Metaphors in Literature and Language

Roy Morrow

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Chapter 1

Metaphor

A **metaphor** is a figure of speech that, for rhetorical effect, directly refers to one thing by mentioning another. It may provide (or obscure) clarity or identify hidden similarities between two different ideas. Metaphors are often compared with other types of figurative language, such as antithesis, hyperbole, metonymy and simile. One of the most commonly cited examples of a metaphor in English literature comes from the "All the world's a stage" monologue from *As You Like It*:

All the world's a stage,

And all the men and women merely players;

They have their exits and their entrances ...

—William Shakespeare, *As You Like It*, 2/7

This quotation expresses a metaphor because the world is not literally a stage, and most humans are not literally actors and actresses playing roles. By asserting that the world is a stage, Shakespeare uses points of comparison between the world and a stage to convey an understanding about the mechanics of the world and the behavior of the people within it.

According to the linguist Anatoly Liberman, "the use of metaphors is relatively late in the modern European languages; it is, in principle, a post-Renaissance phenomenon". In contrast, in the ancient Hebrew psalms (around 1000 B.C.), one finds already vivid and poetic examples of metaphor such

as, "The Lord is my rock, my fortress and my deliverer; my God is my rock, in whom I take refuge, my shield and the horn of my salvation, my stronghold" and "The Lord is my shepherd, I shall not want." At the other extreme, some recent linguistic theories view all language in essence as metaphorical.

The word metaphor itself is a metaphor, coming from a Greek term meaning to "transfer" or "carry across." Metaphors "carry" meaning from one word, image, idea, or situation to another, linking them and creating a metaphor.

Etymology

The English word *metaphor* derives from the 16th-century Old French word *métaphore*, which comes from the Latin *metaphora*, "carrying over", and in turn from the Greek μεταφορά (*metaphorá*), "transference (of ownership)", from μεταφέρω (*metapherō*), "to carry over", "to transfer" and that from μετά (*meta*), "behind", "along with", "across" + φέρω (*pherō*), "to bear", "to carry".

Parts of a metaphor

The Philosophy of Rhetoric (1937) by rhetorician I. A. Richards describes a metaphor as having two parts: the tenor and the vehicle. The tenor is the subject to which attributes are ascribed. The vehicle is the object whose attributes are borrowed. In the previous example, "the world" is compared to a stage, describing it with the attributes of "the stage"; "the world" is the tenor, and "a stage" is the vehicle; "men and

women" is the secondary tenor, and "players" is the secondary vehicle.

Other writers employ the general terms 'ground' and 'figure' to denote the tenor and the vehicle. Cognitive linguistics uses the terms 'target' and 'source', respectively.

Psychologist Julian Jaynes coined the terms 'metaphrand' and 'metaphier', plus two new concepts, 'paraphrand' and 'paraphier'. 'Metaphrand' is equivalent to the metaphor-theory terms 'tenor', 'target', and 'ground'. 'Metaphier' is equivalent to the metaphor-theory terms 'vehicle', 'figure', and 'source'. In a simple metaphor, an obvious attribute of the metaphier exactly characterizes the metaphrand (e.g. the ship plowed the seas). With an inexact metaphor, however, a metaphier might have associated attributes or nuances – its paraphiers – that enrich the metaphor because they "project back" to the metaphrand, potentially creating new ideas – the paraphrands – associated thereafter with the metaphrand or even leading to a new metaphor. For example, in the metaphor "Pat is a tornado", the metaphrand is "Pat", the metaphier is "tornado". As metaphier, "tornado" carries paraphiers such as power, storm and wind, counterclockwise motion, and danger, threat, destruction, etc. The metaphoric meaning of "tornado" is inexact: one might understand that 'Pat is powerfully destructive' through the paraphrand of physical and emotional destruction; another person might understand the metaphor as 'Pat can spin out of control'. In the latter case, the paraphier of 'spinning motion' has become the paraphrand 'psychological spin', suggesting an entirely new metaphor for emotional unpredictability, a possibly apt description for a human being hardly applicable to a tornado. Based on his analysis, Jaynes claims that

metaphors not only enhance description, but "increase enormously our powers of perception...and our understanding of [the world], and literally create new objects".

As a type of comparison

Metaphors are most frequently compared with similes. It is said, for instance, that a metaphor is 'a condensed analogy' or 'analogical fusion' or that they 'operate in a similar fashion' or are 'based on the same mental process' or yet that 'the basic processes of analogy are at work in metaphor'. It is also pointed out that 'a border between metaphor and analogy is fuzzy' and 'the difference between them might be described (metaphorically) as the distance between things being compared'. A metaphor asserts the objects in the comparison are identical on the point of comparison, while a simile merely asserts a similarity through use of words such as "like" or "as". For this reason a common-type metaphor is generally considered more forceful than a simile.

The metaphor category contains these specialized types:

- Allegory: An extended metaphor wherein a story illustrates an important attribute of the subject.
- Antithesis: A rhetorical contrast of ideas by means of parallel arrangements of words, clauses, or sentences.
- Catachresis: A mixed metaphor, sometimes used by design and sometimes by accident (a rhetorical fault).
- Hyperbole: Excessive exaggeration to illustrate a point.

- Parable: An extended metaphor told as an anecdote to illustrate or teach a moral or spiritual lesson, such as in Aesop's fables or Jesus' teaching method as told in the Bible.
- Pun: A verbal device by which multiple definitions of a word or its homophones are used to give a sentence multiple valid readings, typically to humorous effect.
- Similitude: An extended simile or metaphor that has a picture part (*Bildhälfte*), a reality part (*Sachhälfte*), and a point of comparison (*teritiumcomparationis*). Similitudes are found in the parables of Jesus.

Metaphor vs metonymy

Metaphor is distinct from metonymy, both constituting two fundamental modes of thought. Metaphor works by bringing together concepts from different conceptual domains, whereas metonymy uses one element from a given domain to refer to another closely related element. A metaphor creates new links between otherwise distinct conceptual domains, whereas a metonymy relies on pre-existent links within them.

For example, in the phrase "lands belonging to the crown", the word "crown" is a **metonymy** because some monarchs do indeed wear a crown, physically. In other words, there is a pre-existent link between "crown" and "monarchy". On the other hand, when Ghil'adZuckermann argues that the Israeli language is a "phoenicuckoo cross with some magpie characteristics", he is using a **metaphor**. There is no physical link between a language and a bird. The reason the metaphors "phoenix" and "cuckoo" are used is that on the one hand

hybridic "Israeli" is based on Hebrew, which, like a phoenix, rises from the ashes; and on the other hand, hybridic "Israeli" is based on Yiddish, which like a cuckoo, lays its egg in the nest of another bird, tricking it to believe that it is its own egg. Furthermore, the metaphor "magpie" is employed because, according to Zuckermann, hybridic "Israeli" displays the characteristics of a magpie, "stealing" from languages such as Arabic and English.

Subtypes

A dead metaphor is a metaphor in which the sense of a transferred image has become absent. The phrases "to grasp a concept" and "to gather what you've understood" use physical action as a metaphor for understanding. The audience does not need to visualize the action; dead metaphors normally go unnoticed. Some distinguish between a dead metaphor and a cliché. Others use "dead metaphor" to denote both.

A mixed metaphor is a metaphor that leaps from one identification to a second inconsistent with the first, e.g.:

I smell a rat [...] but I'll nip him in the bud" — Irish politician Boyle Roche

This form is often used as a parody of metaphor itself:

If we can hit that bull's-eye then the rest of the dominoes will fall like a house of cards... Checkmate.

- — *Futurama character ZappBrannigan.*

An extended metaphor, or conceit, sets up a principal subject with several subsidiary subjects or comparisons. In the above quote from *As You Like It*, the world is first described as a stage and then the subsidiary subjects men and women are further described in the same context.

An implicit metaphor has no specified tenor, although the vehicle is present. M. H. Abrams offers the following as an example of an implicit metaphor: "That reed was too frail to survive the storm of its sorrows". The reed is the vehicle for the implicit tenor, someone's death, and the "storm" is the vehicle for the person's "sorrows".

Metaphor can serve as a device for persuading an audience of the user's argument or thesis, the so-called rhetorical metaphor.

In rhetoric and literature

Aristotle writes in his work the *Rhetoric* that metaphors make learning pleasant: "To learn easily is naturally pleasant to all people, and words signify something, so whatever words create knowledge in us are the pleasantest." When discussing Aristotle's *Rhetoric*, Jan Garret stated "metaphor most brings about learning; for when [Homer] calls old age "stubble", he creates understanding and knowledge through the genus, since both old age and stubble are [species of the genus of] things that have lost their bloom." Metaphors, according to Aristotle, have "qualities of the exotic and the fascinating; but at the same time we recognize that strangers do not have the same rights as our fellow citizens".

Educational psychologist Andrew Ortony gives more explicit detail: "Metaphors are necessary as a communicative device because they allow the transfer of coherent chunks of characteristics -- perceptual, cognitive, emotional and experiential -- from a vehicle which is known to a topic which is less so. In so doing they circumvent the problem of specifying one by one each of the often unnameable and innumerable characteristics; they avoid discretizing the perceived continuity of experience and are thus closer to experience and consequently more vivid and memorable."

As style in speech and writing

As a characteristic of speech and writing, metaphors can serve the poetic imagination. This allows Sylvia Plath, in her poem "Cut", to compare the blood issuing from her cut thumb to the running of a million soldiers, "redcoats, every one"; and enabling Robert Frost, in "The Road Not Taken", to compare a life to a journey.

Metaphors can be implied and extended throughout pieces of literature.

Larger applications

- Sonja K. Foss characterizes metaphors as "nonliteral comparisons in which a word or phrase from one domain of experience is applied to another domain". She argues that since reality is mediated by the language we use to describe it, the metaphors we use shape the world and our interactions to it.

The term metaphor is used to describe more basic or general aspects of experience and cognition:

- A cognitive metaphor is the association of object to an experience outside the object's environment
- A conceptual metaphor is an underlying association that is systematic in both language and thought
- A root metaphor is the underlying worldview that shapes an individual's understanding of a situation
- A nonlinguistic metaphor is an association between two nonlinguistic realms of experience
- A visual metaphor uses an image to create the link between different ideas

Conceptual metaphors

Some theorists have suggested that metaphors are not merely stylistic, but that they are cognitively important as well. In *Metaphors We Live By*, George Lakoff and Mark Johnson argue that metaphors are pervasive in everyday life, not just in language, but also in thought and action. A common definition of metaphor can be described as a comparison that shows how two things that are not alike in most ways are similar in another important way. They explain how a metaphor is simply understanding and experiencing one kind of thing in terms of another, called a "conduit metaphor". A speaker can put ideas or objects into containers, and then send them along a conduit to a listener who removes the object from the container to make meaning of it. Thus, communication is something that ideas go into, and the container is separate from the ideas themselves. Lakoff and Johnson give several examples of daily metaphors in use, including "argument is war" and "time is

money". Metaphors are widely used in context to describe personal meaning. The authors suggest that communication can be viewed as a machine: "Communication is not what one does with the machine, but is the machine itself."

Experimental evidence shows that "priming" people with material from one area will influence how they perform tasks and interpret language in a metaphorically related area.

As a foundation of our conceptual system

Cognitive linguists emphasize that metaphors serve to facilitate the understanding of one conceptual domain—typically an abstraction such as "life", "theories" or "ideas"—through expressions that relate to another, more familiar conceptual domain—typically more concrete, such as "journey", "buildings" or "food". For example: we *devour* a book of *raw* facts, try to *digest* them, *stew* over them, let them *simmer on the back-burner*, *regurgitate* them in discussions, and *cook* up explanations, hoping they do not seem *half-baked*.

A convenient short-hand way of capturing this view of metaphor is the following: CONCEPTUAL DOMAIN (A) IS CONCEPTUAL DOMAIN (B), which is what is called a **conceptual metaphor**. A conceptual metaphor consists of two conceptual domains, in which one domain is understood in terms of another. A conceptual domain is any coherent organization of experience. For example, we have coherently organized knowledge about journeys that we rely on in understanding life. Lakoff and Johnson greatly contributed to establishing the importance of conceptual metaphor as a framework for thinking in language, leading scholars to

investigate the original ways in which writers used novel metaphors and question the fundamental frameworks of thinking in conceptual metaphors.

From a sociological, cultural, or philosophical perspective, one asks to what extent ideologies maintain and impose conceptual patterns of thought by introducing, supporting, and adapting fundamental patterns of thinking metaphorically. To what extent does the ideology fashion and refashion the idea of the nation as a container with borders? How are enemies and outsiders represented? As diseases? As attackers? How are the metaphoric paths of fate, destiny, history, and progress represented? As the opening of an eternal monumental moment (German fascism)? Or as the path to communism (in Russian or Czech for example)?

Some cognitive scholars have attempted to take on board the idea that different languages have evolved radically different concepts and conceptual metaphors, while others hold to the Sapir-Whorf hypothesis. German philologist Wilhelm von Humboldt contributed significantly to this debate on the relationship between culture, language, and linguistic communities. Humboldt remains, however, relatively unknown in English-speaking nations. Andrew Goatly, in "Washing the Brain", takes on board the dual problem of conceptual metaphor as a framework implicit in the language as a system and the way individuals and ideologies negotiate conceptual metaphors. Neural biological research suggests some metaphors are innate, as demonstrated by reduced metaphorical understanding in psychopathy. James W. Underhill, in *Creating Worldviews: Ideology, Metaphor & Language* (Edinburgh UP), considers the way individual speech

adopts and reinforces certain metaphoric paradigms. This involves a critique of both communist and fascist discourse. Underhill's studies are situated in Czech and German, which allows him to demonstrate the ways individuals are thinking both within and resisting the modes by which ideologies seek to appropriate key concepts such as "the people", "the state", "history", and "struggle".

Though metaphors can be considered to be "in" language, Underhill's chapter on French, English and ethnolinguistics demonstrates that we cannot conceive of language or languages in anything other than metaphoric terms.

Nonlinguistic metaphors

Metaphors can map experience between two nonlinguistic realms. Musicologist Leonard B. Meyer demonstrated how purely rhythmic and harmonic events can express human emotions. It is an open question whether synesthesia experiences are a sensory version of metaphor, the "source" domain being the presented stimulus, such as a musical tone, and the target domain, being the experience in another modality, such as color.

Art theorist Robert Vischer argued that when we look at a painting, we "feel ourselves into it" by imagining our body in the posture of a nonhuman or inanimate object in the painting. For example, the painting *The Lonely Tree* by Caspar David Friedrich shows a tree with contorted, barren limbs. Looking at the painting, we imagine our limbs in a similarly contorted and barren shape, evoking a feeling of strain and distress. Nonlinguistic metaphors may be the foundation of our

experience of visual and musical art, as well as dance and other art forms.

In historical linguistics

In historical onomasiology or in historical linguistics, a metaphor is defined as a semantic change based on a similarity in form or function between the original concept and the target concept named by a word.

For example, **mouse**: *small, gray rodent with a long tail→small, gray computer device with a long cord.*

Some recent linguistic theories view all language in essence as metaphorical.

Historical theories

Friedrich Nietzsche makes metaphor the conceptual center of his early theory of society in *On Truth and Lies in the Non-Moral Sense*. Some sociologists have found his essay useful for thinking about metaphors used in society and for reflecting on their own use of metaphor. Sociologists of religion note the importance of metaphor in religious worldviews, and that it is impossible to think sociologically about religion without metaphor.

Chapter 2

Conceptual Model and Metaphoric Criticism

Conceptual model

A **conceptual model** is a representation of a system. It consists of concepts used to help people know, understand, or simulate a subject the model represents. It is also a set of concepts. In contrast, physical models are physical objects, such as a toy model that may be assembled and made to work like the object it represents.

The term may refer to models that are ormed after a conceptualization or generalization process. Conceptual models are often abstractions of things in the real world, whether physical or social. Semantic studies are relevant to various stages of concept formation. Semantics is basically about concepts, the meaning that thinking beings give to various elements of their experience.

Overview

Models of concepts and models that are conceptual

The term *conceptual model* is normal. It could mean "a model of concept" or it could mean "a model that is conceptual." A distinction can be made between *what models are* and *what models are made of*. With the exception of iconic models, such

as a scale model of Winchester Cathedral, most models are concepts. But they are, mostly, intended to be models of real world states of affairs.

The value of a model is usually directly proportional to how well it corresponds to a past, present, future, actual or potential state of affairs. A model of a concept is quite different because in order to be a good model it need not have this real world correspondence.

In artificial intelligence, conceptual models and conceptual graphs are used for building expert systems and knowledge-based systems; here the analysts are concerned to represent expert opinion on what is true not their own ideas on what is true.

Type and scope of conceptual models

Conceptual models (models that are conceptual) range in type from the more concrete, such as the mental image of a familiar physical object, to the formal generality and abstractness of mathematical models which do not appear to the mind as an image. Conceptual models also range in terms of the scope of the subject matter that they are taken to represent.

A model may, for instance, represent a single thing (e.g. the *Statue of Liberty*), whole classes of things (e.g. *the electron*), and even very vast domains of subject matter such as *the physical universe.* The variety and scope of conceptual models is due to the variety of purposes had by the people using them.

Conceptual modeling is the activity of formally describing some aspects of the physical and social world around us for the purposes of understanding and communication."

Fundamental objectives

A conceptual model's primary objective is to convey the fundamental principles and basic functionality of the system which it represents. Also, a conceptual model must be developed in such a way as to provide an easily understood system interpretation for the model's users. A conceptual model, when implemented properly, should satisfy four fundamental objectives.

- Enhance an individual's understanding of the representative system
- Facilitate efficient conveyance of system details between stakeholders
- Provide a point of reference for system designers to extract system specifications
- Document the system for future reference and provide a means for collaboration

The conceptual model plays an important role in the overall system development life cycle. Figure 1 below, depicts the role of the conceptual model in a typical system development scheme. It is clear that if the conceptual model is not fully developed, the execution of fundamental system properties may not be implemented properly, giving way to future problems or system shortfalls. These failures do occur in the industry and have been linked to; lack of user input, incomplete or unclear requirements, and changing requirements. Those weak links in

the system design and development process can be traced to improper execution of the fundamental objectives of conceptual modeling. The importance of conceptual modeling is evident when such systemic failures are mitigated by thorough system development and adherence to proven development objectives/techniques.

Modelling techniques

As systems have become increasingly complex, the role of conceptual modelling has dramatically expanded. With that expanded presence, the effectiveness of conceptual modeling at capturing the fundamentals of a system is being realized. Building on that realization, numerous conceptual modeling techniques have been created. These techniques can be applied across multiple disciplines to increase the user's understanding of the system to be modeled. A few techniques are briefly described in the following text, however, many more exist or are being developed. Some commonly used conceptual modeling techniques and methods include: workflow modeling, workforce modeling, rapid application development, object-role modeling, and the Unified Modeling Language (UML).

Data flow modeling

Data flow modeling (DFM) is a basic conceptual modeling technique that graphically represents elements of a system. DFM is a fairly simple technique, however, like many conceptual modeling techniques, it is possible to construct higher and lower level representative diagrams. The data flow diagram usually does not convey complex system details such

as parallel development considerations or timing information, but rather works to bring the major system functions into context. Data flow modeling is a central technique used in systems development that utilizes the structured systems analysis and design method (SSADM).

Entity relationship modeling

Entity–relationship modeling (ERM) is a conceptual modeling technique used primarily for software system representation. Entity-relationship diagrams, which are a product of executing the ERM technique, are normally used to represent database models and information systems. The main components of the diagram are the entities and relationships. The entities can represent independent functions, objects, or events. The relationships are responsible for relating the entities to one another. To form a system process, the relationships are combined with the entities and any attributes needed to further describe the process. Multiple diagramming conventions exist for this technique; IDEF1X, Bachman, and EXPRESS, to name a few. These conventions are just different ways of viewing and organizing the data to represent different system aspects.

Event-driven process chain

The event-driven process chain (EPC) is a conceptual modeling technique which is mainly used to systematically improve business process flows. Like most conceptual modeling techniques, the event driven process chain consists of entities/elements and functions that allow relationships to be developed and processed. More specifically, the EPC is made

up of events which define what state a process is in or the rules by which it operates. In order to progress through events, a function/ active event must be executed. Depending on the process flow, the function has the ability to transform event states or link to other event driven process chains. Other elements exist within an EPC, all of which work together to define how and by what rules the system operates. The EPC technique can be applied to business practices such as resource planning, process improvement, and logistics.

Joint application development

The dynamic systems development method uses a specific process called JEFFF to conceptually model a systems life cycle. JEFFF is intended to focus more on the higher level development planning that precedes a project's initialization. The JAD process calls for a series of workshops in which the participants work to identify, define, and generally map a successful project from conception to completion. This method has been found to not work well for large scale applications, however smaller applications usually report some net gain in efficiency.

Place/transition net

Also known as Petri nets, this conceptual modeling technique allows a system to be constructed with elements that can be described by direct mathematical means. The petri net, because of its nondeterministic execution properties and well defined mathematical theory, is a useful technique for modeling concurrent system behavior, i.e. simultaneous process executions.

State transition modeling

State transition modeling makes use of state transition diagrams to describe system behavior. These state transition diagrams use distinct states to define system behavior and changes. Most current modeling tools contain some kind of ability to represent state transition modeling. The use of state transition models can be most easily recognized as logic state diagrams and directed graphs for finite-state machines.

Technique evaluation and selection

Because the conceptual modeling method can sometimes be purposefully vague to account for a broad area of use, the actual application of concept modeling can become difficult. To alleviate this issue, and shed some light on what to consider when selecting an appropriate conceptual modeling technique, the framework proposed by Gemino and Wand will be discussed in the following text. However, before evaluating the effectiveness of a conceptual modeling technique for a particular application, an important concept must be understood; Comparing conceptual models by way of specifically focusing on their graphical or top level representations is shortsighted. Gemino and Wand make a good point when arguing that the emphasis should be placed on a conceptual modeling language when choosing an appropriate technique. In general, a conceptual model is developed using some form of conceptual modeling technique. That technique will utilize a conceptual modeling language that determines the rules for how the model is arrived at. Understanding the capabilities of the specific language used is inherent to properly evaluating a conceptual modeling

technique, as the language reflects the techniques descriptive ability. Also, the conceptual modeling language will directly influence the depth at which the system is capable of being represented, whether it be complex or simple.

Considering affecting factors

Building on some of their earlier work, Gemino and Wand acknowledge some main points to consider when studying the affecting factors: the content that the conceptual model must represent, the method in which the model will be presented, the characteristics of the model's users, and the conceptual model languages specific task. The conceptual model's content should be considered in order to select a technique that would allow relevant information to be presented. The presentation method for selection purposes would focus on the technique's ability to represent the model at the intended level of depth and detail.

The characteristics of the model's users or participants is an important aspect to consider. A participant's background and experience should coincide with the conceptual model's complexity, else misrepresentation of the system or misunderstanding of key system concepts could lead to problems in that system's realization.

The conceptual model language task will further allow an appropriate technique to be chosen. The difference between creating a system conceptual model to convey system functionality and creating a system conceptual model to interpret that functionality could involve two completely different types of conceptual modeling languages.

Considering affected variables

Gemino and Wand go on to expand the affected variable content of their proposed framework by considering the focus of observation and the criterion for comparison. The focus of observation considers whether the conceptual modeling technique will create a "new product", or whether the technique will only bring about a more intimate understanding of the system being modeled. The criterion for comparison would weigh the ability of the conceptual modeling technique to be efficient or effective. A conceptual modeling technique that allows for development of a system model which takes all system variables into account at a high level may make the process of understanding the system functionality more efficient, but the technique lacks the necessary information to explain the internal processes, rendering the model less effective.

When deciding which conceptual technique to use, the recommendations of Gemino and Wand can be applied in order to properly evaluate the scope of the conceptual model in question. Understanding the conceptual models scope will lead to a more informed selection of a technique that properly addresses that particular model. In summary, when deciding between modeling techniques, answering the following questions would allow one to address some important conceptual modeling considerations.

- What content will the conceptual model represent?
- How will the conceptual model be presented?
- Who will be using or participating in the conceptual model?

- How will the conceptual model describe the system?
- What is the conceptual models focus of observation?
- Will the conceptual model be efficient or effective in describing the system?

Another function of the simulation conceptual model is to provide a rational and factual basis for assessment of simulation application appropriateness.

Models in philosophy and science

Mental model

In cognitive psychology and philosophy of mind, a mental model is a representation of something in the mind, but a mental model may also refer to a nonphysical external model of the mind itself.

Metaphysical models

A metaphysical model is a type of conceptual model which is distinguished from other conceptual models by its proposed scope; a metaphysical model intends to represent reality in the broadest possible way. This is to say that it explains the answers to fundamental questions such as whether matter and mind are one or two substances; or whether or not humans have free will.

Conceptual model vs. semantics model

Conceptual Models and semantic models have many similarities, however the way they are presented, the level of

flexibility and the use are different. Conceptual models have a certain purpose in mind, hence the core semantic concepts are predefined in a so-called meta model. This enables a pragmatic modelling but reduces the flexibility, as only the predefined semantic concepts can be used. Samples are flow charts for process behaviour or organisational structure for tree behaviour.

Semantic models are more flexible and open, and therefore more difficult to model. Potentially any semantic concept can be defined, hence the modelling support is very generic. Samples are terminologies, taxonomies or ontologies.

In a concept model each concept has a unique and distinguishable graphical representation, whereas semantic concepts are by default the same. In a concept model each concept has predefined properties that can be populated, whereas semantic concepts are related to concepts that are interpreted as properties. In a concept model operational semantic can be built-in, like the processing of a sequence, whereas a semantic model needs explicit semantic definition of the sequence.

The decision if a concept model or a semantic model is used, depends therefore on the "object under survey", the intended goal, the necessary flexibility as well as how the model is interpreted. In case of human-interpretation there may be a focus on graphical concept models, in case of machine interpretation there may be the focus on semantic models.

Epistemological models

An epistemological model is a type of conceptual model whose proposed scope is the known and the knowable, and the believed and the believable.

Logical models

In logic, a model is a type of interpretation under which a particular statement is true. Logical models can be broadly divided into ones which only attempt to represent concepts, such as mathematical models; and ones which attempt to represent physical objects, and factual relationships, among which are scientific models.

Model theory is the study of (classes of) mathematical structures such as groups, fields, graphs, or even universes of set theory, using tools from mathematical logic. A system that gives meaning to the sentences of a formal language is called a model for the language. If a model for a language moreover satisfies a particular sentence or theory (set of sentences), it is called a model of the sentence or theory. Model theory has close ties to algebra and universal algebra.

Mathematical models

Mathematical models can take many forms, including but not limited to dynamical systems, statistical models, differential equations, or game theoretic models. These and other types of models can overlap, with a given model involving a variety of abstract structures.

A more comprehensive type of mathematical model uses a linguistic version of category theory to model a given situation. Akin to entity-relationship models, custom categories or sketches can be directly translated into database schemas. The difference is that logic is replaced by category theory, which brings powerful theorems to bear on the subject of modeling, especially useful for translating between disparate models (as functors between categories).

Scientific models

A scientific model is a simplified abstract view of a complex reality. A scientific model represents empirical objects, phenomena, and physical processes in a logical way. Attempts to formalize the principles of the empirical sciences use an interpretation to model reality, in the same way logicians axiomatize the principles of logic. The aim of these attempts is to construct a formal system for which reality is the only interpretation. The world is an interpretation (or model) of these sciences, only insofar as these sciences are true.

Statistical models

A statistical model is a probability distribution function proposed as generating data. In a parametric model, the probability distribution function has variable parameters, such as the mean and variance in a normal distribution, or the coefficients for the various exponents of the independent variable in linear regression. A nonparametric model has a distribution function without parameters, such as in bootstrapping, and is only loosely confined by assumptions.

Model selection is a statistical method for selecting a distribution function within a class of them; e.g., in linear regression where the dependent variable is a polynomial of the independent variable with parametric coefficients, model selection is selecting the highest exponent, and may be done with nonparametric means, such as with cross validation.

In statistics there can be models of mental events as well as models of physical events. For example, a statistical model of customer behavior is a model that is conceptual (because behavior is physical), but a statistical model of customer satisfaction is a model of a concept (because satisfaction is a mental not a physical event).

Social and political models

Economic models

In economics, a model is a theoretical construct that represents economic processes by a set of variables and a set of logical and/or quantitative relationships between them.

The economic model is a simplified framework designed to illustrate complex processes, often but not always using mathematical techniques.

Frequently, economic models use structural parameters. Structural parameters are underlying parameters in a model or class of models. A model may have various parameters and those parameters may change to create various properties.

Models in systems architecture

A system model is the conceptual model that describes and represents the structure, behavior, and more views of a system. A system model can represent multiple views of a system by using two different approaches. The first one is the non-architectural approach and the second one is the architectural approach.

The non-architectural approach respectively picks a model for each view. The architectural approach, also known as system architecture, instead of picking many heterogeneous and unrelated models, will use only one integrated architectural model.

Business process modelling

In business process modelling the enterprise process model is often referred to as the *business process model*. Process models are core concepts in the discipline of process engineering. Process models are:

- Processes of the same nature that are classified together into a model.
- A description of a process at the type level.
- Since the process model is at the type level, a process is an instantiation of it.

The same process model is used repeatedly for the development of many applications and thus, has many instantiations.

One possible use of a process model is to prescribe how things must/should/could be done in contrast to the process itself which is really what happens. A process model is roughly an anticipation of what the process will look like. What the process shall be will be determined during actual system development.

Models in information system design

Conceptual models of human activity systems

Conceptual models of human activity systems are used in soft systems methodology (SSM), which is a method of systems analysis concerned with the structuring of problems in management. These models are models of concepts; the authors specifically state that they are not intended to represent a state of affairs in the physical world. They are also used in information requirements analysis (IRA) which is a variant of SSM developed for information system design and software engineering.

Logico-linguistic models

Logico-linguistic modeling is another variant of SSM that uses conceptual models. However, this method combines models of concepts with models of putative real world objects and events. It is a graphical representation of modal logic in which modal operators are used to distinguish statement about concepts from statements about real world objects and events.

Data models

Entity–relationship model

In software engineering, an entity–relationship model (ERM) is an abstract and conceptual representation of data. Entity–relationship modeling is a database modeling method, used to produce a type of conceptual schema or semantic data model of a system, often a relational database, and its requirements in a top-down fashion. Diagrams created by this process are called entity-relationship diagrams, ER diagrams, or ERDs.

Entity–relationship models have had wide application in the building of information systems intended to support activities involving objects and events in the real world. In these cases they are models that are conceptual. However, this modeling method can be used to build computer games or a family tree of the Greek Gods, in these cases it would be used to model concepts.

Domain model

A domain model is a type of conceptual model used to depict the structural elements and their conceptual constraints within a domain of interest (sometimes called the problem domain). A domain model includes the various entities, their attributes and relationships, plus the constraints governing the conceptual integrity of the structural model elements comprising that problem domain. A domain model may also include a number of conceptual views, where each view is pertinent to a particular subject area of the domain or to a

particular subset of the domain model which is of interest to a stakeholder of the domain model.

Like entity–relationship models, domain models can be used to model concepts or to model real world objects and events.

