



UEFDSA newspaper

Joensuu/Kuopio

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ZERO BITCOINS



Sunny spring days

This issue is late, sorry about that.

After spending a couple of months in the dark abyss sleeping like a bear during winter, it is nice to see sun shine and to get some energy. For example, I stopped at the Joensuu central hospital to take the cover photo of this issue.

Regarding the contents of this issue I wish to say some positive words and thank all the authors and photographers. In particular

Szabi, thank you for DOGs, ROCKs and WOODs. It is a collection of interesting stories.

In this issue, we have academic and scientific texts from **Ari J. Tervashonka**, **Chloe Wells** and **Maryam Samavaki**. I wish you all success.

Jari Turunen, thank you for the space photo "Stairway to Heaven" hidden in the document. (Jari's recipe for photography enthusiasts: Pentax K-1 II + Irix Blackstone 15 mm F/2.4, ISO 3200, 30 seconds, internal Astrotracer and long-exposure noise reduction turned on.)



Figure 1: Step-by-step, I am becoming a natural Santa Claus.

Quantitative Biology Journal Club

- **WHAT** A journal club, to discuss research papers using quantitative approaches to tackle biological problems
- **WHO** Whoever thinks numbers are important regardless of career stage, research discipline
- **WHY** Because numbers are important in life sciences
- **WHEN** Every other week, starting November 20th at 2pm
- **WHERE** [Online Microsoft Teams Meeting](#)
- **How** Register to the [mailing list](#) (by sending an email to sylvain.tollis@uef.fi)
 Receive the paper(s) to discuss;
 Read the paper(s), or not!;
 Come with open-mindedness!
 Propose new papers to discuss

Creation of theory — Series part I

Nihilistic elements and despair of theory creation

Ari J. Tervashonka

Philosophically and scientifically the act of theory creation stems from the intellectual need to formalize ideas in a new way. The novelty aspect and sometimes luck determines the effectiveness of the theory and the argumentative spread of the work put into this theory. Sometimes only novelty for theory is that everything clicks in such a way that people understand old ideas in new unison. Theory creation is creative, an intuitive systematic act that in many cases, displays not only the intellectual position of the originator of the theory but also demands a new form of consolidation of facts. In this scope, every new theory is characteristically opinioned voice of cumulated arguments. The only way of knowing which ones are good and bad is the test of time and basically social luck on scientific reception of the theory. Depending on fields of study different rules are applicable, however, in many cases there is need for creative collaboration, intuitive processes, extended periods spent on the work, fundamental problems that carry the novelty along, and years of intellectual preparations.

Sometimes it is a pure miracle that people have the time and guts to finish theories, despite lack of help, arduous situations in a scientific field, a large wall of opposition, cynical disbeliefs conveyed not by the weight of arguments but mostly out of spite. The modern way of publishing doesn't either support the making process of truly substantial theories. If one is lucky, University might support this theory work despite that it is always a risk in terms of time management and for the amount of publications. In many cases, all manner of suboptimal demands hinders the theory creation. Still, theories are carried over and conveyed by scientists and philosophers. Albeit this is easier to be justified in fields of mathematics and theoretical physics, even in these theory intensive fields bigger unification theories are very hard not only do but also to convey reliably. Sometimes matter of opinions, scientific trend fashions and other nonsensical factors can affect the understanding of theories and impair the reception of it in a scientific setting. Sometimes theories can become corners of differing views ostracizing theory makers. Because of these social factors making of theories includes scientific, societal risks that are not, in many cases, justified nor healthy for the development of science.

Despite these hardships, many intuitive people convey their ideas in theory form. Vast intellectual enjoyment of developing systematic explanations and seeking novelty through hard fundamental work in science is what despite everything helps theoreticians to continue these contributions. Historically many theories have been more understood after decades of use and alternatives, sometimes sadly after

the passing of the original maker of the theory. In many cases, theoreticians have forwarded humanity in this way. These difficulties are essential to note at the beginning of this subject because theory creation is not only working on the issue but can also be consistent hardship that can hinder the whole process of creation and reception of theories.

In my research on Oliver Heaviside and his sense of academic community¹, the feeling of struggle was self-evident after reading decades of his work. Heaviside was academically oddity in 19th century Britain without having academic education. Despite this, Heaviside contributed over a thousand pages of academic publications, formulated James Maxwell's electromagnetic equations from quaternion form to vector analysis form that we use even today. His arch type of hermit style of theory creation was in many ways similar aspect that a lot of theory makers have used. To enclose themselves from the hustle and bustle of now, theoreticians can act in reclusive ways to balance the needs for the dedication and cut systematically many non-helpful aspects from their lives to be able to achieve work-intensive theory creation. Even today, this is one of the most popular strategies to survive most of the adverse side effects that come with the theory creation.

Nevertheless, theoreticians still need science community around themselves to provide alternative arguments and thus polish their works. Even extreme examples like in the case of Heaviside quality responses were highlights of his arduous work. It is a delight to see how otherwise a very cynical person transforms to very open and humane person when replying to letters that contain valuable, constructive criticism.

At the end, the act of building theory is long term quest of revealing systematic notion on the part of the world. Half of this endeavour is to formulate an understanding of the subject with immediate connectivity to present and future states of human minds. Sometimes it has taken months, sometimes decades or even multiple lifetimes to polish theory and broaden it to new areas. Barely even the creator of theory wouldn't assume how large spread their theory would cover in future. In the case of Heaviside, vector analysis became later the norm in place of quaternion calculation. Heaviside's transformation of Maxwell's original 20 equations to vector form helped the spread and place of Maxwell's theory in science. He did most of this work alone without much of input from a larger audience.

In this following series, we will venture on different theory creation themes by philosophers, natural philosophers, and scientists. The point of the series is to convey various aspects of theory creation processes to scientific audience and writers. Theory creation is a very individualistic work process that can have a very weighted signature style of personal research. To understand different sides of theory creation, this series will discuss some aspects of the act of theory creation and explain these through historical examples. If you want some specific theory to be analysed, please send a request to UEF DSA Newspaper staff.

¹ <https://hybrislehti.net/akateeminen-osallisuus-viktoriaanisen-ajan-englannissa-oliver-heaviside->

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We call for all the scientific essays, unpublished abstract papers, philosophical writings, and summaries or research with the authors' name on it. If you are a member of DSA, staff member of the UEF or otherwise interested in themes of science and philosophy you can submit your paper in all these categories. We will start our science paper in the following UEFDSA Newspaper issues. Do you want to publish more general material? Do you wish to fatten your writer portfolios? Now there is a great chance to do that and also let other people actually know about your research.

One reason for this call of papers is to promote doctoral students and researchers alike for the wider audience and also promote the constant effort that we do during the doctoral studies. We also want to open this forum for methodological development and general scientific reference frame development that requires more philosophical reach than many of the peer-review papers would allow. This includes also themes that are still within the realm of speculation and try-out phases. Send papers to aritervashonka@hotmail.com for the edit.

Science categories will be

- I. Scientific essays
- II. Philosophical writings
- III. Summaries of research
- IV. Abstract papers
- V. Methodological essays
- VI. Book reviews
- VII. Research reports

Freedom for the scientific essays!

Ari J. Tervashonka – Science series editor in chief

Call for Papers

The Journal of Methodology, *Metodologia*, is a peer-reviewed journal published by the Finnish Methodological Society, which seeks to further methodology and scientific philosophy in all fields of science. It aims to foster the spread of methodological articles that have been published nationally, to develop the methodological know-how in Finland, and to provide a platform for writers to advance themselves as producers of scientific works.

Metodologia publishes scientific contributions related to methodology, philosophy of science, and interdisciplinary methodological subjects. The range of publication formats comprises peer-reviewed articles (theoretical and empirical), essays (peer-reviewed or non-peer-reviewed), book reviews, scientific statements on science and policy, discussions, and doctoral thesis lectures. Essays differ from theory articles since they are primarily meant for speculative theorizing on methodological problems while theory articles address methodological theory or practical methodology. The publications are both in Finnish and English.

