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# A Mini Review between Self-Other-Control and Empathy

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## Abstract

Empathy is the basis for the generation of prosocial behavior and the embodiment of individual socialization. Empathy can help individuals understand others' emotions or feelings more accurately, and correctly predict their next behavioral response according to their emotions or intentions. This article first systematically reviews the concept and core components of empathy, and on this basis, further summarizes the measurement of empathy and related theoretical explanations. Finally, we review the relationship between self-other control and empathy and its theoretical explanations. This article will help subsequent researchers to conduct relevant empirical studies based on this systematic review.

## Keywords

Empathy, Self-Other-Control

## 1. Introduction

Empathy includes emotional and cognitive components. The theoretical mechanism of self-other-control includes psychological theory and self other distinction theory. These two mechanisms are very important in the field of empathy. Researchers often discuss the concept and mechanism of the self other distinction theory with the concepts of empathy, psychological theory and perspective choice (Hoffmann et al., 2016; Tomova et al., 2014; Ruby & Decety, 2001). With the concept of self-other-control proposed, researchers found that self-other-control theory is related to cognitive empathy; some researchers believe that self-other-control theory has nothing to do with emotional empathy, but others believe that self-other-control has a positive impact on emotional empathy. At present, the relationship between self-other-control and empathy is still controversial.

This paper puts forward relevant hypotheses to explore the relationship between them.

## 2. Empathy

### 2.1. The Concept of Empathy

Most early studies on empathy paid more attention to the emotional component of empathy, and some studies defined empathy as an internal sensory and intuitive response generated passively by individuals in the process of feeling the activities of others. For example, a research believed that the reason for individuals to empathy is their own "imagination", which enabled empathizers to "automatically" feel the emotional experience of the target in the process of observing the emotional changes of others. This kind of external stimulus or person's facial expression and body movement caused the empathizers to imitate passively and obtain others' feelings in the imitation. Titchener (1909) believed that empathy was generated from the internal muscle stimulation of individuals. In his view, empathy was not the direct perception of others' activities, but the imagination and reconstruction of others' sensory experiences.

With the development of cognitive science, some researchers began to pay attention to the cognitive components of empathy. Davis (1994) believed that empathy was generated by individuals actively, and was a process in which empathizers actively feel the inner world of others and obtain others' feelings. Gladstein (1983) proposed the two-component theory of empathy, which held that empathy includes both cognitive and emotional components. Cognitive empathy was used to express the learning of others' viewpoints from cognition and understanding of emotions or events from others' perspectives, while affective empathy was used to indicate an individual's experience of others' emotional feelings. More researchers accept and adopt the two-component theory of empathy nowadays (Zheng & Li, 2006).

In combination with this theory and previous views on the concept of empathy, our study defined empathy as the experience and understanding of others' emotional states, feelings and intentions on the basis of individuals' ability to distinguish themselves from others in their minds.

### 2.2. The Components of Empathy

#### 2.2.1. Affective Empathy

Researchers studying the affective components of empathy initially defined it as a passive or active emotional response. Stotland (1969) believed that affective empathy was an individual perceived a certain emotion that others are carrying out or will experience, and produced the same emotional response passively and automatically. Eisenberg & Hand (1979) believed that affective empathy was the process in which individuals produced similar emotional responses to others in the process of understanding others' emotional states. Compared with cognitive empathy, affective empathy was a more primitive and basic kind of empathy,

and its occurrence was more direct, which can be accomplished through "emotional contagion".

The generation of affective empathy was closely related to Mirror neuron system (MNS). When an individual perceived changes in other people's body movements or facial expressions, the motor cortex involved in such movements would be automatically activated in the individual's brain, thus producing emotions similar to those of the other party during such movements (Rizzolatti & Craighero, 1999). In terms of the occurrence process, empathy mainly occur through "imitation" and tend to be an "automatic" process. Some researchers believed that when affective empathy occurs, it is difficult for individuals to detect their own imitation in the process of feeling others' emotions (Giudice et al., 2009).

#### 2.2.2. Cognitive Empathy

Cognitive empathy defined as the process in which individuals learn others' viewpoints cognitively, and then understand others' emotions and ideas (Walter, 2012). The occurrence of cognitive empathy requires individuals to represent and distinguish the relationship between themselves and others in their minds. One sign of the maturity of cognitive empathy is "self-individuation", that is, to distinguish the mental representations of themselves and others cognitively. It made empathy no longer occurs simply through imitation, but identify others' emotions or behaviors while feeling others' emotions through cognitive participation (Zhang & Su, 2008).