Metaphoric criticism

Metaphoric criticism is one school of rhetorical analysis used in English and speech communication studies. Scholars employing metaphoric criticism analyze texts by locating metaphors within texts and evaluating those metaphors in an effort to better understand ways in which authors appeal to their audiences.

Origins

The term "metaphor" can be traced to the trope described by Aristotle in both his *Rhetoric* and *Poetics* as a comparison of two dissimilar objects or concepts in an effort to relate one to the other. James DeMille, in *The Elements of Rhetoric*, defines metaphor as "an implied comparison between two things of unlike nature, for example,

'The colorful display was a magnet for anybody in the room.'" Using DeMille's example, a critic studying metaphor would explore how normally "display" and "magnet" are not considered synonyms. However, in using "magnet" as a metaphor, the above sentence implies that the "display" possess properties of a magnet and draws objects—or, in this case, people—in the room toward it.

In a broader sense, metaphoric criticism can illuminate the world in which we live by analyzing the language—and, in particular, the metaphors—that surround us. The notion that metaphors demonstrate worldviews originates in the work of Kenneth Burke and has been taken up further in the cognitive sciences, particularly by George Lakoff.

Application

Metaphoric criticism focuses on analysis of texts that use metaphors effectively or ineffectively as part of their argument structure. For example, in an article entitled "Five Years After 9/11: Drop the War Metaphor," George Lakoff and Evan Frisch analyze how President Bush's adoption of a "war" metaphor in order to discuss his approach to dealing with terrorism as opposed to a "crime" metaphor provides a barrier from critics for him to move forward with the War in Iraq. Lakoff illustrates the power of the "war" metaphor: "The war metaphor defined war as the only way to defend the nation. From within the war metaphor, being against war as a response was to be unpatriotic, to be against defending the nation. The war metaphor put progressives on the defensive."" Rhetorical critics would not only make these observations in their own criticism, but would also relate to the effect on the audience, and how the metaphor either enhances or challenges the audience's worldview.

Critics examining metaphor have in recent years also started to examine metaphor in visual and electronic media. For example, metaphors can be found in rhetorical presidential television ads. In 1984, President Ronald Reagan's campaign sponsored a commercial showing a grizzly bear as posing a potentially large

threat to the United States. The USSR is never named in that ad, however the assumption of the campaign was that Americans would clearly recognize the "enemy" that the bear represents.

Conduction

In *Rhetorical Criticism*, Sonja K. Foss outlines a four-step procedure for applying metaphoric criticism to texts:

- First, the critic reads or views the entire artifact with specific attention to its context.
- Second, to the critic isolates the metaphor(s) within the text, both obvious and more subtle substitutions of meaning. Here Foss invokes Max Black's interaction theory of "tenor" (the principal subject or focus) and "vehicle" (secondary subject or frame for the metaphor), a method to analyze ways in which the related dissimilar objects actually share similar characteristics.
- Third, the critic sorts the metaphors and looks for patterns of use within the text. The more comprehensive the text, the longer this step will take.
- The critic analyzes the metaphor(s) or groups of metaphors in the artifact to reveal how their structure may affect the intended audience. Foss writes, "Here, the critic suggests what effects the use of the various metaphors may have on the audience and how the metaphors function to argue for a particular attitude toward the ideas presented."

Chapter 3

Models in Philosophy and Science

Mental model

A **mental model** is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts and a person's intuitive perception about his or her own acts and their consequences. Mental models can help shape behaviour and set an approach to solving problems (similar to a personal algorithm) and doing tasks.

A mental model is a kind of internal symbol or representation of external reality, hypothesized to play a major role in cognition, reasoning and decision-making. Kenneth Craik suggested in 1943 that the mind constructs "small-scale models" of reality that it uses to anticipate events.

Jay Wright Forrester defined general mental models as:

The image of the world around us, which we carry in our head, is just a model. Nobody in his head imagines all the world, government or country. He has only selected concepts, and relationships between them, and uses those to represent the real system (Forrester, 1971).

In psychology, the term *mental models*is sometimes used to refer to mental representations or mental simulation generally. At other times it is used to refer to § Mental models and

reasoning and to the mental model theory of reasoning developed by Philip Johnson-Laird and Ruth M.J. Byrne.

History

The term *mental model*is believed to have originated with Kenneth Craik in his 1943 book *The Nature of Explanation*. Georges-Henri Luquet in *Le dessin enfantin* (Children's drawings), published in 1927 by Alcan, Paris, argued that children construct internal models, a view that influenced, among others, child psychologist Jean Piaget.

Philip Johnson-Laird published *Mental Models: Towards a Cognitive Science of Language, Inference and Consciousness* in 1983. In the same year, DedreGentner and Albert Stevens edited a collection of chapters in a book also titled *Mental Models*. The first line of their book explains the idea further: "One function of this chapter is to belabor the obvious; people's views of the world, of themselves, of their own capabilities, and of the tasks that they are asked to perform, or topics they are asked to learn, depend heavily on the conceptualizations that they bring to the task." (see the book: *Mental Models*).

Since then, there has been much discussion and use of the idea in human-computer interaction and usability by researchers including Donald Norman and Steve Krug (in his book *Don't Make Me Think*). Walter Kintsch and Teun A. van Dijk, using the term *situation model* (in their book *Strategies of Discourse Comprehension*, 1983), showed the relevance of mental models for the production and comprehension of discourse.

Charlie Munger popularized the use of multi-disciplinary mental models for making business and investment decisions.

Mental models and reasoning

One view of human reasoning is that it depends on mental models. In this view, mental models can be constructed from perception, imagination, or the comprehension of discourse (Johnson-Laird, 1983). Such mental models are similar to architects' models or to physicists' diagrams in that their structure is analogous to the structure of the situation that they represent, unlike, say, the structure of logical forms used in formal rule theories of reasoning. In this respect, they are a little like pictures in the picture theory of language described by philosopher Ludwig Wittgenstein in 1922. Philip Johnson-Laird and Ruth M.J. Byrne developed their mental model theory of reasoning which makes the assumption that reasoning depends, not on logical form, but on mental models (Johnson-Laird and Byrne, 1991).

Principles of mental models

Mental models are based on a small set of fundamental assumptions (axioms), which distinguish them from other proposed representations in the psychology of reasoning (Byrne and Johnson-Laird, 2009). Each mental model represents a possibility. A mental model represents one possibility, capturing what is common to all the different ways in which the possibility may occur (Johnson-Laird and Byrne, 2002). Mental models are iconic, i.e., each part of a model corresponds to each part of what it represents (Johnson-Laird,

2006). Mental models are based on a principle of truth: they typically represent only those situations that are possible, and each model of a possibility represents only what is true in that possibility according to the proposition. However, mental models can represent what is false, temporarily assumed to be true, for example, in the case of counterfactual conditionals and counterfactual thinking (Byrne, 2005).

Reasoning with mental models

People infer that a conclusion is valid if it holds in all the possibilities. Procedures for reasoning with mental models rely on counter-examples to refute invalid inferences; they establish validity by ensuring that a conclusion holds over all the models of the premises. Reasoners focus on a subset of the possible models of multiple-model problems, often just a single model. The ease with which reasoners can make deductions is affected by many factors, including age and working memory (Barrouillet, et al., 2000). They reject a conclusion if they find a counterexample, i.e., a possibility in which the premises hold, but the conclusion does not (Schroyens, et al. 2003; Verschueren, et al., 2005).

Criticisms

Scientific debate continues about whether human reasoning is based on mental models, versus formal rules of inference (e.g., O'Brien, 2009), domain-specific rules of inference (e.g., Cheng &Holyoak, 2008; Cosmides, 2005), or probabilities (e.g., Oaksford and Chater, 2007). Many empirical comparisons of the different theories have been carried out (e.g., Oberauer, 2006).

Mental models of dynamics systems: mental models in system dynamics

Characteristics

A mental model is generally:

- founded on unquantifiable, impugnable, obscure, or incomplete facts;
- flexible – considerably variable in positive as well as in negative sense;
- an information filter that causes selective perception, perception of only selected parts of information;
- very limited, compared with the complexities of the world, and even when a scientific model is extensive and in accordance with a certain reality in the derivation of logical consequences of it, it must take into account such restrictions as working memory; i.e., rules on the maximum number of elements that people are able to remember, gestaltisms or failure of the principles of logic, etc.;
- dependent on sources of information, which one cannot find anywhere else, are available at any time and can be used.

Mental models are a fundamental way to understand organizational learning. Mental models, in popular science parlance, have been described as "deeply held images of thinking and acting".

Mental models are so basic to understanding the world that people are hardly conscious of them.

Expression of mental models of dynamic systems

S.N. Groesser and M. Schaffernicht (2012) describe three basic methods which are typically used:

- Causal loop diagrams – displaying tendency and a direction of information connections and the resulting causality and feedback loops
- System structure diagrams – another way to express the structure of a qualitative dynamic system
- Stock and flow diagrams - a way to quantify the structure of a dynamic system

These methods allow showing a mental model of a dynamic system, as an explicit, written model about a certain system based on internal beliefs.

Analyzing these graphical representations has been an increasing area of research across many social science fields. Additionally software tools that attempt to capture and analyze the structural and functional properties of individual mental models such as Mental Modeler, "a participatory modeling tool based in fuzzy-logic cognitive mapping", have recently been developed and used to collect/compare/combine mental model representations collected from individuals for use in social science research, collaborative decision-making, and natural resource planning.

Mental model in relation to system dynamics and systemic thinking

In the simplification of reality, creating a model can find a sense of reality, seeking to overcome systemic thinking and system dynamics.

These two disciplines can help to construct a better coordination with the reality of mental models and simulate it accurately. They increase the probability that the consequences of how to decide and act in accordance with how to plan.

- System dynamics – extending mental models through the creation of explicit models, which are clear, easily communicated and can be compared with each other.
- Systemic thinking – seeking the means to improve the mental models and thereby improve the quality of dynamic decisions that are based on mental models.

Experimental studies carried out in weightlessness and on Earth using neuroimaging showed that humans are endowed with a mental model of the effects of gravity on object motion.

Single and double-loop learning

After analyzing the basic characteristics, it is necessary to bring the process of changing the mental models, or the process of learning. Learning is a back-loop process, and

feedback loops can be illustrated as: single-loop learning or double-loop learning.

Single-loop learning

Mental models affect the way that people work with information, and also how they determine the final decision. The decision itself changes, but the mental models remain the same. It is the predominant method of learning, because it is very convenient.

Double-loop learning

- Double-loop learning (*see diagram below*) is used when it is necessary to change the mental model on which a decision depends. Unlike single loops, this model includes a shift in understanding, from simple and static to broader and more dynamic, such as taking into account the changes in the surroundings and the need for expression changes in mental models.

Mental representation

A **mental representation** (or **cognitive representation**), in philosophy of mind, cognitive psychology, neuroscience, and cognitive science, is a hypothetical internal cognitive symbol that represents external reality, or else a mental process that makes use of such a symbol: "a formal system for making explicit certain entities or types of information, together with a specification of how the system does this".

Mental representation is the mental imagery of things that are not actually present to the senses. In contemporary philosophy, specifically in fields of metaphysics such as philosophy of mind and ontology, a mental representation is one of the prevailing ways of explaining and describing the nature of ideas and concepts.

Mental representations (or mental imagery) enable representing things that have never been experienced as well as things that do not exist. Think of yourself traveling to a place you have never visited before, or having a third arm. These things have either never happened or are impossible and do not exist, yet our brain and mental imagery allows us to imagine them. Although visual imagery is more likely to be recalled, mental imagery may involve representations in any of the sensory modalities, such as hearing, smell, or taste. Stephen Kosslyn proposes that images are used to help solve certain types of problems. We are able to visualize the objects in question and mentally represent the images to solve it.

Mental representations also allow people to experience things right in front of them—though the process of how the brain interprets the representational content is debated.

Representational theories of mind

Representationalism (also known as indirect realism) is the view that representations are the main way we access external reality.

The representational theory of mind attempts to explain the nature of ideas, concepts and other mental content in

contemporary philosophy of mind, cognitive science and experimental psychology. In contrast to theories of naive or direct realism, the representational theory of mind postulates the actual existence of mental representations which act as intermediaries between the observing subject and the objects, processes or other entities observed in the external world. These intermediaries stand for or represent to the mind the objects of that world.

For example, when someone arrives at the belief that his or her floor needs sweeping, the representational theory of mind states that he or she forms a mental representation that represents the floor and its state of cleanliness.

The original or "classical" representational theory probably can be traced back to Thomas Hobbes and was a dominant theme in classical empiricism in general. According to this version of the theory, the mental representations were images (often called "ideas") of the objects or states of affairs represented. For modern adherents, such as Jerry Fodor, Steven Pinker and many others, the representational system consists rather of an internal language of thought (i.e., mentalese). The contents of thoughts are represented in symbolic structures (the formulas of Mentalese) which, analogously to natural languages but on a much more abstract level, possess a syntax and semantics very much like those of natural languages. For the Portuguese logician and cognitive scientist Luis M. Augusto, at this abstract, formal level, the syntax of thought is the set of symbol rules (i.e., operations, processes, etc. on and with symbol structures) and the semantics of thought is the set of symbol structures (concepts and propositions). Content (i.e., thought) emerges from the meaningful co-occurrence of both

sets of symbols. For instance, "8 x 9" is a meaningful co-occurrence, whereas "CAT x §" is not; "x" is a symbol rule called for by symbol structures such as "8" and "9", but not by "CAT" and "§".

Canadian philosopher P. Thagard noted in his work “Introduction to Cognitive Science”, that “most cognitive scientists agree that knowledge in the human mind consists of mental representations” and that “cognitive science asserts: that people have mental procedures that operate by means of mental representations for the implementation of thinking and action"

Strong vs weak, restricted vs unrestricted

There are two types of representationalism, strong and weak. Strong representationalism attempts to reduce phenomenal character to intentional content. On the other hand, weak representationalism claims only that phenomenal character supervenes on intentional content. Strong representationalism aims to provide a theory about the nature of phenomenal character, and offers a solution to the hard problem of consciousness. In contrast to this, weak representationalism does not aim to provide a theory of consciousness, nor does it offer a solution to the hard problem of consciousness.

Strong representationalism can be further broken down into restricted and unrestricted versions. The restricted version deals only with certain kinds of phenomenal states e.g. visual perception. Most representationalists endorse an unrestricted version of representationalism. According to the unrestricted version, for any state with phenomenal character that state's

phenomenal character reduces to its intentional content. Only this unrestricted version of representationalism is able to provide a general theory about the nature of phenomenal character, as well as offer a potential solution to the hard problem of consciousness. The successful reduction of the phenomenal character of a state to its intentional content would provide a solution to the hard problem of consciousness once a physicalist account of intentionality is worked out.

Problems for the unrestricted version

When arguing against the unrestricted version of representationalism people will often bring up phenomenal mental states that appear to lack intentional content. The unrestricted version seeks to account for all phenomenal states. Thus, for it to be true, all states with phenomenal character must have intentional content to which that character is reduced. Phenomenal states without intentional content therefore serve as a counterexample to the unrestricted version. If the state has no intentional content its phenomenal character will not be reducible to that state's intentional content, for it has none to begin with.

A common example of this kind of state are moods. Moods are states with phenomenal character that are generally thought to not be directed at anything in particular. Moods are thought to lack directedness, unlike emotions, which are typically thought to be directed at particular things e.g. you are mad *at* your sibling, you are afraid *of* a dangerous animal. People conclude that because moods are undirected they are also nonintentional i.e. they lack intentionality or aboutness. Because they are not directed at anything they are not about

anything. Because they lack intentionality they will lack any intentional content. Lacking intentional content their phenomenal character will not be reducible to intentional content, refuting the representational doctrine.

Though emotions are typically considered as having directedness and intentionality this idea has also been called into question. One might point to emotions a person all of a sudden experiences that do not appear to be directed at or about anything in particular. Emotions elicited by listening to music are another potential example of undirected, nonintentional emotions. Emotions aroused in this way do not seem to necessarily be about anything, including the music that arouses them.

Responses

In response to this objection a proponent of representationalism might reject the undirected non-intentionality of moods, and attempt to identify some intentional content they might plausibly be thought to possess. The proponent of representationalism might also reject the narrow conception of intentionality as being directed at a particular thing, arguing instead for a broader kind of intentionality.

There are three alternative kinds of **directedness** /intentionality one might posit for moods.

- Outward directedness: What it is like to be in mood M is to have a certain kind of outwardly focused representational content.

- Inward directedness: What it is like to be in mood M is to have a certain kind of inwardly focused representational content.
- Hybrid directedness: What it is like to be in mood M is to have both a certain kind of outwardly focused representational content and a certain kind of inwardly focused representational content.

In the case of outward directedness moods might be directed at either the world as a whole, a changing series of objects in the world, or unbound emotion properties projected by people onto things in the world. In the case of inward directedness moods are directed at the overall state of a person's body. In the case of hybrid directedness moods are directed at some combination of inward and outward things.

Further objections

Even if one can identify some possible intentional content for moods we might still question whether that content is able to sufficiently capture the phenomenal character of the mood states they are a part of. Amy Kind contends that in the case of all the previously mentioned kinds of directedness (outward, inward, and hybrid) the intentional content supplied to the mood state is not capable of sufficiently capturing the phenomenal aspects of the mood states. In the case of inward directedness, the phenomenology of the mood does not seem tied to the state of one's body, and even if one's mood is reflected by the overall state of one's body that person will not necessarily be aware of it, demonstrating the insufficiency of the intentional content to adequately capture the phenomenal aspects of the mood. In the case of outward directedness, the

phenomenology of the mood and its intentional content do not seem to share the corresponding relation they should given that the phenomenal character is supposed to reduce to the intentional content. Hybrid directedness, if it can even get off the ground, faces the same objection.

Philosophers

There is a wide debate on what kinds of representations exist. There are several philosophers who bring about different aspects of the debate. Such philosophers include Alex Morgan, GualtieroPiccinini, Uriah Kriegel and others.

Alex Morgan

There are "job description" representations. That is representations that (1) represent something—have intentionality, (2) have a special relation—the represented object does not need to exist, and (3) content plays a causal role in what gets represented: e.g. saying "hello" to a friend, giving a glare to an enemy.

Structural representations are also important. These types of representations are basically mental maps that we have in our minds that correspond exactly to those objects in the world (the intentional content). According to Morgan, structural representations are not the same as mental representations—there is nothing mental about them: plants can have structural representations.

There are also internal representations. These types of representations include those that involve future decisions, episodic memories, or any type of projection into the future.

GualtieroPiccinini

In GualtieroPiccinini's forthcoming work, he discusses topics on natural and nonnatural mental representations. He relies on the natural definition of mental representations given by Grice (1957) where *P entails that P*. e.g. Those spots mean measles, entails that the patient has measles. Then there are nonnatural representations: *P does not entail P*. e.g. The 3 rings on the bell of a bus mean the bus is full—the rings on the bell are independent of the fullness of the bus—we could have assigned something else (just as arbitrary) to signify that the bus is full.

Uriah Kriegel

There are also objective and subjective mental representations. Objective representations are closest to tracking theories—where the brain simply tracks what is in the environment. If there is a blue bird outside my window, the objective representation is that of the blue bird. Subjective representations can vary person-to-person. For example, if I am colorblind, that blue bird outside my window will not *appear* blue to me since I cannot represent the blueness of blue (i.e. I cannot see the color blue). The relationship between these two types of representation can vary.

- Objective varies, but the subjective does not: e.g. brain-in-a-vat

- Subjective varies, but the objective does not: e.g. color-inverted world
- All representations found in objective and none in the subjective: e.g. thermometer
- All representations found in subjective and none in the objective: e.g. an agent that experiences in a void.

Eliminativists think that subjective representations don't exist. Reductivists think subjective representations are reducible to objective. Non-reductivists think that subjective representations are real and distinct.

Cognitive model

A **cognitive model**is an approximation to animal cognitive processes (predominantly human) for the purposes of comprehension and prediction. There are many types of cognitive models, and they can range from box-and-arrow diagrams to a set of equations to software programs that interact with the same tools that humans use to complete tasks (e.g., computer mouse and keyboard).

Relationship to cognitive architectures

Cognitive models can be developed within or without a cognitive architecture, though the two are not always easily distinguishable. In contrast to cognitive architectures, cognitive models tend to be focused on a single cognitive

phenomenon or process (e.g., list learning), how two or more processes interact (e.g., visual search bsc1780 decision making), or making behavioral predictions for a specific task or tool (e.g., how instituting a new software package will affect productivity). Cognitive architectures tend to be focused on the structural properties of the modeled system, and help constrain the development of cognitive models within the architecture. Likewise, model development helps to inform limitations and shortcomings of the architecture. Some of the most popular architectures for cognitive modeling include ACT-R, Clarion, LIDA, and Soar.

History

Cognitive modeling historically developed within cognitive psychology/cognitive science (including human factors), and has received contributions from the fields of machine learning and artificial intelligence among others.

Box-and-arrow models

A number of key terms are used to describe the processes involved in the perception, storage, and production of speech. Typically, they are used by speech pathologists while treating a child patient. The input signal is the speech signal heard by the child, usually assumed to come from an adult speaker. The output signal is the utterance produced by the child. The unseen psychological events that occur between the arrival of an input signal and the production of speech are the focus of psycholinguistic models. Events that process the input signal are referred to as input processes, whereas events that process

the production of speech are referred to as output processes. Some aspects of speech processing are thought to happen online—that is, they occur during the actual perception or production of speech and thus require a share of the attentional resources dedicated to the speech task. Other processes, thought to happen offline, take place as part of the child's background mental processing rather than during the time dedicated to the speech task. In this sense, online processing is sometimes defined as occurring in real-time, whereas offline processing is said to be time-free (Hewlett, 1990). In box-and-arrow psycholinguistic models, each hypothesized level of representation or processing can be represented in a diagram by a "box," and the relationships between them by "arrows," hence the name. Sometimes (as in the models of Smith, 1973, and Menn, 1978, described later in this paper) the arrows represent processes additional to those shown in boxes. Such models make explicit the hypothesized information- processing activities carried out in a particular cognitive function (such as language), in a manner analogous to computer flowcharts that depict the processes and decisions carried out by a computer program. Box-and-arrow models differ widely in the number of unseen psychological processes they describe and thus in the number of boxes they contain. Some have only one or two boxes between the input and output signals (e.g., Menn, 1978; Smith, 1973), whereas others have multiple boxes representing complex relationships between a number of different information-processing events (e.g., Hewlett, 1990; Hewlett, Gibbon, & Cohen- McKenzie, 1998; Stackhouse & Wells, 1997). The most important box, however, and the source of much ongoing debate, is that representing the underlying representation (or UR). In essence, an underlying representation captures information stored in a

child's mind about a word he or she knows and uses. As the following description of several models will illustrate, the nature of this information and thus the type(s) of representation present in the child's knowledge base have captured the attention of researchers for some time. (Elise Baker et al. Psycholinguistic Models of Speech Development and Their Application to Clinical Practice. Journal of Speech, Language, and Hearing Research. June 2001. 44. p 685–702.)

Computational models

A computational model is a mathematical model in computational science that requires extensive computational resources to study the behavior of a complex system by computer simulation. The system under study is often a complex nonlinear system for which simple, intuitive analytical solutions are not readily available. Rather than deriving a mathematical analytical solution to the problem, experimentation with the model is done by changing the parameters of the system in the computer, and studying the differences in the outcome of the experiments. Theories of operation of the model can be derived/deduced from these computational experiments. Examples of common computational models are weather forecasting models, earth simulator models, flight simulator models, molecular protein folding models, and neural network models.

Symbolic

A *symbolic* model is expressed in characters, usually non-numeric ones, that require translation before they can be used.

Subsymbolic

A cognitive model is *subsymbolic* if it is made by constituent entities that are not representations in their turn, e.g., pixels, sound images as perceived by the ear, signal samples; subsymbolic units in neural networks can be considered particular cases of this category.

Hybrid

Hybrid computers are computers that exhibit features of analog computers and digital computers. The digital component normally serves as the controller and provides logical operations, while the analog component normally serves as a solver of differential equations. See more details at hybrid intelligent system.

Dynamical systems

In the traditional computational approach, representations are viewed as static structures of discrete symbols. Cognition takes place by transforming static symbol structures in discrete, sequential steps. Sensory information is transformed into symbolic inputs, which produce symbolic outputs that get transformed into motor outputs. The entire system operates in an ongoing cycle.

What is missing from this traditional view is that human cognition happens continuously and in real time. Breaking down the processes into discrete time steps may not fully capture this behavior. An alternative approach is to define a system with (1) a state of the system at any given time, (2) a

behavior, defined as the change over time in overall state, and (3) a state set or state space, representing the totality of overall states the system could be in. The system is distinguished by the fact that a change in any aspect of the system state depends on other aspects of the same or other system states.

A typical dynamical model is formalized by several differential equations that describe how the system's state changes over time. By doing so, the form of the space of possible trajectories and the internal and external forces that shape a specific trajectory that unfold over time, instead of the physical nature of the underlying mechanisms that manifest this dynamics, carry explanatory force. On this dynamical view, parametric inputs alter the system's intrinsic dynamics, rather than specifying an internal state that describes some external state of affairs.

Early dynamical systems

Associative memory

Early work in the application of dynamical systems to cognition can be found in the model of Hopfield networks. These networks were proposed as a model for associative memory. They represent the neural level of memory, modeling systems of around 30 neurons which can be in either an on or off state. By letting the network learn on its own, structure and computational properties naturally arise. Unlike previous models, “memories” can be formed and recalled by inputting a small portion of the entire memory. Time ordering of memories

can also be encoded. The behavior of the system is modeled with vectors which can change values, representing different states of the system. This early model was a major step toward a dynamical systems view of human cognition, though many details had yet to be added and more phenomena accounted for.

Language acquisition

By taking into account the evolutionary development of the human nervous system and the similarity of the brain to other organs, Elman proposed that language and cognition should be treated as a dynamical system rather than a digital symbol processor. Neural networks of the type Elman implemented have come to be known as Elman networks. Instead of treating language as a collection of static lexical items and grammar rules that are learned and then used according to fixed rules, the dynamical systems view defines the lexicon as regions of state space within a dynamical system. Grammar is made up of attractors and repellers that constrain movement in the state space. This means that representations are sensitive to context, with mental representations viewed as trajectories through mental space instead of objects that are constructed and remain static. Elman networks were trained with simple sentences to represent grammar as a dynamical system. Once a basic grammar had been learned, the networks could then parse complex sentences by predicting which words would appear next according to the dynamical model.

Cognitive development

A classic developmental error has been investigated in the context of dynamical systems: The A-not-B error is proposed to be not a distinct error occurring at a specific age (8 to 10 months), but a feature of a dynamic learning process that is also present in older children. Children 2 years old were found to make an error similar to the A-not-B error when searching for toys hidden in a sandbox. After observing the toy being hidden in location A and repeatedly searching for it there, the 2-year-olds were shown a toy hidden in a new location B. When they looked for the toy, they searched in locations that were biased toward location A. This suggests that there is an ongoing representation of the toy's location that changes over time. The child's past behavior influences its model of locations of the sandbox, and so an account of behavior and learning must take into account how the system of the sandbox and the child's past actions is changing over time.

Locomotion

One proposed mechanism of a dynamical system comes from analysis of continuous-time recurrent neural networks (CTRNNs). By focusing on the output of the neural networks rather than their states and examining fully interconnected networks, three-neuron central pattern generator (CPG) can be used to represent systems such as leg movements during walking. This CPG contains three motor neurons to control the foot, backward swing, and forward swing effectors of the leg. Outputs of the network represent whether the foot is up or down and how much force is being applied to generate torque in the leg joint. One feature of this pattern is that neuron

outputs are either off or on most of the time. Another feature is that the states are quasi-stable, meaning that they will eventually transition to other states. A simple pattern generator circuit like this is proposed to be a building block for a dynamical system. Sets of neurons that simultaneously transition from one quasi-stable state to another are defined as a dynamic module. These modules can in theory be combined to create larger circuits that comprise a complete dynamical system. However, the details of how this combination could occur are not fully worked out.

Modern dynamical systems

Behavioral dynamics

Modern formalizations of dynamical systems applied to the study of cognition vary. One such formalization, referred to as “behavioral dynamics”, treats the agent and the environment as a pair of coupled dynamical systems based on classical dynamical systems theory. In this formalization, the information from the environment informs the agent's behavior and the agent's actions modify the environment. In the specific case of perception-action cycles, the coupling of the environment and the agent is formalized by two functions. The first transforms the representation of the agents action into specific patterns of muscle activation that in turn produce forces in the environment. The second function transforms the information from the environment (i.e., patterns of stimulation at the agent's receptors that reflect the environment's current state) into a representation that is useful for controlling the agentsactions. Other similar dynamical systems have been

proposed (although not developed into a formal framework) in which the agent's nervous systems, the agent's body, and the environment are coupled together

Adaptive behaviors

Behavioral dynamics have been applied to locomotive behavior. Modeling locomotion with behavioral dynamics demonstrates that adaptive behaviors could arise from the interactions of an agent and the environment. According to this framework, adaptive behaviors can be captured by two levels of analysis. At the first level of perception and action, an agent and an environment can be conceptualized as a pair of dynamical systems coupled together by the forces the agent applies to the environment and by the structured information provided by the environment. Thus, behavioral dynamics emerge from the agent-environment interaction. At the second level of time evolution, behavior can be expressed as a dynamical system represented as a vector field. In this vector field, attractors reflect stable behavioral solutions, where as bifurcations reflect changes in behavior. In contrast to previous work on central pattern generators, this framework suggests that stable behavioral patterns are an emergent, self-organizing property of the agent-environment system rather than determined by the structure of either the agent or the environment.

Open dynamical systems

In an extension of classical dynamical systems theory, rather than coupling the environment's and the agent's dynamical systems to each other, an “open dynamical system” defines a “total system”, an “agent system”, and a mechanism to relate

these two systems. The total system is a dynamical system that models an agent in an environment, whereas the agent system is a dynamical system that models an agent's intrinsic dynamics (i.e., the agent's dynamics in the absence of an environment). Importantly, the relation mechanism does not couple the two systems together, but rather continuously modifies the total system into the decoupled agent's total system. By distinguishing between total and agent systems, it is possible to investigate an agent's behavior when it is isolated from the environment and when it is embedded within an environment. This formalization can be seen as a generalization from the classical formalization, whereby the agent system can be viewed as the agent system in an open dynamical system, and the agent coupled to the environment and the environment can be viewed as the total system in an open dynamical system.

Embodied cognition

In the context of dynamical systems and embodied cognition, representations can be conceptualized as indicators or mediators. In the indicator view, internal states carry information about the existence of an object in the environment, where the state of a system during exposure to an object is the representation of that object. In the mediator view, internal states carry information about the environment which is used by the system in obtaining its goals. In this more complex account, the states of the system carries information that mediates between the information the agent takes in from the environment, and the force exerted on the environment by the agents behavior. The application of open dynamical systems have been discussed for four types of classical embodied cognition examples:

- Instances where the environment and agent must work together to achieve a goal, referred to as "intimacy". A classic example of intimacy is the behavior of simple agents working to achieve a goal (e.g., insects traversing the environment). The successful completion of the goal relies fully on the coupling of the agent to the environment.
- Instances where the use of external artifacts improves the performance of tasks relative to performance without these artifacts. The process is referred to as "offloading". A classic example of offloading is the behavior of Scrabble players; people are able to create more words when playing Scrabble if they have the tiles in front of them and are allowed to physically manipulate their arrangement. In this example, the Scrabble tiles allow the agent to offload working memory demands on to the tiles themselves.
- Instances where a functionally equivalent external artifact replaces functions that are normally performed internally by the agent, which is a special case of offloading. One famous example is that of human (specifically the agents Otto and Inga) navigation in a complex environment with or without assistance of an artifact.
- Instances where there is not a single agent. The individual agent is part of larger system that contains multiple agents and multiple artifacts. One famous example, formulated by Ed Hutchins in his book *Cognition in the Wild*, is that of navigating a naval ship.

