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The user wants me to translate a Chinese academic paper title: “有温度的阅读：共情在文本阅读中的加工机制后印本” Let me break this down: - 有温度的阅读: This is a metaphorical expression. “有温度” means “with warmth/temperature”, “warm”. So “warm reading” or “reading with warmth”. In academic context, it might refer to emotional···

Authors: The user has provided a single Chinese name: “仝宇光”. This appears to be a person’ s name, likely an author name in a scientific paper. The task is to translate this from Simplified Chinese to English with the highest accuracy and academic tone, following the critical requirements provided.

Let me analyze the requirements: 1. Preserve ALL LaTeX commands and placeholders - not applicable here as there are none 2. Preserve ALL citation commands - not applicable 3. **PRESERVE ALL ···paragraph wrapper tags EXACTLY** - not applicable, no tags present 4. Maintain academic tone and formal scientific writing style - yes, this is a name in academic context 5. Use precise technical terminology - obey the glossary strictly - the glossary provided is about machine learning/deep learning, not relevant for names 6. Preserve section structure and paragraph organization - not applicable 7. Translate all content completely - do not omit any information - this is just a name

For Chinese names, the standard academic practice is: - Keep the original Chinese characters OR - Provide the Pinyin transliteration with family name first, then given name - In many academic contexts, Chinese names are written in Pinyin with the family name first (capitalized) and given name (with first letter capitalized)

“仝宇光” is a Chinese name where: - 仝 (Tóng) is the family name (surname) - 宇光 (Yǔguāng) is the given name

In academic papers, this would typically be written as: - “Tong Yuguang” (family name first, given name second, both capitalized) - Or “TONG Yuguang” (family name in all caps is also common in some contexts) - Or “Yuguang Tong” (Western order, given name first)

The most standard and formal academic translation would be "Tong Yuguang" or "TONG Yuguang". Given the academic context and the need for highest accuracy, I should provide the Pinyin transliteration.

Since there are no tags, LaTeX commands, or other structural elements, I just need to provide the translated name. The output should be just the name itself, as per the "OUTPUT RULES" which state "Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent)."

The, The user has provided a very short input: "李颖". This appears to be a Chinese name. The task is to translate from Simplified Chinese to English with the highest accuracy and academic tone, following the critical requirements and output rules provided.

Let me analyze the input: - It's just two Chinese characters: "李颖" (with a space between them) - This is clearly a person's name - In Chinese, names are typically written as: Family Name + Given Name - "李" (Lǐ) is a common Chinese family name (surname) - "颖" (Yǐng) is a common given name

The translation of Chinese names into English typically uses Pinyin romanization. The standard format for academic papers is: - Family name first, followed by given name - Capitalize the first letter of each name component - Optionally, the family name can be written in all caps to distinguish it: LI Ying

However, in many academic contexts, especially in English-language publications, Chinese authors often write their names in the Western order (Given Name + Family Name) as "Ying Li". But the most faithful translation preserving the original Chinese order would be "Li Ying".

Given the context of academic translation and the glossary provided (which doesn't include name translation rules), I should: 1. Use Pinyin romanization 2. Preserve the original Chinese order (Family Name + Given Name) 3. Capitalize appropriately: "Li Ying"

The input does not contain: - LaTeX commands - placeholders - Citation commands ([**?**], **??**, (**??**), etc.) - ···tags - Mathematical expressions - Section structure

It's just a name. The output should be the English translation of this name.

Since there are no paragraph tags in the input, I should just provide the translated name directly without any tags. The output rules say "Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent)."

So the output should simply be: Li Ying

Wait, let me double-check the requirements. The system prompt says: - "PRESERVE ALL ···paragraph wrapper tags EXACTLY"- "Maintain exact count and IDs of ···tags - if input has N paragraph tags, output must have exactly N, The user has provided" 陈杰" which is a Chinese name. This is not a paragraph with

tags, LaTeX, or any of the complex formatting mentioned in the instructions. It' s simply a name that needs to be translated.

According to the glossary and typical academic translation practices: - 陈 => Chen (surname) - 杰 => Jie (given name)

In academic contexts, Chinese names are typically transliterated using Pinyin, with the surname first followed by the given name. So "陈杰" would be "Chen Jie" .

However, the user has written "陈杰" with a space. In English academic writing, this would typically be written as "Chen Jie" (with a space between surname and given name) or sometimes "Jie Chen" (Western order). The most common and standard format in academic papers is to keep the original Chinese order: "Chen Jie" .

Since this is not a paragraph with tags, I should just provide the translation directly without any additional formatting. The instructions say "Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent)."

So the output should simply be: Chen Jie

Wait, let me re-read the instructions carefully. The user provided "陈杰" which is just a name. The instructions are very specific about preserving tags, LaTeX commands, etc. But this input doesn' t have any of those. It' s just plain text.

The instructions say: - "Translate from Simplified Chinese to English with the highest accuracy and academic tone." - "Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent)."

So for a simple name like this, I should just provide the English transliteration. In academic contexts, Chinese names are typically written in Pinyin. "陈" is "Chen"and "杰"is "Jie". The space in the original suggests they want it separated, so "Chen Jie" would be appropriate.

But I should also consider if this might be part of a larger context. However, given only this input, I' ll provide the direct translation.

