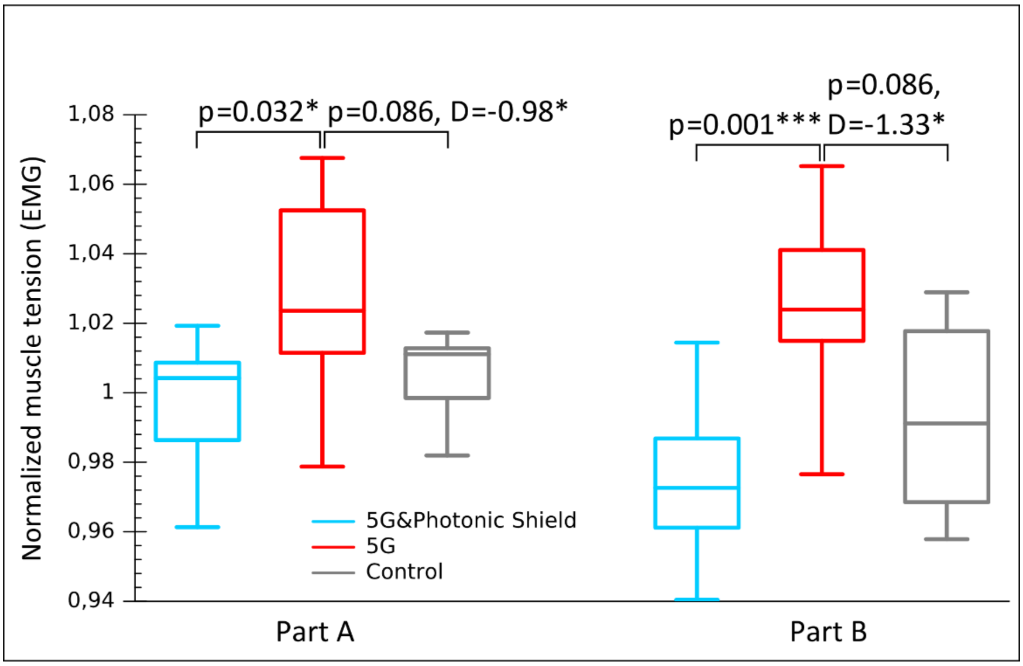


**Figure 6:** Normalized muscle tension (EMG) from the test subjects during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 15 test subjects. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$, or $p < 0.1$ with absolute Cohen's D above 0.5. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

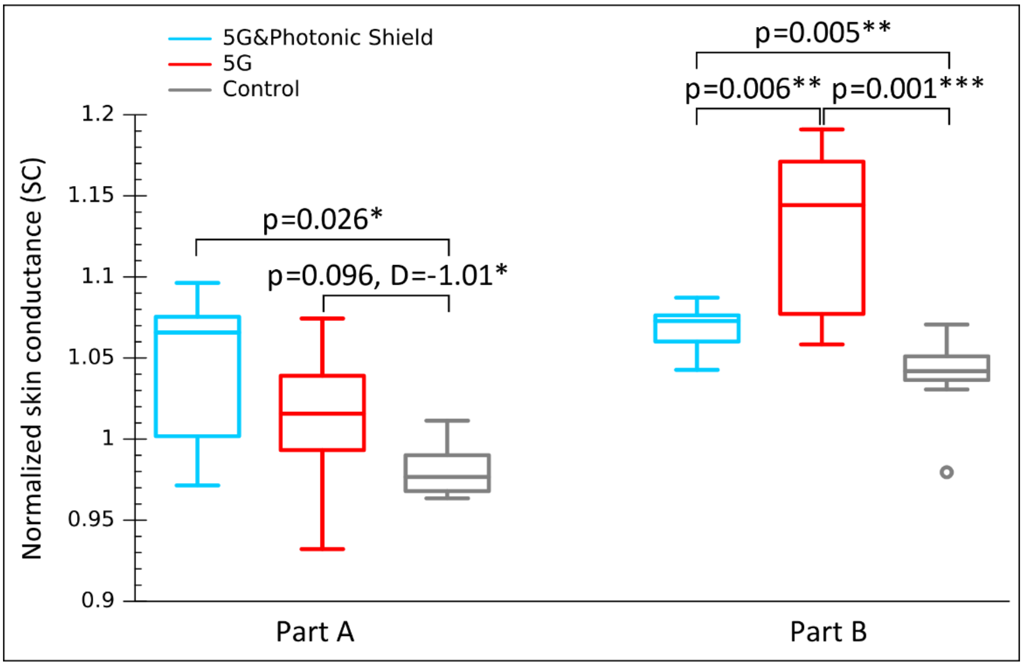


**Figure 7:** Normalized skin conductance (SC) from the test subjects during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 15 test subjects. The single asterisk (*) marks a statistically significant difference between the two situations with $p < 0.05$, or $p < 0.1$ with absolute Cohen's D above 0.5. The double asterisk (**) marks a high statistically significant difference between the two situations with $p < 0.01$. The triple asterisk (***) marks a very high statistical significance of $p < 0.001$.