The interpretations of these examples rely on the following logic: (1) the total system captures embodiment; (2) one or more agent systems capture the intrinsic dynamics of individual agents; (3) the complete behavior of an agent can be understood as a change to the agent's intrinsic dynamics in relation to its situation in the environment; and (4) the paths of an open dynamical system can be interpreted as representational processes. These embodied cognition examples show the importance of studying the emergent dynamics of an agent-environment systems, as well as the intrinsic dynamics of agent systems. Rather than being at odds with traditional cognitive science approaches, dynamical systems are a natural extension of these methods and should be studied in parallel rather than in competition.

Computational models

Computational models have long been used to explore the mechanisms by which language learners process and manipulate linguistic information. Models of this type allow researchers to systematically control important learning variables that are oftentimes difficult to manipulate at all in human participants.

Associative models

Associative neural network models of language acquisition are one of the oldest types of cognitive model, using distributed representations and changes in the weights of the connections between the nodes that make up these representations to simulate learning in a manner reminiscent of the plasticity-

based neuronal reorganization that forms the basis of human learning and memory. Associative models represent a break with classical cognitive models, characterized by discrete and context-free symbols, in favor of a dynamical systems approach to language better capable of handling temporal considerations.

A precursor to this approach, and one of the first model types to account for the dimension of time in linguistic comprehension and production was Elman's simple recurrent network (SRN). By making use of a feedback network to represent the system's past states, SRNs were able in a word-prediction task to cluster input into self-organized grammatical categories based solely on statistical co-occurrence patterns.

Early successes such as these paved the way for dynamical systems research into linguistic acquisition, answering many questions about early linguistic development but leaving many others unanswered, such as how these statistically acquired lexemes are represented. Of particular importance in recent research has been the effort to understand the dynamic interaction of learning (e.g. language-based) and learner (e.g. speaker-based) variables in lexical organization and competition in bilinguals. In the ceaseless effort to move toward more psychologically realistic models, many researchers have turned to a subset of associative models, self-organizing maps (SOMs), as established, cognitively plausible models of language development.

SOMs have been helpful to researchers in identifying and investigating the constraints and variables of interest in a number of acquisition processes, and in exploring the

consequences of these findings on linguistic and cognitive theories. By identifying working memory as an important constraint both for language learners and for current computational models, researchers have been able to show that manipulation of this variable allows for syntactic bootstrapping, drawing not just categorical but actual content meaning from words' positional co-occurrence in sentences.

Probabilistic models

Some recent models of language acquisition have centered around methods of Bayesian Inference to account for infants' abilities to appropriately parse streams of speech and acquire word meanings. Models of this type rely heavily on the notion of conditional probability (the probability of A given B), in line with findings concerning infants' use of transitional probabilities of words and syllables to learn words.

Models that make use of these probabilistic methods have been able to merge the previously dichotomous language acquisition perspectives of social theories that emphasize the importance of learning speaker intentions and statistical and associative theories that rely on cross-situational contexts into a single joint-inference problem. This approach has led to important results in explaining acquisition phenomena such as mutual exclusivity, one-trial learning or fast mapping, and the use of social intentions.

While these results seem to be robust, studies concerning these models' abilities to handle more complex situations such as multiple referent to single label mapping, multiple label to single referent mapping, and bilingual language acquisition in

comparison to associative models' successes in these areas have yet to be explored. Hope remains, though, that these model types may be merged to provide a comprehensive account of language acquisition.

C/V hypothesis

Along the lines of probabilistic frequencies, the C/V hypothesis basically states all language hearers use consonantal frequencies to distinguish between words (lexical distinctions) in continuous speech strings, in comparison to vowels. Vowels are more pertinent to rhythmic identification. Several follow-up studies revealed this finding, as they showed that vowels are processed independently of their local statistical distribution. Other research has shown that the consonant-vowel ratio doesn't influence the sizes of lexicons when comparing distinct languages. In the case of languages with a higher consonant ratio, children may depend more on consonant neighbors than rhyme or vowel frequency.

Algorithms for language acquisition

Some models of language acquisition have been based on adaptive parsing and grammar induction algorithms.

Computational-representational understanding of mind

Computational representational understanding of mind (**CRUM**) is a hypothesis in cognitive science which proposes that thinking is performed by computations operating on

representations. This hypothesis assumes that the mind has mental representations analogous to data structures and computational procedures analogous to algorithms, such that computer programs using algorithms applied to data structures can model the mind and its processes.

CRUM takes into consideration several theoretical approaches of understanding human cognition, including logic, rule, concept, analogy, image, and connection based systems. These serve as the representation aspects of CRUM theory which are then acted upon to simulate certain aspects of human cognition, such as the use of rule-based systems in neuroeconomics.

There is much disagreement on this hypothesis, but CRUM has high regard among some researchers. Philosopher Paul Thagard called it "the most theoretically and experimentally successful approach to mind ever developed".

Memory-prediction framework

The **memory-prediction framework** is a theory of brain function created by Jeff Hawkins and described in his 2004 book *On Intelligence*. This theory concerns the role of the mammalian neocortex and its associations with the hippocampi and the thalamus in matching sensory inputs to stored memory patterns and how this process leads to predictions of what will happen in the future.

Overview

The theory is motivated by the observed similarities between the brain structures (especially neocortical tissue) that are used for a wide range of behaviours available to mammals. The theory posits that the remarkably uniform *physical* arrangement of cortical tissue reflects a single principle or algorithm which underlies all cortical information processing. The basic processing principle is hypothesized to be a feedback/recall loop which involves both cortical and extra-cortical participation (the latter from the thalamus and the hippocampi in particular).

The basic theory: recognition and prediction in bi-directional hierarchies

The central concept of the memory-prediction framework is that bottom-up inputs are matched in a hierarchy of recognition, and evoke a series of top-down expectations encoded as potentiations. These expectations interact with the bottom-up signals to both analyse those inputs and generate predictions of subsequent expected inputs. Each hierarchy level remembers frequently observed temporal sequences of input patterns and generates labels or 'names' for these sequences. When an input sequence matches a memorized sequence at a given level of the hierarchy, a label or 'name' is propagated up the hierarchy – thus eliminating details at higher levels and enabling them to learn higher-order

sequences. This process produces increased invariance at higher levels. Higher levels predict future input by matching partial sequences and projecting their expectations to the lower levels. However, when a mismatch between input and memorized/predicted sequences occurs, a more complete representation propagates upwards. This causes alternative 'interpretations' to be activated at higher levels, which in turn generates other predictions at lower levels.

Consider, for example, the process of vision. Bottom-up information starts as low-level retinal signals (indicating the presence of simple visual elements and contrasts). At higher levels of the hierarchy, increasingly meaningful information is extracted, regarding the presence of lines, regions, motions, etc. Even further up the hierarchy, activity corresponds to the presence of specific objects – and then to behaviours of these objects. Top-down information fills in details about the recognized objects, and also about their expected behaviour as time progresses.

The sensory hierarchy induces a number of differences between the various levels. As one moves up the hierarchy, representations have increased:

- Extent – for example, larger areas of the visual field, or more extensive tactile regions.
- Temporal stability – lower-level entities change quickly, whereas, higher-level percepts tend to be more stable.
- Abstraction – through the process of successive extraction of invariant features, increasingly abstract entities are recognized.

The relationship between sensory and motor processing is an important aspect of the basic theory. It is proposed that the motor areas of the cortex consist of a behavioural hierarchy similar to the sensory hierarchy, with the lowest levels consisting of explicit motor commands to musculature and the highest levels corresponding to abstract prescriptions (e.g. 'resize the browser'). The sensory and motor hierarchies are tightly coupled, with behaviour giving rise to sensory expectations and sensory perceptions driving motor processes.

Finally, it is important to note that all the memories in the cortical hierarchy have to be learnt – this information is not pre-wired in the brain. Hence, the process of extracting this representation from the flow of inputs and behaviorsis theorized as a process that happens continually during cognition.

Other terms

Hawkins has extensive training as an electrical engineer. Another way to describe the theory (hinted at in his book) is as a learning hierarchy of feed forward stochastic state machines. In this view, the brain is analyzed as an encoding problem, not too dissimilar from future-predicting error-correction codes. The hierarchy is a hierarchy of abstraction, with the higher level machines' states representing more abstract conditions or events, and these states predisposing lower-level machines to perform certain transitions. The lower level machines model limited domains of experience, or control or interpret sensors or effectors. The whole system actually controls the organism's behavior. Since the state machine is "feed forward", the organism responds to future events predicted from past data.

Since it is hierarchical, the system exhibits behavioral flexibility, easily producing new sequences of behavior in response to new sensory data. Since the system learns, the new behavior adapts to changing conditions.

That is, the evolutionary purpose of the brain is to predict the future, in admittedly limited ways, so as to change it.

Neurophysiological implementation

The hierarchies described above are theorized to occur primarily in mammalian neocortex. In particular, neocortex is assumed to consist of a large number of columns (as surmised also by Vernon Benjamin Mountcastle from anatomical and theoretical considerations). Each column is attuned to a particular feature at a given level in a hierarchy. It receives bottom-up inputs from lower levels, and top-down inputs from higher levels. (Other columns at the same level also feed into a given column, and serve mostly to inhibit the activation exclusive representations.) When an input is recognized – that is, acceptable agreement is obtained between the bottom-up and top-down sources – a column generates outputs which in turn propagate to both lower and higher levels.

Cortex

These processes map well to specific layers within mammalian cortex. (The cortical layers should not be confused with different levels of the processing hierarchy: all the layers in a single column participate as one element in a single hierarchical level). Bottom-up input arrives at layer 4 (L4), whence it propagates to L2 and L3 for recognition of the

invariant content. Top-down activation arrives to L2 and L3 via L1 (the mostly axonal layer that distributes activation locally across columns). L2 and L3 compare bottom up and top-down information, and generate either the invariant 'names' when sufficient match is achieved, or the more variable signals that occur when this fails. These signals are propagated up the hierarchy (via L5) and also down the hierarchy (via L6 and L1).

Thalamus

To account for storage and recognition of *sequences* of patterns, a combination of two processes is suggested. The nonspecific thalamus acts as a 'delay line' – that is, L5 activates this brain area, which re-activates L1 after a slight delay. Thus, the output of one column generates L1 activity, which will coincide with the input to a column which is temporally subsequent within a sequence. This time ordering operates in conjunction with the higher-level identification of the sequence, which does not change in time; hence, activation of the sequence representation causes the lower-level components to be predicted one after the other. (Besides this role in sequencing, the thalamus is also active as sensory waystation – these roles apparently involve distinct regions of this anatomically non-uniform structure.)

Hippocampus

- Another anatomically diverse brain structure which is hypothesized to play an important role in hierarchical cognition is the hippocampus. It is well known that damage to both hippocampi impairs the formation of long-term declarative memory;

> individuals with such damage are unable to form new memories of episodic nature, although they can recall earlier memories without difficulties and can also learn new skills. In the current theory, the hippocampi are thought of as the top level of the cortical hierarchy; they are specialized to retain memories of events that propagate all the way to the top. As such events fit into predictable patterns, they become memorizable at lower levels in the hierarchy. (Such movement of memories down the hierarchy is, incidentally, a general prediction of the theory.) Thus, the hippocampi continually memorize 'unexpected' events (that is, those not predicted at lower levels); if they are damaged, the entire process of memorization through the hierarchy is compromised.

In 2016 Jeff Hawkins hypothesized that cortical columns did not just capture a sensation, but also the relative location of that sensation, in three dimensions rather than two (*situated capture*), in relation to what was around it. "When the brain builds a model of the world, everything has a location relative to everything else" —Jeff Hawkins.

Explanatory successes and predictions

The memory-prediction framework explains a number of psychologically salient aspects of cognition. For example, the ability of experts in any field to effortlessly analyze and remember complex problems within their field is a natural

consequence of their formation of increasingly refined conceptual hierarchies. Also, the procession from 'perception' to 'understanding' is readily understandable as a result of the matching of top-down and bottom-up expectations. Mismatches, in contrast, generate the exquisite ability of biological cognition to detect unexpected perceptions and situations. (Deficiencies in this regard are a common characteristic of current approaches to artificial intelligence.)

Besides these subjectively satisfying explanations, the framework also makes a number of testable predictions. For example, the important role that prediction plays throughout the sensory hierarchies calls for anticipatory neural activity in certain cells throughout sensory cortex. In addition, cells that 'name' certain invariants should remain active throughout the presence of those invariants, even if the underlying inputs change. The predicted patterns of bottom-up and top-down activity – with former being more complex when expectations are not met – may be detectable, for example by functional magnetic resonance imaging (fMRI).

Although these predictions are not highly specific to the proposed theory, they are sufficiently unambiguous to make verification or rejection of its central tenets possible. See *On Intelligence* for details on the predictions and findings.

Contribution and limitations

By design, the current theory builds on the work of numerous neurobiologists, and it may be argued that most of these ideas have already been proposed by researchers such as Grossberg and Mountcastle. On the other hand, the novel separation of

the conceptual mechanism (i.e., bidirectional processing and invariant recognition) from the biological details (i.e., neural layers, columns and structures) lays the foundation for abstract thinking about a wide range of cognitive processes.

The most significant limitation of this theory is its current lack of detail. For example, the concept of invariance plays a crucial role; Hawkins posits "name cells" for at least some of these invariants. (See also Neuralensemble#Encoding for grandmother neurons which perform this type of function, and mirror neurons for a somatosensory system viewpoint.) But it is far from obvious how to develop a mathematically rigorous definition, which will carry the required conceptual load across the domains presented by Hawkins. Similarly, a complete theory will require credible details on both the short-term dynamics and the learning processes that will enable the cortical layers to behave as advertised.

IBM is implementing Hawkins' model.

Machine learning models

The memory-prediction theory claims a common algorithm is employed by all regions in the neocortex.

The theory has given rise to a number of software models aiming to simulate this common algorithm using a hierarchical memory structure.

The year in the list below indicates when the model was last updated.

Models based on Bayesian networks

The following models use belief propagation or belief revision in singly connected Bayesian networks.

- Hierarchical Temporal Memory (HTM), a model, a related development platform and source code by Numenta, Inc. (2008).
- HtmLib, an alternative implementation of HTM algorithms by Greg Kochaniak with a number of modifications for improving the recognition accuracy and speed (2008).
- Project Neocortex, an open source project for modeling memory-prediction framework (2008).
- SauliusGaralevicius' research page, research papers and programs presenting experimental results with a model of the memory-prediction framework, a basis for the Neocortex project (2007).
- *George, Dileep (2005). "A Hierarchical Bayesian Model of Invariant Pattern Recognition in the Visual Cortex". CiteSeerX 10.1.1.132.6744.*a paper describing earlier pre-HTM Bayesian model by the co-founder of Numenta. This is the first model of memory-prediction framework that uses Bayesian networks and all the above models are based on these initial ideas. Matlab source code of this model had been freely available for download for a number of years.

Other models

- Implementation of MPF, a paper by SauliusGaralevicius describing a method of

classification and prediction in a model that stores temporal sequences and employs unsupervised learning (2005).

- M5, a pattern machine for Palm OS that stores pattern sequences and recalls the patterns relevant to its present environment (2007).
- BrainGame, open source predictor class which learns patterns and can be linked to other predictors (2005).

Space mapping

The **space mapping** methodology for modeling and design optimization of engineering systems was first discovered by John Bandler in 1993. It uses relevant existing knowledge to speed up model generation and design optimization of a system. The knowledge is updated with new validation information from the system when available.

Concept

The space mapping methodology employs a "quasi-global" formulation that intelligently links companion "coarse" (ideal or low-fidelity) and "fine" (practical or high-fidelity) models of different complexities. In engineering design, space mapping aligns a very fast coarse model with the expensive-to-compute fine model so as to avoid direct expensive optimization of the fine model. The alignment can be done either off-line (model enhancement) or on-the-fly with surrogate updates (e.g., aggressive space mapping).

Methodology

At the core of the process is a pair of models: one very accurate but too expensive to use directly with a conventional optimization routine, and one significantly less expensive and, accordingly, less accurate. The latter (fast model) is usually referred to as the "coarse" model (coarse space). The former (slow model) is usually referred to as the "fine" model. A validation space ("reality") represents the fine model, for example, a high-fidelity physics model.

The optimization space, where conventional optimization is carried out, incorporates the coarse model (or surrogate model), for example, the low-fidelity physics or "knowledge" model. In a space-mapping design optimization phase, there is a prediction or "execution" step, where the results of an optimized "mapped coarse model" (updated surrogate) are assigned to the fine model for validation.

After the validation process, if the design specifications are not satisfied, relevant data is transferred to the optimization space ("feedback"), where the mapping-augmented coarse model or surrogate is updated (enhanced, realigned with the fine model) through an iterative optimization process termed "parameter extraction". The mapping formulation itself incorporates "intuition", part of the engineer's so-called "feel" for a problem. In particular, the Aggressive Space Mapping (ASM) process displays key characteristics of cognition (an expert's approach to a problem), and is often illustrated in simple cognitive terms.

Development

Following John Bandler's concept in 1993, algorithms have utilized Broyden updates (aggressive space mapping), trust regions, and artificial neural networks. Developments include implicit space mapping, in which we allow preassigned parameters not used in the optimization process to change in the coarse model, and output space mapping, where a transformation is applied to the response of the model. A 2004 paper reviews the state of the art after the first ten years of development and implementation. Tuning space mapping utilizes a so-called tuning model—constructed invasively from the fine model—as well as a calibration process that translates the adjustment of the optimized tuning model parameters into relevant updates of the design variables. The space mapping concept has been extended to neural-based space mapping for large-signal statistical modeling of nonlinear microwave devices. Space mapping is supported by sound convergence theory and is related to the defect-correction approach.

A 2016 state-of-the-art review is devoted to aggressive space mapping. It spans two decades of development and engineering applications. A comprehensive 2021 review paper discusses space mapping in the context of radio frequency and microwave design optimization; in the context of engineering surrogate model, feature-based and cognition-driven design; and in the context of machine learning, intuition, and human intelligence.

The space mapping methodology can also be used to solve inverse problems. Proven techniques include the Linear Inverse Space Mapping (LISM) algorithm, as well as the Space Mapping with Inverse Difference (SM-ID) method.

Category

Space mapping optimization belongs to the class of surrogate-based optimization methods, that is to say, optimization methods that rely on a surrogate model.

Applications

The space mapping technique has been applied in a variety of disciplines including microwave and electromagnetic design, civil and mechanical applications, aerospace engineering, and biomedical research. Some examples:

- Optimizing aircraft wing curvature
- Automotive crashworthiness design.
- EEG source analysis
- Handset antenna optimization
- Design centering of microwave circuits
- Design of electric machines using multi-physical modeling
- Control of partial differential equations.
- Voice coil actuator design
- Reconstruction of local magnetic properties
- Structural optimization
- Design of microwave filters and multiplexers
- Optimization of delay structures
- Power electronics
- Signal integrity

Simulators

Various simulators can be involved in a space mapping optimization and modeling processes.

- In the microwave and radio frequency (RF) area
- Keysight ADS [1]
- Keysight Momentum [2]
- Ansys HFSS [3]
- CST Microwave Studio [4]
- FEKO [5]
- Sonnet ***em*** [6]

Conferences

Three international workshops have focused significantly on the art, the science and the technology of space mapping.

- First International Workshop on Surrogate Modelling and Space Mapping for Engineering Optimization (Lyngby, Denmark, Nov. 2000)
- Second International Workshop on Surrogate Modelling and Space Mapping for Engineering Optimization (Lyngby, Denmark, Nov. 2006)
- Third International Workshop on Surrogate Modelling and Space Mapping for Engineering Optimization (Reykjavik, Iceland, Aug. 2012)

Terminology

There is a wide spectrum of terminology associated with space mapping: ideal model, coarse model, coarse space, fine model, companion model, cheap model, expensive model, surrogate model, low fidelity (resolution) model, high fidelity (resolution) model, empirical model, simplified physics model, physics-based model, quasi-global model, physically expressive model, device under test, electromagnetics-based model, simulation model, computational model, tuning model, calibration model, surrogate model, surrogate update, mapped coarse model, surrogate optimization, parameter extraction, target response, optimization space, validation space, neuro-space mapping, implicit space mapping, output space mapping, port tuning, predistortion (of design specifications), manifold mapping, defect correction, model management, multi-fidelity models, variable fidelity/variable complexity, multigrid method, coarse grid, fine grid, surrogate-driven, simulation-driven, model-driven, feature-based modeling.

Chapter 4

Metaphors by Type

"Computer metaphor"

Computational theory of mind is not the same as the computer metaphor, comparing the mind to a modern-day digital computer. Computational theory just uses some of the same principles as those found in digital computing. While the computer metaphor draws an analogy between the mind as software and the brain as hardware, CTM is the claim that the mind is a computational system. More specifically, it states that a computational simulation of a mind is sufficient for the actual presence of a mind, and that a mind truly can be simulated computationally.

'Computational system' is not meant to mean a modern-day electronic computer. Rather, a computational system is a symbol manipulator that follows step by step functions to compute input and form output. Alan Turing describes this type of computer in his concept of a Turing machine.

In philosophy of mind, the **computational theory of mind** (**CTM**), also known as **computationalism**, is a family of views that hold that the human mind is an information processing system and that cognition and consciousness together are a form of computation. Warren McCulloch and Walter Pitts (1943) were the first to suggest that neural activity is computational. They argued that neural computations explain cognition. The theory was proposed in its modern form by

Hilary Putnam in 1967, and developed by his PhD student, philosopher and cognitive scientist Jerry Fodor in the 1960s, 1970s and 1980s. Despite being vigorously disputed in analytic philosophy in the 1990s due to work by Putnam himself, John Searle, and others, the view is common in modern cognitive psychology and is presumed by many theorists of evolutionary psychology. In the 2000s and 2010s the view has resurfaced in analytic philosophy (Scheutz 2003, Edelman 2008).

The computational theory of mind holds that the mind is a computational system that is realized (i.e. physically implemented) by neural activity in the brain. The theory can be elaborated in many ways and varies largely based on how the term computation is understood. Computation is commonly understood in terms of Turing machines which manipulate symbols according to a rule, in combination with the internal state of the machine. The critical aspect of such a computational model is that we can abstract away from particular physical details of the machine that is implementing the computation. For example, the appropriate computation could be implemented either by silicon chips or biological neural networks, so long as there is a series of outputs based on manipulations of inputs and internal states, performed according to a rule. CTM, therefore holds that the mind is not simply analogous to a computer program, but that it is literally a computational system.

Computational theories of mind are often said to require mental representation because 'input' into a computation comes in the form of symbols or representations of other objects. A computer cannot compute an actual object, but must interpret and represent the object in some form and then

compute the representation. The computational theory of mind is related to the representational theory of mind in that they both require that mental states are representations. However, the representational theory of mind shifts the focus to the symbols being manipulated. This approach better accounts for systematicity and productivity. In Fodor's original views, the computational theory of mind is also related to the language of thought. The language of thought theory allows the mind to process more complex representations with the help of semantics. (See below in semantics of mental states).

Recent work has suggested that we make a distinction between the mind and cognition. Building from the tradition of McCulloch and Pitts, the *computational theory of cognition* (CTC) states that neural computations explain cognition. The computational theory of mind asserts that not only cognition, but also phenomenal consciousness or qualia, are computational. That is to say, CTM entails CTC. While phenomenal consciousness could fulfill some other functional role, computational theory of cognition leaves open the possibility that some aspects of the mind could be non-computational. CTC therefore provides an important explanatory framework for understanding neural networks, while avoiding counter-arguments that center around phenomenal consciousness.

Early proponents

One of the earliest proponents of the computational theory of mind was Thomas Hobbes, who said, "by reasoning, I understand computation. And to compute is to collect the sum of many things added together at the same time, or to know the

remainder when one thing has been taken from another. To reason therefore is the same as to add or to subtract." Since Hobbes lived before the contemporary identification of computing with instantiating effective procedures, he cannot be interpreted as explicitly endorsing the computational theory of mind, in the contemporary sense.

Causal picture of thoughts

At the heart of the computational theory of mind is the idea that thoughts are a form of computation, and a computation is by definition a systematic set of rules for the relations among representations. This means that a mental state represents something if and only if there is some causal correlation between the mental state and that particular thing. An example would be seeing dark clouds and thinking "clouds mean rain", where there is a correlation between the thought of the clouds and rain, as the clouds causing rain. This is sometimes known as *natural meaning*. Conversely, there is another side to the causality of thoughts and that is the non-natural representation of thoughts. An example would be seeing a red traffic light and thinking "red means stop", there is nothing about the color red that indicates it represents stopping, and thus is just a convention that has been invented, similar to languages and their abilities to form representations.

Semantics of mental states

The computational theory of mind states that the mind functions as a symbolic operator, and that mental representations are symbolic representations; just as the

semantics of language are the features of words and sentences that relate to their meaning, the semantics of mental states are those meanings of representations, the definitions of the 'words' of the language of thought. If these basic mental states can have a particular meaning just as words in a language do, then this means that more complex mental states (thoughts) can be created, even if they have never been encountered before. Just as new sentences that are read can be understood even if they have never been encountered before, as long as the basic components are understood, and it is syntactically correct. For example: "I have eaten plum pudding every day of this fortnight." While it's doubtful many have seen this particular configuration of words, nonetheless most readers should be able to glean an understanding of this sentence because it is syntactically correct and the constituent parts are understood.

Criticism

A range of arguments have been proposed against physicalist conceptions used in computational theories of mind.

An early, though indirect, criticism of the computational theory of mind comes from philosopher John Searle. In his thought experiment known as the Chinese room, Searle attempts to refute the claims that artificially intelligent agents can be said to have intentionality and understanding and that these systems, because they can be said to be minds themselves, are sufficient for the study of the human mind. Searle asks us to imagine that there is a man in a room with no way of communicating with anyone or anything outside of the room except for a piece of paper with symbols written on it that is

passed under the door. With the paper, the man is to use a series of provided rule books to return paper containing different symbols. Unknown to the man in the room, these symbols are of a Chinese language, and this process generates a conversation that a Chinese speaker outside of the room can actually understand. Searle contends that the man in the room does not understand the Chinese conversation. This is essentially what the computational theory of mind presents us—a model in which the mind simply decodes symbols and outputs more symbols. Searle argues that this is not real understanding or intentionality. This was originally written as a repudiation of the idea that computers work like minds.

Searle has further raised questions about what exactly constitutes a computation:

the wall behind my back is right now implementing the WordStar program, because there is some pattern of molecule movements that is isomorphic with the formal structure of WordStar. But if the wall is implementing WordStar, if it is a big enough wall it is implementing any program, including any program implemented in the brain.

Objections like Searle's might be called insufficiency objections. They claim that computational theories of mind fail because computation is insufficient to account for some capacity of the mind. Arguments from qualia, such as Frank Jackson's knowledge argument, can be understood as objections to computational theories of mind in this way—though they take aim at physicalist conceptions of the mind in general, and not computational theories specifically.

There are also objections which are directly tailored for computational theories of mind.

Putnam himself (see in particular *Representation and Reality* and the first part of *Renewing Philosophy*) became a prominent critic of computationalism for a variety of reasons, including ones related to Searle's Chinese room arguments, questions of world-word reference relations, and thoughts about the mind-body relationship. Regarding functionalism in particular, Putnam has claimed along lines similar to, but more general than Searle's arguments, that the question of whether the human mind *can* implement computational states is not relevant to the question of the nature of mind, because "every ordinary open system realizes every abstract finite automaton." Computationalists have responded by aiming to develop criteria describing what exactly counts as an implementation.

Roger Penrose has proposed the idea that the human mind does not use a knowably sound calculation procedure to understand and discover mathematical intricacies. This would mean that a normal Turing complete computer would not be able to ascertain certain mathematical truths that human minds can.

Pancomputationalism

Supporters of CTM are faced with a simple yet important question whose answer has proved elusive and controversial: what does it take for a physical system (such as a mind, or an artificial computer) to perform computations? A very straightforward account is based on a simple mapping between abstract mathematical computations and physical systems: a

system performs computation C if and only if there is a mapping between a sequence of states individuated by C and a sequence of states individuated by a physical description of the system

Putnam (1988) and Searle (1992) argue that this simple mapping account (SMA) trivializes the empirical import of computational descriptions. As Putnam put it, “everything is a Probabilistic Automaton under some Description”. Even rocks, walls, and buckets of water—contrary to appearances—are computing systems. GualtieroPiccinini identifies different versions of Pancomputationalism.

In response to the trivialization criticism, and to restrict SMA, philosophers of mind have offered different accounts of computational systems. These typically include causal account, semantic account, syntactic account, and mechanistic account. Instead of a semantic restriction, the syntactic account imposes a syntactic restriction. The mechanistic account was first introduced by GualtieroPiccinini in 2007.

Prominent scholars

- Daniel Dennett proposed the multiple drafts model, in which consciousness seems linear but is actually blurry and gappy, distributed over space and time in the brain. Consciousness is the computation, there is no extra step or "Cartesian theater" in which you become conscious of the computation.
- Jerry Fodor argues that mental states, such as beliefs and desires, are relations between individuals and mental representations. He maintains that these

representations can only be correctly explained in terms of a language of thought (LOT) in the mind. Further, this language of thought itself is codified in the brain, not just a useful explanatory tool. Fodor adheres to a species of functionalism, maintaining that thinking and other mental processes consist primarily of computations operating on the syntax of the representations that make up the language of thought. In later work (*Concepts* and *The Elm and the Expert*), Fodor has refined and even questioned some of his original computationalist views, and adopted a highly modified version of LOT (see *LOT2*).

- David Marr proposed that cognitive processes have three levels of description: the computational level (which describes that computational problem (i.e., input/output mapping) computed by the cognitive process); the algorithmic level (which presents the algorithm used for computing the problem postulated at the computational level); and the implementational level (which describes the physical implementation of the algorithm postulated at the algorithmic level in biological matter, e.g. the brain). (Marr 1981)
- Ulric Neisser coined the term 'cognitive psychology' in his book published in 1967 (*Cognitive Psychology*), wherein Neisser characterizes people as dynamic information-processing systems whose mental operations might be described in computational terms.
- Steven Pinker described a "language instinct," an evolved, built-in capacity to learn language (if not writing).

- Hilary Putnam proposed functionalism to describe consciousness, asserting that it is the computation that equates to consciousness, regardless of whether the computation is operating in a brain, in a computer, or in a "brain in a vat."
- Georges Rey, professor at the University of Maryland, builds on Jerry Fodor's representational theory of mind to produce his own version of a Computational/Representational Theory of Thought.

