
Interdisciplinarity or Paradisciplinarity? A Reflection on Possible Collaboration between Scientific Disciplines

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When reading studies with large samples that employ psychological tests and multivariate methods of statistical analysis, such as the article by Petra Anýžová in this issue of the *Czech Sociological Review*, I usually wonder how convincing and valuable their results are. A range of similar research studies (not only sociological and psychological) have been published. Despite being based on large data sets with many hundreds and sometimes even thousands of respondents, such studies report relatively weak relationships between variables. The reflections herein are not just a response to the article by Anýžová, but were largely elicited by it.

I would like to emphasise from the outset that I do not consider such surveys to be methodologically flawed or executed incorrectly and I do not think that they should not be published. Studies similar to Petra Anýžová's are based on a large data set acquired from a sample that is close to a random population sample, analysed using sophisticated methods, and interpreted in accordance with recognised psychological theories. Still, I feel something is amiss. Although these studies produce statistically significant results, they do not seem to contribute substantially to psychological knowledge. As someone who is not a sociologist, I don't dare to judge if these studies contribute anything substantial even to sociological knowledge.

Before discussing in detail the contribution of Anýžová's article to psychological knowledge, let me briefly summarise its key points. The article presents a quantitative study whereby the author attempts to unravel a relationship between the values of the Schwartz system and the personality traits from the Big Five model against four other variables (age, gender, attractiveness, and cognitive abilities). Looking at Table 2 in the article, we find that an analysis of a sample of almost 2200 respondents resulted in a statistically significant correlation of 0.042 between Benevolence and Neuroticism, the maximum correlation coefficient being 0.348 (between Openness to Change and Extraversion). This number tells us that about 12% of the variance of the two variables is shared.

In the subsequent analyses, the author uses a generic structural model to examine reciprocal relationships between personality traits and values, a value

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being further predicted by age and gender, and a personality trait predicted by attractiveness and cognitive ability (see the article for details). Combining four value dimensions and five personality traits, twenty models are estimated and interpreted.

In search of the meaning of reported relationships

I do not want to comment here on all the results reported in the article—I selected only the closest relationships to illustrate a problem with the interpretation of the results from a psychologist's point of view. I will slightly simplify matters by adhering to a possible causal interpretation of regression coefficients in the model, even though I have doubts about that. First, I will discuss the model that contains the highest absolute values of the regression coefficients—that is, the model with Conscientiousness (personality trait) and Openness to Change (value).

As shown in Table 3, attractiveness seems to have slightly increased Conscientiousness, cognitive abilities seems to have no effect on Conscientiousness, age could slightly reduce Openness to Change (this is slightly lower among women compared to men). However, the fundamental finding in this particular model is the reciprocal relationship between Conscientiousness and Openness to Change. Although the correlation between these two variables (see Table 2) is only 0.091 (about 0.8% of the shared variance), the result of the model estimation suggests that Openness to Change could reduce Conscientiousness with a standardised regression coefficient of -0.784, and Conscientiousness could increase Openness to change with a standardised regression coefficient of 0.700.

Although these regression coefficients seem impressive because they amount to a high percentage of variance accounted for in both directions (about 61.5% in one and 49% in the other, which adds up to more than 100%, so a straightforward interpretation is not possible), can we imagine the psychological processes underlying these relationships? If these coefficients describe a realistic reciprocal relationship between Openness to Change and Conscientiousness, we should be able to carry out a thought experiment where an increase in Openness to Change would lead to a decrease in Conscientiousness (because the relationship is negative), this decrease in Conscientiousness would lead to a further decrease in Openness to Change (because the relationship is positive), which would in turn lead to an increase in Conscientiousness and then again to an increase in Openness to Change, thus closing the circle. Does this mean that values would fluctuate up and down constantly? Mathematically, this cannot be the case because the absolute values of the regression coefficients are less than one, so these numerical series are bound to converge at some point.

I attempted a simulation of this relationship in ten iterations where I used the results described above as coefficients for changing the standardised values of both variables. For the sake of simplicity, I omitted the influence of demographics and prediction errors—this is merely a game with numbers. These num-

Table 1. Iterations of the reciprocal relationship between Openness to Change and Conscientiousness

