I'm not a bot

Presenter 1: We are going to look at the two words "prediction" and "hypothesis". It's important to know the difference between them.Presenter 2: A hypothesis is an idea about how something works that can be tested using experiments.Presenter 1: A prediction is a statement of what we think will happen if the hypothesis is correct.Presenter 2: So you use your hypothesis to make a prediction.Student 1: I reckon, because there's more oxygen, it'll last longer. So, I'm thinking maybe 40 seconds?Presenter 1: Here, my hypothesis is that the more air and oxygen candles have, the longer they stay alight.Presenter 2: So, if my hypothesis is correct, then my prediction is that candles in larger measuring beakers will burn for longer.Presenter 1: As the volume of air increases, then the time the candle takes to go out also increases. Our graph shows us the pattern in our results.Presenter 2: The bigger the measuring beaker, the more air and the longer the candle burnt.Presenter 1: So, we have seen an experiment looking at how long a candle burns under different beakers.Presenter 2: We have formed a hypothesis and then we have tested it, looking at the difference between the meaning of the word "hypothesis" and the word "prediction". As a library, NLM provides access to scientific literature. Inclusion in an NLM database does not imply endorsement of, or agreement with, the contents by NLM or the National Institutes of Health. Learn more: PMC Disclaimer | PMC Copyright Notice . 2021 Nov 24;36(50):e338. doi: 10.3346/jkms.2021.36.e338Generating a testable working hypothesis is the first step towards conducting original research. Such research may prove or disprove the proposed hypothesis. Case reports, case series, online surveys and other observational studies, clinical trials, and narrative reviews help to generate hypotheses. Observational and interventional studies help to test hypotheses. A good hypothesis is usually based on previous evidence-based reports. Hypotheses without evidence-based justification and a priori ideas are not received favourably by the scientific community. Original research to test a hypothesis should be carefully planned to ensure appropriate methodology and adequate statistical power. While hypotheses can challenge conventional thinking and may be controversial, they should not be destructive. A hypothesis should be tested by ethically sound experiments with meaningful ethical and clinical implications. The coronavirus disease 2019 pandemic has brought into sharp focus numerous hypotheses, some of which were proven (e.g. effectiveness of corticosteroids in those with hypoxia) while others were disproven (e.g. ineffectiveness of hydroxychloroquine and ivermectin).Keywords: Hypotheses, Research Ethics, Study Design, PandemicScience is the systematized description of natural truths and facts. Routine observations of existing life phenomena lead to the creative thinking and generation of ideas about mechanisms of such phenomena and related human interventions. Such ideas presented in a structured format can be viewed as hypotheses. After generating a hypothesis, it is necessary to test it to prove its validity. Thus, hypothesis can be defined as a proposed mechanism of a naturally occurring event or a proposed outcome of an intervention.1,2Hypothesis testing requires choosing the most appropriate methodology and adequately powering statistically the study to be able to prove or disprove it within predetermined and widely accepted levels of certainty. This entails sample size calculation that often takes into account previously published observations and pilot studies.2,3 In the era of digitization, hypothesis generation and testing may benefit from the availability of numerous platforms for data dissemination, social networking, and expert validation. Related expert evaluations may reveal strengths and limitations of proposed ideas at early stages of post-publication promotion, preventing the implementation of unsupported controversial points.4Thus, hypothesis generation is an important initial step in the research workflow, reflecting accumulating evidence and experts' stance. In this article, we overview the genesis and importance of scientific hypotheses and their relevance in the era of the coronavirus disease 2019 (COVID-19) pandemic.Broadly, research can be categorized as primary or secondary. In the context of medicine, primary research may include real-life observations of disease presentations and outcomes. Single case descriptions, which often lead to new ideas and hypotheses, serve as important starting points or justifications for case series and cohort studies. The importance of case descriptions is particularly evident in the context of the COVID-19 pandemic when unique, educational case reports have heralded a new era in clinical medicine.5Case series serve similar purpose to single case reports, but are based on a slightly larger quantum of information. Observational studies, including online surveys, describe the existing phenomena at a larger scale, often involving various control groups. Observational studies include variable-scale epidemiological investigations at different time points. Interventional studies detail the results of therapeutic interventions.Secondary research is based on already published literature and does not directly involve human or animal subjects. Review articles are generated by secondary research. These could be systematic reviews which follow methods akin to primary research but with the unit of study being published papers rather than humans or animals. Systematic reviews have a rigid structure with a mandatory search strategy encompassing