Alternative theories

- Classical associationism
- Connectionism
- Enactivism
- Memory-prediction framework
- Situated cognition
- Perceptual Control Theory

Conceptual metaphor

In cognitive linguistics, **conceptual metaphor**, or **cognitive metaphor**, refers to the understanding of one idea, or conceptual domain, in terms of another. An example of this is the understanding of quantity in terms of directionality (e.g. "the price of peace is *rising*") or the understanding of time in terms of money (e.g. "I *spent* time at work today").

A conceptual domain can be any mental organization of human experience. The regularity with which different languages employ the same metaphors, often perceptually based, has led

to the hypothesis that the mapping between conceptual domains corresponds to neural mappings in the brain. This theory has gained wide attention, although some researchers question its empirical accuracy.

This idea, and a detailed examination of the underlying processes, was first extensively explored by George Lakoff and Mark Johnson in their work *Metaphors We Live By* in 1980. Since then, the field of metaphor studies within the larger discipline of cognitive linguistics has increasingly developed, with several annual academic conferences, scholarly societies, and research labs contributing to the subject area. Some researchers, such as Gerard Steen, have worked to develop empirical investigative tools for metaphor research, including the Metaphor Identification Procedure, or MIP. In Psychology, Raymond W. Gibbs, Jr., has investigated conceptual metaphor and embodiment through a number of psychological experiments. Other cognitive scientists, for example Gilles Fauconnier, study subjects similar to conceptual metaphor under the labels "analogy", "conceptual blending" and "ideasthesia".

Conceptual metaphors are useful for understanding complex ideas in simple terms and therefore are frequently used to give insight to abstract theories and models. For example, the conceptual metaphor of viewing communication as a conduit is one large theory explained with a metaphor. So not only is our everyday communication shaped by the language of conceptual metaphors, but so is the very way we understand scholarly theories. These metaphors are prevalent in communication and we do not just use them in language; we actually perceive and act in accordance with the metaphors.

Criticism and Perspectives on Metaphor

Historical

In the Western philosophical tradition, Aristotle is often situated as the first commentator on the nature of metaphor, writing in the *Poetics*, "A 'metaphorical term' involves the transferred use of a term that properly belongs to something else," and elsewhere in the *Rhetoric* he says that metaphors make learning pleasant; "To learn easily is naturally pleasant to all people, and words signify something, so whatever words create knowledge in us are the pleasantest." Aristotle's writings on metaphor constitute a "substitution view" of metaphor, wherein a metaphor is simply a decorative word or phrase substituted for a more ordinary one. This has been sometimes called the "Traditional View of Metaphor" and at other times the "Classical Theory of Metaphor". Later in the first century A.D., the Roman rhetorician Quintilian builds upon Aristotle's earlier work of metaphor by focusing more on the comparative function of metaphorical language. In his work *InstitutioOratoria,* Quintilian states," In totumautemmetaphorabreviorestsimilitudo" or "on the whole, metaphor is a shorter form of simile". Other philosophers throughout history have lent their perspectives to the discussion of metaphor as well. Friedrich Nietzsche for example, claimed that language as a whole did not portray reality but instead made a series of bold metaphors. Nietzsche believed that each step of cognition, the transfer of real world information to nerve stimuli, the culmination of nerve stimuli

into mental images, the translation of mental images to words, was metaphorical. Modern interpretations of these early theories have also been intensely debated. Janet Soskice, Professor of Philosophical Theology at the University of Cambridge, writes in summary that "it is certain that we shall taste the freshness of their insights only if we free them from the obligation to answer questions that were never theirs to ask". George Lakoff and Mark Johnson, although originally taking a hard-line interpretation of these early authors later concede that Aristotle was working within a different philosophical framework from what we engage with today and that critical interpretations should take this in to account.

Modern

In his 2007 book *The Stuff of Thought*, cognitive scientist Steven Pinker lays out several useful classifications for the study of conceptual metaphor. Pinker first contrasts two perspectives on metaphor, what he calls the killjoy theory and the messianic theory.

The killjoy theory categorizes metaphors as "dead", that is it asserts that modern day speakers are not aware of the comparison made between source and target domains in the everyday metaphors they use. For example, many are not cognizant that the phrase "to come to a head" refers to the accumulation of pus in a pimple. In contrast, the messianic theory correlates more closely with Lakoff and Johnson's idea of a conceptual metaphor. This view states that users of metaphors are aware of how the metaphor maps onto the domains and use them to relate shared perceptual experiences to more complex thoughts.

Another important distinction made by Pinker is that between literary, or poetic metaphors, and conceptual, or generative metaphors. Poetic metaphors are used for a variety of reasons but ultimately highlight similarities or incongruencies in an expressive manner. Pinker's example of this being the classic Shakespearian line "Juliet is the sun". These metaphors can often appear convoluted or unclear without deeper context. Conceptual metaphors result from some inherent relation between two domains. These metaphors, so innate they are consideredcliche are interestingly able to generate infinite new metaphors. For example, thinking back on the conceptual metaphor ARGUMENT IS WAR, one can build many new metaphors such as "I shot him down" or "he blew my argument to pieces".

Pinker himself settles on a moderate view that falls in between the messianic and killjoy theories on metaphor. Perhaps most interestingly, while Pinker concedes that metaphor is a useful way to combat the limited ability of language to express thought, he postulates that a higher level of abstract thought must still be present. Otherwise, Pinker points out, how could we engage in critique of metaphors or employ metaphors for comedic effect?

Major criticisms of work done on conceptual metaphor stem from the way many researchers conduct their research. Many study metaphors in a "top-down" direction, looking first at a few examples to suggest conceptual metaphors, then examining the structure of those metaphors. Researchers would look at their own lexicon, dictionaries, thesauri, and other corpus to study metaphors in language. Critics say this ignored the way language was actually used and focused too much on the

hypothetical metaphors, so many irregularities were overlooked in favor of postulating universal conceptual metaphors. In 2007, Pragglejaz Group came up with a methodology for identifying metaphorical expressions as a response to these criticisms.

Mappings

There are two main roles for the conceptual domains posited in conceptual metaphors:

- **Source domain**: the conceptual domain from which we draw metaphorical expressions (e.g., love is a *journey*).
- **Target domain**: the conceptual domain that we try to understand (e.g., *love* is a journey).

A **mapping** is the way in which a source domain tracks onto and describes aspects of the target domain. Mappings describe the mental organization of information in domains, the underlying phenomenon that drives metaphorical usage in language. This conceptualization relates closely to image schemas, mental representations used in reasoning, through the extension of spatial and physical laws to more complex situations.

A primary tenet of this theory is that metaphors are matter of thought and not merely of language: hence, the term *conceptual metaphor*. The metaphor may seem to consist of words or other linguistic expressions that come from the terminology of the more concrete conceptual domain, but conceptual metaphors underlie a system of related

metaphorical expressions that appear on the linguistic surface. Similarly, the mappings of a conceptual metaphor are themselves motivated by image schemas which are pre-linguistic schemas concerning space, time, moving, controlling, and other core elements of embodied human experience.

Conceptual metaphors typically employ a more abstract concept as target and a more concrete or physical concept as their source. For instance, metaphors such as 'the days [the more abstract or target concept] ahead' or 'giving my time' rely on more concrete concepts, thus expressing time as a path into physical space, or as a substance that can be handled and offered as a gift. Different conceptual metaphors tend to be invoked when the speaker is trying to make a case for a certain point of view or course of action. For instance, one might associate "the days ahead" with leadership, whereas the phrase "giving my time" carries stronger connotations of bargaining. Selection of such metaphors tends to be directed by a subconscious or implicit habit in the mind of the person employing them.

The principle of unidirectionality states that the metaphorical process typically goes from the more concrete to the more abstract, and not the other way around. Accordingly, abstract concepts are understood in terms of prototype concrete processes. The term "concrete," in this theory, has been further specified by Lakoff and Johnson as more closely related to the developmental, physical neural, and interactive body (see embodied philosophy). One manifestation of this view is found in the cognitive science of mathematics, where it is proposed that mathematics itself, the most widely accepted means of abstraction in the human community, is largely metaphorically

constructed, and thereby reflects a cognitive bias unique to humans that uses embodied prototypical processes (e.g. counting, moving along a path) that are understood by all human beings through their experiences.

Conduit metaphor

The conduit metaphor is a dominant class of figurative expressions used when discussing communication itself (metalanguage). It operates whenever people speak or write as if they "insert" their mental contents (feelings, meanings, thoughts, concepts, etc.) into "containers" (words, phrases, sentences, etc.) whose contents are then "extracted" by listeners and readers. Thus, language is viewed as a "conduit" conveying mental content between people.

Defined and described by linguist Michael J. Reddy, PhD, his proposal of this conceptual metaphor refocused debate within and outside the linguistic community on the importance of metaphorical language.

Language and culture as mappings

In their 1980 work, Lakoff and Johnson closely examined a collection of basic conceptual metaphors, including:

- love is a journey
- life is a journey
- social organizations are plants
- love is war

The latter half of each of these phrases invokes certain assumptions about concrete experience and requires the reader or listener to apply them to the preceding abstract concepts of love or organizing in order to understand the sentence in which the conceptual metaphor is used.

There are numerous ways in which conceptual metaphors shape human perception and communication, especially in mass media and in public policy. Recent experiments by Thibodeau and Boroditsky substantiate this line of thought, termed "framing". In the experiments, conceptual metaphors that compared crime to either a beast or a disease had drastic effects on public policy opinions.

Conceptual metaphors are commonplace in language. George Lakoff and Mark Johnson suggest that metaphors may unconsciously shape the way we think and act in their founding work, *Metaphors We Live By* (1980). For example, take the commonly used conceptual metaphor, ARGUMENT IS WAR. This metaphor shapes our language in the way we view argument as a battle to be won. It is not uncommon to hear someone say "He won that argument" or "I attacked every weak point in his argument". The very way argument is conceptualized is shaped by this metaphor of arguments being a war. Argument can be seen in other ways than a battle, but we use this concept to shape the way we think of argument and the way we go about arguing. The same applies for the other conceptual metaphors.

Lakoff and Johnson focus on English, and cognitive scholars writing in English have tended not to investigate the discourse of foreign languages in any great detail to determine the

creative ways in which individuals negotiate, resist, and consolidate conceptual metaphors. Andrew Goatly in his book *Washing the Brain* (2007) considers ideological conceptual metaphors as well as Chinese conceptual metaphors.

James W. Underhill, a modern Humboldtian scholar, attempts to reestablish Wilhelm von Humboldt's concern for the different ways languages frame reality, and the strategies individuals adopt in creatively resisting and modifying existing patterns of thought. Taking on board the Lakoff-Johnson paradigm of conceptual metaphor, he investigates the way in which Czech communists appropriated the concept of the people, the state and struggle, and the way German Communists harnessed concepts of eternity and purity. He also reminds us that, as Klemperer demonstrates, resisting patterns of thought means engaging in conceptual metaphors and refusing the logic that ideologies impose upon them. In multilingual studies (based on Czech, German, French & English), Underhill considers how different cultures reformulate key concepts such as truth, love, hate and war.

Family roles and ethics

George Lakoff makes similar claims on the overlap of conceptual metaphors, culture, and society in his book *Moral Politics* and his later book on framing, *Don't Think of an Elephant!*.Lakoff claims that the public political arena in America reflects a basic conceptual metaphor of 'the family.' Accordingly, people understand political leaders in terms of 'strict father' and 'nurturant mother' roles. Two basic views of political economy arise from this desire to see the nation-state

act 'more like a father' or 'more like a mother.' He further amplified these views in his latest book, *The Political Mind.*

Urban theorist and ethicist Jane Jacobs made this distinction in less gender-driven terms by differentiating between a 'Guardian Ethic' and a 'Trader Ethic'. She states that guarding and trading are two concrete activities that human beings must learn to apply metaphorically to all choices in later life. In a society where guarding children is the primary female duty and trading in a market economy is the primary male duty, Lakoff posits that children assign the 'guardian' and 'trader' roles to their mothers and fathers, respectively.

Linguistics and politics

Lakoff, Johnson, and Pinker are among the many cognitive scientists that devote a significant amount of time to current events and political theory, suggesting that respected linguists and theorists of conceptual metaphor may tend to channel their theories into political realms.

Critics of this ethics-driven approach to language tend to accept that idioms reflect underlying conceptual metaphors, but that actual grammar, and the more basic cross-cultural concepts of scientific method and mathematical practice tend to minimize the impact of metaphors. Such critics tend to see Lakoff and Jacobs as 'left-wing figures,' and would not accept their politics as any kind of crusade against an ontology embedded in language and culture, but rather, as an idiosyncratic pastime, not part of the science of linguistics nor of much use. And others further, such as Deleuze and Guattari, Michel Foucault and, more recently, Manuel de

Landa would criticize both of these two positions for mutually constituting the same old ontological ideology that would try to separate two parts of a whole that is greater than the sum of its parts.

Lakoff's 1987 work, *Women, Fire, and Dangerous Things,* answered some of these criticisms before they were even made: he explores the effects of cognitive metaphors (both culturally specific and human-universal) on the grammar per se of several languages, and the evidence of the limitations of the classical logical-positivist or Anglo-American School philosophical concept of the category usually used to explain or describe the scientific method.Lakoff's reliance on empirical scientific evidence, *i.e.* specifically falsifiable predictions, in the 1987 work and in *Philosophy in the Flesh* (1999) suggests that the cognitive-metaphor position has no objections to the scientific method, but instead considers the scientific method a finely developed reasoning system used to discover phenomena which are subsequently understood in terms of new conceptual metaphors (such as the metaphor of fluid motion for conducted electricity, which is described in terms of "current" "flowing" against "impedance," or the gravitational metaphor for static-electric phenomena, or the "planetary orbit" model of the atomic nucleus and electrons, as used by Niels Bohr).

Further, partly in response to such criticisms, Lakoff and Rafael E. Núñez, in 2000, proposed a cognitive science of mathematics that would explain mathematics as a consequence of, not an alternative to, the human reliance on conceptual metaphor to understand abstraction in terms of basic experiential concretes.

Literature

The Linguistic Society of America has argued that "the most recent linguistic approach to literature is that of cognitive metaphor, which claims that metaphor is not a mode of language, but a mode of thought. Metaphors project structures from source domains of schematized bodily or enculturated experience into abstract target domains. We conceive the abstract idea of life in terms of our experiences of a journey, a year, or a day. We do not understand Robert Frost's 'Stopping by Woods on a Snowy Evening' to be about a horse-and-wagon journey but about life. We understand Emily Dickinson's 'Because I could not stop for Death' as a poem about the end of the human life span, not a trip in a carriage. This work is redefining the critical notion of imagery. Perhaps for this reason, cognitive metaphor has significant promise for some kind of rapprochement between linguistics and literary study."

Education

Teaching thinking by analogy (metaphor) is one of the main themes of The Private Eye Project. The idea of encouraging use of conceptual metaphors can also be seen in other educational programs touting the cultivation of "critical thinking skills".

The work of political scientist RūtaKazlauskaitė examines metaphorical models in school-history knowledge of the controversial Polish-Lithuanian past. On the basis of Lakoff and Johnson's conceptual metaphor theory, she shows how the implicit metaphorical models of everyday experience, which inform the abstract conceptualization of the past, truth,

objectivity, knowledge, and multiperspectivity in the school textbooks, obstruct an understanding of the divergent narratives of past experience.

Language learning

There is some evidence that an understanding of underlying conceptual metaphors can aid the retention of vocabulary for people learning a foreign language. To improve learners' awareness of conceptual metaphor, one monolingual learner's dictionary, the Macmillan English Dictionary has introduced 50 or so 'metaphor boxes' covering the most salient Lakoffian metaphors in English. For example, the dictionary entry for *conversation* includes a box with the heading: 'A conversation is like a **journey**, with the speakers going from one place to another', followed by vocabulary items (words and phrases) which embody this metaphorical schema. Language teaching experts are beginning to explore the relevance of conceptual metaphor to how learners learn and what teachers do in the classroom.

Conceptual metaphorical mapping in animals

A current study showed a natural tendency to systematically map an abstract dimension, such as social status, in our closest and non-linguistic relatives, the chimpanzees. In detail, discrimination performances between familiar conspecific faces were systematically modulated by the spatial location and the social status of the presented individuals, leading to

discrimination facilitation or deterioration. High-ranked individuals presented at spatially higher position and low-ranked individuals presented at lower position led to discrimination facilitation, while high-ranked individuals at lower positions and low-ranked individuals at higher position led to discrimination deterioration. This suggests that this tendency had already evolved in the common ancestors of humans and chimpanzees and is not uniquely human, but describes a conceptual metaphorical mapping that predates language.

Conduit metaphor

In linguistics, the **conduit metaphor** is a dominant class of figurative expressions used when discussing communication itself (metalanguage). It operates whenever people speak or write as if they "insert" their mental contents (feelings, meanings, thoughts, concepts, etc.) into "containers" (words, phrases, sentences, etc.) whose contents are then "extracted" by listeners and readers. Thus, language is viewed as a "conduit" conveying mental content between people.

Defined and described by linguist Michael J. Reddy, PhD, his proposal of this conceptual metaphor refocused debate within and outside the linguistic community on the importance of metaphorical language.

Fellow linguist George Lakoff stated that

"The contemporary theory that metaphor is primarily conceptual, conventional, and part of the ordinary system of thought and language can be traced to Michael Reddy's now

classic essay... With a single, thoroughly analyzed example, he allowed us to see, albeit in a restricted domain, that ordinary everyday English is largely metaphorical, dispelling once and for all the traditional view that metaphor is primarily in the realm of poetic or 'figurative' language. Reddy showed, for a single, very significant case, that the locus of metaphor is thought, not language, that metaphor is a major and indispensable part of our ordinary, conventional way of conceptualizing the world, and that our everyday behavior reflects our metaphorical understanding of experience. Though other theorists had noticed some of these characteristics of metaphor, Reddy was the first to demonstrate them by rigorous linguistic analysis, stating generalizations over voluminous examples."

Background

The genesis of Reddy's paper drew inspiration from work done by others in several disciplines, as well as linguistics. Research on information theory had led Norbert Wiener to publish the seminal book on cybernetics, in which he had stated, "Society can only be understood through a study of the messages and communications facilities which belong to it." Social-systems theorist Donald Schön had examined the impacts of metaphorical speech on public-policy problems, putting forth the idea that people's conflicting frames of reference were often to blame for communication breakdown. Schön's frame-restructuring solution was similar in some ways to Thomas Kuhn's groundbreaking views on the shifting of scientific paradigms through what he called the "translation" process.

Research within linguistics (including the controversial Sapir-Whorf hypothesis and Max Black's arguments against it), coupled with Uriel Weinreich's assertion that "Language is its own metalanguage," prompted Reddy to approach the conduit metaphor's exposition and its possible impact on language and thought with caution.

Summary of Reddy's paper

- The way English speakers discuss communication depends on the semantics of the language itself
- English has a default conceptual framework for communicating (the conduit metaphor)
- The conduit metaphor has a self-reinforcing bias
- A contrasting, more accurate, seldom-used non-metaphorical framework exists (the toolmakers paradigm)
- The resulting frame conflict may negatively impact solutions to social and cultural problems

Research into core expressions

Reddy collected and studied examples of how English speakers talk about success or failure in communication. The overwhelming majority of what he calls **core expressions** involved dead metaphors selected from speakers' internal thoughts and feelings. Speakers then "put these thoughts into words" and listeners "take them out of the words." Since words are actually marks or sounds and do not literally have "insides," people talk about language largely in terms of metaphors.

Most English core expressions used in talking about communication assert that actual thoughts and feelings pass back and forth between people through the conduit of words. These core expressions and the few that do not qualify as conduit metaphors are listed in the paper's extensive appendix, which itself has been cited by Andrew Ortony as "a major piece of work, providing linguistics with an unusual corpus, as well as substantiating Reddy's claims about the pervasiveness of the root metaphor."

Major framework

There are two distinct but similar frameworks in which the conduit metaphor appears. Four types of core expressions constitute the **major framework**. (In the following example sentences, the operative core expressions are italicized.)

Language is a conduit

These commonplace examples—

- You can't *get* your *concept across* to the class that way
- His *feelings came through to* her only vaguely
- They never *give* us any *idea* of what they expect

—are understood metaphorically. In 1., people do not actually "get across" concepts by talking; in 2., feelings do not really "come through to" people; and in 3., people do not in fact "give" to others their ideas, which are mental states. Listeners assemble from their own mental states a partial replica of the

speakers'. These core expressions assert figuratively that *language literally transfers people's mental contents to others.*

Speakers insert thoughts into words

These examples—

- *Practice capturing* your *feelings in* complete *sentences*
- I need to *put* each *idea into phrases* with care
- *Insert* that *thought further down in* the *paragraph*
- She *forced* her *meanings into* the wrong *lyrics*
- Please *pack* more *sensation into* fewer *stanzas*
- He *loads* an *argument with* more *viewpoints* than it can withstand

—show that in 1., the speaker might be inexperienced in ensnaring meaning; in 2., be clumsy when putting it in; in 3., put it in the wrong place; in 4., compel words to accommodate meanings for which there is not enough room; in 5., fail to put in enough; or in 6., put in too much. These core expressions assert that *speakers "insert" mental content into the "containers" represented by words with varying degrees of success.*

Words contain thoughts

These examples indicate that sounds and marks can be "containers" for mental content:

- The *sense* of loneliness *is in* just about every *sentence*
- His *story was pregnant with meaning*

- The entire *paragraph was full of emotion*
- These *lines* indeed rhyme, but they *are devoid of feeling*
- Your *words are hollow*—you don't mean them.

These core expressions assert that *words contain or do not contain mental content, depending on the success or failure of the insertion process.*

Listeners extract thoughts from words

These examples—

- I couldn't actually *extract* coherent *ideas from* that *prose*.
- You *found* some challenging *concepts in* the *essay*
- They wouldn't really *get* any *hatred out of* those *statements*
- Her *remark is* truly *impenetrable*
- The author's *intentions are going to be locked up in* that dense *chapter* forever
- *Hiding* the *meaning in* his *sentences* is just his style.
- They're *reading things into* the *poem*

—indicate that speakers and writers are responsible to a large extent for the mental content conveyed by language, and that listeners and readers play a more passive role. However, in 7., a reader can add something to the container that was not originally there. Overall, these core expressions assert that *listeners must "extract" mental content from words.*

Minor framework

Instead of words, an "idea space" between people's heads can be the container for mental content. The conduit is no longer a sealed pipeline between people, but an open pipe allowing mental content to escape into, or enter from, this space. Three types of core expressions constitute the **minor framework** of the conduit metaphor.

Speakers eject thoughts into idea space

These examples—

- She *poured out* the *sorrow* she'd been holding back
- He finally *got* those *ideas out there*

—show that *speakers and writers can eject mental content into an external idea space outside people.*

Idea space contains thoughts

These examples—

- That *theory has been floating around* for a century
- His crazy *notions made their way* immediately *into cyberspace*
- Those *opinions are on* the *streets* of Brooklyn, not in a classroom

—indicate that *mental content has a material existence in an idea space, existing outside people.*

Listeners extract thoughts from idea space

The following examples—

- I had to *absorb* Einstein's *ideas* gradually
- His deepest *emotions went right over* her *head*
- We couldn't *get* all that *stuff into* our *brains* in one afternoon

—demonstrate that *mental content from an idea space may or may not re-enter people.*

Logical apparatus

The italicized words in the above examples are interchangeable with a wide array of terms that label mental content, the containers in which the content may be placed, and the ways in which these containers may be transferred in the conduit-metaphor paradigm.

Reddy developed a **logical apparatus** for diagramming the conduit metaphor's many permutations in both frameworks. Mental contents (feelings, emotions, ideas, etc.) are represented by **RM**, which stands for "repertoire member." Containers (words, phrases, sentences, etc.) are represented by **S**, which stands for "signal." Thus, "I need to *put* each *idea into phrases* with care" can be rendered as the core expression ***put*** **RM** ***into*** **S**. Reddy uses this logical apparatus throughout the appendix to his paper to clarify distinctions between metalingual expressions that use the conduit metaphor and the minority that do not.

The toolmakers paradigm

- In order to examine the effects of the objectification of mental content in communication using the conduit metaphor, Reddy proposes an alternate, contrasting, "radical subjectivist" conception of communication called the **toolmakers paradigm**.

A person's mental content is in fact isolated from others'. This isolation can be represented by a wheel-shaped compound, each wedge-shaped sector of which is an environment (a brain) bounded by two spokes and part of the circumference (*right*). They all contain differing amounts and types of plants, rocks, water, etc. (repertoire members). The wheel's hub has machinery that can deliver sheets of paper between sectors (communication). People use it to exchange crude blueprints (signals) for making tools, shelters, foods, etc., but they have no other contact whatsoever, and know of others' existence by inferences based on these blueprints.

Living in a forested sector, Alex builds a wooden rake, draws three identical blueprints, and drops them in the slots for Bob, Curt and Don. Bob finds a piece of wood for the handle, but because he lives in a rocky sector, starts making a stone rake head. (Alex had not considered wood to be unavailable or wrong for the rake head, so it was not specified.)

When halfway done, Bob connects his stone head to the handle, realizes it will be heavy, and decides it must be a device for digging up rocks when clearing a field for planting. (He infers that Alex must be either very strong or has only small rocks in his sector.) Bob decides two large prongs will

make his tool lighter, thus finishing with a two-bladed pickax. He makes three identical blueprints for his pickax and drops them in the slots for Alex, Curt and Don.

Alex assembles a kind of rock-pick, but must modify the design if a wooden, two-pronged head is to be strong enough. (He cannot see much use for the tool in his largely rock-free sector, sensing that Bob has misunderstood his rake.) Alex draws a second blueprint for the rake head and sends it out as before. Curt crafts a hoe for slicing cleanly through roots to clear out a swamp. Don creates a gaff for fishing.

Blueprint users (language users) in the toolmakers paradigm can converge by inference on accurate replications of others' tools (mental content) after a laborious series of exchanges. Using the same diagram for the conduit-metaphor paradigm instead, the hub is a duplicator that can transfer *actual* materials and constructions among sectors, ending the isolation.

No guesswork or construction is needed: Alex puts the rake in a special chamber, pushes a button, and precise replicas appear instantly in similar chambers for Bob, Curt and Don.

The subjectivist toolmakers paradigm embodies a language requiring real effort to overcome failures in communication, whereas the objectivist conduit-metaphor paradigm embodies one in which very little effort is needed for success.

Core expressions are pervasive and unavoidable

Although the toolmakers paradigm is available as a more accurate model of communication, the conduit metaphor is

pervasive and difficult to avoid in English syntax and semantics. Thinking in terms of another model of communication is generally brief, isolated and fragmentary because of an entrenched system of opposing attitudes and assumptions.

Pervasive

Reddy's tally of core expressions is about 140. Examining alternative ways of speaking about communication—either metaphorically opposed or neutral to the conduit-metaphor framework—results in a list of 30 to 40 expressions. Thus, 70% of the metalingual apparatus of the English language is based on the conduit metaphor. The influence of the remaining 30% is weakened by several factors.

- They are usually multisyllabic, Latinate abstractions (e.g. "communicate," "disseminate," "notify," "disclose," etc.), which are neither graphic nor metaphorically coherent
- Most can be used with adjuncts such as "in words," thereby losing their neutrality and lending added support to the conduit metaphor. ("Communicate your feelings using simpler words," for example, avoids the conduit metaphor, whereas, "Communicate your feelings *in* simpler words," does not.)
- Many of these expressions have etymological roots arising directly from the conduit-metaphor framework ("express," "disclose," etc.)

Unavoidable

Speaking carefully and attentively, it is possible to avoid conduit-metaphor expressions. For example, "Did you get anything out of that article?" might be replaced by, "Were you able to construct anything of interest on the basis of the assigned text?" Eschewing obvious conduit-metaphor expressions when communication is the topic is difficult. "Try to communicate more effectively" differs in impact from "You've got to learn how to put your thoughts into words." Reddy proceeds to show that even if avoidance were possible, it does not necessarily free people from the framework.

Semantic pathology via metonymy

A **semantic pathology** arises "whenever two or more incompatible senses capable of figuring meaningfully in the same context develop around the same name." "I'm sorry" is an example of two contextually relevant meanings in collision. A person may expect an apology when the other wishes only to sympathize, or anticipate sympathy but hear an apology instead.

Pathology in linguistic theory

Many other terms are ambiguous between mental content and the words "containing" it. For instance the word "poem" denotes a particular grouping of the sounds or marks (signals) exchanged between people. However, its use in sentences reveals that it can refer to thoughts or feelings (repertoire members). In this example—

- The poem has four lines and forty words

—"poem" refers to a text. The word-sense can be labeled $POEM_1$. However, in this example—

- Eliot's poem is so utterly depressing

—"poem" refers to the mental content assembled in its reading. The word-sense in this case can be labeled $POEM_2$. Moreover, this example—

- Her poem is so sloppy!

—can be understood as either $POEM_1$ or $POEM_2$ (polysemy).

The ambiguity of "poem" is intimately related to the conduit metaphor. If words contain ideas, then $POEM_1$ contains $POEM_2$. When two entities are commonly found together, one of their names—usually the more concrete—will develop a new sense referring to the other (the process of metonymy). Just as $ROSE_1$ (the blossom) developed $ROSE_2$ (a shade of pinkish red) by metonymy, so $POEM_1$ gave rise to $POEM_2$.

In the toolmakers paradigm, words do not contain ideas, so $POEM_1$ cannot contain $POEM_2$; therefore, a distinction between them must be preserved. Although there is only one $POEM_1$ in most cases, the differences in mental content among people (and the difficult task of assembling it based on instructions in the text) mean that there are as many $POEM_2$s as there are people. These internal $POEM_2$s will only come to resemble one another after people expend effort comparing their mental content.

If language had been operating historically under the toolmakers paradigm, these two different concepts would not currently be accessed by the same word: talking about mental content and signals as if they were the same would have led to insoluble confusion. The ambiguity of "poem" would thus have been an incurable semantic pathology. However, the conduit metaphor can completely ignore it.

"Poem" is a paradigm case for the entire class of English words denoting signals ("word," "phrase," "sentence," "essay," "novel," "speech," "text," etc.), demonstrating that semantic structures can be completely normal in one view of reality and pathological in another. This lends support to the theory that language and views about reality develop together.

Pathology in mathematical information theory

Evidence of the biasing power of the conduit metaphor can be found in fields outside of linguistics. Information theory, with its concept-free algorithms and computers as models, would seem to be immune from effects arising from semantic pathology, because the framework shares many attributes with the toolmakers paradigm. Nevertheless, there is evidence that use of the conduit metaphor has hampered investigators' attempts to develop the theory.

Communication is the transfer of information (a selection from a set of alternatives). This set and a language (*code*) relating the alternatives to physical signals are established. A copy of each (an "*a priori* shared context") is placed with the sender and receiver. A sequence of the alternatives (the *message*) is selected for communication to the receiver, but the message

itself is not sent. The selected alternatives are related by the code to energy patterns (the *signal*) that travel quickly and unmodified. Mathematics is used to measure quantitatively how much the received signal narrows down the possible selections from stored alternatives.

