Hypothesis in ERC – How to do it right

The highly prestigious ERC grant has a list of explicitly mentioned requirements that applicants must ensure to include in their project application. In addition to these, we know from our ongoing experience that there also exist various "unwritten" and elusive ERC expectations which reviewers will oftentimes look for as well. We recommend also taking these expectations into account when constructing your ERC application.

One such expectation is for researchers to present hypothesis-driven research. Our hands-on experience shows this expectation to be sustainable and explicit in Evaluation Summary Reports (ESRs) of ERC applications across the different panels, for both awarded and rejected applications. In these reports, reviewers tied the hypothesis, directly to the ground-breaking nature of the project, its impact and ambition level, and referred to it as a key indicator of the competitiveness of the proposal. Respectively, we also saw reports that addressed the absence of a hypothesis as an indication to a potentially less competitive proposal.

We have come to note that for many applicants, constructing a hypothesis for their research is somewhat out of their 'comfort zone', and therefore proves to be a more challenging process than expected. To help applicants on their path to

hypothesis-driven research, we provide a set of helpful guidelines. These will help you in drafting a hypothesis at the expected ERC level.

Breaking down the components of a Hypothesis

A good research hypothesis guides the research plan. By "good hypothesis" we refer to one which represents a cause-and-effect scenario, which can be represented in the form of the following generalized statement:

If **[(***validated***)***A***]** *consequently* **[***B***]**

Legend:
- [(Validated) A] indicates the relevant variables for the research and the relations between them, to be validated.
- [B] is the predicted outcome (the "prediction"), which is expected to be the consequence of [(validated) A].

More specifically – a good hypothesis should clearly present the variables for exploration, allow a comparison between these variables, validate the relations and, last but not least, offer a daring prediction about the potential outcome of this process.

Let's further understand each aspect of the hypothesis (variables, relations, & prediction), how to present each one in the most competitive manner in grant applications, and how this translates into the project's methodology building blocks.

Variables

Variables are the subject of exploration. Exploring them will guide both the specific research at hand and impact the overall research landscape. Selection of these variables should derive from the underlying theory that led to the creation of the research hypothesis in the first place. The chosen methodology should utilize the relevant tools with which it is possible to both test these variables, and validate the relations between them.

Relation(s) between the variables

Validating the relation(s) between the variables is the main hypothesis exploration process. Therefore, the process must be well defined and reflect motivation, rationale, and the ambitious nature of the project.

Prediction

A good hypothesis presentation is reflected through the significant scientific challenges and conceptual risks involved. The prediction should be daring, focused, novel, and represent the nature of the underlying theory. It should be of significant value to the project as well as to the scientific landscape, whether it is confirmed or refuted.

The expectation is that the presented **methodology** of the ERC project will enable the entire process of exploring the **variables** and the **relations**, and testing the **prediction**.

The prediction should be both based (to some extent) on preliminary findings, and also reflect novel and daring attributes that aim for a significant leap forward from the available knowledge (including the preliminary findings) in an unprecedented manner.

In this context, be aware of this important note: if the outcome of the hypothesis exploration process of the *variables* and the *relations* only *reassures* the knowledge stemming from the preliminary findings (or other state-of-the-art knowledge), this may render the hypothesis to be weak and non-competitive. In line with this, any prior knowledge of the outcome of the *prediction's* testing may render the hypothesis to be less competitive as well.

Why is hypothesis-driven research important in ERC? How does this link to presenting the methodology?

ERC aims higher than any other grant, with the intent to fund frontier research that can lead to paradigm shifts, ground-breaking discoveries, and/or significant scientific breakthroughs. In this context, it is important to understand how the high-risk / high-gain requirements link to the unofficial expectation of presenting hypothesis-driven research in ERC proposals.

High-Risk

Research at the expected ERC level must be high-risk in nature. Projects that aim lower are simply irrelevant by ERC standards. What is the connection between hypothesis-driven research and the expected high-risk? To start, a good scientific hypothesis, by definition, can either be proven **right** or **wrong**. This creates an inherent level of uncertainty which increases the risk associated with the project. If there is high certainty that the hypothesis will be proven right (as expected in other research schemes), it means that it is not risky enough for ERC. In other words, the expectation is to have a hypothesis that is likely to succeed as much as it is likely to fail.

For the risk to be inherent to the hypothesis, the proposition should be ambitious and creative, yet feasible. It should present a novel perspective and explanation of the research problem.

Finally, it should be reflected in the ERC project proposal through the combination of layers detailed above, as explained here:

- The selection of the variables: Ask yourself: How broad is the landscape to which the variables can relate? Why haven't they been studied before? Why aren't they trivial?
- The relation between them: Does the proposed relation between the variables address a fundamental question in the field? Why is this crucial? Why is it not stating the obvious?
- The prediction: How bold is the presented prediction? What are its chances of failing? Why is this causation radical? How fundamental can the insights generated by this causation be to the field?

