

Article

Discerning Meaning and Producing Information: Semiosis in Knowing the Past

Kenneth Thibodeau [†]

U.S. National Archives and Records Administration, College Park, MD 20740, USA; KThibodeau@fordham.edu

[†] Retired 1 January 2011.

Abstract: This article explores how the meaning of information related to things, people, events, and processes in the past is discerned and interpreted to satisfy some current purpose. Starting from the premise that Information about the Past results from a cognitive construction, it considers factors that affect the probability of success in producing Information about the Past. The article analyzes the process, components, and products of learning about the past, building on Constructed Past Theory and applying concepts from semiotics. It identifies characteristic ways in which things in the past are misinterpreted.

Keywords: cognitive disparity; constructed past theory; semiotics



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1. Introduction

This article extends Constructed Past Theory (CPT), focusing on a common problem in producing Information about the Past: the situation in which things in the past had different significance than in the context in which the information is produced. The problem is twofold: the need, first, to recognize that there were different meanings and to discern what they were, and second, to respect past meanings while producing information that satisfies the purpose for which the information is sought.

CPT presumes that information about things that existed or happened in the past results from cognitive processes. It is well established in psychology that human memory is constructed. In the mind, construction of the past can continue even in what is nominally recall [1,2]. More generally, biosemiotics tells us that in all living things, “organic information is not a thing or a property but the result of a process” [3] (p. 583).

CPT focuses on information and knowledge of the past that is expressed outside of the mind in persistent, empirically accessible forms. Hence, the theory is grounded in semiotics and primarily demonstrated by examples of Information about the Past constructed in a variety of disciplines.

A construction of the past is a duplex process. The first, the Intentional Approach, identifies what information is desired; determines how and from what sources it is to be acquired; decides what the outcome should be; and shapes the desired product. The second process comprises the actual construction. There can be tension within the overall process because things that were meaningful and their meanings in the past may have been different than understood in the Intentional Approach. The tension may be reflected in Cognitive Disparity, differences between the understanding of information that shapes the process of construction and the understanding of information in the past.

This article examines how Cognitive Disparity can impact construction of the past, identifying major ways such disparity can appear in constructions. Part 2 describes the conceptual orientation of CPT and the methods being used in developing it. Part 3 describes semiotic concepts in CPT; describes relevant CPT classes; and shows how the elements and processes of constructing the past can give rise to Cognitive Disparity. Part 4 applies CPT concepts to identify and characterize three general types of Cognitive Disparity.

2. Scope and Methods

Constructed Past Theory is being developed as a formal model using the UML standard [4]. The model will facilitate implementation in software. The model is, and will remain for some time, in progress. To date, it has been articulated primarily in class diagrams. UML classes mentioned in this article are identifiable by capitalized names and defined in Appendix A, Constructed Past Theory Glossary.

CPT is a metamodel. Its basic concepts are mostly abstract classes; that is, they have no direct members that are empirical instances. Subclasses of the basic classes may have empirical members. For example, the abstract class, Purpose, described in part 3, has subclasses that can have empirical members, such as publications or manuscripts, but every empirical instance must be assigned to a subclass, not to Purpose in general. Abstract classes support application of CPT to a variety of fields including anthropology, archaeology, biology, education, history, literary criticism, philosophy, psychology, and social sciences, as well as artistic creations.

CPT assumes a minimal ontology. Starting with the W3C OWL distinction between thing and nothing [5], CPT divides thing into entity and event. An entity is some material or conceptual thing that exists or existed. An event is some thing that happens or happened. CPT makes no presumptions about what existed or happened in the past or why or how things happened. What things existed and what events happened in the past are determined in specific constructions of the past, not in the theory itself. Accordingly, different fields may define additional subclasses and other classes as appropriate. This has already been done in archaeology [6,7].

Many of the CPT concepts discussed below were defined in a previous article [8], but several have been revised or renamed, and some new ones have been introduced. Such changes are identified in Appendix A, which defines terms and indicates differences from the previous article.

As in the use of models in system engineering [9], each class diagram includes only the classes and relationships relevant to what is under consideration. For example, the CPT UML model defines a tree of subclasses of sources of Information about the Past according to how they relate to particular topics, but it includes another tree of subclasses according to the genres in which they are expressed [8]. Instances can have multiple inheritance. For example, Xenophon's *Anabasis* is both an historical account and a subject of study [10,11]. Similarly, information about the physical world can be both a product of scientific research and a subject of the history of science [12,13].

3. Information and Understanding in Constructed Past Theory

3.1. The Semiotic Foundation

CPT characterizes the production of Information about the Past using concepts from semiotics, which investigates how information is created and communicated by means of signs. A founder of modern semiotics, Peirce, defined a sign as "something which stands to somebody for something in some respect or capacity" [14] (volume 2, p. 228). A sign is a triadic relationship of (1) a signifier, which stands for something, (2) the signified or referent to which the signifier refers, and (3) an interpretant, which specifies how the signifier relates to the signified. Unfortunately, 'sign' is used ambiguously to refer either to the entire triad of signifier, referent, and signified or only to the signifier. In CPT, 'sign' refers to the triad.

Semiotics has largely addressed how humans use signs [15,16]. However, the scope of semiotics is broader. Biosemiotics embraces other life forms at the level of cells, organisms, species, and ecological networks [17]. Biosemiotics has also enriched semiotic theory conceptually. As Peirce's "stands for" indicates, semiotics often treats the relationship between signifier and signified as representation. However, representation does not appropriately describe this relationship in the semiotic system common to all life forms, the genetic code. The genetic code is a set of instructions that guides RNA in the manufacture of proteins [3].

The use of signs as instruction also occurs in human semiosis, as Wittgenstein recognized in his exposition of language games [18].

With these insights, Peirce's definition of sign can be generalized to "something that relates to something else for some Sign User in some way under some conditions," where "way" indicates the manner in which the relationship works and "conditions" indicate the circumstances in which it works that way. A Sign User is an entity capable of forming, recognizing, interpreting, and applying signs. A semiotic system can be created and sustained by many Sign Users acting in collaboration. Human semiotic systems are commonly shared by social or cultural groups. Sign Users include artifactual systems, such as digital computers, analog processors, and hybrid analog/digital systems. Thus, five categories of semiosis can be distinguished: individual, social, biological, ecological, and artifactual [19–21].

3.2. *The Problem of Cognitive Disparity*

Information about the past can be very different than Information from the Past. Information about the past is a product of a construction. Information from the past existed in and survives from the past. CPT uses "Information from the past," rather than "information in the past," because what is available depends on what survives from the past. Something that survives from the past is classified as a Vestige in CPT. A Vestige is either a Relic or a Trace. A Relic is a material Vestige—e.g., a fossil or artifact. A Trace is a Vestige contained in or on a Relic that presents or can be used to derive information about the Relic, some other thing, or both. For example, an embossed number on a glass vessel might indicate the volume of liquid the vessel could hold—a property of the vessel—while writing on a piece of pottery might identify the potter, providing data both about the pottery and the person. Similarly, tree rings provide Traces of climatic, competitive, and phenological events as well as the ages of trees [22,23]. Although a Trace must have a physical instantiation, the Trace can provide information about an abstract thing or attribute. Often, Vestiges are only fragmentary remnants, and they may be misleading, possibly in more than one way. Even in cases where extensive records were kept of an activity, documents only capture a fraction of what occurred or was the case, and they may embody implicit bias.

