Scripts and Conceptual Change

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Abstract: Object and event concepts are represented differently in the cognitive process. Schank and Abelson have proposed to use scripts to describe people's knowledge of events, and subsequent cognitive studies indicate that our event knowledge is organized in the form of temporal and causal sequences. In this paper, I propose a frame representation of scripts that offers detailed analysis of the temporal and causal structures within event concepts. The frame representation displays the cognitive mechanisms behind the conceptual change involved event concepts, and it also distinguishes several different types of conceptual change between scripts.

1. Objects vs. Events

When philosophers of science studied conceptual change in the last couple decades, they frequently concentrated on a specific kind of conceptual development - taxonomic changes, or changes of classification systems. Consequently, they interpreted many important historical episodes of scientific change as some kind of taxonomic transformation. For example, the Copernican revolution has been illustrated as a radical reform of the taxonomy of celestial bodies, the chemical revolution as a reconstruction of the classification of substance, and the Darwin revolution as a restructure of the kind hierarchy of biological organism (Kuhn 1987 ; Thagard 1992; Hull 1989). Undoubtedly, analyzing taxonomic systems can enable us to display the cognitive mechanisms behind conceptual change with such revolutionary characters as incommensurable communities and discontinuous development. However, all taxonomic terms are object concepts, referring to instances that typically have volume and mass and usually are containable and storable, such as cars, air and birds. The world that we live in consists not only in a variety of objects, but also in a variety of events, such as engine cycles, wars, and metabolism. Unlike objects, events have neither mass nor volume, and they are not containable or storable. A typical event is a sequence of actions or a series of changes of state, which always varies with time. As reported by many cognitive studies, events are recognized, memorized, and understood by human in ways significantly different from how objects are learned, and event concepts are represented in the cognitive process differently from how object concepts are (Barsalou & Sewell 1985; Chi 1992; Chen 2003). So, whatever we have learned through analyzing taxonomic transformation can display only one kind of conceptual change.

In this paper I will offer a preliminary analysis of conceptual change between event concepts. In the following sections, I will first introduce the script model offered by Schank and Abelson to capture people's event knowledge. Subsequent cognitive studies indicate that our event knowledge is organized in the form of temporal and causal sequences. To represent the unique intraconceptual relations within event concepts, I propose a frame representation that offers detailed analysis of the temporal and causal structures of event concepts. The frame representation displays the cognitive mechanisms behind the conceptual change between event concepts, and it also distinguishes several different types of conceptual change by scripts.

2. The Script Model

Schank and Abelson in 1977 proposed a script model to represent event knowledge. According Schank and Abelson, people's knowledge of events consists in a variety of stereotyped sequences of routine actions. Examples of these stereotyped sequences of actions include riding a bus, visiting a doctor, eating in a restaurant, and so on. Through experiences, people acquire these cultural stereotypes along with their idiosyncratic variations. Schank and Abelson call these cultural stereotypes of action sequences "scripts". According to Schank and Abelson, "a script is a predetermined, stereotyped sequences of actions that defines a well-known situation" (Schank & Abelson 1977: 41). Similar to other schematic structures in knowledge representation such as schemas, scripts are made up of slots and the connections between these slots. For each of these slots, there are default values that reflect a well-known, stereotyped situation. However, scripts are different from other schematic structures in two aspects. First, the slots in scripts specify actions in a sequence; second, the connections between actions in scripts are temporal and causal. These temporal and causal connections make a script "an interconnected whole", in the sense that "what is in one slot affects what can be in another" (*Ibid*.).

Figure 1 is an outline of the script for "going to a restaurant" (Schank & Abelson 1977: 43). To be more specific, Figure 1 describes the sequence of actions happening in a particular kind of restaurant - coffee shops. Schank and Abelson called this specific version "the coffee shop track", a distinct subclass of "going to a restaurant". The restaurant script has many other distinct tracks, such as "the formal restaurant track", "the fast-food restaurant track", and "the take-away restaurant track", each of which has its unique structure.

The restaurant script has two main components. The first and the major one is a sequence of actions, which begins with "costumer goes into restaurant" and ends with "customer leaves restaurant". These actions are linked temporally and causally - a proceeding action not only occurs earlier, but also functions as one of the preconditions that enables the successive action. The preconditions for the beginning action are indicated by the entry conditions "customer is hungry" and "customer has money", and consequences of the ending actions are marked by the results "customer has less money", "customer is not hungry" and "owner has more money". The other component of the script is a list of objects that function as general preconditions for the sequence of actions. These objects are further divided into two groups: role and prop. Roles are the actors who take the actions; "customer", "cook", "waiter", "owner" and "cashier" are the standard roles in the restaurant script. Props are the means that the actors use to accomplish the actions; "table", "menu", "food", "check" and "money" are the typical props in the restaurant script.

