

**THE ATTRIBUTE-SPACE-TIME CLASSIFICATION OF MIRROR-IMAGE  
INVERSION SENTENCES IN MODERN CHINESE**

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**ABSTRACT**

Mirror-image inversion sentences (MISs) are characterized by the symmetric reciprocity of syntactic components and the maintenance of propositional meanings. The previous classifications about MISs in modern Chinese have appeared confusions, cross-omissions or incomplete generalizations, no matter from the perspectives of described words, body words or constructions. Based on the three elements (i.e. attribute, space and time) of events, this paper finds that MISs in modern Chinese can fall into six categories, namely the attributive type, the spatial type, the temporal type, the attributive-temporal type, the spatial-temporal type and the attributive-spatial-temporal type.

**Key Words:** Mirror-image inverse sentences (MISs); attribute; space; time.

**1.INTRODUCTION**

The word order for modern Chinese is relatively fixed, such as *X* and *Y* before and after *P* in sentence pattern *X+P+Y* cannot be swapped arbitrarily. When *X* and *Y* commute, there are usually two kinds of results: one is that the propositional meaning is changed. For example, after *Zhang San Ai Li Si* (*John loves Mary*) becomes *Li Si Ai Zhang San* (*Mary loves John*), the propositional meaning is changed from “Ai (Zhang San, Li Si) / Love (John, Mary)” to “Ai (Li Si, Zhang San) / Love (Mary, John)”. Second, the propositional meaning is no longer reasonable. For example, when *Wo chi fan* (*I eat rice*) becomes \**Fan chi wo* (\**Rice eats me*), the meaning of the latter no longer makes sense. However, there is also a special phenomenon in which the propositional meaning does not change after the reciprocity of *X* and *Y*, for example:

(1) *Xichang tong tielu: Tielu tong Xichang*

(2) *Chuanghu yijinghule zhi: Zhi yijinghule chuanghu*

(Lv, 1979)

In view of the typical characteristics of “symmetry of syntactic components and maintenance of propositional meanings” for the above examples, this paper names these special sentences in modern Chinese as “mirror-image inversion sentences (MISs)” and formalizes a MIS as

$$X+P+Y \leftrightarrow Y+P+X$$

In the above formula, “**P**” is a described word, which is generally acted as a verb and its additional components and can be omitted in some structures; “**X**” and “**Y**” are body words, which refer to symmetrical components that can be exchanged before and after the described word and cannot be omitted. “ $\leftrightarrow$ ” refers to the relationship of a logical equivalence, indicating that the two clauses, namely “**X+P+Y**” and “**Y+P+X**”, own the same propositional meaning.

Thus, example (1) can be expressed as example (3) in this paper:

(3) *Xichang tong tielu*  $\leftrightarrow$  *Tielu tong xichang*

In example (3), “**tong**” is the described word; “**Xichang**” and “**tielu**” are the body words; Both the two clauses *Xichang tong tielu* and *Tielu tong Xichang* describe the spatial relationships between “**Xichang**” and “**tielu**”.

Studying MISs in modern Chinese can enrich linguistic theory, facilitate natural language processing and provide strategies for teaching Chinese as a foreign language. However, the present classifications of MISs in modern Chinese, no matter from the perspective of described words, body words or constructions, have appeared confusions, cross-omissions or incomplete generalizations. Therefore, this paper attempts to reclassify MISs presented in the previous literature from the three elements (i.e. attribute, space and time) of events.

## 2. PREVIOUS STUDIES ON THE CLASSIFICATIONS OF MISS

### 2.1 From the perspective of described words

Bai (1994) incidentally mentioned three categories of MISs (i.e. “resemblance”, “attachment” and “collocation”) when he classified Chinese double-faced verbs. However, there are many other MISs that cannot be incorporated into the above three categories, such as *Xichang tong tielu*  $\leftrightarrow$  *Tielu tong Xichang*, *Dahai longzhaozhe wuyun*  $\leftrightarrow$  *Wuyun longzhaozhe dahai*, *Wo xiangsi ni*  $\leftrightarrow$  *Ni xiangsi wo* and so on.

