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Thinking Style as Input: Information Seeking and Processing

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Biography

The author was born in Ulsan, South Korea, on January 23, 1995. Youlim graduated from Luhe High School in Beijing, China, 2013. In 2017, she received her bachelor's in psychology from College of Saint Benedict / Saint John's University in Saint Joseph, Minnesota. Youlim received her Master of Arts degree in Psychological Science at DePaul University in Chicago, Illinois.

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Abstract

In this dissertation, I propose that thinking style and cognitive load are associated with information-processing. Analytic thinkers focus on focal objects, whereas holistic thinkers focus on the relation between focal objects and peripheral objects. In addition, cognitive load also increases people's heuristic use in information-processing. Across two studies, I investigated the relationship between thinking style and information-processing, moderated by time pressure (Study 1) or accuracy motivation (Study 2). Results showed opposite patterns of what past literature has demonstrated. Relatively holistic thinkers were less likely to search for additional suspect cues with higher levels of confidence compared to relatively analytic thinkers. Cognitive load motivated information seeking but decreased levels of confidence. Together, these studies create a mixed relationship among thinking style, cognitive load, and information-processing, implying that individual and cultural differences in information-processing might depend on the type of decision-making.

Keywords: thinking style, cognitive load, information processing

Thinking Style as Input: Cultural Differences in Information Seeking and Processing

Living in this complex society, people have unlimited access to relevant and irrelevant information. Evidence suggests that people selectively pay attention to specific information (for review, see Wickens & Carswell, 2006), and their information-processing is influenced by many other factors (e.g., Simon, 1979). People decide which information they want to seek and which information they want to process (Newell & Simon, 1972; Simon, 1978). Information-processing has gained attention in psychology over the past decade due to mounting evidence that it potentially shapes how people understand the task's environment, operate the information, and make corresponding decisions.

Researchers have investigated how personality traits and states influence people's information-processing (Humphreys & Revelle, 1984). People engage in information-processing by seeking information and processing information. Specifically, individuals can vary in motivation in information-processing (Bilancini & Boncinelli, 2018). When people are motivated, they tend to use more cognitive effort to engage in systematic information-processing. On the contrary, if they perceive the cost of systematic processing is more than the benefit of heuristic processing, people will engage in heuristic information-processing to save their resources (Chaiken et al., 1989; De Dreu et al., 2008). Interestingly, heuristic information-processing can be helpful (Schooler & Hertwig, 2005; Stupple et al., 2017) but also detrimental (Kornell et al., 2011; Masip et al., 2009) to understanding information and decision-making.

Although the association between individual differences and heuristic-systematic information-processing has been a popular research topic, two of its

specific characteristics have been underexplored. The first is whether thinking style is linked to information-processing. Researchers have used personality characteristics to define individual differences in information-processing. However, they underestimated the effects of individual differences in thinking style on information-processing. The second characteristic that lacks understanding is whether people's thinking styles would motivate people to seek and process additional information, decreasing the susceptibility of heuristic use.

Psychologists then theorize that self-construal is linked to thinking style because cultural traditions shape how people should process and evaluate information. For example, evidence suggests that East Asians who are relatively holistic thinkers are more likely to have mixed self-evaluations and emotions than Americans who are relatively analytic thinkers (Ji et al., 2001; Spencer-Rodgers et al., 2010). A collectivistic culture emphasizes social relations and context. As a result, East Asians develop an interdependent self-construal and attend to context to make decisions (Haberstroh et al., 2002). They also develop a holistic thinking style by combining the person and social context as a whole to interpret others' behaviors (Nisbett et al., 2001). On the other hand, an individualistic culture emphasizes autonomy and uniqueness, establishing independent self-construal and analytic thinking style (Markus & Kitayama, 1991).

Nevertheless, researchers have found that East Asians and European Americans have lay dispositionism. Regardless of their cultural background, people with lay dispositionism tend to use dispositional factors to explain others' cognitions and behaviors while ignoring situational factors. However, a critical difference between East Asians and European Americans is that compared to European Americans, East Asians have a more malleable dispositionism (Choi et al., 1999). It is

because collectivistic cultures emphasize social harmony and relationships (Markus & Kitayama, 1991). Thus, East Asians believe that information can be contradicting, flexible, and interconnected with each other (Yama, 2017). They are also less likely to make dispositional attributions because they integrate contradictory and situational information (Choi et al., 2003). This difference in causal attribution suggests an association between thinking style and information-processing.

Information seeking and processing could be a state or a trait, leading to either heuristic or systematic decision-making. Specifically, if one prefers integrating more information, they will seek additional information before making final decisions; in contrast, if one prefers focusing on specific information, they will only pay attention to the already available information. In the current review, I summarize the information-processing model, examine the existing literature on cultural differences in information-processing, and present the heuristic-systematic model. Following will be defining a fast-and-frugal heuristic, the take-the-best heuristic. At this point, I will combine the information-processing model, the heuristic-systematic model, and the take-the-best heuristic to suggest a link between cultural differences in information-processing and heuristic use. I then outline a pilot study and two experimental studies to assess the effects of thinking style on heuristic use. In other words, how participants' thinking style motivates them to seek additional information after having the most discriminating and helpful cue.