Cognitive Disparity occurs when Information about the Past misrepresents information from the same past. Cognitive Disparity has similarities with the concept of cognitive dissonance in psychology—where an individual or group holds conflicting ideas or beliefs, or where behavior is inconsistent with cognitions. However, Cognitive Disparity does not relate to inconsistencies within an individual or group, but to discrepancies between Information about the Past and information from the same past.

Many factors can give rise to differences between Information about the Past and Information from the Past. Some are obvious in the brief introduction to semiotics above. Semiotic systems are conventional, not predetermined by factors outside of semiosis. The number of semiotic systems and the possible constructs of meaning within them are unbounded, possibly infinite. Moreover, it cannot be assumed that it is always possible to translate between semiotic systems without altering meaning [24]. Differences can arise in all three facets of semiosis. Meaning is specified semantically through the relationships between signifiers and their referents, syntactically through relationships among signs, and pragmatically in actions and reactions related to their use [25]. The difficulty is further complicated by the basic fact that semiotic systems can and frequently do change over time. Such changes can occur within a period of time in the past under investigation.

3.3. *Cognitive Disparity in Constructed Past Theory*

Several CPT concepts can help in recognizing and characterizing Cognitive Disparity. The construction of a past entails adapting Information from the Past, integrating it into an outcome that satisfies the Purpose of the construction, illustrated in Figure 1, Context of Construction.

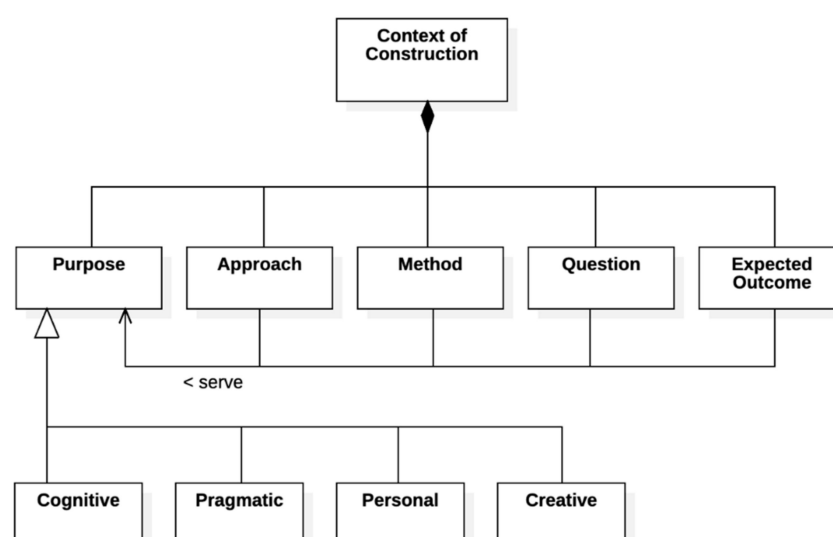


Figure 1. Context of Construction. The Context of Construction consists of the Purpose for which a construction is undertaken; the Approach that guides the process; the Method(s) used to obtain or produce the desired information; the Question(s) to be answered; and the Expected Outcome, which includes at least the Constructed Past. The other four components of Context of Construction all serve the Purpose. Purpose has four subclasses: Cognitive, Pragmatic, Personal, and Creative.

CPT distinguishes four categories of Purpose: Cognitive, Pragmatic, Personal, and Creative. Constructions undertaken for a Cognitive Purpose aim at producing objective information, adding information to an existing store or confirming or improving Information about the Past. Investigations in disciplines such as history, archaeology, epidemiology, and climatology have purposes that are primarily cognitive. Pragmatic efforts use Information about the Past for ulterior applications, such as making a case in judicial proceedings; using family history in psychotherapy; or improving efficiency in business. Personal undertakings aim to satisfy subjective desires, such as learning about ancestors or simply indulging curiosity. Creative Purposes use information in imaginative endeavors, such as historical novels or memorials to historic events.

Purpose is a facet of the context in which a construction is undertaken. Figure 1 shows all of these facets: Purpose, Approach, Method, Question, and Expected Outcome. Together, they constitute the Interpretive Norms of a construction. If the Context of Construction disappears, so do its constituents, indicated by the black diamond at the end of the lines linking the Context of Construction and its constituents. Differences among facets could be trivial. In more complex cases, the differences could be substantial; for example, Method could involve producing instruments designed specifically to capture desired data.

Figure 1 shows that all other components of the Context of Construction should serve the Purpose. Thus, the arrows from other constituents all point to Purpose. If the Purpose were changed, one or more of the others would have to be modified appropriately.

Approach is the way the effort is directed. It may be set by the discipline of the investigator. A cultural anthropologist uses a different Approach than a biological anthropologist. In creative projects, it depends on what the artists want to express. Approach also includes assumptions about the past and how it should be regarded. Assumptions might come from traditions or schools of thought; from a decision to organize Information about the Past under an existing taxonomy; or from religious beliefs or aesthetic preferences. Approach also includes whether the project aims to merely obtain relevant information, which could be accomplished by consulting an authoritative source; produce new information, which might entail conducting field work; or critique prior constructions on the same topic, which would entail identifying and analyzing prior constructions in the same area.

Opposite Approaches can be legitimate and valuable, although they produce different results. A topic could be approached retrospectively to determine how some entity, state

of affairs or event came about, or prospectively to determine the aftermath or impact of something in the past. A retrospective inquiry regarding a given data set might identify its sources, including both observations and other data sets from which it obtained data. It might try to understand the processing of raw data or the workflows that enabled data from multiple data sets to be brought together. In contrast, a prospective review might seek to identify what other data sets used data from the given one; how and to what extent they transformed the source data; what publications were based on it; and whether conclusions were well grounded in the data [26–28].

Questions aim at the Expected Outcome. They specify the types and quantities of data needed. Methods align with Approach and determine the articulation of questions. They can be qualitative, quantitative, or a combination. Methods can entail constraints—for example, if an investigation includes a statistical sample, every item in the sample must be drawn from the same population. Methods may include techniques for observation, discovery, processing, or analysis. Techniques range from basic processes—such as cleaning pottery shards found in archaeological excavations [29]—to use of sophisticated technologies—e.g., ground sensing radar—to find evidence where none was previously known, or laser ablation to determine what an ancient work of art originally looked like [30,31]. Techniques for processing and analysis include computer applications ranging from common database management systems to specialized algorithms such as point cloud processing software [32]. Together, Purpose, Approach, Questions and Methods influence what the Expected Outcome of the project will be and how precisely it is envisaged.

