Essential vocabulary of academic culture

In science and other academic fields, when we refer to something as a theory (e.g., "Theory A, X Theory, the theory of Y"), we do not mean theory in the sense of conjecture, guess, or something that has not been proven (which is the colloquial meaning of 'theory'). A theory is not necessarily something that is not true, or that is not yet proven. Many times we work with theories that are considered proven, true, and scientific fact (especially in the sciences and social sciences). It is not true that a theory is unproven, and becomes a "law" after being proven true.

1. Theory

Definition. A theory is an explanatory conceptual framework, that is, a complex concept or a set of principles, which together forms a coherent framework for explaining something.

Characteristics. A theory may consist of several components – several propositions, or even laws, which together form a coherent concept that explains something.

A theory might be true – proven or confirmed by scientific research; a theory might be disproven; or its status may currently be unknown (i.e., we do not know yet if it should be accepted). In the pure sciences, many theories are considered to be proven true (e.g., evolutionary theory, big bang theory). For other theories, scientists are in the process of trying to verify or disprove them (e.g., string theory). Some may have been disproven (but you may learn about them to understand the history of your field.)

In the humanities and in some social sciences, one may use a certain theory simply because it scholars find it useful for analyzing things (e.g., in literature, poetry, music, sociolinguistics), without necessarily trying to prove it first. Thus, the above definition (explanatory conceptual framework) holds true for theories in various fields; an added characteristic in science and some social sciences is that researchers attempt to prove or disprove them.

Examples: Sciences

Evolution. The theory of evolution consists of several components or propositions, e.g.: [1] living organisms have descended with modifications from species that lived before them [2] Changes arise through genetic mutation (change); [3] Successful traits allow members of a species to better adapt to their environments, and [4] these successful traits are passed down to descendants (natural selection). This theory has been proven and accepted as scientific fact.

Note that "survival of the fittest" is not an accurate representation of evolution or natural selection; the phrase was not coined by Darwin or mainstream biologists. Also note that evolutionary theory does not explain how life first originated on Earth. That is a separate issue, and biologists hope to have a theory for that someday (abiogenesis theory) to go along with evolutionary theory.

Relativity. The special theory of relativity deals with how matter and energy are related, and this includes the famous law $E=mc^2$ about the mass-energy relationship. The general theory of relativity explains the relationship between space and time, including gravity. Both have been proven and accepted as factual.

String theory in physics attempts to go beyond relativity and the Standard Model to better explain the various types of matter (particles) and forces in the universe. Scientists are attempting to verify several different forms of string theory; it may be many decades before any one form of string theory is confirmed and accepted.

Inflation theory attempts to explain how the Big Bang happened; cosmologists and astrophysicists are currently trying to verify it.

Examples: Social sciences

Game theory in economics explains consumer choices and choices in competitive contexts; social choice theory attempts to explain large scale behavior and decision making.

Psychology: **Self-determination theory** explains types of psychological motivation, its components, and how it affects learning and other cognitive tasks. **Prospect theory** explains irrational human choices in economic behavior. **Attachment theory** explains how children need to form an emotional attachment to one or both parents by age three; those who do so grow up more emotionally healthy, while those who do not can grow up with attachment disorders (e.g., avoidant attachment patterns) and problems in future social relationships. **Attribution theory** explains how people sometimes make errors in judgment and decision making due to cognitive biases; these errors involving incorrect attributions – assumptions about causes, reasons or explanations for happenings, for people's behavior, or their own decisions. **Schema theory** explains how conceptual knowledge is stored in the brain or mind. Other psychological theories deal with how the mind interprets visual information, and how it recognizes colors, sounds, objects, and people's faces.

Linguistics: Different theories exist regarding the syntax (abstract grammatical structure) of human languages; how humans learn a first language (as children); how humans learn a second language as adults; or how we interpret language in real contexts (pragmatics). Most of these have not yet been "proven," but linguists use them because they find them to be useful tools for research and analysis. These include various forms of syntactic theory from Noam Chomsky. Chomsky has revised his theories of syntax over the years; the current one is called **minimalism** or the minimalist program (previously, government and binding theory). In phonology, **optimality theory** attempts to explain the sound systems of various languages based on universal constraints.

Examples: Humanities

Literary theory: This subsumes insights drawn from various specific theories, and refers to a general body of concepts for analyzing literature. This includes how to understand plot structure, character development, background information about authors and their time period, linguistic devices, metaphors, symbolism, literary themes, and various philosophical and social issues in literature. More specific schools of thought in literary theory have their own more specific theories for certain types of literature or issues, e.g., gender theory, cultural theory (e.g., for cross-cultural issues in literature and comparative literature), queer theory ('queer' as in LGBT identity and issues), structuralism, post-structuralism, and postmodernism.

