VALUING NATURE PROGRAMME

Demystifying Interdisciplinary Working
(in Valuing Nature)

Valuing Nature Paper | June 2020

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The Valuing Nature Programme has established extensive interdisciplinary partnerships with the aim of improving our understanding of the value of nature and the use of these values in decision making. Articulating the values of nature requires research bringing together varieties of disciplines as recognised by the Valuing Nature Network. However, the mechanisms of interdisciplinary working are not always clear and the complexities are often understated. Interdisciplinary approaches can prove interesting, frustrating, challenging and rewarding. As the Valuing Nature Programme draws to a close this report brings together experiences of the contributors and the broader audience to share the lessons learned from this innovative programme, in order to ensure the improved success of interdisciplinary working into the future. **This report aims to clarify why interdisciplinary working is needed now more than ever, what interdisciplinarity is, and how it can be successfully achieved and sustained.**

Who is the target audience?

This report is aimed at a broad audience of both specialists and non-specialists with an interest in working beyond traditional disciplinary boundaries and across the science-policy interface. This includes academics, businesses, consultancies, government bodies, general publics, NGOs, and funding bodies. **In this context, the discussion extends beyond academic disciplines and also includes engagement with a host of stakeholders to recognise that interdisciplinary working can just as equally occur between a government official and a biologist, as between an economist and an artist.**

What does the report contain?

In this report we begin by discussing why interdisciplinary processes are particularly relevant at this time. **Section 2** provides a "how to" for undertaking successful interdisciplinary working, including top tips. **Section 3** provides the current understanding of terms and definitions surrounding interdisciplinarity. **Sections 4—6** provide an overview of the positives, negatives, barriers and solutions of interdisciplinary working.

How was this report developed?

This report is the culmination of decades of experience from an extensive body of contributors. Specific activity leading to the development of this report has been focussed in the previous 6 years through engagement with the Valuing Nature Programme, and associated projects, workshops and conferences.
To inform this report two Mentimeter surveys were undertaken at two highly interdisciplinary and policy orientated conferences: the Valuing Nature Annual Conference 2019 (94 participants) and the envecon: Applied Environmental Economics conference in 2020 (37 participants). The results of these surveys are presented in this report.

Whilst the importance of the different terms and definitions is recognised, for the purpose of this report the term "interdisciplinary" is used in its broadest sense, encapsulating a range of activities from cross to multi to inter to trans. In this context it is defined as "projects that integrate both academic researchers from different unrelated disciplines and user-group participants to reach a common goal". (Tress, B., Tress, G., van der Valk, A., & Fry, G. (2003). Interdisciplinary and transdisciplinary landscape studies: potential and limitations. Wageningen: Delta Program.)

1. Why Interdisciplinary working?

This is a time of unprecedented change. To be successful in finding and managing solutions to the complex issues of the day, from pandemics to climate change to biodiversity loss, transformative approaches are needed. Thinking in individual disciplinary terms is as crucial as ever in order to progress specialist approaches. However, if we accept the definition of 'wicked problems'[1], problems with multiple interconnected aspects which lack right and wrong solutions, and the current context as 'volatile, uncertain, complex, ambiguous'[2], it becomes clear that innovative interdisciplinary approaches are also required. To address today's complex technical, societal and environmental challenges we need to break down the disciplinary silos, think outside the usual boxes, and bring a broad range of specialists and approaches together to best understand and provide viable solutions to these challenges **(See Box 1).**

1   Original reference Rittel, Horst W. J.; Webber, Melvin M. (1973). "Dilemmas in a General Theory of Planning" (PDF). Policy Sciences. 4 (2): 155–169. And this is good too Lotz-Sisitka, H., et al., 2015. 'Transformative, transgressive social learning: rethinking higher education pedagogy in times of systemic global dysfunction'. Current Opinion in Environmental Sustainability, 16:73–80.

2   http://usawc.libanswers.com/faq/84869

The paper is still under review in People and Nature:

Holland, R., Ketsopoulou, I., Beaumont, N., Austen, M., Hooper, T., Gross, R., 774 Heptonstall, P., Watson, J., Taylor, G., 2016. How consistent and comparable are ecosystem services and energy system scenarios? UK Energy Research Centre.