The Expected Outcome is the ultimate result or consequence of a construction of the past. The Expected Outcome may be limited to the desired information, but the information may serve an ulterior purpose, such as achieving a practical objective. In creative endeavors, the Constructed Past may be inspirational or might serve to validate that the object of interest is an appropriate vehicle for communicating artistic intent or for reaching a target public. Projects undertaken for personal reasons may satisfy vanity or improve ability to relate to another person, group, or organization. As with postulations about things in the past, CPT is neutral with regard to any ulterior purpose served by a construction of the past, but such purposes should be taken into consideration in examining and evaluating individual constructions.

Aspects of the Context of Construction vary from case to case and are out of the scope of the CPT metamodel, although relevant in its application to specific cases. The CPT model does address the contexts in which information was produced and interpreted in the past, facilitating the identification and analysis of Cognitive Disparity. Context, however, is a vague term, with over 150 definitions in cognitive disciplines [33]. CPT distinguishes two related but different contexts of Information from the Past: syndetic and circumstantial.

Syndetic Context comprises things that are interconnected in the production and interpretation of information. Connections within Syndetic Context are established empirically by Sign Users, given the affordances of the semiotic systems and semiotic scaffoldings they use, the latter being the process of integrating beyond a single platform or improving the platform. A semiotic system consists of a set of signs, a structured set of relationships between signifiers and their mappings, and a set of rules. The rules define individual signs; set criteria for well-formed signs at both simple and compound levels; and govern the sequencing of signs in given contexts [5]. A Sign User can use one or more semiotic systems—e.g., a mathematician uses different semiotic systems in professional work and social interactions.

A semiotic scaffold is a platform on which one or more semiotic systems operate. Semiotic scaffolding may be “a succession of stages of evolution, development or sign process in which the previous stages form the conditions for the subsequent stages” [34] (p. 213). Semiotic systems can change either independent of scaffolds or as a result of changes in the scaffold [35]. Recognizing changes in semiotic scaffolding and systems may be important in understanding the lives of individuals or the evolution of species, ecosystems, and cultures.

The duplex process of constructing a past parallels the basic semiotic actions of interpreting existing signs and establishing new ones. The Constructor interprets past meanings and produces new information.

Circumstantial Context refers to the situations in which semiosis occurs. Circumstantial Context includes broadly the context of culture as described in anthropology [36] and more immediately the context of situation as defined in systemic functional linguistics. Within a culture, the context of situation characterizes cases where language is used to accomplish different types of activities [37,38]. While it was developed in linguistics, the concept of the context of situation can be applied to situations where other modes of communication are used.

CPT uses a circumstantial rather than situational approach to qualify context, because a Target Past may encompass many situations. The context of situation encompasses an activity and its intended outcome, the topic and medium of communication, its social and physical setting, and the relationships between or among persons interacting in the activity. Facets of the context of situation can be used to identify situations in the Target Past as well as potential areas of Cognitive Disparity. CPT supports this by the way it defines concepts related to semiosis.

The model defines datum as a signifier linked to Informative Norms—such as rules, definitions, schemas, conditions, conventions, and precedents—that determine its referent and govern its syntax and use. Informative Norms include what semioticians call communicative codes—general principles or conventions that guide the articulation and interpretation of messages, enabling and constraining communication [39]. “Since the meaning of a sign depends on the code within which it is situated, codes provide a framework within which signs make sense. Indeed, we cannot grant something the status of a sign if it does not function within a code” [40]. CPT uses the term Informative Norm to avoid confusion with organic codes as used in biosemiotics. Moreover, Informative Norm has a broader scope than communicative code, encompassing not only expression and interpretation but also enhancement, restriction, and other alterations of signs and their interrelationships. Informative Norms facilitate types of interactions and promote particular objectives. Informative Norms may change over time, even with structured data, as evinced in the common problem of schema evolution [41].

CPT defines Information as a set of data together with their Informative Norms. Given that ‘Information’ is often used to refer to distinct and heterogeneous elements, CPT uses ‘Information Bundle’ to designate a coherent set of data and Informative Norms. An activity may involve several Information Bundles. Businesses have different ways of dealing with supply, sales, customer relations, and human resources. Many computer applications for businesses treat these Information Bundles so distinctly that they have been referred to as silos [42]. Information bundles differ on the basis of both data and norms. In medicine, diagnosis and prognosis are two related but distinct Information Bundles, and diagnosis involves different lower-level Information Bundles depending on whether data comes from medical imaging, chemical analyses, or microscopic examination. An Information Bundle is a semiotic system or subsystem. It may map to a context of situation, but that needs to be verified empirically.

An Interpretive Context is a range of circumstances in which a Sign User can produce or interpret information in or for some use or uses. The Interpretive Context includes the possible and appropriate uses for an Information Bundle and for any combination of bundles; the conditions that determine when and where each use is appropriate; the participants who could produce or interpret the information; the roles participants could play; the material and nonmaterial things that could be involved; and the technological, semiotic, or other means available for accomplishing the relevant uses. Thus, an Interpretive Context is the intersection of a Syndetic Context with a Circumstantial Context.

The Sign User who constructs a past is classified in CPT as a Constructor. The Constructor role can be filled by a person, group, or system. Constructor functions may be exercised by several different entities. For example, an institution may formulate a research

agenda, while responsibility for carrying out different parts of the agenda could be assigned to different researchers, and they might have assistants. In such cases, the Constructor is the ensemble of all those involved. Systems, such as artificial intelligence or data analytic applications, can be considered as Constructors because they produce Information about the Past and are distinct from the people who create, operate, and maintain them.

The Constructor role includes several functions. The initiating function defines what information is sought, how it is to be obtained, and what the result should be. The information gathering function identifies and selects relevant sources of information, and obtains or produces the information needed. The information processing function evaluates, analyzes, synthesizes, or otherwise processes the information to satisfy the Purpose. The output function uses the results of information gathering and processing to achieve the Expected Outcome. Some constructions may not need all Constructor functions.

A construction of the past occurs within an Intentional Arena that comprises the Context of Construction and Target Past. The Target Past identifies the things about which information is sought, the information sought, and the time(s) during which they are of interest. The Context of Construction and Target Past form an Interpretive Context for learning about the past. The scope of the Target Past necessarily responds to Purpose; Questions must be applicable to things in the Target Past; and Methods must be able to use available information. The Context of Construction and Target Past may evolve together in the course of construction. Increasing familiarity with sources of desired information may lead to expansion or contraction of scope; availability of data in specific formats may prompt changes in methods; and insights gained may lead to modifications of the Expected Outcome.

The Target Past has three interdependent components: the Target Domain, the Time Window, and Target Information. The Target Domain is the set of entities, events, and states of affairs about which information is sought. The Time Window comprises the period or periods during which things are of interest. The Time Window is a separate component because different things may be of interest during different periods. Target Information is information about the Target Domain. Distinguishing Target Information from the Target Domain provides flexibility regarding referents. Target Information could be about one or more specific things in the Target Domain or it could concern groups of things, relationships among things, complex States of Affairs, or processes that involve different things in different ways. It could also be about the Target Domain as a whole or only certain features of it. The distinction also provides discretion as to the definition and tracking of characteristics of the information itself—e.g., source, data of acquisition, quality, status, et al.