multiple databases, systematic screening of search results against pre-defined inclusion and exclusion criteria, critical appraisal of study quality and an optional component of collating results across studies quantitatively to derive summary estimates (meta-analysis).6 Narrative reviews, on the other hand, have a more flexible structure. Systematic literature searches to minimise bias in selection of articles are highly recommended but not mandatory.7 Narrative reviews are influenced by the authors' viewpoint who may preferentially analyse selected sets of articles.8In relation to primary research, case studies and case series are generally not driven by a working hypothesis. Rather, they serve as a basis to generate a hypothesis. Observational or interventional studies should have a hypothesis for choosing research design and sample size. The results of observational and interventional studies further lead to the generation of new hypotheses, testing of which forms the basis of future studies. Review articles, on the other hand, may not be hypothesis-driven, but form fertile ground to generate future hypotheses for evaluation. Fig. 1 summarizes which type of studies are hypothesis-driven and which lead on to hypothesis generation.A review of the published literature did not enable the identification of clearly defined standards for working and scientific hypotheses. It is essential to distinguish influential versus not influential hypotheses, evidence-based hypotheses versus a priori statements and ideas, ethical versus unethical, or potentially harmful ideas. The following points are proposed for consideration while generating working and scientific hypotheses.1,2Table 1 summarizes these points.Points to be considered while evaluating the validity of hypothesesBacked by evidence-based dataTestable by relevant study designsSupported by preliminary (pilot) studiesTestable by ethical studiesMaintaining a balance between scientific temper and controversyA scientific hypothesis should have a sound basis on previously published literature as well as the scientist's observations. Randomly generated (a priori) hypotheses are unlikely to be proven. A thorough literature search should form the basis of a hypothesis based on published evidence.7Unless a scientific hypothesis can be tested, it can neither be proven nor be disproven. Therefore, a scientific hypothesis should be amenable to testing with the available technologies and the present understanding of science.If a hypothesis is based purely on a novel observation by the scientist in question, it should be grounded on some preliminary studies to support it. For example, if a drug that targets a specific cell population is hypothesized to be useful in a particular disease setting, then there must be some preliminary evidence that the specific cell population plays a role in driving that disease process.The hypothesis should be testable by experiments that are ethically acceptable.9 For example, a hypothesis that parachutes reduce mortality from falls from an airplane cannot be tested using a randomized controlled trial.10 This is because it is obvious that all those jumping from a flying plane without a parachute would likely die. Similarly, the hypothesis that smoking tobacco causes lung cancer cannot be tested by a clinical trial that makes people take up smoking (since there is considerable evidence for the health hazards associated with smoking). Instead, long-term observational studies comparing outcomes in those who smoke and those who do not, as was performed in the landmark epidemiological case control study by Doll and Hill,11 are more ethical and practical.Novel findings, including novel hypotheses, particularly those that challenge established norms, are bound to face resistance for their wider acceptance. Such resistance is inevitable until the time such findings are proven with appropriate scientific rigor. However, hypotheses that generate controversy are generally unwelcome. For example, at the time the pandemic of human immunodeficiency virus (HIV) and AIDS was taking foot, there were numerous deniers that refused to believe that HIV caused AIDS.12,13 Similarly, at a time when climate change is causing catastrophic changes to weather patterns worldwide, denial that climate change is occurring and consequent attempts to block climate change are certainly unwelcome.14 The denialism and misinformation during the COVID-19 pandemic, including unfortunate examples of vaccine hesitancy, are more recent examples of controversial hypotheses not backed by science.15,16 An example of a controversial hypothesis that was a revolutionary scientific breakthrough was the hypothesis put forth by Warren and Marshall that Helicobacter pylori causes peptic ulcers. Initially, the hypothesis that a microorganism could cause gastritis and gastric ulcers faced immense resistance. When the scientists that proposed the hypothesis themselves ingested H. pylori to induce gastritis in themselves, only then could they convince the wider world about their hypothesis. Such was the impact of the hypothesis was that Barry Marshall and Robin Warren were awarded the Nobel Prize in Physiology or Medicine in 2005 for this discovery.17,18Influential hypotheses are those that have stood the test of time. An archetype of an influential hypothesis is that proposed by Edward Jenner in the eighteenth century that cowpox infection protects against smallpox. While this observation had been reported for nearly a century before this time, it had not been suitably tested and publicised until Jenner conducted his experiments on a young boy by demonstrating protection against smallpox after