The sequence of actions in this script can be analyzed at two levels of abstraction. At a more abstract level, it is divided into what are referred to as scenes, such as "entering", "ordering", "eating" and "exiting". At a more concrete level, the sequence is divided into actions under different scenes. In this way, there is an hierarchical structure within a script. At the top of this hierarchy is a notion that summarizes the whole event of going to a restaurant. The overall event is then broken into four scenes, which in turn decompose into actions. Similar to the hierarchical structures of object concepts (taxonomies), there is a basic level within the hierarchical structure of scripts. Experiments show that subjects prefer to use statements of actions at an intermediate level of abstraction - the level of scene - to describe events (Abbott, *et al.* 1985).

A more important interconceptual structure within scripts is the temporal, causal links between actions. As Schank and Abelson put in, "the restaurant script is a giant causal link" (Schank & Abelson 1977: 45). Schank and Abelson suggested strong causal connections between scenes and between actions. Each scene and action is causally linked with the one preceding and the one succeeding in time. In other words, each scene and action in the script results in conditions that enable the next to occur. To perform the next scene or action in the sequence, the previous scene or action must be completed satisfactory. Otherwise, a new scene or new action that is not prescribed in the original version of the script will be needed in order to get thing going again.

Script: Restaurant
Track: Coffee Shop
Props: Tables, menus, food, check, money
Roles: Customer, cook, owner, waiter, cashier

Entry Conditions: Customer is hungry.
Customer has money.

Results: Customer has less money.
Customer is not hungry.
Owner has more money.

Scenes:

1. Entering
   Customer goes into restaurant.
   Customer looks around.
   Customer decides where to sit.
   Customer goes to the table and sits down.

2. Ordering
   Customer picks up menus.
   Customer decides on food.
   Customer orders food from waiter.
   Waiter tells cook the order.
   Cook prepares food.

3. Eating
   Cook gives food to waiter.
   Waiter gives food to customer.
   Customer eat food.

4. Exiting
   Waiter writes out check.
   Waiter brings check to customer.
   Customer gives tips to waiter.
   Customer goes to cash register.
   Customer gives money to cashier.
   Customer leaves restaurant.

Figure 1. The Restaurant Script.
Adapted from Schank & Abelson (1977).

3. Dimensional Organizations

There are two different ways to represent temporal orders. The first one is to represent them the same way as the ordering of objects along certain dimensions such as size. Specifically, this is to represent stereotyped sequences of actions by temporal properties that indicate how early or late actions occur in the sequence. In the restaurant script, for example, "customer reads the menu" could have a property "early" and "customer leaves the tip" could have "late". When judging which of two actions comes earlier, one can simply choose the action with property "early" without search the whole sequence.

However, Schank and Abelson reasoned that temporal orders in event concepts are represented in a different way. According to the script model, an action's position in a sequence is represented by its relations to other actions in the causal chain. The causal relations that typically occur in well-known situations would be learned and represented in the forms of various associations in the memory. These associations function as pathways for eliciting priming or activation. A cue or a stimulus would spread along these pathways following the orders defined by the causal associations. In this way, orders of activation could determine the process time. For information to be used in such tasks as recognition judgments, it must be first activated and then inspected. Information near to the cue would be activated and inspected faster than information far away from the cue. By emphasizing on the causal connections between actions within scripts, Schank and Abelson implied that temporal orders in event concepts are represented as dimensional organizations, in which their components are chained together according to increasing or decreasing values on some dimension.

A direct implication of Schank and Abelson's script model is the so-called gap-size or distance effect; that is, when subjects are asked to process information about actions in a sequence, they should react relatively fast if the actions are close together. For example, it should take relatively short time to read the following pair of statements from the restaurant script: "waiter brings check to customer" and "customer gives money to cashier", because the "gap" between these two actions is small. But it should take more time to read the following pair of statements: "customer picks up menu" and "customer gives money to cashier", because the "gap" between these two actions is larger. Here the size of a "gap" is understood as the number of actions intervening between the two target statements in the underlying script.

