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Is viewing a painting really like reading? : an investigation of trans-symbolic comprehension processes

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ABSTRACT

IS VIEWING A PAINTING REALLY LIKE READING? AN INVESTIGATION OF TRANS-SYMBOLIC COMPREHENSION PROCESSES

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Humans form mental models of the world around them. A large body of research has outlined these mental processes for comprehending texts, yet less work has been conducted in the world of comprehending artworks. The recent trans-symbolic comprehension (TSC) framework has posited that there are shared comprehension processes between the domains of text and artwork. The current study tested this claim by having individuals think aloud while viewing paintings and reading texts. The think-aloud protocols were then parsed and coded for six distinct mental processes that the TSC framework claims are required for comprehension across symbol systems. It was hypothesized that individuals would have profiles of TSC processes across both symbol systems. Coherence-building TSCs were also hypothesized to be related of one's aesthetic experience. No profiles of comprehension emerged as significant in the analyses, suggesting that participants do not use similar frequencies of TSC processes for paintings and texts. The coherence-building hypothesis was supported. However, bridging and elaborative inferences predicted the three aesthetic responses differently. Overall, the results provide some support for the TSC framework. Limitations and future avenues of research are also discussed.

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IS VIEWING A PAINTING REALLY LIKE READING? AN INVESTIGATION OF TRANS-SYMBOLIC COMPREHENSION PROCESSES

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DEDICATION

This thesis is dedicated to Dr. Justin Kline and the outstanding staff
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CHAPTER 1

INTRODUCTION

Humans form mental models of what they experience. Mental models are mental representations of the events and situations that surround us (Johnson-Laird, 1983). For example, consider a person reading a story. The reader's mental model of the story would include the events, actions and motivations of the characters and how they all fit together to form a coherent whole as the reader progresses through the story. Mental models are often described as cognitive representations in which the affective states of the comprehender are either downplayed or ignored (Kintsch, 1988; van den Broek, 2010, Zajonc, 2000). However, people may experience a wide range of affective responses to what they are comprehending. This is certainly true for understanding narratives (e.g., written stories, movies) when we often experience suspense and surprise along with other responses. Affective responses also occur for artifacts commonly referred to as "art," such as paintings, sculptures, music, etc. Affective responses to artwork are collectively called aesthetic experiences. Comprehending artwork, like written text, also requires the construction of a mental model (e.g., what does a painting represent?). The overall goal of this thesis is to examine the relationship between aspects of building a mental model across different media (texts and paintings) and aesthetic experiences.

General Comprehension

A mental model is often thought of as an endpoint of comprehension processes. Comprehension processes are those processes that are required for the construction of a coherent mental model of the stimulus. Generally, a mental model contains the representation of several components that are explicit in the stimulus, such as the events and actions depicted by the author or painter. Mental models also include the multifaceted relationships between the components. Often the relations are implicit and must be inferred by the comprehender based on one's world knowledge. For example, a reader may infer that the stolen bicycle was the cause of John's anger when reading, "John learned that someone had stolen his bicycle. He was pissed." Without this inference, the reader would think that these were two unrelated events. Similarly, when viewers see Grant Wood's *American Gothic*, they may readily infer that the man and woman are married farmers, although it is actually a father and his daughter (Wood, 1930, 1941). Discourse researchers have argued that mental models of discourse (often referred to as *situation models*; van Dijk & Kintsch, 1983) contain explicit and inferred content and their relations on temporal, causal, spatial, and motivational dimensions (Graesser, Singer, & Trabasso, 1994; McNamara & Magliano, 2009).

The processes leading to the construction of a mental model can be parsed into two categories. Some of the processes are tied to the specific medium of the stimulus (e.g., words vs images), whereas others are thought to span across all media. Loughlin et al. (2015) uses the term "symbol-specific" to refer to mental processes that are tied to specific media (Loughlin, 2013; Loughlin, Grossnickle, Dinsmore, & Alexander, 2015). For example, for reading text, these would include processes devoted to word decoding and computing syntactic structures, to

name a few. In text, the processes occur sequentially as words and clauses are encoded by the reader. For paintings and other visual representations, the processes involved in pattern recognition of objects may dominate (e.g., scene recognition). Unlike text, which is encoded across a sequence of symbols often arranged hierarchically (words, sentences, paragraphs) and ordered by the author, encoding the "symbols" in a representational painting would be done more quickly and largely in the order dictated by the viewer (rather than the painter), even though spatial representations are often thought to be hierarchically represented in the mind (Solso, 2003).

Loughlin et al. (2015) and others (Benton, 1992; Gernsbacher, 1990; Magliano, Loschky, Clinton, & Larson, 2013) have also argued for processes that contribute to the mental model independent of the medium. In contrast to symbol-specific processes, Loughlin et al. (2015) refer to these as "trans-symbolic" processes (TSCs). They empirically identified TSCs in a recent study. In their study, they had 4th and 8th graders think aloud as they viewed two representational paintings. They then parsed the verbal protocols into thought units. The thought units were then categorized into six categories. The categories that they empirically derived included *observations*, *activated prior knowledge*, *inferences*, *elaborations*, *evaluations and responses*, and *metacognitive* statements. Table 1 presents a sample of trans-symbolic processes, their definitions, as well as example statements taken from Loughlin et al. (2015). Observational statements were those that simply described the content which was explicitly presented in the painting. Evaluations and responses included statements that referred to the artistic qualities of the painting, as well as emotional and aesthetic responses. Inferences were categorized as statements which related two aspects of a painting with each other. Similarly, elaborations were

defined as statements that drew connections between aspects in the painting but were not readily available in the painting. These statements were essentially inferences that reflected the "story" that the viewer had generated while viewing the painting. Statements of activated prior knowledge were those in which the viewer recalled personal experiences that were related to the painting. Lastly, metacognitive statements included those that reflected one's understanding of the painting.

Table 1. *Example Trans-Symbolic Categories in Loughlin et al. (2015)*

Trans-Symbolic Processes	*Definition*	*Example Statement*
Observations (Paraphrases)	Statements which regarded objects, agents, location, characteristics, action, visual elements	"I see a clock." "That's a man." "She's very tiny."
Bridging Inferences	Statements which reflect an effort to meaningfully relate observable aspects of the paintings with one another	"I think they are in love, because he is kissing her." "The mother is holding her baby."
Elaborations	Statements which extend past information presented in the painting	"I think they're going to move and she's happy about it and he gives her flowers."
Metacognitive	Monitoring comprehension of the entirety of the painting	"I have no idea why that trashcan is there."
Evaluations and Responses	Interpreting artist's purpose Reacting affectively to the painting	"It makes me laugh!"

Although Loughlin et al. (2015) only utilized paintings, they argued that these types of thoughts were trans-symbolic because similar categories have been identified in verbal protocols to text (Coleman, 2013; Magliano, Millis, The R-SAT Development Team, & Levinstein, 2011; McMaster et al., 2012). An important aspect to the current study is to directly test whether the same categories arise for both text and paintings in the same experiment.

The distinction between trans-symbolic and symbol-specific processes map onto similar distinctions made by other researchers. With the introduction of the structure-building framework, Gernsbacher (1990) argued that the comprehension and production of language requires general cognitive processes and mechanisms. Although the structure-building framework is most often employed for language comprehension, the mechanisms and products described are somewhat applicable to comprehension across different media. To illustrate this point, Gernsbacher, Varner and Faust (1990) compared comprehenders' comprehension scores between narratives presented in written, visual (pictures stories) and auditory modalities. They found high correlations (.72 to .92) between participants' comprehension scores for the three modalities. These findings suggest the existence of a general comprehension skill, one that operates across media. The researchers explained the existence of this skill with the structure-building framework. In this framework, the construction of a mental representation occurs by laying a foundation of the encoded information, mapping incoming information onto that structure, or, when the information is unrelated or less coherent, the information is shifted onto a new knowledge structure. It is through these processes, Gernsbacher argues, that comprehension occurs. These processes would be considered trans-symbolic under the distinction made by Loughlin et al. (2015), as they encompass comprehension in more than one modality.