2. Law

Definition. A single, simple statement, that is universal (always or generally true) – usually in the form of a simple, general sentence or a formula.

Characteristics. A law can be in the form of a formula or equation (as in physics), or a single sentence-like statement. It is true, at least for its intended domain. For example, Newton never thought about black holes or traveling at light speed when he formulated the law of gravity and his laws of motion; his laws apply to the "normal" world.

In the social sciences and humanities, the term 'law' may be used more loosely for something that is generally true (though maybe not always).

Laws are extremely rare in humanities fields.

Examples: Science

Newton's law of gravity, $F=G(m_1m_2/r^2)$ and Newton's laws of motion (e.g., F=ma); these always hold true in the "normal" world or universe.

Various other laws in physics and chemistry: the laws of thermodynamics, Ohm's Law, Kirchoff's Law, Coulomb's Law, Avrogado's Law, Boyle's Law, law of conservation of mass, law of conservation of energy, Dalton's Law, Faraday's Law, ideal gas law (PV=nRT), and many others.

Examples: Social sciences

Economics laws, e.g., laws of supply and demand, Hotelling's Law, laws of returns (diminishing returns, increasing returns).

Laws are less common in social sciences (other than economics) or humanities. In linguistics, Zipf's law states that the frequency of words in a language follow a logarithmic distribution, which also correlates to word length; high frequency words tend to be shorter, and longer words tend to be less frequent.

3. Model

Definition. A description of some complex phenomena, but not a complete explanation or theory. It is a complex framework, but it is [1] not fully explanatory – it does not try to explain everything, or [2] it merely describes rather than explains relationships between components of the model.

Characteristics. This term may be used somewhat differently in different fields, but a model generally attempts to describe complex relationships or phenomena, by [1] organizing and categorizing things, or [2] by providing a simplified representation, e.g., in the form of a graphical model or a metaphorical description.

Examples: Science

In physics, the **Standard Model** of quantum physics describes the relationships and categories among the various forces, particles and parameters (mathematical constants) that make up the universe. It provides an incomplete description of these components (e.g., gravity and dark matter are not included) and an incomplete explanation of their relationships; it does not fully explain why things are they way they are. Other theories (e.g., string theory) would be needed for a complete explanation.

Examples: Social sciences

Economics propose various probabilistic, statistical, or qualitative (descriptive) models for describing and explaining various economic processes or situations. These may not be full theories because they are fully explanatory, and/or may not be scientifically falsifiable; if unfalsifiable, they cannot really be scientifically proven, but may nonetheless be useful.

Various models are used in psychology and linguistics to explain how human behavior or human cognition work. Those in research psychology, social psychology, or counseling psychology find them useful frameworks for their work (without necessarily trying to prove them). These might include models of group interaction and behavior, models of clinical behavior, or statistical models of relationships. For example, neural network models are computational models of neurons, which attempt to describe and (partly) explain how the brain might learn certain aspects of language. **Dual route models** of reading explain how the brain recognizes and interprets regular and irregular words in reading text (i.e., recognizing common irregular words holistically, while recognizing other words by letter-to-sound lookup in the mental lexicon). Other models attempt to explain how readers' minds interpret text from the level of word recognition to the level of understanding the meaning of the whole text, and integrating new information from each successive sentence into their understanding of the text. The **stage model** explains how children first learn to read, by first learning letters as symbols, then associating them with sounds and learning to read phonetically, and then learning complex spelling patterns.

In sociolinguistics, Kachru's Three-Circle Model describes the relative status of English in different countries. In the first-circle countries (the U.S., U.K., Canada, Ireland, New Zealand, Australia), English is the dominant native language of most people and it is the "official" language. In the second-circle countries (e.g., Hong Kong, Singapore, South Africa, Nigeria, India), English is not the first language of most people, but it is used officially for education or government. In the third-circle countries (e.g., China, Korea, Russia), it is a fully foreign language. This model does not attempt to explain why English has a particular status in a country or how or why a country is in a particular circle or might move to a more inner circle; it merely describes its status and some sociolinguistic relationships.

4. Hypothesis

Definition. A proposed explanation, that consists of a single statement. It is an informed guess, based either on a theory that one works with, or based on observation.