Motivation as a Trait or a State

Information-processing requires a control system. A control system helps people determine the conditions and actions needed to execute information-processing (Simon, 1979). For example, people must have the motivation to process information to perform a problem-solving task. They will stop information-processing whenever

they are satisfied or believe they have put sufficient effort into the task. Being motivated could be a state of mind which plays an essential role in information seeking and processing. Information-processing requires people's allocation of resources, so people calculate costs and benefits to solve problems (Wang et al., 2022). It also requires people to consider the availability of resources and trade-offs between task components due to their limited resources (Lang et al., 2007). Indeed, the levels of these processes depend on people's motives and motivations. Some researchers state that personality traits and states influence the width and depth of information-processing (Humphreys & Revelle, 1984). However, motives and motivation are two different things. Personality traits involve motives, but personality states involve motivation. When people try hard, try to receive incentives, or try to accomplish complex or important tasks, they will increase their on-task effort and allocate their cognitive resources to the on-going task.

People have motives to seek additional information when their actual and desired knowledge levels have discrepancies (Feng et al., 2014; Kuttschreuter, 2006). For example, when people perceive a discrepancy between their actual and desired vaccine knowledge, they are more likely to use systematic information-processing by actively seeking additional information (Yan et al., 2019). Furthermore, people will also pay more attention to task-relevant information if they perceive the task is self-related (Kim et al., 2018). As such, if people with high confidence in their knowledge make decisions, they may be less willing to use cognitive effort because their actual and desired knowledge have a slight discrepancy. On the other hand, they will save their cognitive resources if they perceive a task as irrelevant or unimportant. In sum, being motivated could be a trait that encourages people to use more cognitive effort to seek and process additional information.

Not surprisingly, people's motivation for information-processing can be temporarily changed, meaning that being motivated also could be a state. State motivation is a temporary motivation influenced by situational factors. For instance, people feel motivated by boosted dopamine (Westbrook et al., 2020), but they can be easily bored because of sleep deprivation (Sullan et al., 2021). Interpretations of mood could impact people's motivation as well. In a related study, Martin and colleagues (1993; Study 1) showed participants a movie eliciting either positive or negative feelings. After asking participants to report their feelings about the movie, they then instructed participants to interpret their current feelings. Participants were told to stop seeking additional information whenever they thought they had enough information to make impressions of a target or when they started not enjoying the ongoing task. Compared to those in positive moods, participants in negative moods spent more time and sought more information until they believed they had sufficient information. In contrast, when the experimenter allowed them to stop whenever they no longer enjoyed the task, participants in negative moods spent less time and sought less information. These altogether suggest that information-processing not only relies on personality traits, but it also depends on the state of mind.

Now I have defined information seeking and processing and outlined the association between motivation and information-processing. To investigate how culture influences motivation in information-processing, understanding the effects of culture on decision-making will be helpful.

Automatic and Effortful Inferences: How Might Thinking Style Influences Decision-Making?

Culture is a system in which people share and practice their values, norms, and beliefs (Yang & Wang, 2019). Culture also serves as a system in which people

differentiate groups to define who they are (Kühnen & Oyserman, 2002; Trafimow et al., 1991; Triandis, 1995) and integrate their internal nervous system and external environments (Cole & Packer, 2019; Lalwani & Shavitt, 2013; Saulton et al., 2017). According to Markus and Kitayama (1991), people construe themselves either independently or interdependently. Individuals with independent self-construals define themselves in terms of internal attributes and emphasize their uniqueness and autonomy. On the other hand, individuals with interdependent self-construals define themselves in terms of social relationships and emphasize their collective group and social harmony.

Self-Construal, Thinking Style and Information Processing

Culture mediates how people behave and think (Markus & Kitayama, 1991), so it is not surprising that culture also influences information-processing. Collectivistic cultures focus on the field and context because people emphasize social relationships and harmony. Therefore, interdependent individuals pay attention to relationships between people and objects. In contrast, individualistic cultures view the world as discrete and discontinuous, believing that rules and properties can explain one's cognition and behavior (Monga & Williams, 2016). For instance, Kühnen and colleagues (2001) found that when completing a task requiring decontextualized and analytic thinking, participants in the independence-priming condition performed better than those in the interdependence-priming condition. In addition, when asked to draw a line in a square which had the same length as the line in another square, American participants performed better than Japanese participants. However, when asked to draw a line in a square which had the same proportion as the line in another square (the relative task), Japanese performed better than Americans, demonstrating the cultural differences in contextual information-processing (Kitayama et al., 2003).

Nonetheless, culture is not fixed and immutable. Culture of cognitions sometimes can be primed (Oyserman & Lee, 2007; Oyserman et al., 2009), changing people's thoughts and views about themselves and their environment (Oyserman & Lee, 2008). In light of these findings, Kitayama and colleagues (2003) found that both Japanese and Americans tended to show the cognition standard in their host culture. Japanese living in America showed similar cognitive patterns to Americans, and Americans in Japan showed similar cognitive patterns to native Japanese. These cross-cultural comparisons evidence the linkage between culture and information-processing, even if culture is temporarily primed.