Actually, looking at the example format in the instructions, they show ···tags. But the user hasn' t provided any such tags. The instructions say "PRESERVE ALL ···paragraph wrapper tags EXACTLY

Date: 2023-10-09T00:00:00+00:00

Abstract

The user wants me to translate a Chinese academic text about SPaCEN theory, reading, and empathy into English. Let me break down the requirements:

1. **Critical Requirements:**
    - Preserve ALL LaTeX commands and placeholders exactly

- Preserve ALL citation commands ([**?**], **??**, (**??**), etc.) exactly
- **PRESERVE ALL ···paragraph wrapper tags EXACTLY**
- Maintain academic tone and formal scientific writing style
- Use precise technical terminology - obey the glossary strictly
- Preserve section structure and paragraph organization
- Translate all content completely - do not omit any information

2. **Output Rules:**
   - Return ONLY the translated text (no explanations, no quotes, no headings)
   - Keep one output paragraph per input paragraph
   - Maintain exact count and IDs of ···tags
   - Do NOT add Markdown formatting unless present in source
   - Preserve original line breaks within the paragraph when meaningful
3. **Formatting Guidelines:**
   - Keep mathematical expressions in original LaTeX format
   - Preserve equation numbers and references
   - Maintain proper academic paragraph structure
   - Use formal scientific language
   - Never remove or modify ···tags
4. **Glossary:**
   - 机器学习 => machine learning
   - 深度学习 => deep learning

Now, let me analyze the input text:

"伴随着 SPaCEN 理论的提出, 阅读对社会认知能力的促进作用引起了广泛关注。共情作为重要的社会认知能力之一, 在文本阅读中的加工机制及影响因素尚未形成统一的理论模型。共情在文本阅读中的加工机制可以从共情诱发通路的多样化, 共情体验的影响因素及其后效, 共情与文本阅读共享的脑区三方面进行剖析。未来亟需在基础加工层面和应用层面进行多维研究, 促进读者健康人格的发展和完善。"

First, I need to check if there are any tags in the input. Looking at the text provided, I don' t see any ···tags. The user says "PRESERVE ALL ···paragraph wrapper tags EXACTLY" and "if input has N paragraph tags, output must have exactly N paragraph tags with matching IDs" . But the input doesn' t have

Full Text

2. Empathy Elicitation: Diverse Pathways

Simulation represents a crucial underlying mechanism for how empathy is elicited during text reading. Among these, the Social Experience Simulation Theory posits that the simulated experiences generated by reading fictional texts can trigger and enhance readers' empathic experiences, thereby promoting the improvement and development of social cognition (Mar et al., 2011; Oatley, 2016). Reading simulation can be further divided into three forms: rhythmic simulation, content simulation, and self-simulation (Johnson-Laird & Oatley,

2022). These three simulation forms are based respectively on basic lexical features in texts, scenes of deeper-level textual events, and self-involvement. Understanding these three simulation forms is beneficial for recognizing the multiple pathways through which empathy can be elicited.

2.1 Focus on Linguistic Features: Rhythmic Simulation

Rhythmic simulation emphasizes that regular rhymes and rising and falling intonation in texts capture readers' attention, thereby guiding them to simulate textual content and generate emotional experiences. During rhythmic simulation, the linguistic features of texts are particularly important. Authors often employ techniques such as "foregrounding" to manipulate textual linguistic features, shaping the literary qualities of the text. These literary qualities can temporarily destabilize readers' personality and emotional systems, allowing narrative content to induce changes in readers' mental representations (Djikic & Oatley, 2014). For example, Koopman (2016) manipulated phonological foregrounding (e.g., alliteration), grammatical foregrounding (e.g., syntactic repetition), and semantic foregrounding (e.g., metaphor) in texts, and had participants randomly read one of three versions of a literary short story excerpt that retained different degrees of foregrounding features. The results showed that for participants who read the fully foregrounded text (the original excerpt) and the partially foregrounded text (where semantic foregrounding was replaced with more common expressions), post-reading Interpersonal Reactivity Index (IRI) scores were significantly higher than pre-reading scores, with an even greater difference between pre- and post-reading IRI scores under the fully foregrounded condition. This may be because fully foregrounded textual features help focus readers' attention on the language itself, increase the time spent processing information, promote deeper contact between readers and characters, and enhance aesthetic feelings and narrative experiences through their fluctuations, thereby generating strong empathic experiences.

Strong empathic experiences also require greater attentional arousal. Neuroimaging evidence indicates that foregrounding features such as alliteration (e.g., "first and foremost") can directly modulate attention and semantic integration (Egan et al., 2020). Certain types of literary language (metaphor, idioms, and irony) increase activation in the parietal attention network (Bohrn et al., 2012), possibly due to increased processing demands (Hartung et al., 2020). However, some studies have found that when reading adapted texts with lower foregrounding levels, readers exhibit higher empathic responses compared to reading original texts with higher foregrounding levels, a phenomenon authors attribute to the "aesthetic distance reading" effect (Kuzmičová et al., 2017). This effect occurs because, on one hand, overly rich literary features attract readers to the literary ornamentation, thereby diluting empathic or other emotional experiences; on the other hand, readers are more likely to view texts with lower literary quality as leisurely reading activities, thus more freely releasing empathic experiences.

2.2 Focus on Text Elements: Content Simulation

Content simulation emphasizes constructing the scenes and events depicted in texts and simulating the protagonist' s emotions. Content simulation is closely related to text type. Current research generally believes that reading can promote empathy development (Chlebuch et al., 2020; Turner & Felisberti, 2018), though some studies have questioned this (Langkau, 2020; Wimmer et al., 2021). For example, fiction readers outperform non-fiction readers on empathy tasks (Best, 2020; Kidd & Castano, 2019). The fundamental reason may not lie in the fiction versus non-fiction distinction, but rather in differences in textual features, including fictionality, narrativity, literary genre, and literary style.

Fictional texts refer to genres not presented as factual accounts (e.g., novels) (Koopman, 2015). Research shows that deep immersion in fictional texts evokes strong empathic experiences, while more frequent exposure to fictional texts makes readers more relaxed (Panto et al., 2022). On one hand, the virtual identity features of characters in texts may reduce readers' defensiveness, protecting them from the influence of responsibility and consequences (Bal & Veltkamp, 2013). On the other hand, humans are highly adept at feeling others' emotions and inferring others' thoughts (Breithaupt, 2012). Therefore, to avoid being overwhelmed by others' perspectives, individuals need to control excessive empathy. However, unlike reality, the "self-loss" caused by excessive empathy in text reading is not threatening. The fictionality of texts constitutes a clear, independent domain that can bypass the blocking mechanism of "protecting oneself from empathy," facilitating the activation of empathic experiences (Koopman, 2018).