Construction Material comprises items that present or enable information about things in the Target Domain and possibly other things used as precedents or for comparison. Figure 2, Construction Material, identifies its major subclasses. There are two direct subclasses: Vestige, defined above, and Constructed Past, comprising products of earlier constructions and interim products of the current construction. A Vestige contains Information from the Past—information that existed in the past—whereas a Constructed Past contains Information about the Past; that is, produced after the fact. A Vestige may be a thing in the Target Domain, or it may only serve as a source of Target Information.

Both Vestiges and Constructed Pasts may either present or enable Information about the Past. Something presents information when a Sign User recognizes it as having an established meaning. Something enables information when a Sign User is able to interpret in a way that gives it a new or different meaning, regardless of whether it is perceived as already having meaning. For example, a name and a pair of dates on a gravestone presents information about the person buried beneath it, but understanding any additional text may require determining why it is included and whether it is original or a quotation, and if the latter, of what. Presenting vs. enabling information depends as much on the interpreter as on the content. In analysis of text, a scholar may readily understand its literal meaning but miss that it is ironic if unfamiliar with the author.

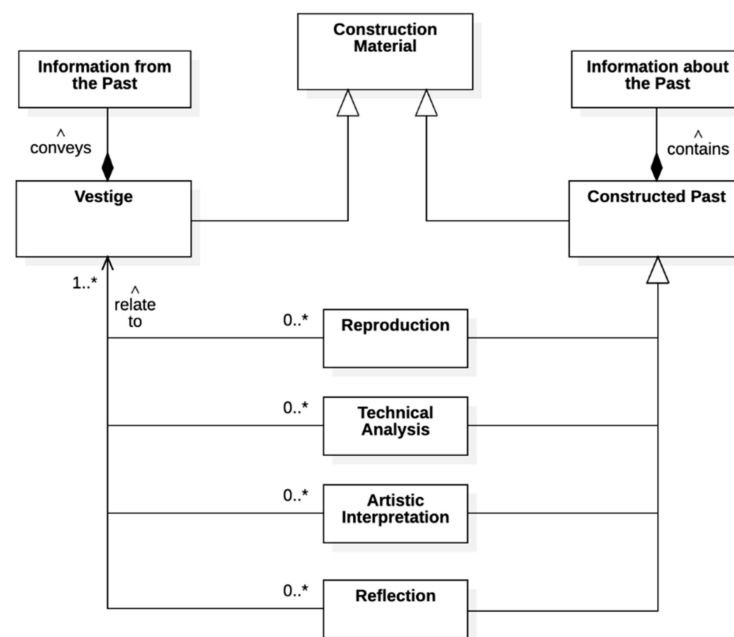


Figure 2. Construction Material. Construction Material conveys information related to a Target Past. Its subclasses, Vestige and Constructed Past, respectively provide information from or about the past. Constructed Past has several subclasses: Reflection, Reproduction, Technical Analysis, and Artistic Interpretation. All relate to one or more Vestiges, as indicated by “1..*” at the arrow pointing to Vestige.

A Constructed Past can take whatever form the Constructor deems appropriate. The form might be envisioned or described in the initial Context of Construction, but the result could differ substantially from what was anticipated. A Constructed Past might contain other constructed pasts. In a scholarly edition of correspondence, each edited document might be considered a Constructed Past in itself. A construction project might produce interim products which then become sources of information for the final product. There can be significant differences between the Target Domain and Time Window of a Constructed Past used as Construction Material and those of a project that uses it.

Figure 2 includes four subclasses of Constructed Past: Reproduction, Technical Analysis, Artistic Interpretation, and Reflection. Reproductions copy, resemble, render, or substitute for the Vestiges to which they are related. Technical Analyses present new information about them. Artistic Interpretations are inspired by Vestiges, and Reflections are about Vestiges.

A Reproduction duplicates or approximates a Vestige in whole or part. It could be a copy, a restoration, a transcription, a physical or virtual model, or a performance or recitation [43]. A Technical Analysis is the result of scrutiny performed after or outside of the Target Past, using an analytic method—such as ground-penetrating radar scans of archaeological sites or virtual models in analysis of old architecture—that was not available or used in the Target Past. For example, analysis of features such as sentence structures, vocabulary, the use of certain linguistic structures, and speech patterns can be used to estimate the age of authors of text messages even when the messaging system contains no age data [44]. Analysis of the color of a fabric can identify the dye used and that information could support inferences about trade networks and cross-cultural influences [45]. Technical analyses can range from spreadsheets developed in small research projects to the massive data sets developed under the auspices of the World Data System [46]. An Artistic Interpretation is an original creative work, such as a historical novel, a painting, or a statue, that references something in the past. Reflection encompasses any construction that provides information not covered by any of the other subclasses of Constructed Past.

Reflections are generally conceptual objects—e.g., descriptions, biographies, audit reports, anthologies, and critical catalogs.

All the subclasses of Constructed Past refer in some way to one or more Vestiges. The numeric annotations at the ends of the links representing these relationships in Figure 2 indicate that there may not be any of a type of Constructed Past related to a given Vestige, but there could be one or more. If one does exist, it must relate to at least one Vestige.

3.4. Conspectus on CPT Classes

This section describes the relationships among CPT classes described above. The classes and relationships illustrated in Figure 3, Construction of a Past, could be shown as an UML class diagram, but the ad hoc format illustrates that the relationships are not linear but exist within an Interpretive Context defined by the Intentional Arena, represented by the bounding square in the figure. The structural elements, namely Target Domain, Target Information, Construction Material, and Constructed Past, are shown within the blue-green diamond, which represents the construction.