Wong and colleagues (2021) state that cultural differences in information-processing occur because collectivistic and individualistic cultures promote different personal goals and interpersonal relationships (Oyserman et al., 2009), establishing corresponding information-processing mechanisms. The individualistic culture encourages independent individuals to identify themselves as independent of others. In contrast, the collectivistic culture encourages interdependent individuals to define themselves as being connected with others, and it expects individuals to maintain and promote positive social relationships (Wong & Wyer, 2016). As a result, interdependent individuals are more likely to describe their identity while perceiving themselves as a collective group (Triandis, 1995), and they evaluate others and themselves in terms of social context (Markus & Kitayama, 1991). In this sense, self-construal shapes how people think. This association between self-construal and thinking style can be found between cultures and within a culture. For example, Northern Italians who were relatively independent showed more analytic thinking than Southern Italians who were relatively interdependent (Knight & Nisbett, 2007).

Furthermore, Berry (1976) categorized thinking styles as field dependence or

field independence in response to this converging evidence linking culture and thinking style. People who are field dependent tend to perceive or think about a stimulus based on its context, whereas people who are field independent tend to decontextualize the stimulus and its context. Accordingly, Masuda and Nisbett (2001) examined whether Americans and Japanese would look at and encode the target objects differently. They found that compared to American participants, Japanese participants were more likely to encode the target objects with their related contexts. They also recalled background information better than Americans, reflecting the cultural differences in context sensitivity and contextual information-processing.

A robust group of cross-cultural findings has now shown that people process information based on their cultural background because they differ in perceptions of contextual information. In a related study, Kokkoris and Kühnen (2014) randomly assigned participants to one of two conditions: the likes condition and the dislikes condition. Participants learned that the target liked all four movie genres in the likes-only condition. In the dislikes condition, participants knew that the target enjoyed watching comedies and dramas but disliked sci-fi and thrillers. Participants then completed the Authenticity Scale regarding the target and rated the usefulness of additional dispositional and contextual information (the authors provided that information). The analysis showed no significant difference in the ratings of dispositional information. However, Chinese participants perceived contextual information as more helpful than German participants, especially when the target showed culturally incongruent behaviors.

Masuda and Nisbett's (2001) influential article on the linkage between culture and information-processing proposes two distinct thinking styles as causal factors: holistic and analytic. It is important to acknowledge that analytic thinking and holistic

thinking are not two different systems. They are rather distinct styles of cognition (Buchtel & Norenzayan, 2008; Norenzayan et al., 2002; Yama, 2017). Masuda and Nisbett defined that people with an analytic thinking style tend to focus on focal objects while detaching the objects from their context. Analytic thinkers also prefer using the rules to categorize, explain, and predict others' behaviors. On the other hand, people with a holistic thinking style focus on the relations between focal objects and their context while perceiving them as a whole. They also prefer using contextual information to explain and predict others' behaviors. Extending this theory of thinking style, Nisbett and Masuda (2003) posit that Westerners who are relatively analytic thinkers separate a focal object from its context, attributing the object based on its primary categories. They rely on this experience-based knowledge of categories to explain and predict the object's behavior, decontextualize the object from its context to infer the object's behavior, and use formal logic to avoid contradicting information (Choi et al., 1999; Ji et al., 2000; Liu & Orth, 2021; Lo et al., 2021; Masuda & Nisbett, 2001). In contrast, Easterners who are relatively holistic thinkers pay attention to the relations between the object and its context. Their selective attention to contextual information consequently increases the proportions of contextual information-processing (E & Zhang, 2017). In other words, holistic thinkers are more likely to refer to contextual factors than analytic thinkers in causal attributions and predictions (Choi & Nisbett, 1998; Lee et al., 1996; Morris & Peng, 1994), even when inferring animals and inanimate objects (Morris & Peng, 1994; Peng & Knowles, 2003).

The Fundamental Attribution Error

As its name implies, causal attribution refers to one's interpretations of a particular outcome or behavior. Answering "why questions" can guide people to

develop causal schemas (Kelley, 1967; cited from Bennett, 2017), allowing people to use experience-based knowledge of causal schemas to predict future outcomes or behavior. People infer causal factors by attributing either dispositional or situational factors (Bennett, 2017). If individuals attribute one's behaviors to dispositional factors, they believe that the behaviors reflect the target's characteristics. However, if individuals attribute one's behaviors to situational factors, they decontextualize the behaviors from the target's personalities. For example, a car seemed to be about to move forward quickly as it slipped between cars on the highway. A dispositional attribution could be the driver is a violent driver, whereas a situational attribution could be that the driver needs to go to restroom as soon as possible. Indeed, dispositional and situational attributions are independent of others (Shimizu & Uleman, 2021). When judging ambiguous behaviors, dispositional attribution is linked to spontaneous activation of the temporal lobe (Mason & Morris, 2010) and medial prefrontal cortex (Moran et al., 2014). However, situational attribution is linked to spontaneous activation of the left dorsolateral prefrontal cortex (Mason & Morris, 2010). Together, these neurological findings yield a double dissociation of dispositional and situational attributions.

The skill of causal attribution helps people interpret and predict others' behaviors and cognitions. People believe they are critical and logical thinkers (Ross, 2018), but they often make inaccurate attributions. People are more likely to make dispositional attributions than situational attributions (Krull et al., 1999; Swift et al., 2013), committing the fundamental attribution error. The fundamental attribution error refers to a tendency where individuals believe that dispositional factors can override situational factors, attributing one's behaviors to their characteristics while ignoring situational factors (Jones & Harris, 1967; Ross, 1977). People commit the

fundamental attribution error not only in causal attribution but also in numerous social settings: emotion perception (Adams Jr et al., 2015; Albohn & Adams Jr, 2020; Hess et al., 2004), judging crime (Morris & Peng, 1994), understanding of behavioral genetics (Morosoli et al., 2019), watching a drama or movie (Tal-Or & Papirman, 2007), and evaluating applicants (Swift et al., 2013).