Holland, R., Beaumont, N., Hooper, T., Austen, M., Gross, R., Heptonstall, P., 778 Ketsopoulou, I., Winksel, M., Watson, J., Taylor, G., 2018. Incorporating ecosystem services into the design of future energy systems. Applied Energy, 222, 812-822.
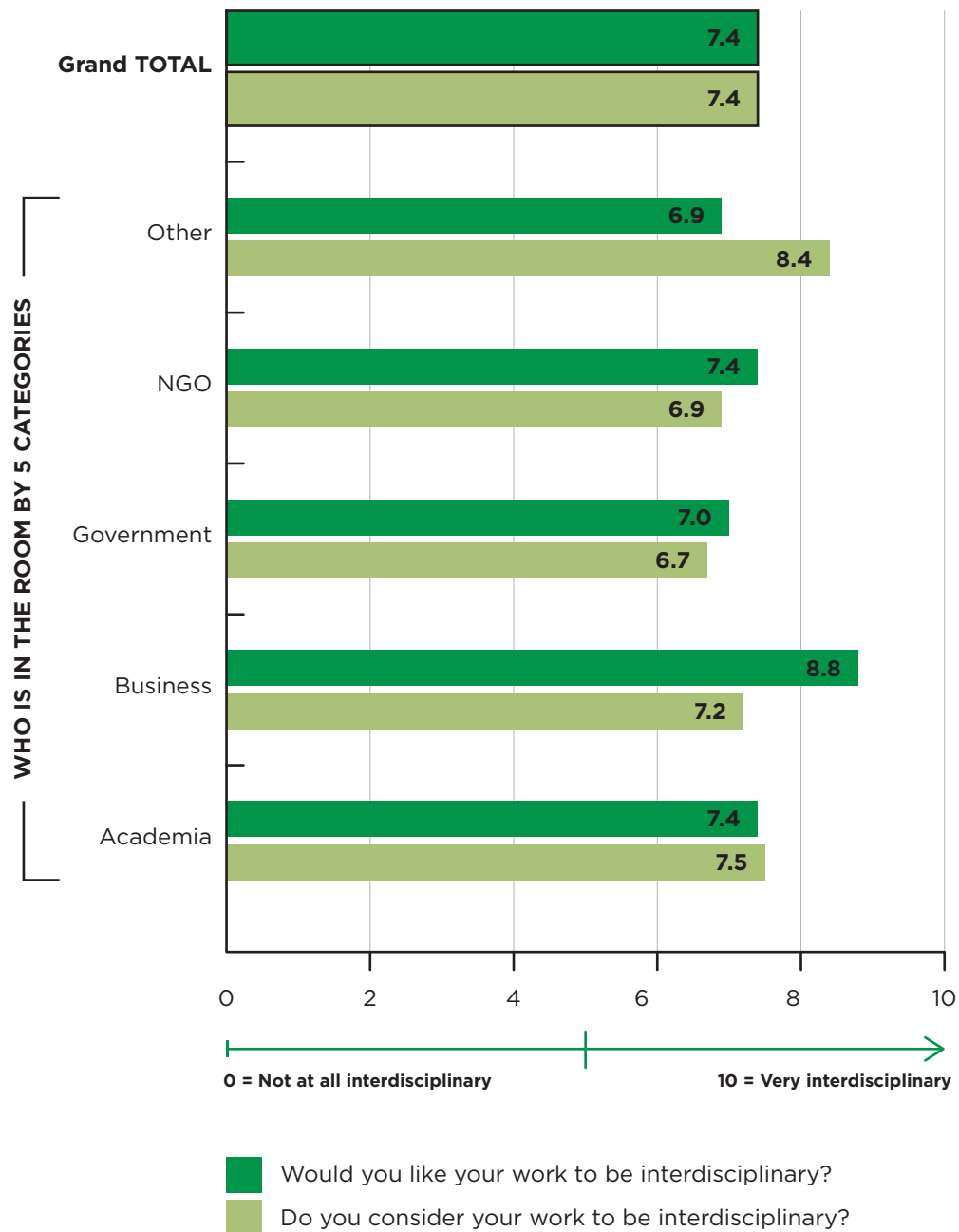
Box 1: **An energy case study**

In the energy sector, to fulfil changing needs whilst aspiring to meet Net Zero, an interdisciplinary whole systems approach is essential (Holland *et al.,* 2016). Not doing so risks the pursuit of energy policies which are not feasible, sustainable or socially acceptable (Hooper *et al.,* 2018). Methods for evaluating the environmental and social impacts of low carbon energy scenarios are currently often developed independently and without a whole-systems perspective (Holland *et al.,* 2018). Interdisciplinary approaches can help academics and decision-makers take a whole-systems perspective on energy futures in a way that integrates energy, social and environmental considerations. There is clearly an essential role of interdisciplinary and transdisciplinary research in furthering our understanding of the impact of energy transitions on people and nature, this includes researchers and practitioners in engineering, environmental sciences, computer sciences, mathematics, geoscience, economics, anthropology, business, and psychology.

The benefits of interdisciplinary working are acknowledged to be substantial, and more likely to lead to fundamental advances and richer outcomes **for researchers and others,** even though its challenges, higher risks and requirements for more time and flexibility are also accepted. For academics it can be stimulating and lead to ground breaking collaborations; for user groups it can radically improve the relevance of answers provided to difficult questions; and for research commissioners it can drive the development of impactful proposals and projects. An interdisciplinary approach is critical in forming bridges between research providers and research users, including academics, government officials, businesses, NGOs, and consultancy sectors. Communication between these groups is key to ensuring that research is focussed and delivered in a way that can be impactful and have maximum positive influence on society.

To explore the current extent and prospects for future interdisciplinary working, the participants at the special session of the Valuing Nature Annual Conference 2019 were asked about the level of their interdisciplinary working. The results showed that those in businesses, government officials, and NGOs felt that their work was less interdisciplinary than academics, but that many would wish to see this increase. This aspiration potentially reflects the recognition by these sectors that to effectively address the current and forthcoming challenges there is a need to shift current work patterns to encompass a broader range of disciplines and approaches.

Figure 1: How Valuing Nature Annual Conference 2019 participants consider their work to be in terms of the degree of interdisciplinarity, and also how interdisciplinary they would like it to be.

WHO IS IN THE ROOM BY 5 CATEGORIES

Grand TOTAL — 7.4 / 7.4
Other — 6.9 / 8.4
NGO — 7.4 / 6.9
Government — 7.0 / 6.7
Business — 8.8 / 7.2
Academia — 7.4 / 7.5

0 = Not at all interdisciplinary   10 = Very interdisciplinary

■ Would you like your work to be interdisciplinary?
■ Do you consider your work to be interdisciplinary?

2. 7 Principles of Interdisciplinary Working

1 **Respect:** Disciplines and activities should not be considered in a hierarchical fashion even though oversimplification of disciplines which are unfamiliar is common. Artists for example may risk being instrumentalised to simply decorate or communicate a scientific project, rather than forming meaningful collaborations about conceptualising the problem and seeking solutions.

Top tips to avoid this include: keeping an open mind, listening deeply and asking questions; avoiding pre-conceptions, assumptions and patronisation; developing project guidelines for the team to maintain respect and equality; acknowledge and demonstrate appreciation for all of the contributors involved in achieving goals, for example making regular references to each other in presentations and discussions; and writing a joint publication early in the process to provide a shared goal to work towards.
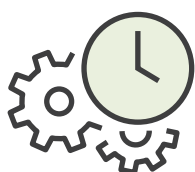
2 **Take time:** Successful interdisciplinary work requires additional time as there is a need to learn and understand each other's different backgrounds, methods and language.

Top tips to ensure this include: build additional time into project timelines, both overall and for specific activities to build the interdisciplinary capacity of the team; build additional time into meetings to enable extended discussion; explicitly budget for the extra time, resources and activities required – good interdisciplinary working requires investment.

3 **Communicate:** Don't make assumptions that language and forms of communication within your discipline are universal. Although colleagues in different disciplines may be using the same words, they may have very different meanings.