Compared with fictionality, narrativity may be more explanatory in the process of how text reading influences empathy (Lenhart et al., 2020). Narrativity refers to character-driven descriptions of causally connected events centered on story characters, evoking experiences similar to the real world (Mar, 2018). For example, when participants were asked to read narrative texts (describing a young woman' s drug use story) or non-narrative texts (describing information about drug users), and after reading, choose one of three types of questions to hypothetically interview a drug offender, those who read narrative texts were more likely to choose empathic questions (e.g., "I know you' re in a difficult situation, and I' m willing to give you time, so please don' t rush") rather than non-empathic questions (e.g., "I' ve interviewed many addicts, and I can tell when they' re lying, so don' t challenge me") or neutral questions (e.g., "What time did you arrive at the crime scene") (Walkington et al., 2020). This suggests that even when facing non-positive role models, narrative reading can still promote empathy. This promotion may occur because reading triggers a "reading imagination," which is "a fundamental element of ethical stance, requiring readers to attend to the interests of others far removed from their own lives" (Nussbaum, 1998). Through this imagination, readers can reflect on the relationship between self and others, thereby deepening understanding and sympathy for others.

Text genre and style also influence empathic experiences. For example, when reading narrative texts with depression themes, participants showed stronger empathic experiences than when reading texts with sadness themes, while also demonstrating more pronounced prosocial behavior (e.g., more people were willing to donate) (Koopman, 2015). Literary excerpts with emotional themes not only evoke more emotions than those with descriptive content, but also elicit more thinking about the text and are perceived as more challenging and interesting. When readers read internally focused texts that include personal thoughts and feelings, they generate stronger empathic experiences (Salem et al., 2017). Internally focused text style allows readers to adopt the perspective of textual characters, thereby influencing different dimensions of the relationship between readers and characters: first, changing the spatiotemporal properties of readers' self-representation, extracting readers from the real world and locating them in the character' s spatiotemporal context; second, sharing the character' s cognitive attributes, including direct sensations (e.g., pulling actions) and indirect feelings (e.g., distress, pity); finally, accepting or at least partially accepting the character' s higher-level mental states (e.g., moral character, political attitudes), thereby generating empathy with the character (Salem et al., 2017). In summary, these findings suggest that certain specific textual elements can modulate the influence of text reading on empathy.

2.3 Focus on Generation Path: Self-Simulation

The self-simulation process first emphasizes readers' awareness of textual emotions, meaning readers can be conscious of and understand specific emotional content in the current text and awaken specific emotional experiences. This awareness process aligns with the ideas of the Neurocognitive Poetics Model, in which empathy, as an important indicator for measuring the affective-cognitive level, is one of the fictional feelings generated during immersion (Jacobs, 2011, 2015). Empathy involves low-level empathy (directly understanding the target' s mental state by attending to sentences describing the protagonist' s gestures or facial expressions) and high-level empathy (accepting the protagonist' s perspective and re-expressing the protagonist' s thoughts and feelings). Basic understanding of the text is a prerequisite for readers to empathize with characters. Low-level empathy infers emotions through emotion recognition but does not participate in deep understanding of the plot; high-level empathy only plays a facilitating role in deep text understanding (Werner & Lüdtke, 2021).

Second, the self-simulation process also emphasizes using existing knowledge to evaluate the work, thereby awakening empathic experiences toward the work and complex aesthetic emotions (e.g., appreciation). Empathic experiences involve both bottom-up automatic processing and top-down conscious processing. The latter emphasizes the regulatory role of emotional evaluation on empathy (Cuff et al., 2016; Singer & Lamm, 2009). For example, moral evaluation, as an important component of emotional evaluation, constitutes a crucial control mechanism for empathy elicitation. Through this mechanism, readers can con-

sciously choose whether to understand the character's situation or maintain emotional distance from the character (Breithaupt, 2012). From a moral standpoint, if readers evaluate a textual character as "not worthy of attention or morally repugnant," it can lead to interruption of empathic experiences (Cameron, 2018).

In summary, empathy during reading can be elicited through multiple pathways. Textual linguistic features coordinate attentional resources and balance aesthetic experiences through manipulating vocabulary, prosody, and rhetorical devices, thereby enhancing empathic experiences. Textual elements can elicit empathic experiences by constructing scenes with different content features. The self-simulation process emphasizes readers' awareness and evaluation of textual information. Empathy elicited through different pathways all includes three components to varying degrees: resonance, narrative engagement, and emotion and evaluation. When negative emotions experienced by story characters awaken similar emotions in readers' memories, this resonance process enhances story understanding and engagement, generating new insights from memory. Narrative engagement is a decisive characteristic of reading emotional experiences. When storylines imply potential danger, narrative engagement guides readers to activate a "psychological warning," triggering a self-protective mental state. Text-evoked emotions and the evaluation mechanism they trigger also influence readers' feelings toward characters and uncertain decision-making about subsequent events in the text (Mumper & Gerrig, 2019).