Constructing the equation of causality should reflect the hypothesis ambition and risk level. However, one should note that while striving for a high-risk project, it is important not to present a hypothesis that is too ambitious, rendering the project unrealistic or unfeasible.

High-Gain

In addition to the high-risk factor we explored above, an ERC project is also expected to produce a high-gain outcome with ground-breaking impact. In order to present an ERC project with the potential for this type of high-gain, the hypothesis should address a significant knowledge gap or major challenge, and present novel ways to tackle these. Pursuing the hypothesis should lead to major breakthroughs, pushing the current research boundaries and going considerably beyond previous research attempts.

Further, it should indicate not only the project's potential to be disruptive to the field but possibly to other fields as well, indicating the project's added value to the bigger picture. When constructed correctly, impact will be achieved whether the hypothesis is verified or refuted, as any of the events should lead to fundamental insights. This is in line with ERC's expectation for open-ended research as well. As the hypothesis illustrates the new path to take, it can imply to potential other future directions and questions. Namely, the initial assumptions themselves should encourage the discovery process, as they indicate the potential for further investigation.

Guidelines for hypothesis in ERC

For all of the above to be accomplished, we have curated the following guidelines which can assist you in forming and showcasing the desired hypothesis for ERC:

Conceptual guidelines-

- First, identify a major unresolved research question or a significant gap in a specific body of research.
- Then, attempt to tentatively answer this question in the form of a hypothesis (prediction or a statement).
- Make sure not to confuse the hypothesis with the project's mission statement. The hypothesis is the underlying assumption on which the project's aim is built.
- Note that not every argument is a hypothesis, but rather the argument should consist of the conditions explained in this article.
- Make sure that the hypothesis reflects the theory on which it is based and makes it easy to envision how it fits into the "big picture".
- The hypothesis should, on one hand, reflect the conceptual risk in the selected research path. On the other hand, it should be sufficiently supported by preliminary results.
- The hypothesis should not be too narrow (focused on a specific aspect) as this may result in a limited project scope and thus limited risk and gain.
- The hypothesis should not be too general, as this would limit the potential gain of testing it.

- It should provide a clear presentation of the causal or correlational relations using identified variables in a direct and explicit way.

Operational guidelines –

- Demonstrate the ability of the hypothesis to be tested, and either verified or refuted.
- Avoid "fishing expeditions" as they are, by definition, not hypothesis-driven.
- Make sure to have a clear distinction between the research question, the hypothesis and the mission statement (objectives and goals).
- When drafting the theoretical reasoning and rationale behind the novel hypothesis, avoid being occupied with collecting preliminary evidence that would automatically support it, diminishing the risk. Instead, face alternative hypotheses to crystallize the potential ground-breaking nature of the scientific claim. This, in turn, should demonstrate the PI's creativity and dynamic thinking, which is by nature important in dealing with uncertainties.

Exceptions in ERC applications – When not to include a hypothesis.

There are some cases in which a hypothesis is not expected nor needed for the ERC application. These cases are typically discipline-oriented. Disciplines such as Engineering, Computer Sciences, Law, Earth observation, materials, etc., are not

used to working with hypotheses, and as a result hypothesis-driven research is not expected when applying to ERC in these disciplines. In these cases – it is recommended simply to not include one.

If the application does not call for a hypothesis, the project's potential to generate fundamental breakthroughs should be reflected by other means. Proposing a novel approach for tackling a given subject or condition, or using a method that in itself presents a radical shift in light of what has previously been done, without a hypothesis as part of the process, will meet this expectation. The elemental requirement which one should keep in mind is presenting a substantial innovation which implies a clear potential to generate ground-breaking insights that should be disruptive to the field.

However, we must clarify that the exception presented above does not apply to applicants who are not used to working with hypothesis, but at the same time it is a recognized working tool in their discipline. In such cases, the expectation from these researchers would be to present a hypothesis-driven project, even if they are not used to it.

Given the above exception, your first step would be to understand if your ERC application should be hypothesis-driven, or whether a different approach needs to be implemented. There is no "one size fits all" answer to these cases, and each project will eventually need to be evaluated given its own unique parameters and goals.

Conclusion

Structuring a hypothesis in your ERC application (if expected), given the fine inherent balances of the ERC requirements, as well as the various nuances of each research discipline, is a challenging task. With the help of our above-mentioned guidelines and additional points, you can begin to draft a hypothesis for your ERC application. It is important to keep in mind that a successfully constructed hypothesis is essential to an overall successful ERC application, but it is only one of the critical elements. Writing a successful ERC proposal requires substantial preparation. Our ERC Knowledge Base can be a first step as it includes a wide selection of articles and guides that can help you throughout the entire ERC proposal preparation process. Next, we invite you to refer as well to our comprehensive ERC course, and our ERC proposal preparation services.