Top tips to enable good communication include: as a collaborative team activity develop a project-specific dictionary of terms; be honest and do not be afraid to admit that you do not understand what someone is saying – there are no stupid questions; listen actively and repeat back what you have heard in your own words to ensure that you have understood fully; visit a relevant field site and ask each team member to explain what they see – it is probable that each individual will view the same space in a different way; remember that simplicity in communication is not the same as being simple – to successfully explain a complex issue to a non-expert requires skill and depth of understanding, and does not make the issue less complex but more relevant for the listener.

4 **Embrace personalities:** Interdisciplinary working is not just about bringing two or more disciplines together, it is about bringing two or more people together. For successful interdisciplinary working, different personality types need to interact harmoniously.

Top tips to secure this include: creating opportunities to get to know each other, ideally outside of the usual work place, for example through social events, STEM outreach activities, and field trips. Undertaking team activities such as outreach and STEM events can be particularly valuable as they remove people from their comfort zones, place them in an impartial space and create a shared experience. It is also important to remember that no one person embodies an entire discipline. Every discipline has internal debates about values, working methods and foci, and if you do not find working with a particular discipline to be rewarding, you may need to explore the discipline further, in order to find the best representative for your team/project.

> **❝** The social science fellow in the project and I (the natural science fellow) get along very well, which is always a prerequisite (I believe) to be able to work with somebody. **❞** VNP/CoastWEB team

5 **Prepare:** When developing an interdisciplinary collaboration it is not always possible to draw on previous experiences – careful consideration at the outset is key to success.

Top tips for good preparation include: take time at the beginning of a project or proposal to determine if an interdisciplinary approach is required and if so what the required disciplines are and how they will be organised and managed; be clear about who will be collaborating and why and who will be delivering what and to whom, and when; ensure everyone is clear of their roles and responsibilities; have an agreed publication strategy with an emphasis on inclusivity.
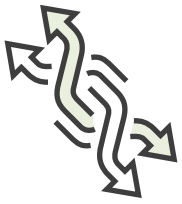
6 **Adapt:** Interdisciplinary working can be risky and unpredictable and as such there is a greater need for adaptability as a project progresses.

Top tips for adaptability include: have a jointly developed Gantt chart which is regularly revisited – if an activity is slipping or struggling be proactive in addressing this and do not be afraid to change direction if needed; at the project development stage ensure that there are clear risk management strategies to address non-delivery or the delivery of alternative outputs; interdisciplinary projects are likely to have strong inter-dependencies between work packages and/or tasks so ensure that options are in place if there are delays in the different components; maintain open communication and encourage partners to vocalise concerns without the risk of reprimand.
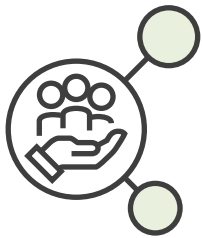
7 **Share:** Interdisciplinary working is challenging and to support and improve success, the sharing of experiences is critical before, during and after a project is undertaken.

Top tips for sharing include: meet and discuss with other people who are working in an interdisciplinary context; keep a record or diary of what works well and what works less well; take time to read some of the extensive interdisciplinary literature; [3] write up and publicise your own interdisciplinary experiences.

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3 **Benham and Daniell (2016) Putting transdisciplinary research into practice: A participatory approach to understanding change in coastal socio-ecological systems.** — could ref for institutional and practical constraints on researchers.

Bark et al. (2016) Evaluating an interdisciplinary research project: lessons learned from organisations, researchers and funders — gives a good overview of complexities of interdisciplinary working and also includes recommendations

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Botey et al. (2012) Ecosystem Management Research: Clarifying the Concept of Interdisciplinary Work — shows how researchers differ on the terminology but share an understanding about what it is: both a 'way to do research' and a 'way of thinking about research'. Differences between researchers suggest a growing interest in developing deeper engagements with theoretical discussions of interdisciplinarity. Authors also claim that interdisciplinarity is under theorised — A broader engagement with theoretical debates in research supporting EM might mean more critique and awareness about interdisciplinary practice and more effective interdisciplinary practice.

Botey et al. (2014) Interdisciplinary Research for Ecosystem Management.

Gaziulusoy et al. (2016) Identifying and addressing challenges faced by transdisciplinary research teams in climate change research — authors reflect on learning in first 15months of a project.


Cundill et al., (2019) The future is collaborative. Nature Climate Change — challenges/opportunities. Really short comment article.

3. What is interdisciplinary working?

Primarily, it is important to note that the concept of interdisciplinarity extends beyond academic disciplines and is equally relevant to academics, businesses, government officials, NGOs and a range of other stakeholders, both within and between their work areas, and in crossing the bridges between these sectors.

Working across and between disciplines is not a new concept. Indeed this has been an established method of working for centuries, although in the 20th century, as academic fields became increasingly specialised, the extent of single discipline working grew. However, in the early 21st century, there has been a growing awareness of the limitations of single discipline working, resulting in a swell of interest around interdisciplinary working. As a direct result, definitions of interdisciplinary working have become more explicitly characterised, and a multitude of nuances have emerged, with distinctions made between concepts of cross-, multi-, inter- and trans-disciplinary working see **Figure 2.** This increasing differentiation in terminology has, however, caused some degree of confusion. To address this confusion this section provides explicit definitions of the most commonly used terms in the hope that further clarification may help the development of interdisciplinary partnerships, the understanding of how people work together and what options are available, and aid the structuring of engagement for more successful outcomes.