However, initial empirical studies did not verify the existence of such a gap-size effect. In 1981, Nottenburg and Shoben conducted a timed judgment experiments to measure the reaction time that subjects needed to judge which of two actions from a given script (e.g. "customer picks up menu" and "customer gives tip to waiter") occurred sooner (or later). They reasoned that, if temporal information is processed sequentially as suggested by Schank and Abelson, subjects would search from the ends of the script sequentially until both actions had been activated and their temporal relations could be determined. So, if two actions are close together, subjects should be able to reach a decision quickly. However, the subjects in their experiments reacted slower as actions became closer together - the time that the subjects needed to make judgments regarding two adjunct actions was about 10% longer than the time regarding actions that were far apart (Nottenburg & Shoben 1980). This is the so-called reverse gap-size effect.

Based upon the result of their experiments, Nottenburg & Shoben subjected that temporal information is processed in the same way as the ordering of objects along certain dimensions such as size. In this kind of ordering, it has been well documented that reaction times decrease as the distance between a pair of objects on the dimension of interest increases. For example, the reaction time to decide whether an elephant or a mouse is larger would be faster than the time to decide between an elephant and a whale (*Ibid.*).

However, there was problems in Nottenburg and Shoben's experiments. They paid little attention to the hierarchical structure of scripts and sometimes asked the subjects to make judgments between actions that belong to two different levels of abstraction, the abstract scene level and the concrete action level. In the restaurant script, for example, some actions mentioned by Nottenburg and Shoben, such as "customer orders food" and "customer eats food", are actually scenes. When the subjects were asked to judge which one of two actions occur earlier, they may have to search by switching levels, which might have obscured the desired gap-size effect. Thus, the failure to appreciate the hierarchical structure of scripts could have accounted for the reverse gap-size effect reported by Nottenburg and Shoben (Abbott, *et al.* 1985). Some other reports of reverse gap-size effect could also be attributed to faults in experimental designs. For example, Franklin and Bower in 1988 observed the reverse gap-size effect - the subjects in their experiments acted more quickly to decide which one of two actions occurred earlier when the linear distance between the actions in time increased (Franklin & Bower 1988). But later it was found that such a reverse gap-size effect was probably caused by the experimental design that tested the subjects repeatedly on the same materials (Zacks & Tversky 2001).

Direct observations of the gap-size effect were first reported by Foss and Bower in 1986. In a series of experiments, Foss and Bower measured the time that subjects needed to understand a pair of statements that describe two actions in a sequence. The subjects were given two kinds of statement pairs - near-event sequences and far-event sequences. Near-event sequences contain two actions that are relatively close, such as "John made a sign" and "John participated in an anti-nuclear rally". Far-event sequences however contain two actions that are relatively far apart, such as "John made a sign" and "John wanted to stop construction of a nuclear power plant". The results of their experiments showed that the time it took to understand these pairs of actions depended on the distance of the events in the sequence: events that were further apart took longer to understand (Foss & Bower 1986).

4. Representing Event Concepts by Frames

Now, the consensus among cognitive scientists is that our knowledge of events consists in stereotyped sequences of actions structured in the form of dimensional organization in which temporally successive actions are also causally related. Schank and Abelson's script model can outline the temporal order of an action sequence, but it reveals very little about how the actions of a sequence are causally chained together. A script offers little detail for the causal connections between actions, except listing the beginning and ending points of the sequence. From the restaurant script, for example, we do not know how scene "entering" actually causes scene "ordering", nor do we have any idea of the specific kind of causal connections in effect. Furthermore, the script model does not display the roles of objects in temporal sequences. Our experience tells us that a different state of a related object could change the action sequence; for example, if certain foods are not available in a restaurant, or the waiter does not interact with a customer immediately after s/he walks in, the action sequence would proceed in a way significantly different from the one outlined in the restaurant script. To overcome these problems, I propose to use frames to capture the dimensional organizations within event concepts.