Li (1998) further divided MISs into six categories, namely “mixed”, “attached”, “supplied”, “shrouded”, “filled” and “entered” sentences. Li's classification included more examples. However, the following questions need to be considered: first of all, the “supplied” category is open to question. After the body words are exchanged, the emphasis of those sentences is changed from “supplied” to “distributed”. Second, the semantic difference between “shrouded” and “filled” is not big enough to make them two categories. Third, the sentences collected by the “entered” category are not comprehensive enough, and there are similar sentences with verb “guo (pass)” or “qu (go)” are not included.

Zhang & Chen (2000) expanded the categories of MISs more widely. They believed that MISs should also include “shi/dengyu/xiang” sentences which indicated the equal relationship between the two things, “dui/chao/ai/kou” sentences which indicated the opposite relationship, and the sentences which indicated the purely quantitative relationship. For example, *Beijing shi zhongguo de shoudu*  $\leftrightarrow$  *Zhongguo de shoudu shi Beijing*, *Xiaomen duizhe chezhan*  $\leftrightarrow$  *Chezhan duizhe xiaomen*, *Yijin wubaike*  $\leftrightarrow$  *Wubaike yijin*, etc. However, Zhang & Chen adopted the meanings of the described words to classify MISs on one hand but added several categories from

the meanings of the body words on the other hand. The mixed standards lead to the confusion of classifications.

The classifications of MISs in modern Chinese from the perspective of described words have some problems such as different classification results, intersection confusions, incomplete or over-generalizations and so on. The biggest problem is that such a classification might lead to the indecisive number of MISs because the number must depend on the semantic categories of the described words. However, how much meaning does a described word have? It's hard to know.

## 2.2 From the perspective of body words

Zhang (1993) divided MISs into six categories according to the semantic roles of the body words. The six categories included: location +V+ existent, location +V+ vehicle /human, supply +V+ user, patient +V+ instrument, patient +V+ time and material +V+ material. Zhang is a pioneer in the classification of MISs based on the semantic roles of the body words. However, how many semantic roles are there? How to determine which semantic role a body word is? Zhang did not give a clear answer.

In order to avoid the above problems, researchers suggest that semantic roles should be limited. For example, Hong (2005) limited the semantic roles to the six roles proposed by Meng (1999): instrument, patient, result, location, object and agent. Hong conducted a corpus study on the basis of 30 combinations of six roles and found that there were only nine reversible combinations. Hong's classification is more comprehensive than Zhang's, taking into account the two clauses of MISs. However, no matter how to define the semantic roles, Hong cannot answer where the meaning of a semantic role comes from?

Other researchers suggest that MISs should be classified from the perspective of the functional relationship of the body words, of which Zhou (2007) is a representative. Zhou firstly divided MISs into the spatial-positional relationship and the quantitative-proportional relationship, and then classified those relationships into subcategories according to the way in which they were generated. However, there are some problems in Zhou's subcategories, such as over-open criteria, strong subjectivity and so on. For example, why did she attribute the clauses of *Shangceng fang shuiguo* ↔ *Shuiguo fang shangceng*, which had the features of containment and dependency, to "containment type" rather than "dependency type", she did not explain clearly.

The classification of MISs from the body words shows the importance of body words. However, this classification has also some inherent problems, such as the indecisive number of semantic roles and the difficulty in determining semantic roles. On the other hand, this classification has also some problems such as too open standards and strong subjectivity.

The classification of MISs based on the described words and body words adopts the traditional bottom-up (i.e. part-whole) approach, so there are many problems. Therefore, more and more researchers suggest that MISs should be classified from top to bottom (from the whole to the part).

### 2.3 From the perspective of the constructions

Song (1991) started from the overall meanings of the sentences to make a special classification of MISs. However, such a classification has the following problems: First of all, the grammatical meaning of clause (a) cannot generalize the grammatical meaning of clause (b). For example, in (a), *Yiguo fan chi sanshige ren* can be said to mean “a pot of rice is provided for thirty people”, which expresses the meaning of “to provide”; However, *sanshige ren chi yiguo fan* in (b) cannot be described as “thirty people are provided for a pot of rice”, nor can it mean “to provide”. Secondly, the classification is not comprehensive. For example, *Xichang tong tielu* ↔ *Tielu tong Xichang*, *wo xiangsi ni* ↔ *ni xiangsi wo* cannot fall into Song’s categories.