Cognitive empathy emphasized the need for individuals to "stand in the perspective of others", which requires individuals to suppress "egocentric bias", get rid of the constraints of their own inherent concepts, and enter the inner psychology of the other party to speculate the psychological feeling process of others (Wispe, 1986). From the perspective of its mechanism, cognitive empathy is a top-down process regulated by higher cognitive executive functions such as inhibitory control and theory of mind (Zelazo et al., 2010; Singer, 2006).

### 2.3. The Measurement of Empathy

Different researchers pay different attention to empathy, so many methods of measuring empathy have been developed for different components of empathy. This study focused on the different effects of self-other control on the two components of empathy. In terms of the measurement method of empathy, this study chose the director task with good ecological validity and is widely used to measure the level of individual cognitive empathy. Moreover, in order to more accurately measure the level of individual affective empathy and cognitive empathy in the same experiment, we adopted the two-dimension empathy test as the empathy measurement method in this study. The specific methods and advantages of each empathy measurement method are described in detail below.

#### 2.3.1. One of the Measures of Cognitive Empathy—Perspective-Taking

Perspective-taking refer to the ability of individuals to distinguish between their

own and others' opinions and to infer and react to others' opinions based on relevant information (Decety & Jackson, 2004). Perspective-taking was generally divided into cognitive Perspective-taking and affective Perspective-taking. Cognitive Perspective-taking refer to individuals' thinking or inferences about other people or the environment and other relevant information, while affective Perspective-taking refer to individuals' consciousness and inferences about other people's emotional or emotional states. Conceptually, affective Perspective-taking was cognitive empathy in general.

Many researchers put forward the different points of view on the association between perspective-taking and cognitive empathy: Davis (1980) measured Perspective-taking as a sub-dimension of cognitive empathy when compiling the widely used Interpersonal Response Index (IRI) scale; Decety & Jackson (2004) also point out that Perspective-taking is an important component of cognitive empathy from the view of epistemological; Preston & De Waal (2002) indicated that cognitive empathy refer to the ability of individuals to correctly select others' opinions after sharing emotions with others and perspective-taking was almost equivalent to cognitive empathy.

In the experimental operation, many researchers also measured the ability of perspective-taking to be equivalent to cognitive empathy: A researcher measured the level of cognitive empathy by measuring the participants' perspective-taking ability. Rameson et al. (2012) used different methods to measure perspective-taking, but they also used perspective-taking as an indicator to measure cognitive empathy. In the study of Miklikowska et al. (2011), individuals' cognitive empathy level was judged according to their performance in the story expression task in which they imagined themselves in someone else's situation.

From the theoretical view, the Russian Doll Model of Empathy proposed by De Waal (2008) can explain the relationship between perspective-taking and cognitive empathy. In this model, empathy is divided into three components, from the inside out. Among them, the innermost and most basic component is the Perception-Action Mechanism (PAM), which is mainly manifested in the form of emotional contagion, that is, affective empathy in the general sense. The middle layer is developed from the inner layer, and its core is sympathic concern, which refers to the individual's attempt to combine the emotions felt with the environment of others, and to understand the causes of others' emotions, namely cognitive empathy in the general sense. The outside layer is empathic perceptive-taking, which is similar to what we call "transpositional consideration". On the basis of the development of cognitive empathy, viewpoint taking is a more advanced form of cognitive empathy developed through the continuous development of the ability to distinguish between self and others.

In study 1, we referred to the research method of Santiesteban et al. (2012), combined with previous studies and theories, and used the director task to measure participants' perspective-taking ability as a measure of cognitive empathy.

### 2.3.2. Director Task

The Director Task was developed by Keysar Task et al., which is based on computer operation and is used to measure individual perspect-picking ability. The task required the subjects to use the mouse to move objects in different squares on the screen in accordance with the standardized voice commands emitted by the headset. A bookshelf with 16 compartments appears on the screen, with different objects in eight of the compartments. The task was used to measure the ability of perspective-taking, which was judged by the number of errors in the director condition. The subjects were asked to move certain objects to different positions while standing at the point of the director. The subjects could see all the objects in the cells, but some compartments were hidden from view from the director.