A frame is a set of multi-valued attributes integrated by structural connections. Figure 2 is a partial frame representation of an object concept "car". The frame divides features into two groups, attributes and values. All exemplars of "car" share the properties in the attribute list such as "engine" and "size". Features in the value list, however, are activated selectively to represent the prototype of a specific subordinate concept. For example, a typical compact car is one whose values for both "engine" and "size" are restricted to "small". This frame representation outlines two important kinds of intraconceptual relations. First, there are hierarchical relations between features. Contrary to the conventional assumption that all features within a concept are structurally equal, the frame representation divides features into two different levels. Some are attributes, such as "engine" and “size”, and the rest are values. A value is always attached to a particular attribute and functions as an instance of the attribute. Consequently, not all features within the superordinate concept are functionally equal: only attributes can be used as classification standards. The second kind of intraconceptual relations represented in the frame model appears as horizontal relations between features. There are connections between attributes and between values: the power of “engine” is always correlated to “size”. These connections between attributes and between values, also called structural invariants, impose constraints to the activations of values and produce systematic variability in values: if the value of “engine” is “large”, then the value of “size” would likely also be “large”.

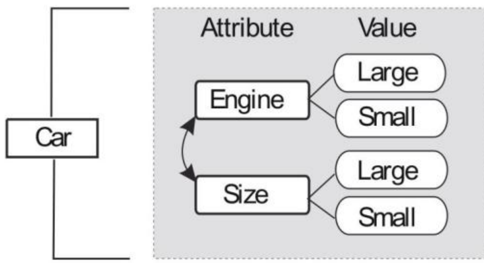

Figure 2. A Partial Frame for Car .

Using frames to represent event concepts requires a more complicate structure. Barsalou has offered a couple examples of frame representations for such events as “engine cycle” and “buying things” (Barsalou 1992). These frame models for event concepts usually contains two interconnected frames, representing both the sequence of actions and the related objects. Figure 3 is a partial frame representation for script “going to a formal restaurant”. It contains two frames. On the left-hand side of Figure 3 is a component frame that contains the major objects listed in the script (“customer”, “waiter”, “food” and “money”). These objects are treated as attributes, each of which has its own values. Unlike object concepts, however, values in the component frame are not parts or components of the attributes, but either states of the props or actions of the actors. For example, "owned by customer" and "owned by restaurant" are the two states of "money", and "walking", "selecting" and "eating" are the three actions of "customer". The frame also indicates that there are constraint relations between different sets of values. For example, if the value of "customer" is "selecting", then the value of "waiter" is typically "interacting with the customer", or if the value of "customer" is "eating", then the value of "waiter" is "interacting with others".

On top of the right-hand side of Figure 3 is another frame that captures the sequence of actions. The four attributes of this frame represent four specific moments in the sequence, or the four scenes in the script. Each of these attributes takes a set specific values corresponding to the attributes in the component frame. In Figure 3, for example, "ordering" in the action sequence takes four specific values from the four attributes in the component frame: "customer selecting", "waiter interacting with the customer", "food owned by the restaurant" and "money owned by the customer". These values display the causal connections that connect "ordering" with the proceeding scene "entering" and the consequent scene "eating". For example, "food owned by the restaurant" and "money owned by the customer" are two states that enable action "ordering", and "customer selecting" and "waiter interacting with the customer" are two actions that result in changes of state in "ordering" that subsequently enable action "eating". Enablement and resulting-in are different kinds of causal relations and play different roles in the sequence of actions (Schank & Abelson 1977). In this way, the frame outlines the causal connections between actions and distinguishes different kinds of causality.