Thinking Style and the Fundamental Attribution Error

Interestingly, the fundamental attribution error occurs across cultures (Bauman & Skitka, 2010; Choi et al., 1999; Han et al., 2011; Knowles et al., 2001; Krull et al., 1999; Owe et al., 2013). For example, both independent and interdependent individuals committed the fundamental attribution error that an essay reflected the essayist's belief of personality (Bauman & Skitka, 2010). In another study, participants, regardless of their cultural background, also believed that the questioner was more intelligent than the answerer even though they knew that experimenters randomly assigned the targets' roles (Krull et al., 1999). Still, interdependent individuals make fewer dispositional inferences when dispositional factors are not salient. When they view the target's actions as ambiguous, interdependent individuals seek out situational information before making final interpretations (Choi et al., 1999), suggesting cultural differences in information-processing. More specifically, culture may influence the later information-processing stage in causal attribution – systematic processing.

People commit the fundamental attribution error because they have the illusion of personal objectivity (Ross, 2018). Westerners commit the fundamental attribution error because they believe that people's behaviors reflect their characteristics (Markus & Kitayama, 1991). Westerners are also more confident in their decision-making (Mann et al., 1998), which in turn increases heuristic use in

causal attribution. On the other hand, East Asians are less likely to commit the fundamental attribution error because they perceive personal characteristics as malleable and social context as influential . Another reason people commit the fundamental attribution error is that making situational attributions requires effortful consideration of the context (Berry & Frederickson, 2015). Dispositional factors are more salient than situational factors (Berry & Frederickson, 2015), so integrating situational factors requires additional cognitive effort in causal attribution.

Attribution is a multiple-stage process, including both automatic and effortful stages (Jen & Lien, 2010). Boosting motives and motivation can increase people's willingness to seek and process information (Feng et al., 2014; Kim et al., 2018). Research suggests that motivation and cognitive effort play important roles in the fundamental attribution error (Dean & Koenig, 2019), because motivation levels shape the amount and depth of information-processing (De Dreu et al., 2008). People automatically make dispositional interpretations, but they will then effortfully revise their initial interpretations before making final decisions. In this sense, if an individual fails at the second step of causal attribution with little motivation and cognitive effort, they will commit the fundamental attribution error (Krull, 1993; Krull et al., 1999).

Of importance is that individualistic and collectivistic cultures differ in situationism, not in dispositionism. Although Westerners understand that situations can influence one's actions and cognitions, they do not apply situational factors (Gawronski, 2004). On the contrary, East Asians seek additional contextual information because they believe that context influences people's behaviors and cognitions (Becker et al., 2018; Choi & Nisbett, 1998; Morris & Peng, 1994; Owe et al., 2013). They are also less likely to perceive information as irrelevant and exclude irrelevant information (Dogruel, 2018; Higgins & Bhatt, 2001; Kokkoris & Kühnen,

2014; Russell et al., 2019). For instance, four experimental studies found that since East Asians integrated more information than European Americans, they showed a more holistic thinking style and made more situational attributions (Choi et al., 2003). East Asians tend to use effortful information-processing to revise their initial dispositional attributions compared to Westerners (Bennett, 2017; Choi et al., 1999; Gilbert et al., 1988; Smith & Francis, 2005).

East Asians also seemed to pay attention to contextual information in causal attribution. Such a link between culture and selective attention to context has emerged even when culture is temporarily primed (Kim et al., 2007). In a related study, interdependence-primed participants did not provide old and redundant information in response to a second question. In contrast, independent-primed participants similarly responded to two questions about happiness and satisfaction, demonstrating that interdependence-primed participants paid closer attention to context than independence-primed participants (Haberstroh et al., 2002; Study 1). These results suggest that primed- or chronic- interdependent individuals tend to pay more attention to context than independent individuals. In other words, holistic thinkers are more willing to use additional effort in information-processing.

If this link between culture and information-processing is valid, this would partially explain the cultural differences in the fundamental attribution error. Smith and DeCoster (2000) argued that people make automatic and effortful causal attributions. The heuristic system refers to automatic inference in the attribution process, and the analytic system refers to effortful inference in the correction stage. People may make automatic inferences when their cognitive resources are limited because effortful inferences require significant cognitive effort in information-processing. In this case, holistic thinkers use more cognitive effort than analytic

thinkers due to their complex cognitive structures and increased information-processing. Although there is no research directly examining the association between thinking style and cognitive effort in information-processing, Jen and Lien (2010) found that increased cognitive load leads to higher proportions of committing the fundamental attribution errors, but they failed to find the cultural differences in causal attribution. A potential alternative explanation is that analytic and holistic thinkers differ in the process of information seeking, not the process of causal attributions. It is still possible that holistic thinkers seek more situational information than analytic thinkers to interpret one's behaviors. However, they both commit the fundamental attribution errors when their cognitive resources are limited. In addition, Jen and Lien provided situational information to participants in their study. In reality, people need to seek information by themselves. Therefore, when people need to seek information actively, analytic and holistic thinkers might engage in different information-processing.