inoculation with cowpox.19 These experiments were the basis for widespread smallpox immunization strategies worldwide in the 20th century which resulted in the elimination of smallpox as a human disease today.20Other influential hypotheses are those which have been read and cited widely. An example of this is the hygiene hypothesis proposing an inverse relationship between infections in early life and allergies or autoimmunity in adulthood. An analysis reported that this hypothesis had been cited more than 3,000 times on Scopus.1The COVID-19 pandemic devastated the world like no other in recent memory. During this period, various hypotheses emerged, understandably so considering the public health emergency situation with innumerable deaths and suffering for humanity. Within weeks of the first reports of COVID-19, aberrant immune system activation was identified as a key driver of organ dysfunction and mortality in this disease.21 Consequently, numerous drugs that suppress the immune system or abrogate the activation of the immune system were hypothesized to have a role in COVID-19.22 One of the earliest drugs hypothesized to have a benefit was hydroxychloroquine. Hydroxychloroquine was proposed to interfere with Toll-like receptor activation and consequently ameliorate the aberrant immune system activation leading to pathology in COVID-19.22 The drug was also hypothesized to have a prophylactic role in preventing infection or disease severity in COVID-19. It was also touted as a wonder drug for the disease by many prominent international figures. However, later studies which were well-designed randomized controlled trials failed to demonstrate any benefit of hydroxychloroquine in COVID-19.23,24,25,26 Subsequently, azithromycin27,28 and ivermectin29 were hypothesized as potential therapies for COVID-19, but were not supported by evidence from randomized controlled trials. The role of vitamin D in preventing disease severity was also proposed, but has not been proven definitively until now.30,31 On the other hand, randomized controlled trials identified the evidence supporting dexamethasone32 and interleukin-6 pathway blockade with tocilizumab as effective therapies for COVID-19 in specific situations such as at the onset of hypoxia.33,34 Clues towards the apparent effectiveness of various drugs against severe acute respiratory syndrome coronavirus 2 in vitro but their ineffectiveness in vivo have recently been identified. Many of these drugs are weak, lipophilic bases and some others induce phospholipidosis which results in apparent in vitro effectiveness due to non-specific off-target effects that are not replicated inside living systems.35,36Another hypothesis proposed was the association of the routine policy of vaccination with Bacillus Calmette-Guerin (BCG) with lower deaths due to COVID-19. This hypothesis emerged in the middle of 2020 when COVID-19 was still taking foot in many parts of the world.37,38 Subsequently, many countries which had lower deaths at that time point went on to have higher numbers of mortality, comparable to other areas of the world. Furthermore, the hypothesis that BCG vaccination reduced COVID-19 mortality was a classic example of ecological fallacy. Associations between population level events (ecological studies; in this case, BCG vaccination and COVID-19 mortality) cannot be directly extrapolated to the individual level. Furthermore, such associations cannot per se be attributed as causal in nature, and can only serve to generate hypotheses that need to be tested at the individual level.39Traditionally, publication after peer review has been considered the gold standard before any new idea finds acceptability amongst the scientific community. Getting a work (including a working or scientific hypothesis) reviewed by experts in the field before experiments are conducted to prove or disprove it helps to refine the idea further as well as improve the experiments planned to test the hypothesis.40 A route towards this has been the emergence of journals dedicated to publishing hypotheses such as the Central Asian Journal of Medical Hypotheses and Ethics.41 Another means of publishing hypotheses is through registered research protocols detailing the background, hypothesis, and methodology of a particular study. If such protocols are published after peer review, then the journal commits to publishing the completed study irrespective of whether the study hypothesis is proven or disproven.42 In the post-pandemic world, online research methods such as online surveys powered via social media channels such as Twitter and Instagram might serve as critical tools to generate as well as to preliminarily test the appropriateness of hypotheses for further evaluation.43,44Some radical hypotheses might be difficult to publish after traditional peer review. These hypotheses might only be acceptable by the scientific community after they are tested in research studies. Preprints might be a way to disseminate such controversial and ground-breaking hypotheses.45 However, scientists might prefer to keep their hypotheses confidential for the fear of plagiarism of ideas, avoiding online posting and publishing until they have tested the hypotheses.Publication of hypotheses is important, however, a balance is required between scientific temper and controversy. Journal editors and reviewers might keep in mind these specific points, summarized in Table 2 and detailed hereafter, while judging the merit of hypotheses for publication. Keeping in mind the ethical principle of primum non nocere, a hypothesis should be published only if it is testable in a manner that is ethically appropriate.46 Such hypotheses