Our journal adheres to the principles of open science. Through our extensive peer-review process, we publish high-quality articles and essays. To find out more, please visit our homepage: [Peer Review Process](#)

In the spirit of open and free science, our journal does not adhere to strict themes or too limiting thematic constraints for publications. Proposal for publications can therefore be submitted electronically at any time. They can either take the form of a concise abstract of approximately 600 words or a transcript in its early or final stage. We do not set time limits for our writers for the initial transcript, as thorough and high-quality transcripts require time.

Proposals can be sent to journalofmethodology@gmail.com

Additional information on our journal, submission and writing guidelines, or peer review process is available on our homepage <https://www.journalofmethodology.com> or by contacting journalofmethodology@gmail.com.

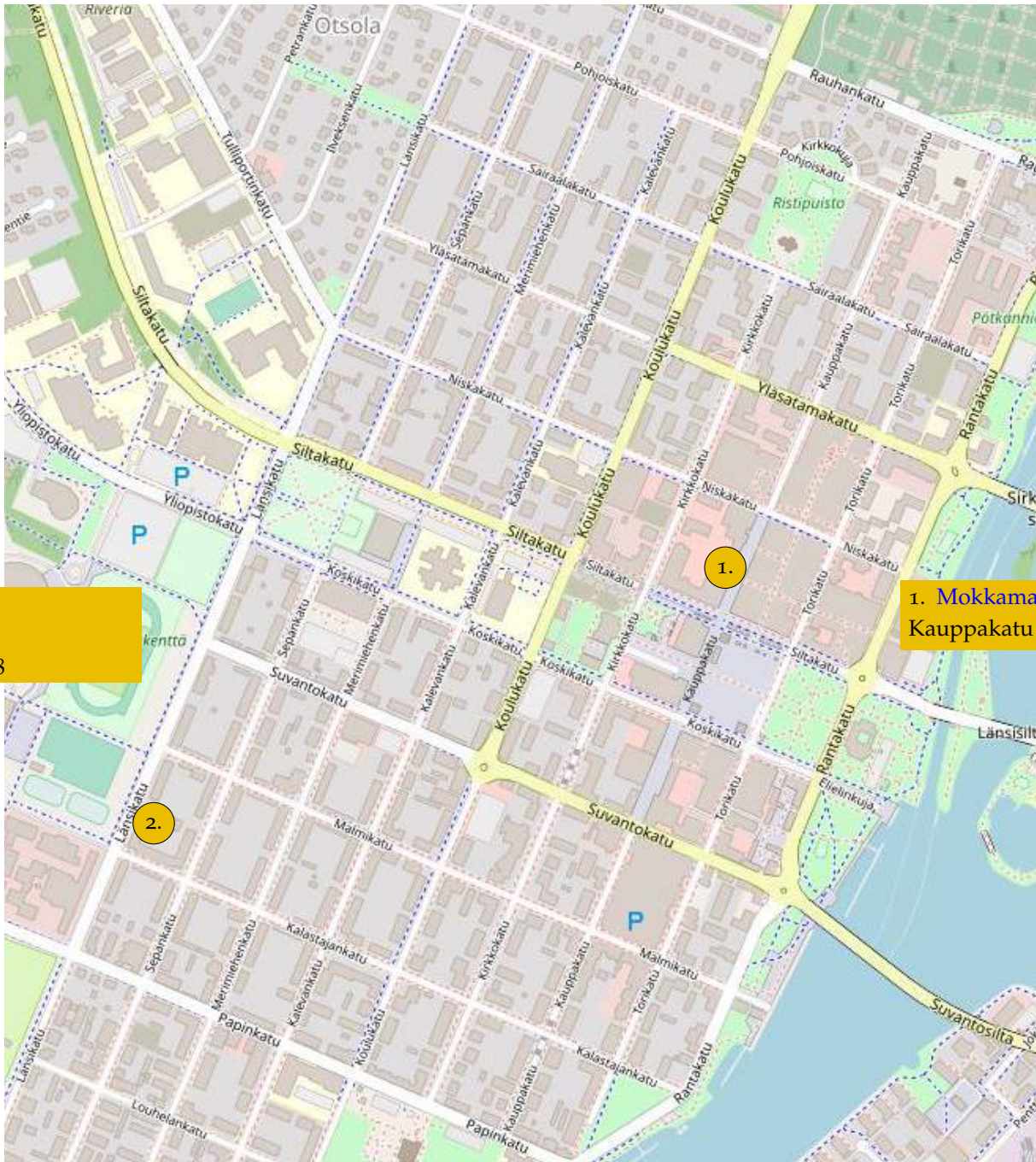
We are looking forward to receiving your publication proposal!

The publishers of *Metodologia*

Places in Joensuu

UEFDSA recommends these places in Joensuu.

Suggest more places to uefdsa.editingoffice@gmail.com



2. Gaude pizzeria
Länsikatu 18

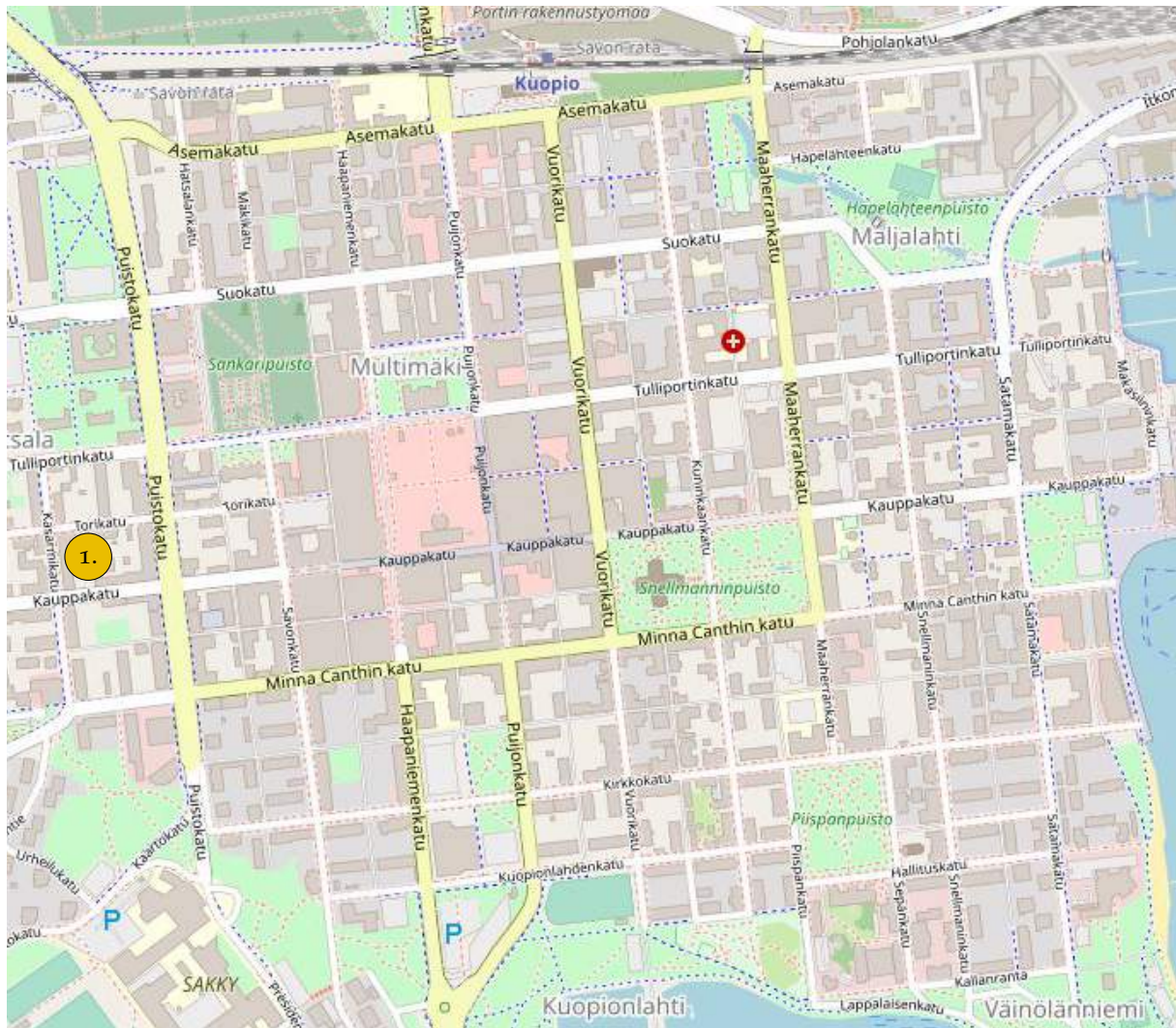
1. Mokkaaa
Kauppakatu 25

Places in Kuopio

UEFDSA recommends these places in Kuopio.