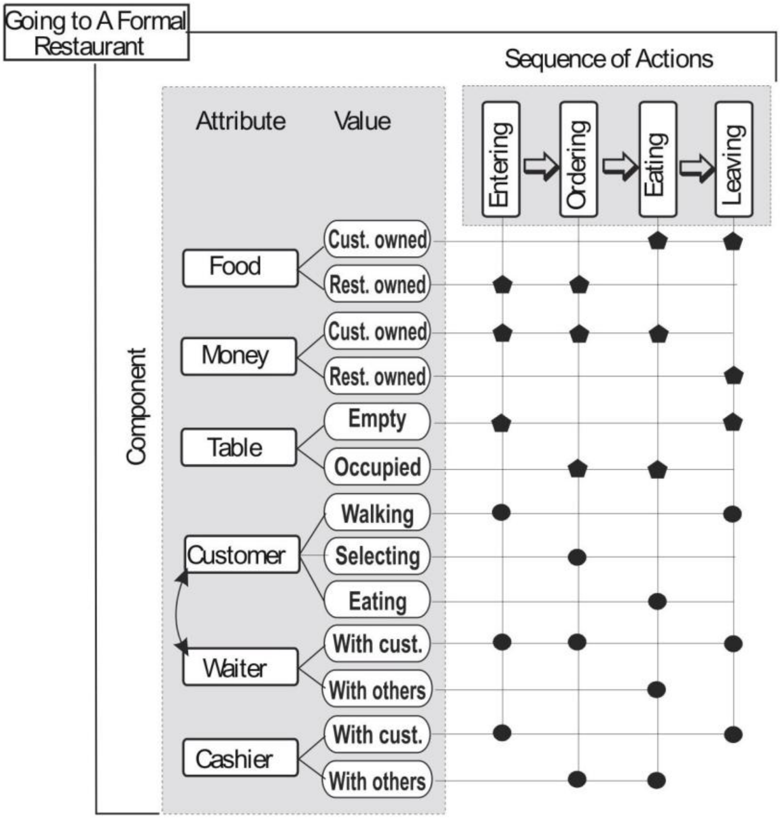

Figure 3. A Partial Frame for Going to A Formal Restaurant .

5. Misconception of Events

As stereotyped sequences of actions, scripts enable understanding when we observe conventional, routine events. For example, when we read a story that John went to a restaurant, ordered food, and later paid and left, we can understand this event by activating the restaurant script. The script would allow us to elaborate many unstated connections and answer such questions as "Did John eat?" "Did he talk to a waiter?" and "Did he receive a bill?"

However, using scripts to understand events is not fault-proof. Consider the following story: "John went to a restaurant, ordered a Big Mac, paid for it and found a nice park to sit down". If we know the meaning of "Big Mac", we would activate the fast food track of the restaurant script and understand the event. But if a reader does not know the meaning of "Big Mac", s/he might activate a different track such as formal restaurant. If so, the sequence of actions described by the story would seem rather odd - the formal restaurant track predicts that the customer should eat before pay and should eat inside rather than outside the restaurant. Without an appropriate script, the reader might not be able to elaborate the unstated connections, nor could s/he answer such questions as "Did John eat?". This is an example of misconception of events - an inappropriate script (the formal restaurant track) has been activated to represent an event that occurs in a fast food restaurant.

Misconception of events makes understanding difficult - "the lack of applicability of available scripts would make it harder (and take more time) for a hearer to understand" (Schank & Abelson 1977: 41). To amend this kind of misconception, a conceptual change, that is, a shift from a previous and inappropriate script to a proper one, is required. Misconception of events could also cause communication failure between individuals. When two persons activate different scripts to represent the same event, they could experience communication difficulties. A conceptual change, from the script adopted by one to the script adopted by the other, is also required for both sides to understand each other. How hard it would be or how much more time it would take for an individual or a community to complete such a conceptual change depends on two factors: first, the extent to which the two relevant scripts differentiate from each other; and second, what kinds of cognitive mechanisms are available for eliminating these differences.

6. Structural Differences Between Event Concepts

The frame representation of event concepts offers an effective method to analyze the relations between different scripts. Consider the following two scripts, or two different tracks of the restaurant script: the formal restaurant track and the take-away restaurant track. Figure 4 is a partial frame representation for script "going to a take-away restaurant". Comparing Figure 3 and Figure 4, we can identify the following structural differences:

First, overlapping sequences of actions. In the formal restaurant track, "entering"-"ordering"-"eating"-"leaving" is the temporal order of the sequence, while in the take-away restaurant track, "ordering" proceeds "entering" and "eating" follows "leaving". Changes in the temporal orders affect the meanings of many actions in the sequences. In the take-away track, for example, "ordering" includes actions of using telephones because it occurs before "entering", and "eating" includes actions of opening boxes because it happens after "leaving". These are not merely revisions of referents, but modifications of the underlying part-whole relations between actions at different hierarchical levels. For example, "waiter gives food to customer" is a part of "leaving" in the take-away track, but a part of "eating" in the formal restaurant track. So, the scenes in these two tracks are not merely different, but overlapping. Second, inconsistent causal connections. In the formal restaurant track, "eating" is directly enabled by the state "customer has money", but this is no longer a precondition for "eating" in the take-away track. Furthermore, such an action as "customer decides on food" results in change of state during "entering" in the take-away track, but this is not the case in the formal track. Similar to changes in the temporal orders, changes in the causal connections also alter the meanings of many actions in the sequences. In the take-away track, for instance, "entering" no longer includes such actions as "customer looks around" and "customer decides where to sit", because customers simply do not need to make these decisions.