The similarity between the frameworks of information theory and the toolmakers paradigm is that

- the shared context corresponds to the repertoire members
- the signal does not contain the message
- the signal carries neither the alternatives nor a replica of the message
- the signal in the former is the blueprint in the latter
- the receiver uses the signal to duplicate the sender's selection process and recreate the message
- if a signal is received and the shared context is damaged or missing, the proper selection cannot be made

This analogy has withstood information theory's utility in simple, technical applications, but in biology, the social sciences, human language and behavior, it has been historically less successful. These attempts foundered by misunderstanding the conceptual framework of the theory rather than its mathematics. Reliance on ordinary language has made the information theory's insights less clear.

The negative impact of ordinary language on information theory's use in other fields can be traced to terms the founders themselves used to label parts of their paradigm, telegraphy. The set of alternatives (repertoire members) were called the

"alphabet." While true for telegraphy, Claude Shannon and Warren Weaver used it as a nomenclature referring to any set of alternative states, behaviors, etc. The alphabet confuses the distinction between signals and repertoire members in human communication. Despite Weaver's particular interest in applying the theory to language, this fact went unrecognized.

Shannon and Weaver were also unaware that the choice of the term "message" to represent the selection of alternatives from the repertoire shared the same semantic pathology as "poem."

- I got your message ($MESSAGE_1$), but had no time to read it
- Okay, John, I get the message ($MESSAGE_2$); let's leave him alone

Because $MESSAGE_1$ is the *signal* and $MESSAGE_2$ is the *repertoire members* in communication, the reasoning is faulty. The ambiguity is trivial in the conduit-metaphor framework, but fatal for information theory, which is based on the idea that $MESSAGE_2$ cannot be transmitted. Although Shannon and Weaver noted the distinction between "received" and "transmitted" signals based on possible distortion and noise, they wrote the word "message" on the receiving end of their paradigm.

Weaver employed many conduit-metaphor expressions; for example, "How precisely do the transmitted symbols *convey* the desired meaning?" [italics Reddy's]. He also contrasted two "messages, one of which is *heavily loaded with meaning* and the other of which is pure nonsense." Weaver wrote as if repertoire members are sent, adding that the sender "changes the *message* into the *signal*" [italics Weaver's]. A code specifies

how two systems relate, without changing anything; it preserves in the receiver the organizational pattern of the sender. Marks and sounds do not change into electrons, just as thoughts do not change into words.

Shannon correctly wrote, "The *receiver* ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal." But conduit metaphorisms continue to appear in the form of "encode" and "decode," defined as putting the repertoire members *into* code and taking them *out,* respectively. In addition, because the theory conceives of information as the ability to copy an organization via nonrandom selections, the term "information content" is itself a misnomer: signals do something but cannot contain anything. The conduit metaphor has thus influenced the thinking of information theorists in a counterproductive way.

Confusion between the message and the signal persisted for two decades as theorists in other fields of inquiry drew on the insights of information theory. Kenneth K. Sereno and C. David Mortensen wrote that "investigators have yet to establish a completely acceptable definition of communication".

"Those models based upon a mathematical conception describe communication as analogous to the operations of an information processing machine: an event occurs in which a *source* or *sender transmits a signal* or *message* through a *channel* to some *destination* or *receiver.*" [italicsSereno& Mortensen's]

Additionally, when they state, "The theory was concerned with the problem of defining the quantity of information contained

in a message to be transmitted...," information is contained in a transmitted "message". If it refers to $MESSAGE_1$, it is the conduit metaphor asserting that information is contained in the signals. If it is $MESSAGE_2$, it is the repertoire members that are sent in signals, which contain measurable information. The insights of information theory have been challenged by using the conduit metaphor instead of the more accurate toolmakers paradigm, upon which its premises were initially based.

Opposition of conflicting paradigms

The conduit-metaphor paradigm states that communication failure needs explanation, because success should be automatic: materials are naturally gathered, but misguided people expend energy scattering them. Conversely, the toolmakers paradigm states that partial miscommunication is inherent and can only be fixed by continuous effort and extensive verbal interaction: materials are gathered using energy or they will be naturally scattered. Reddy explores some of the potential social and psychological effects of believing that communication is a "success without effort" system, whereas it is an "energy must be expended" system. The conduit metaphor objectifies meaning and influences people to talk and think about mental content as if it possessed an external, inter-subjective reality.

Cultural and social implications

Having discussed the conduit metaphor's impact on theorists within and outside of linguistics, Reddy speculates about its distorting potential in culture and society. He points out that

- You'll*find* better *ideas* than that *in the library*

is a conduit metaphor asserting that ideas are in words, which are on pages, which are in books, which are in libraries—with the result that "ideas are in libraries." The implication of this minor-framework core expression is that libraries full of books, tapes, photographs, videos and electronic media contain culture.

In the toolmakers-paradigm perspective, there are no ideas in the words; therefore, none in libraries. Instead, there are patterns of marks, bumps or magnetized particles capable of creating patterns of noise and light. Using these patterns as instructions, people can reconstruct mental content resembling that of those long gone. Since people in the past experienced a different world and used slightly different language instructions, a person unschooled in the language and lacking a full reservoir of mental content from which to draw, is unlikely to reconstruct a cultural heritage.

Because culture does not exist in books or libraries, it must be continually reconstructed in people's brains. Libraries preserve the opportunity to perform this reconstruction, but if language skills and the habit of reconstruction are not preserved, there will be no culture. Thus, Reddy asserts that the only way to preserve culture is to train people to "regrow" it in others.

He stresses that the difference of viewpoint between the conduit metaphor and the toolmakers paradigm is profound. Humanists—those traditionally charged with reconstructing culture and teaching others to reconstruct it—are increasingly rare. Reddy proposes that, despite a sophisticated system for mass communication, there is actually less communication;

and moreover, that people are following a flawed manual. The conduit-metaphor influenced view is that the more signals created and preserved, the more ideas "transferred" and "stored." Society is thus often neglecting the human ability to reconstruct thought patterns based on signals. This ability atrophies when "extraction" is seen as a trivial process not requiring instruction past a rudimentary level.

Reddy concludes that the conduit metaphor may continue to have negative technological and social consequences: mass communications systems that largely ignore the internal, human systems responsible for the majority of the work in communicating. Because the logical framework of the conduit metaphor indicates people think in terms of "capturing ideas in words"—despite there being no ideas "within" the ever-increasing stream of words—a burgeoning public may be less culturally informed than expected.

Post-publication research by others

Since the publication of Reddy's paper in 1979, it has garnered a large number of citations in linguistics, as well as a wide spectrum of other fields of inquiry. In 2007, a search at Web of Science revealed 354 citations broken down roughly as follows: 137 in linguistics; 45 in information science; 43 in psychology; 38 in education; 17 in sociology; 15 in anthropology; 10 in law; 9 in business/economics; 8 in neurology; 7 in medicine; 5 in political science; 4 each in the arts, biology, environmental science, and mathematics; and 1 each in architecture, geography, parapsychology and robotics.

Dead metaphor

A **dead metaphor** is a figure of speech which has lost the original imagery of its meaning by extensive, repetitive, and popular usage. Because dead metaphors have a conventional meaning that differs from the original, they can be understood without knowing their earlier connotation. Dead metaphors are generally the result of a semantic shift in the evolution of a language, a process called the **literalization** of a metaphor. A distinction is often made between those dead metaphors whose origins are entirely unknown to the majority of people using them (such as the expression "to kick the bucket") and those whose source is widely known or symbolism easily understood but not often thought about (the idea of "falling in love").

The long standing metaphorical application of a term can similarly lose their metaphorical quality, coming simply to denote a larger application of the term. The wings of a plane now no longer seem to metaphorically referto a bird's wings; rather, the term 'wing' was expanded to include non-living things. Similarly, the legs of a chair is no longer a metaphor but an expansion of the term "leg" to include any supporting pillar.

There is debate among literary scholars whether so-called "dead metaphors" are dead or are metaphors. Literary scholar R.W. Gibbs noted that for a metaphor to be dead, it would necessarily lose the metaphorical qualities that it comprises. These qualities, however, still remain. A person can understand the expression "falling head-over-heels in love" even if they have never encountered that variant of the phrase

"falling in love". Analytic philosopher Max Black argued that the dead metaphor should not be considered a metaphor at all, but rather classified as a separate vocabulary item.

Examples

- Time is running out (In reference to an hourglass)
- Roll up the window
- Hang up the phone
- Face and hands on a clock
- Fly off the handle
- Body of an essay
- Deadline
- Brand new
- Go belly up
- Laughing stock
- Glove compartment
- Cut! (in film)
- To tape something (record)
- Hold your horses
- Dialing a phone
- Sound like a broken record
- Rewind
- Patching up code
- Footage (in film)

Desktop metaphor

In computing, the **desktop metaphor** is an interface metaphor which is a set of unifying concepts used by graphical user interfaces to help users interact more easily with the

computer. The desktop metaphor treats the computer monitor as if it is the top of the user's desk, upon which *objects* such as documents and folders of documents can be placed. A document can be opened into a window, which represents a paper copy of the document placed on the desktop. Small applications called desk accessories are also available, such as a desk calculator or notepad, etc.

The desktop metaphor itself has been extended and stretched with various implementations of desktop environments, since access to features and usability of the computer are usually more important than maintaining the 'purity' of the metaphor. Hence we find trash cans on the desktop, as well as disks and network volumes (which can be thought of as filing cabinets—not something normally found *on* a desktop). Other features such as menu bars or taskbars have no direct counterpart on a real-world desktop, though this may vary by environment and the function provided; for instance, a familiar wall calendar can sometimes be displayed or otherwise accessed via a taskbar or menu bar belonging to the desktop.

History

The desktop metaphor was first introduced by Alan Kay at Xerox PARC in 1970 and elaborated in a series of innovative software applications developed by PARC scientists throughout the ensuing decade. The first computer to use an early version of the desktop metaphor was the experimental Xerox Alto, and the first commercial computer that adopted this kind of interface was the Xerox Star. The use of window controls to contain related information predates the desktop metaphor, with a primitive version appearing in Douglas Engelbart's

"Mother of All Demos", though it was incorporated by PARC in the environment of the Smalltalk language.

One of the first desktop-like interfaces on the market was a program called Magic Desk I. Built as a cartridge for the Commodore 64 home computer in 1983, a very primitive GUI presented a low resolution sketch of a desktop, complete with telephone, drawers, calculator, etc. The user made their choices by moving a sprite depicting a hand pointing by using the same joystick the user may have used for video gaming. Onscreen options were chosen by pushing the fire button on the joystick. The Magic Desk I program featured a typewriter graphically emulated complete with audio effects. Other applications included a calculator, rolodex organiser, and a terminal emulator. Files could be archived into the drawers of the desktop. A trashcan was also present.

The first computer to popularise the desktop metaphor, using it as a standard feature over the earlier command-line interface was the Apple Macintosh in 1984. The desktop metaphor is ubiquitous in modern-day personal computing; it is found in most desktop environments of modern operating systems: Windows as well as macOS, Linux, and other Unix-like systems.

BeOS observed the desktop metaphor more strictly than many other systems. For example, external hard drives appeared on the 'desktop', while internal ones were accessed clicking on an icon representing the computer itself. By comparison, the Mac OS places all drives on the desktop itself by default, while in Windows the user can access the drives through an icon labelled "Computer".

Amiga terminology for its desktop metaphor was taken directly from workshop jargon. The desktop was called Workbench, programs were called tools, small applications (applets) were utilities, directories were drawers, etc. Icons of objects were animated and the directories are shown as drawers which were represented as either open or closed. As in the classic Mac OS and macOS desktop, an icon for a floppy disk or CD-ROM would appear on the desktop when the disk was inserted into the drive, as it was a virtual counterpart of a physical floppy disk or CD-ROM on the surface of a workbench.

Paper paradigm

The *paper paradigm* refers to the paradigm used by most modern computers and operating systems. The paper paradigm consists of, usually, black text on a white background, files within folders, and a "desktop". The paper paradigm was created by many individuals and organisations, such as Douglas Engelbart, Xerox PARC, and Apple Computer, and was an attempt to make computers more user-friendly by making them resemble the common workplace of the time (with papers, folders, and a desktop). It was first presented to the public by Engelbart in 1968, in what is now referred to as "The Mother of All Demos".

From John Siracusa:

Back in 1984, explanations of the original Mac interface to users who had never seen a GUI before inevitably included an explanation of icons that went something like this: "This icon represents your file on disk." But to the surprise of many, users very quickly discarded any semblance of indirection. This

icon *is* my file. My file *is* this icon. One is not a "representation of" or an "interface to" the other. Such relationships were foreign to most people, and constituted unnecessary mental baggage when there was a much more simple and direct connection to what they knew of reality.

Since then, many aspects of computers have wandered away from the paper paradigm by implementing features such as "shortcuts" to files, hypertext, and non-spatial file browsing. A shortcut (a link to a file that acts as a redirecting proxy, not the actual file) and hypertext have no real-world equivalent. Non-spatial file browsing, as well, may confuse novice users, as they can often have more than one window representing the same folder open at the same time, something that is impossible in reality. These and other departures from real-world equivalents are violations of the pure paper paradigm.

Metaphorical extension

A **metaphorical extension** is the "extension of meaning in a new direction" through popular adoption of an original metaphorical comparison.

Metaphorical extension is almost a universal and natural process in any language undergone by every word. In general, it's not even perceived in everyday usage as meaning change. When it is least obvious, users don't even see it as extending the meaning of a word. Consider the example of illuminate: it originally meant "to light up" something dim or dark, but has evolved to mean "to clarify", "to edify". After a while these new meanings seem so natural as to be integral parts of the word,

where senses such as "to celebrate" and "to adorn a page with designs" seem like more obvious additions.

Radiation

According to linguist Jeffrey Henning:

Radiation is metaphorical extension on a grander scale, with new meanings radiating from a central semantic core to embrace many related ideas. The word head originally referred to that part of the human body above the rest. Since the top of a nail, pin or screw is, like the human head, the top of a slim outline, that sense has become included in the meaning of head. Since the bulb of a cabbage or lettuce is round like the human head, that sense has become included in the meaning of head. Know where I'm headed with this? The meaning of the word head has radiated out to include the head of a coin (the side picturing the human head), the head of the list (the top item in the list), the head of a table, the head of the family, a head of cattle, $50 a head.

Other words that have similarly radiated meanings outward from a central core include the words fire, root and sun.

Examples

A crane at a construction site was given its name by comparison to the long-necked bird of the same name. When the meaning of the word daughter was first extended from that of "one's female child" to "a female descendant" (as in daughter

of Eve), the listener might not have even noticed that the meaning had been extended.

The late Admiral, mathematician, and computer pioneer, Grace Murray Hopper, frequently repeated a favorite amusing story in front of many audiences about an early computer that experienced an episode where it kept calculating incorrectly. When technicians examined the machine's hardwired logic (the wiring, in the World War II era computer), a huge moth was discovered such that its body was shorting out one of the vacuum tube and relay circuits and causing the repetitive fault, and so may have played a key role in popularizing the term which was in use in hardware engineering from at least Edison's time (see Computer bug#Etymology). Since the Admiral's speeches, both hardware faults and software errors are now routinely referred to as "bugs", and getting the flaws out of a product is known as *'debugging'* the system. Her team almost certainly coined the latter term. A particular type of software program designed to aid software development is known as a "debugger" complements the program known as a compiler, the first of which was developed by G.M. Hopper.

The use of bug to refer to a computer error in logic was a *metaphorical extension* that has become so popular that it is now part of the regular meaning of "bug". The computer industry has a host of words whose meaning has been extended through such metaphors, including "mouse" for possessing a 'tail' similar to said rodent now used widely for these computer input devices—even though the more modern wireless ones have lost the metaphorical tail entirely.

Interface metaphor

In user interface design, an **interface metaphor** is a set of user interface visuals, actions and procedures that exploit specific knowledge that users already have of other domains. The purpose of the interface metaphor is to give the user instantaneous knowledge about how to interact with the user interface. They are designed to be similar to physical entities but also have their own properties (e.g., desktop metaphor and web portals). They can be based on an activity, an object (skeuomorph), or a combination of both and work with users' familiar knowledge to help them understand 'the unfamiliar', and placed in the terms so the user may better understand.

An example of an interface metaphor is the file and folder analogy for the file system of an operating system. Another example is the tree view representation of a file system, as in a file manager.

Generation of metaphors

Historical contributions

In the mid-twentieth century, computers were extremely rare and used only by specialists. They were equipped with complicated interfaces comprehensible only to these select few. In 1968, Douglas Engelbart gave a demonstration which astonished executives at Xerox. They began work on what would eventually become the Xerox Alto. In 1973, Xerox completed work on the first personal computer, the Xerox Alto, which had a sophisticated graphical user interface (GUI)

involving windows, icons, menus and a pointer. (WIMP) Unfortunately, the Xerox Alto, and its successor the Xerox Star were far too expensive for the average consumer, and suffered from poor marketing. In 1984 Apple Computer launched the Apple Macintosh, which was the first affordable and commercially successful personal computer to include a graphical user interface. The Macintosh was the second Apple Computer to ship with a graphical user interface, with the Apple Lisa being the first. In 1985, Microsoft released Microsoft Windows which bore a striking resemblance to both Macintosh, and to the Alto's interface. Windows eventually overtook Apple in the PC market to become the predominant GUI-based operating system.

Evaluation

Software designers attempt to make computer applications easier to use for both novice and expert users by creating concrete metaphors that resemble the users' real-world experiences. Continual technological improvement has made metaphors depict these real-world experiences more realistically to ultimately enhance interface performance. Beginning users, however, could use a sort of help box, because the metaphor is not always going to be clear enough for them to understand, no matter how much effort its programmers devote to making it resemble something the users understand. Experts, on the other hand, understand what is going on with the technical aspects of an interface metaphor. They know what they want to do and they know how to do it—and so they design shortcuts to facilitate achieving their goals.

While the concept behind interface metaphors appears simple (to promote more efficient facilitation of a computer), a lack of empirical evidence exists to support these claims. Little research has actually been completed that demonstrates the benefits of implementing metaphors in computer systems as well as what makes a metaphor most effective.

Internet metaphors

Internet metaphors provide users and researchers of the Internet a structure for understanding and communicating its various functions, uses, and experiences. An advantage of employing metaphors is that they permit individuals to visualize an abstract concept or phenomenon with which they have limited experience by comparing it with a concrete, well-understood concept such as physical movement through space. Metaphors to describe the Internet have been utilized since its creation and developed out of the need for the Internet to be understood by everyone when the goals and parameters of the Internet were still unclear. Metaphors helped to overcome the problems of the invisibility and intangibility of the Internet's infrastructure and to fill linguistic gaps where no literal expressions existed.

"Highways, webs, clouds, matrices, frontiers, railroads, tidal waves, libraries, shopping malls, and village squares are all examples of metaphors that have been used in discussions of the Internet." Over time these metaphors have become embedded in cultural communications, subconsciously shaping the cognitive frameworks and perceptions of users who guide the Internet's future development. Popular metaphors may also reflect the intentions of Internet designers or the views of

government officials. Internet researchers tend to agree that popular metaphors should be re-examined often to determine if they accurately reflect the realities of the Internet, but many disagree on which metaphors are worth keeping and which ones should be left behind.

Overview

Internet metaphors guide future action and perception of the Internet's capabilities on an individual and societal level. Internet metaphors are contestable and sometimes may present political, educational, and cognitive issues. Tensions between producer and user, commercial and non-commercial interests, and uncertainty regarding privacy all influence the shape these metaphors take.

Common Internet metaphors such as the information superhighway are often criticized for failing to adequately reflect the reality of the Internet as they emphasize the speed of information transmission over the communal and relationship building aspects of the Internet. Internet researchers from a variety of disciplines are engaged in the analysis of metaphors across many domains in order to reveal their impact on user perception and determine which metaphors are best suited for conceptualizing the Internet. Results of this research have become the focus of a popular debate on *which* metaphors should be applied in political, educational, and commercial settings as well as which aspects of the Internet remain unaccounted for with current metaphors, limiting the scope of users understanding.

Metaphors of the Internet often reveal the intentions of designers and industry spokespeople. "For instance, those who use metaphors of consumption and shopping malls will devote resources to developing secure exchange mechanisms. Broadcasting metaphors carry with them assumptions about the nature of interactions between audiences and content providers that are more passive than those suggested by interactive game metaphors and applications. Computer security experts deploy metaphors that invoke fear, anxiety, and apocalyptic threat" (Wyatt, 2004, p. 244). The extent to which the Internet is understood across individuals and groups determines their ability to navigate and build Web sites and social networks, attend online school, send e-mail, and a variety of other functions. Internet metaphors provide a comprehensive picture of the Internet as a whole as well as describe and explain the various tools, purposes, and protocols that regulate the use of these communication technologies.

Without the use of metaphors the concept of the Internet is abstract and its infrastructure difficult to comprehend. When it was introduced the Internet created a linguistic gap as no literal expressions existed to define its functions and properties. Internet metaphors arose out of this predicament so that it could be adequately described and explained to the public. Essentially all language now used to communicate about the Internet is of a metaphorical nature, although users are often unaware of this reality because it is embedded in a cultural context that is widely accepted. There are several types of metaphors that serve various purposes and can range from describing the nature of online relationships, modeling the Internet visually, to the specific functions of the Internet as a tool. Each metaphor has implications for the experience

and understanding of the Internet by its users and tends to emphasize some aspects of the Internet over others. Some metaphors emphasize space (Matlock, Castro, Fleming, Gann, &Maglio, 2014).

Popular culture

Common recurring themes regarding the Internet appear in popular media and reflect pervasive cultural attitudes and perceptions. Although other models and constructed metaphors of the Internet found in scholarly research and theoretical frameworks may be more accurate sources on the *effects* of the Internet, mass media messages in popular culture are more likely to influence how people think about and interact with the Internet.

The very first metaphor to describe the Internet was the World Wide Web, proposed in 1989. However, uncertainty surrounding the structure and properties of the Internet was apparent in the newspapers of the 1990s that presented a vast array of contradicting visual models to explain the Internet. Spatial constructs were utilized to make the Internet appear as a tangible entity placed within a familiar geographical context. A popular metaphor adopted around the same time was cyberspace, coined by William Gibson in his novel *Neuromancer* to describe the world of computers and the society that gathers around them.

Howard Rheingold, an Internet enthusiast of the 1990s, propagated the metaphor of virtual communities and offered a vivid description of the Internet as "...a place for conversation or publication, like a giant coffee-house with a thousand

rooms; it is also a world-wide digital version of the Speaker's Corner in London's Hyde Park, an unedited collection of letters to the editor, a floating flea market, a huge vanity publisher, and a collection of every odd-special interest group in the world" (Rheingold 1993, p. 130).

In 1991, Al Gore's choice to use the information superhighway as a metaphor shifted perceptions of the Internet as a communal enterprise to an economic model that emphasized the speed of information transmission. While this metaphor can still be found in popular culture, it has generally been dropped in favor of other metaphors due to its limited interpretation of other aspects of the Internet such as social networks. The most common types of metaphors in usage today relate to either social or functional aspects of the Internet or representations of its infrastructure through visual metaphors and models.

Social metaphors

Internet metaphors frequently arise from social exchanges and processes that occur online and incorporate common terms that describe offline social activities and realities. These metaphors often point to the fundamental elements that make up social interactions, even though online interactions differ in significant ways from face-to-face communication. Therefore, social metaphors tend to communicate more about the values of society rather than the technology of the Internet itself.

Metaphors such as the electronic neighborhood and virtual community point to ways in which individuals connect to others and build relationships by joining a social network.

Global village is another metaphor that evokes the imagery of closeness and interconnectedness that might be found in a small village, but is applied to the worldwide community of Internet users. However, the global village metaphor has been criticized for suggesting that the *entire* world is connected by the Internet as the continued existence of social divides prevent many individuals from accessing the Internet.

The electronic frontier metaphor conceptualizes the Internet as a vast unexplored territory, a source of new resources, and a place to forge new social and business connections. Similar to the American ideology of the Western Frontier, the electronic frontier invokes the image of a better future to come through new opportunities afforded by the Internet. The Electronic Frontier Foundation is a non-profit digital rights group that adopted the use of this metaphor to denote their dedication to the protection of personal freedoms and fair use within the digital landscape. Social metaphors and their pervasive influence indicate the increasing importance placed on social interaction on the Internet.

Functional metaphors

Functional metaphors of the Internet shape our understanding of the medium itself and give us clues as to how we should actually use the Internet and interpret its infrastructure for design and policy making. These exist at the level of the Internet as a whole, at the level of a website, and the level of individual pages. The majority of these types of metaphors are based on the concept of various spaces and physical places; therefore, most are considered spatial metaphors. However, this aspect should not be considered the only defining feature

of a functional metaphor as social metaphors are often spatial in nature. Cyberspace is the most widely used spatial metaphor of the Internet and the implications of its use can be seen in the *Oxford English Dictionary* definition, which denotes cyberspace as a space within whose boundaries digital communications take place. The implications of this spatial metaphor in discourse on law can be seen in instances where the application of traditional laws governing real property are applied to Internet spaces. However, arguments against this type of ruling have claimed that the Internet is a borderless space, which should not be subject to the laws applied to places. Others have argued that the Internet is in fact a real space not sealed from the real world and can be zoned, trespassed upon, or divided up into holdings like real property.

Other functional metaphors are based on travel within space, such as *surfing* the Net, which suggests that the Internet is similar to an ocean. Mark McCahill coined 'surfing the internet' in an analogy with browsing a library shelf as an information space. Web*sites* indicate components of a space, which are static and fixed, whereas web*pages* suggest pages of a book. Similarly, focal points of the Internet structure are called nodes. Home pages, chat rooms, windows, and the idea that one can *jump* from one page to the next also invoke spatial imagery that guide the functions that users perform on the Internet.

Other metaphors refer to the Internet as another dimension beyond typical spaces, such as portals and gateways, which refer to access and communication functions. Firewalls invoke the image of physically blocking the incoming of information such as viruses and pop-up ads.

Designers of computer systems often use spatial metaphors as a way of controlling the complexity of interfaces. Designers create actions, procedures, and concepts of systems based on similar actions, procedures, and concepts of other domains such as physical spaces so that they will be familiar to users. In designing hypertext, a system that links topics on a screen to related information, navigational metaphors such as landmarks, routes, and way-finding have often been implemented for users' ease of understanding how hypertext functions.

Visual metaphors

Visual metaphors are popular in conceptualizing the Internet and are often deployed in commercial promotions through visual media and imagery. The most common visual metaphor is a network of wires with nodes and route lines plotted on a geographically based map. However, maps of Internet infrastructure produced for network marketing are rarely based on actual pathways of wires and cable on the ground, but are instead based on circuit diagrams similar to those seen on subway maps. The globe, or the Earth viewed from space, with network arcs of data flow wrapped around it, is another dominant metaphor for the Internet in Western contexts and is connected with the metaphor of the global village. Many abstract visual metaphors based on organic structures and patterns are found in literature on the Internet's infrastructure. Often, these metaphors are used as a visual shorthand in explanations as they allow one to refer to the Internet as a definite object without having to explain the intricate details of its functioning. Clouds are the most common of abstract metaphors employed for this purpose in

cloud computing and have been used since the creation of the Internet. Other abstract metaphors of the Internet draw on the fractal branching of trees and leaves, and the lattices of coral and webs, while others are based on the aesthetics of astronomy such as gas nebulas, and star clusters.

Technical methods such as algorithms are often used to create huge, complex graphs or maps of raw data from networks and the topology of connections. The typical result of this process are visual representations of the Internet that are elaborate and visually striking, resembling organic structures. These artistic, abstract representations of the Internet have been featured in art galleries, sold as wall posters, used on book covers, and have been claimed to be a picture of the *whole* Internet by many fans. However, there are no instructions on how these images may be interpreted. The main function of these representations has sometimes been explained as a metaphor for the complexity of the Internet.

Primary metaphor

Primary metaphor is a term named by Joseph Grady for the basic connection that exist between subjective or abstract experiences such as *good* and concrete experiences such as *up*. These two concepts usually correlate in experience, and form the primary metaphor *good is up*. Likewise there is a correlation between *knowing* and *seeing* forming the primary metaphor *knowing is seeing*. Two such primary metaphors are used when understanding an expression such as *glass ceiling*.

An example of a primary metaphor could be that of Shakespeare's 'As You Like It', where life is depicted as being

similar to a theater. Therefore, 'LIFE' relates to a conceptual experience, and 'THEATER' represents a concrete experience. Thus forming the primary metaphor; LIFE IS THEATER.

Transfer (propaganda)

Transfer is a technique used in propaganda and advertising. Also known as association, this is a technique of projecting positive or negative qualities (praise or blame) of a person, entity, object, or value (an individual, group, organization, nation, patriotism, etc.) to another in order to make the second more acceptable or to discredit it. It evokes an emotional response, which stimulates the target to identify with recognized authorities. Often highly visual, this technique often utilizes symbols superimposed over other visual images. An example of common use of this technique in the United States is for the President to be filmed or photographed in front of the country's flag. Another technique used is celebrity endorsement.

Cuckoo's egg (metaphor)

A **cuckoo's egg** is a metaphor for brood parasitism, where a parasitic bird deposits its egg into a host's nest, which then incubates and feeds the chick that hatches, even at the expense of its own offspring. That original biological meaning has been extended to other uses, including one which references spycraft and another piece of malware.

History

The concept has been in use in the study of brood parasitism in birds since the 19th century. It first evolved a metaphoric meaning of "misplaced trust", wherein the chick hatched of a cuckoo's egg incubated and raised by unknowing victim parents will first begin to starve and outgrow them as it or they kill off the birds' legitimate offspring.

The first well known application to spycraft was in the 1989 book *The Cuckoo's Egg: Tracking a Spy Through the Maze of Computer Espionage* by Clifford Stoll, in which Stoll deployed a honeypot to catch a cyber hacker that had accessed the secure computer system of the classified U.S. government Lawrence Berkeley National Laboratory.

Stoll chronicles the so-called 'Cuckoo's Egg Investigation', "a term coined by American press to describe (at the time) the farthest reaching computer-mediated espionage penetration by foreign agents", which was also known as Operation Equalizer initiated and executed by the KGB through a small cadre of German hackers.

In his book Stoll describes the hacker employing a Trojan horse strategy to penetrate the secure Livermore Laboratory computer system:

I watched the cuckoo lay its egg: once again, he manipulated the files in my computer to make himself super-user. His same old trick: use the Gnu-Emacs move-mail to substitute his tainted program for the system's atrun file. Five minutes later, shazam! He was system manager.

Extended metaphor

An **extended metaphor**, also known as a conceit or sustained metaphor, is an author's exploitation of a single metaphor or analogy at length through multiple linked tenors, vehicles, and grounds throughout a poem or story. Tenor is the subject of the metaphor, vehicle is the image or subject that carries the weight of the comparison, and ground is the shared proprieties of the two compared subjects. Another way to think of extended metaphors is in terms of implications of a base metaphor. These implications are repeatedly emphasized, discovered, rediscovered, and progressed in new ways.

Examples

William Shakespeare

Symbolism is a common theme of extended metaphors. This is often seen in William Shakespeare's work. For example, in Sonnet 18 the speaker offers an extended metaphor which compares his love to Summer. Shakespeare also makes use of extended metaphors in Romeo and Juliet, most notably in the balcony scene where Romeo offers an extended metaphor comparing Juliet to the sun.

- It is the east, and Juliet is the sun.
- Arise, fair sun, and kill the envious moon,
- Who is already sick and pale with grief,
- That thou her maid art far more fair than she:
- Be not her maid, since she is envious;
- Her vestal livery is but sick and green

- And none but fools do wear it; cast it off.