The whole task consisted of 64 trials, and participants were required to complete 64 operations, each time they were asked to move an object in the compartment. The task consisted of 8 experimental conditions, 8 control conditions and 48 filling conditions. In the director condition (experimental condition), there will be a distracting object that is the correct choice from the subject's point of view, but invisible from the director's point of view, and therefore the wrong answer. Instructions for the "moving balls to the left", for example, from the standpoint of the participants, the gray compartment within the background of white golf is the target object, but from the perspective of the designator yellow tennis for the target object, because golf for the director is not visible, therefore, the correct operation for mobile yellow instead of white golf tennis (Figure 1(a)).

The arrangement of objects in the compartment under the control condition is the same and corresponds to the experimental condition, except that the objects used to interfere with the selection of subjects in the experimental condition are replaced with irrelevant objects. For example, the control condition in Figure 1(b) corresponds to the experimental condition in Figure 1(a). There is only one difference between the two in the display of objects on the screen. The plane (irrelevant object) in Figure 1(b) replaces the white golf ball (interfering object) in Figure 1(a). Under the filling condition, all objects indicated by the instruction are visible to both the subject and the indicator.

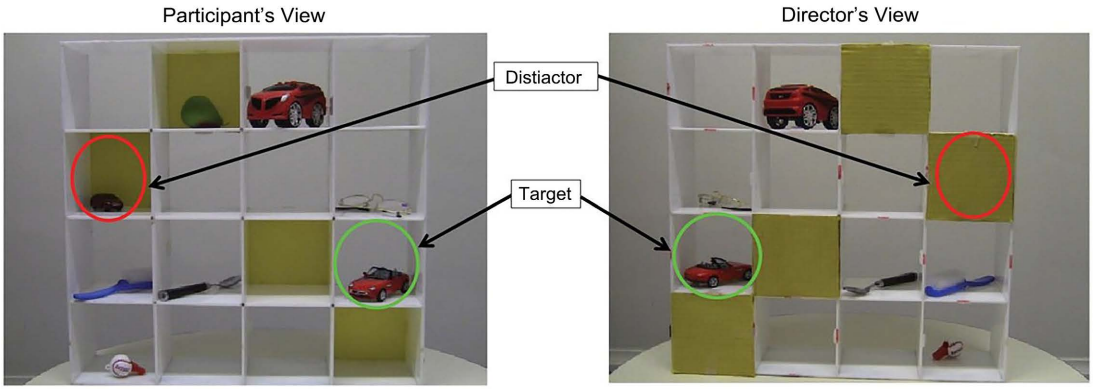


Figure 1. Indicator task example.

In the course of the experiment, the order of all the questions was balanced, and the order of each experiment was random. In terms of time arrangement, at the beginning of the task, the fixation point of 500 milliseconds will appear first, followed by the instruction, each instruction narrated time is 2.2 seconds, there will be 1.5 seconds of reaction time after the instruction, the participant needs to make a quick response. If the failure to respond in time is considered as a mistake, each trial will appear about 4.5 seconds.

In this experiment, the director task was used to judge the cognitive empathy ability of the subjects according to the number of errors in the perspective-taking condition. The fewer errors, the stronger the cognitive empathy ability.

#### 2.3.3. Interpersonal Reactivity Index (IRI)

The Interpersonal Reactivity Index is a standardized self-report scale developed by Davis (1980) to measure individual trait empathy. The scale consists of 28 questions, including 4 dimensions named empathic concern (EC), personal distress (PD), perspective-taking (PT) and fantasy (FS). The perspective-taking and fantasy dimensions reflect individual cognitive empathy, while personal distress and empathic concern dimensions reflect individual affective empathy. Each subscale has 7 questions and uses a five-point rating. IRI consists of 28 items, with internal consistency reliability of 0.53 - 0.78 and retest reliability of 0.56 - 0.82. Since IRI can measure both affective empathy and cognitive empathy, it has been widely used since the scale was published and is considered as one of the most important tools for measuring empathy (Muncer & Ling, 2006). Chinese researchers Rong & Sun et al. (2010) revised the Chinese version of the Interpersonal Response Index (IRI-C) with a total of 22 items, with internal consistency reliability of 0.53 - 0.78 and retest reliability of 0.56 - 0.82.