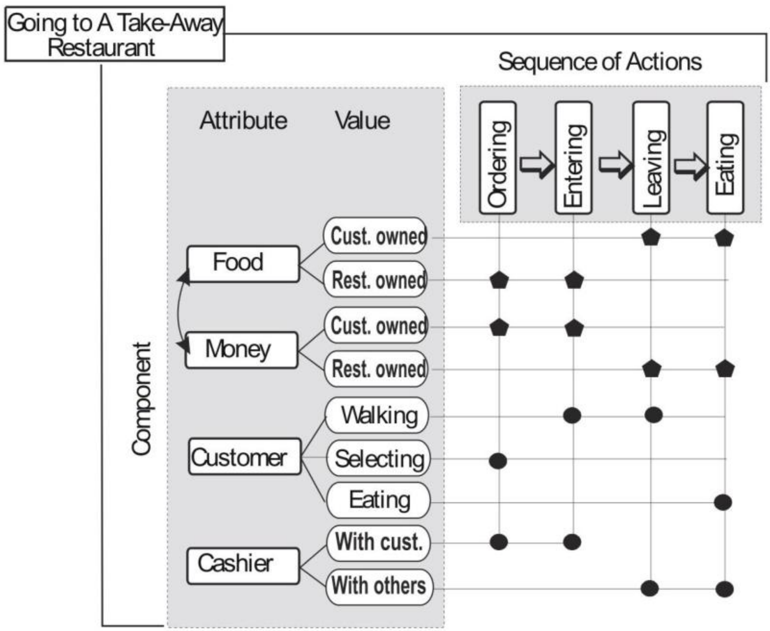

Figure 4. A Partial Frame for Going to A Take-Away Restaurant .

Third, incompatible constraint relations. The constraint relations between "customer" and "waiter" in the formal track no longer exist in the take-away track. Because customers always eat their food after leaving take-away restaurants, there are no needs to require waiters not to bother customers when they are eating. On the other hand, the take-away track has new constraint relations not in the formal track. In take-away restaurants, "food" and "money" are never in the same hand - customers must pay before they can get the food.

Fourth, incompatible attribute lists. The formal and take-away tracks involve different lists of objects. Some component attributes in one track are dropped in the other; for instance, "table" and "waiter" are not in the take-away track. Furthermore, some attributes such as "cashier" have different meanings in different tracks. In a formal restaurant, a cashier is the person who receives payment from customers, but in a take-away restaurant, a cashier typically also acts as a waiter, doing such jobs as taking orders and bringing food to customers. Thus, these attribute lists are overlapping and incompatible.

Each of these structural differences constitutes a possible source for misconception, and each of these structural differences indicates a specific direction for conceptual change to amend the misconception of events. But it is very important to note that neither of these structural differences would appear one at a time and neither of those cognitive mechanisms could be utilized individually. Since an event concepts is a giant causal link, no structural differences can be isolated locally. A difference between two sequences of actions must have correlated variations in other structural aspects such as causal connections, constraint relations, and attribute lists. So, any attempt to revise event concepts for the propose of eliminating misconception must be holistic.

7. A Different Kind of Conceptual Change

By analyzing the structural differences between scripts, the frame representation also reveals a distinct characteristics of conceptual change by scripts. A shift from one script to another is different in many aspects from a shift from one taxonomy to another. Specifically, conceptual change between scripts has its unique cognitive mechanisms dissimilar to those underneath conceptual change between object concepts.

To achieve a conceptual change between taxonomies, one must somehow adjust the corresponding object concepts, more specifically, either one or both the corresponding attribute lists. How a domain is classified or how a taxonomy is constructed is directly determined by the numbers of attributes and values, as well as the relations between attributes and the relations between attributes and values. For example, since the frame of “car” (Figure 2) has two attributes and each of them has two values, there are four possible property combinations (2x2) and thereby four possible concepts at the subordinate level. But due to the constraints between the value sets, some of these property combinations are conceptually impossible, such as “large engine” with “small size”. The results are only two property combinations, which form two subordinate concepts - “compact car” and “full-size car”. Any piecemeal adjustment in the list of attributes, such as adding or deleting an attribute or a value, altering the hierarchical relations between attributes and values, and changing the horizontal relations between attributes, could cause holistic change in the taxonomy. For example, adding a value “medium” to attribute “size” would cause a differentiation of the subordinate concepts - some instances of “compact car” are now put under a different subordinate concept “mid-size car”. Similarly, replacing attribute “size” with “door number” would cause a reorganization of the taxonomy - “coupe”, “sedan” and “wagon” would become the new subordinates, and some instances of different concepts in the old taxonomy are now put together. Thus, holistic taxonomic change can be achieved by adjusting attribute lists in a piecemeal manner.