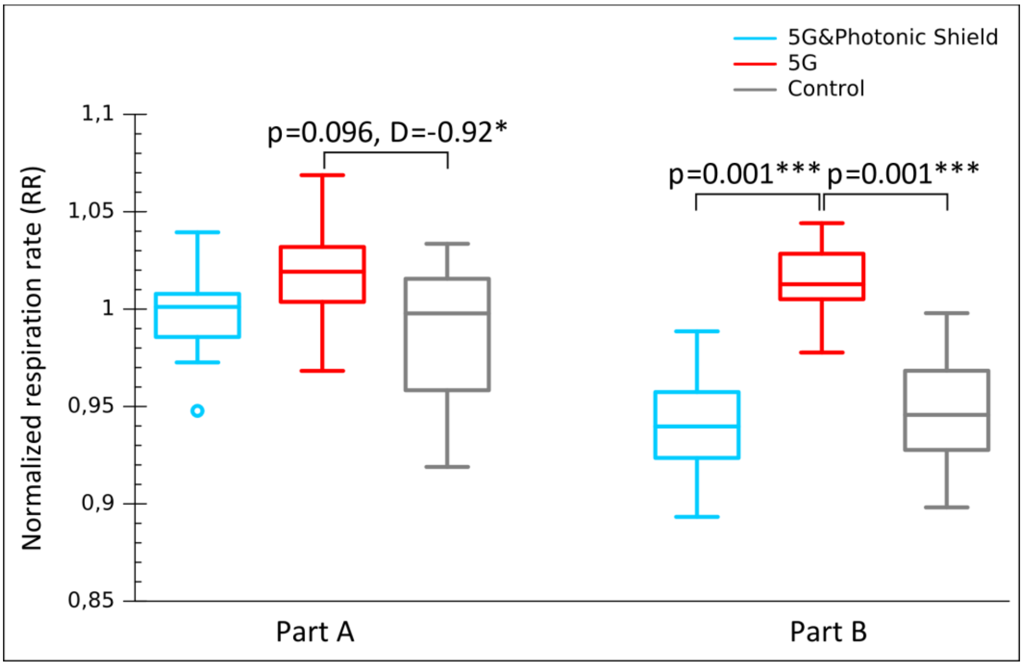


**Figure 8:** Normalized respiration rate (RR) from the test subjects during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 15 test subjects. The single asterisk (*) marks a statistically

significant difference between the two situations with p < 0.05. The triple asterisk (***) marks a very high statistical significance of p < 0.001.

Finger temperature (TEMP, Figure 9) shows a very similar pattern to the respiration rate. Especially in Part B, the differences again corroborate the protective effect of the Photonic Shield card, as the 5G&Photonic Shield situation is similar to the Control situation.

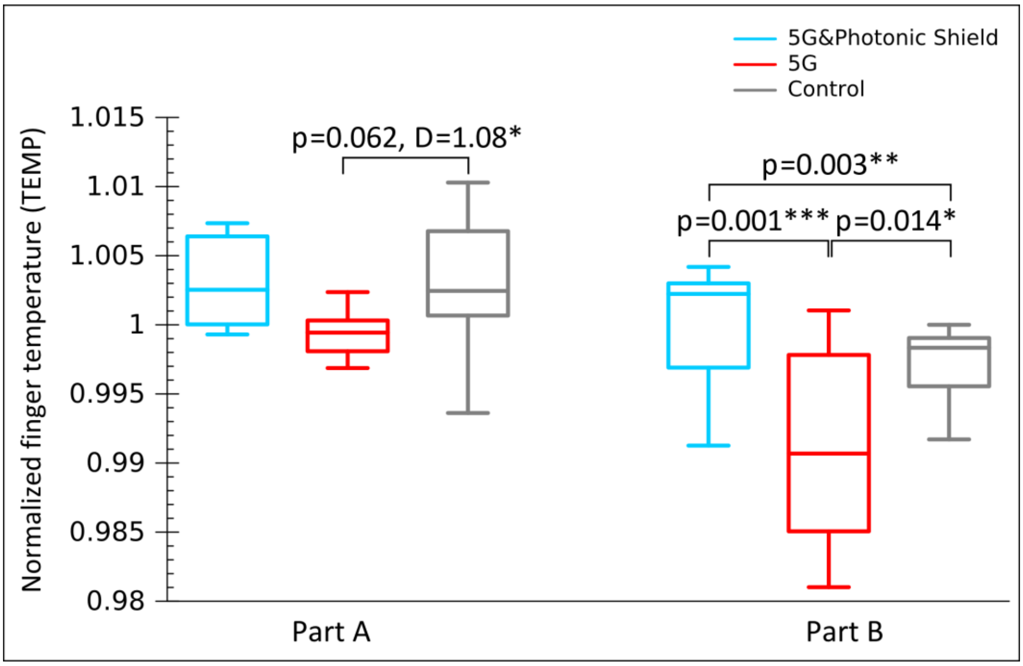


**Figure 9:** Normalized finger temperature (TEMP) from the test subjects during two parts of measurements for the three test situations. N = 15, each point taken from the geometric median of 15 test subjects. The single asterisk (*) marks a statistically significant difference between the two situations with p < 0.05, or p < 0.1 with absolute Cohen's D above 0.5. The double asterisk (**) marks a high statistically significant difference between the two situations with p < 0.01. The triple asterisk (***) marks a very high statistical significance of p < 0.001.