#### 2.3.4. Multifaceted Empathy Test, MET

Multifaceted Empathy Test is a computer-operated empathy test task developed by Dziobek et al. (2008). This test has high ecological validity and can measure individual affective empathy and cognitive empathy separately. The test consisted of 40 pictures of people in emotional situations, half of which showed positive emotions and the other half showed negative emotions. For example, the bicycle race line winner, lying on the lawn to relax the child, and so on. Participants were asked to answer two questions about each picture: "1) How is the person in the picture feeling right now? 2) To what extent do you empathize with the emotions of the people in the pictures?" The first test tested participants' cognitive empathy, asking them to choose the correct answer from four choices. The second question was used to measure the participants' affective empathy and asked them to choose a scale from 1 to 9 that best matched their psychological feelings, with 1 being not at all and 9 being very strong. The score of empathy level was calculated according to the sum of the self-rated scores of the subjects (**Figure 2**). The score of cognitive empathy level was calculated according to the proportion of the number of correct answers chosen by the subjects

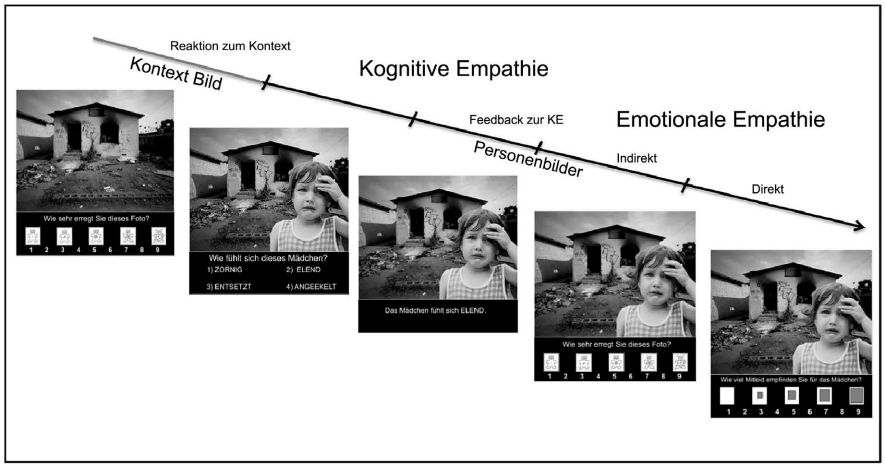


**Figure 2.** Two-dimensional empathy test.

in the total questions (**Figure 2**).

In study 2, the Multifaceted Empathy Test was used to measure the level of affective empathy and cognitive empathy after different experimental operations.

## 2.4. The Theoretical Model of Empathy

In this study, empathy is divided into affective empathy and cognitive empathy according to Decety & Jackson (2004). Although the occurrence mechanism and time sequence of these two components are different, they are closely related. In order to introduce the mechanism and relationship between affective empathy and cognitive empathy in detail, and to lay a theoretical foundation for explaining the relationship between self-other control and cognitive empathy and affective empathy, we will introduce the relevant theoretical models of empathy in detail below.

### 2.4.1. Emotion Sharing Theory

Emotion sharing theory was first proposed by Jeannerod (1999). According to this theory, the basis of empathy between individuals and others is emotional sharing, and the typical representative process is emotional infection (Jeannerod, 1999; Decety & Sommerville, 2003; Decety & Jackson, 2004; Decety & Lamm, 2006). When individuals perceive external information such as body movements, facial expressions, or voices, they automatically and synchronously activate similar movements. At the same time, the brain regions involved in the action or emotion are also activated, allowing individuals to share representations with others (Decety, 2002; Decety & Lamm, 2006). However, some researchers believe that the emotion sharing theory can only explain the occurrence of affective empathy, because individuals do not distinguish between themselves and others in the process of emotional infection, and are in an emotional state that does not know the cause of their own emotions. A typical emotional infection is that of crying among infants and young children (Decety & Lamm, 2006). Decety & Lamm (2006) argued that imagination, perception and imitation can all

produce emotional sharing.

#### 2.4.2. Perception-Action Model (PAM)

This model was proposed by Preston & De Waal (2002). According to this model, perception and action are related in the human brain, and when an individual perceives the state of others, the resonance of action will be generated automatically (Preston, 2007). Cognitive neuroscience evidence for the Perception-Action Model comes from the discovery of the mirror nervous system, and the existence of mirror neurons discovered by Rizzolatti & Craighero (1999) while studying the premotor cortex in monkeys. The mirror nervous system in humans includes the ventral premotor cortex, the inferior parietal limbic region and the posterior inferior frontal gyrus, all of which are activated in the process of observing and performing behaviors of others (Demiris et al., 2014). The discovery of the mirror nervous system supports the Perception-Action Model, in which when an individual perceives an activity performed by others, it activates similar brain regions activated when the individual perceives the activity performed by others (Preston, 2007).