should be grounded in reality and lend themselves to further testing to either prove or disprove them. It must be considered that subsequent experiments to prove or disprove a hypothesis have an equal chance of failing or succeeding, akin to tossing a coin. A pre-conceived belief that a hypothesis is unlikely to be proven correct should not form the basis of rejection of such a hypothesis for publication. In this context, hypotheses generated after a thorough literature search to identify knowledge gaps or based on concrete clinical observations on a considerable number of patients (as opposed to random observations on a few patients) are more likely to be acceptable for publication by peer-reviewed journals. Also, hypotheses should be considered for publication or rejection based on their implications for science at large rather than whether the subsequent experiments to test them end up with results in favour of or against the original hypothesis.Points to be considered before a hypothesis is acceptable for publicationExperiments required to test hypotheses should be ethically acceptable as per the World Medical Association declaration on ethics and related statementsPilot studies support hypothesesSingle clinical observations and expert opinion surveys may support hypothesesTesting hypotheses requires robust methodology and statistical powerHypotheses that challenge established views and concepts require proper evidence-based justificationHypotheses form an important part of the scientific literature. The COVID-19 pandemic has reiterated the importance and relevance of hypotheses for dealing with public health emergencies and highlighted the need for evidence-based and ethical hypotheses. A good hypothesis is testable in a relevant study design, backed by preliminary evidence, and has positive ethical and clinical implications. General medical journals might consider publishing hypotheses as a specific article type to enable more rapid advancement of science.1.Gasparyan AY, Ayvazyan L, Mukanova U, Yessirkepov M, Kitas GD. Scientific hypotheses: writing, promoting, and predicting implications. J Korean Med Sci. 2019;34(45):e300. doi: 10.3346/jkms.2019.34.e300. [DOI] [PMC free article] [PubMed] [Google Scholar]2.Misra DP, Agarwal V. Generating working hypotheses for original research studies. Cent Asian J Med Hypotheses Ethics. 2020;1(1):1419. [Google Scholar]3.Misra DP, Zimba O, Gasparyan AY. Statistical data presentation: a primer for rheumatology researchers. 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J Clin Pharmacol. 2005;45(4):371377. doi: 10.1177/0091270004273680. [DOI] [PubMed] [Google Scholar]Articles from Journal of Korean Medical Science are provided here courtesy of Korean Academy of Medical Sciences In the research process, developing a working hypothesis is a vital step that guides the investigation. A working hypothesis serves as a temporary explanation or a proposed answer to a research problem, subject to testing and validation. In this blog, well explore what working hypotheses are, how to develop them, their significance in research, and why they might not always be applicable in certain research types like exploratory studies.Table of ContentsA working hypothesis is a preliminary statement or idea that researchers create as a foundation for their study. It provides a focused direction for gathering and analyzing data. Unlike a formal hypothesis, which is definitive and designed for rigorous testing, a working hypothesis is more flexible. It evolves as new data or insights emerge during the research process.For example, if a company observes a decline in sales, a working hypothesis might be, The decline in sales is due to reduced customer engagement on digital platforms. This provisional idea provides a starting point for further investigation.Key characteristics of a working hypothesis include:Provisional: It is a tentative assumption, open to refinement.Focused: It narrows the scope of research to specific areas.Testable: It is designed to be evaluated using evidence or data.Methods to develop hypotheses Developing a robust working hypothesis requires creativity and systematic thinking. Researchers use various methods to arrive at plausible hypotheses. Here are some common strategies:1. Engaging in expert discussions Consulting with experts in the field provides valuable insights that can shape a working hypothesis. Experienced professionals often bring nuanced perspectives, helping researchers identify relevant patterns or issues. For instance, if a business researcher is studying employee turnover, discussions with HR managers might reveal underlying trends such as job dissatisfaction or better opportunities elsewhere.2. Examining existing data Analyzing historical data or patterns can be an excellent starting point. By identifying trends or anomalies in existing records, researchers can craft hypotheses that align with observed realities. For instance, reviewing sales data during different seasons could lead to a hypothesis about seasonal demand fluctuations.3. Reviewing literature and similar studies Reviewing academic articles, case studies, and industry reports offers insights into previously established findings and gaps in knowledge. These resources often highlight recurring themes, which can inspire a hypothesis. For instance, a researcher studying consumer behavior might hypothesize that price sensitivity increases during economic downturns, based on patterns in prior studies.4. Using analogical reasoning Analogical reasoning involves drawing parallels between two seemingly different contexts. This method can spark innovative hypotheses. For instance, if a researcher