Figure 2: A spectrum of 5 forms of working
www.arj.no/2012/03/12/disciplinarities-2/
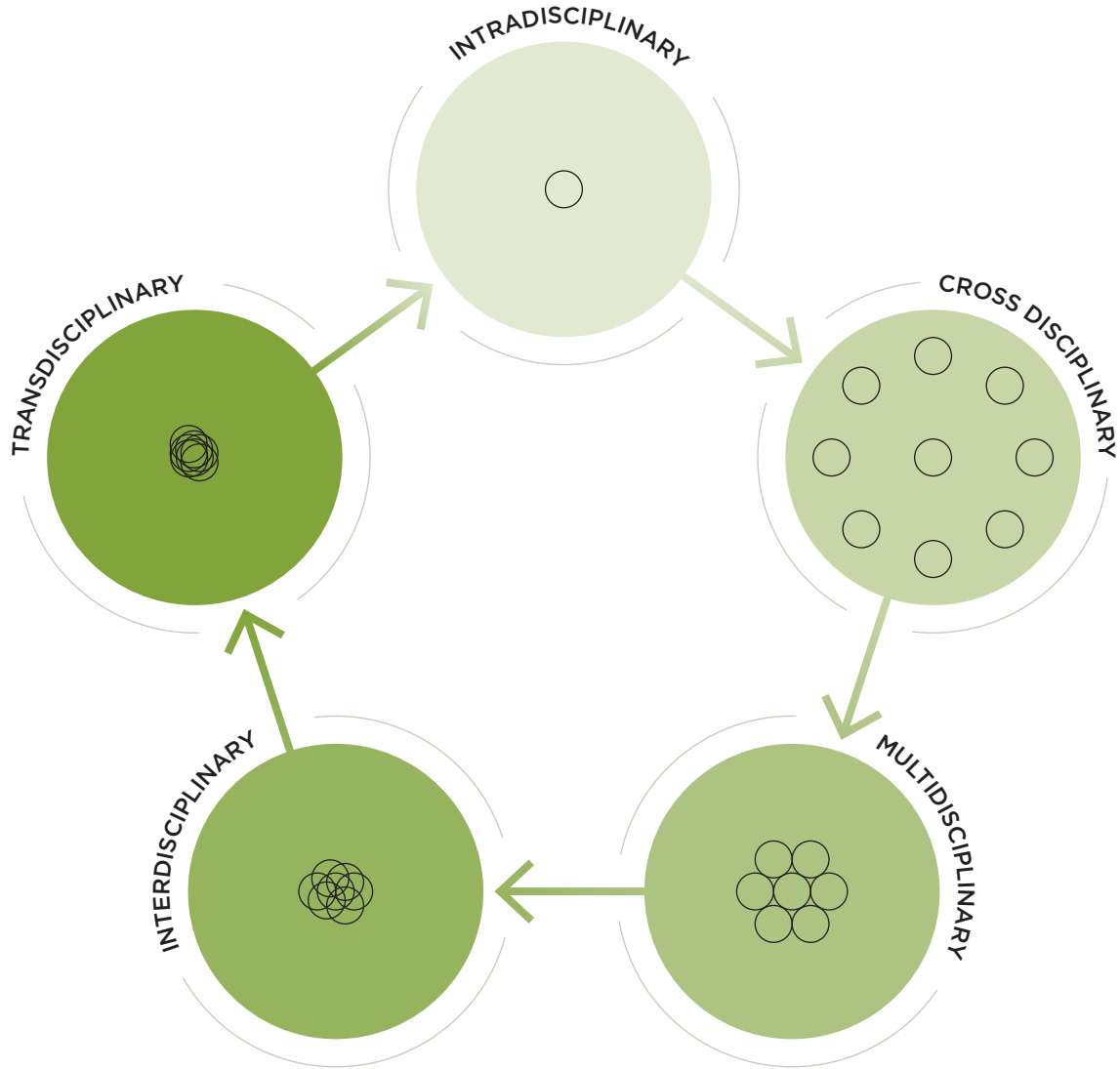
Intradisciplinary working

Definition: Working within a single discipline either as an individual or a collaboration of people from the same discipline.

Example: A team of hydrologists modelling water flows to understand future flood exposure.

Metaphorical example: Here we use a series of food orientated metaphors to provide further clarification of the different methods of working. Intradisciplinary working can be portrayed using a simple apple, it is one food type (to represent one discipline) standing alone.

Crossdisciplinary working

Definition: Working in one discipline with awareness of one or more other disciplines, sometimes using your discipline in the context of issues normally belonging to another. This approach rarely involves the deep engagement with expertise from another discipline. [4]

Example: The physics of music, whereby the physics researchers apply their standard approaches, for example around standing waves, to understand how musical sound is possible, but they may not learn much about music, and equally the endeavour does not enable musicians to undertake research into physics.

Metaphorical example: Cross disciplinary working can be portrayed using apple and cheese to represent two different disciplines which do not directly interact, but which benefit from the proximity, awareness or investigation of the other.

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4   Sierra, Marie; Wise, Kit; and Brewin, Ross, 2018. 'The Interdisciplinary Witness: Interdisciplinary Pedagogy and Speaking the New' in Sierra, Marie and Wise, Kit, Transformative Pedagogies and the Environment: Creative Agency Through Contemporary Art and Design. Champaign, IL: Common Ground Research Networks.

Multidisciplinary working

Definition: A process whereby people from different disciplines work together simultaneously or in close succession, sharing their disciplinary knowledge in a way which is additive rather than integrative. That is, the disciplinary perspectives are not changed by the process, only contrasted (Klein, 1990).

Example: Multi-disciplinary teams in healthcare ensure that all aspects of a case are reviewed in the best interests of the patient, but there is no expectation that the surgeon will learn how to do the physio's job or vice versa.

Metaphorical example: Multidisciplinary working can be portrayed using apple sauce and pork. In this case the two food types (disciplines) benefit from more active mixing.

Interdisciplinary working

Definition: Integrating knowledge and methods from different disciplines, using a true synthesis of two or more disciplines, leading to the establishment of a new level of discourse and integration of knowledge.[5] The collaboration between scientists from different disciplines with the goal of producing new knowledge" (van Rijnsoever and Hessels, 2011: 464).

Example: See Box 2

Metaphorical example: Interdisciplinary working can be portrayed using apple crumble as the two disciplines (apple and crumble) are integrally combined, but the individual parts can still be observed.

Transdisciplinary working

Definition: A holistic approach which creates a unity of intellectual frameworks beyond the disciplinary perspectives,[6] subordinating disciplines and resulting in an outcome which is not recognisable from the original parts (Klein, 1990).

Example: Early discussions of general systems theory when it was being held forward as a grand synthesis of knowledge.

Metaphorical example: Transdisciplinary working can be portrayed using apple cake where the component parts, or disciplines, can no longer be separately observed.