#### 2.4.3. Brain Circuits for Empathy Model

The Brain Circuits for Empathy Model was proposed by Walter (2012) (**Figure 3**). According to this model, empathy can be aroused bottom-up by direct emotional infection or top-down by emotional information containing background and content, that is, empathy for others can be generated without direct contact with specific emotions. The former bottom-up mode of emotional activation is basically consistent with the Perception-Action Model mentioned above, mainly relying on the individual's "automatic imitation". In the process of top-down processing, individuals mainly produce emotional perception and understanding of high-level emotional information through projection, thus producing empathy. Projection refers to the transformation of others' emotional states into similar mental representations of their own, so as to simulate others' mental states in mind and produce emotional experiences consistent with others.

#### 2.4.4. Russian Doll Model

De Waal (2008) decomposed empathy into three interconnected levels from the perspective of the development and biological evolution of individuals' ability to distinguish between themselves and others, and proposed the "Russian Doll Model" for the development of empathy (**Figure 4**). In this model, the outer layer is a higher form of empathy that arises from the more elementary components of the inner layer. According to this model, the core mechanism of empathy is the perception-action model mentioned above, which is mainly manifested as emotional infection. It is also at the heart of the doll model in its most primitive position, while the middle and outer layers are based on this basic social emotion that humans have long developed and deeply rooted. The middle layer is compassionate care. When an individual is affected by emotion, if he

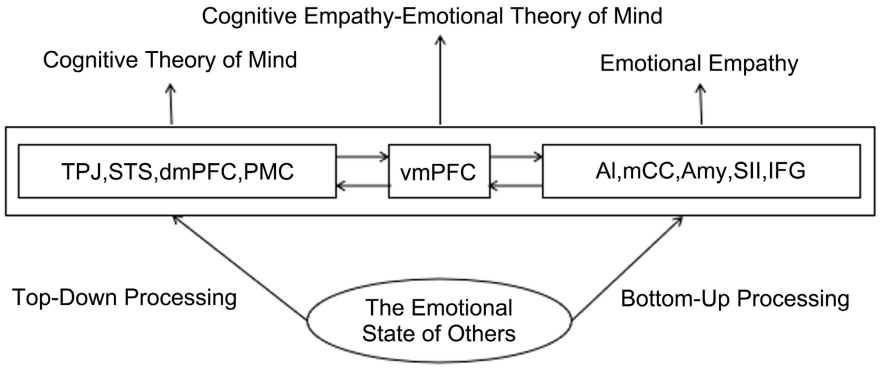


**Figure 3.** The empathy loop model.

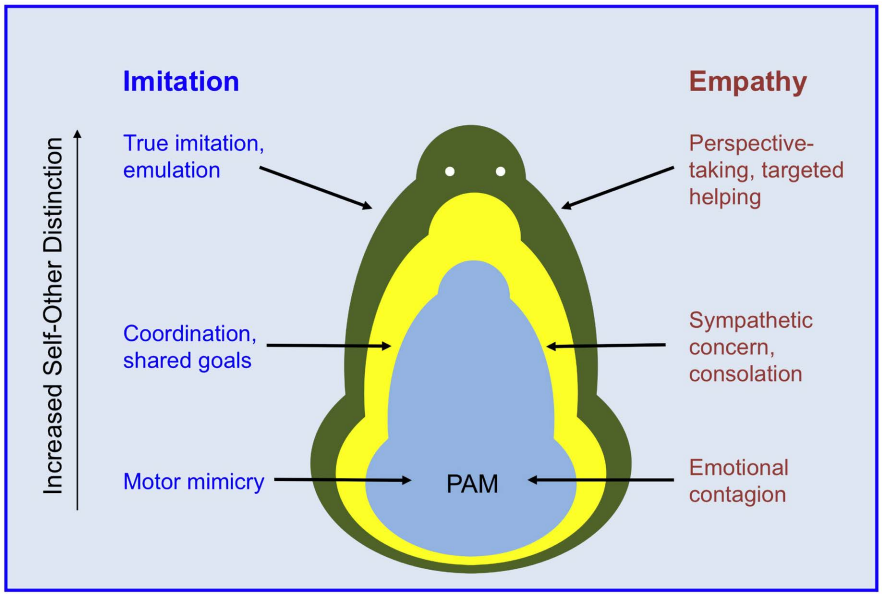


**Figure 4.** Russian nesting doll model.

tries to combine the feeling of this emotion with the environment of others, and tries to analyze and understand the cause of others' emotions, he will have compassionate care. De Waal argues that this compassionate concern is what we call cognitive empathy in general. The outermost layer is perspective-taking, which emphasizes understanding and adopting the viewpoints of others, which is similar to what we call " transpositional consideration " and is a more advanced form of cognitive empathy (De Waal & Aureli, 1996). Although the middle and outer layers of the Russian Doll Model depend on the continuous development of individuals' ability to distinguish between themselves and others, the core of these outer layers is always the PAM model.