Suggest more places to uefdsa.editingoffice@gmail.com

1. [Bierstube](#), Kasarmikatu 57



DOG_s, ROCK_s & WOOD_s

WHEN YOU THINK
OF MIDDLE OF
(K)NOWHERE,
WHAT DO YOU
THINK
FIRST?

Slogan of University of Eastern Finland ?

Puijo and its tower
reaching
defiantly skywards?

Of forbidding rocks
in lakes around?

NO MATTER of your
answer(s) if you are outdoor
lovers, then Kuopio is the
perfect choice for you,
where you have the opportunity to
immerse yourself into
breathtaking domains.

The magic of walking routes in wilderness
areas reside in experiencing the unknown
while receiving benefits to be close to city,
to your health such as fresh air and calming surroundings.



Thanks to be in the **middle of Knowhere** we should not even think about to take a **break from the rush of our daily lives** -like people in bigger European cities- **to reach NATURE...** we just simply should walk/bike 😊 to enjoy the beauty and peace of being in natural setting around us.

AND **FINNS** living here do so a lot, you might remember my last blog about [DOGS, BIKE, and sauna](#).

They **do like to BIKE and WALK**, often with their **DOGS**, but did you know that the [oldest WOOD was named after a husky](#) and found at Nordic, aged over 9000 ys? Or even [Dogwoods](#) exist ;)

Many interesting stories...

Hereby I would like to bring forward my own story from Kuopio.



You might think that in the middle of nowhere, less than 400 kms from arctic circle we have darkness in winter. But in fact, we have light all year round. Just different kinds of lights... Between late November and February, the sunshine doesn't fall in the necessary angle against us, so we can't even feel the warmth of sunlight against our jacket... Instead, we carry out many cloudy, dark days (possibly depending on our mood). But sometimes we have blue sky in these days, when temperature drops well below minus twenty Celsius /-10 F°/... than we have sunlight, however still from below the horizon, which is reflected and scattered in the sky. I love these colors: "The blue and white, are the colors of freedom" ([Jukka Kuoppamäki](#), 1972), and short pale blue moments with snowy scenario at mornings and early afternoons.

Thanks to arctic weather we had last week, I enjoyed these beautiful scenarios and visited our giant woods, the President, again... I still remember the wonder I felt when I first saw the giant trees in the city of Kuopio, the President and the Admiral in '98, when I was first visiting the Venice of the North. I simply could not believe that the place they grew was truly only a few hundred kilometers from the Arctic Circle, where the trees are mostly stunted evergreens... So, I let my mind wander along with my body, to make a point to pay attention to pieces of these giant woods in the downtown.

I studied the shape of a those few leafs remained or the sound of a gust of wind. Seeing such giants from the old times still standing in the Barracks Park (Kasarmipuisto) in the center of Kuopio, is simply a surrealistic and beautiful experience. I truly cannot get enough of their visage...

The bigger of the two, "the **President**", the largest of its kind in Finland, is a three-pronged Berlin poplar that has grown well over 35 meters tall and has a ground circumference of 7 meters. It is akin to the world tree in Nordic mythology, Yggdrasil, or the Hometrees in James Cameron's Avatar. The President and the Admiral reach for the blue sky in thousands of colors in these autumnal days, and take their spectators to a place known only from books or movies...

I have lost count of how many times I have made the journey to see these fabled trees and listened to the sound of the wind blowing through their branches. I believe I am not the only one either, as the trees must have been a place of worship during the centuries past (in my imagination, anyways...). They serve as symbols of strength and wisdom, nourishing the hearts and minds of the passersby.



The President on the left, Admiral on the right



Scientific Papers – I. Essays

Ari J. Tervashonka – Prioritization in academic work

Everyone partaking in academic life needs at some point to consider prioritization of their timetables. People have differing difficulties with it some woke up at 15:00 to make morning coffee and others slave in office for so long that they are out of ideas even when they step inside the office. Research is always a creative process, even in most strict settings. You always have to think about the new novelty values of research, new cases, angles and sources. Any humanities subject is also subject to be full of creativity needing processes before the research is even formalized not to even talk about finished research. In mathematics, this problem comes from the need to do abstract mathematical thinking that also requires imagination and keen sense. These and many more accomplishments in research are possible due to creative processes. For many who are doing research first time while working on the dissertation, face the dilemma of maintaining the relatively challenging workload and prioritizing the effort in the way that would at the same time, enable creative thinking and effective work routine. At the same time it is also about resting, being elsewhere with the thoughts to be able to start working again with the fresh mind.

Division of labour

To ensure that you do enough is essential for many reasons, not only that you can work effectively but also that you can measure your progress during long processes. Also to know what your own condition is, can be very helpful. Some would want to work similarly every day, and some need way more variety to be able to function. Whatever is the case, same rules apply for prioritization of work. What you can do is to have at least vague idea what you want to accomplish this year, when you think about that and other projects more than once there will be interruptions during the year. For these you can allocate weekends or 20 % of the time of the year as wasted time, free time, relaxing time. (20 % rule is for all times, including weekends, holidays ext.) Sometimes timetables are tighter, and you will not have the luxury to have free time, but there has to be enough time to recuperate to stay in peak creative condition most of the time because this condition alone is vital to be able to work on different scientific projects effectively.

When you know what will eventually happen during the year and you have allocated time for possible disasters (let us be honest), you can decide as vaguely how parts of these projects will be done in 12 months, after these divisions by weeks. Afterwards, you have the longer-term, monthly mid-term and weekly demands for your timetable. It means that you do not have to work every day, but you should have something done each week. When something not planned happens you allocate first your “disaster time” for it until you run out of it, then you pretty much have to allocate your free time to make ends meet. Nevertheless, even then, when you have times when you have too much work, you have to keep balancing the free time and cut extra work when doing them is not feasible. It is good sometimes to use stress to work more effectively but very rarely if any person can maintain that same situation for prolonged times. Typically there has to be balanced for stress hormone levels and sufficient work hours.

Signs of too much work

If you have been stressing uselessly or working too much in either case, there will be symptoms. University is an exceedingly right place to get to know your own limits and signs of overwork and stress. Usually, these vary hugely, so here is the list

- Red spots on the hands between thumb and index finger
- So much exhaustion that you are not able to sleep
- At evening rising heat levels on cheeks (also more redness nearby cheekbones)

- Lowering eyesight or lowering sharpness or colour vision of eyes
- Stomach acids, aching stomach, or other ways how the stomach is not working
- Spastic muscles or hurting joints and muscles (even after walking or relaxing otherwise)
- Headaches
- Memory loss
- Inefficient learning
- Rising heart rate and rising temperatures and sweating
- Normal limitations of behaviour differ (such as limitations of getting frustrated or angry)
- Shaking hands, tinnitus, eye tic
- Irregular behaviour with food (this can go in any direction really)
- Resulting in weight gain or lose, muscle lose
- General bad temper
- Feelings of exhaustion
- Feelings of despair, dystopia, existentialism, the disparity with the world, depressive feelings

Here to name few. These are not placed in terms of severity. For any person, the severity of these and more symptoms vary. Also, the feeling of the same symptom can vary. So why there is no warning text for starting scientists on the non-health beneficial reactions of overworking. Maybe because of expectations, customs, cultures and more. However, despite everything, long term work on anything is taxing for a normal human, and even in University, a large majority of people are biologically very ordinary people, despite what they might want to believe. Still, we have our unique ways of handling stress and otherwise surviving challenging times. University is a better place of getting to know these limits and ways how to handle yourself before going to work life. In University, you can and should sometimes fail to be able actually to learn more. In work-life failures might get you booted from the work and failures are not valued, even when these can become starting points of success. A lot of this is more to do with appearances than realities that can be even more frustrating to a researcher.