Magliano et al. (2013) also acknowledge two separate categories of comprehension processes. The researchers make the claim that comprehension processes operate in the "front end" or the "back end" of comprehension. Front-end processes include the perceptual processes required to decode visual information. These perceptual processes would be labeled as symbol-specific as defined by Loughlin et al. (2015). These include processes such as semantic

processing and orthographic encoding. Back-end processes are those involved in forming a coherent mental representation from the output of the front-end processes. Processes such as event segmentation, generating inferences between ideas, and structuring the information in a coherent manner are considered to occur at the back end of comprehension (Magliano et al., 2013). These back-end processes lead to the construction of mental representations referred to as textbase and situation models (van Dijk & Kintsch, 1983). Though the encoding processes that lead to comprehension may differ, the researchers claim that back-end processes occur in a similar manner across static and dynamic media (text, images, and films). Hence, back-end processes are theoretically akin to TSCs outlined by Loughlin et al. (2015).

Even if the comprehension of texts and artworks can be explained through a general comprehension skill (Gernsbacher et al., 1990) or TSCs (Loughlin et al., 2015), it is still an empirical question of the extent to which TSCs occur across media. As will be addressed in more detail below, the first hypothesis addressed in the current study is the frequency of TSC in two categories of media, written narratives and paintings. There are a wide variety of comprehension components that have been identified and defined across these two media. Whereas Loughlin and colleagues (2015) have identified a set of TSC processes for artworks, the current study seeks to identify these processes in both artwork and text comprehension.

Think-aloud protocols are a common research tool that has been utilized to assess comprehension processes (Afflerbach & Johnston 1984; Ericsson & Simon, 1993). In these tasks, participants are prompted to type out their thoughts or to say them aloud as they occur while reading and/or viewing paintings. The verbal protocols are then classified into different categories of thoughts using a coding scheme. Psychologists construct coding schemes that

reflect their research interests. Table 2 presents a sample of coding schemes used in studies that have used verbal protocols in both text and artwork studies. All but one study coded for paraphrases of explicit content, the presence of bridging inferences, and the presence of elaborations. The fact that researchers have used these three categories across media suggests that these are candidate trans-symbolic processes. Paraphrases measure the attention to explicit content, bridges indicate the comprehender is attempting to create a coherent situation model, and elaborations indicate that the comprehender uses one's world knowledge in creating the model.

There are some differences on the think-aloud categories and how they are collected across texts and artworks. Besides paraphrases, bridges and elaborations, metacognitive statements are the most prevalent, at least for texts. Metacognitive statements include content about the comprehender's perceived understanding of the material. Example metacognitive statements include, "I understand the moral of the story" or "I get what the author means here." Sixty-two percent of the text-oriented studies in Table 2 included metacognitive statements. In contrast, only 33% of the artwork-oriented studies included metacognitive statements. The difference is probably based on the fact that the text-oriented studies were measuring learning, and metacognition is an important indicator for learning outcomes (Azevedo, 2009; Graesser, McNamara, & VanLehn, 2005; Vrugt & Oort, 2008). Another difference is the evaluation category. Only a quarter of the text-oriented studies classified protocols on evaluation. Evaluation refers to any judgment of the quality of the stimulus and any emotional or aesthetic responses. However, all of the artwork-oriented studies included evaluation. One reason for this is that the purpose of artwork is to produce aesthetic experiences and that the purpose behind the

text-oriented studies is largely learning. The reason cited above for metacognition holds here as well as that the research interests reflect the think-aloud categories utilized in each study.

Table 2. *Common Thought Categories from Sample Texts and Paintings Think-Aloud Studies (Adapted from Loughlin et al., (2015)*

Citation	Thought Categories From Think-Aloud Studies						
	Parap-hrase	Bridging Inference	Elaboration	Predictive Inference	Metacog-nitive	Theme or Narrative	Evaluation
Texts							
Bohn-Gettler & Rapp (2011)[a]	x	x	x	x	x		x
Carlson, Seipel, & McMaster (2014)[a]	x	x	x	x	x		x
Coté, Goldman, & Saul (1998)[a]	x	x	x		x		
Kendeou & van den Broek (2007)[a]	x	x	x		x		
Magliano, Millis, RSAT Dev Team, & Levinstein (2011)[a]	x	x	x				
McNamara, Levinstein, & Boonthum (2004)[b]	x	x	x				
Ozuru, Best, & McNamara (2004)[a]	x	x	x		x		
Artworks							
Bruder & Ucok (2000)	x	x	x		x		x
Franklin, Becklin, & Doyle (1993)	x	x	x			x	x
Ishisaka & Takahashi (2006)	x	x	x				x
Loughlin et al. (2015)	x	x	x		x		x
Moore (1973)	x	x	x				x
Stout (1995)	x					x	x

Note. a and b denote narrative and expository texts, respectively.

The placement of verbal protocols within a task also differs between artwork- and text-oriented studies. For artworks, the researchers typically have the participant think aloud as they view the artwork. For text, researchers have options of when to prompt for think-aloud protocols. One is that they are produced when the participant elects to reveal her or his thoughts, perhaps prodded to do so following a period of silence. Alternatively, the researcher may ask for verbal protocols after reading target sentences (which may include a few to all sentences), after paragraphs, or after the entire passage. The benefit for collecting verbal protocols after each sentence is that the researcher can get a moment-to-moment understanding of the comprehender's mental model construction across the entire text. The downside is that providing verbal protocols can be intrusive, unnatural, and possibly interfere with comprehension. That is one reason why Magliano and colleagues (2011) collected verbal protocols roughly once per paragraph instead of after each sentence.

There are no published studies of which I am aware that have collected and examined verbal protocols for both media in the same study. What is needed is a direct comparison of the prevalence of the putative TSCs for text and artwork using the same participants to control for differences across studies (e.g., demographics, materials, context). The study's design allows for comparisons to be made between participants' responses for the narratives and representational paintings.

CHAPTER TWO

PROFILES OF COMPREHENSION ACROSS MEDIA

Comprehenders who rely on specific comprehension processes to establish a sufficient mental representation of a text may also default to a similar processing profile for artworks, or vice versa. Due to the gap between discourse and artwork comprehension research, it is difficult to assess the extent to which the justification of this reasoning would be supported in the literature. Few studies have identified specific comprehension processes involved in understanding artwork (Loughlin et al., 2015, Millis & Larson, 2008). However, if TSCs exist, it would stand to reason that this hypothesis may be appropriately tested through the usage of think-aloud protocols (Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007; van den Broek, McMaster, Rapp, Kendeou, Espin, & Deno, 2006).

Individual differences in comprehension across media have been addressed to some extent by Gernsbacher and colleagues (1990). As mentioned above, Gernsbacher et al. (1990) have argued that comprehension skills may be applied to both written, auditory and non-verbal modalities. In their first experiment, they found that comprehension in verbal tasks highly correlated with comprehension of non-verbal picture stories. In a second experiment, they showed that skilled comprehenders have greater access to recently comprehended information than less skilled comprehenders across three common modalities. They then demonstrated that less skilled comprehenders recalled less information immediately after comprehending stories that were presented in scrambled fragments. This suggests that the less skilled comprehenders had less access to the recently encoded information.

Gernsbacher et al. (1990) propose several explanations for the individual differences found in their study. Comprehenders may differ in the extent to which they shift incoming information onto new knowledge structures and map information onto existing knowledge structures. In addition to integrating new information, comprehenders can also differ to the extent to which related prior knowledge is activated and suppressed during comprehension. Activating and suppressing appropriate prior knowledge is important for constructing a coherent mental representation, as connections made to irrelevant prior knowledge may result in a misunderstanding of the original source. These broad processes of activation of prior knowledge, mapping, and shifting may give researchers a perspective of how individuals comprehend stimuli across media. For example, individuals who do not suppress activated prior knowledge sufficiently may struggle with mapping and integrating information in different media. Viewing trans-symbolic comprehension in this light may prove a useful guide for identifying profiles of comprehension across media.

A group of researchers have identified two profiles of struggling readers in elementary students (Rapp et al., 2007). The students were asked to read a series of short stories and to think aloud as they read. The responses were coded into 11 categories—associations to background knowledge, bridging inferences, reinstatements, elaborations, predictive inferences, metacognitive statements, paraphrases, repetitions of the text, and questions regarding the text—and identified the subgroups via cluster analysis. Two of these subgroups of comprehenders have been defined as paraphrasers and elaborators. Paraphrasers tend to reproduce recent explicit text in their verbal protocols, whereas elaborators tend to activate and mention personal experiences in theirs. In the context of struggling readers, McMaster and colleagues (2012) further

investigated the processing differences between paraphrasers and elaborators using think-aloud protocols. They found the paraphrasers made fewer inferencing statements than other readers and were much less likely to establish coherence. On the other hand, elaborators were more likely to make inferences, but their inferences tended to have a high number of irrelevant elaborations (McMaster et al., 2012). Interestingly, comprehension tests presented after reading were insensitive to the differences in comprehension processes each reader engaged in.