## 3. Self-Other Control

### 3.1. The Concept of Self-Other Control

Imitation often occurs in human social activities (Hamilton, 2008). Many studies have proved that in the process of interaction with others, individuals generally

have the tendency to automatically imitate others' actions (Brass et al., 2001, 2003, 2009; Genschow et al., 2017; Heyes, 2011). The activity of the mirror neural system in individual brains is associated with this tendency to automatic imitation (Perry et al., 2017). Through the automatic imitation mechanism of the human body, the brain can match the observed actions with the perception generated by the actions, which helps us understand the intention of others' actions or speculate the reasons behind others' behaviors (Pawling, Kirkham, Hayes, & Tipper, 2017). However, automatic imitation will also bring problems to individual social activities: when the action automatically imitated is inconsistent with the active intention of the individual, the representation activated by the action intention of the individual will conflict with the representation generated by the imitation of others. In order to perform actions correctly, individuals need to properly regulate the tendency of automatic imitation according to the current environment and background. Such a self-regulation process is self-other control (Wang & Su, 2019). In this study, self-other control is defined as a process in which individuals distinguish the action representations of themselves and others in their minds according to different environments and backgrounds through the participation of cognitive functions, and regulate the possible contradictions or conflicts between them, so as to control their own external action imitation behaviors.

### 3.2. The Measurement of Self-Other Control

The imitation-inhibition task (Brass et al., 2000) is the classic task of measuring self-other control. The task goes like following: first, there is a gaze in the center of the screen for 500 milliseconds, followed by a static hand for about 2000 milliseconds, which then moves one finger (middle or index) up and down at a time for 1000 milliseconds. A number ("1" or "2") appears between the index and middle fingers at the same time as the fingers move. In the experiment, the subjects were asked to respond only according to the response signal: when they saw "1", they were asked to lift the same finger as the one on the screen, and when they saw "2", they were asked to lift the opposite finger from the one on the screen (i.e. the hand on the screen raised the index finger, and the participants were asked to lift the middle finger; The hand on the screen raises the middle finger, asking the participants to raise the index finger). Therefore, the finger lifting dimension was included with 2 conditions—consistent or inconsistent with the finger lifting mode of the target hand (**Figure 5**). During the experiment, the subjects were asked to place their index finger on the number key "7" and their middle finger on the number key "8". After each finger movement, they were required to quickly hit the corresponding number key, and their self-other control level was judged according to the response time of the key.

The basic logic of the imitation-inhibition task is that the subject will automatically generate the tendency of imitating the finger movements on the screen in the process of the task. Under the consistent condition, the subject's automatic imitation tendency will promote the same finger movements, while under

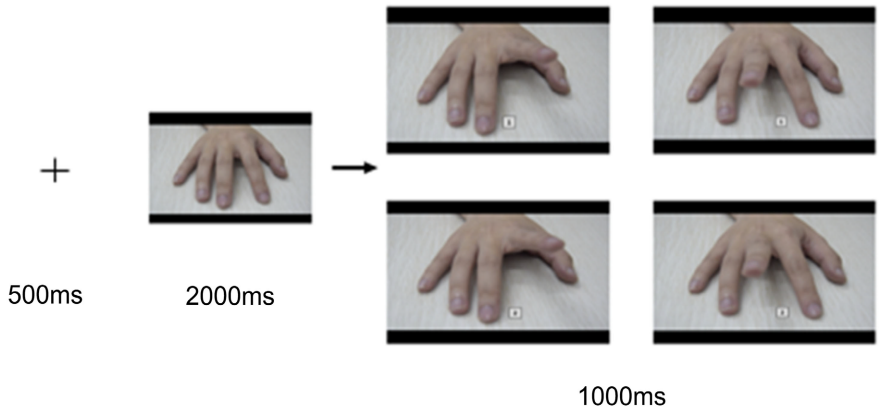


Figure 5. Mimic-inhibit task flow.

inconsistent condition, this tendency interferes with the movement of different fingers. However, individuals with stronger self-other control ability can better control their own automatic imitation tendency, so the individual's finger response is faster under inconsistent conditions. The imitative inhibition task has been widely used in research on self-other control (Wang & Su, 2019). Previous studies have found that, compared with the consistent condition, the reaction time of the subjects under the inconsistent condition is slower and the error rate is higher (Brass et al., 2001, 2003, 2005; Genschow et al., 2017).