## 3.3 Standardized effective size

Besides the statistical difference in significance, we also calculated the standardized effect size (Cohen's D). Cohen's D value indicates the magnitude and direction in terms of the effect tested being greater or less than that of the control, from which a protective effect can then be inferred. For better understanding, we present the standardized effect size in colour coding for the intensity of the tested impact and its direction. The values for all parameters in both parts are presented in Table 3 below.

In accordance with the working hypothesis, Table 3 shows the similarity of the Control and 5G&Photonic Shield situations (compare the first row with the third and the second with the fourth; they both demonstrate the comparison of either 5G&Photonic Shield or Control to the 5G burdened situation). The same colours (direction of the effect) and shade can be seen except for heart rate (HR) and SC in Part A. The blue colour for EMG, SC, and RR and the red colour for the TEMP parameter indicate that the shielding effect maintained the state exhibited by the human body when *it was not under the burdensome influence of nearby 5G radiation*. The overall result, together with the significantly smaller deviation for SC and TEMP in the case of 5G&Photonic Shield situation compared to 5G situation (see Table 1b and Figures 7 and 9), strongly supports the protective effect of the Photonic Shield.

**Table 3:** Cohen's D effect size for the measured physiological parameters. Negative values (blue colour) signify that the first situation decreased the parameter compared to the second situation, while the positive values (red colour) signify an increase of the parameter. Underlined values indicate results where the difference between the two tested situations is statistically significant: $p < 0.05$, or $0.05 < p < 0.1$ with the absolute Cohen's D value above 0.5. Other values are not statistically significant, at least after the Holm-Bonferroni correction. The intensity of the background colour signifies the difference magnitude (an absolute value less than 0.2 indicates a *small difference*, an absolute value between 0.2 and 0.8 indicates a *medium difference*, an absolute value between 0.8 and 2 indicates a *large difference,* and an absolute value above 2 indicates a *huge difference*). **Marks**: HR – heart rate, EMG – muscle tension, SC – skin conductance, RR – respiration rate, and TEMP – finger temperature.

| Comparison | Time | HR | EMG | SC | RR | TEMP |
|---|---|---|---|---|---|---|
| Control vs. 5G | Part A | <u>-0.91</u> | <u>-0.98</u> | <u>-1.01</u> | <u>-0.92</u> | <u>1.08</u> |
| | Part B | <u>-4.35</u> | <u>-1.33</u> | <u>-2.13</u> | <u>-2.82</u> | <u>1.12</u> |
| 5G&Photonic Shield vs. 5G | Part A | 0.16 | <u>-1.24</u> | 0.74 | -0.84 | 1.44 |
| | Part B | -0.02 | <u>-2.32</u> | <u>-1.51</u> | <u>-3.06</u> | <u>1.50</u> |
| 5G&Photonic Shield vs. Control | Part A | <u>0.94</u> | -0.56 | <u>1.89</u> | 0.29 | -0.05 |
| | Part B | <u>3.71</u> | -0.79 | <u>1.52</u> | -0.10 | <u>0.78</u> |

# 4 CONCLUSION

Testing the effect of the product Photonic Shield on the human organism when exposed to 5G microwave radiation validates the assumed protective influence and corroborated the working hypothesis. It is substantiated by:

a) high overall statistical differences between the two testing situations 5G&Photonic Shield situation vs. 5G (see Table 2), wherein in both cases, the test subjects were exposed to the same procedure and the same dose of 5G microwave radiation.

b) the overall similarity of differences between the Control situation and the 5G&Photonic Shield situation against 5G exposure situation (see Table 3, first four rows and the discussion below). The similarity means that the 5G&Photonic Shield situation (therefore Photonic Shield influence under intensive 5G irradiation) yielded very similar results to the control situation that was not subject to such radiation. This is persuasively demonstrated by four of five parameters: EMG, SC, RR, and TEMP.

In addition to Table 3, the protective effect can also be seen in Figures 6-8. Here we can clearly see that the supposedly shielded situation subjected to 5G emission (blue box plots) has a similar value to the control situation (unshielded, but also without intensive 5G emission, grey box plots). The unshielded situation exposed to 5G radiation (red box plots) tends to be significantly different from the other two.

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