For artworks, it is unknown if similar profiles of comprehension processes exist as they do for struggling readers. Regarding individual differences, the closest relation researchers have examined is the difference between art experts and novices (Bullot & Reber, 2013; Cupchik, 1995; Leder, Gerger, Brieber, & Schwarz, 2014; Millis, 2001; Winston & Cupchik, 1992). Winston and Cupchik (1992) reported that art experts preferred artwork that was more cognitively challenging, and art novices preferred artwork that was more emotionally provocative. Similarly, Millis (2001) showed that novices preferred representational artwork over abstract artwork, but the reverse was true for more experienced art viewers. It may be the case that art experts engage in more meaning-making activities with artwork before reaching a satisfactory mental representation (Leder, Belke, Oeberst, & Augustin, 2004; Leder, & Nadal, 2014). If so, art experts may provide more inferences in their think-aloud protocols than novices.

CHAPTER THREE

AESTHETIC EXPERIENCES

Aesthetic experiences include all the complex physiological, cognitive and emotional reactions we have to aesthetic objects (Fechner, 1876). Aesthetic objects are often broadly defined, typically based on their intended goal. On the one hand, some aesthetic objects are artifacts designed to evoke specific cognitive and emotional reactions, such as suspense in a narrative or a sense of wonder in a painting. On the other hand, other aesthetic objects are designed to create any number of reactions. In these instances, the interpretation is entirely dependent on the viewer's prior knowledge and motivation to process and ultimately make sense of the artifact as an artwork.

Aesthetic experiences are often difficult to measure accurately because of their potential richness. That is, aesthetic experiences can be observed on physiological, cognitive, and affective levels simultaneously (Winkielman & Cacioppo, 2001). Another source of the difficulty is that they are often are fleeting. Nevertheless, researchers attempt to measure aspects of one's experiences by using Likert-type scales, physiological measures, and think-aloud protocols. Responses to these tasks are referred to as *aesthetic responses*. The methods used to measure these responses will briefly be reviewed below.

In regard to Likert-type scales, there are two general ways of capturing aesthetic responses. In an appraisal approach, distinct emotions are measured that arise while viewing aesthetic objects. Often unidimensional Likert-type scales are used to measure these responses

(Graf & Landwehr, 2017; Leder et al., 2006; Millis, 2001; Millis & Larson, 2008; Silvia, 2005), such as the degree to which viewers agree to statements such as, "I experienced pleasure while viewing the painting" (1 = strongly disagree, 6 = strongly agree).

An alternative method of measuring aesthetic reactions focuses on the level of arousal experienced by the viewer. Whereas an appraisal approach focuses on individual emotions, an arousal perspective tries to account for the commonality among all emotional states (Armstrong & Detweiler-Bedell, 2008; Berlyne, 1971). Researchers have argued that emotional states can be captured by values on two dimensions: arousal and valence (Russell, 2003). Early research on aesthetics perspectives neglected the specific emotions elicited during aesthetic experiences and viewed all aesthetic emotions to take place on a two-dimensional scale, with the intensity and positive-negative valences on both scales (Berlyne, 1971). More recent arousal-based approaches have adapted two-dimensional Likert-type scales to record the participant's responses in terms of the level of arousal and the valence of a specific *emotion* (Leder, Gerger, Dressler, & Schabmann, 2012; Russell, 2003). These two-dimensional scales can either be presented plainly as paired items or on x- and y-axes. The x- and y-axes create a more representative measure of recording participants' experienced aesthetic responses in terms of arousal and response (Russell, 2003).

Another increasingly popular method of measuring aesthetic experiences is conducted through facial electromyography (fEMG) equipment (Cacioppo, Petty, Losch, & Kim, 1986; Chatterjee, 2004; Pelowski, Markey, Lauring, & Leder, 2016; Winkielman & Cacioppo, 2001). This method measures the activation of the zygomaticus major and corrugator supercilli muscle regions, related to positive and negative affective states, respectively, in real time while

participants view artwork. Although this method of measurement is unable to discriminate between specific aesthetic responses, it can provide a direct physiological measurement of one's overall affective state. Leder (2013) has advocated the use of neurological and physiological measures, arguing that these will ultimately provide a more complete, objective picture of the aesthetic experience (Leder, 2013).

Aesthetic experiences that arise during reading have been theorized to occur in a similar manner (Silvia, 2006). The measurements of aesthetic experiences that arise during reading are measured similarly as studies utilizing artworks. Silvia (2006) employed an appraisal approach to measure readers' aesthetic responses as they progressed through evocative poetry. Additional studies have focused on emotions that are related to comprehension processes during reading (Bohn-Gettler & Rapp, 2011; Brunyé, Ditman, Mahoney & Taylor, 2011; D'Mello & Graesser, 2012). D'Mello and Graesser (2012) focused on the aesthetic responses related to comprehension and learning, such as frustration, boredom, enjoyment, and interest.

CHAPTER FOUR

THE RELATIONSHIP BETWEEN TRANS-SYMBOLIC COMPREHENSION PROCESSES AND AESTHETIC EXPERIENCES

Considerable research has been conducted on features of narratives and corresponding aesthetic responses. Indeed, researchers and educators in literacy criticism, philosophy, and cognitive science have addressed the issue of what gives rise to aesthetic responses. For the most part, researchers have not addressed the role of whether TSCs contribute to aesthetic responses. Instead, researchers in text have identified structural features of narratives and their correspondence to responses such as suspense, curiosity, interest, and surprise (Brewer & Lichtenstein, 1982; Zillman, 1994). For example, if the reader knows that the bomb in the castle will explode in three minutes as the heroine struggles to escape, the reader most likely will experience suspense. It is reasonable to assume that to experience these responses, the reader must comprehend the passage, and that if comprehension requires TSCs, then they would be predictive of such responses.

However, not all the TSCs may be related to aesthetic experiences in similar ways. Paraphrasing, bridging and elaborative inferences are traditionally regarded as *coherence-building* mental processes (Graesser, Singer & Trabasso, 1994; Magliano et al., 2011). These processes give rise to coherent mental representations. The remaining TSCs—metacognitive, evaluations, and responses—can be thought of as processes associated with the construction of mental models rather than the cause of mental models. They will be referred to as *assessments* of

comprehension as they are dependent on the coherence-building processes. For example, evaluations of the stimulus or emotional responses of oneself cannot occur without first having a basic understanding of the stimulus and oneself. Metacognitive processes are similarly tied closely to the construction of mental models.

In the context of aesthetic responses to artworks, Graf and Landwehr have proposed the pleasure-interest model of aesthetic liking (PIA model; Graf & Landwehr, 2015). The PIA model posits that fluency is a major determinant for the emotions that arise while viewing works of art. Fluency has been defined by the subjective ease of processing information (Belke, Leder, Strobach, & Carbon, 2010; Forster, Leder, & Ansorge, 2013; Reber, Schwarz, & Winkielman, 2004). The PIA model posits that fluency discrepancies are responsible for aesthetic experiences that immediately occur after being exposed to the stimulus. If the initial processing is easier than expected, a positive fluency discrepancy occurs. However, if the processing is harder than expected, a negative fluency discrepancy occurs. According to the model, positive fluency discrepancy results in a positive affective state (pleasure), whereas negative fluency discrepancy results in a negative affective state (displeasure). The model assumes that when a negative fluency discrepancy occurs, the viewer may be motivated to reduce the discrepancy by engaging in various forms of controlled processing. If so, the model predicts an increase in interest. Therefore, one would expect a correlation between interest and understanding. Unsuccessful reductions of disfluency are assumed to result in states of confusion. In this manner, the PIA model aligns with the perspective taken by D'Mello and Grasser (2012).

It is noteworthy that the PIA model does not fully describe the processes underlying fluency (Forster, Gerger, & Leder, 2015; Pelowski, Markey, Forster, Gerger, & Leder, 2017).

Rather, they and other researchers have documented different sources of fluency in art, such as contrast (Gombrich, 1984; Solso, 1994), symmetry (Arnheim, 1974; Jacobsen, Schubotz, Höfel, & van Cramon, 2006), mere exposure (Zajonc, 1968) and prototypicality (Hekkert & Wieringen, 1990). It is reasonable to think that processes involved in comprehension, such as the proposed TSCs, are related to experienced fluency. Specifically, the PIA model assumes if one can form a coherent mental representation, effectively reducing the original disfluency (to the extent that this had occurred), they would then experience a positive affective state. If engaging in coherence-building TSCs—such as paraphrasing, bridging and elaborating—increases the coherence of the mental representation of the text or artwork, we would expect that the extent to which these processes occur would be predictive of the amount of reported pleasure, interest, and understanding.