Lu (2006) made a more comprehensive classification of MISs. Starting from the construction meaning of one of the two clauses, Lu divided the MISs into six categories: supplement, existence, causation, interaction, equivalence and relative position. Lu's categories of “supplement”, “existence” and “causation” are based on the grammatical meanings of MISs. While the categories of “interaction”, “equivalence” and “relative position” are based on the relationship between the two body words. Lu’s classification criteria are inconsistent and can easily lead to confusion. Moreover, some of the sentences such as *Wojia zai Emeishan fujin* ↔ *Emeishan zai wojia fujin*, are clearly beyond the scope of his defined MISs.

The biggest drawback for the classification from the perspective of the construction meaning is that it cannot answer the question “Where does the construction meaning come from?” and “How many constructional meanings are there?”.

Taxonomy has three basic principles: First, there should be no omissions; Second, there should be no crossing; Third, the standard should be unified (Liao, 2000). Looking back on the classifications of the MISs, all of them have the problems of confusion, cross-omission or incomplete generalization.

## 3. THE CLASSIFICATION OF MISS FROM THE PERSPECTIVE OF EVENT

### 3.1 Events and event elements

Different from the mainstream views in the current event structure theory, the event in this paper is a holistic event which integrates the basic views of “event” in ontology, philosophy, cognitive science, linguistics and so on. The overall view of events in this paper mainly includes the following three viewpoints:

Viewpoint 1: Events include real events and linguistic events. As a linguistic study, the event should be firstly the conceptual result of a real event in the objective world. Thus, it should be a reasonable scheme to examine the structure of linguistic events from the perspective of real event structure.

Viewpoint 2: Real events refer to the states or changes of the nature of the objective objects in a certain time and space, including all the static states and dynamic changes of the objective objects in the objective world.

Viewpoint 3: Linguistic events are the whole semantic content of real events expressed by language, which can be represented as different categories of linguistic events with the prominence or concealment of the elements of linguistic events, and can be encoded into specific linguistic expressions.

According to viewpoint 2, real events should include three elements of an object: attribute (a), space (s) and time (t). According to viewpoint 1, linguistic events are conceptualized as real events. Therefore, through the combination of attribute, space and time, linguistic events can be divided into the following eight categories: the zero type ( $E_0$ ), the attributive type ( $E_a$ ), the spatial type ( $E_s$ ), the temporal type ( $E_t$ ), the attributive-spatial type ( $E_a-E_s$ ), the attributive-temporal type ( $E_a-E_t$ ), the spatial-temporal type ( $E_s-E_t$ ) and the attributive-spatial-temporal type ( $E_a-E_s-E_t$ ). Because zero type are logically impossible to exist, linguistic events actually exist in only the latter seven categories, namely:

$$E=\{E_a, E_s, E_t, E_a-E_s, E_a-E_t, E_s-E_t, E_a-E_s-E_t\}$$

### 3.2 Definitions of attributive, spatial and temporal features/relationships

#### 3.2.1 Definitions of attributive features/relationships

This paper defines attributes as all the properties of an object except time and space. Attributes can be further divided into attributive features and relationships.

Attributive features refer to all kinds of properties of a single object besides time and space, such as color, taste, texture, character, degree, elasticity, hardness, humidity, quantity and so on. For example, the object “flower” has the property of “red”, and the attributive feature of “flower” can be said to be “red” as in “the flower is red”.

Attributive relationships refer to the comparisons between various properties of two objects besides time and space, such as the comparisons between color, taste, texture, character, degree, elasticity, hardness, humidity and quantity. For example, by comparing the characters between “son” and “father”, it can be said that the two persons have similar attributive relationship in character, it can be expressed as “son is like father”; Conversely, it can also be said that the two have no similar attributive relationship in character, which can be expressed as “son is not like father”.

#### 3.2.2 Definitions of spatial features/relationships

This paper holds that “space” includes “spatial features” and “spatial relationships”, and defines “space” as the spatial location, distribution and correlation of objects. Accordingly, the definitions of “spatial features” and “spatial relationships” can be expressed as follows:

Firstly, spatial features refer to the spatial location, distribution and correlation of a single object, such as the east, south, west, north, up, down, left, right, front and back of a single object. For example, if the object “John” is in the position of “above”. It can be said that the spatial feature of “John” is “above” as in “John is above”.