In this paradigm, participants' self-other control ability is judged according to their reaction time under inconsistent conditions. The shorter the reaction time is, the stronger their self-other control ability is (Brass et al., 2001). It is important to note that recently have researchers let participants constantly under the condition of inconsistent task training, found that individuals respond to complete tasks faster gradually, and at the completion of training subjects after senior cognitive abilities (such as empathy, pain empathy) has improved significantly, suggesting that inhibition by imitation training, It can affect the development of higher cognitive function by improving the self-control ability of individual and others. In this study, the imitative inhibition paradigm was used to measure and manipulate participants' self-control.

### 3.3. Theoretical Mechanisms of Self-Other-Control

Since the concept of self-other control was put forward, research on its mechanism mostly focus on cognitive neuroscience. Many researchers have discussed the brain regions related to self-other control and the brain mechanism of its generation (Brass et al., 2005, 2009; Spengler et al., 2009). The research on self-other control is still in its infancy, and most behavioral studies adopt the imitation inhibition paradigm mentioned above. The mechanism of self-other control can be explained by the theory of mind and the theory of self-other differentiation. More detail of the theory of self-other control was shown following.

#### 3.3.1. Theory of Mind

The theory of mind was first proposed by Premack & Wooddruff (1978). According to this theory, individuals have the ability to attribute their own and other individuals' behaviors to their psychological states, thus deducing the causes of behaviors and forming a theoretical system. Some researchers also call the theory of mind "Social Intelligence" and defined it that individuals can represent the psychological states of themselves and others (such as emotions, intentions, expectations, etc.) in their brains in the process of social activities, and infer the behavioral intentions and emotional feelings of others, and this ability depends on the development of the cognitive system (Singer, 2006).

The theory of mind emphasizes the ability of individuals to distinguish between themselves and others, which affects individuals' perception and understanding of others in interpersonal interaction and is the basis of individuals' higher cognitive ability. When the emotional states, perceptions or beliefs of others are different from their own, individuals need to control the processing of information of themselves and others in their minds in real-time according to their own purposes and intentions and under the influence of the current environment and background (Brass et al., 2009; de Guzman et al., 2016; Santiesteban et al., 2012; Sowden et al., 2016). In these social cognitive processes, individuals also need self-other control to distinguish between self and other representations and regulate the conflicts between them.

#### 3.3.2. Self-Other Distinction Theory

Self-Other Distinction Theory is proposed by Lombardo & Baron-Cohen (2011). Lambardo found in his study of autism spectrum disorders that autism sufferers are prone to mindblindness. In social communication, they tend to be more self-centered and tend to ignore others' feelings and ideas, which is also an important reason for the common social dysfunction of individuals with Autism Spectrum Disorder. On this basis, Lombardo proposed the self-other distinction theory, which believes that individuals need to make correct judgments based on others' information and environment in the process of social communication. In the process of information analysis, individuals need to overcome their own egoism and make more judgments based on goals, which is the process of self-others distinction. To put it simply, individuals tend to judge from their own perspective when making inferences about others' behaviors or emotions, and put themselves in things and emotions to judge. It is up to the individual to overcome this tendency and make correct inferences from the standpoint of others.

Self-other distinction theory is important in the field of empathy, and its concept and mechanism are often discussed by researchers together with the concepts of empathy, theory of mind, and perspective-taking (Lamm et al., 2016; Hoffmann et al., 2016; Batson, 1997; Tomova et al., 2014; Ruby & Decety, 2001; Santiesteban et al., 2012; Preckel et al., 2018). In studies of self-other control, self-other distinction is often used to replace the concept of self-other control, or

self-other distinction theory is used to explain self-other control (Jeannerod, 2004).