T. S. Eliot

In the following passage from "The Love Song of J. Alfred Prufrock", T. S. Eliot provides another example of an extended metaphor:

- The yellow fog that rubs its back upon the window-panes,
- The yellow smoke that rubs its muzzle on the window-panes
- Licked its tongue into the corners of the evening,
- Lingered upon the pools that stand in drains,
- Let fall upon its back the soot that falls from chimneys,
- Slipped by the terrace, made a sudden leap,
- And seeing that it was a soft October night,
- Curled once about the house, and fell asleep.

Qualities (grounds) that we associate with cats (vehicle), color, rubbing, muzzling, licking, slipping, leaping, curling, sleeping, are used to describe the fog (tenor).

Robert Frost

The commonly used "life-is-a-journey" metaphor conceptualized by Lakoff and Johnson (1980 and 1989) is extended in Robert Frost's "The Road Not Taken". An excerpt is provided below:

- I shall be telling this with a sigh
- Somewhere ages and ages hence:
- Two roads diverged in a wood, and I,

- I took the one less traveled by,
- And that has made all the difference.

This poem can be understood if the reader has knowledge of the "life-is-a-journey" metaphor. That knowledge includes understanding of other grounds between the tenor (life) and vehicle (journey) that are not as transparent in this poem. Holyoak (2005) gives examples of these grounds, "person is a traveler, purposes are destinations, actions are routes, difficulties in life are impediments to travel, counselors are guides, and progress is the distance traveled".

Walt Whitman

Whitman's O Captain! My Captain! uses the extended metaphor of Abraham Lincoln as the captain of the 'ship' that is the United States of America.

Pataphor

The *pataphor* (Spanish: *patáfora*, French: *pataphore*) is a term coined by writer and musician Pablo Lopez ("Paul Avion"), for an unusually extended metaphor based on Alfred Jarry's "science" of pataphysics. As Jarry claimed that pataphysics existed "as far from metaphysics as metaphysics extends from regular reality", a pataphor attempts to create a figure of speech that exists as far from metaphor as metaphor exists from non-figurative language. Whereas a metaphor is the comparison of a real object or event with a seemingly unrelated subject in order to emphasize the similarities between the two, the pataphor uses the newly created metaphorical similarity as a reality on which to base itself. In going beyond mere

ornamentation of the original idea, the pataphor seeks to describe a new and separate world, in which an idea or aspect has taken on a life of its own.

Like pataphysics itself, pataphors essentially describe two degrees of separation from reality (rather than merely one degree of separation, which is the world of metaphors and metaphysics). The pataphormay also be said to function as a critical tool, describing the world of "assumptions based on assumptions", such as belief systems or rhetoric run amok. The following is an example.

"Non-figurative:

- Tom and Alice stood side by side in the lunch line.

Metaphor

- Tom and Alice stood side by side in the lunch line; two pieces positioned on a chessboard.

Pataphor

- Tom took a step closer to Alice and made a date for Friday night, checkmating. Rudy was furious at losing to Margaret so easily and dumped the board on the rose-colored quilt, stomping downstairs."

Thus, the pataphor has created a world where the chessboard exists, including the characters who live in that world, entirely abandoning the original context.

The pataphor has been subject to commercial interpretations, usage in speculative computer applications, applied to highly imaginative problem solving methods and even politics on the international level or theatre The Firesign Theatre (a comedy troupe whose jokes often rely on pataphors). There is a band called Pataphor and an interactive fiction in the Interactive Fiction Database called "PataNoir," based on pataphors.

Pataphors have been the subject of art exhibits, as in Tara Strickstein's 2010 "Pataphor" exhibit at Next Art Fair/Art Chicago.

There is also a book of pataphorical art called *Pataphor* by Dutch artist Hidde van Schie.

It is worth noting that a pataphor is not the traditional metaphorical conceit but rather a set of metaphor built upon an initial metaphor, obscuring its own origin rather than reiterating the same analogy in myriad ways.

Invariance principle (linguistics)

In cognitive linguistics, the **invariance principle** is a simple attempt to explain similarities and differences between how an idea is understood in "ordinary" usage, and how it is understood when used as a conceptual metaphor.

Kövecses (2002: 102) provides the following examples based on the semantics of the English verb *to give*:

- She gave him a book. (source language)

Based on the metaphor CAUSATION IS TRANSFER we get:

- (a) She gave him a kiss.
- (b) She gave him a headache.

However, the metaphor does not work in exactly the same way in each case, as seen in:

- (a') She gave him a kiss, *and he still has it.*
- (b') She gave him a headache, *and he still has it.*

The invariance principle offers the hypothesis that metaphor only maps components of meaning from the source language that remain coherent in the target context. The components of meaning that remain coherent in the target context retain their "basic structure" in some sense, so this is a form of invariance.

George Lakoff and Mark Turner originated the idea under the name *invariance hypothesis*, later revising and renaming it. Lakoff (1993: 215) defines the invariance principle as: "Metaphorical mappings preserve the cognitive topology (that is, the image-schema structure) of the source domain, in a way consistent with the inherent structure of the target domain".

Metaphor in philosophy

Metaphor, the description of one thing as something else, has become of interest in recent decades to both analytic philosophy and continental philosophy, but for different reasons.

Metaphor in analytic philosophy

In the Anglo-American tradition of analytic philosophy (in particular, in the philosophy of language), metaphor has attracted interest because it does not conform to accepted truth-conditional semantics, the conditions which determine whether or not a statement is true. Taken literally, the statement "Juliet is the sun" (from *Romeo and Juliet*) is false, if not nonsensical, yet, taken metaphorically, it is meaningful and may be true, but in a sense which is far from clear. The comparison theory of metaphor asserts that one can express the truth value of a metaphor by listing all the respects in which the two terms are alike or similar; for example: Juliet is *like* the sun because she shares with it qualities such as radiance, brilliance, the fact that she makes the day and that she gets up every morning. However, this results in re-casting metaphor as simile. Because it can only explain the truth of metaphor by in effect losing metaphor, the comparison theory is rarely defended.

In contrast, two leading theorists emphasize the fact that truth conditions cannot be specified for a metaphor. Max Black maintains that metaphors are too open-ended to be able to function as referring expressions, and so cannot be expressions which have truth conditions (Black 1962). If metaphors are used in contexts where precise terminology is expected (for example, in a scientific theory), then their role, Black argues, is purely heuristic, that is, they are means to an end or ways of assisting understanding, rather than being terms which can be tested for truth or falsity (Black 1962, p. 37). Donald Davidson also thinks it a mistake to look for the

truth conditions of a metaphor, since, in his words, "much of what we are caused to notice [in a metaphor] is not propositional in character", that is to say, metaphor is a prompt to thought which cannot be reduced to or contained by a series of truth conditions (Davidson 1984, p. 263). What metaphor does, Davidson maintains, is make us see one thing as something else by "making [a] literal statement that inspires or prompts the insight" (Davidson 1984, p. 263). Seeing one thing as something else is not the recognition of some truth or fact, and so "the attempt to give literal expression to the content of the metaphor is simply misguided" (Davidson 1984, p. 263).

Max Black develops the idea that metaphor actually creates insight or new meaning (Black 1979). His interactionist theory asserts that at the heart of a metaphor is the interaction between its two subject terms, where the interaction provides the condition for a meaning which neither of the subject terms possesses independently of the metaphorical context. The primary subject in a metaphor, he claims, is coloured by a set of "associated implications" normally predicated of the secondary subject (Black 1979, p. 28). From the number of possible meanings which could result, the primary subject sieves the qualities predicable of the secondary subject, letting through only those that fit.

The interaction, as a process, brings into being what Black terms an "implication-complex", a system of associated implications shared by the linguistic community as well as an impulse of free meaning, free in that it is meaning which was unavailable prior to the metaphor's introduction (Black 1979, p. 28).

In a different, naturalist, approach, some English-speaking philosophers close to cognitive science, such as Lakoff, have made metaphor the central aspect of human rationality.

Metaphor in continental philosophy

Whereas analytic philosophy examines metaphor within the philosophy of language, continental philosophy assigns much wider significance to metaphor. This is because the climate within continental thought has been more favourable to the propagation of new branches of enquiry from nineteenth century German philosophy. Although Kant and Hegel sit quite happily on both analytic and continental curricula, it is only the latter which has seriously addressed the need to rethink how the world appears to us and how it is made manifest to us in the light of their metaphysics. Metaphor has proven to be extremely important for this rethinking because it is the process of conceptual borrowing or reassignment which revises our perception of the world.

The major shift which occurs in Kantian continental philosophy, according to Cazeaux, is the departure 'from dualistic thought, i.e. thinking which remains within the boundaries created by oppositions, such as mind—body and subjective—objective' (Cazeaux 2007, p. 4). The turn away from dualistic thought is made by Kant on account of his representing experience as the subjective determination of an objective world, thereby placing in a relationship terms which normally stand as opposites in a dualism. As a result of this shift, without conventional dualisms to fall back upon, the process of conceptual borrowing and cross-referral presented by metaphor becomes central as the means by which the

textures and complexities of experience can be articulated. Theses to this effect, but with significant differences, can be found in Kierkegaard, Nietzsche, Heidegger, Merleau-Ponty, Bachelard, Paul Ricoeur, and Derrida.

To give two examples. According to Nietzsche, we are in metaphor or we are metaphor: our being is not derived from a Platonic, eternal essence or from a Cartesian thinking substance but (in as much as there is a way of being we can call ours) is emergent from tensional interactions between competing drives or perspectives (Nietzsche 2000). We customarily hold truth to be a relation of correspondence between knowledge and reality but, Nietzsche declares, it is in fact 'a movable host of metaphors, metonymies, and anthropomorphisms' due to the fundamentally metaphorical nature of concept-formation, a series of creative leaps from nerve stimulus to retinal image (first metaphor) to sound as signifier (second metaphor) (Nietzsche 2000, p. 55). Our categories, and the judgments we form with them, can never correspond to things in themselves because they are formed through a series of transformations which ensures that 'there is no causality, no correctness, and no expression' connecting the first stage (the stimulus) with the last (the concept) (Nietzsche 2000, p. 58).

For Ricoeur, metaphor is also 'living' – hence the title of his book, *La Métaphore vive* (Ricoeur 1975) (translated into English as *The Rule of Metaphor* (Ricoeur 1977)) – but in a different sense from Nietzsche. Metaphor is living, Ricoeur claims, in that it is the principle which revives our perception of the world and through which we become aware of our creative capacity for seeing the world anew. This process, he thinks, is

both paradoxical and Kantian in nature: paradoxical in that the creative combination of terms in a metaphor nevertheless produces meaning which has the character of a discovery (how can something be both a creation and a discovery?), and Kantian because the paradox mirrors Kant's theory of experience in which the subjective application of concepts nevertheless yields perception of an objective world. The tension between the subjective, creative and the objective, discovery aspects of a metaphor, Ricoeur argues, proceeds 'from the very structures of the mind, which it is the task of [Kant's] transcendental philosophy to articulate' (Ricoeur 1977, p. 300). Unfortunately, the part of Kant's philosophy which Ricoeur appeals to is highly problematic: the schema or schematism, the operation which Kant dismisses as 'an art concealed in the depths of the human soul' (Kant 1929, p. 183, A141, B180-81). Ricoeur's Kantianism is considered at length by Cazeaux (Cazeaux 2007) and Stellardi (Stellardi 2000), with the former providing an account of how the schematism might afford a coherent explanation of metaphor.

Another reason for the attention paid by continental philosophy to metaphor is the questioning of boundaries – between subject areas and between the wider concepts of ethics, epistemology and aesthetics – which has occurred within postmodernism. Principal concerns in these debates are the status of knowledge and the way in which the concepts of truth and objectivity are understood. Philosophy has been under attack on this score with its history of 'universal truths', e.g. Descartes's cogito, Kant's table of categories, and Hegel's Absolute Consciousness. The main arguments against this universalism invoke metaphor on two related accounts: (1) the fact that key epistemological concepts have metaphors at their

root, for example, “mirroring”, “correspondence”, “sense data”, is taken as evidence of the contingent, communal, subjective basis of knowledge, and (2) because metaphor (as a form of dislocated or dislocating predication) works by testing the appropriate with the inappropriate, it is seen as a means of challenging the boundaries whereby one subject defines itself in relation to another.

Chapter 5

Narrative Techniques

- A **narrative technique** (known for literary fictional narratives as a **literary technique**, **literary device**, or **fictional device**) is any of several specific methods the creator of a narrative uses to convey what they want—in other words, a strategy used in the making of a narrative to relay information to the audience and particularly to develop the narrative, usually in order to make it more complete, complex, or interesting. Literary techniques are distinguished from literary elements, which exist inherently in works of writing.

Setting (narrative)

A **setting** (or **backdrop**) is the time and geographic locationwithin a narrative, either nonfiction or fiction. It is a literary element. The setting initiates the main backdrop and mood for a story. The setting can be referred to as story world or *milieu* to include a context (especially society) beyond the immediate surroundings of the story. Elements of setting may include culture, historical period, geography, and hour. Along with the plot, character, theme, and style, setting is considered one of the fundamental components of fiction.

Role

Setting may refer to the social milieu in which the events of a novel occur. The elements of the story setting include the passage of time, which may be static in some stories or dynamic in others with, for example, changing seasons.

A setting can take three basic forms. One is the natural world, or in an outside place. In this setting, the natural landscapes of the world play an important part in a narrative, along with living creatures and different times of weather conditions and seasons.

The second form exists as the cultural and historical background in which the narrative resides. Past events that have impacted the cultural background of characters or locations are significant in this way. The third form of a setting is a public or private place that has been created/maintained and/or resided in by people. Examples of this include a house, a park, a street, a school, etc.

Types

Setting may take various forms:

- Alternate history
- Campaign setting
- Constructed world
- Dystopia
- Fantasy world
- Fictional city

- Fictional country
- Fictional crossover
- Fictional location
- Fictional universe
- Future history
- Imaginary world
- Mythical place
- Parallel universe
- Planets in science fiction
- Simulated reality
- Utopia
- Virtual reality

Backstory

A **backstory**, **background story**, **back-story**, or **background** is a set of events invented for a plot, presented as preceding and leading up to that plot. It is a literary device of a narrative history all chronologically earlier than the narrative of primary interest.

In acting, it is the history of the character before the drama begins, and is created during the actor's preparation.

It is the history of characters and other elements that underlie the situation existing at the main narrative's start. Even a purely historical work selectively reveals backstory to the audience.

Usage

As a literary device, backstory is often employed to lend depth or believability to the **main story**. The usefulness of having a dramatic revelation was recognized by Aristotle, in *Poetics*.

Backstories are usually revealed, partially or in full, chronologically or otherwise, as the main narrative unfolds. However, a story creator may also create portions of a backstory or even an entire backstory that is solely for their own use.

Backstory may be revealed by various means, including flashbacks, dialogue, direct narration, summary, recollection, and exposition. The original *Star Wars* movie and its first two sequels are examples of a work with a preconceived backstory, which was later released as the "prequel" second set of three movies.

Recollection

Recollection is the fiction-writing mode whereby a character calls something to mind, or remembers it. A character's memory plays a role for conveying backstory, as it allows a fiction-writer to bring forth information from earlier in the story or from before the beginning of the story. Although recollection is not widely recognized as a distinct fiction-writing mode, recollection is commonly used by authors of fiction.

For example, Orson Scott Card observes that "If it's a memory the character could have called to mind at any point, having her think about it just in time to make a key decision may seem like an implausible coincidence . . . ." Furthermore, "If the memory is going to prompt a present decision, then the memory in turn must have been prompted by a recent event."

Shared universe

In a shared universe more than one author may shape the same backstory. The later creation of a backstory that conflicts with a previously written main story may require the adjustment device known as retroactive continuity, informally known as "retcon".

Acting

Actors may create their own backstories for characters, going beyond the sometimes meager information in a script. Filling in details helps an actor interpret the script and create fully imagined characters.

Chekhov's gun

Chekhov's gun (**Chekhov's rifle**, Russian: Чеховскоеружьё) is a dramatic principle that states that every element in a story must be necessary, and irrelevant elements should be removed. Elements should not appear to make "false promises" by never coming into play. The statement is recorded in letters by Anton Chekhov several times, with some variation: It is derived from

the idea that if a gun is placed in a scene it must at some point be used, as in his own play *The Seagull*. Ernest Hemingway mocked the principle in his essay "The Art of the Short Story", giving the example of two characters that are introduced and then never mentioned again in his short story "Fifty Grand". Hemingway valued inconsequential details, but conceded that readers will inevitably seek symbolism and significance in these inconsequential details. Other writers have noted that too much emphasis on the principle can make a story predictable and leave it colorless.

Principles

- "Remove everything that has no relevance to the story. If you say in the first chapter that there is a rifle hanging on the wall, in the second or third chapter it absolutely must go off. If it's not going to be fired, it shouldn't be hanging there."
- "One must never place a loaded rifle on the stage if it isn't going to go off. It's wrong to make promises you don't mean to keep." Chekhov, letter to AleksandrSemenovichLazarev (pseudonym of A. S. Gruzinsky), 1 November 1889. Here the "gun" is a monologue that Chekhov deemed superfluous and unrelated to the rest of the play.
- "If in the first act you have hung a pistol on the wall, then in the following one it should be fired. Otherwise don't put it there." From Gurlyand's*Reminiscences of A. P. Chekhov*, in *Teatriiskusstvo* 1904, No. 28, 11 July, p. 521.

Cliffhanger

A **cliffhanger** or **cliffhanger ending** is a plot device in fiction which features a main character in a precarious or difficult dilemma or confronted with a shocking revelation at the end of an episode or a movie of serialized fiction. A cliffhanger is hoped to incentivize the audience to return to see how the characters resolve the dilemma.

Some serials end with the caveat, "to be Continued" or "the end?"; in movie serials and television series, the following episode sometimes begins with a recap sequence.

Cliffhangers were used as literary devices in several works of the medieval era, with *One Thousand and One Nights* ending on a cliffhanger each night. Cliffhangers appeared as an element of the Victorian serial novel that emerged in the 1840s, with many associating the form with Charles Dickens, a pioneer of the serial publication of narrative fiction. Following the enormous success of Dickens by the 1860s cliffhanger endings had become a staple part of the sensation serials.

History

Cliffhangers were used as literary devices in several works of the medieval era. The Arabic literary work *One Thousand and One Nights* involves Scheherazade narrating a series of stories to King Shahryār for 1,001 nights, with each night ending on a cliffhanger in order to save herself from execution. Some medieval Chinese ballads like the *Liu chih-yuan chu-kung-tiao*

ended each chapter on a cliffhanger to keep the audience in suspense.

Victorian serials

Cliffhangers became prominent with the serial publication of narrative fiction, pioneered by Charles Dickens. Printed episodically in magazines, Dickens's cliffhangers triggered desperation in his readers. Writing in the *New Yorker*, Emily Nussbaum captured the anticipation of those waiting for the next installment of Dickens' *The Old Curiosity Shop*;

In 1841, Dickens fanboys rioted on the dock of New York Harbor, as they waited for a British ship carrying the next installment, screaming, "Is little Nell dead?"

On Dickens' instalment format and cliffhangers—first seen with *The Pickwick Papers* in 1836—Leslie Howsam in *The Cambridge Companion to the History of the Book* (2015) writes, "It inspired a narrative that Dickens would explore and develop throughout his career. The instalments would typically culminate at a point in the plot that created reader anticipation and thus reader demand, generating a plot and sub-plot motif that would come to typify the novel structure."

With each new instalment widely anticipated with its cliffhanger ending, Dickens' audience was enormous (his instalment format was also much more affordable and accessible to the masses, with the audience more evenly distributed across income levels than previous). The popularity of Dickens's serial publications saw the cliffhanger become a staple part of the sensation serials by the 1860s.

Etymology

The term "cliffhanger" is considered to have originated with the serialised version of Thomas Hardy's *A Pair of Blue Eyes* (which was published in *Tinsley's Magazine* between September 1872 and July 1873) in which Henry Knight, one of the protagonists, is left hanging off a cliff.

However, according to the Random House *Historical Dictionary of American Slang*, the term's first use in print was in 1937.

Serial media

Early film

Cliffhangers were especially popular from the 1910s through to the 1930s serials when nickelodeons and movie theaters filled the cultural niche later primarily occupied by television.

During the 1910s, when Fort Lee, New Jersey was a center of film production, the cliffs facing New York and the Hudson River were frequently used as film locations. The most notable of these films was *The Perils of Pauline*, a serial which helped popularize the term cliffhanger. In them, the serial would often end suddenly leaving actressPearl White's Pauline character literally hanging from a cliff.

Modern usage

Cliffhangers are often used in television series, especially soap operas and game shows.

Several Australiansoap operas, which went off air over summer, such as *Number 96*, *The Restless Years*, and *Prisoner*, ended each year with major and much publicized catastrophe, such as a character being shot in the final seconds of the year's closing episode.

Cliffhangers are commonly used in Japanese manga and anime. In contrast to American superhero comics, Japanese manga are much more frequently written with cliffhangers, often with each volume or issue. This is particularly the case with shōnen manga, especially those published by *Weekly Shōnen Jump*, such as *Dragon Ball*, *Shaman King*, and *One Piece*.

During its original run, *Doctor Who*was written in a serialised format that usually ended each episode within a serial on a cliffhanger. In the first few years of the show, the final episodes of each serial would have a cliffhanger that would lead into the next serial. The programme's cliffhangers sometimes caused controversy, most notably Part Three of *The Deadly Assassin* (1976), which was altered for future broadcasts following a complaint from campaigner Mary Whitehouse. Whitehouse objected to the violence of the scene (the Doctor's head is held underwater in an attempt to drown him). She often cited it in interviews as one of the most frightening scenes in *Doctor Who*, her reasoning being that children would not know if the Doctor survived until the following week and that they would "have this strong image in their minds" during all that time. The producer of *Doctor Who* at the time, Philip Hinchcliffe, cited the 1950s radio serial *Journey into Space* as an influence for its use of cliffhangers. A later serial, *Dragonfire* (1987), is notable for having a

cliffhanger that involved the Seventh Doctor literally hanging from a cliff, which has been described as "the most ludicrous ever presented in *Doctor Who*". Another British science fiction series, *Blake's 7* (1978-81), employed end-of-season cliffhangers for each of the four seasons the series was on air, most notably for its final episode in 1981 in which the whole of the main cast are seemingly killed. The final cliffhanger was never resolved.

Cliffhangers were rare on American primetime television before 1980, as television networks preferred the flexibility of airing episodes in any order. The sitcom*Soap* was the first US primetime television programme to utilise the end-of-season cliffhanger, at the end of its first season in 1978. Cliffhangers then went on to become a staple of American primetime soap operas; the phenomenal success of the 1980 "Who shot J.R.?" third season-ending cliffhanger of *Dallas*, and the "Who Done It" fourth-season episode that finally solved the mystery, contributed to the cliffhanger becoming a common storytelling device on American television. Another notable cliffhanger was the "Moldavian Massacre" on *Dynasty* in 1985, which fueled speculation throughout the summer months regarding who lived or died when almost all the characters attended a wedding in the country of Moldavia, only to have revolutionaries topple the government and machine-gun the entire wedding party. Other primetime soap operas, such as *Falcon Crest* and *Knots Landing*, also employed dramatic end-of-season cliffhangers on an annual basis. Sitcoms also utilised the cliffhanger device. As well as the aforementioned *Soap*, the long-running sitcom *Cheers* would often incorporate cliffhanger season endings, largely (in its earlier years) to increase interest in the on-and-off relationship between its two

lead characters, Sam Malone and Diane Chambers. These cliffhangers did not place the characters in peril of any kind, but rather left their relationship (which was at the core of the show) hanging in the balance.

Cliffhanger endings in films date back to the early 20th century, and were prominently used in the movie serials of the 1930s (such as *Flash Gordon*and *Buck Rogers*), though these tended to be resolved with the next installment the following week. A longer term cliffhanger was employed in the *Star Wars* film series, in *The Empire Strikes Back* (1980) in which Darth Vader made a shock revelation to Luke Skywalker that he was his father, and the life of Han Solo was in jeopardy after he was frozen and taken away by a bounty hunter. These plotlines were left unresolved until the next film in the series three years later. The first two films in the *Back to the Future* series end in cliffhangers, with the first displaying the "to be continued" title card.

The two main ways for cliffhangers to keep readers/viewers coming back is to either involve characters in a suspenseful, possibly life-threatening situation, or to feature a sudden shocking revelation. Cliffhangers are also used to leave open the possibility of a character being killed off due to the actor not continuing to play the role.

Cliffhangers are also sometimes deliberately inserted by writers who are uncertain whether a new series or season will be commissioned, in the hope that viewers will demand to know how the situation is resolved. Such was the case with the second season of *Twin Peaks*, which ended in a cliffhanger similar to the first season with a high degree of uncertainty

about the fate of the protagonist, but the cliffhanger could not save the show from being canceled, resulting in the unresolved ending. The final episodes of soaps *Dallas* and *Dynasty* also ended in similar fashion, though all three shows would return years later in some form or other to resolve these storylines. The Australian soap opera *Return To Eden* ended in 1986 with a dramatic cliffhanger in anticipation of a second season. However, the network chose not to renew the show and so a hastily filmed five-minute "conclusion" was filmed and added on to the end of existing final episode to provide closure. Some shows, however, became known for never being resolved. In addition to the aforementioned *Blake's 7*, the supernatural series *Angel*, the original 1984 series *V* and its 2009 remake, all ended with unresolved cliffhangers.

The cliffhanger has become a genre staple (especially in comics, due to the multi-part storylines becoming the norm instead of self-contained stories) to such a degree, in fact, that series writers no longer feel they have to be immediately resolved, or even referenced, when the next episode is shown, variously because the writer didn't feel it was "a strong enough opener," or simply "couldn't be bothered." The heavily serialized television drama *True Blood* has become notorious for cliffhangers. Not only do the seasons conclude with cliffhangers, but almost every episode finishes at a cliffhanger directly after or during a highly dramatic moment, much like the primetime soap operas of the 1980s and 90s.

Commercial breaks can be a nuisance to script writers because some sort of incompleteness or minor cliffhanger should be provided before each to stop the viewer from changing channels during the commercial break. Sometimes a series ends with an

unintended cliffhanger caused by a very abrupt ending without a satisfactory dénouement, but merely assuming that the viewer will assume that everything sorted itself out.

Sometimes a movie, book, or season of a television show will end with the defeat of the main villain before a second, evidently more powerful villain makes a brief appearance (becoming the villain of the next film). Occasionally an element other than a villain is also used to tease at a sequel.

Peter Hogg's novel *Smilla's Sense of Snow* ends with a deliberate cliffhanger, with the protagonist and main villain involved in a life-and-death chase on the arctic ice off Greenland - and in this case, the author has no intention of ever writing a sequel, the ambiguous ending being part and parcel of the basic ideas permeating the book's plot. Similarly, Michael Flynn's science fiction novelette *The Forest of Time* ends with a deliberate and permanent cliffhanger: readers are not to be ever told where the protagonist ended up in his wandering the "forest" of alternate history timelines and whether he ever got back to his home and his beloved, nor whether the war which takes a large part of the plot ended in victory for the Good Guys or the Bad Guys.

George Cukor, when adapting in 1972 Graham Greene's *Travels with My Aunt* deliberately introduced a cliffhanger missing from the original. While Greene's book ended with the protagonists definitely choosing the adventurous and rather shady life of smugglers in Paraguay and closing off other options for their future, at the conclusion of the Cukor film a character is seen tossing a coin whose fall would determine

their next move, and the film ends on a freeze frame shot as the characters await the fall of the coin.

Eucatastrophe

A **eucatastrophe** is a sudden turn of events at the end of a story which ensures that the protagonist does not meet some terrible, impending, and very plausible and probable doom. The writer J. R. R. Tolkien coined the word by affixing the Greek prefix *eu*, meaning *good*, to *catastrophe*, the word traditionally used in classically inspired literary criticism to refer to the "unraveling" or conclusion of a drama's plot.

For Tolkien, the term appears to have had a thematic meaning that went beyond its literal etymological meaning in terms of form. In his definition as outlined in his 1947 essay "On Fairy-Stories", eucatastrophe is a fundamental part of his conception of mythopoeia. Though Tolkien's interest is in myth, it is also connected to the gospel; Tolkien calls the Incarnation of Christ the eucatastrophe of "human history" and the Resurrection the eucatastrophe of the Incarnation.

Eucatastrophe has been labelled by some as a form of *deus ex machina*, due to both sharing an impossible problem being suddenly resolved. However, differences between the two have also been noted, such as its inherent connection to an optimistic view on the unfolding of events in the narrative of the world. In Tolkien's view, eucatastrophe can also occur without the use of a *deus ex machina*.

Examples in Tolkien's work

The best-known and most fully realized eucatastrophe in Tolkien's work occurs in the climax of *The Lord of the Rings*. Though victory seems assured for Sauron, the One Ring is permanently destroyed as a result of Gollum's waylaying of Frodo at Mount Doom. Frodo essentially fails his impossible quest at its very end, claiming the Ring for himself – however, at this moment, Gollum suddenly appears, steals the ring, and in his ecstatic gloating falls into the fire. If not for Frodo's previous mercy in sparing Gollum's life (a great risk due to Gollum's obvious treachery, met with bitter protest by Sam), and if not for the Ring's own corruptive influence on Gollum, Sauron would surely have reclaimed it. Thus, Evil is inadvertently and unforeseeably defeated through a small act of kindness and through its own corruptive machinations.

Another example of eucatastrophe is the recurring role of the eagles as unexpected rescuers throughout Tolkien's writing. While their role has been described as that of a deus ex machina, Tolkien described Bilbo's "eucatastrophic emotion" at the eagles' appearance in *The Hobbit* as one of the key moments of the book.

Flashback (narrative)

A **flashback** (sometimes called an **analepsis**) is an interjected scene that takes the narrative back in time from the current point in the story. Flashbacks are often used to recount events that happened before the story's primary sequence of events to fill in crucial backstory. In the opposite direction, a

flashforward (or prolepsis) reveals events that will occur in the future. Both flashback and flashforwardare used to cohere a story, develop a character, or add structure to the narrative. In literature, **internal analepsis** is a flashback to an earlier point in the narrative; **external analepsis** is a flashback to a time before the narrative started.

In film, flashbacks depict the subjective experience of a character by showing a memory of a previous event and they are often used to "resolve an enigma". Flashbacks are important in film noir and melodrama films. In films and television, several camera techniques, editing approaches and special effects have evolved to alert the viewer that the action shown is a flashback or flashforward; for example, the edges of the picture may be deliberately blurred, photography may be jarring or choppy, or unusual coloration or sepia tone, or monochrome when most of the story is in full color, may be used. The scene may fade or dissolve, often with the camera focused on the face of the character and there is typically a voice-over by a narrator (who is often, but not always, the character who is experiencing the memory).

Notable examples

Literature

An early example of analepsis is in the *Ramayana* and *Mahabharata*, where the main story is narrated through a frame story set at a later time. Another early use of this device in a murder mystery was in "The Three Apples", an *Arabian Nights* tale. The story begins with the discovery of a young

woman's dead body. After the murderer later reveals himself, he narrates his reasons for the murder in a series of flashbacks leading up to the discovery of her dead body at the beginning of the story. Flashbacks are also employed in several other *Arabian Nights* tales such as "Sinbad the Sailor" and "The City of Brass".