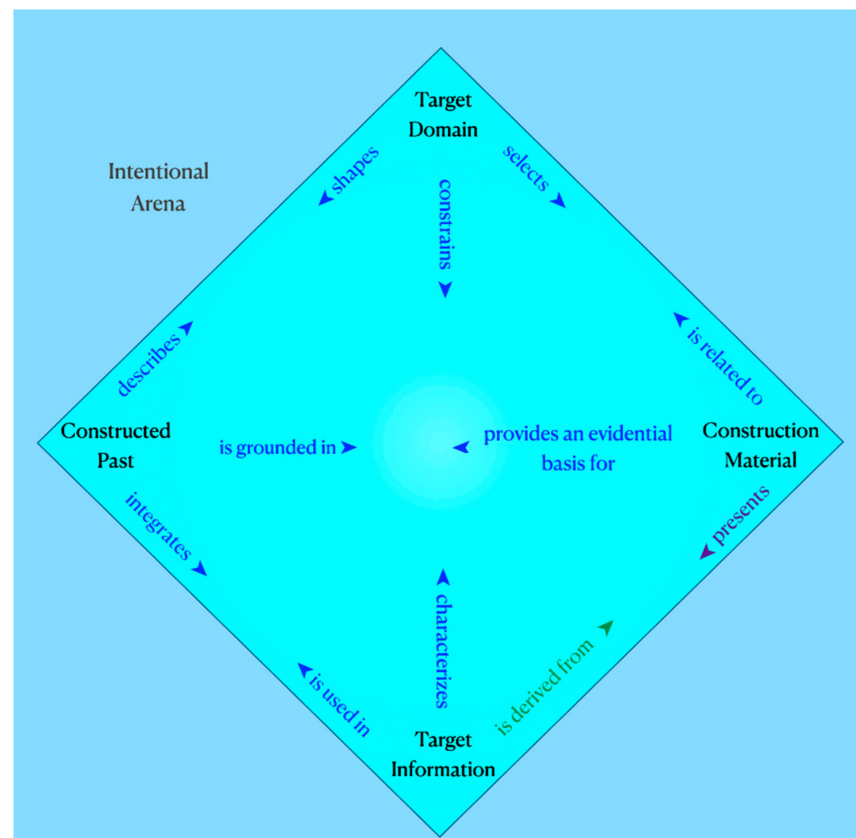


Figure 3. Construction of a Past, showing the main components of a construction (the Target Domain, Target Information, Construction Material, and Constructed Past) and their interrelationships. The Intentional Arena encompasses the four components as the Interpretive Context in which they are developed. The components are displayed within a diamond to indicate that the relationships are not discrete, but interrelated. The solid border of the diamond represents the Time Window.

Most of the pairs of relationships between structural elements mirror each other. Thus, the Target Domain selects Construction Material, which is related to things in the domain. Similarly, the Target Domain shapes the Constructed Past, which describes things in the domain. The Target Domain constrains Target Information to that which characterizes entities, groups, events, or states of affairs in the domain or aspects of the domain. Construction Material provides an evidential basis for the Constructed Past, establishing its ground. The Constructed Past integrates the Target Information, which is used in it. The relationships

between Construction Material and Target Information are different, as indicated by colors that differ both from each other and those of the other relationships. While parallel, these two relationships distinguish information presented by Construction Material from that enabled by it. These two types of information necessarily are different. Construction Material presents information when something in it is recognized as such. Information is derived from Construction Material when it is interpreted in a way that gives it a new or different meaning.

The coherence of the elements and relationships in a construction is reflected in the interdependent relationships between pairs of structural elements. Target Information is used in a Constructed Past because the Construction Material from which it comes is related to the Target Domain. Decisions on what information to derive from Construction Material and how it is derived are shaped by the articulation of the Target Domain. The integration of Target Information in a Constructed Past crystalizes the description of the Target Domain.

Each relationship in Figure 3 is operative across a field, with its dominant, but not exclusive, impact in the direction in which it points. The field extends across the corner from which a relationship originates. Thus, the Target Domain selects Construction Material with a view towards integrating information from it in a Constructed Past; the Constructed Past describes the Target Domain by integrating Target Information. In the case of Construction Material/Target Information, both presented and derived information relate to the Target Domain. At least one and possibly both may be used in the Constructed Past. The fields of each of the central relationships—i.e., *constrains*, *is grounded in*, *provides an evidential basis for*, and *characterizes*—extend to both adjacent edges. The Target Domain *constrains* Target Information to that which can be obtained from the selected Construction Material in order to shape and enable the production of a Constructed Past that satisfies the Context of Construction. The Constructed Past is grounded in Construction Material by using Target Information that describes the Target Domain appropriately.

Figure 4, *Constructor Activities*, displays, superimposed on the background of Figure 3, the activities that the Constructor performs with respect to the four structural components. The Constructor specifies the Target Domain, interprets Construction Material, determines the use of Target Information, and produces the Constructed Past.

Each activity ranges over a field determined by the two structural components adjacent to the one at which an activity points. Decisions on the selection of items included in Construction Material depend on how the Constructor interprets them in relation to the Target Domain. Similarly, the specification of the Target Domain shapes the production of the Constructed Past. How the Constructor interprets Construction Material leads to the extraction or derivation of Target Information used to produce the Constructed Past.

This synthetic view of structural elements, Constructor activities, and relationships in a Constructed Past provides a background for considering how sense is made of things in the past. In particular, the Constructor's Interpretive Context governs the interpretation of Construction Material and the interpretation and production of Target Information from it, as well as its integration in producing the Constructed Past. The coherence of this Interpretive Context can entail presumptions, orientations, expectations, and criteria that give rise to Cognitive Disparity.

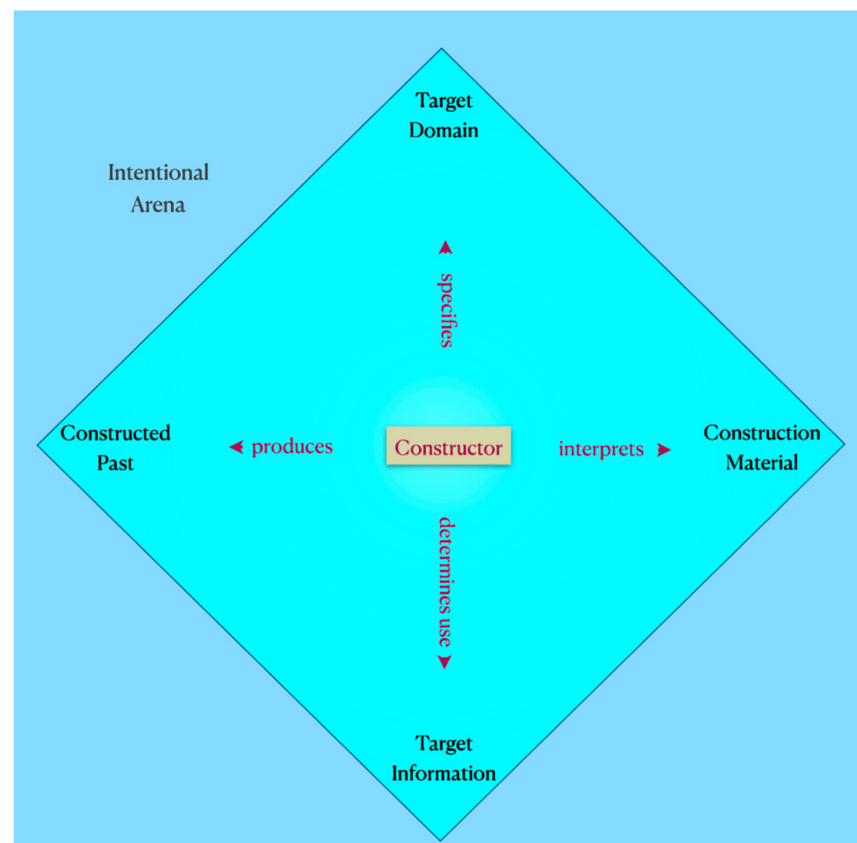


Figure 4. Constructor Activities. Activities of the Constructor superimposed on the background of Figure 3. The activities are not independent of one another. For example, specification of the Target Domain substantially impacts the interpretation of Construction Material, the use of Target Information, and the production of the Constructed Past.