Prioritization

It is not only about timetables or how much you have to do, but also about what condition you are. Therefore your knowledge of yourself, your limitations and developments to overcome many limitations are important information that is needed to establish good prioritization for work. Prioritization of work is therefore relative to conditions, alternative timelines, and to earlier discussed general and specific plans.

First, you need to establish clear goals as said for a year, months and sometimes for a week if needed. The main point is that if you need to hurry only your surplus projects suffer, but you still get your main works done during the year. Not every year can be stellar productivity year but by categorizing what is essential and what is not, you can at least survive bad years while being somewhat on the plus side when it comes to work effort. On good years this balance becomes a guideline for maintaining the balance between work and free time. Even if you would be capable of doing work non-stop for a month or two, it might

deteriorate your working conditions for the rest of the year. Weekly spurts are okay, but month or more are already questionable.

Otherwise, prioritization is easy, you just classify everything that you work on essential in the scale of 'this has to be done' to 'this is totally optional if I have time'. The amount of prioritized work should always be somewhat limited to the realm of possibility. If one year is not enough to do one year part of your general effort, something is wrong. In the long run you can always exceed your own limits, learn new skills and make work more efficient. Sometimes it can feel as some of the limitations disappearing completely. This development can happen in themes of memorization, intuition, general creativity and knowledge of optimal execution of understood problems in life and work.

Affecting factors

For prioritization to work there has to be a balance between a lot of other factors, such as the will to commit to the work, feeling of importance so that we actually want to dedicate ourselves for arduous work for extended periods. Sometimes life drags people, family life, debts, relatives and friends, sometimes business can fall down, or other projects.

For this theme, many older academics whom with I have discussed on this topic have typically said that you have to dedicate attention almost solely on what you wish to accomplish. Sometimes this is not a feasible choice for many people. Additionally, it does not consider the eminent long term impact of gathering different talents and capabilities for yourself. Many of these developments are incremental and very hard to coincide with sole focus alone. You have to keep your thinking, intuition and creativity open enough with new ideas and that is not possible if you lock yourself to book chamber to think about the world. Science has this side, but the most essential effects come from other people in combination. You are gathering the leads on how to do science properly. Priority is not just to execute things, but to overcome limitations of today so that in future you are able to shoulder much heavier tasks and responsibilities without overworking yourself. Sometimes this road of development is not straight; it is not mentioned in University curriculums nor talks of professionals. These topics are in many cases, something that is connected to you and who you will become in terms of skills, knowledge and wisdom. Remember that plans and prioritization are there to help you, not to hinder your growth. In science, there are no maximums, the only endless sea of possibilities that is why prioritization and common sense are needed at least every week to remain in the feasible ranges of improvement and significant work results.

Chloe Wells – Preparing for your doctoral defence

As doctoral students at UEF we will have to defend our work in order to gain our doctorates. But what exactly does the doctoral defence involve? What are the steps and stages beforehand? And how can you best prepare for the occasion? As someone who has just successfully defended my PhD in Human Geography, I'm here to offer you some insights and advice.

What is a doctoral defence?

The doctoral defence is a formal, structured occasion where you, the doctoral candidate, are questioned about your work by an opponent appointed by your faculty. You will know in advance who your opponent will be. Only once the defence has taken place can you be awarded your doctoral degree. The defence is open to the public (although this year, Corona virus precautions in place at UEF have meant online streaming of doctoral defences rather than large in-person groups of attendees). The defence can only take place after your doctoral dissertation has been published.

How do I get my doctoral dissertation published?

There are two types of doctoral dissertations: article-based and monograph. You will decide which type you will write with your supervisors. The article-based dissertation is made up of (usually) three or four peer-reviewed scientific journal articles plus an introductory section which links the articles together. The dissertation monograph is a long scientific text made up of chapters. Usually the chapters go something like: introduction, literature review, theoretical framework, methodology, results, discussion, conclusion but there is some flexibility to the structure. If you have written a monograph this will be sent to two external pre-examiners for review. This is a bit like the peer review process for a scientific article. The pre-examiners will make suggestions for changes to your text and state whether they think it can be published and defended. One of your pre-examiners may be your opponent at the defence so you should pay careful attention to their comments on your work and consider changing your text accordingly. It is *your* work, however, so if you don't make the pre-examiners' suggested changes that is also OK – just be prepared to explain why you didn't make these changes during your defence!

When you are in the process of finalising your text, get in touch with the editor of the series you will publish in. Doing this in advance means the editor is aware that your text is 'on its way' and will soon be in the queue for publication. For doctoral dissertations published by UEF the series and their editors / editors-in-chief are (as at end November 2020):

Publications of the University of Eastern Finland. Dissertations in Education, Humanities, and Theology: Matti Kotiranta / Sirpa Kärkkäinen

Publications of the University of Eastern Finland. Dissertations in Forestry and Natural Sciences: Pertti Pasanen, Raine Kortet, Jukka Tuomela, Matti Tedre

Publications of the University of Eastern Finland. Dissertations in Health Sciences: Tomi Laitinen

Publications of the University of Eastern Finland. Dissertations in Social Sciences and Business Studies: Markus Mättö

Once your dissertation text is finalised to your own and your supervisors' satisfaction – including undergoing a language check if needed - and you have the documentation of permission to defend from your faculty, you can send the text to the editor of the publication series. Once the editor has approved the text it can be sent to the publisher/printing house. The layout of the text can be done by yourself or by the printing house. For speed and to reduce stress I advise letting the printing house do the layout! The printing house will send you a .pdf and hard copy proof to check for errors in the text. Take your time and do this carefully; this is your last chance to make any (small) changes to the text! Once you have approved the proof, the copies of the thesis will be printed. The printers will send copies to the Finnish national repository library in Helsinki, to the UEF library, and to your faculty. The faculty will send a copy to your opponent. The remaining printed copies are sent to you. You should make sure the Dean of your faculty, your supervisors, custos (the person who 'chairs' your defence) and your department all receive a hard copy. You may also wish to give copies to article co-authors, colleagues, family and friends etc. The remaining copies should be brought to your defence to be handed out to attendees. Don't forget to keep a copy for yourself to bring to the defence! It helps to mark this copy with post-its showing where each chapter or article starts so you can quickly turn to this page during the defence (see photo below). I also kept a 'clean' copy for myself which is displayed on my bookshelf. Your dissertation will also be published open access as a .pdf here (<https://erepo.uef.fi/>) about 10 days before your defence.



Figure 1: Joensuu's kosiosusi with the copy of my thesis I used at my defence. Note all the post-its stuck in it!

This page (<https://www3.uef.fi/en/web/dpmm/publishing>) from the Doctoral Program in Molecular Medicine sets out the publication process quite clearly. If you have any questions about what order to do things in (I know I did!) you should ask your supervisor(s) for advice.

How can I best prepare for my defence?

A few weeks before the defence start thinking about what questions you will likely be asked and how you will answer these. Things you will almost certainly be asked about regardless of your field include: your research questions(s) or hypotheses, methods, results, and conclusions. Think about how you can explain these in one sentence and in more detail. Think how you will *defend* your work. For example, if you are asked: "Why didn't you use method X?" answer using the structure define-defend: "(define:) My study uses method Y, not method X. (defend:) I chose method Y because . . . Method Y is more suitable than method X in the context of my research because . . ." Remember that it is perfectly OK that your research has limits; one doctoral dissertation cannot include everything! During your defence you should

acknowledge these limits and explain why you limited your work the way you did.