There is some existing evidence that supports this notion of coherence-building TSCs relating to one's aesthetic experience. Leder and colleagues (2006) reported that descriptive-titled paintings lead to higher ratings of liking than untitled images. It is thought that the descriptive titles provided a guide for one's understanding of the image. Presumably, the descriptive title would make the processing of the image to be more fluent, leading to a pleasant experience. Similarly, Millis (2001) reported that elaborative-titled paintings and photographs led to higher aesthetic ratings than descriptive-titled images. The effect disappeared when the elaborative titles were paired to a randomly chosen image. These findings suggest that elaborations increase aesthetic pleasure when they contribute to a coherent representation. In an unpublished study, Steciuch, Millis, and Santuzzi (2018) report similar findings for descriptive- and elaborative-titled images across different mediums within artworks. These findings support

the notion that creating rich, meaningful representations of the artwork is an implicitly positive experience. Together, these effects can be explained with TSCs working to construct richer, coherent mental representations.

CHAPTER FIVE

CURRENT STUDY

The current study investigated which TSCs occur while viewing texts and paintings, as well as the corresponding aesthetic responses they evoke. Short stories and representational paintings were utilized in this study. Participants viewed each story and painting and typed out their thoughts pertaining to the material. These thoughts were then coded for specific TSC categories. To assess the extent to which aesthetic responses are related or evoked during these processes, participants also provided self-reports of experienced engagement, pleasure, interest, and understanding for each material. Three hypotheses addressed specific points of interest. They are defined in the following sections.

Hypothesis 1: Trans-symbolic processes occur to the same extent across media.

The first hypothesis investigated the claim that these comprehension processes occur in similar frequencies across these two media. There are two forms of this hypothesis. The strong form of this hypothesis predicts that the frequencies for each thought category occur to the same extent for paintings as they do for text and that they occur above zero in both. It also contends that there are no differences among the correlations between all the trans-symbolic processes across media. One challenge to this viewpoint is that there are likely differences across and within media in the degree to which they afford trans-symbolic processes. For example, viewing some artworks may produce more elaborations that others. Therefore, a more lenient and

exploratory form of the hypothesis would state that for any given category, the prevalence will be statistically greater than zero, but differences between the modalities can occur. This more lenient form of the hypothesis is neutral as to whether there are differences in frequencies across categories.

Hypothesis 2: Individuals have stable profiles of trans-symbolic comprehension processes, akin to "paraphrasers" and "elaborators" defined in previous discourse research.

This hypothesis posits that individuals engage in similar patterns, or profiles, of comprehension processes across media. If profiles of TSCs exist across different media, then within an individual there should be a pattern in the frequencies of the processes that should occur in written narratives and paintings. For example, an individual might paraphrase and bridge more than they elaborate and rarely produce evaluative and metacognitive statements. This would constitute a profile if that pattern occurs for an individual across media. To assess this hypothesis, the two most frequent categories were computed and profiles of comprehension were determined based on the relationships between the two. For example, if the two most frequent TSCs are bridging inferences and elaborations, one can compute several comprehension profiles.

Hypothesis 3: Coherence-building trans-symbolic processes are correlated with one's aesthetic experience.

The occurrence of coherence-building TSCs should be related with measures of one's aesthetic experience. This is the *coherence-building hypothesis*. This hypothesis relies on the assumption that aesthetic experiences depend on the coherence of the mental model. Of the TSCs

considered here, paraphrasing, bridging, and elaborating most contribute to the building of the mental model (Magliano et al., 2011). In contrast, metacognitive awareness and evaluations appear to be a consequence of building a mental model in that they reflect the comprehender's own awareness of the coherence of his or her mental model. Similarly, responses are the result of the constructed model. To test this assumption, correlations were computed between the number of paraphrases, bridging inferences, and elaborations and one's perceived understanding (a rough measure of coherence) and metacognitive statements. If this assumption was met by obtaining statistically significant positive correlations, then the three coherence-building strategies were used to predict one's interest and pleasure. It was predicted that they should result in positive correlations. Correlations were computed across the three coherence building strategies to the evaluation statements because evaluations partly reflect aesthetic experiences ("I like this painting") and the cognitive mastering of the stimuli that rely less on emotional responses ("This painting appears to be from the Renaissance"; Leder et al., 2004). Given these observations, it was also predicted that evaluative statements would positively correlate with one's pleasure and interest ratings because they may be measuring the same constructs, although this prediction was not directly related to the coherence-building hypothesis.

CHAPTER SIX

METHODOLOGY

Participants

Ninety introductory psychology students participated in the study for partial course credit. The average age of participants was 19.8 (*SD* = 2.2). Forty-seven percent of the participants were female and 53% were male. Participants were required to be native English speakers.

Materials

The study utilized both representational paintings and short, complete narratives. The selection of the items was guided by two criteria. The first was that the items were not too difficult or obscure to comprehend, as determined by the author. If the items were too difficult, then the protocols would probably only reveal negatively valenced metacognitive statements, if anything at all. The second consideration was that the paintings and texts both should enable participants to generate elaborations and bridging inferences. To address this concern, only items that were purely representational were selected. Two texts and paintings were chosen from the fable, drama, and science fiction genres. The items were selected from conducting Google searches with the genre and media as search terms (e.g., fable paintings, fable short stories). To narrow down the results, further selection criteria included the presence of at least two identifiable agents and two identifiable objects in each text and painting. Images that contained

graphic or inappropriate content were also excluded. A total of six paintings and six texts were chosen and decided upon with the author's advisor. For the short stories, the average length was 425 words, with an average Flesch-Kincaid grade level of 7.3. The list of texts and paintings are presented in the appendix.

Procedure

Upon arriving, participants signed the sign-in sheet and waited until all participants arrived. They were then given an informed consent form and asked to read it. After asking if they had any questions about the consent form, they were asked to sign it. It was then explained to participants that they would be viewing short stories and representational paintings and that they would type out their thoughts when prompted to do so. For paintings, the prompt, "What are you thinking about now?" was used. For texts, the prompt, "What are your thoughts pertaining to the text?" was used. The think-aloud protocols were positioned underneath the paintings concurrently and at the "peaks" of the short stories, which occurred towards the end. Different prompts for the two media were employed because the texts were presented paragraph by paragraph. To ensure that participants typed out their thoughts pertaining to the entire text, this different wording was employed. After completing each painting and story, participants were then asked to rate their pleasure, interest, and understanding on Likert-type items ranging from 1 (low) to 6 (high). Participants first completed a practice painting and practice text to get familiar with the think-aloud protocols. After completing the two practice items, the experimenter asked if they had any questions and they were then allowed to begin the experiment. The paintings and texts were presented in counterbalanced blocks, in that participants either saw the six paintings and then the six texts or in the opposite order. After completing the task, they completed a short

demographic survey. They were then debriefed and thanked for participating. For 88 participants, the experiment took no longer than 60 minutes and 36.7 (*SD* = 24.37) minutes on average to complete. Two participants spent 88 and 90 minutes on the task. After reviewing notes of their behavior and confirming with the participants after the experiment, it was determined that they were engaged with the task and simply slow readers. They were included in the analyses.

CHAPTER SEVEN

RESULTS

Coding Rubric of Think-Aloud Protocols

The think-aloud protocols were scored in a manner similar to previous text and artwork studies (Loughlin et al., 2015; Magliano et al., 2011). Participants' think-aloud protocols were first parsed into independent clauses. Any subjective clause which did not form its own sentence was not considered to be its own clause. A correlation coefficient of $r = .90$ was achieved with the author's thesis advisor on parsing five participants' protocols into independent clauses. The remaining think-aloud protocols were then parsed into independent clauses. There were originally 1,080 think-aloud protocols, and the final count of parsed independent clauses was 4,544. The average number of clauses per item per participant was 4.19. See Table 3 for a breakdown of the average number of clauses across media and genres. The author and a second coder then categorized each clause into one of six mutually exclusive categories. The categories were: (1) paraphrase, (2) bridging inference, (3) elaboration, (4) metacognitive, (5) evaluation, and (6) emotional responses. The two coders took a random sample of 14 participants (15.5% of the data) for each text and painting and coded the clauses separately. The categorization was then compared for acceptable inter-rater reliability (Cohen's kappa = .80). Each painting and text took 1-3 iterations to achieve a kappa level of .80 or higher. The experimenter then completed the remaining think-aloud

protocols. The correlations among the TSCs and the ratings of pleasure, interest and understanding are shown in Table 4 and Table 5.