Secondly, spatial relationships refer to the relationships between the spatial positions,

distributions and correlations of two objects, such as the east, south, west, north, up, down, left, right, front and back relationships between two objects. For example, between the two objects “John” and “stage”, there is a positional relationship between “John” is above “stage” or “stage” is below “John”. It can be said that the spatial relationship between “John” and “stage” is “above” or “down”, which is expressed as “John is above the stage” or “\* The stage is below John”.

### 3.2.3 Definitions of temporal features/relationships

In this paper, time is simply described as “the time point, time period of objects and the characteristics of the movement change in a certain time point or time period”. Like attribute and space, time is divided into “temporal features” and “temporal relationships”.

Temporal features refer to the time point, time period of a single object and the characteristics of the movement change in a certain time point or time period. For example, the object “John” continues to “run” in a certain period of time, expressing “John” has the time feature of “run”. It can be said that “John ran for an hour”.

Temporal relationships refer to the relationships between the time points, time periods of two objects and the characteristics of the movement change in a certain time point or time period. For example, the object “John” continues to “eat” for a certain period of time; Another object “rice” continued to be “eaten” during the same period of time. In the process of continuous motion change, there is a temporal relationship between “John” and “rice” in the same period of time. It can be said that “John eats rice” or “Rice is eaten by John”.

In view of the fact that both temporal features and temporal relationships are related to the motion characteristics of an object at a certain time point or time period, this paper proposes that time is related to motion (i.e. action), and that the existence of action is temporal, and an action event is a temporal event. Further, an action event (i.e., a temporal event) necessarily involves two objects, the action sender and the action receiver. Among them, the sender must exist, and the receiver may or may not exist. In a complex event with temporal events, the sender and receiver exist in two ways: explicitly and implicitly. Thus, a complex event with temporal events has several possible scenarios, namely:

(1) If the action sender exists explicitly and the action receiver does not exist, the temporal features of the event exist explicitly.

(2) If the action sender exists implicitly and the action receiver does not exist, the temporal features of the event exist implicitly.

(3) If both the action sender and the action receiver exist explicitly, the temporal relationships of the event exist explicitly.

(4) If the action sender exists explicitly and the action receiver exists implicitly, the temporal relationships of the event exist implicitly.

(5) If the action sender exists implicitly and the action receiver exists explicitly, the temporal relationships of the event exist implicitly.

(6) If the action sender exists implicitly and the action receiver exists implicitly, the temporal relationships of the event exist implicitly.

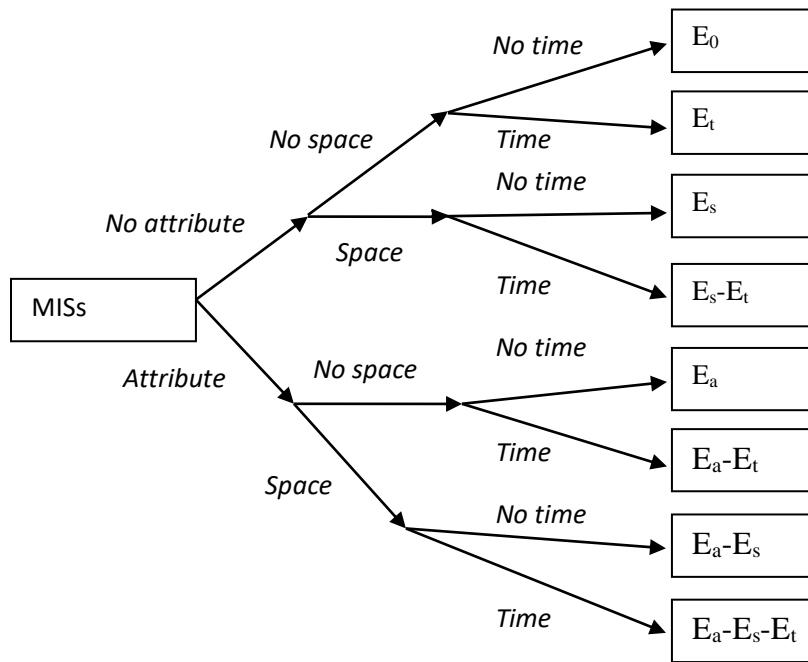
In short, when only the action sender exists in a complex event, the event may have either explicit or implicit temporal features; When there are both the action sender and the action



receiver in a complex event, the event may have an explicit or implicit temporal relationship.