In good time before your defence you also need to write your *lectio praecursoria*. This is a short speech given by you at the beginning of the defence. Your *lectio praecursoria* is your time to shine so invest effort in writing and rehearsing it. In your *lectio praecursoria* you can preempt some of the questions you might be asked by your opponent and answer or discuss these. You could also talk about: the current 'state of the art' in your field; how you became interested in your research topic and the theories, concepts you used; the gap your research fills; the wider relevance of your study; what you enjoyed about conducting your research etc. The *lectio praecursoria* is different to a conference presentation or lecture; it should 'sell' your research work and contribution. For two recent examples of *lectio praecursoria* in the field of Human Geography check these links:

https://www.academia.edu/44524395/Lectio_Praecursoria,

https://www.academia.edu/42249799/Lectio_Praecursoria_Opening_lecture_statement_of_public_examination_of_doctoral_dissertation

In the weeks before your defence you will also need to prepare a press release about your work to be published on the UEF website (here's mine: <https://www.uef.fi/en/article/new-research-with-young-people-in-finland-shows-the-meanings-and-memories-they-associate-with-the>). The press release will also be sent out to media outlets so you may get requests for interviews or more information from them.

Self-care in the days leading up to the defence is very important. Exercise, eat well, rest. Clear your schedule so that the days before the defence are free from deadlines or a heavy work load. Depending on your own personality and preference you may need peace, quiet and alone time or social support in order to get in the right frame of mind for your defence: the aim is to be feeling calm and confident.

Re-read your dissertation and (if applicable) your pre-examiners' statements in the days before your defence, and practice your *lectio praecursoria* so that you can read it calmly and fluently and you are sure that it easily fits within the time allowed (in my faculty its 15-20 minutes but check with your supervisors/custos).

What will happen the day before and the day of my defence?

I'm basing this answer on my own experience of defending during corona-time; your experience may vary! Your faculty and department may also have different traditions; check with your supervisors.

The day before I met with my supervisor, who would also be acting as custos, read him my *lectio praecursoria* and got his feedback on it. That evening my supervisors and I went to dinner with my opponent. This was a great way for my opponent and I to 'break the ice' and get to know each other a bit before the defence. We were not allowed to discuss my work though!

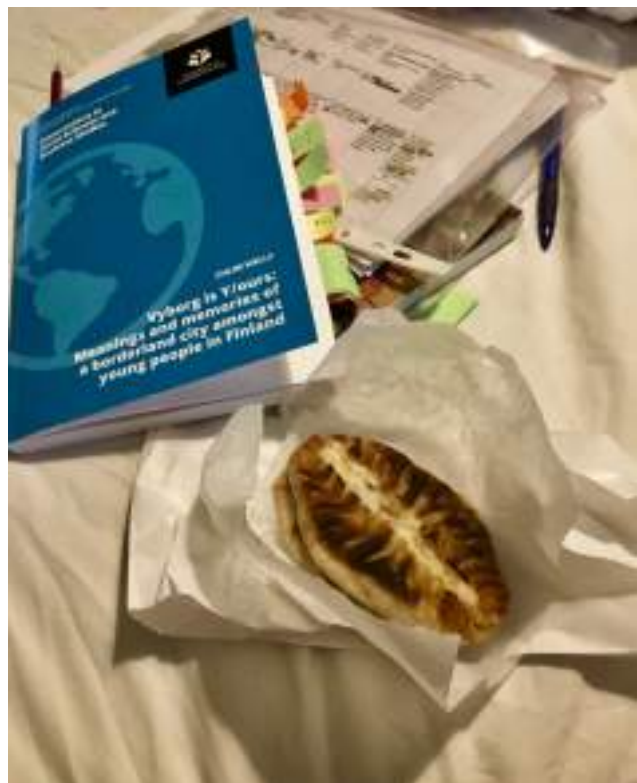


Figure 2: Re-reading my monograph the day before my defence whilst enjoying some Karelian pies

The day of, because my defence would be live-streamed, I had a rehearsal with someone from the IT department. Then myself, my custos/supervisor and the opponent just had to wait until it was time! The limited in-person audience went into the room at 12.00 and we entered at 12.15. The defence ended just after 14.00. There was a formal 'receiving line' where people congratulated me and then we enjoyed skumppa (sparkling wine), coffee and cake for a couple of hours with 15-20 colleagues and friends. This took place in the large lobby of the Metria building so people could be physically distanced. That evening we had a small, informal *karonkka* dinner with my supervisors, opponent and one friend/colleague. The ceremony and celebration of 'defence day' reminded me a bit of a wedding! Personally, I was extremely happy with how the defence went and was very touched that, even during this difficult time, people turned up to attend the defence and/or celebrate with me afterwards at the coffee service. It was also wonderful that the defence was live-streamed on an open platform so that colleagues and friends elsewhere, and my family in England, could watch proceedings!



Figure 3: Post-defence, pre-celebratory skumppa: (from left:) my opponent Prof. Anna-Kaisa

Kestävän kehityksen arvojen ja normien tuottamisen yhteiskunnalliset ongelmat

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Johdanto

Kun aloitin valmistelun kestävän kehityksen teeman käsittelemiseksi tässä esseessä jouduin huomaamaan että mitä enemmän kirjallisuutta, dokumentteja ja nauhoituksia kävin läpi työhön keskittyminen hankaloitui. Syynä ei ollut tiedon puute tai sen määrä vaan koko asian ympärillä käytävän diskurssin leväperäisyys verrattuna niihin tuloksiin minkä edessä seisomme tänä päivänä. Kun puhutaan kestävästä kehityksestä, teki mieli kysyä mistä ihmeen kestävyydestä tässä oikein keskustellaan. Jos asia olisikin niin yksinkertainen kuin erottelut riistokapitalismin ja utopististen viherkommunien välillä tai erottelu lyhyen tai pitkän tähtäimen ekonomien välillä. Ei, kestävän kehityksen täytyy perustua laajemmalle ilmiökimpulle mikä ei ole selitettävissä vain yhden tieteenalan keinoin.

Koska kestävän kehitykseen liittyvät ongelmat ovat laajoja sekä poikkitieteellisiä, tämän esseen tarkoituksena on esittää kriittinen pohdinta Suomen kestävästä kehityksestä. Keskeisenä kysymyksenä on miten suomalainen yhteiskunta kykenee kehittämään kestävää kehitystä. Lähestyn ongelmaa aineistollisilta lähtökohdilta humanistisella ottella. Yksi osa tätä aineistollista lähestymistapaa edustaa Pekka Himasen Sininen kirja (2012), mitä käsittelen lähinnä talousmaantieteen näkökulmasta suhteessa kestävään kehitykseen. Kirja tarjoaa herkullisen poikkileikkauksen Suomen poliittisen päätöksenteon eri diskursseista, mistä itseasiassa Suomen tulevaisuuden aiheen ympärillä keskustellaan tai työryhmän mukaan tulisi keskustella. Esseen teemaan nähden Himasen väliraportti on aiheen rajoituessa Suomeen Globaalia loppuraporttia järkevämpi keskeinen lähdevalinta. laadullisesti lähde ei ole ongelmaton. Vaikka se on julkaistu Oxford University pressiltä, Suomessa työryhmän työn tuloksia on kuvailtu valtion filosofiaksi tai pamfletiksi. Tämän esseen kannalta tutkimus tarjoaa uuden kootun lähtökohdan Suomen kestävän kehityksen ratkaisuun.

Käytän monesti termiä kestävä kehitys suoraan sisältyvänä ideana kirjoittaessani Suomen tulevaisuudesta. Tämä on sikäli tärkeä huomio, koska Suomella, tai millä tahansa muulla maalla ei ole tulevaisuutta ilman kestävää kehitystä.