	Openness to Change	Conscientiousness
i0	0	0
i1	1	$0 + (1 - 0) \times (-0.784) = -0.784$
i2	$1 + (-0.784 - 0) \times 0.700 = 0.4512$	$-0.784 + (0.4512 - 1) \times (-0.784) = -0.3537$
i3	$0.4512 + [-0.3537 - (-0.784)] \times 0.700 = 0.7524$	$-0.3537 + (0.7524 - 0.4512) \times (-0.784) = -0.5899$
i4	$0.7524 + [-0.5899 - (-0.3537)] \times 0.700 = 0.5871$	$-0.5899 + (0.5871 - 0.7524) \times (-0.784) = -0.4603$
i5	$0.5871 + [-0.4603 - (-0.5899)] \times 0.700 = 0.6778$	$-0.4603 + (0.6778 - 0.5871) \times (-0.784) = -0.5314$
i6	$0.6778 + [-0.5314 - (-0.4603)] \times 0.700 = 0.6280$	$-0.5314 + (0.6280 - 0.6778) \times (-0.784) = -0.4924$
i7	$0.6280 + [-0.4924 - (-0.5314)] \times 0.700 = 0.6553$	$-0.4924 + (0.6553 - 0.6280) \times (-0.784) = -0.5138$
i8	$0.6553 + [-0.5138 - (-0.4924)] \times 0.700 = 0.6403$	$-0.5138 + (0.6403 - 0.6553) \times (-0.784) = -0.5020$
i9	$0.6403 + [-0.5020 - (-0.5138)] \times 0.700 = 0.6486$	$-0.5020 + (0.6486 - 0.6403) \times (-0.784) = -0.5085$
i10	$0.6486 + [-0.5085 - (-0.5020)] \times 0.700 = 0.6441$	$-0.5085 + (0.6441 - 0.6486) \times (-0.784) = -0.5049$

Note: The values are deliberately reported with a larger number of decimal places than is customary (meaningful) so that readers can recalculate the process if they wish. The entire calculation was performed in MS Excel.

bers, however, emerged from real analysis and the author is trying to interpret the results fairly, and so am I. At the beginning (i0), our hypothetical respondent has average values of both variables ($z = 0$). Let us assume that something happens that results in an increase of his Openness to Change by one standard deviation (in line i1 the value of Openness to Change is 1). For example, this individual could get a good offer or experience something very positive that could change their view of the values. What happens to the value of Conscientiousness? If we use a simple regression relationship where the difference between the latest and the previous value of Openness to Change is added to the previous value of Conscientiousness (0 in point i0; here at points i1 and i0—i.e. $1 - 0$) multiplied by standardized regression coefficient expressing the influence of Openness to Change to Conscientiousness (-0.784), we get the same number in this iteration (-0.784) as the new value of Conscientiousness.

Our simulation, however, cannot end at this point because we know that Conscientiousness increases Openness to Change. Therefore, we need to add the difference between the latest and the previous value of Conscientiousness (here at points i1 and i0; i.e. $-0.784 - 0$), multiplied by a standardised regression coefficient to express the influence of Conscientiousness on Openness to Change (0.700), to the latest value of Openness to Change in point i1. Owing to the increase in Openness to Change in the previous step, there is a decrease in Conscientiousness, the value of this product is negative, and Openness to Change decreases in step i2

from 1 to 0.4512. When we repeat this process, the values of both variables change only in the third decimal place after ten iterations, and later they do not change at all. In other words, the two number series converge.

It is of course possible to insert any increase or decrease of Openness to Change and any initial value (not just average) and observe how the two values stabilise gradually. The values in Table 1 suggest that if Openness to Change initially increased by one standard deviation, a further increase in this value dimension would ultimately be from 0 to about 0.45 in standard deviation units, and Conscientiousness would fall due to the reciprocal relationship with Openness to Change from 0 to about -0.51. These are changes that are considered clinically relevant in psychology or medicine, for instance. They are, however, based on a very weak association between the two variables, as mentioned above (-0.091).

For the purpose of comparison, let us present an analogous simulation of the reciprocal relationship of Openness to Change and Extraversion—these two variables show the closest mutual linear relationship with a correlation of 0.348 (approx. 12.1% of the shared variance). According to the structural model, Openness to Change increases Extraversion with standardised regression coefficient of 0.180. On the other hand, Extraversion increases Openness to change with a coefficient of 0.176. If we create the same sequence of steps where the standardised values of both variables are initially zero (i.e. average) and we increase Openness to Change by one standard deviation, the process results in Extraversion increase of 0.180 and this leads to further increase in Openness to Change from the increase in Extraversion in the previous step multiplied by a regression coefficient of 0.176, and so on. We reach a convergence of the two series of values in the fourth step with the value of Openness to Change stabilised at 1.0327 and the value of Extraversion being 0.186.