4. Cognitive Disparity in Constructing the Past

The outcome of a construction should both accomplish the Purpose for which it was undertaken and interpret information from or about the past appropriately. While Purpose determines specific criteria for success, general standards can be derived from each of the subclasses of Purpose.

Success in constructions undertaken for Cognitive Purposes requires that past information be understood in conformance with its meaning in the past. The challenge of doing so can be intensified by the extent to which the Constructed Past relies on Information about the Past rather than Information from the Past. Even when semiotic differences are recognized and respected, information obtained from a previous Constructed Past could be misleading, either because it was processed to serve a Purpose not compatible with the current one or because the way it represents the past does not suit the Method or respond to the Questions in the Context of Construction. However, Information about the Past can also contribute to the success of cognitive projects. For example, information gained from Reproductions or Technical Analyses can enrich understanding of the past beyond what could be obtained from Vestiges without such efforts. Moreover, Information from the Past can be misleading when Vestiges are insufficient; have been altered over time; are not representative of the things they are used to inform about; or are or have been taken out of context physically or conceptually.

In constructions undertaken for Pragmatic Purposes, success is also dependent on fidelity to the meaning of Information from the Past, although in this context the representation of what was, what happened, and what things meant in the past has to be attuned to the Expected Outcome. In personal and creative projects, satisfaction of Purpose does not always require fidelity to Information from the Past. Some creative projects may intention-

ally and appropriately distort information in order to be thought-provoking, achieve shock value, or bring out irony or humor. Thus, adapting Information from the Past to suit the Context of Construction is not necessarily inappropriate, although in many personal and creative constructions, at least some degree of understanding of past meanings is crucial.

Any Purpose that relies on valid knowledge of the past can only be achieved if Information from the Past is not distorted or misinterpreted. Even when information used in constructing a past comes through the intermediary of prior Constructed Pasts, constructions that have a cognitive component should recognize and respect the semantic, syntactic, and pragmatic characteristics of Information from the Past. This raises the issue of how to recognize when the same or similar things have incongruous or incompatible meanings in different Interpretive Contexts or when different Interpretive Contexts use different semiotic processes. Failure to recognize either produces Cognitive Disparity.

The variety, complexity and extent of possible Cognitive Disparity is undoubtedly greater in dealing with the human past, but recent research in bioelectric and morphogenetic codes [47,48] indicates there is much to be learned about semiosis in other organisms—e.g., in understanding how animals evolved semiotic systems that enable them to navigate great distances [49]. Cognitive Disparity can occur between the Context of Construction and Construction Material, including both previous constructions, and Vestiges. Cognitive Disparity can also occur between or among Vestiges. Vestiges from different domains in a comparative study may have different Interpretive Contexts. Even in studies of a single domain, individuals or groups of people in the Target Domain may have conceived of things differently. Distinct contexts of situation may entail different interpretations of apparently identical or similar signs even among people who generally shared the same Interpretive Context. Finally, as noted above, semiotic scaffoldings are often progressive, entailing changes in meanings. Cognitive Disparity between or among multiple Contexts of Interpretation that shaped information derived from Vestiges increases the complexity of construction. Recognizing such disparity and distinguishing variant meanings in Information from the Past is as important as eliminating Cognitive Disparity between the Context of Construction and Information from the Past.

Three broad categories of Cognitive Disparity can be distinguished. Difficulties in interpreting information from or about the past or within the past include Incomprehension, Misapprehension, and Misconstruction. Incomprehension is an inability to interpret one or more things in the Construction Material. Misapprehension is a failure to recognize that past meanings are different from or additional to those of the Intentional Arena. Misconstruction is the imposition of anachronistic or otherwise inappropriate concepts, categories, relationships, or other interpretive norms on things in the past.

4.1. Incomprehension

A basic form of Cognitive Disparity is Incomprehension, an inability to understand something from a different Interpretive Context. Something can be incomprehensible because it is foreign to the Constructor's Interpretive Context or beyond the Constructor's capability given the approach and methods adopted in a construction. Incomprehension can occur in physical or conceptual realms and can relate to the semantic, syntactic, or pragmatic aspects of meaning.

An example of Incomprehension of physical material emerges from research on the Paleolithic structure built with mammoth bones known as Kostenki 11 in Russia. Contrary to conclusions from prior excavations of similar sites in Europe, the findings at Kostenki 11 do not support classifying it as a domestic structure. Its purpose remains unknown [50].

The best known example of Incomprehension in the conceptual realm is probably the Rosetta Stone. Even before the stone was discovered during Napoleon's campaign in Egypt (1798–1801), Europeans knew that Egyptian hieroglyphics were a written language, but they did not understand its semantics. The stone was quickly recognized as a key to deciphering hieroglyphics on the assumption that its three different scripts presented the same content. In principle, the Greek text was central to decoding both the hieroglyphics

and the third, little known script; however, there was a problem of Incomprehension even of the Greek because scholars were not familiar with the idiom used in Ptolemaic Egypt. Because of these difficulties, in spite of widespread interest, deciphering the Rosetta Stone took two decades [51].

Incomprehension can also result from failure to recognize that a signifier had multivalent meanings. In medieval hermeneutics; for example a words could be mapped to the properties, qualities, and the behavior of material objects. Words and other signifiers often had layered meanings with Informative Norms leading not only from signifier to referent, but also to consideration of that referent as itself a signifier whose interpretation depended on the context in which it was used. “Contrary to many modern habits of thought, for medieval exegetes, the problem was not so much the opaque literality of the material world but its potentially overwhelming polysemy, as read through the lenses of scriptural citation, typological argument, etymology, analogy, and allegory” [52] (p. 4).

Another example of Incomprehension is that Europeans recognized that Polynesians had effective techniques for navigating long distances in the open ocean from the time of Captain Cook’s voyage in 1769–70. However, it took two centuries before Westerners understood how the Polynesians did it [53]. In the interim, Polynesian navigation techniques could only be described as incomprehensible to Europeans.

These examples show that Incomprehension can take different forms. At Kostenki 11, even though similar structures are found widely across Eastern Europe, the distinctive features of Kostenki 11 and its earlier dating set it apart from the functional interpretation of other mammoth bone structures. At present, the Interpretive Context of Paleolithic archaeology related to structures made of mammoth bones does not include norms that enable definitive interpretation of its function. Medieval hermeneutics illustrates that correctly interpreting past meanings can be insufficient when things had multiple meanings. In the case of the Rosetta Stone, European linguists had Information Bundles that enabled them to translate ancient Greek into their own languages, but at the time of discovery of the stone, those bundles lacked the norms that would have enabled them to deal with the idiom of Ptolemaic Greek. Moreover, they had no information that would have enabled interpreting either the hieroglyphic or demotic scripts. In the third example, Europeans from the time of Captain Cook had sophisticated information for navigating the high seas by determination of longitude and latitude, but Polynesian methods used a different semiotics incomprehensible even to experts in European navigation methods.