Kestävän kehityksen normien tuottamisen ongelmista

Sinisen kirjan julkistaminen tapahtui navakassa poliittisessa vastatuulella, mutta väliraportin varsinainen sisältö jäi käsittelemättä. Nähdäkseni Himasen raportti tarjoaa suppean poliittisen maantieteen katsauksen niistä kootuista ristiriidoista, jotka ovat heikentämässä Suomen taloudellista sekä ekologista tilannetta. Kuitenkin näiden ristiriitojen esille tuonnissa näkyy länsimainen patina, ekologisuutta kyllä rummutetaan, mutta varsinaisia suunnitelmia tai esimerkkejä ei ole löydettävissä. Tämä ei ole kuitenkaan uutta Suomen poliittisella kentällä.

Samalla kun Suomi kamppailee näkemysten puutteessa Tanska panostaa tuntuvasti uusiutuvaan energiaan, tuulivoimaan. Saksa on puolestaan harpannut eteenpäin aurinkoenergian saralla. Parhaimpina säinä alkukesästä uutisoitiin massiivinen 50,6% aurinkoenergian sähköntuotantoluku¹, joka konkreettisesti kertoo Saksan satsauksista uusiutuvaan energiaan. Jopa energian nälkäiset Aasian maat kuten Etelä-Korea ja Kiina pyrkivät löytämään lisää energiaratkaisuja. Kiinan kohdalla energiaratkaisuista ei voida Etelä-Korean tavoin puhua ratkaisuina. Siinä missä Etelä-Korea on ylittänyt kansainväliset uusiutuvan energian käytön suositukset kolminkertaisesti, Kiinan energiasektori paisuu lähes hallitsematonta vauhtia, niin nopeasti kuin on taloudellisesti mahdollista². Tämä vauhti yhdistettynä energiasektorin paisumisen sisältöön on kaukana ekologisuudesta.³

Esimerkkien jälkeen voidaan kysyä, missä on Suomen konkreettinen energiasuunnitelma? Ekologisesti tai taloudellisesti ajatellen energiasuunnitelma on yksi keskeisimpiä vaikuttavia tekijöitä kestävän kehityksen kannalta. Onko suunnitelma halvoissa Itäisen naapurin öljyssä ja maakaasussa? Vaiko surkukupaisissa mittasuhteissa työstetyssä ydinvoimasektorissa, joka kamppailee hinnan nousujen, rakennustöiden ongelmien sekä kiristyvien turvallisuus-standardien kanssa. On huomioitava että Olkiluodon tapaisten farssien maksumiehenä ovat energiateollisuuden asiakkaat, kaikki suomalaiset.

¹ Täytyy huomioida että tämä tulos saatiin aikaan Saksan kansallisena vapaapäivänä, jolloin teollisuuden energiankulutus on paljon pienempi. Ks. Ylen uutiset Saksan aurinkovoimasta.

² Bradshaw 2014, 128 Kiinan talouden kasvu on vuodesta 1980 GDP per capita mitattuna yli kaksinkertaistunut jokaisen 10 vuoden välein.

³ Kiinan tavoite viisinkertaistaa ydinvoiman tuotanto vuoteen 2020 mennessä, huomioiden että Kiinalla on jo 9 ydinvoimalaa, Kopomaa, Peltonen & Litmanen 2008, 150.

Ongelma on tiivistettynä ekologinen ongelma jolle ei ole vielä poliittista ratkaisua. Juuri tämän ratkaisun luonne vaatisi että myös yhteiskunta itse sisällyttäisi aidolla tavalla kestävän kehityksen myös poliittisiin päätöksiin. Eli ongelmana ei ole se ettemme tietäisi mitä luonnossa on tapahtumassa, kuinka paljon hiilijalanjälkiä jätämme tuleville sukupolville maksettavaksi tai ettemme osaisi arvioida eri teollisuudenhaarojen ympäristöpäästöjä. Näillä alueilla tehdään jatkuvasti tutkimusta ja selvitystä, mutta edelleen se kokonaisuus mikä näitä tietoja soveltaa on yhteiskunta.

Kestävän kehityksen ja taloudellisen kasvun ristiriita on tämän ajan tuntuvin yhteiskunnallinen ilmiö yhteiskunnan ympäristösuhteen näkökulmasta. Ristiriidan ytimenä on ongelma markkinoiden kasvun ja kestävän kehityksen tärkeysjärjestyksestä. Vaikka asia on itsestään selvä ympäristötutkijoille, se ei tarkoita että markkinataloudellisesti varsinkaan globaalilla tasolla kestäväällä kehityksellä olisi tällä hetkellä muuta kuin imago arvoa kansainvälisille yrityksille. Surullinen tosiasia on, ettei vuosikymmeniä jatkuneet diskurssit ole vielä ruokkineet tarpeeksi lainsäädäntöä globaaleilla mittasuhteilla. Paikallisesti joihinkin jo huomattavissa oleviin ongelmiin on suhtauduttu lähes asiaankuuluvalla vakavuudella⁴, mutta jatkuvan talouskasvun mantra on edelleen tärkeysjärjestyksessä ykkösenä. Ideaalissa maailmassa kestävän kehityksen vaatimus sanelisi talouskasvun reunaehdot. Tämä tarkoittaisi että globaalilla lainsäädäntöyhteistyöllä voitaisiin pakottaa kaikkien maiden teollisuustoimijat suunnittelemaan materiaalituotanto-, jalostus-, tuotanto- ja logistiikka prosessit ekologisesti kestäviksi ja vasta näiden reunaehtojen jälkeen toimijat pääsisivät toteuttamaan normaalia voiton maksimointia ekologisen kantokyvyn puitteiden sisällä. kuitenkin voimme todeta ettemme ihan vielä ole tässä vaiheessa yhteiskunnallisessa tai globaalissa mittasuhteessa. Sen sijaan voimme vaikuttaa yhteiskuntien sisällölliseen muotoon, joka loppulta tuottaa ja jatkuvasti muuntaa ympäristöä kattavaa normistoa.

Miten yhteiskunta voi sitten toiminnallaan tuottaa tulevaisuudessa parempia ympäristönormeja? Lähestyn asiaa humanistisesti energiasuunnitelmaa yhteiskunnallisesti vielä tärkeämmästä asiasta eli yhteiskunnan sisällöstä. Koska normit muodostuvat yhteiskunnallisen yhteistoiminnan piirissä, yhteiskunnan omat valuviat vuotavat heikkouksia ympäristöä käsitteleviin normeihin. Tämä teema

⁴ Kalifornian juomavesi.

tulee vahvasti esiin Himasen kirjoituksessa yhteiskunnassa elämisen mielekkyyden kannalta. Humanistinen painotuksen voi huomata dignity, eli arvokkuuden käsitteen keskeisestä asemasta Sinisessä kirjassa. Käsitteellä pyritään pureutumaan elämän laatuun, eli määrittelemään miten elämän arvokkuus on yhteydessä elämisen laatuun.