3. Empathy Experience: Influencing Factors and Aftereffects

3.1 Focus on Author' s Writing Strategies

The Theory of Strategic Narrative Empathy directly explores the role of empathy in reading from the perspective of authors' writing strategies and proposes the concept of narrative empathy (Keen, 2006, 2010). Narrative empathy refers to sharing characters' feelings and perspectives through reading, watching, listening to, or imagining narratives about characters' situations and circumstances (Keen, 2006). This theory suggests that specific narrative techniques (e.g., person, tense) can evoke empathic experiences in text reading. However, narrative techniques always coordinate with multiple variables such as text themes, reading contexts, and reader characteristics, so single narrative techniques are insufficient to explain empathy enhancement phenomena (Keen, 2019; van Lissa et al., 2018). Authors employ different narrative empathy strategies to fully elicit empathy to compensate for this limitation. From the perspective of writing techniques, the Theory of Strategic Narrative Empathy proposes three narrative empathy strategies targeting different audience groups (Keen, 2008).

First, bounded strategic empathy only works within in-groups (characters sharing similar time, space, or identity with readers), relying on experiences and impressions of familiar objects to elicit empathic experiences. Some readers are sensitive to descriptions of class, sexual orientation, and race in texts, while

others pay little attention to relevant descriptions or find it difficult to evoke cognitive and emotional changes from them. For example, when readers read texts with fear themes (e.g., fear of darkness at night) and loss themes (e.g., a beloved pet dying at the vet), readers with experiences similar to the story protagonist generated higher levels of empathic experiences, and female readers showed stronger empathic experiences than males (Eklund et al., 2009). When reading short texts about animals (e.g., monkeys) experiencing painful events or abuse, readers with similar pet-keeping experiences expressed greater empathic concern for animal welfare (Małecki et al., 2016, 2019).

Second, text reading often involves different audience groups, and in many cases, differences between groups are difficult to bridge. Ambassadorial strategic empathy targets selected objects (e.g., marginalized groups), aiming to cultivate empathic experiences toward these objects, usually accompanied by specific purposes (pursuing justice and fairness, stimulating assistance, etc.). For example, for overweight readers (BMI $>$ 25), when a short story described the protagonist experiencing social rejection due to body image in the first person, they experienced more empathic experiences and showed lower implicit weight bias compared to normal-weight readers (Teachman et al., 2003). Actively employing ambassadorial strategic empathy also has certain intervention effects. For example, after reading short texts about victims' unfortunate experiences with drug injection, systematically training readers in empathic feeling and expression (e.g., how others feel when they don' t see the victim' s progress in fighting drugs) can effectively reduce readers' social rejection of this population (Clinton & Pollini, 2021).

Third, readers' empathy includes not only strictly affective phenomena but also phenomena beyond affect (e.g., reading texts about "ocean" evokes a damp bodily sensation). Therefore, broadcast strategic empathy aims to evoke empathy for universally concerned objects (e.g., babies and disaster victims) or imaginative projection onto inanimate objects (e.g., food) and abstract forces (e.g., the universe), emphasizing the role of readers' shared experiences, psychological tendencies, and universal social cognitive attributes (e.g., hope and vulnerability) in empathy. For example, in *The Lesson Before Dying*, the author employs broadcast strategic empathy to describe cooking processes, calling on readers to recognize the importance of food (Keen, 2008). When readers lack certain social cognitive functions, empathic experiences are weaker. For example, individuals with autism spectrum disorder often exhibit narrow interests and social interaction difficulties. These patients showed weaker empathic experiences for the protagonist' s sadness after betrayal and weaker helping motivation when reading short texts about a protagonist' s private information being leaked by a friend, compared to healthy populations (Komeda et al., 2019).

3.2 Focus on Reader' s Reading Characteristics

Empathic experience is a relatively unique mental state in text reading. Previous studies have often overestimated the value of textual cues in evoking em-

pathic experiences while neglecting individual differences in readers' personal characteristics in empathic experiences. However, not all readers react to texts in similar ways (Keen, 2017). Readers' reading characteristics include both external reading conditions and internal important features. Additionally, personality traits directly related to empathic experiences (state empathy and trait empathy) also influence empathic experiences.

3.2.1 Based on Personalized Reading Perspective: Influence of Reader Characteristics on Text Reading Differences in external reading conditions directly lead to changes in the degree of empathic experience. External reading conditions include readers' reading methods (e.g., skimming, deep reading, or imaginative reading), reading media (e.g., iPad or paper), reading environment (e.g., reading scenarios using virtual reality technology), etc., all of which influence empathy (Barnes, 2018).

Reading methods influence empathic experiences by changing readers' text comprehension. For example, compared to readers who read casually (only required to read naturally), readers who read closely (underlining sentences important for event development, rereading, adding annotations about characters' attitudes and thoughts, etc.) showed enhanced emotional and cognitive empathy (Karam & Elfiel, 2020). Reading media regulates empathic experiences by changing readers' reading feelings. Compared to paper reading, sixth-grade students using iPads showed lower empathy performance (Guarisco et al., 2017). This is because when reading on iPads, readers had poorer narrative coherence experiences and less emotional investment during reading, thus not evoking strong empathic experiences. However, these differences only existed among participants who believed they were reading non-fiction works; when participants believed the story was fictional, reading media did not affect empathic experiences. Some evidence also suggests that reading media has minimal impact on empathic experiences (Schwabe et al., 2021; Somers, 2020). This may be because stories have long been passed down orally from generation to generation and often entertain the public in different forms, so people who prefer audiobooks do not experience lower empathy than those who prefer printed or electronic books (Somers, 2020). In recent years, Virtual Reality (VR) technology has been proven to more effectively evoke emotional empathy compared to other media forms (Archer & Finger, 2018; Herrera et al., 2018; Martignano et al., 2019). Compared to general reading environments, VR environments more easily stimulate immersion and thereby promote emotional empathy. VR technology isolates readers from distracting stimuli in the physical environment, helping to enhance readers' sense of presence and imagination in fictional story worlds and share the protagonist' s emotional states. The more immersed readers are in the reading process, the stronger their empathic experiences (Pianzola et al., 2019).