Altogether, the evidence suggests that thinking style is associated with information-processing. Since dispositional factors are easily accessible and require less cognitive effort, both analytic and holistic thinkers make automatic dispositional attributions. Though, holistic thinkers later seek and use situational factors to finalize their interpretations of one's behavior, because they perceive situational information as relevant and helpful. In turn, holistic thinkers use more cognitive effort than analytic thinkers due to additional information-processing. Indeed, studies have repeatedly found an association between cognitive effort and automatic and effortful information-processing. The cognitive miser is linked to the fundamental attribution error (Gill & Andreychik, 2014). People prefer heuristic processing (dispositional inferences) to systematic processing (situational inferences) to attribute others'

behaviors (Wong & Weiner, 1981). I will now address how heuristic use differs between holistic and analytic thinkers due to their information-processing preferences.

Heuristics

When processing information, people engage in either heuristic or systematic processing (Evans, 2003; Jen & Lien, 2010; Sloman, 1996; Smith & DeCoster, 2000; Stanovich & West, 2000). Systematic processing requires two elements: the ability and motivation of systematic processing. In systematic processing, people effortfully seek and process information and logically analyze it to make decisions. In contrast, heuristic processing has three elements: availability, accessibility, and perceived reliability (Chaiken & Ledgerwood, 2012; Chaiken et al., 1989; Krull et al., 1999). Busenitz and Barney (1997) defined heuristic processing as "biases and heuristics are decision rules, cognitive mechanisms, and subjective opinions people use to assist in making decisions" (p.12). In reality, people often cherry-pick specific information and perceive heuristics as effective, especially when making uncertain decisions (Gallimore & Wolverton, 1997; Kastenmüller et al., 2010; Messick & Schell, 1992; Pitz & Sachs, 1984). Nevertheless, people still use heuristics to make quick decisions by ignoring some information, because they do not have enough time and energy to engage in systematic processing (Gigerenzer & Goldstein, 1999).

Take-the-best Heuristic (TTB)

The take-the-best heuristic is a type of one-reason decision with two principles: recognition and information-seeking (Newell & Shanks, 2003). The first, the recognition principle, refers to the tendency in which people recognize the best among a range of alternatives and choose the recognized one. The second principle states that when people recognize multiple best options, they choose the optimal option according to the validities of ranked cues or features. People search cues

according to cue rank and stop searching for additional features once the most discriminating feature is available (searching rule; Lawrence et al., 2018). If the cue with the highest validity cannot discriminate the options, people will search for the next best cue (stopping rule; Štukelj, 2020). Lastly, people use the available information to make decisions (Gigerenzer & Goldstein, 1999), but other cues cannot overturn the best discriminating cue (decision rule; Garcia-Retamero et al., 2007).

Although the take-the-best heuristic is simple, it sometimes can exceed other decision-making strategies when there is a high cost of information and limited available information (Fechner et al., 2018; Gigerenzer & Goldstein, 1999; Hogarth & Karelaia, 2006; Newell & Shanks, 2003). Unlike recognition heuristics, the take-the-best heuristic involves both automatic and systematic stages. When using the recognition heuristic, people use a cue recognized faster than alternatives. On the other hand, recognition does not play an important role in the take-the-best heuristic. Although people use cues based on automatic recognition, they systematically use their established cue rank to judge which information they should use. In other words, the take-the-best heuristic provides an order of information seeking, a stopping method of information seeking, and a decision-making criterion for the available information. People choose the first cue that comes to mind and retrieve the cue value from their memory (either 0 or 1). They then use the ordered cues to determine whether they should seek additional information. If they perceive that the best discriminating cue is satisfactory, they will ignore irrelevant alternatives (Gigerenzer & Gaissmaier, 2011; Gigerenzer & Goldstein, 1996; Scheuerman et al., 2019). Considering that people selectively view information rather than search all of it at once, the take-the-best heuristic is considered a fast-and-frugal heuristic (Garcia-Retamero et al., 2007). In such systematic information seeking and processing, some

researchers argue that the take-the-best heuristic is not always fast and frugal because it involves some computations and selectively searches some of the information available in the environment. Therefore, the take-the-best heuristic is “fast or frugal.” For example, the take-the-best heuristic can be slow when it requires attentional control and search costs, and it can be fast when additional information can increase coherence among cues (Bobadilla-Suarez & Love, 2018). In sum, people systematically use their mental shortcuts in decision-making, selectively rank cues, and automatically recall them based on their validities.

People often use the take-the-best heuristic. For instance, they use it in medical decisions (Marewski & Gigerenzer, 2012) and environment exploration (Yahosseini & Moussaïd, 2019). In a lab setting where participants had to pay for additional information, participants violated the frugal stopping rule and decision rule of the take-the-best heuristic. However, most of them used a frugal stopping rule when they had access to only two pieces of information rather than six. Furthermore, participants stopped buying additional information when they had the most valid cue, suggesting that the number of available information is the key to using the take-the-best heuristic (Newell & Shanks, 2003). Yet, in reality, people have access to unlimited information. Resonating with this, Graefe and Armstrong (2012) sampled U.S. presidential elections from 1972 to 2008. They found that voters usually decided based on the most critical issue (such as a political party), even though they indicated that they had considered lots of information about the candidates. Altogether, these findings yield the importance of the amount of available information on the stopping rule of the take-the-best heuristic.