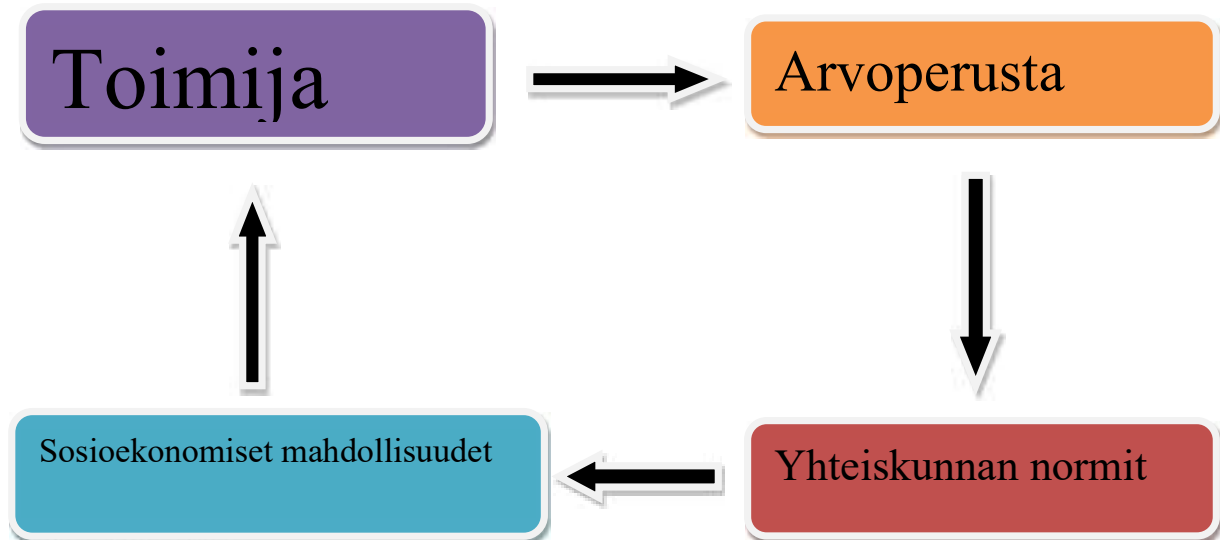
Yleensä ympäristöä koskeissa asioissa lähdetään ympäristöstä, mutta ei juurikaan puhuta tarpeeksi siinä olevien toimijoiden keskinäisistä suhteista. Ympäristötieteissä lähtökohtana on että ekologisesti kestävästi toimiva ympäristö on painavin edellytys kaikelle ihmisen toiminnalle. Sen sijaan Himanen lähtee humanistisen painotuksen kautta kysymään miten saamme yhteiskunnasta toimija näkökulmasta kestävä, niin että ihmiset kykenevät elämään yhteiskunnassa kestävällä tavalla. Tämä tarkoittaa että Rawlsin ”Justice as fairness” tulisi aidolla tavalla ilmentyä yhteiskunnassa. Nähdäkseni ympäristölle kestäviä normeja tuottava yhteiskunta ei voi lähteä kehittymään ilman että ihmisten keskinäinen oikeudenmukaisuus kehittyy. Jos yhteiskuntaa ajattelee toimijoiden näkökulmasta systeeminä, eivät oikeudenmukaisesti ristiriitaisessa asemassa olevat toimijat kovin helposti muodosta eheitä ympäristönormeja. Yhtenä suurimpana vaikuttavana tekijänä ovat sosioekonomiset erot jotka ilmenevät merkitsevinä eroina yhteiskunnallisessa norminmuodostuksessa, ääripäinä koulutuksen puute ja aktiivinen lobbaus.

Sosioekonomisilla eroilla on huomattavia vaikutuksia yhteiskunnalliseen toimijuuteen ja kestävä kehityksen normien tuottamisessa tämä ero ilmenee lobbauksen vaikutuksena erittäin konkreettisella ja yhteiskunnan normeja uudelleen määrittävällä tavalla. Himasen Sinisessä kirjassa tarjotaan joitakin vastauksia kestävä kehityksen ongelmiin yhteiskunnallisella tasolta. Ekologisena puolena käytetään lähes Keynesiläistä logiikkaa, joka tässä kontekstissa tarkoittaa että mikäli hoidamme yhteiskunnan toimintoja suuremmalla oikeudenmukaisuudella ja näemme ihmisarvon keskeisenä yhteiskunnan mittarina, tästä seuraa että myös ympäristö hyötyy yhteiskunnan arvomuutoksesta. Keynesiläinen rahapolitiikka ei suinkaan kaventanut tuloeroja, mutta logiikan käyttäminen tuo uudenlaisen näkökulman yleensä ympäristökeskeisesti ajateltuun kestäväan kehitykseen.

Yhteiskunnallisen normeja määrittävien arvojen muodostumisen diskurssi

Kootusti yhteiskunnan normien muodostuminen arvojen kautta voidaan esittää seuraavalla tavalla.

Normien tuottamisen yhteiskunnallinen kausaalisuhde



Tervashonka 2014

Toimija: Yhteiskunnan yksilö, liikkeet, puolueet, kartellit.

Arvoperusta: Yhteiskuntanormien muuttumisen yhteydessä vallitsevien diskurssien tuottamat arvoperustat. Mitä varten tarvitsemme kyseisen normin ja miksi se on oikeutettu.

Yhteiskunnan normit: Käytyjen diskurssien tuottamat yhteiskunnan toimintoja säätelevät lait, normit ja totunnaisuudet.

Sosioekonomiset mahdollisuudet: Normien ja lakien puitteissa suodut mahdollisuudet per. yhteiskunnassa oleva toimija. Yhteen kerättyinä näistä tekijöistä muodostuu toimijan sosioekonomiset rajoitteet ja mahdollisuudet.

Aluksi yhteiskunnan eri toimijoiden välisellä diskurssilla uudelleenmääritetään jatkuvasti mitkä ovat yhteiskuntaa ohjaavia arvoja. Arvojen lisäksi myös määrittyy tabut, niin normatiiviset tabut kuin poliittiset tabut. Arvojen muodostuminen ja uudelleentuottaminen rajaavat ne aiheet mistä käydään julkista keskustelua. Tämän yhteiskunnallisen keskustelun tuotteena ovat yhteiskunnan normit, sovitut pelisäännöt ja viimekädessä lait joiden puitteissa yhteiskunnassa toimijat tuottavat uusia arvoja ja normeja. Yhteiskunnan normit ja lait kuitenkin tuottavat erilaisia sosioekonomisia puitteita jotka merkitsevät ja erittelevät eri yksilöitä ja yhteisöjä toisiinsa nähden yhteiskunnallisina osina ja toimijoina. Näin ollen sosioekonomiset puitteet jakavat eri resursseja kuten, raha, tieto, aika normien kautta mahdollisuuksiksi, koulutukseksi ja sosiaalisekonomiseksi saavutettavuudeksi. Näillä tekijöillä on yhdessä huomattava vaikutus yksilön tai yhteisön toimijuuteen yhteiskunnassa.

Suomalaisessa yhteiskunnassa tuloeroja on yritetty tasoittaa, on pyritty ainakin paperilla ehkäisemään köyhyyttä ja on joltain osin herätty tajuamaan köyhyyden stigma, esimerkiksi sosiaaliekonominen epätasa-arvo vrt. koulutustaso. Tästä on historiallisesti ollut hyötyä hyvinvointivaltion muodostamisessa ja joskus köhivän talouskasvun muodossa. Näistä hyödyistä ja pyrkimyksistä huolimatta suomalainen malli ei ole onnistunut poistamaan toimijoiden välisiä epätasa-arvon suhteita. Tämä ei tarkoita sitä että musta tuntuu pohjalla normia käsittelevän mielipide pitäisi olla samalla tasolla kuin pyyteettömästi toimivan kouluttautuneen henkilön konkreettinen työpanos. Epätasa-arvo tässä mielessä on enemmänkin kuin pelkkä arvokysymys, se on kysymys yhdenvertaisuudesta ja samanlaisista aidoista mahdollisuuksista samanlaiseen sosioekonomiseen painoarvoon yhteiskunnallisen arvojen ja normien muodostamisen vaikuttavien diskursseihin nähden.

Ympäristön tulevaisuuden kannalta kestävän kehityksen vaatimus on ilmeinen. Kuitenkin näitä ympäristöön vahvasti liittyviä diskursseja voidaan muotoilla eri tarkoitusperillä kielteiseen suuntaan. Tilanteessa jossa yhteiskunnallisten toimijoiden painoarvo on suorassa epäsuhdassa tai jokin osapuoli hallitsee diskurssin viitekehyksiä (arvoja ja normien muodostamista) päädytään hankaliin yhteiskunnallisiin tilanteisiin joiden lieveilmiöt maksaa luonto. Otan esimerkiksi ekomatkailun. Edeltävästi luontoarvojen takia luonnonsuojelualueita poliittisen hyväksynnän saavuttamiseksi tehneet henkilöt tekivät ratkaisun suhteessa arvohyvään. Nykyään luonnonsuojelualueita pyritään hyötykäyttämään eräänlaisina koskemattoman luonnon esimerkkeinä, joita mainostamalla luontoa suojelevat tahot voivat rahoittaa toimintaansa ja nostaa

muutenkin luontoa arvona jalustalle. Tällä toiminnalla saavutetaan sekä välinehyvää rahoituksen muodossa sekä arvohyvää, koska ympäristötietoisuus laimennettuna versiona leviää paremmin.