observes that tech startups thrive in collaborative coworking spaces, they might hypothesize that shared office spaces enhance innovation in other industries as well.5. Brainstorming and intuitive thinking Creative brainstorming sessions encourage free-flowing ideas without immediate judgment. While not all ideas will translate into testable hypotheses, this process often leads to unique perspectives. Researchers can then refine these ideas into actionable hypotheses.Role of working hypotheses in research Working hypotheses play a pivotal role in the research process, helping researchers maintain clarity and focus. Heres how they contribute:1. Narrowing the research scope A well-defined hypothesis acts as a filter, eliminating irrelevant data and focusing efforts on pertinent aspects of the study. For instance, a marketing researcher studying low customer retention might hypothesize, Lack of loyalty programs is a significant factor. This narrows their investigation to loyalty programs instead of general customer behavior.2. Guiding data collection With a hypothesis in place, researchers can design targeted data collection strategies. It dictates what information is relevant and the best methods to obtain it, saving time and resources.3. Enhancing analytical precision Hypotheses provide a framework for analysis, ensuring that the interpretation of data remains aligned with the research objective. This reduces the risk of subjective or biased conclusions.4. Enabling predictions and testing Working hypotheses allow researchers to make predictions that can be empirically tested. For example, a researcher hypothesizing that employee training reduces turnover can design experiments or surveys to evaluate this relationship.Avoiding hypotheses in exploratory research While working hypotheses are invaluable in many research contexts, they may not be suitable for exploratory research. Heres why:1. Exploratory research seeks to identify unknowns Exploratory research is conducted when there is limited prior knowledge about a topic. It focuses on uncovering new patterns, relationships, or phenomena. Imposing a hypothesis too early might restrict the researchers openness to unexpected findings. For instance, a study on the impact of AI in education might need to explore various dimensions before forming a hypothesis.2. Premature hypotheses can bias results When researchers begin with a hypothesis in exploratory studies, they risk introducing confirmation bias, where they seek evidence that supports the hypothesis while ignoring contradictory data. This can compromise the integrity of the research.3. Flexibility is critical Exploratory research thrives on flexibility, allowing the investigation to adapt as new insights emerge. Hypotheses, which are inherently more structured, might constrain this adaptive process.Instead of hypotheses, exploratory researchers often use research questions or objectives to guide their studies. For example, instead of hypothesizing, AI improves student performance, a researcher might ask, What are the impacts of AI tools on various aspects of student learning?Conclusion Working hypotheses are fundamental tools in the research process, providing direction, focus, and clarity. They help researchers narrow their scope, refine their methods, and test their predictions. Developing hypotheses requires creativity, critical thinking, and reliance on diverse sources like expert input, data analysis, and literature reviews. However, its important to recognize that not all research requires a hypothesis. In exploratory studies, remaining hypothesis-free allows for greater openness to new discoveries.What do you think? Have you ever faced challenges in crafting a working hypothesis? How do you balance flexibility and focus in your research process?[Editors note: This post is part of a series devoted to tools and frameworks for researchers to plan better projects right from the start. Please read the first post for the general outline of the series.]In the previous posts, we have analyzed conceptual frameworks for research projects that have more concrete objectives in mind, especially in terms of contributing to policymaking. There are however, occasions in which there is no sufficient knowledge on a given field or problem to launch one of these conceptual frameworks. This might be especially the case in contexts with weak research environments, or in relatively new fields or for emerging policy problems on which there is not yet enough evidence to very concretely define them. In those cases, one option is to deploy a working hypothesis.What are working hypothesis?This hypothesis is used as a foundation tool for the research process, and it is not meant to be proven right or wrong. A working hypothesis is an educated guess or assumption to start research. Its intend is to help the researcher organize its work by connecting ideas in different steps: Allowing for hypothesis and sub-hypothesis to be developed. This will create some order about the exploratory topics of the research. Organizing the existing research. This is particularly relevant in a new field. It is possible to identify various sources of valuable research. However, since they might be dispersed among different fields, working hypothesis allows the research to organize this background information. Finally, a working hypothesis is used to develop the research tools such as questionnaires or interview questions.Since a working hypothesis is usually employed in a new area of research, or with highly complex questions such as those that emerge when trying to integrate a policy intervention (i.e. social protection policies), it usually employs