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5   Schuitema, G., Sintov, N., 2017. Should we quit our jobs? Challenges, barriers and recommendations for interdisciplinary energy research. Energy Policy, 101, 246-250.

6   Marilyn Stember (1991) Advancing the social sciences through the interdisciplinary enterprise, The Social Science Journal, 28:1, 1-14, DOI: 10.1016/0362-3319(91)90040-B.

Box 2: **Interdisciplinary example**

Jo Hodges and Robbie Coleman were artists on the Nil by Mouth project working with Soil Scientist Lorna Dawson. Lorna introduced Jo and Robbie to research into the health benefits of physical contact with soil. See the work here: **https://www.johodges.co.uk/gallery_697419.html** Specifically Lorna talked about research into Mycobacterium vaccae and how it has antidepressant effects because it stimulates the release of serotonin and norepinephrine in the brain. Jo and Robbie imagined how this might be translated into a therapy, and created an installation imagining the therapy suite. This piece proposes that as a therapy rather than simply getting out and gardening, getting your hands dirty, you'll enter a therapy suite and be exposed to the treatment by breathing in the active ingredient whilst listening to soothing sounds. This piece comes from a deep philosophical engagement with the issues, thinking about the value of different sorts of human experience. It was possible because a space was created where artists and scientists spent extended time together exchanging ways of working and aspects of their disciplines. The artists' shone a side light onto the soil science, opening up a different way of understanding not only the science, but also the way that science becomes everyday experience.

Accepting these definitions, it is clear that the majority of work that is often named as interdisciplinary is in fact multidisciplinary, with outcomes resulting from different disciplines but lacking true integration and new thinking in research or practice. Environmental Impact Assessment is a good example where we often say we are doing interdisciplinary working, but it is actually most often multi-disciplinary.

The terms are depicted as separate but in reality there is a continuous spectrum from intra-disciplinary through to transdisciplinary working, and projects and collaborations may shift between the different states during their lifetimes. In addition, although the terms are often presented in a linear or hierarchal fashion, one should not be considered to be preferable to another; each have a different and important role to play and the right model will depend on each individual project or programme. All methods should be viewed as complementary to pursuit of knowledge and not competitive or detrimental to the other. These approaches form a toolkit to select from according to the particular needs of the topic in hand.

Whilst the importance of the different terms and definitions is recognised, for the purpose of this report the term "interdisciplinary" is used in its broadest sense, encapsulating a range of activities from cross to multi to inter to trans. In this context it is defined as "projects that integrate both academic researchers from different unrelated disciplines and user-group participants to reach a common goal"[7].

7   Tress, B., Tress, G., van der Valk, A., & Fry, G. (2003). Interdisciplinary and transdisciplinary landscape studies: potential and limitations. Wageningen: Delta Program.

4. The positives and negatives of interdisciplinary working

Interdisciplinary approaches can prove interesting, frustrating, challenging and rewarding. To better understand the perceptions of interdisciplinary working, we asked the audience of the Valuing Nature Annual Conference (2019) to provide the first words which came into their mind when thinking about interdisciplinary working, particularly in the context of research and practice around valuing nature. A total of 110 words were used to describe interdisciplinary work as depicted in **Figure 3.** Eighty two (82%) of responses were considered positive, 5% negative and 12% neither positive nor negative.

The most commonly used word was *"Challenging"* with 1 in 10 participants using this word to describe their experience of interdisciplinary work. For context, examples of answers including the word challenging were: (i) Fun Challenging Stimulating Vital, (ii) Important Challenging Exciting Innovative, and (iii) Rewarding Challenging Important. This context demonstrates that the word *"Challenging"* was often used in a positive way. Participants also highlighted *"Important", "Essential"* and *"Necessary"* as key words, supporting a strong need for this type of integrative work at the current time. The key words that described the negative aspects of the interdisciplinary work were *"Difficult"* and *"Time-consuming".*

Figure 3: A diagrammatic representation of the words used to describe interdisciplinary working, with the size of the word corresponding to frequency of use.

Positives of interdisciplinary work have been previously documented to include, better problem identification, better solutions and better engagement with stakeholders. This is in addition to opening up new funding avenues, providing intellectual stimulation, and fundamentally being fun to undertake. To validate and further explore these suggestions, the Valuing Nature audience was again surveyed with the majority believing that interdisciplinary work can provide better solutions **(Figure 4).**

There was also some interesting variation in the opinions of people from different backgrounds. Amongst "academia", "government" and "NGO" participants, the most common positive reason cited, related to the intellectual stimulation afforded by interdisciplinary working, while for "business" participants "engaging stakeholders" was viewed as more important. An open discussion session led to a number of additional positive factors also being suggested, including: (i) added value of interdisciplinary working in terms of recognising the limitations of one's own discipline; (ii) providing longer lasting solutions to environmental challenges; (iii) establishing a shared language between researchers and policymakers; and (iv) challenging the research community to sharpen disciplinary approaches and deliver applied and actionable knowledge.

Figure 4: What are the positives of interdisciplinary working?