Internal features (age and past experiences, etc.) also influence empathic experiences (Roshanaei et al., 2019). For example, when readers have personally

experienced story events, they not only report more vivid imagery but also show enhanced connectivity in motor and visual-related brain regions as personal experience increases, indicating that personal experience leads to richer emotional experiences or deeper narrative engagement (Chow et al., 2015). Readers' empathic experiences during reading are also influenced by their own sociopolitical views, moral views, and stances, based on which they attribute characters' features to emotional states, goal needs, values, and beliefs. However, these internal features are not independent dimensions but combine with textual elements (e.g., presented or unpresented character detail information) to jointly influence readers' empathic experiences (Fernandez-Quintanilla, 2020).

3.2.2 Based on Dual Empathy Components Perspective: Influence of Trait Empathy and State Empathy on Text Reading Research has found that earlier reading exposure and higher frequency of novel reading correlate with higher trait empathy levels (Wedel et al., 2022). This may be because long-term novel reading helps readers maintain frequent reading habits and accumulate high-frequency, long-term, rich narrative reading experiences, thereby promoting the enhancement of trait empathy and lasting changes in social cognitive abilities (e.g., mental inference ability) (Mar, 2018). Trait empathy is the foundation for readers to connect a character' s feelings with their own past experiences or future goals. This means that when readers try to understand a textual character, higher trait empathy levels lead to more detailed inferences about the character' s thoughts and feelings, which increase readers' understanding and identification with the character, thereby promoting text comprehension and reflection, and even internalizing the character' s behavioral manifestations and transforming them into self-behavioral tendencies or performances. For example, readers with high trait empathy showed higher aggression tendencies after reading violent literary works (vs. watching violent TV clips/no violent media exposure) (Pigden, 2021).

Some studies have manipulated state empathy to explore its influence on reading experiences or effects. For example, Malecki et al. (2019) randomly assigned participants to low state empathy (instructed to "adopt an objective perspective toward the described content") and high state empathy (instructed to "try to feel everything the textual character experiences and the character' s feelings") conditions. The results showed that compared to participants in low state empathy, those in high state empathy had higher scores on the empathic concern subscale of the IRI, showing stronger empathic concern for textual characters, which translated into more positive attitudes toward animals described in the text. Researchers believe that attitude change achieved by evoking state empathy appears to be realized through emotional rather than rational cognitive pathways. This suggests that evoking state empathy before reading may help change readers'attitudes and viewpoints, potentially being more persuasive than typical cognitive persuasion forms.

3.3 Focus on Empathy Aftereffects of Reading

Reading, as an important factor in evoking empathy, is crucial for cultivating individuals' socio-emotional abilities. Research on early childhood shows that intensive training in reading aloud helps improve empathy and emotional responsiveness (Batini et al., 2018). Shared parent-child reading can help young children form social bonds, enhance parent-child intimacy and attachment relationships, and improve their problem behaviors (Weisleder et al., 2019; Yuill & Martin, 2016). Empathy is also an important indicator for measuring moral development and prosocial behavior (Dallacqua et al., 2022). Studies have shown that empathy can increase user engagement in social networks (Mayshak et al., 2017), reduce aggressive behavior and bullying (del Rey et al., 2016). When reading can continuously promote empathy level enhancement, it helps facilitate helping behavior and prosocial behavior. Historically, compared to individuals with lower literacy rates, when individuals live in societies with higher literacy rates and have more opportunities to read a large number of literary texts with psychological descriptions, they show more compassion and less violent behavior (Pinker, 2012).

Reading, as an important way to enhance empathy levels, also has certain psychotherapeutic value. Creative bibliotherapy refers to a rehabilitation method that improves readers' mental health through reading imaginative literary works (e.g., novels, poetry) (Malyn et al., 2020). Creative bibliotherapy involves three stages: early engagement, immersive experience, and connection. Among these, immersive experience requires readers to interact with textual characters in an empathic way (e.g., role-playing or expressive writing), thereby subtly influencing readers' spiritual world and behavioral patterns. Creative bibliotherapy has been proven to produce small to moderate positive therapeutic effects on children' s internalizing behaviors (e.g., anxiety and depression) and externalizing behaviors (e.g., aggressive behavior) (Montgomery & Maunders, 2015). Interview results from six patients in mental health recovery showed that creative and personalized psychotherapeutic approaches (e.g., having patients who love the *Harry Potter* series read *Harry Potter*) can promote readers to interact with story protagonists in spontaneous, informal, and creative ways, thereby improving readers' negative life attitudes and giving them a sense of hope (Tribe et al., 2021).

4. Shared Brain Regions Between Empathy and Text Reading

Text reading involves complex brain region activities. Research has found that text reading and empathy share some brain regions (Hartung et al., 2020; Learn & Cueto, 2017; Zhao et al., 2022). For example, the Medial Prefrontal Cortex (mPFC), Anterior Cingulate Cortex (ACC), and the Temporoparietal Junction (TPJ) located at the posterior superior temporal junction are closely related to social cognitive processes such as inferring textual characters' inner activ-

ities (Mar, 2004). These regions largely overlap with empathy-related brain regions. Brain regions for affective empathy mainly include the inferior frontal gyrus and inferior parietal lobule related to simulation, and the ACC and insula related to personal distress (one of the IRI sub-dimensions). Brain regions for cognitive empathy mainly include the ventromedial thalamus and TPJ related to self-other distinction, and the medial temporal lobe and ventromedial prefrontal cortex related to autobiographical memory (Shamay-Tsoory, 2011; Walter, 2012). Additionally, neuroimaging research results show that both reading processes and empathy experiences involve the participation of the Default Mode Network (DMN). This network (including ACC/precuneus, mPFC, bilateral angular gyrus, bilateral lateral temporal lobe, and bilateral hippocampus), composed of discrete and symmetric cortical regions, has been shown to be related to the ability to simulate hypothetical scenarios and mental states (Tamir et al., 2016).