Paralleling this, research has shown that the use of the take-the-best heuristic is based on the accessibility of information in memory (Khader et al., 2013; Khader et

al., 2011; Platzer et al., 2014). When they had increased information costs by retrieving the information to make decisions, participants preferred the take-the-best heuristic (Bröder & Schiffer, 2003). Participants also used the instructed stopping rule of the take-the-best heuristic and the cue rank (Garcia-Retamero et al., 2007), indicating that giving instructions can influence people's use of the take-the-best heuristic. People learn what kind of information they should search for and how to rank the information through observation and socialization (Gigerenzer & Goldstein, 1999). In this sense, since thinking style is related to people's perceptions of information, it might influence the searching and stopping rules of the take-the-best heuristic.

The Causes of Heuristics

A breadth of research has now been gathered to show that people engage in heuristic processing when their motivation or ability for systematic processing is low (Chaiken et al., 1989). They seek information systematically when they perceive that their current and desired knowledge do not match (Chaiken, 1980; Eagly & Chaiken, 1993). According to Chaiken et al. (1989), people are motivated to achieve their information-processing goals until they are confident in their decisions. In this case, it is possible that having a high level of knowledge helps people attain their processing goals. People with high levels of knowledge are more likely to engage in systematic processing than those with a low level of knowledge (Trumbo, 2002), so they become confident in their information-processing (Jepsen, 2007; Wei et al., 2016; Yan et al., 2019). Having a high level of knowledge also motivates individuals to seek information because it has fewer cognitive costs than having a low level of knowledge (Brucks, 1985). When people cannot confidently make decisions due to limited information, they engage in systematic processing (Johnson, 2005).

As mentioned, confidence may serve the critical function of information-processing. People increase their effort in information-processing when their actual confidence falls below their desired confidence (Chaiken & Ledgerwood, 2012; Chaiken et al., 1989; Eagly & Chaiken, 1993). People are motivated to engage in systematic information-processing when their confidence levels do not match their desired levels. In contrast, when these two levels of confidence match or actual confidence are higher than desired confidence, people are likely to engage in heuristic processing (Chang, 2004; Kim et al., 2018). Similarly, overconfidence may increase people's susceptibility to heuristic processing. Overconfidence is often linked to poor decision-making and is pervasive among laypeople and experts (Griffin & Tversky, 1992; Lechuga & Wiebe, 2011). Entrepreneurs with high confidence levels were more likely to use heuristic processing than managers with low confidence levels (Busenitz & Barney, 1997). Another example is the fundamental attribution error, a heuristic processing in causal attribution. The fundamental attribution error occurs with overconfidence in predicting future actions and outcomes (Ross, 2018).

It has been proposed that culture can impact people's preferences of heuristic or systematic processing, because Westerners tend to be more confident in their decision-making than East Asians (Mann et al., 1998), and they tend to ignore situational factors (Choi et al., 1999). I will now review the cultural differences in heuristics.

Heuristics and Thinking Style

Unfortunately, no research has directly examined the impact of thinking style on the take-the-best heuristic use. Though, evidence suggests that thinking style influences susceptibility to other types of heuristics (Gallimore & Wolverton, 1997). In their experiment, Cheek and Norem (2017) found a significant bivariate correlation

between thinking style and susceptibility to anchoring. While self-construal did not correlate with the anchoring heuristic, participants with a more holistic thinking style did not rely too heavily on the first piece of information as those with a more analytic thinking style. In another experiment, neither independent nor interdependent self-construal was related to essay-attitude consistency (Bauman & Skitka, 2010). These findings suggest that although researchers sometimes use self-construal and thinking style interchangeably, thinking style is the variable directly linked to people's heuristic use. Therefore, it is crucial to distinguish between self-construal and thinking style in cross-cultural studies. Participants who were primed with a holistic thinking style also showed less cause-effect magnitude correspondence between cause and effect (Geng et al., 2020; Spina et al., 2010), indicating that analytic thinkers have more simple causal theories than holistic thinkers (Duttle & Inukai, 2017).

Time pressure has additionally emerged in research examining cultural differences in susceptibility to heuristics. Li and colleagues (2015) randomly assigned participants to either the time constraint condition or the control condition, and they told participants to imagine that they would choose an apartment to live in next semester. Participants rated the importance of six apartment attributes and chose the best option afterward. In the time constraint condition, participants needed to choose the apartment with the time limit. The results reflected that the impact of the time constraint was more substantial on Hong Kong Chinese than on European Canadians. More specifically, Hong Kong Chinese explored more information without time constraints. In contrast, the searching rule did not differ between European Canadians' time constraint and control conditions. Hong Kong Chinese were also more likely to seek information based on its cue validity when they needed to make decisions as soon as possible.

It is still unclear about the direct link between thinking style and the searching and stopping rules of the take-the-best heuristic. However, multiple findings in the literature on cultural differences in heuristics suggest that holistic thinkers have a lower susceptibility to heuristics than analytic thinkers (e.g., Cheek & Norem, 2017; Spina et al., 2010). Holistic thinkers integrate more contextual information in their decision-making, perceiving context as informative (Han et al., 2011; Kastenmüller et al., 2010; Masuda & Nisbett, 2001). Consequently, thinking style influences information-processing. Regardless of their thinking styles, people will automatically search for the best discriminating cue at the beginning. However, while analytic thinkers will follow the stopping rule of the take-the-best heuristic that they stop at the first best discriminating cue, holistic thinkers are likely to violate the frugal stopping rule. They will search for additional information after having the first best discriminating cue because their thinking style motivates them to use more cognitive effort in information-processing.