Note: multi-code question
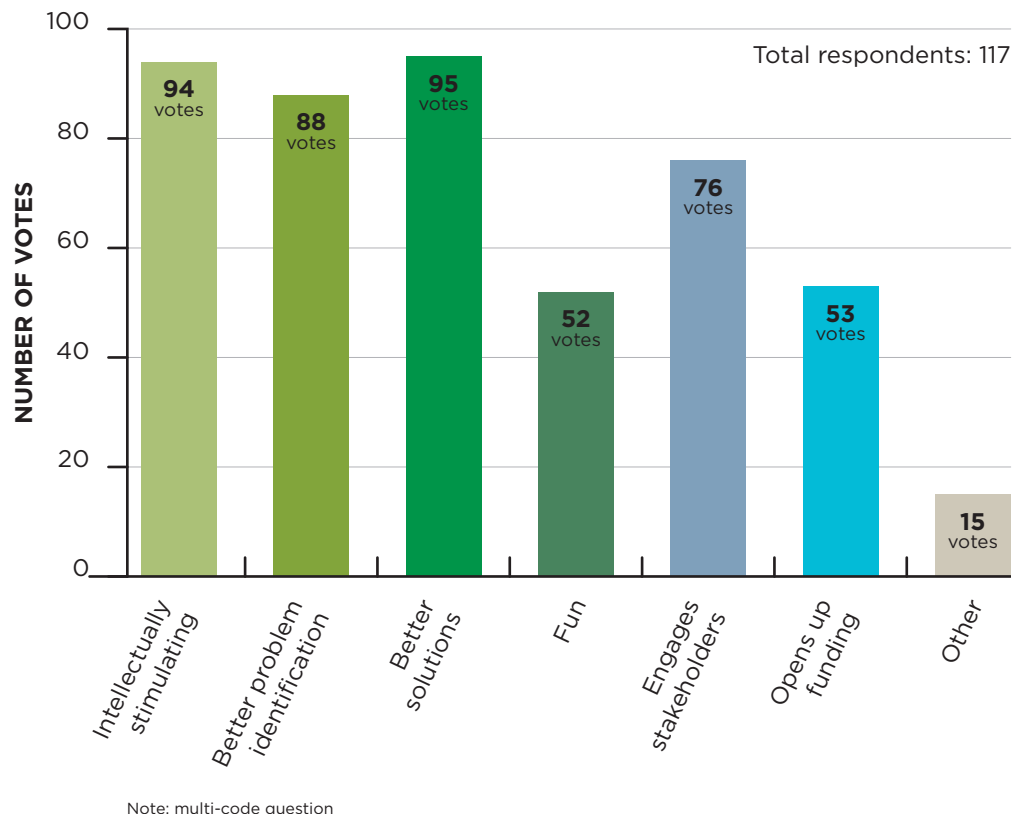
> **Interdisciplinary working is never boring or dull! But its benefits are great and many — inspiration, different ways of thinking and working, etc.**
> VNP/CoastWEB team

Box 3: **Interdisciplinary working can light up dark spaces**

Single discipline working has clear advantages *"but it also creates blind spots, eddies of ignorance in epistemological space, which can only be perceived from another perspective. This is interesting... because it shifts the emphasis of interdisciplinarity from the purloining of other disciplines' methods in the hope that you can apply them within your own discipline, to illuminating, by the methods of one's own discipline, what those other disciplines may be methodologically unable to access."* (Macdonald nd, np)

> **Fun, as it is really interesting and sometimes a great relief to learn of the approaches and concepts of other disciplines.** VNP/CoastWEB team

> **I have been involved in a series of interdisciplinary projects at the EU level and the outcomes have been very 'lucrative' in terms of 'impact' — i.e. the interdisciplinary seem to 'breed' linkage with stakeholders and update in the policy, planning, and commercial sectors...** VNP/CoastWEB team

> **❝ The relationship was especially extremely enriching. ❞**
> VNP/CoastWEB team

As with positive aspects, a number of negative attributes have been previously associated with interdisciplinary working. These include, that it is time consuming, frustrating and confusing. Additionally, interdisciplinary practitioners have reported that it can dilute disciplinary research, is not respected and can be hard to publish in academic journals. It has also been reported that it can be hard to select the right mix of disciplines to address a particular question.

Again, to explore the validity of these claims, the survey asked Valuing Nature Annual Conference (2019) participants to select which options applied. The results indicate that a substantial majority felt that the time consuming nature of interdisciplinary working is the main negative factor, with very little differentiation across the different backgrounds of survey respondents, see **Figure 5.** In the following open discussion, additional negatives were also raised around the conflicting priorities of disciplines, which can make it difficult to achieve a consensus and reach conclusions. Moreover, some respondents highlighted the difficulties of writing proposals and planning the work programme in advance, without necessarily knowing what the positive synergy of interdisciplinary working will be and therefore somewhat asking funders to 'take our word for it'.
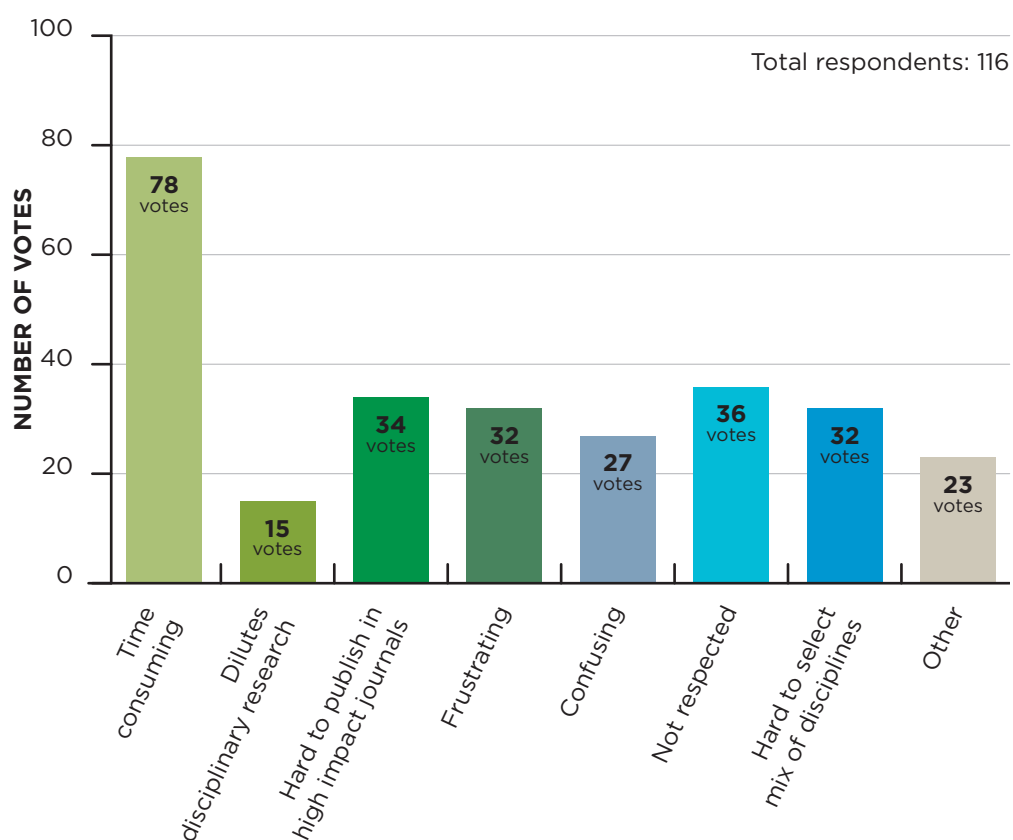
> **❝ The main difficulty for me is where there can be a fundamental misunderstanding of my role and skill set and this is where I am frequently expected to make difficult data accessible or act as an illustrator or designer. ❞** VNP/CoastWEB team

> **❝** Frustrating, as sometimes language and different concepts can make progress slow and communication difficult. **❞**
>
> VNP/CoastWEB team

Figure 5: What are the negatives of interdisciplinary working?