4.2. Misapprehension

Misapprehension is a failure to recognize that information from or about the past has a meaning different from or additional to that recognized by the Constructor. It can result from different factors and take a variety of forms. Misapprehension occurs today in different understanding of system requirements between technicians and users. Users identify and articulate requirements in terms of their activities, whereas systems analysts and developers understand them in relation to system components, functions, and codes [54].

Misapprehension can occur when the same signifiers exist in both the Context of Construction and an Interpretive Context in Construction Material, leading to the assumption that they referred to the same things in the same ways. Many characteristics of built structures are common across time and space, including physical attributes such as size and building materials, and functional attributes such as domestic, commercial, or hygienic uses. However, some characteristics of structures are shaped by culture and may not be recognized in the Context of Construction. One significant culturally bound characteristic is that of a built structure as performative space. A space can add meaning and coherence to actions performed in it, as in Tacitus’ Death of Messalina [55], or its design can shape motion through it to impart meaning, as in the design of an Assyrian royal palace [56].

Misapprehension can easily arise from a realist orientation or ontology that leads the Constructor to dismiss or explain away things regarded as false, unreal, or impos-

sible [57,58]. This approach, if applied absolutely, renders much of human experience incomprehensible. Characterizing something the Constructor regards as false or nonexistent as delusional limits understanding of different world views. Aristotle's concept of the willing suspension of disbelief is necessary not only for efficacy of theatrical performance, but also for the understanding of broad swaths of human experience. An example of such Misapprehension in the history of chemistry is the dismissal of the work of Joseph Priestly and others in the eighteenth century on a substance—phlogiston—whose existence Lavoisier disproved and mainstream chemistry has denied ever since. The belief of Priestly and his contemporaries in the existence of phlogiston was a rational view of the evidence available to them and the methods they had for interpreting it. As Chang has noted, "It is tempting to say 'Priestley was wrong, because phlogiston simply doesn't exist', but how do we know that? To most phlogistonists, phlogiston was very real: not only observable, but even directly manipulable. It is no use pointing out that it was impossible to isolate phlogiston in its pure form. If we really required such material isolatability, we would have to renounce a whole range of scientific concepts from quarks to energy" [59] (p. 4).

Misapprehension can also result from limited access to a Target Domain as well as limitations in the Constructor's ways of representing things in the past. "Material culture exists in 3D full colour perceived by all the senses working together, but it is conveyed via words and limited, 2D, mostly black and white illustrations" [45] (p. 541). Even full-color 3D access to ancient relics such as mosaics or painted statuary, either directly or via some Reproduction, may be mistaken as an adequate exposure to something from the past, because other aspects, such as the effect of daylight or odors, as well as cultural connotations, may have been important in the original context but unobservable in the present [60,61].

Misapprehension of something in the past may only be partial. Scholars examining ancient accounting practices have been careful to consider them in context and to avoid projecting modern concepts, such as 'economy' and 'price mechanism,' onto ancient activities, while also discerning differences in different times and places [62]. Nevertheless, even nuanced and evidence-based descriptions of accounting practices cannot be said to give a complete picture of accounting in ancient civilizations. That requires supplementing such focused research with consideration of broader questions, such as how accounting activities legitimized and preserved the status quo in ancient societies. Research investigating such questions has revealed that in ancient Egypt, "Accounting functioned as a performative ritual that constructed coherence and order in the cosmos, on earth and in the netherworld. Accounting numbers were frequently combined with linguistic texts and pictorial scenes in architecture to produce a monumental discourse that made possible the construction and perpetuation of this orderly schema" [63] (p. 348). Discernment of such meanings not only enriches the history of accounting but also enables a deeper understanding of the cultural, social, and political realities of other civilizations.

4.3. Misconstruction

Misconstruction imposes inappropriate concepts, categories, relationships, or other interpretive norms on things. An example of Misconstruction is the classification of long walls erected in northeastern Asia during the eleventh to thirteenth centuries. Over a period of ninety years, scholars described these walls as military structures comparable to the great wall of China. However, research in the last decade indicates that the long-wall in the territory of the Liao empire was not constructed for defensive purposes, but as a method for monitoring and controlling the movement of nomadic populations and goods [64].

A reverse error of Misconstruction concerns prehistoric megasites in Ukraine. Although comparable in population to the earliest known cities in Mesopotamia and possibly predating them by a few centuries, the 6000 year old Trypillia settlements in Ukraine have not been included in accounts of the appearance of urban centers, apparently because they do not exhibit evidence of the hierarchical structure of the ancient cities examined in earlier research [65–69].

An example of Misconstruction in the intellectual domain is the attribution of the discovery of oxygen to Scheele, Priestly, and Lavoisier. All three isolated the gas we recognize as oxygen, but someone cannot be said to have discovered a thing when his idea of its nature is incompatible with the current conception of it. Scheele named the gas he had isolated ‘fire air.’ Priestly termed it ‘dephlogisticated air.’ The names reflect an understanding of elemental substances and chemical processes that is fundamentally different from the theory that emerged in the century after them. Even Lavoisier, who refined the experimental methods of Scheele and Priestly—thus initiating the ‘chemical revolution’ that was the death knell for their time-worn ideas—and correctly identified several empirical properties of oxygen, gave the gas this name because he hypothesized that it is an essential ingredient in all acids [70–73].

A more egregious Misconstruction can be found in Arthur Koestler’s perennially popular *The Sleepwalkers*. Koestler characterized the development of planetary theory as “a history of collective obsessions and controlled schizophrenics,” and singled out Johannes Kepler as a prime example of someone whose scientific work was more typical of a sleepwalker than a rational thinker [74] (p. 15). Neither the fact that a testable hypothesis turns out to be false nor the fact that Kepler, like other scientists, was human justify such epithets. Kepler’s astronomical work was founded on the principles that the universe is rational and knowable; the laws of nature are quantitative; the laws of nature should be expressed in mathematical formulas; and such formulas are credible only if supported by empirical data [75–77]. Kepler’s work on planetary theory overall displays the hallmark that distinguishes modern science from what came before it: to qualify as a scientific theory or hypothesis, a proposition must enable the formulation of conditions, preferably quantified, that can be empirically falsified [78].

Incomprehension, Misapprehension, and Misconstruction can occur in the same situations. Misapprehension and Misconstruction can be the result of inadequate or misdirected efforts to overcome Incomprehension. Misconstruction is the mirror image of Misapprehension. Misapprehension fails to recognize differences in meaning. Misconstruction inappropriately identifies or characterizes things in the past. Misconstruction may be a consequence of either Incomprehension or Misapprehension, and Misconstruction may entail Misapprehension.

An example of linked Misconstruction and Misapprehension occurs with the interpretation of color in studies of ancient Mesopotamia. Over the last half century, many scholars have asserted that the Akkadian language contained just four primary color words, namely white, black, red, and yellow-green, due to the misapplication of the concept that colors are represented by abstract terms and express early forms of scientific classification, whereas Akkadian, like other ancient and modern languages, refers to some colors using terms that represent physical things, such as stones or dyes, based on material characteristics such as brightness and luster. This Misconstruction impeded the recognition that both the language and the use of colors, in particular blue, for which there was not an abstract name, in Mesopotamian royal palaces expressed the wealth, authority, and power of the king [79].