Analepsiswas used extensively by author Ford Madox Ford, and by poet, author, historian and mythologist Robert Graves. The 1927 book *The Bridge of San Luis Rey* by Thornton Wilder is the progenitor of the modern disaster epic in literature and film-making, where a single disaster intertwines the victims, whose lives are then explored by means of flashbacks of events leading up to the disaster. Analepsis is also used in *Night* by Elie Wiesel. If flashbacks are extensive and in chronological order, one can say that these form the present of the story, while the rest of the story consists of flash forwards. If flashbacks are presented in non-chronological order, the time at which the story takes place can be ambiguous: An example of such an occurrence is in *Slaughterhouse-Five* where the narrative jumps back and forth in time, so there is no actual present time line. *OsLusíadas* is a story about voyage of Vasco da Gama to India and back. The narration starts when they were arriving in Africa but it quickly flashes back to the beginning of the story which is when they were leaving Portugal.

The *Harry Potter* series employs a magical device called a Pensieve, which changes the nature of flashbacks from a mere narrative device to an event directly experienced by the characters, who are thus able to provide commentary.

Film

The creator of the flashback technique in cinema was *Histoire d'un crime* directed by Ferdinand Zecca in 1901. Flashbacks were first employed during the sound era in RoubenMamoulian's 1931 film *City Streets*, but were rare until about 1939 when, in William Wyler's *Wuthering Heights* as in Emily Brontë's original novel, the housekeeper Ellen narrates the main story to overnight visitor Mr. Lockwood, who has witnessed Heathcliff's frantic pursuit of what is apparently a ghost. More famously, also in 1939, Marcel Carné's film *Le Jour Se Lève*is told almost entirely through flashback: the story starts with the murder of a man in a hotel. While the murderer, played by Jean Gabin, is surrounded by the police, several flashbacks tell the story of why he killed the man at the beginning of the film.

One of the most famous examples of a flashback is in the Orson Welles' film *Citizen Kane* (1941). The protagonist, Charles Foster Kane, dies at the beginning, uttering the word *Rosebud*. The remainder of the film is framed by a reporter's interviewing Kane's friends and associates, in a futile effort to discover what the word meant to Kane. As the interviews proceed, pieces of Kane's life unfold in flashback, but Welles' use of such unconventional flashbacks was thought to have been influenced by William K. Howard's *The Power and the Glory*. Lubitsch used a flashback in *Heaven Can Wait* (1943) which tells the story of Henry Van Cleve. Though usually used to clarify plot or backstory, flashbacks can also act as an unreliable narrator. The multiple and contradictory staged reconstructions of a crime in Errol Morris's 1988 documentary *The Thin Blue Line* are presented as flashbacks based on

divergent testimony. Akira Kurosawa's 1950 *Rashomon* does this in the most celebrated fictional use of contested multiple testimonies.

Sometimes a flashback is inserted into a film even though there was none in the original source from which the film was adapted. The 1956 film version of Rodgers and Hammerstein's stage musical *Carousel* used a flashback device which somewhat takes the impact away from a very dramatic plot development later in the film. This was done because the plot of *Carousel* was then considered unusually strong for a film musical. In the film version of *Camelot* (1967), according to Alan Jay Lerner, a flashback was added not to soften the blow of a later plot development but because the stage show had been criticized for shifting too abruptly in tone from near-comedy to tragedy.

In Billy Wilder's film noir*Double Indemnity* (1944), a flashback from the main character is used to provide a confession to his fraudulent and criminal activities. Fish & Cat is the first single-shot movie with several flashbacks.

A good example of both flashback and flashforward is the first scene of *La Jetée* (1962). As we learn a few minutes later, what we are seeing in that scene is a flashback to the past, since the present of the film's diegesis is a time directly following World War III. However, as we learn at the very end of the film, that scene also doubles as a prolepsis, since the dying man the boy is seeing is, in fact, himself. In other words, he is proleptically seeing his own death. We thus have an analepsis and prolepsis in the very same scene.

Occasionally, a story may contain a flashback within a flashback, with the earliest known example appearing in Jacques Feyder's*L'Atlantide*. *Little Annie Rooney* (1925) contains a flashback scene in a Chinese laundry, with a flashback within that flashback in the corner of the screen. In John Ford's *The Man Who Shot Liberty Valance* (1962), the main action of the film is told in flashback, with the scene of Liberty Valance's murder occurring as a flashback within that flashback. Other examples that contains flashbacks within flashbacks are the 1968 Japanese film*Lone Wolf Isazo* and 2004's *The Phantom of the Opera*, where almost the entire film (set in 1870) is told as a flashback from 1919 (in black-and-white) and contains other flashbacks; for example, Madame Giry rescuing the Phantom from a freak show. An extremely convoluted story may contain flashbacks within flashbacks within flashbacks, as in *Six Degrees of Separation*, *Passage to Marseille*, and *The Locket*.

This technique is a hallmark of Kannada movie director Upendra. He has employed this technique in his movies - *Om* (1995), *A*(1998) and the futuristic flick *Super* (2010) - set in 2030 containing multiple flashbacks ranging from 2010 to 2015 depicting a Utopian India.

Satyajit Ray experimented with flashbacks in *The Adversary* (Pratidwandi, 1972), pioneering the technique of photo-negative flashbacks. He also uses flashbacks in other films such as Nayak (1966), Kapurush- O - Mahapurush(1965), Aranyer Din Ratri (1970), Jalsaghar(1959). In fact, in Nayak, the entire film proceeds in a non linear narrative which explores the Hero (Arindam's) past through seven flashbacks

and two dreams. He also uses extensive flashbacks in the Kanchenjunga (1962).

Quentin Tarantino makes extensive use of the flashback and flashforward in many of his films. In *Reservoir Dogs* (1992), for example, scenes of the story present are intercut with various flashbacks to give each character's backstory and motivation additional context. In *Pulp Fiction* (1994), which uses a highly nonlinear narrative, traditional flashback is also used in the sequence titled "The Gold Watch". Other films, such as his two-part *Kill Bill* (Part I 2003, Part II 2004), also feature a narrative that bounces between present time and flashbacks.

Television

The television series *Quantico*, *Kung Fu*, *Psych*, *How I Met Your Mother*, *Grounded for Life*, *Once Upon a Time*, and *I Didn't Do It* use flashbacks in every episode. Flashbacks were also a predominant feature of the television shows *Lost*, *Arrow*, Phineas and Ferb, *Orange Is the New Black*, *13 Reasons Why*, *Elite* and *Quicksand*. Many detective shows routinely use flashback in the last act to reveal the culprit's plot, e.g. *Murder, She Wrote*, *Banacek,Columbo.*

The anime *Inuyasha* uses flashbacks that take one back half a century ago in the two-part episode "The Tragic Love Song of Destiny" in the sixth season narrated by the elderly younger sister of Lady Kikyo, Lady Kaede; Episodes 147 and 148.

In *Princess Half-Demon*, the ongoing spinoff to the anime stated above, the premiere takes us back eighteen years ago, five months since the conclusion of the original series' seventh season. Episode Fifteen "Farewell Under the Lunar Eclipse" is

narrated by Riku that explains what had happened before and right after the Half-Demon Princesses were born; namely where Inuyasha and nineteen-year-old Kagome Higurashi had ended up, trapped within the Black Pearl at the border of the afterlife for fourteen long years.

The 2D hand-drawn animated show *Tangled* (later renamed *Rapunzel's Tangled Adventure*) for its second and third seasons) began showing flashbacks set a quarter of a century ago in the Dark Kingdom, where the heavenly Moonstone resides within for hundreds of years in the second season's premiere "Beyond the Walls of Corona", "Rapunzel and the Great Tree" and the finale "Destinies Collide."

The Nickelodeon animated show *Mysticons* ninth episode "The Astromancer Job" had a flashback set one millennium ago, revealing how Imani Firewing, the original Mysticon Dragon Mage, had beaten Queen Necrafa of the Undead, and how her devoted henchman General Bane was transformed into "Dreadbane" through contact with the lich queen's necklace.

Flashforward

A **flashforward** (also spelled **flash-forward**, and more formally known as **prolepsis**) is a scene that temporarily takes the narrative forward in time from the current point of the story in literature, film, television and other media. Flashforwardsare often used to represent events expected, projected, or imagined to occur in the future. They may also reveal significant parts of the story that have not yet occurred, but soon will in greater detail. It is similar to foreshadowing, in which future events are not shown but rather implicitly hinted at. It is also similar

to an ellipsis, however an ellipsis takes the narrative forward and is intended to skim over boring or uninteresting details, for example the aging of a character. It is primarily a postmodernnarrative device, named by analogy to the more traditional flashback, which reveals events that occurred in the past.

Examples in literature

An early example of prolepsis which predates the postmodern period is Charles Dickens' novel *A Christmas Carol*, in which the protagonist Ebenezer Scrooge is shown the future following his death. The subsequent events of the story imply that this future will be averted by this foreknowledge.

Terry Brooks' *Word & Void* series features a protagonist who, when he sleeps, moves forwards and backwards through time to before and after a great cataclysm. This is both analepsis and prolepsis.

Muriel Spark makes extensive use of prolepsis in her novel *The Prime of Miss Jean Brodie*. In Boruto: Naruto Next Generations, the protagonist BorutoUzumaki faces an enemy named Kawaki in a ruined Hidden Leaf Village in the opening scene of the anime and manga series

Examples in television

Every season of *Damages* makes an extensive use of flashforwards, revealing the outcome of the season to the viewer. The whole season then revolves around discovering the

circumstances that led to this outcome. For instance, the first season starts with a flashforward of the protagonist, Ellen Parsons, running in the streets of New York, covered in blood. 6 months earlier, she was only a naive young woman who had just become a lawyer in the firm of a powerful attorney, Patty Hewes. What led Ellen to the situation presented in the flashforwards is revealed little by little throughout the season. Furthermore, the series is known for its misleading use of flashforwards, which are often examples of the red herring device.

After making extensive use of flashbacks in the first two seasons, the TV series *Lost* started using flashforwards as well throughout the remainder of the series. The first instance of this was a major plot twist in the third season finale: what appeared to be a flashback to before the characters were stranded on the island, was revealed at the end of the two-part episode to be a flashforward of them returned to civilization. A later episode featured what appeared to be flashforwards involving the couple Jin and Sun, showing them safely returned home and awaiting the birth of their baby, but it is then revealed that Jin's scenes were flashbacks and only Sun's were flashforwards (reflecting the fact that they are separated in time and space).

The series finale of *Star Trek: Voyager*, "Endgame", uses a technique similar to a flashforward. It depicts a future in which the U.S.S. *Voyager* has returned home after decades lost in deep space with various personal tragedies, prompting the ship's captain to use time travel to return to the timeframe of the series and return the crew home more directly.

The U.S. sci-fi TV series *FlashForward* revolves around everyone on Earth losing consciousness for 137 seconds, during which each person experiences a glimpse of events 6 months in the future. The series was itself based loosely on the novel Flashforward by Robert J. Sawyer.

British soap opera *Hollyoaks* flashed forward six months in May 2010 for a special episode.

The last episode of *Six Feet Under* ends with an extensive flashforward depicting the deaths of all the central characters for several decades in the future.

Breaking Bad uses flashforwards throughout its second season showing a mystery regarding debris and corpses in Walter White's house and neighborhood, revealed to be the result of two planes crashing overhead. The first half of the fifth season begins with a flashforward one year into the future where Walter is fifty-two years old, and the second half begins with a continuation of the story, where he returns to his abandoned home. The plot of these flashforwardsis resumed in the series finale.

Better Call Saul, a spin-off of *Breaking Bad*, follows a trend of starting each season with a flashforward scene, set after the events of *Breaking Bad* (and thus several years in the future relative to the time frame of the events narrated in *Better Call Saul*), and shot in black and white.

How to Get Away with Murder used in every episode flashforwards of scenes from future episodes until ninth episode of the first season.

Quantico used flashforwards in order to unravel the future events that have occurred in the first and second season.

The Netflix series *Elite* used flashforwards to unravel the murder mystery of a future event, in the first season.

The Netflix series *Quicksand* used flashforwards to unravel the circumstances leading to a school shooting, in the first season.

The CW series *Arrow* utilizes flashforwards in its seventh season, having previously employed extensive flashbacks for its first five seasons. There are also flashforwards throughout the fourth season foreshadowing the character Laurel Lance's death.

Hollyoaks has a flashforward to New Year's Eve 2020 to see where the characters are in a year's time.

Examples in film

Midway through the film *They Shoot Horses, Don't They?*, there is an abrupt flashforward when Robert, the character played by Michael Sarrazin, is seen being thrust into a jail cell by a police officer, even though he has done nothing to provoke such treatment. The audience is notified, later in the story, that Sarrazin's character would have indeed made choices that warrant his arrest.

The film *Arrival* relies extensively on prolepsis throughout the movie, disguised as flashbacks (like the aforementioned episode of *Lost*). The main character gains precognitive ability after learning the language of the aliens, and proceeds to use it

to prevent the outbreak of war. She uses information revealed to her in the future to convince a military leader not to attack the aliens in the present.

Examples in video games

In *Until Dawn*, players may find artifacts left by the Native American tribe who lived on the mountain that show premonitions of possible future events. Whether they come true is dependent on player actions; for example, one shows another character's death in a scene that can be avoided.

Foreshadowing

Foreshadowing is a literary device in which a writer gives an advance hint of what is to come later in the story. Foreshadowing often appears at the beginning of a story, or a chapter, and it helps the reader develop expectations about the upcoming events.

A writer may implement foreshadowing in many different ways. Some of these ways include: character dialogues, plot events, and changes in setting. Even the title of a work or a chapter can act as a clue that suggests what is going to happen. Foreshadowing in fiction creates an atmosphere of suspense in a story, so that the readers are interested and want to know more.

This literary device is generally used to build anticipation in the minds of readers about what might happen next, thus adding dramatic tension to a story. Moreover, foreshadowing

can make extraordinary and bizarre events appear credible, some events are predicted in order to make the audience feel anticipated for them.

Hints may be about future events, character revelations, and plot twists to create mood, convey theme and building suspense, usually to hint the good events that will likely cross paths or happen to the main character later on.

Plot can be delayed by situations or events to give the impression that something momentous will occur to build anticipation and emphasize importance to them, giving the audience a series of questions particularly after cliff hangers.

This literary device is frequently adapted for use by composers of theatrical music, in the composition of operas, musicals, radio, film, television, gaming, podcast, and internet scores and underscores, and incidental music for spoken theatrical productions.

Conceptions

Foreshadowing can be accomplished by the use of story-driven or fictional events which can bring original dialogue, emotional investment in the plot, such as for the main character, unknown and present characters.

- A flashback is the interruption of a sequential narrative plot to present important events that have happened in the past to present plot points that are difficult to bring into the narrative, such as

character traits, events, or themes which may drive the current narrative or to be revealed.

- Flash-forward, moving the plot forward in time where formerly revealed or new character traits, events, or themes of the past or present are brought into the story. Themes that can be flash-forwards are shown to embellish past or current plot points.

Misconceptions

Foreshadowing is often confused with other literary techniques. Some of these techniques include:

- A "red herring", is a hint that is designed to mislead the audience. However, foreshadowing only hints at a possible outcome within the confinement of a narrative, and knowingly leads readers in the right direction.
- A "flashforward" is a scene that takes the narrative forward in time from the current point of the story in literature, film, television, and other media. Foreshadowing is sometimes employed through characters' explicitly predicting the future. Flash-forward occurs when scenes are shown out of chronological order in a nonlinear narrative, and chronology is inconsistent in an anachronist order such as to get the reader or audience thinking about the climax or reveals.
- The "Chekhov's gun", everything superfluous must be deleted.

By analogy to foreshadowing, the literary critic Gary Morson describes its opposite, **sideshadowing**. Found notably in the epic novels of Leo Tolstoy and Fyodor Dostoevsky, it is the practice of including scenes that turn out to have no relevance to the plot. This, according to Morson, increases the verisimilitude of the fiction because the audience knows that in real life, unlike in novels, most events are in fact inconsequential. This "sense of structurelessness" invites the audience to "interpret and question the events that actually do come to pass".

Frame story

A **frame story** (also known as a **frame tale**, **frame narrative**, **sandwich narrative** or **intercalation**) is a literary technique that serves as a companion piece to a story within a story, where an introductory or main narrative sets the stage either for a more emphasized second narrative or for a set of shorter stories. The frame story leads readers from a first story into one or more other stories within it. The frame story may also be used to inform readers about aspects of the secondary narrative(s) that may otherwise be hard to understand. This should not be confused with narrative structure.

Origins

Some of the earliest frame stories are from ancient Egypt, including one in the Papyrus Westcar, the *Tale of the Shipwrecked Sailor*, and *The Eloquent Peasant*. Other early examples are from Indian literature, including the Sanskrit epics*Mahabharata*, *Ramayana*, *Panchatantra*, Syntipas's*The*

Seven Wise Masters, and the fable collections *Hitopadesha* and *Vikram and The Vampire*. This form gradually spread west through the centuries and became popular, giving rise to such classic frame tale collections as the *One Thousand and One Nights* (*Arabian Nights*), *The Decameron*, and the *Canterbury Tales*, in which each pilgrim tells his own kind of tale, and whose frame story "was once the most admired part of Chaucer's work".

The use of a frame story in which a single narrative is set in the context of the telling of a story is also a technique with a long history, dating back at least to the beginning section of Homer's *Odyssey*, in which the narrator Odysseus tells of his wandering in the court of King Alcinous.

A set of stories

A frame story is a literary device that acts as a convenient conceit to organize a set of smaller narratives, either devised by the author or taken from a previous stock of popular tales, slightly altered by the author for the purpose of the longer narrative. Sometimes a story within the main narrative encapsulates some aspect of the framing story, in which case it is called a *miseen abyme*.

A typical frame story is *One Thousand and One Nights*, in which the character Shahrazad narrates a set of fairy tales to the Sultan Shahriyar over many nights. Many of Shahrazad's tales are also frame stories, such as *Tale of Sindbad the Seaman and Sindbad the Landsman*, a collection of adventures related by Sindbad the Seaman to Sindbad the Landsman.

Ovid's *Metamorphoses* makes extensive use of framing, with the stories nested several deep, allowing the inclusion of many different tales in one work. Emily Brontë's*Wuthering Heights* uses this literary device to tell the story of Heathcliff and Catherine, along with the subplots. Her sister Anne uses this device in her epistolary novel*The Tenant of Wildfell Hall*. The main heroine's diary is framed by the narrator's story and letters. Mary Shelley's novel *Frankenstein* has multiple framed narratives. In the book, Robert Walton writes letters to his sister, describing the story told to him by the scientist Victor Frankenstein. Frankenstein's story contains the monster's story, and its story even briefly contains the tale of a family whom he had been observing.

Frame stories have appeared in comic books. Neil Gaiman's comic book series *The Sandman* featured a story arc called *Worlds End* which consisted of frame stories, and sometimes even featured stories within stories within stories.

Sometimes, as in Washington Irving's *Sketch Book*, which contains "The Legend of Sleepy Hollow" and "Rip Van Winkle" among others, the conceit is that the author of the book is not the real author but a fictional character, in this case a man named Crayon. Here the frame includes the world of the imagined Crayon, his stories, and the reader who is assumed to play along and "know" who Crayon is.

Single story

When there is a single story, the frame story is used for other purposes – chiefly to position the reader's attitude toward the tale. This can be done in a variety of ways.

Casting doubt on the narrator

A common reason to frame a single story is to draw attention to the narrator's unreliability. By explicitly making the narrator a character within the frame story, the writer distances him or herself from the narrator. The writer may characterize the narrator to cast doubt on the narrator's truthfulness, as when in P. G. Wodehouse's stories of MrMulliner, Mulliner is made a fly fisherman, a person who is expected to tell tales of unbelievably large fish. The movie *Amadeus*is framed as a story an old Antonio Salieri tells to a young priest, because the movie is based more on stories Salieri told about Mozart than on historical fact.

Procatalepsis

Another use is a form of procatalepsis, where the writer puts the readers' possible reactions to the story in the characters listening to it.

In *The Princess Bride* the frame of a grandfather reading the story to his reluctant grandson puts the cynical reaction a viewer might have to the romantic fairytale into the story in the grandson's persona, and helps defuse it.

This is the use when the frame tells a story that lacks a strong narrative hook in its opening; the narrator can engage the reader's interest by telling the story to answer the curiosity of his listeners, or by warning them that the story began in an ordinary seeming way, but they must follow it to understand later actions, thereby identifying the reader's wondering whether the story is worth reading to the listeners'.Such an

approach was used, too, by Edith Wharton in her novella Ethan Frome, in which a nameless narrator hears from many characters in the town of Starkfield about the main character Ethan's story.

Dream vision

A specialized form of the frame is a dream vision, where the narrator claims to have gone to sleep, dreamed the events of the story, and then awoken to tell the tale. In medieval Europe, this was a common device, used to indicate that the events included are fictional; Geoffrey Chaucer used it in *The Book of the Duchess*, *The House of Fame*, *Parlement of Foules*, and *The Legend of Good Women* (the last also containing a multi-story frame story within the dream). In modern usage, it is sometimes used in works of fantasy as a means toward suspension of disbelief about the marvels depicted in the story. J.R.R. Tolkien, in his essay "On Fairy-Stories" complained of such devices as unwillingness to treat the genre seriously; he used frame stories of different kinds in his Middle-earth writings. Lewis Carroll's *Alice* stories (*Alice's Adventures in Wonderland* and *Through the Looking-Glass*) includes such a frame, the stories themselves using dream-like logic and sequences. The writer John Bunyan used a dream device in the Christian allegory Pilgrim's Progress and its sequel, explaining that they were dreams he had while he was in prison and felt God wanted him to write down. This worked because it made what might have been seen as a fantasy more like a divine revelation to others who believed as he did.

Still, even when the story proceeds realistically, the dream frame casts doubt on the events. In the book *The Wonderful*

Wizard of Oz, the events really occur; the dream frame added for the movie detracts from the validity of the fantasy.

Use

To be a frame narrative, the story must act primarily as an occasion for the telling of other stories. For example, Odysseus narrates much of the *Odyssey* to the Phaeacians, but, even though this recollection forms a great part of the poem, the events after and before the interpolated recollection are of greater interest than the memory.

A film that plays with frame narrative is the 1994 *Forrest Gump*. Most of it is narrated by Forrest to various companions on the park bench. However, in the last fifth or so of the film, Forrest gets up and leaves the bench, and we follow him as he meets with Jenny and her son. This final segment suddenly has no narrator unlike the rest of the film that came before it, but is instead told through Forrest and Jenny's dialogues.

This approach is also demonstrated in the 2008 film *Slumdog Millionaire* (adapted from the 2005 novel *Q & A*), about a poor street kid named Jamal who comes close to winning *Kaun Banega Crorepati* (the Indian equivalent of *Who Wants to Be a Millionaire?*) but finds himself accused of cheating. Most of the story is narrated at a police station by Jamal, who explains how he knew the answers to each of the questions as the show is played back on video. The show itself then serves as another framing device, as Jamal sees flashbacks of his past as each question is asked. The last portion of the film then unfolds without any narrator.

Compared to reprise

In musical sonata form or rondo, a reprised theme occurs at the beginning and end of the work, or returns periodically. A framing device may take the form of a recurrent element at the beginning and end of the narrative. For example, a story may begin with a character visiting a park under one set of circumstances, then returning at the end to the same park under a different set of circumstances, having undergone a change that allows him or her to see the park in a new light.

A framing device might simply be a defining image of the narrative or art that is used at the beginning and end of the work, as in the film *Chariots of Fire* which begins and ends with the characters running along a beach, accompanied at both times by the movie's famous theme music. This scene, although chronologically in the middle of the film and unimportant to the straightforward plot, serves to convey a defining emotion and tone that sets the context for the main story.

Story within a story

A **story within a story**, also referred to as an **embedded narrative**, is a literary device in which a character within a story becomes the narrator of a second story (within the first one). Multiple layers of stories within stories are sometimes called**nested stories**. A play may have a brief play within it, such as Shakespeare's play *Hamlet*; a film may show the characters watching a short film; or a novel may contain a short story within the novel. A story within a story can be used

in all types of narration: novels, short stories, plays, television programs, films, poems, songs, and philosophical essays.

The inner stories are told either simply to add entertainment or more usually to act as an example to the other characters. In either case, the inner story often has a symbolic and psychological significance for the characters in the outer story. There is often some parallel between the two stories, and the fiction of the inner story is used to reveal the truth in the outer story. Often the stories within a story are used to satirize views, not only in the outer story, but also in the real world. When a story is told within another instead of being told as part of the plot, it allows the author to play on the reader's perceptions of the characters—the motives and the reliability of the storyteller are automatically in question.

Stories within a story may disclose the background of characters or events, tell of myths and legends that influence the plot, or even seem to be extraneous diversions from the plot. In some cases, the story within a story is involved in the action of the plot of the outer story. In others, the inner story is independent, so that it can either be skipped over or be read separately, although many subtle connections may be lost. Sometimes, the inner story serves as an outlet for discarded ideas that the author deemed to be of too much merit to leave out completely, somewhat analogous to the inclusion of deleted scenes with home video releases of films. Often there is more than one level of internal stories, leading to deeply-nested fiction. *Miseen abyme* is the French term for a similar literary device (also referring to the practice in heraldry of placing the image of a small shield on a larger shield).

Frame stories and anthology works

The literary device of stories within a story dates back to a device known as a "frame story", where a supplemental story is used to help tell the main story. Typically, the outer story or "frame" does not have much matter, and most of the work consists of one or more complete stories told by one or more storytellers.

The earliest examples of "frame stories" and "stories within stories" were in ancient Egyptian and Indian literature, such as the Egyptian "Tale of the Shipwrecked Sailor" and Indian epics like the *Ramayana*, *Seven Wise Masters*, *Hitopadesha* and *Vikram and the Vampire*. In Vishnu Sarma's*Panchatantra*, an inter-woven series of colorful animal tales are told with one narrative opening within another, sometimes three or four layers deep, and then unexpectedly snapping shut in irregular rhythms to sustain attention. In the epic *Mahabharata*, the Kurukshetra War is narrated by a character in Vyasa's *Jaya*, which itself is narrated by a character in Vaisampayana's *Bharata*, which itself is narrated by a character in Ugrasrava's*Mahabharata*.

Both *The Golden Ass* by Apuleius and *Metamorphoses* by Ovid extend the depths of framing to several degrees. Another early example is the *One Thousand and One Nights* (*Arabian Nights*), where the general story is narrated by an unknown narrator, and in this narration the stories are told by Scheherazade. In many of Scheherazade's narrations, there are also stories narrated, and even in some of these, there are some other stories. An example of this is "The Three Apples", a murder mystery narrated by Scheherazade. Within the story, after the

murderer reveals himself, he narrates a flashback of events leading up to the murder. Within this flashback, an unreliable narrator tells a story to mislead the would-be murderer, who later discovers that he was misled after another character narrates the truth to him. As the story concludes, the "Tale of Núr al-DínAlí and his Son" is narrated within it. This perennially popular work can be traced back to Arabic, Persian, and Indian storytelling traditions.

Mary Shelley's *Frankenstein* has a deeply nested frame story structure, that features the narration of Walton, who records the narration of Victor Frankenstein, who recounts the narration of his creation, who narrates the story of a cabin dwelling family he secretly observes. Another classic novel with a frame story is *Wuthering Heights*, the majority of which is recounted by the central family's housekeeper to a boarder. Similarly, Roald Dahl's story *The Wonderful Story of Henry Sugar* is about a rich bachelor who finds an essay written by someone who learned to "see" playing cards from the reverse side. The full text of this essay is included in the story, and itself includes a lengthy sub-story told as a true experience by one of the essay's protagonists, Imhrat Khan.

Chaucer's *The Canterbury Tales* and Boccaccio's *Decameron* are also classic frame stories. In Chaucer's *Canterbury Tales*, the characters tell tales suited to their personalities and tell them in ways that highlight their personalities. The noble knight tells a noble story, the boring character tells a very dull tale, and the rude miller tells a smutty tale. Homer's *Odyssey* too makes use of this device; Odysseus' adventures at sea are all narrated by Odysseus to the court of king Alcinous in Scheria. Other shorter tales, many of them false, account for much of

the *Odyssey*. Many modern children's story collections are essentially anthology works connected by this device, such as Arnold Lobel's*Mouse Tales*, Paula Fox's *The Little Swineherd*, and Phillip and Hillary Sherlock's *Ears and Tails and Common Sense*. A well-known modern example of framing is the fantasy genre work *The Princess Bride* (both the book and the movie). In the movie, a grandfather is reading the story of "The Princess Bride" to his grandson. In the book, a more detailed frame story has a father editing a much longer (but fictive) work for his son, creating his own "Good Parts Version" (as the book called it) by leaving out all the parts that would bore or displease a young boy. Both the book and the movie assert that the central story is from a book called "The Princess Bride" by a nonexistent author named S. Morgenstern.

In the Welsh novel, *AelwydF'Ewythr Robert* (1852) by GwilymHiraethog, a visitor to a farm in north Wales tells the story of *Uncle Tom's Cabin* to those gathered around the hearth. Sometimes a frame story exists in the same setting as the main story. On the television series *The Young Indiana Jones Chronicles*, each episode was framed as though it were being told by Indy when he was older (usually acted by George Hall, but once by Harrison Ford). The same device of an adult narrator representing the older version of a young protagonist is used in the films *Stand By Me* and *A Christmas Story*, and the television show *The Wonder Years* and *How I Met Your Mother*.

Frame stories in music

In *The Amory Wars*, a tale told through the music of Coheed and Cambria, tells a story for the first two albums but reveals

that the story is being actively written by a character called the Writer in the third. During the album, the Writer delves into his own story and kills one of the characters, much to the dismay of the main character. The critically acclaimed Beatles album *Sgt. Pepper's Lonely Hearts Club Band* is presented as a stage show by the fictional eponymous band, and one of its songs, "A Day in the Life" is in the form of a story within a dream. Similarly, the Fugees album *The Score* is presented as the soundtrack to a fictional movie, as are several other notable concept albums, while Wyclef Jean's *The Carnival* is presented as testimony at a trial. The majority of Ayreon's albums outline a sprawling, loosely interconnected science fiction narrative, as do the albums of Janelle Monae. On Tom Waits's concept album, *Alice* (consisting of music he wrote for the musical of the same name) most of the songs are (very) loosely inspired by both *Alice in Wonderland* and the book's real life author, Lewis Carroll, and inspiration Alice Liddell. The song "Poor Edward," however, is presented as a story told by a narrator about Edward Mordrake, and the song "Fish and Bird" is presented as a retold story that the narrator heard from a sailor.

Examples of nested stories by type

Nested books

In his 1895 historical novel*Pharaoh*, BolesławPrus introduces a number of stories within the story, ranging in length from vignettes to full-blown stories, many of them drawn from ancient Egyptiantexts, that further the plot, illuminate characters, and even inspire the fashioning of individual

characters. Jan Potocki's*The Manuscript Found in Saragossa* (1797–1805) has an interlocking structure with stories-within-stories reaching several levels of depth.