qualitative methods such as interviews, focus groups, participatory research, etc.A working hypothesis model is very flexible and it is linked to exploratory research process. As such, these hypothesis are very useful at the onset of a research project. But this framework is very useful in other occasions as well. For example, research projects that are interdisciplinary in nature (which could potentially very effectively contribute to addressing in a more holistic way certain policy problems that are interdisciplinary by nature), are probably very good candidates for this model. Interdisciplinary projects tend to bring together existing models and knowledge from diverse fields. In this context, working hypothesis are a useful tool to bring together this knowledge in the form of plausible hypothesis to investigate. This is also the case for very practical research questions, which are often needed in public policy. There might be very little practical knowledge on a field, but significant theoretical knowledge, or knowledge from similar cases that might be useful. Working hypothesis is a way to bring all that knowledge to play into a very concrete and practical research question.If you are interested in the working hypothesis model, some possible reads include:How to make our Ideas clear, an essay by Charles S. Peirce.A different approach to new fields or research may also be analyzed, including grounded theory.#concepts #conceptualframework #research #researchwriting Using the scientific method, before any statistical analysis can be conducted, a researcher must generate a guess, or hypothesis about what is going on. The process begins with a Working Hypothesis. This is a direct statement of the research idea. For example, a plant biologist may think that plant height may be affected by applying different fertilizers. So they might say: "Plants with different fertilizers will grow to different heights". But according to the Popperian Principle of Falsification, we can't conclusively affirm a hypothesis, but we can conclusively negate a hypothesis. So we need to translate the working hypothesis into a framework wherein we state a null hypothesis that the average height (or mean height) for plants with the different fertilizers will all be the same. The alternative hypothesis (which the biologist hopes to show) is that they are not all equal, but rather some of the fertilizer treatments have produced plants with different mean heights. The strength of the data will determine whether the null hypothesis can be rejected with a specified level of confidence. Pictured in the graph below, we can imagine testing three kinds of fertilizer and also one group of plants that are untreated (the control). The plant biologist kept all the plants under controlled conditions in the greenhouse, to focus on the effect of the fertilizer, the only thing we know to differ among the plants. At the end of the experiment, the biologist measured the height of each plant. Plant height is the dependent or response variable and is plotted on the vertical (\(y\)) axis. The biologist used a simple boxplot to plot the difference in the heights. Figure \(\PageIndex{1}\): Boxplot of plant height distribution by fertilizer. This boxplot is a customary way to show treatment (or factor) level differences. In this case, there was only one treatment: fertilizer. The fertilizer treatment had four levels that included the control, which received no fertilizer. Using this language convention is important because later on we will be using ANOVA to handle multi-factor studies (for example if the biologist manipulated the amount of water AND the type of fertilizer) and we will need to be able to refer to different treatments, each with their own set of levels. Another alternative for viewing the differences in the heights is with a means plot (a scatter or interval plot): Figure \(\PageIndex{2}\): Means plot for fertilizer with 95% confidence limits. This second method to plot the difference in the means of the treatments provides essentially the same information. However, this plot illustrates the variability in the data with 'error bars' that are the 95% confidence interval limits around the means. In between the statement of a Working Hypothesis and the creation of the 95% confidence intervals used to create this means plot is a 7-step process of statistical hypothesis testing, presented in the following section. Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Provisional version pending further researchA working hypothesis is a hypothesis that is provisionally accepted as a basis for further ongoing research[1] in the hope that a tenable theory will be produced, even if the hypothesis ultimately fails.[2] Like all hypotheses, a working hypothesis is constructed as a statement of expectations, which can be linked to deductive, exploratory research[3][4] in empirical investigation and is often used as a conceptual framework in qualitative research.[5][6] The term "working" indicates that the hypothesis is subject to change.[3]Use of the phrase "working hypothesis" goes back to at least the 1850s.[7]Charles Sanders Peirce came to hold that an explanatory hypothesis is not only justifiable as a tentative conclusion by its plausibility (by which he meant its naturalness and economy of explanation),[8] but also justifiable as a starting point by the broader promise that the hypothesis holds for research. This idea of justifying a hypothesis as potentially fruitful (at the level of research method), not merely as plausible (at the level of logical conclusions), is essential for the idea of a working hypothesis, as later elaborated by Peirce's fellow p