Mikä sitten on ongelma? Periaatteessa nyt samasta luonnonsuojelun prosessista saadaan arvohyvän lisäksi välinehyvää. Yhteiskunnan ja luonnon kannalta tilanne ei kuitenkaan ole välttämättä paras mahdollinen. Kysymykset siitä, keille tai mille saatu välinehyvä jaetaan. Eli saako ympäristön suojelutoiminta aidosti ansionsa mukaan ympäristöturismista vai onko tämä välinehyvän määrä promillen luokkaa. Toinen kysymys on suojellun ympäristön kuormituksen määrä. Jos ympäristöä pyritään matkailun keinoin hyödyntämään resurssina, markkinatalouden sääntöjen mukaan luontoa siis potentialisoidaan ja loppupeleissä jos onnistutaan, niin siitä seuraa ympäristölle kestävämpiä kuormitusta.

Kun kysymyksiä välinehyvän ja rasituksen suhteista pohditaan uudelleen yhteiskunnallisten normien tuottamisen kausaalisuhteiden kautta, voidaan huomata että yhteiskunnallisten toimijoiden väliset epätasa-arvot suhteessa esimerkiksi koskeviin diskursseihin, vääristää tuotettuja arvoja ja siten normeja. Luonnosta tehdään ensin sakraali, että sille voidaan sijoittaa välinearvo ja välinearvoa pyritään markkinalähtöisesti muuttamaan välinehyväksi. Toisin sanoen suojellusta luonnosta tuotetaan arvokas ja tätä arvoa pyritään välineellistämisen kautta hyödyntämään, jotta siitä voidaan saada välinehyötyjä, rahaa ja julkisuutta.

Suomen yhteiskunnan tulevaisuus

Kestävän kehityksen ja Suomen yhteiskunnan kehityksen keskinäinen suhde ei ole vielääkään kaikista diskursseista huolimatta suorassa linjassa. Toisaalta hippi puheista on päästy 50 vuodessa poliittisesti hyväksyttävään kestävä kehityksen diskurssiin. Tällä hetkellä voidaan sanoa että tilanne on hitaasti paranemaan päin, mutta tämän kehityksen hintana on ollut luonnon markkinoiminen ja pahimmillaan luontoarvojen muuttaminen resursseiksi. Yhteiskunnallisen normin tuottamisen kausaliiteetti vinouttaa ympäristökeskustelua niin kauan kielteisellä tavalla kun yhteiskunnallinen toiminta ei seuraa omia arvoja.

Olen analyysissä päässyt tämän kautta siihen johtopäätökseen ettei tällä kausaalilla toimimattomalla suhteella kyetä tuottamaan aidosti toimivia ympäristönormeja. Kestävän kehityksen kannalta tämä ei ole paras mahdollinen uutinen. Tässä mielessä voidaan sanoa että fraasi tie helvettiin on kivetty hyvin aikomuksin. Kuvainnollisesti fraasi tarjoaa lähtökohdan. Ei riitä että pyritään hyvään, vaan täytyy diskurssien vapauttamiseen pyrkiä, jotta nämä pyrkimykset olisivat aitoja tekoja, ei hyviä pyrkimyksiä. Leonardo DiCaprio esitti puheessaan YK:n ilmastokokouksessa että hänen työnään on teeskennellä ja tämän ei pitäisi olla eri maiden hallinnon tehtävä. Sama pätee siihen miten eri yhteiskunnissa normien muodostumisen kausaliiteetti pätee. Suomessa hallinnollisen läpinäkyvyyden toteutuksella, ei siitä puhumalla, tuodaan tietoja helpommin eri diskursseihin. Myös yhdenvertaisten sosiaaliekonomisten mahdollisuuksien vartiointi tulisi olla hyvinvointivaltion aito tehtävä. Hyvinvointivaltion hyvinvointi ei automaattisesti tarkoita yksilön tai muiden yhteiskunnan toimijoiden hyvinvointia, sen tulisi olla puite minkä varassa yhteiskunta toimii, ei kaiken yhteiskunnallisen tekemisen kohde.

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Scientific Papers – IV. Abstract papers

Navier–Stokes equations on Riemannian manifolds

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There is no doubt that mathematics is the universe’s language, transmitting the signals in the mind to the general relativity equations that qualify the star-galaxy motion. However, almost all people find mathematics boring, dry and irrelevant. Riemannian geometry has evolved into one of the most important aspects in modern mathematics by expanding on 20th century ideas. Thus, the mathematical language of physics has been transformed by Riemannian geometry. Moreover, different physical findings need to be carried out extensively by nonlinear analysis.

I am currently a postdoctoral researcher in the Mathematics and Photonics at the University of Eastern Finland. My research interests lie at the interface of geometry and analysis, including differential geometry and PDEs on Riemannian manifolds. Specifically, I worked on the Navier–Stokes equations with connections to the above-mentioned fields. The fluid flow equations are referred to as the Navier–Stokes equations, the methods used to solve these are called the Computational Fluid Dynamics. This system is dominant on plenty of natural hydrodynamic phenomena and by solving it we can obtain parameters such as pressure, velocity, and water level in the desired phenomenon. I studied the Navier–Stokes equations on compact Riemannian manifolds and establish a series of results that relate the behavior of solutions to this system and the underlying geometry of the manifold. The motivation for such a formulation comes from atmospheric models as well

as some thin film flows on curved surfaces. More precisely, I studied properties of solutions in the presence of Killing vector fields. My main results concerned the decomposition of the flows to the Killing component and its orthogonal complement.

1 On Navier–Stokes equations

By increasing human knowledge in the fields of mathematics and physics, it was possible, through the use of mathematical equations and physical concepts, to discover and understand many laws of natural phenomena and explain how they can be expressed through mathematical equations. Newton’s three laws are a prime example to substantiate this claim. The flow of various fluids and the properties of each of these fluids are another example and various relationships have been suggested for them. Renowned scientists like Euler, Bernoulli, Navier and Stokes have contributed greatly to understanding the properties of fluids and various currents. Navier–Stokes equations are arguably the most complete set of fluid flow equations to date. The nonlinear system of Navier–Stokes equations forms the mathematical model governing motions, currents, and fluid dynamics (whether liquids or gases).

Navier–Stokes equations refer to time-dependent continuity second-order nonlinear partial differential equations that describe the motion of incompressible fluids and are the fundamental equations of fluid dynamics. The solutions may be used to model weather, water flow in a pipe, air flow around an airplane wing and many other things. Navier–Stokes equations can be written in \mathbb{R}^n as follows

$$\begin{aligned} u_t + u\nabla u - \mu\Delta u + \nabla p &= f \\ \nabla \cdot u &= 0 \end{aligned}$$

where $u : \mathbb{R}^{n+1} \rightarrow \mathbb{R}^n$ is the velocity of the fluid, u_t the change of velocity with time, $p : \mathbb{R}^{n+1} \rightarrow \mathbb{R}$ the pressure, ∇p the pressure gradient (∇ is the Levi-Civita connection associated with the metric), Δu the diffusion (Δ is laplacian); f represents the external force that acts on the fluid (gravitational force or electromagnetic) and the convection acceleration term which is the nonlinear part is defined as

$$\operatorname{div}(u \otimes u) = u\nabla u + \operatorname{div}(u)u .$$

When the flow is slow, it is convenient to consider a linearized version of Navier–Stokes equations which are called Stokes equations. The study of the

Stokes system is not only significant as such, but is also an essential starting point for the formation of nonlinear theory.

If you are interested in my research work, please see my doctoral thesis by following the link.

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