A broader combination of Misconstruction and Misapprehension is the supposed dichotomy of the holy and the profane in religions in the ancient Near East. “It is a modern construction which has been anachronistically read into the sources of the Old Testament and the ancient Near East at large” [80] (p. 410). The assumption that this dichotomy appropriately characterizes the past entails a failure to recognize other important distinctions, such as between the pure and the impure. Furthermore, “If we understand Mesopotamian religion more broadly as a system of symbols and a system of communication with a specific function and meaning for their producers and recipients, we must seek for other categories to describe the divine and the institutions, symbolic actions and concepts that relate to it” [80] (p. 416).

Regardless of their differences, ideas about reducing cognitive dissonance in psychology can be adapted to reducing cognitive disparity in constructions of the past: “Dissonance can be reduced by removing dissonant cognitions, adding new consonant cognitions, re-

ducing the importance of dissonant cognitions, or increasing the importance of consonant cognitions” [81] (p. 4). However, before disparate interpretations can be removed, corrected, or reduced in importance, they must be recognized. This can be considerably more difficult than in dealing with cognitive dissonance of living people in constructions where there is no direct access to the cognitive or perceptive states of people in the past and often no direct Vestiges of their speech or gestural expressions. Analogous issues exists in various aspects of biosemiosis—notably, where the fossil record of extinct species is insufficient to determine how they interacted with their environment. Additional research is needed to identify methods for recognizing and eliminating Cognitive Disparity or reducing its impact on construction of the past.

5. Conclusions

The production of information about the past is a dual process of semiosis, involving recognizing the meaning of information that survives from the past and then respecting that meaning in satisfying the Purpose for which Information about the Past is sought. Satisfying the Purpose, using the Approach, Methods and other facets of the Context of Construction can introduce a Cognitive Disparity that distorts Information from the Past. The research developed characterizations of three general classes of possible misunderstanding of Information from the Past: Misunderstanding, Misapprehension and Misconstruction. Awareness and application of these concepts can facilitate recognizing and reducing Cognitive Disparity, improving the production of Information about the Past.

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Appendix A

Table A1. Glossary of UML Classes in Constructed Past Theory.

Term	Definition	Change	Term
Approach	The direction of an effort to learn about the past. A component of Context of Construction.	not defined previously	
Artistic Interpretation	An original work in an artistic form that references something in the past. A subclass of Constructed Past.	new term	
Circumstantial Context	The situation in which semiosis occurs.	new term	
Cognitive Disparity	A situation where Information about the Past misrepresents information from the same past.	new term	
Cognitive Purpose	An intention primarily to produce information about a Target Past. A subclass of Purpose of Construction.	new term	
Constructed Past	The information that results from an effort to learn about a target past. When used in a subsequent effort, a subclass of Construction Material.	revised definition	
Construction Material	A physical source of information about a Target Past.	revised definition	
Constructor	A person, organization, or group responsible for producing a constructed past.	unchanged	

Table A1. Cont.

Term	Definition	Change	Term
Context of Construction	The context in which a construction of the past is undertaken, including its Purpose, Approach, Method, Question, and Expected Outcome.	replaces Intent of Construction	
Creative Purpose	An intention primarily to produce information about a Target Past for use in an imaginative endeavor, such as an artistic work. A subclass of Purpose.	new term	
Expected Outcome	The ultimate consequence of a construction of the past. A component of Context of Construction.	not defined previously	
Incomprehension	An inability to understand something from a different Interpretive Context. A subclass of Cognitive Disparity.	new term	
Information about the Past	Information produced or obtained from a source or sources outside of the domain of a Target Past.	new term	
Information about the Past	Information produced in a construction of the past.	new term	
Information Bundle	A coherent set of data together with the norms that define their semantics, syntax, and pragmatics.	new term	
Information from the Past	Information obtained from a Vestige of a Target Past.	new term	
Informative Norm	The rules, definitions, schemas, conditions, conventions, and precedents that determine the referent of a datum and govern its syntax and use.		
Intentional Arena	The delineation of what things a construction of the past is about; what information about those things is sought; how that information is acquired and processed; and the outcome of the effort.	renamed and redefined	Intentional Domain
Interpretive Context	A range of circumstances in which a Sign User can produce or interpret information in or for some use or uses.	new term	
Method	A technique or process used to produce information about a Target Past. A component of Context of Construction.	not explicitly defined previously	
Misapprehension	A failure to recognize that information from or about the past has a meaning different from or additional to that of the Constructor. A subclass of Cognitive Disparity.	new term	
Misconstruction	An inappropriate identification or characterization of something in the past. A subclass of Cognitive Disparity.	new term	
Personal Purpose	An intention primarily to produce information about a Target Past to satisfy a subjective desire. A subclass of Purpose.	new term	
Pragmatic Purpose	An intention primarily to gain information about a Target Past that would contribute to achieving a practical objective. A subclass of Purpose.	new term	
Purpose of Construction	The motivation for seeking to know about a Target Past. A component of Context of Construction.	unchanged	
Question	An interrogatory expression of information sought about a Target Past. A component of Context of Construction.	not explicitly defined previously	
Reflection	A result of considering information from or about the past, separate from reproductions, technical analysis, and artistic interpretation. A subclass of Constructed Past.	revised definition	
Relic	A material Vestige, such as a fossil, evolutionary remnant, old building, manufactured product, book or work of art. A subclass of Vestige.	unchanged	

Table A1. Cont.

Term	Definition	Change	Term
Reproduction	Something that duplicates or approximates a Vestige in whole or part. A subclass of Constructed Past.	new term	
Sign User	A physical entity capable of forming, recognizing, interpreting, and applying signs.	new term	
Syndetic Context	Things that are interconnected in the production and interpretation of meanings in a semiotic system.	new term	
Target Domain	The set of entities, events, and states of affairs about which information is sought. A component of Target Past.	renamed	Field of Interest
Target Information	Information about the Target Domain, its characteristics, or things in it. A component of Target Past.	new term	
Target Past	The combination of the Target Domain, Time Window, and Target Information in a construction of the past. A subclass of Intentional Arena.	renamed and redefined	Sphere of Interest
Technical Analysis	A result of scrutiny of information from or about a Target Past using an analytic method that was not available or not used in the Target Past. A subclass of Constructed Past.	new term	
Time Window	The time period or periods during which a construction of the past seeks information about objects in the Field of Interest. A component of Target Past.	renamed and redefined	Time of Interest
Trace	A Vestige contained in or on a Relic that conveys data referring to some property of the Relic, to something else, or both. A subclass of Vestige.	unchanged	
Vestige	Something that existed within and survives from the Target Past and that presents or enables the production of information relevant to the Target Past. When used in a construction, a subclass of Construction Material.	redefined	

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