Table 3. *Mean Frequency of Independent Clauses Across Media and Genre*

		Genre			
		Fable	Drama	Science Fiction	Row Mean
Media	Paintings Mean(*SD*)	4.732(*2.73*)	4.391(*2.55*)	4.715(*3.04*)	4.613(*2.78*)
	Texts	3.628(*2.32*)	4.033(*2.05*)	3.672(*2.07*)	3.778(*2.15*)
	Column Mean	4.178(*2.59*)	4.211(*2.32*)	4.192(*2.64*)	4.194(*2.52*)

Note. Standard deviations listed in parentheses.

Table 4. *Correlations Between Pleasure, Interest and Understanding Within and Across Media*

		Paintings		Texts	
	Aesthetic Response	Pleasure	Interest	Pleasure	Interest
Paintings	Pleasure	1			
	Interest	**.33****	1		
	Understand	**.22***	**.41***		
Texts	Pleasure	**.35****	**.27***	1	
	Interest	**.35****	**.24***	**.51***	1
	Understand	**.32****	**.28****	**.46****	**.54****

Note. Significant correlations noted with * = $p < .05$, ** = $p < .01$.

Table 5. *Correlation Matrix Between Trans-Symbolic Comprehension Processes Across Media*

		Paintings						Texts					
		Paraphrase	Bridge	Elaboration	Metacog	Evaluation	Response	Paraphrase	Bridge	Elaboration	Metacog	Evaluation	Response
Paintings	Paraphrase	1											
	Bridge	**.33****	1										
	Elaboration	**.22***	**.41***	1									
	Metacog	.10	-.08	-.05	1								
	Evaluation	**.25****	.05	.20	**.23***	1							
	Response	**.32****	.19	.20	**.23***	**.34****	1						
Texts	Paraphrase	**.35****	**.27***	.12	.01	-.02	-.02	1					
	Bridge	**.35****	**.24***	**.28***	**.27***	-.01	.05	**.51***	1				
	Elaboration	**.32****	**.28****	**.32****	**.29****	.15	.11	**.46****	**.54****	1			
	Metacog	**.22***	.06	-.10	**.35****	-.01	**.27***	-.14	.08	-.01	1		
	Evaluation	.03	.08	.17	.16	.18	.21	-.18	-.13	**-.33****	.12	1	
	Response	.09	-.07	.03	**.26***	.16	**.47****	**-.23***	**-.28****	-.18	**.35****	**.39****	1

Note. Significance indicated with * = $p < .05$, ** = $p < .01$.

Hypothesis 1: Trans-symbolic processes occur to the same extent across media.

For each participant, the mean number of each TSC was computed, both for stories and for paintings, separately. The overall average number of thoughts per story and painting was 4.21. The frequencies of each trans-symbolic process were calculated and mean differences across media were assessed with paired-samples *t* tests. Table 6 displays the mean frequencies of each TSC, as well as the *t*-values and *p*-values. The *t* tests revealed that the amount of elaborations, metacognitive statements, evaluations, and responses differed between artworks and texts. In contrast, the mean frequency of the paraphrases and bridging inferences did not differ across media. These findings support the weaker form of the hypothesis, given that all frequencies were statistically greater than zero despite some differences between the two media.

Table 6. *Mean Frequency of Each Trans-Symbolic Comprehension Process*

Trans-Symbolic Comprehension Process	Media		*t-value*	*p-value*
	Paintings	Texts		
Paraphrase	.870(*.70*)	.828(*.80*)	.468	.641
Bridge	.840(*.65*)	.817(*.57*)	.279	.781
Elaboration	1.223(*.76*)	.759(*.49*)	5.856	.001
Metacognitive	.493(*.72*)	.261(*.39*)	3.191	.002
Evaluation	.722(*.79*)	.540(*.54*)	1.927	.057
Response	.435(*.59*)	.570(*.68*)	-1.923	.058

Note. Standard deviations listed in parentheses.

Hypothesis 2: Individuals have stable profiles of trans-symbolic comprehension processes, akin to "paraphrasers" and "elaborators" defined in previous discourse research.

The second hypothesis was tested by calculating "profiles of comprehension" similarly to those discussed in the discourse comprehension literature (McMaster et al., 2012). This was

tested by first determining the two most common thought categories for both texts and paintings. The two most common thought categories were paraphrases and elaborations and bridges and elaborations for paintings and texts, respectively. Given the two previously defined profiles of comprehension of paraphrasers and elaborators reported by McMaster et al. (2012), these two categories were chosen for the comparisons. Specifically, if a participant had a greater frequency of paraphrases than elaborations for both paintings and texts, this would suggest that she or he is a paraphraser. Likewise, if a participant had a greater frequency of paraphrases than elaborations for both paintings and texts, this would suggest that he or she is a paraphraser. Profiles were defined if participants fell into one of these categories greater than chance. Table 7 displays the frequencies of participants who fit into the nine groups, including ties. The χ^2 statistic was not significant, $\chi^2(4) = 3.518$, $p = .475$. By this metric, the pattern suggests that there are no differences in expected frequencies in each group. That is, although an individual may paraphrase more than elaborate for paintings, it is not certain that he or she will have a similar profile for written texts.

Given that the frequencies of each thought category differed, the lack of a significant finding for the profiles of comprehension may have been to a different number of paraphrases and elaborations. For example, the total number of paraphrases and elaborations was 0.87 and 1.23 for paintings and 0.83 and 0.76 for texts, respectively. As an exploratory analysis, Z-scores were computed for each of the coherence-building TSCs for the texts and the paintings. All possible comparisons were then made with paraphrases, bridging inferences, and elaborations in an exploratory effort. None of the patterns for the profiles of comprehension hypothesis were

significant, *p*'s > .05. Therefore, there was no support for the profiles of comprehension hypothesis.

Table 7. *Distribution of Profiles of Comprehenders Across Media*

		Texts		
		Para > Elab	Para = Elab	Para < Elab
Paintings	Para > Elab	14	4	10
	Para = Elab	4	0	3
	Para < Elab	19	8	28

Hypothesis 3: Coherence-building TSCs are predictive of one's aesthetic experience.

See Table 8 for means and standard deviations of the three aesthetic responses. This hypothesis assumes that the coherence-building TSCs of paraphrasing, bridging, and elaborating would be correlated with measures of understanding. The overall correlation between understanding ratings and the number of paraphrases, bridges, and elaborations were .13, .02, and .09, respectively. The corresponding correlations with the number of metacognitive statements were .06, .12, and .05, respectively. The correlations were quite low and none were statistically significant. This casts doubt on the ability to test the hypothesis because it appears that the two measures of coherence were not related to the coherence-building TSCs. However, the correlations were based on scores that averaged over items and participants and may include error variability that could decrease the overall correlations.

Table 8. *Mean Ratings of Pleasure, Interest, and Understanding Across Media.*

Aesthetic Response	Media	
	Paintings	Texts
Pleasure	3.65 (*1.45*)	3.93 (*1.55*)
Interest	4.24 (*1.33*)	4.07 (*2.17*)
Understand	3.45 (*1.50*)	4.16 (*1.51*)

Note. Standard deviations presented in parentheses.

To partial out the source of the error variability, linear mixed-effects models were computed for each aesthetic response. Originally it was hypothesized that the coherence-building TSCs would predict aesthetic responses of interest and pleasure. But it also could be the case that the assessment-related TSCs (metacognitive, evaluations, and responses) also predict the aesthetic responses. In fact, these may be even more predictive because both aesthetic responses (pleasure, interest) and assessment-related TSCs are presumably the result of comprehension rather than directly related to the process of comprehension. Therefore, all the TSCs as predictors were included in the same step in each model that predicted ratings of pleasure, interest, and understanding. Understanding was included in this context because it provides a stronger test of whether the coherence-building TSCs were related to individuals' mental models rather than the overall correlations.