### 3.3 The attribute-space-time classification of MISs in Modern Chinese

Based on the definitions of attribute, space and time, the detailed steps for determining MISs can be shown as figure 1:



**Figure 1 Flow chart of attribute-space-time determination of MISs**

According to Figure 1, the detailed steps for classifying MISs may be expressed as the followings:

Step 1: See if there is an attribute, if there isn't, then enter step 2; if there is, then enter step 5;

Step 2: And see if there is a space, if there isn't, then enter step 3; if there is, then enter step 4;

Step 3: And see if there is a time, if there isn't, then this event is  $E_0$ ; if there is, then this event is  $E_t$ ;

Step 4 : And see if there is a time, if not, then this event is  $E_s$ ; if there is, then this event is  $E_s-E_t$ ;

Step 5: And see if there is a space, if there isn't, then enter step 6; if there is, then enter step 7;

Step 6: And see if there is a time, if there isn't, then this event is  $E_a$ ; if there is, then this event is  $E_a-E_t$ ;

Step 7: And see if there is a time, if there isn't, then this event is  $E_a-E_s$ ; if there is, then this event is  $E_a-E_s-E_t$ .

This paper finds that there are six categories of MISs in modern Chinese:  $E_a$ ,  $E_s$ ,  $E_t$ ,  $E_a-E_t$ ,  $E_s-E_t$  and  $E_a-E_s-E_t$ . According to the definition of attribute, space and time, the six categories can be further divided into the following subcategories shown in Figure 2.

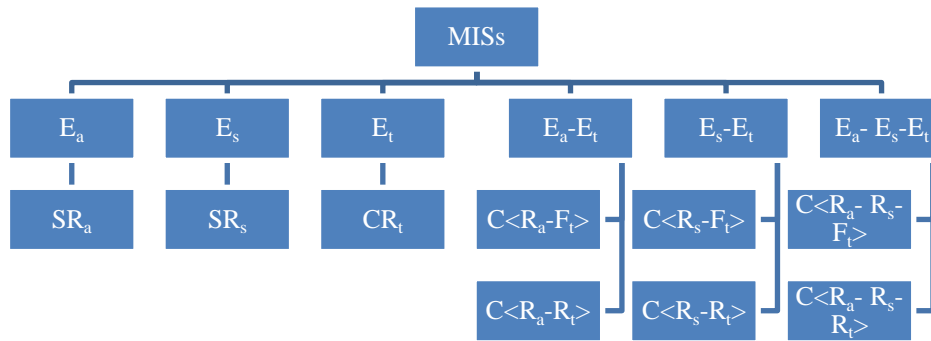


Figure 2 Classification of MISs in Modern Chinese

Examples of the above subcategories of MISs are given below.

3.3.1  $E_a$

This category has the subcategory of the simple attributive-relationship ( $SR_a$ ), which refer to those MISs only with the attributive relationship, such as example (4)-(6).

( 4 ) *Yizhi lazhu yimao qian ↔ Yimao qian yizhi lazhu* (Xing, 1984)

Example (4) expresses the quantitative equivalence between two objects, “yizhi lazhu (a candle)” and “yimao qian (a dime)”, in terms of value.

( 5 ) *Wo xiang wo gege ↔ Wo gege xiang wo* (Bai, 1994)

Examples (5) expresses the similar relationship in appearance and character between the two objects, “wo (I)” and “wo gege (my brother)”.

( 6 ) *Ganxing renshi butongyu lixing renshi ↔ Lixing renshi butongyu ganxing renshi* (Tao, 1987)

Examples (6) expresses the unequal nature between the two objects, “ganxing zhishi (perceptual knowledge)” and “lixing zhishi (rational knowledge)”.