Rationale

Taken together, the take-the-best heuristic is a type of information-processing, perhaps explaining the cultural differences in the fundamental attribution error which is an outcome of information-processing. Self-construal is associated with thinking style, shaping how people process information, which in turn should be reflected in differences in heuristic use. Compared to analytic thinkers, holistic thinkers are less likely to commit the fundamental attribution error, because they integrate context (e.g., situation) to overwrite their dispositional attributions (Choi et al., 1999; Kastenmüller et al., 2010; Lieberman et al., 2005; Mason & Morris, 2010) while focusing on internal factors (e.g., an actor's characteristics). Cultural differences in communication goals (Matsumoto et al., 2008; Matsumoto et al., 2005), meaning

extraction, person perception, and attribution (Newman & Erber, 2018) also explain this variation in the fundamental attribution error. Holistic thinkers believe that others' behaviors are influenced by their social context and view dispositional factors as malleable. Therefore, they consider contextual information more important in the diagnosis than dispositional factors (Choi et al., 1999; Norenzayan et al., 2002). In addition, since Westerners who are relatively analytic thinkers are more confident in their decisions than East Asians who are relatively holistic thinkers, they are likely to cherry-pick information (Mann et al., 1998; Masuda et al., 2012; Ross, 2018). In this sense, Westerners cherry-pick dispositional information and then commit the fundamental attribution. On the other hand, East Asians are not confident in their decision-making, so they are motivated to engage in effortful information-processing. Hence, they might have a longer stopping rule of the take-the-best heuristic compared to analytic thinkers because they search for additional information after having the first best discriminating cue, violating the frugal stopping rule of the take-the-best heuristic.

Although many researchers have investigated the impact of thinking style on heuristic-systematic information-processing, no past study has sought to clarify the impact of thinking style on the take-the-best heuristic. Specifically in fact finding, thinking style may influence people's motivation in information-processing and the take-the-best heuristic use between analytic and holistic thinkers. The idea that thinking style might influence fact finding is essential primarily when people serve on a jury (최 & 허, 2020). People with a holistic thinking style may make biased decisions when context increases bias, whereas people with an analytic thinking style are more likely to make biased decisions when context decreases bias (Krishna et al.,

2008).

Furthermore, in the present study, we only recruited Americans as participants because of two issues: (1) we did not have enough time to recruit participants out-of-state, and (2) indeed, cultural differences are not restricted to between nations (e.g., Chinese versus Americans) only. Even within a nation, there is within-cultural variability. For example, Huang and colleagues (2014) demonstrated the differences in self-cognitions between Tibetans and Han Chinese. While private, collective, and relational self-cognitions differed among Han Chinese, Tibetans continuously showed similar judgments regarding these three types of self-cognitions. In addition, Del Campo et al. (2016) showed that the impact of time pressure on heuristic use might differ within one country. In the time constraint condition, Vienna participants used the take-the-best heuristic, but Madrid participants did not, and even rational decision-makers showed increased the take-the-best heuristic use. Hence, recruiting Americans only will not bias our results.

The following two studies aimed to find evidence for the interaction of thinking style and cognitive resources on information-processing in fact finding. I predicted that holistic thinkers would consistently seek more information than analytic thinkers, and I also predicted that time pressure would increase people's heuristic use, shortening their stopping rule of the take-the-best heuristic. Previous findings have shown the effects of information-processing priming by giving participants instructions about processing information (e.g., Wong et al., 2021). Hence, I will first examine validify cue ranks (Pilot Test). I will further test the extent to which primed-thinking style and time pressure will yield the susceptibility to the take-the-best heuristic (searching and stopping rules). Indeed, many researchers have operationalized reaction time as a dependent measure of information seeking and

processing. In this series of studies, however, I measured the number of information requested by participants instead of their reaction time. Provided that East Asians can explore a vast amount of information at great speed (Li et al., 2015) and that Study 1 was designed to manipulate time constraints, measuring reaction time may not be appropriate to detect the intertwining of thinking style and cognitive resources in information-processing. Lastly, I assessed whether encouraging participants to strive for high accuracy would reduce their susceptibility to the take-the-best heuristic.

Pilot Test

To establish cue ranks and time limit for Study 1, this pilot study measured participants' perceived cue rank in each criminal case and reaction time on decision-making. Participants ranked six cues by evaluating how important a cue is to identify a murderer. They also identified who was more likely to have committed the crime after reading cues about two suspects.

Fact finding plays a crucial role in determining intentions of crime because judges tend to sentence victims based on their intentions of crime (최 & 허, 2020). People link actions' causation and consequence with actors' desires and beliefs (Cushman, 2008). If one believes that the actor is late on purpose, they will perceive this misbehaving as an unacceptable action. Therefore, they will punish the perpetrator more harshly. Similarly, 최 and 허 (2020) argued that understanding how thinking style impacts intentional judgments is needed because holistic thinkers might integrate contexts to determine perpetrators' actions, while analytic thinkers might focus on perpetrators only. Judges and juries with a holistic thinking style may judge the intention based on the overall context of the case in consideration of the moral characteristics of both parties.