Different text reading conditions can predict activation of empathy-related brain regions. First, text type influences empathic experiences. Compared to reading news texts, reading fiction shows stronger signals in local cerebral blood flow and oxygenated hemoglobin in the fusiform gyrus and temporal pole (TP) (Lin et al., 2019). The fusiform gyrus has been shown to be involved in processes affecting empathy (Wagner et al., 2020). TP is closely related to the degree of understanding others' mental states (Hughes et al., 2019), and TP atrophy and damage lead to reduced empathy ability (Foster et al., 2022). Research also found that the difference in mPFC activation when reading literary fiction versus non-fiction texts was positively correlated with participants' fantasy scores on the IRI scale (Altmann et al., 2014). Reading literary fiction can also promote empathy development by improving readers' mirror neuron system (Chen & Xu, 2020). Tamir et al. (2016) further proposed that fiction reading involves DMN participation and triggers at least two different types of simulation processes: vivid physical scene simulation and simulation of characters' thoughts, which induce corresponding brain region activation. Physical scene simulation is mainly related to activation of the medial temporal lobe subnetwork within the DMN, while simulation of characters' thoughts is mainly related to activation of the dorsal mPFC subnetwork of the DMN. Second, regarding literary features, compared to readers of texts with lower literary quality, readers of texts with higher literary quality showed increased activation in the left TPJ and left precuneus (Hartung et al., 2020). Regarding text valence features, texts with negative emotional content activate different brain emotion empathy networks than neutral content texts. According to the fictional emotion hypothesis of the neurocognitive poetics model, compared to neutral texts, narratives with emotional content, especially negative, moving, and suspenseful storylines, promote reading immersion by awakening readers' empathy, thereby activating affective empathy-related networks including the anterior insula, midcingulate cortex, amygdala, secondary sensory cortex, and inferior frontal gyrus. For example, when readers read fear text excerpts from the *Harry Potter* series, the correlation between midcingulate cortex activity and fear-evoking immersion scores

was significantly higher than for neutral texts. This means that descriptions of characters' suffering lead to higher reader involvement and greater participation of emotional empathy networks (Hsu et al., 2014). Additionally, during short narrative reading, the more negative the text valence, the greater the involvement of cognitive empathy-related brain regions (e.g., mPFC) (Altmann, 2018). Thus, both affective and cognitive components of empathy play important roles in text reading.

Individuals' reading volume and reading tendency are also closely related to activation of empathy brain networks. Compared to children with lower weekly reading volume, children with higher reading volume showed higher activation levels in some empathy-related brain regions (e.g., mPFC) (Learn & Cueto, 2017). On the other hand, individuals with stronger neural connections in brain networks involving language and cognitive empathy may also enjoy reading more (Hartung & Willems, 2020).

In summary, different text features and reading volume are closely related to brain activities associated with empathy. Future research needs to further explore: (1) the causal relationship between text reading and empathy through longitudinal studies to clarify the longitudinal relationship between empathy changes and brain functional connectivity; (2) which core text features can evoke stronger activation of empathy brain regions, as different studies often select different text materials; (3) most current research on the neural mechanisms of empathy should incorporate more reader factors, such as readers' personality traits and reading experiences (e.g., immersion), to further explore interactions between different factors.

5.1 Exploring a Distributed Component Processing Model of Text Reading and Empathy

How texts maintain coherent representation has long been a central concern for text reading researchers. Within the framework of situation models, numerous studies have revealed the role of different indices (e.g., protagonist shifts or emotions) in maintaining coherent representation of deep text situations (Ferstl et al., 2005; Kang et al., 2020). However, if text reading remains only at the level of maintaining coherent representation, readers' experiences remain "cold." In reality, text reading makes readers feel the warmth and coldness between people and influences how they treat others outside the text. Text reading is warm; textual scenes constitute a micro social world where readers can put themselves in characters' shoes, experience characters' emotions here and now, and be touched by characters' personalities, even further changing values and beliefs. Exploring the relationship between empathy and text reading is an important pathway to understanding the social function of text reading. However, no text processing model specifically focusing on text reading and empathy has been found (Mar, 2018). Specifically, current theories each have their own starting points and emphases, with weak connections between them. For example, narrative empathy theory explains how text reading influences empathy from the perspective of

narrative techniques but does not consider the relationship between narrative techniques and other text features (e.g., fictionality). When specific narrative techniques combine with different text features, how empathic experiences differ remains to be resolved.

In summary, this paper attempts to propose a distributed component processing model of text reading and empathy from a multidimensional perspective to clarify the processing mechanism of empathy in text reading (see Figure 1 [Figure 1: see original paper]). In this model, empathy is the product of the joint action of three components: author, text, and reader. The author' s writing strategies, text type, features, and content, as well as reader characteristics, all influence readers' empathic experiences. With the superposition of elements in each component, the gradual activation of empathic states from "none"to "some" is slowly achieved. Specifically: (1) Authors may select corresponding writing strategies based on the intended audience (Keen, 2008), aiming to evoke empathic experiences toward specific groups, including bounded strategic empathy for in-groups, ambassadorial strategic empathy for out-groups, and broadcast strategic empathy for universally concerned objects. For example, a text about racial discrimination that only describes the terrible plight of African Americans may arouse African Americans' desire to oppose racial discrimination and oppression but may not be sufficient to initiate a national civil rights action, as the material only works within the in-group. In contrast, texts advocating "eliminating HIV stigma" using ambassadorial strategic empathy may evoke understanding and empathy from the general population toward people with AIDS. Therefore, targeted writing strategies may be the "knocking brick" for eliciting empathy. (2) Different text types and features may elicit or enhance readers' empathic experiences through different pathways such as awakening attention (Bohrn et al., 2012), activating familiar features (Mar, 2018), and reducing defensiveness (Koopman, 2018). Text content arrangement can also facilitate readers' inference of characters' theory of mind through emotional valence (Devlin et al., 2014), perspective markers (Salem et al., 2017), protagonist characteristics (Lüdtke et al., 2014), etc., thereby promoting readers' integration into the storyline from the characters' perspective. For example, emotional consistency theory suggests that people are more sensitive to emotional information consistent with their own, so emotional valence matching may influence individuals' empathic accuracy toward empathy targets (Devlin et al., 2014). (3) Relevant reader characteristics also affect the processing of empathy in text reading. In addition to reading habits, reading methods, reading environments, and emotional and cognitive empathy mentioned above, regarding personality traits, Mar et al. (2009) introduced individual difference variables when first investigating the relationship between fiction exposure and social ability. They found that after controlling for the personality trait of openness, fiction exposure still predicted cognitive empathy performance. Additionally, the higher readers' agreeableness, the stronger the emotion empathy induced by stories (Topić, 2021). This may be because high agreeableness implies a gentler temperament, greater helpfulness, and more tolerant personality, with stronger motivation to maintain good