### 3.3.2 E<sub>s</sub>

This category has the subcategory of the simple spatial-relationship (SR<sub>s</sub>), which refer to those MISs only with the spatial relationship, such as example (7).

( 7 ) Zhixian A *pingxingyu* zhixian B ↔ Zhixian B *pingxingyu* zhixian A (Tao, 1987)

Example (7) describes a parallel relationship between two objects “zhixian A (horizontal line A)” and “zhixian B (horizontal line B)”.

### 3.3.3 E<sub>t</sub>

This category has the subcategory of the complex temporal-relationship (CR<sub>t</sub>), which refer to those MISs only with the temporal relationship, such as example (8).

( 8 ) Maijinde *yujianle* maijinde ↔ Maijinde *yujianle* maijinde (Tao, 1987)

In Example (8), the objects “majinde (the gold buyer)” and “majinde (the gold seller)” are the action sender and the action receiver respectively, and both of them simultaneously send and receive an action of “yujian (meet)”, thus there is a complicated temporal relationship in this event.

### 3.3.4 E<sub>a</sub>-E<sub>t</sub>

This category has the subcategories of the complex attributive relationship-temporal feature type (C<R<sub>a</sub>-F<sub>t</sub>>) and the complex attributive relationship-temporal relationship type (C<R<sub>a</sub>-R<sub>t</sub>>), such as examples (9)-(13).

C<R<sub>a</sub>-F<sub>t</sub>> refer to those MISs with an attributive relationship and a temporal feature, such as

( 9 ) Yiba yizi *zuo* liangnian ↔ Liangnian *zuo* yiba yizi (Xiang, 1991)

In example (9), there is not only a quantitative equivalence between the two objects “yiba yizi (a chair)” and “liangnian (two years)” in term of time consumption, but also a temporal feature marked by the action concept “zuo (sit)”.

C<R<sub>a</sub>-R<sub>t</sub>> refer to those MISs with an attributive relationship and a temporal relationship, such as

( 10 ) Shige ren *chi* yiguo fan ↔ Yiguo fan *chi* shige ren (Zhu, 1982)

In example (10), there is not only a quantitative equivalence between the two objects “shige ren (ten persons)” and “yiguo fan (one pot of rice)” in terms of accommodation, but also a temporal relationship marked by the action concept “chi (eat)”.

( 11 ) Liangge ren *jiang* yige xiaoshi ↔ Yige xiaoshi *jiang* liangge ren (Song, 1991)

In example (11), there is not only a quantitative equivalence between the two objects “liangge ren (two persons)” and “yige xiaoshi (one hour)” in terms of allocation, but also a temporal relationship marked by the action concept “shuo (speak)”.

( 12 ) *Liangge xingqi du yiben shu ↔ Yiben shu du liangge xingqi* (Xiang, 1991)

In example (12), there is not only a quantitative equivalence between the two objects “liangge xingqi (two weeks)” and “yiben shu (one book)” in terms of allocation, but also a temporal relationship marked by the action concept “du (read)”.

( 13 ) *Yitiao feizao xi wuci ↔ Wuci xi yitiao feizao* (Xiang, 1991)

In example (13), there is not only a quantitative equivalence between the two object "yitiao feizao (a bar of soap)" and "wuci (five times)" in distribution, but also a temporal relationship marked by the action concept "xi (wash)".

### 3.3.5 E<sub>s</sub>-E<sub>t</sub>

There are two subcategories for E<sub>s</sub>-E<sub>t</sub>: the complex spatial relationship-temporal feature type (C<Rs-Ft>) and the complex spatial relationship-temporal relationship type (C<Rs-Rt>), such as examples (14)-(17).

C<Rs-Ft> refer to those MISs with a spatial relationship and a temporal feature, such as example (14).

( 14 ) *Jundui zhule zhesuoer fang ↔ Zhesuoer fang zhule jundui* (Ma, 1955)

Example (14) not only expresses the spatial relationship between the two objects “jundui (the army)” and “zhesuoer fang (this house)”, but also the temporal feature marked by the action concept "zhu (dwell)".

C<Rs-Rt> refer to those MISs with a spatial relationship and a temporal relationship, such as example (15).