Total respondents: 116

NUMBER OF VOTES

- Time consuming — **78** votes
- Dilutes disciplinary research — **15** votes
- Hard to publish in high impact journals — **34** votes
- Frustrating — **32** votes
- Confusing — **27** votes
- Not respected — **36** votes
- Hard to select mix of disciplines — **32** votes
- Other — **23** votes

Note: multi-code question

> **❝** The assumption of what I can bring to the table can be rather simplistic. I think that my role in a project such as this is to shed a different light upon the study. **❞** VNP/CoastWEB team

5. Barriers to interdisciplinary working

A broad range of barriers to interdisciplinary working were identified from Valuing Nature Annual Conference survey **(see Figure 6),** and from the feedback from the interdisciplinary research teams of the VNP funded projects. These include the following:

i. **Inadequate communication:** The absence of a common language between disciplines can be highly problematic leading to misunderstandings and requiring considerable time and effort to overcome. Differing habits between disciplines can also hamper communication, including different time scales and publication and conference styles.

ii. **Poor understanding of 'the other':** Poor familiarity with other disciplines can cause issues of not knowing which discipline to work with, and also in some cases can lead to a lack of respect and incorrect assumptions. This is exacerbated by not knowing where to look to find out about other disciplines and individuals / organisations due in part to an absence of appropriately structured and supported networking opportunities. For example, at conferences with mixed disciplines, break out and non-plenary sessions are often organised by discipline, thereby forcing people to remain in their disciplinary silo. It is also difficult to rapidly gain an overview of other disciplines and sometimes, what might be assumed as novel, will have already been explored at length, leading to time lost to re-inventing wheels.

❝ Difficult to do any interdisciplinary work within the standard UK funding routes, still... Largely because peer-review is fraught with problems... **❞**
VNP/CoastWEB team

> **❝** You're almost expected to identify with a 'main'
> discipline however interdisciplinary you are. **❞**
> VNP/CoastWEB team

iii. **Lack of time and facilitation:** Interdisciplinary working often requires more time in comparison to interdisciplinary work. Given busy schedules it is easy to neglect the time that is required to build strong and successful interdisciplinary partnerships. It can also be difficult to manage interdisciplinary teams and keep everyone focused on the bigger picture and end goal, which may be more challenging than retreating into disciplinary silos.

iv. **Narrow Academic Training:** Education from the start doesn't encourage interdisciplinary working as we are often forced to choose between social and natural sciences at a young age. University-level systems are also not fully adapted to cultivate interdisciplinary research(ers), for example inter-department activities and placements[8] are often the exception rather than the norm, and the evaluation of PhDs is complex if research stretches across disciplines, as evaluation criteria tend to be discipline specific.
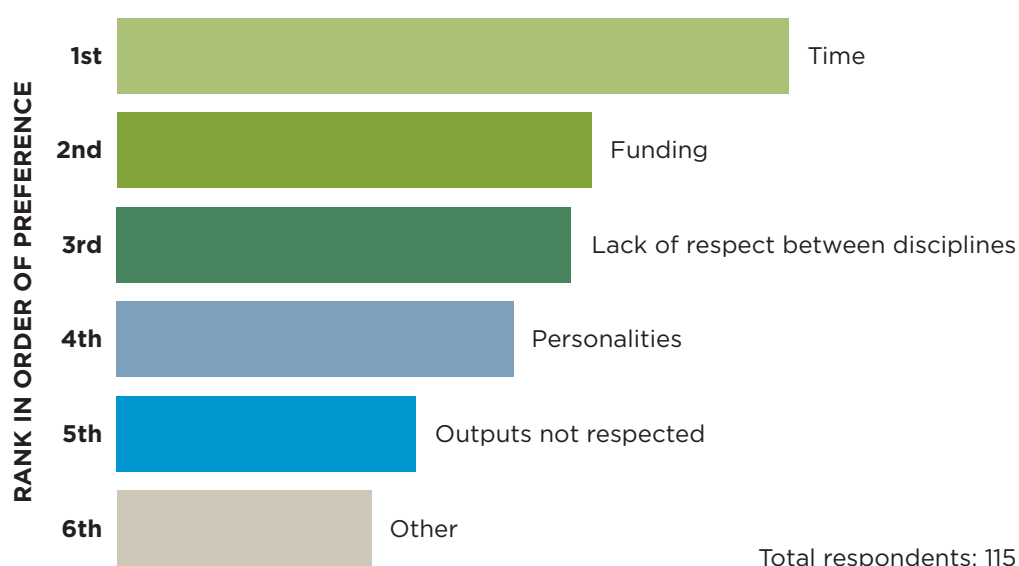
8 https://valuing-nature.net/
   valuing-nature-placements

> **❝** The language and working method can initially
> prove a barrier to communication making it mutually
> problematic to establish a basis upon which
> collaboration can take place. **❞** VNP/CoastWEB team

v. **Funding constraints:** Funding is a major barrier, with limited funding being available for interdisciplinary research and not proportionally / equally distributed over disciplines. The issue is exacerbated as funding evaluation criteria are rarely designed to be sensitive to evaluating interdisciplinary research, and the review process has been established primarily to assess single discipline applications.

vi. **Impediment to career progression:** There is an absence of incentives to engage in interdisciplinary research, which can imply extra costs and fewer rewards for researchers, which is particularly problematic for early stage career researchers torn between pursuing interdisciplinary research or mono-disciplinary publications.[9] In some disciplines it can be considered a reputational risk to engage in interdisciplinary research. Furthermore, as single discipline research is dominant it can be necessary to forge your own career path to be interdisciplinary.

vii. **Current evaluation of 'success':** There is a lack of a framework to judge the success of interdisciplinary work and the usual metrics do not always transfer across. Standard research metrics, such as publications and institutional rewards tend to favour mono-disciplinary research in the short term. Similarly in other non-academic environments there are disciplinary gate keepers at higher levels of decision making who don't like or understand analysis that feels 'too different'.