Linear mixed-effects models were constructed in R using the lme4 package (Bates, Maechler, Bolker, & Walker, 2015). These models were constructed to test the extent to which each trans-symbolic comprehension process predicted each aesthetic response separately (i.e., separate models for pleasure, interest, and understanding). The unit of analysis was the clause. An initial null model for each outcome was constructed to obtain intraclass correlations (ICCs), with participants and materials as random factors. The predictors reported in the final models do not include p-values because random factors in mixed-effects models adjust the degrees of freedom from whole numbers into estimated degrees of freedom that typically include several decimal places. The degrees of freedom can be calculated by subtracting the fixed and random factors from the number of total observations, similarly to how *df*s are calculated for traditional

ANOVAs (Bates, 2006). However, in the interpretation of these results, none of the *t*-values were close to the critical *t*-value, and this calculation was not needed. Therefore, no *p*-values are listed with the predictors within the final models.

Pleasure

For the null model predicting pleasure, the ICC was .536, suggesting that substantial variance was accounted for by the random factors. Next, Genre (fable, science fiction, drama) was added as a fixed factor. Genre did not significantly improve model fit. Next, Media (painting versus story) was added as a fixed factor to assess the differences between paintings and texts. Media did not significantly improve model fit but was retained to assess interactions with trans-symbolic processes. Finally, the trans-symbolic categories were added to the model. This step resulted in a significant improvement in model fit. Each trans-symbolic category was entered as an interaction with media. The Media by trans-symbolic categories interaction did not improve model fit. In this and subsequent linear mixed-effects models, the final model only contains significant predictors. For pleasure, the final model contained paraphrases, elaborations, metacognitive statements, and evaluations as predictors. See Table 9 for model fit indices and Table 10 for final model estimates.

In sum, the results show that paraphrases (β = .06), elaborations (β = .06), and evaluations (β = .09) positively predicted pleasure. Metacognitive statements (β = -.19) negatively predicted pleasure. Interestingly, these trans-symbolic categories did not interact with Media, suggesting that they operate in a similar fashion across both Media.

Table 9. *LMM Fit Indices with Pleasure as Outcome*

Model	AIC	Deviance	*p* (Change in Deviance)
Null Model	3675.9	3667.9	--
Genre	3677.1	3665.1	.2416
Genre + Media	3677.8	3663.8	.2573
Genre + Media + TSCs	3659.8	3633.5	>.001

Table 10. *Model Estimates for Final LMM Predicting Pleasure*

	b	*SE*	*t*
Intercept	3.52	.318	11.07
Paraphrase	.06	.034	1.863
Elaboration	.06	.035	1.724
Metacognitive	-.19	.049	-3.843
Evaluation	.09	.039	2.325

Interest

For interest, an initial null model for each outcome was constructed to obtain the ICCs with participants and materials as random factors. For the null model predicting interest, the ICC was .432, suggesting that substantial variance was accounted for by the random factors. Next, Genre were added as a fixed factor to assess any differences between them. Genre did not significantly improve model fit. Next, Media was added as a fixed factor to assess the differences between paintings and texts. Media did not significantly improve model fit but was retained to assess interactions with trans-symbolic processes. Finally, the trans-symbolic categories were added to the model. This step resulted in a significant improvement in model fit. Each trans-symbolic category was entered as an interaction with media. The Media by trans-symbolic categories interaction also improved model fit. The final model contained paraphrases, bridges,

elaborations, evaluations, responses, and the metacognitive by Media interaction as predictors. See Table 11 for model fit indices and Table 12 for final model estimates.

In sum, the results show that paraphrases (β = .13), bridges (β = .11), elaborations (β = .14), evaluations (β = .13) and responses (β = .08) positively predicted interest. Only metacognitive statements interacted with Media. Specifically, the metacognitive statements were more predictive of lower interest for paintings than the texts. This is displayed in Figure 1. Also notable was the strength of the TSC beta weights, which were roughly twice the size of the beta weights for pleasure. The coherence-building TSCs were most predictive of interest.

Table 11. *LMM Fit Indices with Interest as Outcome*

Model	AIC	Deviance	*p* (Change in Deviance)
Null Model	3589.5	3581.5	--
Genre	3593.5	3581.5	.9870
Genre + Media	3595.0	3581.0	.4755
Genre + Media + TSCs	3558.9	3552.9	>.001
Genre + Media + TSCs + TSCs × Media	3557.4	3519.4	.0359

Table 12. *Model Estimates for Final LMM Predicting Interest*

	b	*SE*	*t*
Intercept	3.76	.294	12.766
Paraphrase	.13	.033	3.864
Bridge	.12	.036	3.241
Elaboration	.14	.034	4.066
Evaluation	.13	.037	3.411
Response	.08	.042	1.798
Genre + Media + TSCs + TSCs × Media	-.21	.092	2.302

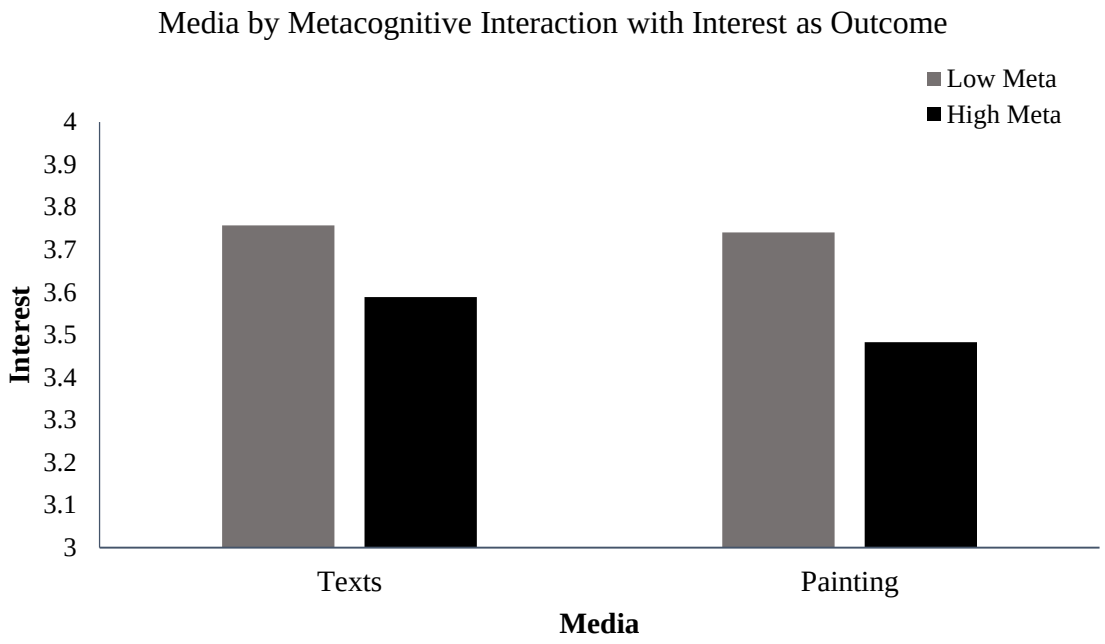

Figure 1. *Interaction with Media and Metacognitive Statements with Interest.*

Understanding

For understanding, an initial null model for each outcome was constructed to obtain ICCs with participants and materials as random factors. For the null model predicting understanding, the ICC was .668, suggesting that substantial variance was accounted for by the random factors. Next, Genre was added as a fixed factor to assess any differences between them. Genre did significantly improve model fit. Next, Media was added as a fixed factor to assess the differences between paintings and texts. Media did significantly improve model fit and was retained to assess interactions with trans-symbolic processes. Finally, the trans-symbolic categories were added to the model. This step resulted in a significant improvement in model fit. Each trans-symbolic category was entered as an interaction with media. The Media by trans-symbolic categories interaction did not improve model fit. The final model contained Genre, Media,

paraphrases, bridges, metacognitive statements, evaluations, and responses. See Table 13 for model fit indices and Table 14 for final model estimates.

In sum, the results show that Genre and Media predicted understanding. Specifically, participants had greater understanding for the fables (M = -.74) than the science fiction genre. Also, participants had greater understanding for the texts (M = .64) than the paintings. For the trans-symbolic categories, paraphrases (β = .08), bridges (β = .06), metacognitive statements (β = -.47), and evaluations (β = .07) predicted understanding.

Table 13. *LMM Fit Indices with Understanding as Outcome*

Model	AIC	Deviance	*p* (Change in Deviance)
Null Model	3662.1	3654.1	--
Genre	3660.2	3648.2	.051
Genre + Media	3653.9	3639.9	.004
Genre + Media + TSCs	3544.7	3518.7	.509

Table 14. *Model Estimates for Final LMM Predicting Understanding*

	b	*SE*	*t*
Intercept	3.71	.246	15.08
ScienceFiction	-.74	.267	2.784
Media	.64	.219	2.914
Paraphrase	.08	.033	2.412
Bridge	.06	.036	1.630
Metacognitive	-.47	.047	9.981
Evaluation	.07	.037	2.026

Note. The Science Fiction effect is in reference to the fable condition. The Media effect is in reference to the paintings.