( 15 ) *Kache Zhuang wuyanmei ↔ Wuyanmei Zhuang kache* (Shi, 1986)

( 16 ) *Xiaren chao jiucai ↔ Jiucai chao xiaren* (Ma, 1955)

In example (15), there is a spatial relationship between the two objects “kache (truck)” and “wuyanmei (anthracite)” and a temporal relationship marked by the action concept "zhuang (carry)". Example (16) shows the spatial relationship between the two objects “xiaren (shrimp)” and “jiucai (leek)” and the temporal relationship marked by the action concept “chao (stir-fry)”.

( 17 ) *Bushang xiu jinxian ↔ Jinxian xiu bushang* (Bai, 1994)

In example (17), there is a spatial relationship between the two objects “bu (cloth)” and “jinxian (golden thread)” and also a temporal relationship marked by the action concept “xiu (embroider)”.

### 3.3.6 $E_a-E_s-E_t$

There are two subcategories of this type: the complex attributive relationship-spatial relationship-temporal feature type ( $C\langle Ra-Rs-Ft \rangle$ ) and the complex attributive relationship-spatial relationship-temporal relationship type ( $C\langle Ra-Rs-Rt \rangle$ ), such as examples (18)-(20).

$C\langle Ra-Rs-Ft \rangle$  refer to those MISs with an attributive relationship, a spatial relationship and a temporal relationship as shown in the following example.

( 18 ) *Liangge ren **zuo** yitiao bandeng ↔ Yitiao bandeng **zuo** liangge ren* (Song, 1991)

Example (18) not only shows a quantitative- attribute relationship and a spatial relationship in use between the two objects “liangge ren (two persons)” and “yitiao bandeng (one bench)”, but also a temporal relationship marked by the action concept “zuo (sit)”.

$C\langle Ra-Rs-Ft \rangle$  refer to those MISs with an attributive relationship, a spatial relationship and a temporal relationship as shown in the following examples.

( 19 ) *Sizhang zhi **hu** yige chuanghu ↔ yige chuanghu **hu** sizhang zhi* (Li, 1986)

( 20 ) *Yige qingjiao **chao** liangge jidan ↔ liangge jidan **chao** yige qingjiao* (Zhang & Chen, 2000)

Example (19) shows an attributive relationship and a spatial relationship between the two objects “sizhang zhi (four sheets of paper)” and “yige chuanghu (a window)”, and also a temporal relationship marked by the action concept “hu (paste)”. Example (20) not only shows an attributive relationship and a spatial relationship between the two objects “yige qingjiao (one green pepper)” and “liangge jidan (two eggs)”, but also a temporal relationship marked by the action concept “chao (scramble)”.

## 4. CONCLUSIONS

By combining attribute, space and time of events with features and relationships of events, this paper makes a classification of mirror-image inversed sentences (MISs) in modern Chinese. According to the prominence and concealment of attribute, space and time, this paper finds that there are six categories of MISs: the attributive type ( $E_a$ ), the spatial type ( $E_s$ ), the temporal type ( $E_t$ ), the attributive-spatial type ( $E_a-E_s$ ), the spatial-temporal type ( $E_s-E_t$ ) and the attributive-spatial-temporal type ( $E_a-E_s-E_t$ ). According to the features/relationships of attribute, space and time, the above six categories can be further classified into the following subcategories: the simple attributive-relationship type ( $SR_a$ ), the simple spatial-relationship type ( $SR_s$ ), the simple temporal-relationship type ( $SR_t$ ), the complex attributive-relationship and temporal feature type ( $C\langle Ra-Ft \rangle$ ), the complex attributive-relationship and temporal relationship type ( $C\langle Ra-Rt \rangle$ ), the

complex spatial-relationship and temporal feature type (C<R<sub>s</sub>-F<sub>t</sub>>), the complex spatial-relationship and temporal relationship type (C<R<sub>s</sub>-R<sub>t</sub>>), the complex attributive-relationship, spatial-relationship and temporal feature type (C<R<sub>a</sub>-R<sub>s</sub>-F<sub>t</sub>>), and the complex attributive-relationship, spatial-relationship and temporal relationship type (C<R<sub>a</sub>-R<sub>s</sub>-R<sub>t</sub>>).

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