## 4. The Relationship between Self-Other Control and Empathy

Since the concept of self-other control was proposed, some researchers believe that it has a deep connection with the individual's higher social cognition (Brass et al., 2009; Spengler et al., 2009). Although the concept of self-other control comes from imitation study development, recent studies have shown that the self-other control reflected in action imitative control is universal in the field, and different types of social cognition may involve the process of self-other control, that is, self-other control affects the generation and development of higher social cognition (Wang & Su, 2019). Empathy is an essential social cognitive ability in human social life. Exploring the relationship between self-otherness control and empathy is of great significance for us to understand the internal processing mechanism of social cognition.

### 4.1. The Relationship between Self-Other Control and Cognitive Empathy

From the concept and process of self-other control, self-otherness control is the basis of cognitive empathy and other higher social cognitive functions. The ability of self-other control is positively correlated with the ability of cognitive empathy. For example, Santiesteban et al. (2012) found that individuals improved their self-other control ability and thus their cognitive empathy level through imitative inhibition training. Currently, there are few behavioral studies on the relationship between self-other control and cognitive empathy, but most researchers believe that self-otherness control is related to an individual's cognitive empathy ability (Hoffmann et al., 2016; Batson, 1997; Tomova et al., 2014; Ruby & Decety, 2001; Santiesteban et al., 2012).

From a theoretical perspective, the Russian Doll Model can be used to explain the relationship between self-other control and cognitive empathy. According to the Russian Doll Model, empathy consists of three components, the innermost is the perception-action model (PAM), which is mainly manifested as emotional infection, that is, affective empathy, which is the most primitive component of empathy. When cognition is involved in empathy, an intermediate component, sympathic concern, is developed, which is also known as cognitive empathy. The outermost and highest component, viewpoint selection, can be developed only when the individual's ability to distinguish between self and others is developed (De Waal & Aureli, 1996).

From a cognitive neuroscience perspective, a lot of research on self-other control has found that anterior fronto-median cortex (aFMC) and temporo-parietal junction (TPJ) are two brain regions associated with self-other control. At the same time, these two brain regions are also considered the core brain regions of cognitive empathy (Frith & Singer, 2008). Therefore, from the evidence of brain

science research, self-other control is an important factor affecting cognitive empathy.

In this study, we referred to the methods of Santiesteban et al. and used the paradigm of perspective-taking to measure participants' level of cognitive empathy.

### 4.2. The Relationship between Self-Other Control and Affective Empathy

Affective empathy occurs mainly through simulation mechanism. Individuals can quickly imitate and copy others' emotions through "simulation", so as to feel others' emotions. This simulation process is based on brain activities such as the mirror nervous system, and it is difficult for individuals to consciously control this simulation process, because it is automated (Heyes, 2011). However, the occurrence process of self-other control is mainly to restrain individual imitation and regulate individual behavior according to the environment or individual purpose (Brass et al., 2000). Conceptually, there is no correlation between self-control and affective empathy.

Some researchers believe that although affective empathy is based on the automatic simulation of emotions, not all "shared representations" will promote individual affective empathy, because the mirror neuron system is not a separate activity and is also regulated by executive function (Brass et al., 2005, 2009). If an individual executive function is strong, it can prevent the activation of "shared representation" in the mirror neuron system through executive function, thus reducing the probability of emotional empathy. Thus, self-other control may be the regulation or suppression of emotion or action simulation.

Cognitive neuroscience also provides some evidence that self-other control does not affect affective empathy. A large number of studies have proved that the core brain regions involved in affective empathy include the dorsal anterior cingulate cortex (dACC), anterior insula (AI), and mirror nervous system (MNS) (Benuzzi et al., 2008). There is no overlap with the brain regions involved in self-other control. In addition, studies on self-other control also mention that the main role of self-other control is to control the tendency of automatic imitation, which is mainly related to the mirror nervous system (Brass et al., 2003, 2009). Therefore, it can be concluded that self-other control regulates the occurrence of automatic imitation tendencies related to affective empathy, but self-other control has no correlation with affective empathy.

The relationship between self-other control and empathy is still controversial, and some researchers believe that self-other control does not affect affective empathy (Brass et al., 2005, 2009; De Waal, 2008; Spengler et al., 2009). However, empirical studies have been lacking to confirm this conclusion. Recently, a researcher (Genschow et al., 2017) found that an individual's self-otherness control ability was positively correlated with the score of the sub-dimension of personal distress in the dimension of affective empathy. Therefore, the researcher be-

lieved that self-other control had a positive influence on affective empathy. The results of this study are different from previous studies, but we believe that self-other control does not affect empathy based on relevant theories. To support our hypothesis, we designed study 2 to explore the relationship between self-otherness control and affective empathy.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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