CHAPTER EIGHT

DISCUSSION

The guiding research question and hypotheses addressed the extent that this framework accounted for these putative similarities between processing information across two modalities, written texts and representational paintings. This was motivated not only by the Loughlin and colleagues (2015) study which identified potential TSCs, but also the similarities between theories of discourse and aesthetics.

The first hypothesis looked at differences in frequencies, the thought categories—paraphrases, bridging inferences, elaborations, metacognitive, evaluations, and responses—were present for both media. However, elaborations, metacognitive statements, and evaluations occurred more frequently for the paintings than the texts. Because all occurred above chance, the results support a weak form of the hypothesis that TSCs occur across media. This indicates that although all the TSCs occur when viewing paintings and reading stories, one media may favor some TSCs while another media favors others. Paintings often elicit an "aesthetic mode" of evaluation that affords more of a reflective style of processing for that media (Cupchik & Gebotys, 1988). In this reflective style, thoughts about the stimuli might elicit more evaluative statements given that the stimuli are considered "art" (Pelowski, Gerger, Chetouani, Markey, & Leder, 2017). This idea is supported in these more frequent categories of associations with prior knowledge, awareness of one's understanding, and evaluations of the artistic creation. On the

other hand, written texts elicited more emotional responses than the paintings. One possible explanation for this is that the texts may have been more evocative than the paintings. This may not be surprising given that language can be used to create precise changes in a mental model that change across time. Changes across time are important for evoking emotional responses, such as surprise, suspense, or curiosity (Brewer & Lichtenstein, 1982). Given that the study utilized just six paintings and six texts, it would be somewhat premature to generalize the differences in frequencies among the TSCs to all stimuli across these two media.

The second hypothesis explored the possibility that individuals have profiles of comprehension across these two modalities. This was motivated by previous discourse research which has described paraphrasers and elaborators as two profiles of comprehension. In this study, even when correcting for the differences in frequencies across media, no patterns of the thought categories were significant across texts and paintings. Although Gernsbacher and colleagues (1990) report high correlations between comprehension scores across 3 modalities, they did not investigate the processes responsible for the successful comprehension scores. This hypothesis was based on the findings of Rapp and colleagues (2007) as well as McMaster and colleagues (2012), but those studies used students who read narrative texts within a learning context. The purpose of the reader may encourage the reader to engage in heuristics which may look like profiles. In the present study, learning was not emphasized as a task goal. Perhaps the differences in reading context and reading goals were responsible for the reason they found the profiles of comprehension the study tried to replicate. Reading or looking at paintings for enjoyment may not elicit similar patterns of TSCs and may simply vary too much for individuals to display any profile-like thoughts across media.

The third hypothesis asserted that there would be a relationship between the TSCs and aesthetic experiences. This was assessed by subjecting the three aesthetic responses separately to linear mixed-effects modelling with the TSCs as predictors. The significant relationships between the predictors and their aesthetic responses are described below, and Table 15 displays the beta weights for each predictor and the three aesthetic responses. In the table, non-bolded coefficients were not included in the final models.

Table 15. *Comparison of Beta Weights for Trans-Symbolic Processes Predicting Aesthetic Responses*

	Aesthetic Responses		
Trans-Symbolic Processes	Pleasure	Interest	Understanding
Paraphrase	**.06***	**.13***	**.08***
Bridge	.04	**.13***	**.06***
Elaboration	**.06***	**.14***	.03
Metacognitive	**-.19***	-.07	**-.47***
Evaluation	**.09***	**.13***	**.07***
Response	.03	**.08***	.03

Note: Significant predictors noted with **bold** lettering indicates that they were in the final model.

Paraphrases

Paraphrases were predictive of all three aesthetic responses. This finding supports the notion that meaning-making processes have a positive effect on one's aesthetic experience. The broad positive relationship between paraphrasing and pleasure, interest, and understanding speaks to the importance of maintaining explicit information from the source material. Paraphrasing can be thought as the foundational process for constructing a coherent representation of the source. With these paraphrases, individuals can generate inferences to enrich and embellish their mental representations. This coincides with several aesthetic

appreciation models (Graf & Landwehr, 2015; Leder & Nadal, 2014), but will be discussed in more detail later in the discussion.

Bridging Inferences

Bridging inferences were predictive of interest and understanding. The relationship between bridging inferences and interest is somewhat intuitive. As bridging inferences are generated while the individual perceives the stimulus, they contribute to an evaluative feeling of successful comprehension, which elicits further processing that would constitute a type of interest (Graf & Landwehr, 2015). Bridging inferences are theorized to be necessary for comprehension in both discourse and aesthetic comprehension (Graesser, Millis, & Zwaan, 1997, Long & Lea, 2005; McNamara and Magliano, 2009, Millis, 2001); hence, it is not surprising to find that bridging inferences are predictive of one's understanding. A perplexing finding is the lack of significant relationship between bridging inferences and pleasure. Millis and Larson (2008) report moderate relationships between the number of activated concepts and one's aesthetic experience. One explanation is that Millis and Larson (2008) collapsed the many different types of inferences into one inference category. This is supported by the relationship found between elaborations and the two aesthetic experiences, as noted below.

Elaborations

Elaborative inferences were predictive of pleasure and interest. This finding, in combination with the relationships between bridging inferences and interest, supports the meaning-making perspective. Specifically, that generating knowledge and inferring mental states of agents within the material have positive effects on one's emotional state. Given that

elaborations were coded as statements regarding any inferences made about an agents' mental state *or* the viewers' previous experience, it is unclear whether both types of these inferences affect pleasure and interest in the same way. However, it is interesting to note that elaborations and bridging inferences are predictive of separate emotions. Although both are predictive of interest, elaborations predicted pleasure, whereas bridging inferences predicted understanding. The slight differences between these two types of inferences speaks to the importance of investigating the various categories of meaning-making strategies that individuals engage in.

Metacognitive Statements

Metacognitive statements were predictive of pleasure and understanding. The negative relationship between metacognitive statements and understanding is straightforward, as the majority of statements referred to individuals' *lack* of understanding. The negative relationship between metacognitive statements and pleasure is also somewhat straightforward, as a lack of understanding is typically associated with a lower level of pleasure (Graf & Landwehr, 2017).

Evaluations

Evaluations were predictive of all three aesthetic responses. This TSC category requires viewers to first have an understanding before they can provide evaluative statements. These statements are reflective of the viewers' thoughts on the objective characteristics of the material. While the coding rubric was not sensitive to positive or negative evaluations of the stimulus, individuals' evaluations were still positively related to their aesthetic experience. This is somewhat surprising, given that there is a large amount of individual differences in individuals' reactions to the texts and paintings.

Responses

Responses were only predictive of interest. The emotional responses to the materials typically consisted of "I do/do not like this painting/text" or other simple preference statements. It is unclear why these statements were related to one's interest; however, the lack of relationship between the responses and pleasure is somewhat perplexing. Liking and preferential statements are typically reported to be highly correlated with one another (Cupchik & Gebotys, 1988; Leder et al., 2006). The lack of relationship between responses and pleasure may be due to the insensitivity of the coding rubric. However, an alternative explanation is that the emotional responses were not positively or negatively valenced enough to generate a sufficient change in pleasure. For interest, the relationship is less clear. One speculation is that interest can be related to a moderate change of one's emotional state. While this cannot be determined definitively from the methodologies of this thesis, future studies may consider investigating this possibility.

Although not the original intent of this master's thesis, it is interesting to note that TSC processes have some overlapping explanatory utility with existing models of aesthetic appreciation. For instance, Leder and Nadal (2014) theorized that a stage of cognitive mastering occurs when art viewers interpret the visual stimuli they are experiencing. This stage is dependent on preexisting characteristics like art knowledge, art interest, need for cognitive closure, etc., but ultimately depends on the viewer's ability to construct a meaningful representation. While the model does not provide explicit descriptions of the construction of meaningful representations, it still assumes viewers are engaging in some process to understand the artwork.