Conceptual change between scripts, however, has a different cognitive mechanism. Similar to object concepts, one can change event concepts by altering their attribute lists. However, dissimilar to object concepts, one cannot do so in a piecemeal manner. Changes of the attribute list in an event concept always require corresponding alternations of other structural relations, including those in the sequence frames, such as the sequence of actions and the causal connections between actions. Furthermore, changes of the attribute list in an event concept inevitably alter the meaning of the concept in a holistic way. For example, different attribute lists in the two restaurant tracks discussed in the last section require different sequences of actions as well as different causal connections between actions, which in turn cause conflicting expectations between those who adopt the two corresponding scripts. Adopting the take-away track, customers would expect that foods are ready when they enter, or at least they would expect little waiting time. Different causal connections in this example could cause conflicting expectations regarding the behavior of waiters. Adopting the take-away track, customers would not expect to interact with anybody from the restaurant during leaving. Sometime, the holistic implications generated by changes of attribute lists could go beyond the observable level and alter the nature of the event as a whole. For example, the new constraint relations that corresponds to the new attribute list in the take-away track imply a new assumption regarding business transactions - no loan in take-away restaurants. The new attribute list itself also entail a different assumption regarding the division of labor in the business - no waiters are needed in take-away restaurants.

To object concepts, adjustments of attribute lists can be done not only in a piecemeal, but also in a consensual manner. Many cognitive studies have showed that when we construct a frame to represent an object concept, our selections of the attributes are not arbitrary. People often agree with each other on selected attributes in the process of frame construction, although they shared very little in their background beliefs and eventually adopt totally different frames. They frequently prefer features that contain rich spacial information as attributes. For biological objects, body parts are such preferable features - they are spatially salient because they are identifiable by their shapes and because they collectively outline the overall shape of the referents. Thus, body parts are frequently selected as attributes in constructing frames for biological concepts (Rosch, *et al.* 1976; Tversky & Hemenway 1984). The preference for spatially salient features in attribute selection can provide a common platform to form a chain of reasoning for conceptual change. By focusing on the justifications for the attribute adjustments, scientists can offer reasoned arguments for conceptual transformation between object concepts, and the scientific community can eventually reach consensus through a series of rational debates (Nersessian 1984; Shapere 1989).

Unlike object concepts, it is difficult to reach consensus regarding attribute adjustments in event concepts. Because of its holistic nature, any change of the attribute list in an event concept requires alternations in the sequence frame. To construct a sequence frame, one must bring order to a temporal flux of continuous change. Forming a sequence frame involves a process of conceptual partitioning, in which the mind extends a boundary around a portion of what would otherwise be a continuum of time. Cognitive studies have found that people are able to cut the continuity of temporal experience into discrete, bounded units in a non-arbitrary and consistent way. In a series of experiments, Newtson and Engquist asked subjects to break a continuous steam of action, such as a man searching for a lost item in a desk, into meaningful units. The subjects were instructed to identify those "breakpoints" at which one meaningful actions ends and another begins. Repeated tests showed that the subjects never selected these breakpoints randomly or arbitrary. Instead, most breakpoints that they picked correspond to moments at which the most physical features of the action are changing, and the units that they identified are significantly related to the meaning of the behavior or the event. Consequently, there is reasonably good agreement across the subjects as to what the breakpoints are, and the units identified by one group of the subjects can be reproduced with reasonable accuracy by others (Newtson & Engquist 1976). Thus, we do not conceptualize sequences of actions arbitrarily. But our consensus on temporal partitioning is not as strong as the one based on the preference for spatially salient features in object concepts. The same researchers found that subjects readily varied the number of breakpoints identified in a given sequence, in response to a variety of different situations (Newtson, *et al.* 1976). This is partly because the consensus in temporal partitioning is highly contextual, reflecting our interpretations of the meaning of the action. The complexity in temporal partitioning makes it difficult to reach consensus on attribute selections, and subsequently difficult to form a chain of reasoning for conceptual change between event concepts.

Because of the holistic nature of event concepts and the contextual nature of temporal partitioning, conceptual change between event concepts exhibits many unique characteristics that cannot be found in taxonomic change. In many ways, this is a distinct kind of conceptual change that deserves our further investigation.

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