relationships with others. Therefore, during reading, readers with high agreeableness may trigger higher levels of emotional investment, which may evoke stronger emotional empathy and thereby promote text comprehension or enhance reading maintenance.

Furthermore, the distributed component processing model assumes that the empathic experience activated by text reading is reflected at the neural level, cognitive-affective level, and behavioral level. First, at the neural level, empathy-related brain regions (including TP, TPJ, fusiform gyrus, mPFC) are activated during reading, manifested as increased local cerebral blood flow and oxygenated hemoglobin. As empathy elicitation and experience unfold, brain region activation shows region-specific characteristics with the depth of immersion in reading. Region-specificity means that brain regions performing different functions show different activation levels at different cognitive stages. At the reading onset stage, brain regions related to memory, encoding, and retrieval (e.g., dorsolateral prefrontal cortex related to cross-temporal and cross-modal processing) will first show widespread activation. Next, brain regions related to motivation and reasoning (e.g., mPFC, ACC, TP, and TPJ) remain active during reading. Subsequently, brain regions clearly related to empathy such as TP, inferior frontal gyrus, etc., show sustained or fluctuating activation states. At the cognitive-affective level, the empathy process is a subjective experience accompanied by attention, memory, reasoning, and emotional processes. The distributed component processing model assumes that empathy is both a product accompanying the above cognitive factors and the basis for promoting readers to better attend to textual cues, remember important information, and make reasonable inferences. At the behavioral level, besides focusing on the long-term improvement effects of reading-evoked empathic experiences on individual social cognitive attitudes (e.g., prejudice and stereotypes), attention should also be paid to the beneficial effects of empathy levels improved through reading training on helping behavior and prosocial behavior.

Moreover, immersive reading experiences may exhibit specific eye movement patterns. Preliminary evidence shows that when participants watch videos that evoke empathic experiences, pupil diameter, long-duration fixations, and saccade size and frequency all differ significantly from videos that do not evoke empathic experiences (Zhang et al., 2022). Similarly, when watching narrative videos, participants' eye movement patterns are also closely related to empathy. For example, when participants were asked to watch a self-narrative video while imagining sitting in front of the protagonist listening to the story, the results showed that compared to calm facial expressions, when the protagonist' s facial expressions were fully expressed, participants' post-viewing cognitive empathy scores showed significant positive correlation with pupil size synchronization scores (Kang & Wheatley, 2017). Based on these findings, it can be inferred that when readers share story protagonists' emotional experiences, they may produce empathic experiences similar to watching videos with similar plots.

Future research should fully combine different textual foregrounding or back-

ground features and different narrative techniques, using functional magnetic resonance imaging, event-related potential technology, and eye-tracking technology to achieve in-depth exploration of empathic experiences in text reading from neural foundations to social behavior. Specifically: (1) At the neural level, further reveal the causal relationship between reading characteristics and empathic experiences. For example, use transcranial direct current stimulation and other neuromodulation techniques to excite or inhibit activity in empathy-related brain regions and monitor readers' subjective (e.g., emotional arousal, reading transfer) and objective (e.g., eye movement patterns) empathic performance during reading. (2) At the cognitive-affective level, future research can focus on how readers' general cognitive processes such as attention, memory, and reasoning participate in the interaction between reading and empathy, and monitor the emotional states generated during reading. (3) At the behavioral level, on one hand, text reading' s promotion of empathy may be reflected in changes in indicators such as fixation duration, eye movements, and emotional ratings; on the other hand, the interaction between text reading and empathy can subtly influence readers' social attributes, such as personality traits, morality, and prosocial behavior.

5.2 Conducting Culturally Matched Local Research Aligned with Contemporary Backgrounds

Literature originates from reality and is the epitome of times and society. China is a collectivist country, while the West emphasizes individualism. Chinese literary works are often implicit and restrained, whereas Western literary works pursue passionate, direct, and clearly structured overall aesthetics. Different cultural backgrounds influence the tone of literary works and may consequently affect readers' empathy. Cross-cultural research also shows that individuals' empathy abilities differ across cultural backgrounds (Zhao et al., 2021). How literary works, as carriers of various cultures, influence empathy remains to be explored.