In line with this idea, almost every other model of aesthetic appreciation defines the experience of understanding an artwork with seemingly vague terms. Whether it be referred to as disfluency reduction (Graf & Landwehr, 2015), cognitive mastery (Leder et al., 2004), appreciation (Tinio, 2013), or meaning making (Millis & Larson, 2008), it is likely the case that TSCs are operating behind the scenes in these models of aesthetic appreciation (Magliano et al., 2013). For example, Graf and Landwehr (2015) posit that art viewers who are experiencing disfluency (difficulty processing) will engage in a controlled processing style to reduce the disfluency. TSCs are likely part of the controlled processing, in that generating bridging and elaborative inferences are theorized to increase the coherence of their mental model and therefore perceived understanding (Graf & Landwehr, 2015; Pelowski et al., 2017; van den Broek, Lorch, Linderholm, & Gustafson, 2001).

In sum, the coherence-building hypothesis was supported in that some of the TSCs were predictive of aesthetic responses. As individuals made more paraphrases, bridging and elaborative inferences, they reported higher interest. Pleasure and understanding were predicted by paraphrases, elaborations, paraphrases and bridging inferences, respectively. While not all the coherence-building TSCs were predictive of all the aesthetic responses, it is clear that there are significant relationships between them and one's emotional state. More importantly, in one instance the TSCs did interact with the media, suggesting that the emotional impact of constructing a mental representation differs slightly across media. The finding that metacognitive statements are more predictive of interest for paintings than texts can be interpreted in two ways. The first is that the individuals may have had less experience with interpreting artworks and therefore were less equipped to form coherent representations; the other is that participants'

interest was linked to their understanding of the paintings, which was lower than the texts. Without a measure of art experience or art knowledge, it is unknown if either explanation is more likely.

The implications of establishing a relationship between specific mental processes and one's self-appraised emotional state have great utility in the field of aesthetics. While many aesthetic appreciation theories have postulated a relationship between controlled processing, engagement, cognitive mastery and positive emotional outcomes, very few have identified specific mental processes which are responsible for these effects. Though accounting for these emotional outcomes was not the original intent of Loughlin and colleagues' (2015) framework, the framework can be used to shed light into individuals' minds as they build an understanding. Keeping concepts active in working memory, inferring relationships between two explicit concepts, and associating the stimuli with prior knowledge may be more descriptive processes of cognitive mastering and disfluency reduction. These processes have been shown to have positive relationships with positive emotions and overlap with the predicted effects in the Leder and colleagues (2004; Leder & Nadal, 2014) and Graf and Landwehr (2015) models.

Placing a pin on the exact mental processes that are responsible for emotional outcomes should be of greater interest for aesthetics researchers. Current models of aesthetic appreciation accurately describe the order of mental operations which give rise to positive and negative emotions. However, the next logical step is to parse apart the somewhat ill-defined processes of forming an understanding of an artwork. The TSC framework provides a reasonable application of how these previously ill-defined processes may account for aesthetic appreciation. Further research should continue identifying mental processes from think-aloud protocols in this manner.

Previous empirical work has supported the notion that cognitive processes result in positive experiences. For example, Experiment 1 in Leder and colleagues (2006) found that the number of self-reported thoughts positively predicted the liking of an elaborative-titled painting. This coincides with the findings of the current study but is less specific. Millis and Larson (2008) also find that the number of activated concepts (thoughts) predicted liking, but they did not examine the specific types of inferences made in individuals' inferences and statements. Graf and Landwehr (2017), as well as Steciuch, Kopatich, Feller, Durik, and Millis (2018) report that those who engage in a controlled processing style report greater pleasure and interest for abstract images (Steciuch, Kopatich, Feller, Durik, & Millis, 2018). Given these empirical findings, it is only natural that the next steps in research further parse the cognitive processes responsible for aesthetic appreciation.

Limitations

The current study is not without its limitations. A common critique of studies that employ think-aloud protocols refers to the potentially disruptive effect that typing out one's thoughts has on natural thinking. As individuals list their thoughts, they may focus on a lack of understanding when they otherwise would not have (Baumann, Seifert-Kessell, & Jones, 1992). This may result in a greater or lesser perceived understanding. In addition, think-aloud prompts and their location may affect which part of the stimulus is thought about. Because the texts were presented paragraph by paragraph across different screens in contrast to the painting, which were shown in their entirety on a single screen, there was a concern that participants would limit their thoughts to the current paragraph rather than the entire text. To encourage participants to list their thoughts to the entire text, rather than just the paragraph that was displayed on the screen at the

time, the prompt for the texts included the phrase, “thoughts pertaining to the text,” which remained on the screen as they typed out their thoughts. In contrast, the prompt to the paintings was, “What are you thinking about now?” which was thought to be sufficiently directed towards the painting. Although no formal analysis was performed to examine whether the thoughts to the narratives were limited to the last paragraph read, it is noteworthy that both prompts led participants to be on task. That is, that there was no irregular, unrelated thoughts listed to any of the stimulus materials.

A related, potential issue was the manner in which the thoughts were coded. Because individuals’ thoughts were parsed into independent clauses, it is possible that a single thought may have been split into two clauses. This method was chosen over parsing the thoughts into “thought units” because of the larger risk of mistakenly inferring what clauses and sentences were related to one another. Therefore, parsing the thoughts into independent clauses was selected as the best method of parsing. An additional problem with the coding rubric was the insensitivity to the valence of metacognitive statements, evaluations, and responses, as well as the relevancy of elaborations. For example, the metacognitive statements of “I understand this” and “I do not understand this” both received a “1” for being related to metacognition. Similarly, for elaborations, an association with a previous personal experience that may be completely unrelated to the painting or text was coded identically as elaborations that were more obviously constructive to their understanding of the material. Future think-aloud studies should note the valence and relevance of the thought protocols and potentially create more sensitive analyses. However, given that significant relationships were found between each of the TSCs defined and aesthetic response, this may be a minor issue.

There is an additional challenge to the findings due to the materials and procedures that were used. Whereas the current study included three separate genres of paintings and texts, in both media there are many more that exist in the world. However, it might also be considered a strength of the study. Different genres of both paintings and texts may afford various mental processes, but given the fact that only one genre difference was found for understanding, it is notable that the ratings and correlations among genres did not differ significantly in the linear mixed-effects models. Additionally, the contexts in which these materials are read and viewed may differ greatly, altering individuals' thoughts and responses to them. In discourse literature, reading for entertainment, understanding, and evaluating have all received attention (Narvaez, van den Broek, & Ruiz, 1999; van den Broek, Lorch, Linderholm, & Gustafson, 2001; Zwaan, 1994). This is also prevalent in the aesthetics literature, where a general distinction has been made for abstract and representational works of art (Cupchik & Gebotys, 1988). Future studies should also consider these different more abstract styles of artworks and texts and assess the extent to which TSCs are used to comprehend them.

Conclusion

In summary, the findings of this thesis provide some support for the trans-symbolic comprehension framework proposed by Loughlin and colleagues (2015). Each of the TSCs occurred in both meda greater than chance. Interestingly, there were some differences on their frequencies across the media, but these may be partially explained by the mode of reception that people have towards paintings versus texts. For example, it is likely that people tend to approach paintings with the goal to evaluate them because they do not think there is one intended interpretation. The study also found that some of the TSCs predicted some of the aesthetic

responses, but these relations did not depend on the media. Indeed, this suggests that there is a relation between successful comprehension and aesthetic experiences. Moreover, it suggests that the aesthetic experiences arise at the back end where the mental model is being constructed and not at the front end in which the stimulus is encoded via the symbol-specific systems. Overall, the question of whether a coherence-building mental process is truly essential for comprehension across symbol systems is an important issue for cognitive psychologists. The nature of trans-symbolic comprehension appears to be somewhat consistent across texts and paintings, but there are still many fundamental questions about the intricacies of these TSCs which have yet to be answered, or even asked.

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APPENDIX A

LIST OF MATERIALS

List of creators of texts and paintings, with year published and original titles.

Creator	Year	Title	Genre
Artists			
Frans Snyders	1640	Fable of the Fox and the Heron	Fable
Josef Stevens	1846	Dog Carrying Dinner to its Master	Fable
Frank Paul	1928	Mastermind of Mars	Science Fiction
Simon Stalenhag	Unknown	Milk	Science Fiction
Winslow Homer	1872	Snap the Whip	Drama
Joseph Wright	1765	A Philosopher Lecturing on the Orrery	Drama
Authors			
Hiroko Fujita & Fran Stallings	2015	How to Fool a Cat	Fable
Amy Friedman & Meredith Johnson	1997	The Squire's Bride	Fable
Andy Bottomley	2012	Water Water	Science Fiction
Zakeri Ruhnke	2013	City Lights	Science Fiction
Diane Dickson	2012	The Mountain Man	Drama
Linda Bond	2011	The Last Laugh	Drama