9 Schuitema, G., Sintov, N., 2017. Should we quit our jobs? Challenges, barriers and recommendations for interdisciplinary energy research. Energy Policy, 101, 246-250.

Figure 6: What are the barriers to interdisciplinary working?

RANK IN ORDER OF PREFERENCE

1st — Time
2nd — Funding
3rd — Lack of respect between disciplines
4th — Personalities
5th — Outputs not respected
6th — Other

Total respondents: 115

6. Solutions to interdisciplinary working

10 Assmuth, T. and Lyytimäki, J., 2015. Co-constructing inclusive knowledge within converging fields: Environmental governance and health care. Environmental Science & Policy, 51, pp.338-350.

11 Energy Research & Social Science Volume 25, March 2017, Pages 9-18

Original research article
The reality of cross-disciplinary energy research in the United Kingdom: A social science perspective

B.Mallaband, G.Wood, K.Buchanan, S.Staddon, N.M.Moglese, E. Gabe-Thomas

https://doi.org/10.1016/
j.erss.2016.11.001

Following the identification of barriers it is possible to determine potential solutions to encourage more successful interdisciplinary working in the future. Solutions include:

i. **Enhanced communication:** Expending time and resource on communication is a key solution, in addition to sharing case studies, templates, experiences and examples of how to work in an interdisciplinary manner. Sharing where interdisciplinary working has been a success will encourage further application (Assmuth, T. and Lyytimäki, J., 2015),[10] but sharing failures is also important to enable learning and to prevent the repetition of the same mistakes. There is a tendency to undertake interdisciplinary work and reflect on it afterwards, but it is recommended to actively promote continuous communication, within-project learning, and ongoing reflection.[11]

ii. **Improving understanding of 'the other':** Improved understanding of 'the other' can be achieved through the investment of time, patience and funded support to provide a space to understand different disciplines' languages, working habits and 'success criteria'. In addition, the formation of new networks should be actively enabled and institutional management needs to acknowledge the complexities of interdisciplinary work, including providing time and resources for these interactions. Some recent funding schemes have provided a valuable template in providing networking opportunities prior to proposal development, where people can learn about other disciplines within the context of the 'problem' or 'question' being posed.

> **"** I have just submitted a marie curie application that has a strong natural but also a strong social component. I would have never done it before, if I hadn't been interacting with social scientists. **"**
> VNP/CoastWEB team

iii. **Time allowance and active facilitation:** The need for additional time is a repeating theme, as is the requirement for considered preparation and facilitation. Core initial activities should include: selecting appropriate group members; establishing ground rules; and explicating and bridging epistemological and methodological differences.[12] Every member of an interdisciplinary team should be clear and in agreement about the ultimate goal from the start regardless of conflicting priorities. Equally there needs to be acceptance that an interdisciplinary team might also discover a different 'big picture' and define a different goal during the project term, precisely because there is an aspect of 'not knowing' inherent in interdisciplinary working.

iv. **Revised academic training:** Training in how to conduct interdisciplinary research is much needed and should start early to properly equip academics and user groups. Training should establish a foundational understanding of different research epistemologies, methodologies, research traditions, goals and outcomes. Formal and on-the-job interdisciplinary training needs to start early and focus on cross-cutting knowledge and skills whilst also allowing individuals to develop their own expertise.

❝ The way I look at ecosystems has changed as a result of interacting with social scientists. Before, I looked at ecosystems as if they were in an ideal/pristine world. I was interested in understanding the functioning of biological interactions alone (it's still what I love the most), but I now realise that the social component is as key as the natural. ❞ VNP/CoastWEB team

v. **New approaches to funding:** Funding schemes should stimulate interdisciplinary research and include truly interdisciplinary committees for the reviewing of research funding proposals. Interdisciplinary proposals should be evaluated based on scientific rigour, the establishment of a new level of discourse, and true integration of knowledge. Acceptance of a requirement for funding for additional time and activities to deepen interdisciplinary collaborations is encouraged. This interdisciplinary funding should prioritise MSc, PhD and Early Career researchers, if a sustainable shift in the extent and success of interdisciplinary working is to be achieved.

vi. **Changes to career progression:** To equalise the opportunities for intra disciplinary and interdisciplinary working, the conceptualisation of new practices and incentive structures among academic institutions, funding agencies, and publication outlets will be required. Research employee evaluation criteria should be made common to align interdisciplinary activities with expectations of departments and universities.

vii. **New methods to evaluate 'success':** Improved metrics and criteria for measuring the success of interdisciplinary working should be developed, including enduring evaluation approaches that recognise the added value of interdisciplinary work. Evaluation criteria of researchers' output, contribution and quality should be comparable across disciplines rather than based on unique standards of single disciplines. Publishing interdisciplinary work within single discipline journal should also be supported through the engagement of academic publishers, particularly where this work articulates new viewpoints and/or insights. Wider exposure to current or new interdisciplinary journals, such as People and Nature, is also beneficial.

Figure 7: What are the solutions to support the interdisciplinary work?

RANK IN ORDER OF PREFERENCE

1st	More programmes like Valuing Nature
2nd	Projects that last longer
3rd	Increased funding
4th	More good practice examples
5th	Greater respect between disciplines
6th	Publish more interdisciplinary research
7th	Other

Total respondents: 113

> " The result are several collaborations, that were not even in the project call, but that are truly interdisciplinary and exciting — This wouldn't have occurred to us, if it hadn't been for the different views I have as a natural scientist (and a bit idealistic natural scientist) compared to the pragmatic views of the social fellow. "
>
> VNP/CoastWEB team

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