The need to appreciate the complexity of relationships

How to interpret these two simulations? For the originally very weak negative relationship between Openness to Change and Conscientiousness (-0.091), we can see that a relatively large increase in Openness to Change would be considerably weakened (from 0 to only 0.65 instead of 1) by reciprocal relationship, and there would also be a relatively large decrease in Conscientiousness (from 0 to -0.51). On the other hand, for a rather weak positive relationship between Openness to Change and Extraversion (0.348), an initial increase in Openness to Change would even be slightly increased (from 0 to even 1.03 instead of 1) and Extraversion would increase from 0 to about 0.19. We can therefore see that the values of the regression coefficients from the abovementioned study are difficult to interpret when it comes to reciprocal relationships. We can see that a relatively strong positive relationship was weakened significantly and the initially very weak negative relationship became relatively stronger.

I am aware that my simulations are probably a very idealistic attempt to

explain the results that emerged from Petra Anýžová's study. First of all, the uncertainty that is present in all regression relations in sociology, psychology, and related sciences is not incorporated; second, all twenty models that the author estimated separately should be interconnected, making the entire simulation even more complex, and the resulting values would consequently be different. However, the question of the meaningfulness of such simulations remains open.

In search of the meaning of the variables

The considerable generality of the variables examined casts even more significant doubt on the interpretability of results such as these. Personality traits capture relatively general tendencies in people's experience and behaviour. The behaviour of two extraverts can vary considerably, depending on other characteristics, not just other traits from the Big Five model but also intellect, education, the culture the extraverts come from, and interests. The same applies to other personality traits as well as value dimensions. What does it mean that an individual is open to change or, conversely, conservative? In some people, extreme Openness to Change can be reflected in a search for innovative solutions to scientific problems or artistic outbursts. In others it may lead to an openness in relationships, experimentation with drugs, or ingenuity in the violation of rules and laws. Conversely, strong Conservatism can be manifested as great moderation, self-sacrifice, or extremism, or even as the violent assertion of the 'right' values.

Thus, if we find that more than 2000 people have statistically significant correlations slightly above 0.2 between Benevolence and Universalism on the one hand and Friendliness on the other, or a correlation slightly above 0.3 between Stimulation and Extraversion, does this tell us anything more substantial about these people, anything other than what is already known from many previous studies? Does this say anything about society?

The descriptive statistics provided by Anýžová could be very interesting for the authors of the questionnaires used in her study, as the study specifies the distribution of the values of individual scales in the population. I see the potential for a significant contribution to psychological research in this information. However, a meaningful assessment of value orientations based on Extraversion or Neuroticism and based on established relationships is probably not possible.

Interdisciplinarity or paradisciplinarity?

The reader may ask now, okay, he explained why such research does not generate useful results, but what is his reasoning good for? I need to reiterate here that I am not responding to Petra Anýžová's article because I think it is poor in methodological or general scientific terms. I do not consider myself an arbiter of scientific research quality in other disciplines. I would like to evaluate it mainly

within the limited range of my own research interests in psychology. I am looking for an answer to the question of how to conduct research that is not only paradisciplinary but truly interdisciplinary.

In my opinion, neuroscience and psychiatric research today represent real interdisciplinarity with psychology, because answering research questions that are at the boundaries of both (or all) of these disciplines requires using appropriate psychological methods based on relevant theory. In other scientific disciplines this is often not the case. We sometimes find that psychological method is being used somewhat mechanically or is not justified very well and the interpretation of the results does not link the two scientific disciplines, which results in their working 'para', separately, or in a side by side fashion, and not in the manner of 'inter'—together or across.

I could certainly mention studies I consider to be more problematic cases of (mis)using psychological knowledge in other disciplines than the one I am reacting to here. In general, psychological methods or knowledge have recently been employed in a number of scientific disciplines, including those with a tradition of using them (neuroscience and psychiatry), but recently also religion, behavioural economy, human biology, toxicology, and many others. I am therefore afraid that the number of paradisciplinary studies will continue to increase in the future.

One possible cause of this situation is that scientists are sometimes challenged or directly pushed towards interdisciplinarity by those who are in charge of research funding. In other cases we are simply tempted by our professional or collegial overlaps—either we are interested in some issues from a related field or we find common interests in debates with colleagues from other scientific disciplines. Sometimes an existing instrument or technology from another field, such as a device or software, could help to solve a problem. Interdisciplinarity is therefore a naturally occurring need or circumstance in research. That is why, when planning a study, it is desirable to try linking two (or more) disciplines to seek out as many common themes and concepts as possible in communication with experts in a given field.

I do not know whether the readers of these comments share my suspicion that some research that aims for interdisciplinarity (interconnecting scientific disciplines in order to increase knowledge in both or all of them) is in fact paradisciplinary, meaning that the different disciplines do not contribute to each other. I believe, however, that we should discuss how to change this situation. Perhaps these comments will contribute to this discussion.