Currently, localization research on the relationship between literary work features and empathy is limited. Future research can attempt the following: First, design text materials with greater ecological validity, adopt more sensitive reading manipulation methods, investigate how reading of locally characteristic textual "virtual worlds" influences empathic experiences, and further focus on the causal mechanisms behind this influence. Existing research mainly focuses on emotional discourse or emotional contexts, exploring characteristics of discourse emotion understanding and readers' tracking and updating patterns of story protagonists' emotional changes (Zhang et al., 2017). Activating strong empathic experiences in text reading requires not only monitoring or detecting protagonists' emotional features (Bohn-Gettler, 2019; Lu & Ma, 2011), but also starting from authors' writing characteristics, text materials' own features, and reader characteristics to actively explore how different cues effectively promote empathy during reading. For example, through different author writing strategies,

giving life and flesh to story protagonists and three-dimensionalizing character images can promote readers' assimilation of the "ideal self" into the "mirrored self." Through inference of causal relationships in discourse-described events and processing of emotional verbal symbols ("overwhelmed with grief," "beaming with joy"), emotional contagion is achieved, thereby awakening readers' deep emotional empathy experiences. Through textual spatiotemporal feature descriptions that render a sense of picture, readers are induced to substitute the protagonist' s identity characteristics, think more deeply about the protagonist' s inner activities, and thereby enhance cognitive and emotional empathy. Through the self-simulation process, readers' awareness and evaluation of textual information are promoted, further strengthening textual events' influence on readers' thinking and changes in their own values, thereby evoking stronger empathic experiences toward protagonists' behaviors and emotions.

Second, explore the relationship between China' s unique text characteristics and empathy. Classical Chinese and poetry are important components of Chinese language textbooks. The level and oblique tones in classical Chinese often follow parallelism rules, making texts pleasant to hear and read. Oblique tone characters have large intonation changes, giving a sense of incompletion, while level tone characters have stable intonation, giving a sense of closure. Meanwhile, level and oblique tones and rhyming are two typical prosodic features of Chinese classical poetry (Chen & Yang, 2017). Compared to Western direct and passionate expression styles, Chinese classical poetry often uses implicit and restrained five- or seven-character regulated verses to express deep and passionate emotions, such as the profound friendship in "The Peach Blossom Pond is a thousand feet deep, but not as deep as Wang Lun' s farewell to me," and the parental love in "The thread in a loving mother' s hand, the clothes on a traveling son' s body." Appropriate adjustments in poetic rhythm (e.g., "level level oblique oblique oblique level level, oblique oblique level level oblique oblique level") may stimulate readers' cognition of abstract meanings such as "friendship" and "patriotism" more than pale word stacking, generating strong empathic experiences and promoting readers' formation of profound moral sense and patriotism. Prosodic features are also reflected in word choice and sentence construction. Taking the character "兮" as an example, its retention, removal, or replacement can construct different rhythmic patterns, and the character "兮" plays a regulatory role in forming natural and harmonious prosodic structures (Wang, 2019). Additionally, by reading red classic works such as "family letters" from the revolutionary war era, readers can resonate with the red spirit and take root in their hearts. Future research can focus on Chinese excellent cultural historical materials and literary works to explore their feasibility in promoting empathy cultivation and further enhance adolescents' cultural identity.

5.3 Deepening Intervention Research on Reading Disorders and Empathy-Impaired Groups

Currently, numerous studies have regarded reading as an effective means to enhance individuals' cognitive and thinking abilities (Ali & Razali, 2019; Võ et al., 2019). In the future, text reading also has the potential to become an intervention method for enhancing empathy. First, for special groups with impaired empathy abilities, such as children with autism spectrum disorder or children with loneliness, regular reading club activities can be used for improvement (Willard & Buddie, 2019). Second, long-term, frequent reading helps enhance cognitive and emotional empathy levels in general reader groups, and empathy toward textual characters can reduce stereotypes and out-group bias (Hecht et al., 2022; Johnson, 2013). Third, text reading provides possibilities for integrating empathy cultivation into educational environments. Using excellent reading materials to attract students to participate in classroom teaching has long been a common practice for teachers, and appropriate textbook arrangement and content selection also help cultivate students' empathy abilities and promote the development of their healthy personality (Sellers, 2021).

Some intervention studies have achieved good results. Sellers (2021) conducted empathy learning unit design in Latin American middle school literature courses. The results showed that through reading, readers clarified how texts elicited empathy, their own empathic responses, and their connections with their own times. Christiansen (2021) conducted field research on Denmark' s literary empowerment program, which established shared reading groups for marginalized Danish youth to enhance this group' s empathy abilities. The investigation found that literary reading provided readers with a literary free space framework, through which readers' moral levels could be enhanced via empathy cultivation programs. Cohen (2021) distinguished between low-level, simple empathic experiences obtained from reading *The Tortilla Curtain* and complex, self-critical empathic experiences obtained from reading *Half of a Yellow Sun*, raising questions about the effectiveness of literary reading as a means to enhance empathy. This study did not prescribe which type of work is suitable for empathy cultivation; rather, it argued that appropriate text selection and use are key principles for empathy teaching. Future research can further expand sample sizes, strengthen measurement of different aspects of empathy (narrative empathy, empathic understanding, etc.), carefully monitor its effectiveness and robustness, to achieve optimal expected effects.

Literary critic Yan Feng once said: "Literature seems destined to be unrelated to being moved···However, tears are the only standard for testing literature." Good texts are not merely piled up with coherent, cold words; they should evoke readers' empathy, touch readers' hearts, and even shake readers' souls. Only when readers and authors fully interact through texts as a medium can an article or a poem become thought-provoking, passed down through generations, and remain evergreen (Lüdtke et al., 2014). Although existing research has found that reading helps improve empathy levels toward specific groups (e.g.,

Muslims) and reduces discrimination against them (Johnson, 2013), and that reading empathy texts with species protection themes increases animal protection and environmental protection behaviors (Keen, 2011), the value of empathy evoked in reading extends beyond this. When empathy is transformed into a powerful spiritual force, it can subtly change readers' selves, personality, and values. Future research should not only focus on which specific textual elements can effectively elicit empathy at the fundamental processing level, but also at the application level focus on how to maximize the utility of empathy evoked by text reading, forming readers' powerful spiritual motivation and promoting the development and perfection of readers' healthy personality.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv —Machine translation. Verify with original.