The provenance of the story is sometimes explained internally, as in *The Lord of the Rings* by J. R. R. Tolkien, which depicts the Red Book of Westmarch (a story-internal version of the book itself) as a history compiled by several of the characters. The subtitle of *The Hobbit* ("There and Back Again") is depicted as part of a rejected title of this book within a book, and *The Lord of the Rings* is a part of the final title.

An example of an interconnected inner story is "The Mad Trist" in Edgar Allan Poe's *Fall of the House of Usher*, where through somewhat mystical means the narrator's reading of the story within a story influences the reality of the story he has been telling, so that what happens in "The Mad Trist" begins happening in "The Fall of the House of Usher".Also, in *Don Quixote* by Miguel de Cervantes, there are many stories within the story that influence the hero's actions (there are others that even the author himself admits are purely digressive).

A commonly independently anthologised story is "The Grand Inquisitor" by Dostoevsky from his long psychological novel*The Brothers Karamazov*, which is told by one brother to another to explain, in part, his view on religion and morality. It also, in a succinct way, dramatizes many of Dostoevsky's interior conflicts.

An example of a "bonus material" style inner story is the chapter "The Town Ho's Story" in Herman Melville's novel *Moby-Dick*; that chapter tells a fully formed story of an exciting mutiny and contains many plot ideas that Melville had

conceived during the early stages of writing *Moby-Dick*—ideas originally intended to be used later in the novel—but as the writing progressed, these plot ideas eventually proved impossible to fit around the characters that Melville went on to create and develop. Instead of discarding the ideas altogether, Melville wove them into a coherent short story and had the character Ishmael demonstrate his eloquence and intelligence by telling the story to his impressed friends.

One of the most complicated structures of a story within a story was used by Vladimir Nabokov in his novel *The Gift*. There, as inner stories, function both poems and short stories by the main character Fyodor Cherdyntsev as well as the whole Chapter IV, a critical biography of Nikolay Chernyshevsky (also written by Fyodor). This novel is considered one of the first metanovels in literature.

With the rise of literary modernism, writers experimented with ways in which multiple narratives might nest imperfectly within each other. A particularly ingenious example of nested narratives is James Merrill's 1974 modernist poem "Lost in Translation".

In RabihAlameddine's novel *The Hakawati*, or *The Storyteller*, the protagonist describes coming home to the funeral of his father, one of a long line of traditional Arabic storytellers. Throughout the narrative, the author becomes hakawati (an Arabic word for a teller of traditional tales) himself, weaving the tale of the story of his own life and that of his family with folkloric versions of tales from Qur'an, the Old Testament, Ovid, and One Thousand and One Nights. Both the tales he tells of his family (going back to his grandfather) and the

embedded folk tales, themselves embed other tales, often 2 or more layers deep. In Sue Townsend's *Adrian Mole: The Wilderness Years*, Adrian writes a book entitled *Lo! The Flat Hills of My Homeland*, in which the main character, Jake Westmorland, writes a book called *Sparg of Kronk*, whose eponymous character, Sparg, writes a book with no language.

In Anthony Horowitz's *Magpie Murders*, a significant proportion of the book features a fictional but authentically formatted mystery novel by Alan Conway, titled 'Magpie Murders'. The secondary novel ends before its conclusion returning the narrative to the original, and primary, story where the protagonist and reviewer of the book attempts to find the final chapter. As this progresses characters and messages within the fictional 'Magpie Murders' manifest themselves within the primary narrative and the final chapter's content reveals the reason for its original absence.

Dreams are a common way of including stories inside stories, and can sometimes go several levels deep. Both the book *The Arabian Nightmare* and the curse of "eternal waking" from the Neil Gaiman series *The Sandman* feature an endless series of waking from one dream into another dream. In Charles Maturin's novel *Melmoth the Wanderer*, the use of vast stories-within-stories creates a sense of dream-like quality in the reader.

Religion and philosophy

This structure is also found in classic religious and philosophical texts. The structure of *The Symposium* and *Phaedo*, attributed to Plato, is of a story within a story within a

story. In the Christian Bible, the gospels are accounts of the life and ministry of Jesus. However, they also include within them the parables that Jesus told. In more modern philosophical work,JosteinGaarder's books often feature this device. Examples are *The Solitaire Mystery*, where the protagonist receives a small book from a baker, in which the baker tells the story of a sailor who tells the story of another sailor, and *Sophie's World* about a girl who is actually a character in a book that is being read by Hilde, a girl in another dimension. Later on in the book Sophie questions this idea, and realizes that Hilde too could be a character in a story that in turn is being read by another.

Nested science fiction

The experimental modernist works that incorporate multiple narratives into one story are quite often science-fiction or science fiction influenced. These include most of the various novels written by the American author Kurt Vonnegut. Vonnegut includes the recurring character Kilgore Trout in many of his novels. Trout acts as the mysterious science fiction writer who enhances the morals of the novels through plot descriptions of his stories. Books such as *Breakfast of Champions* and *God Bless You, Mr. Rosewater*are sprinkled with these plot descriptions. StanisławLem's*Tale of the Three Storytelling Machines of King Genius* from *The Cyberiad* has several levels of storytelling. All levels tell stories of the same person, Trurl.

House of Leaves is the tale of a man who finds a manuscript telling the story of a documentary that may or may not have ever existed, contains multiple layers of plot. The book

includes footnotes and letters that tell their own stories only vaguely related to the events in the main narrative of the book, and footnotes for fake books.

Robert A. Heinlein's later books (*The Number of the Beast*, *The Cat Who Walks Through Walls* and *To Sail Beyond the Sunset*) propose the idea that every real universe is a fiction in another universe. This hypothesis enables many writers who are characters in the books to interact with their own creations. Margaret Atwood's novel *The Blind Assassin* is interspersed with excerpts from a novel written by one of the main characters; the novel-within-a-novel itself contains a science fiction story written by one of *that* novel's characters.

In Philip K. Dick's novel *The Man in the High Castle*, each character comes into interaction with a book called *The Grasshopper Lies Heavy*, which was written by the Man in the High Castle. As Dick's novel details a world in which the Axis Powers of World War II had succeeded in dominating the known world, the novel within the novel details an alternative to this history in which the Allies overcome the Axis and bring stability to the world – a victory which itself is quite different from real history.

In *Red Orc's Rage* by Philip J. Farmer a doubly recursive method is used to intertwine its fictional layers. This novel is part of a science-fiction series, the *World of Tiers*. Farmer collaborated in the writing of this novel with an American psychiatrist, Dr. A. James Giannini. Dr. Giannini had previously used the World of Tiers series in treating patients in group therapy. During these therapeutic sessions, the content and process of the text and novelist was discussed rather than

the lives of the patients. In this way subconscious defenses could be circumvented. Farmer took the real life case-studies and melded these with adventures of his characters in the series.

The *Quantum Leap* novel *Knights of the Morningstar* also features a character who writes a book by that name. In Matthew Stover's novel *Shatterpoint*, the protagonist Mace Windu narrates the story within his journal, while the main story is being told from the third-person limited point of view.

Several *Star Trek* tales are stories or events within stories, such as Gene Roddenberry's novelization of *Star Trek: The Motion Picture*, J. A. Lawrence's *Mudd's Angels*, John M. Ford's *The Final Reflection*, Margaret Wander Bonanno's*Strangers from the Sky* (which adopts the conceit that it is book from the future by an author called Gen Jaramet-Sauner), and J. R. Rasmussen's "Research" in the anthology *Star Trek: Strange New Worlds II*.Steven Barnes's novelization of "Far Beyond the Stars" partners with Greg Cox's *The Eugenics Wars: The Rise and Fall of Khan Noonien Singh* (Volume Two) to tell us that the story "Far Beyond the Stars"—and, by extension, all of *Star Trek* itself—is the creation of 1950s writer Benny Russell.

The book *Cloud Atlas* (later adapted into a film by The Wachowkis and Tom Tykwer) consisted of six interlinked stories nested inside each other in a Russian doll fashion. The first story (that of Adam Ewing in the 1850s befriending an escaped slave) is interrupted halfway through and revealed to be part of a journal being read by composer Robert Frobisher in 1930s Belgium. His own story of working for a more famous composer is told in a series of letters to his lover Rufus

Sixsmith, which are interrupted halfway through and revealed to be in the possession of an investigative journalist named Luisa Rey and so on. Each of the first five tales are interrupted in the middle, with the sixth tale being told in full, before the preceding five tales are finished in reverse order. Each layer of the story either challenges the veracity of the previous layer, or is challenged by the succeeding layer. Presuming each layer to be a true telling within the overall story, a chain of events is created linking Adam Ewing's embrace of the abolitionist movement in the 1850s to the religious redemption of a post-apocalyptic tribal man over a century after the fall of modern civilization. The characters in each nested layer take inspiration or lessons from the stories of their predecessors in a manner that validates a belief stated in the sixth tale that "Our lives are not our own. We are bound to others, past and present and by each crime, and every kindness, we birth our future."

Play or film within a book

The Crying of Lot 49 by Thomas Pynchon has several characters seeing a play called *The Courier's Tragedy* by the fictitious Jacobeanplaywright Richard Wharfinger. The events of the play broadly mirror those of the novel and give the main character, Oedipa Maas, a greater context with which to consider her predicament; the play concerns a feud between two rival mail distribution companies, which appears to be ongoing to the present day, and in which, if this is the case, Oedipa has found herself involved. As in *Hamlet*, the director makes changes to the original script; in this instance, a couplet that was added, possibly by religious zealots intent on giving the play extra moral gravity, are said only on the night that Oedipa sees the

play. From what Pynchon relates, this is the only mention in the play of Thurn and Taxis' rivals' name—Trystero—and it is the seed for the conspiracy that unfurls. A significant portion of Walter Moers' *Labyrinth of Dreaming Books* is an ekphrasis on the subject of an epic puppet theater presentation. Another example is found in Samuel Delany's *Trouble on Triton*, which features a theater company that produces elaborate staged spectacles for randomly selected single-person audiences. Plays produced by the "Caws of Art" theater company also feature in Russell Hoban's modern fable, *The Mouse and His Child*. Raina Telgemeier's best-selling *Drama* is a graphic novel about a middle-school musical production, and the tentative romantic fumblings of its cast members.

In Manuel Puig's*Kiss of the Spider Woman*, ekphrases on various old movies, some real, and some fictional, make up a substantial portion of the narrative. In Paul Russell's *Boys of Life*, descriptions of movies by director/antihero Carlos (loosely inspired by controversial director Pier Paolo Pasolini) provide a narrative counterpoint and add a touch of surrealism to the main narrative. They additionally raise the question of whether works of artistic genius justify or atone for the sins and crimes of their creators.

Nested plays

This dramatic device was probably first used by Thomas Kyd in *The Spanish Tragedy* around 1587, where the play is presented before an audience of two of the characters, who comment upon the action. From references in other contemporary works, Kyd is also assumed to have been the writer of an early, lost version of *Hamlet* (the so-called *Ur-Hamlet*), with a play-within-

a-play interlude. William Shakespeare's *Hamlet* retains this device by having Hamlet ask some strolling players to perform the *Murder of Gonzago*. The action and characters in *The Murder* mirror the murder of Hamlet's father in the main action, and Prince Hamlet writes additional material to emphasize this. Hamlet wishes to provoke the murderer, his uncle, and sums this up by saying "the play's the thing wherein I'll catch the conscience of the king." Hamlet calls this new play *The Mouse-trap* (a title that Agatha Christie later took for the long-running play *The Mousetrap*). Christie's work was parodied in Tom Stoppard's *The Real Inspector Hound*, in which two theater critics are drawn into the murder mystery they are watching. The audience is similarly absorbed into the action in Woody Allen's play *God*, which is about two failed playwrights in Ancient Greece. The phrase *The Conscience of the King* also became the title of a Star Trek episode featuring a production of Hamlet which leads to the exposure of a murderer (although not a king).

The play *I Hate Hamlet* and the movie *A Midwinter's Tale* are about a production of *Hamlet*, which in turn includes a production of *The Murder of Gonzago*, as does the *Hamlet*-based film *Rosencrantz & Guildenstern Are Dead*, which even features a third-level puppet theatre version within their play. Similarly, in Anton Chekhov's *The Seagull* there are specific allusions to *Hamlet*: in the first act a son stages a play to impress his mother, a professional actress, and her new lover; the mother responds by comparing her son to Hamlet. Later he tries to come between them, as Hamlet had done with his mother and her new husband. The tragic developments in the plot follow in part from the scorn the mother shows for her son's play.

Shakespeare adopted the play-within-a-play device for many of his other plays as well, including *A Midsummer Night's Dream* and *Love's Labours Lost*. Almost the whole of *The Taming of the Shrew* is a play-within-a-play, presented to convince Christopher Sly, a drunken tinker, that he is a nobleman watching a private performance, but the device has no relevance to the plot (unless Katharina's subservience to her "lord" in the last scene is intended to strengthen the deception against the tinker) and is often dropped in modern productions. The musical *Kiss Me, Kate* is about the production of a fictitious musical, *The Taming of the Shrew*, based on the Shakespeare play of the same name, and features several scenes from it. *Pericles* draws in part on the 14th century *ConfessioAmantis* (itself a frame story) by John Gower and Shakespeare has the ghost of Gower "assume man's infirmities" to introduce his work to the contemporary audience and comment on the action of the play.

In Francis Beaumont's *Knight of the Burning Pestle* (ca. 1608) a supposed common citizen from the audience, actually a "planted" actor, condemns the play that has just started and "persuades" the players to present something about a shopkeeper. The citizen's "apprentice" then acts, pretending to extemporise, in the rest of the play. This is a satirical tilt at Beaumont's playwright contemporaries and their current fashion for offering plays about London life.

The opera *Pagliacci* is about a troupe of actors who perform a play about marital infidelity that mirrors their own lives, and composer Richard Rodney Bennett and playwright-librettistBeverley Cross's *The Mines of Sulphur* features a ghostly troupe of actors who perform a play about murder that

similarly mirrors the lives of their hosts, from whom they depart, leaving them with the plague as nemesis.John Adams' *Nixon in China* (1985-7) features a surreal version of Madam Mao's *Red Detachment of Women*, illuminating the ascendance of human values over the disillusionment of high politics in the meeting.

In Bertolt Brecht's *The Caucasian Chalk Circle*, a play is staged as a parable to villagers in the Soviet Union to justify the re-allocation of their farmland: the tale describes how a child is awarded to a servant-girl rather than its natural mother, an aristocrat, as the woman most likely to care for it well. This kind of play-within-a-play, which appears at the beginning of the main play and acts as a 'frame' for it, is called an *'induction'*. Brecht's one-act play *The Elephant Calf* (1926) is a play-within-a-play performed in the foyer of the theatre during his *Man Equals Man*.

In Jean Giraudoux's play *Ondine*, all of act two is a series of scenes within scenes, sometimes two levels deep. This increases the dramatic tensionand also makes more poignant the inevitable failure of the relationship between the mortal Hans and water spriteOndine.

The Two-Character Play by Tennessee Williams has a concurrent double plot with the convention of a play within a play. Felice and Clare are siblings and are both actor/producers touring 'The Two-Character Play.' They have supposedly been abandoned by their crew and have been left to put on the play by themselves. The characters in the play are also brother and sister and are also named Clare and Felice.

The Mysteries, a modern reworking of the medieval mystery plays, remains faithful to its roots by having the modern actors play the sincere, naïve tradesmen and women as they take part in the original performances.

Alternatively, a play might be about the production of a play, and include the performance of all or part of the play, as in *Noises Off*, *A Chorus of Disapproval* or *Lilies*. Similarly, the musical *Man of La Mancha* presents the story of Don Quixote as an impromptu play staged in prison by *Quixote*'s author, Miguel de Cervantes.

In most stagings of the musical *Cats*, which include the song "Growltiger's Last Stand" — a recollection of an old play by Gus the Theatre Cat — the character of Lady Griddlebone sings "The Ballad of Billy McCaw". (However, many productions of the show omit "Growltiger's Last Stand", and "The Ballad of Billy McCaw" has at times been replaced with a mock aria, so this metastoryisn't always seen.) Depending on the production, there is another musical scene called The Awful Battle of the Pekes and the Pollices where the Jellicles put on a show for their leader. In *Lestat: The Musical*, there are three play within a plays. First, when Lestat visits his childhood friend, Nicolas, who works in a theater, where he discovers his love for theater; and two more when the Theater of the Vampires perform. One is used as a plot mechanism to explain the vampire god, Marius, which sparks an interest in Lestat to find him.

A play within a play also occurs in the musical *The King and I*, where Princess Tuptim and the royal dancers give a performance of *Small House of Uncle Thomas* (or *Uncle Tom's Cabin*) to their English guests. The play mirrors Tuptim's

situation, as she wishes to run away from slavery to be with her lover, LunTha.

In stagings of Dina Rubina's play *Always the Same Dream*, the story is about staging a school play based on a poem by Pushkin.

Joseph Heller's 1967 play *We Bombed in New Haven* is about actors engaged in a play about military airmen; the actors themselves become at times unsure whether they are actors or actual airmen.

The 1937 musical *Babes in Arms* is about a group of kids putting on a musical to raise money. The central plot device was retained for the popular 1939 film version with Judy Garland and Mickey Rooney. A similar plot was recycled for the films *White Christmas* and *The Blues Brothers*.

Nested films

TV Tropes maintains a list of feature films that feature this plot device. *Singin' in the Rain* (1952) is frequently listed as the earliest example, although there are antecedents in silent cinema such as *Mabel's Dramatic Career* (1913).

The François Truffaut film *Day for Night* is about the making of a fictitious movie called *Meet Pamela* (*Je vousprésente Pamela*) and shows the interactions of the actors as they are making this movie about a woman who falls for her husband's father. The story of *Pamela* involves lust, betrayal, death, sorrow, and change, events that are mirrored in the experiences of the actors portrayed in *Day for Night*. There are a wealth of other movies that revolve around the film industry itself, even if not

centering exclusively on one nested film. These include the darkly satirical classic *Sunset Boulevard* about an aging star and her parasitic victim, and the Coen Brothers' farce *Hail, Caesar!*

The script to Karel Reisz's movie *The French Lieutenant's Woman* (1981), written by Harold Pinter, is a film-within-a-film adaptation of John Fowles's book. In addition to the Victorian love story of the book, Pinter creates a present-day background story that shows a love affair between the main actors.

In Buster Keaton's *Sherlock Jr.*, Keaton's protagonist actually enters into a film while it is playing in a cinema, as does the main character in the Arnold Schwarzenegger children's film *The Last Action Hero*. A similar device is used in the seminal music video *Take on me* by A-ha, which features a young woman entering a cartoon universe. Conversely, Woody Allen's *Purple Rose of Cairo* is about a movie character exiting the movie to interact with the real world. Allen's earlier film *Play it Again, Sam* featured liberal use of characters, dialogue and clips from the film classic *Casablanca* as a central device.

The 2002 Pedro Almodóvar film *Talk to Her* (*Hable con ella*) has the chief character Benigno tell a story called *The Shrinking Lover* to Alicia, a long-term comatose patient whom Benigno, a male nurse, is assigned to care for. The film presents *The Shrinking Lover* in the form of a black-and-white silent melodrama. To prove his love to a scientist girlfriend, *The Shrinking Lover* protagonist drinks a potion that makes him progressively smaller. The resulting seven-minute scene, which is readily intelligible and enjoyable as a stand-alone short subject, is considerably more overtly comic than the rest of

Talk to Her—the protagonist climbs giant breasts as if they were rock formations and even ventures his way inside a (compared to him) gigantic vagina. Critics have noted that *The Shrinking Lover* essentially is a sex metaphor. Later in *Talk to Her*, the comatose Alicia is discovered to be pregnant and Benigno is sentenced to jail for rape. *The Shrinking Lover*was namedBest Scene of 2002 in the *Skandies*, an annual survey of online cinephiles and critics invited each year by critic Mike D'Angelo.

Tropic Thunder (2008) is a comedy film revolving around a group of prima donna actors making a Vietnam War film (itself also named "Tropic Thunder") when their fed-up writer and director decide to abandon them in the middle of the jungle, forcing them to fight their way out. The concept was perhaps inspired by the 1986 comedy Three Amigos, where three washed-up silent film stars are expected to live out a real-life version of their old hit movies. The same idea of life being forced to imitate art was also reprised in the Star Trek parody *Galaxy Quest*.

The first episode of the anime series *The Melancholy OfHaruhiSuzumiya* consists almost entirely of a poorly made film that the protagonists created, complete with Kyon's typical, sarcastic commentary.

Chuck Jones's 1953 cartoon*Duck Amuck* shows Daffy Duck trapped in a cartoon that an unseen animator repeatedly manipulates. At the end, it is revealed that the whole cartoon was being controlled by Bugs Bunny. The *Duck Amuck* plot was essentially replicated in one of Jones' later cartoons, *Rabbit Rampage* (1955), in which Bugs Bunny turns out to be the

victim of the sadistic animator (Elmer Fudd). A similar plot was also included in an episode of *Baby Looney Tunes*, in which Bugs was the victim, Daffy was the animator, and it was made on a computer instead of a pencil and paper. In 2007, the *Duck Amuck* sequence was parodied on *Drawn Together* ("Nipple Ring-Ring Goes to Foster Care").

All feature-length films by JörgButtgereit except *Schramm* feature a film within the film. In *Nekromantik*, the protagonist goes to the cinema to see the fictional slasher film *Vera*. In *Der Todesking* one of the character watches a video of the fictional Nazi exploitation film *Vera - Todesengel der Gestapo* and in *Nekromantik 2*, the characters go to see a movie called *Mon dejeuner avec Vera*, which is a parody of Louis Malle's*My Dinner with André*.

Quentin Tarantino's *InglouriousBasterds* depicts a Nazi propaganda film called *Nation's Pride*, which glorifies a soldier in the German army. *Nation's Pride* is directed by Eli Roth.

Joe Dante's *Matinee* depicts *Mant*, an early-'60s sci-fi/horror movie about a man who turns into an ant. In one scene, the protagonists see a Disney-style family movie called *The Shook-Up Shopping Cart*.

Story within a film

The 2002 martial arts epic *Hero* presented the same narrative several different times, as recounted by different storytellers, but with both factual and aesthetic differences. Similarly, in the whimsical 1988 Terry Gilliam film *The Adventures of Baron Munchausen*, and the 2003 Tim Burton film *Big Fish*, the bulk of the film is a series of stories told by an (extremely)

unreliable narrator. In the 2006 Tarsem film *The Fall*, an injured silent-movie stuntman tells heroic fantasy stories to a little girl with a broken arm to pass time in the hospital, which the film visualizes and presents with the stuntman's voice becoming voiceover narration. The fantasy tale bleeds back into and comments on the film's "present-tense" story. There are often incongruities based on the fact that the stuntman is an American and the girl Persian—the stuntman's voiceover refers to "Indians," “a squaw” and “a teepee,” but the visuals show a Bollywood-style devi and a Taj Mahal-like castle. The same conceit of an unreliable narrator was used to very different effect in the 1995 crime drama *The Usual Suspects* (which garnered an Oscar for Kevin Spacey's performance).

The seminal 1950 Japanese film *Rashomon*, based on the Japanese short story "In a Grove" (1921), utilizes the flashback-within-a-flashback technique. The story unfolds in flashback as the four witnesses in the story—the bandit, the murdered samurai, his wife, and the nameless woodcutter—recount the events of one afternoon in a grove. But it is also a flashback within a flashback, because the accounts of the witnesses are being retold by a woodcutter and a priest to a ribald commoner as they wait out a rainstorm in a ruined gatehouse.

The movie *Inception* has a deeply nested structure that is itself part of the setting, as the characters travel deeper and deeper into layers of dreams within dreams. Similarly, in the beginning of the music video for the Michael Jackson song "Thriller", the heroine is terrorized by her monster boyfriend in what turns out to be a movie within a dream. The film *The Grand Budapest Hotel* has four layers of narration; starting

with a young girl at the author's memorial reading his book, it cuts to the old author in 1985 telling of an incident in 1968 when he, as a young author, stayed at the hotel and met the owner, old Zero. He was then told the story of young Zero and M Gustave, from 1932, which makes up most of the narrative.

Play within a film

The 2001 film *Moulin Rouge!*features a fictitious musical within a film, called "Spectacular Spectacular". The 1942 Ernst Lubitsch comedy *To Be or Not to Be* confuses the audience in the opening scenes with a play, "The Naughty Nazis", about Adolf Hitler which appears to be taking place within the actual plot of the film. Thereafter, the acting company players serve as the protagonists of the film and frequently use acting/costumes to deceive various characters in the film. *Hamlet* also serves as an important throughline in the film, as suggested by the title. Laurence Olivier sets the opening scene of his 1944 film of *Henry V* in the tiring room of the old Globe Theatre as the actors prepare for their roles on stage. The early part of the film follows the actors in these "stage" performances and only later does the action almost imperceptibly expand to the full realism of the Battle of Agincourt. By way of increasingly more artificial sets (based on mediaeval paintings) the film finally returns to The Globe.

Mel Brooks' film, *The Producers*, revolves around a scheme to make money by producing a disastrously bad Broadway musical, *Springtime for Hitler.*Ironically the film itself was later made into its own Broadway musical (although a more intentionally successful one). The Outkast music video for the song "Roses" is a short film about a high school musical. In

Diary of a Wimpy Kid, the middle-schoolers put on a play of *The Wizard of Oz*, while *High School Musical* is a romantic comedy about the eponymous musical itself. A high school production is also featured in the gay teen romantic comedy *Love, Simon*.

A 2012 Italian film *Caesar Must Die* stars real-life Italian prisoners who rehearse Shakespeare's *Julius Caesar* in Rebibbia prison playing *fictional* Italian prisoners rehearsing the same play in the same prison. In addition, the film itself becomes an*Julius Caesar* adaption of sorts as the scenes are frequently acted all around the prison, outside of rehearsals, and the prison life becomes indistinguishable from the play.

The main plot device in *Repo! The Genetic Opera* is an opera which is going to be held the night of the events of the movie. All of the principal characters of the film play a role in the opera, though the audience watching the opera is unaware that some of the events portrayed are more than drama. The 1990 biopic *Korczak*, about the last days of a Jewish children's orphanage in Nazi occupied Poland, features an amateur production of Rabindranath Tagore's *The Post Office*, which was selected by the orphanage's visionary leader as a way of preparing his charges for their own impending death. That same production is also featured in the stage play *Korczak's Children,* also inspired by the same historical events.

TV show within a film

The 1973 film adaptation (The National Health) of Peter Nichols's 1969 play of the same name features a send-up of a typical American hospital soap opera being shown on a

television situated in an underfunded, unmistakably BritishNHS hospital. The Jim Carrey film *The Truman Show* is about a person who grows to adulthood without ever realizing that he is the unwitting hero of the immersive eponymous television show.

In *Toy Story 2*, the lead character Woody learns that he was based on the lead character of the same name of a 1950sWestern show known as Woody's Roundup, which was seemingly cancelled due to the rise of Sputnik and children wanting to play with space toys like Buzz Lightyear.

Nested video games

The first example of a video game within a video game is almost certainly Tim Stryker's 80s era text-only game Fazuul (also the world's first online multiplayer game), in which one of the objects that the player can create is a minigame. Another early use of this trope was in Cliff Johnson's 1987 hit *The Fool's Errand*, a thematically linked narrative puzzle game, in which several of the puzzles were semi-independent games played against NPCs.

Power Factor has been cited as a rare example of a video game in which the entire concept is a video game within a video game: The player takes on the role of a character who is playing a "Virtual Reality Simulator", in which he in turn takes on the role of the hero Redd Ace. The *.hack* franchise also gives the concept a central role. It features a narrative in which internet advancements have created an MMORPG franchise called The World. Protagonists Kite and Haseo try to uncover

the mysteries of the events surrounding The World. Characters in .hack are self-aware that they are video game characters.

More commonly, however, the video game within a video game device takes the form of mini-games that are non-plot oriented, and optional to the completion of the game. For example, in the *Yakuza* and *Shenmue* franchises, there are playable arcade machines featuring other Sega games that are scattered throughout the game world.

In *Final Fantasy VII* there are several video games that can be played in an arcade in the Gold Saucer theme park. In *Animal Crossing*, the player can acquire individual NES emulations through various means and place them within their house, where they are playable in their entirety. When placed in the house, the games take the form of a Nintendo Entertainment System. In *Fallout 4*, and *Fallout 76* the protagonist can find several cartridges throughout the wasteland that can be played on his pip-boy (an electronic device that exists only in the world of the game) or any terminal computer.

TV show within a video game

In the Remedy video game title *Max Payne,* players can chance upon a number of ongoing television shows when activating or happening upon various television sets within the game environs, depending on where they are within the unfolding game narrative. Among them are *Lords & Ladies*, *Captain Baseball Bat Boy*, *Dick Justice* and the pinnacle television serial *Address Unknown* – heavily inspired by David Lynch-style film narrative, particularly *Twin Peaks*, *Address Unknown*

sometimes prophesies events or character motives yet to occur in the Max Payne narrative.

In *Grand Theft Auto IV*, the player can watch several TV channels which include many programs: reality shows, cartoons, and even game shows.

Nested TV shows

Terrance & Phillip from *South Park* comments on the levels of violence and acceptable behaviour in the media and allow criticism of the outer cartoon to be addressed in the cartoon itself. Similarly, on the long running animated sitcom *The Simpsons*, Bart's favorite cartoon, *Itchy and Scratchy* (a parody of *Tom & Jerry*), often echoes the plotlines of the main show. *The Simpsons* also parodied this structure with numerous 'layers' of sub-stories in the Season 17 episode "The Seemingly Never-Ending Story".

On the show *Dear White People*, the *Scandal* parody *Defamation* offers an ironic commentary on the main show's theme of interracial relationships. Similarly, each season of the HBO show *Insecure* has featured a different fictional show, including the slavery-era soap opera *Due North*, the rebooted black 90s sitcom *Kev'yn,* and the investigative documentary series *Looking for LaToya*.

The Irish television series *Father Ted* features a television show, *Father Ben*, which has characters and storylines almost identical to that of *Father Ted*.

The television shows *30 Rock*, *Studio 60 on the Sunset Strip*, *Sonny with a Chance*, and *Kappa Mikey* feature a sketch show within the TV show.

An extended plotline on the semi-autobiographical sitcom *Seinfeld* dealt with the main characters developing a sitcom about their lives. The gag was reprised on *Curb Your Enthusiasm*, another semi-autobiographical show by and about *Seinfeld* co-creator Larry David, when the long-anticipated *Seinfeld* reunion was staged entirely inside the new show.

The *USS Callister* episode of the *Black Mirror* anthology television series is about a man obsessed with a *Star Trek*-like show, who recreates it as part of a virtual reality game.

The concept of a film within a television series is employed in the Macross universe. *The Super Dimension Fortress Macross: Do You Remember Love?* (1984) was originally intended as an alternative theatrical re-telling of the television series *The Super Dimension Fortress Macross* (1982), but was later "retconned" into the Macrosscanon as a popular movie within the television series *Macross 7* (1994).

Film within a TV show

Seinfeld had a number of reoccurring fictional films, most notably *Rochelle, Rochelle*, a parody of artsy but exploitative foreign films, while the trippy, metaphysically loopy thriller *Death Castle* is a central element of the *Master of None* episode *New York, I Love You.*