Characteristics. A hypothesis consists of one specific statement, which can be tested and thereby confirmed or disconfirmed (disproven). It is often a prediction from an existing theory or model about a specific case or phenomenon, e.g., theory X predicts that Y should happen is situation Z. Scholars and scientists often work within an existing theory that they accept, or want to prove. In an accepted theory, one wants to see what happens in a specific case; theory X leads to some prediction for situation Z (theory X predicts that in situation Z, Y should happen). In other cases, people want to prove theory X by testing various hypotheses that come from theory X for situations B, C, D... Occasionally, one might develop and test hypotheses, and from those, construct a new theory. Most academic and scientific research, though, is about applying or extending an existing theory through hypothesis testing, or doing hypothesis testing to prove an unconfirmed theory.

Examples: Science

The Standard Model in physics predicted, or hypothesized, the existence of a force particle (the Higgs boson) that is responsible for mass; this particle was discovered in 2012. The whole model is thus confirmed.

Evolutionary theory leads to many hypotheses about how particular animals might have developed, and much evidence in the fossil record confirms this. Evolutionary theory also leads to predictions about patterns that we would expect to see in the human genome (DNA), and in fact, the strongest evidence for evolution comes from genetics.

Inflation theory (in cosmology) predicts that certain patterns should be seen in the cosmic background radiation (CMB) that reflect how the Big Bang happened; these are currently being tested.

Particular linguistic theories predict that children will learn their first language in certain ways but not others, that is, they generate hypotheses about how specific aspects of this would happen. Some of these hypotheses have been confirmed by studying how children's language abilities develop.

One popular one is the critical period hypothesis, which has become a complex concept and the subject of much research and debate. The CPH basically claims that children must have meaningful exposure to language by a certain age in order to learn their first language; if deprived of linguistic input, they fail. This implies that it is harder to learn a language naturally when older. Much research has validated the CPH in general, but many details of it are debated and remain to be worked out. For example, how are syntax and phonology affected differently in first and second language acquisition, and how and why is second language acquisition different from first language acquisition? Because of the complexity of this issue and the differing views on these questions, it might be accurate to say that this is now more of a group of related models or theories than just a hypothesis.

5. Other terms

Law cf. Rule. If it is not always true, or has not quite been proven, other terms may be used such as 'rule', e.g., L'Hôpital's rule in calculus. In math, the term 'theorem' has a similar meaning – something accepted as generally true, like a law, though it cannot quite be proven. In math and logic, a postulate or axiom is a proposition that is self-evident and requires no proof, and it in turn is used in proofs of other propositions.

6. General research approaches

Research that make heavy use of statistical data, experimental data, or statistical analysis of comparative data are typically what we call **quantitative** research – following strict scientific criteria. This involves statistical comparisons of two or more groups (e.g., control group and treatment/target groups), or between one's hypothesis (e.g., X and Y are correlated, or that Z exists) and a null hypothesis (that no relationship exists between X and Y, or that Z does not exist). Such research is common in science, engineering, and social science fields.

Other papers may rely on observational data (including ethnographic data) and the researcher's own interpretation of the data. This is **qualitative** research, which is common in humanities and social science fields. More specifically, this can include:

- ethnographic data[1] – observational data of people, including customs and social interactions (anthropology, sociology), or classroom interactions in education research
- examples, anecdotes
- case studies
- interview or survey data (open-ended, introspective, or subjective questions)
- historical documents or other historical evidence
- historical narrative, or background

1 'Ethno-' means people, from Greek; here it can refer to observing and recording data ('-graphic') about individuals or several people, e.g., when an anthropologist observes people in their daily lives and social interactions, or when an observer records what happens in a classroom.

Other research may be more **theoretical**, such as in philosophy or theoretical linguistics (e..g, syntactic theory). This consists of, e.g, theoretical analysis or discussion, argumentation based on hypothetical examples), syllogism (e.g., in philosophy) or other logical argumentation, and mathematical proofs or arguments.

In many fields, a mixture of these approaches is common. Literary analysis often makes use of literary theories and qualitative information such as historical background relevant to the literature. In linguistics, some pursue purely theoretical work (e.g., syntax), some do qualitative work (e.g, pragmatics, sociolinguistics), and some do qualitative work (e.g., computational linguistics, psycholinguistics, text linguistics). In social science fields, methods vary according to the research area and how scientific one's goals are – trying to prove something, versus simply describing and holistically analyzing something. Thus, some do qualitative work, some do quantitative work, and some use both together (mixed methods) in their research.

Academic paradigms

A paradigm is an academic worldview – how a community of scholars think, and their academic culture, e.g., how they do their academic work in their field. This includes the various goals, values (what they consider important, good, or worthwhile), the questions that drive the field, and important theories or concepts that they all share, as well as their research methods. Their research methods – how they do their work – depends on the objectives of the field. Scientists are concerned with understanding ultimate realities and truths of the universe, and are concerned with proving things – hence the focus on scientific methods and quantitative research. Other fields that do not share those assumptions and goals may value qualitative methods instead.