Method

Participants

A hundred participants read a brief description of the study and indicated their willingness to participate through Amazon MTurk online platform in exchange for one dollar. Participants in the United States participated in this pilot study. Participants were instructed that they would read four invented criminal cases and their job was to identify a murderer in each case. Upon their completion, participants reported their demographic information and were debriefed.

Procedure

Participants completed all study materials online via Qualtrics. Once they agreed to participate in the pilot study, they received the following instruction: "In this research study, you will read four invented criminal cases. For each criminal case, you will read a description of a crime scene. After reading the description, you need to rank the validity of six cues according to their importance. Next, you will read the list of two suspects' profiles to identify which of them is more likely to have committed the crime." After then, participants read four invented criminal cases and identified a murderer in each case (Appendix A). The four criminal cases were roughly equivalent in length. Participants read a description of a crime scene within each criminal case. Each criminal case described four cues found at the crime site, and the four cues were italicized to emphasize their importance. Four cues were generated based on the cues found at the crime site, being relevant cues about the perpetrator. The suspect profiles were generated based on the four cues found at the crime site to discriminate between two suspects. For example, a cover story mentioned that a handbag was found next to the body, suspects profiles were about handbag brands (e.g., Chanel vs. Burberry). Participants then ranked the importance of the six cues only based on the cue type

(e.g., blood type or handbag). In additional to the four relevant cues, additional two cues were included as random cues about suspects because they were not mentioned in the description of the crime site, and they also told nothing about the perpetrator. The six cues were presented all at once. Next, participants identified the murderer of the case based on the suspect profiles (e.g., blood type: Suspect A = B, Suspect B = O; Appendix B) in a different section. They needed only one cue to differentiate the two suspects because the suspects have thoroughly different profiles. Lastly, participants reported their confidence in the identification of the murderer. Participants read four criminal cases in random order (see Appendix C for the detailed procedure).

Results

Table 1 shows how participants ranked six cues within each scenario. The closer to 1 indicated the most important the cue was, whereas the closer to 6 indicated the least important the cue was. Participants perceived cue rank mostly matched with the order of presentations. The only exceptions were the fifth (perfume) and the sixth cue (car) in scenario 1. Participants perceived car as more important than perfume, so car was presented as the fifth cue and perfume as the sixth cue in Studies 1 and 2. I used the 75th percentile of reaction time on identification in the pilot study as the time limit in Study 1. A descriptive analysis showed that participants spent 81.25 seconds on average to identify a murderer in a criminal case in the pilot test. Therefore, participants in the time constraints condition were instructed that they had only 117 seconds per criminal case in Study 1.

Study 1

The goal of Study 1 was to investigate whether thinking style is related to

Table 1

Perceived Cue Ranking in the Pilot Study.

Scenario 1	*M*(*SD*)	Scenario 2	*M*(*SD*)	Scenario 3	*M*(*SD*)	Scenario 4	*M*(*SD*)
Blood Type	2.10(1.50)	New Wound	2.55(1.55)	Hair Style	2.79(1.73)	Blood Type	2.21(1.25)
Condom	2.91(1.64)	Crime History	2.98(1.52)	Recent Shopping List	3.20(1.48)	Fingerprint	2.3(1.07)
Handbag	3.27(1.40)	Shoe Size	3.05(1.40)	Cigarette	3.20(1.63)	Left-handed	3.01(1.07)
Cigarette	3.48(1.20)	Cigarette	3.52(1.56)	Relationship with the Victim	3.40(1.53)	Music Preference	3.72(1.41)
Perfume	4.64(1.19)	Mobile Device	3.97(1.58)	Favorite Coffee	4.20(1.55)	Coffee	4.86(1.27)
Car	4.60(1.73)	Hobby	4.93(1.56)	Mobile Device	4.21(1.84)	Car	4.9(1.50)

people's information seeking and processing in fact finding. Participants' thinking styles were primed before they read four criminal murder cases. In each case, participants were instructed to identify the murderer. Identifying a murderer in a criminal case has successfully assessed people's use of the take-the-best heuristic (Bröder & Schiffer, 2003). In addition, the present study aimed to assess the interaction of thinking style and time constraints on information-processing. Research has suggested that time pressure gives people additional cognitive load, increasing their heuristic use (Del Campo et al., 2016). Therefore, the following statements are Study 1's hypotheses:

Hypothesis I(a): Holistic-primed participants will seek more cues about the suspects than no-prime participants.

Hypothesis I(b): Participants in the time-unconstrained condition will seek more cues about the suspects compared to those in the time-constrained condition.

Hypothesis I(c): Time pressure will reduce the difference in the number of requested cues about suspects between no-prime participants and holistic-primed participants.

Hypothesis II(a): No-prime participants will be more confident in their identification of the murderers than holistic-primed participants.

Hypothesis II(b): Participants in the time-unconstrained condition will be more confident in their identification of the murderers compared to those in the time-constrained condition.

Method

Participants

Two hundred and thirty-six English-speaking participants were recruited via DePaul SONA system in exchange for 0.5 SONA credit, ranging from 18 to 32 years

old (M = 19.5, SD = 2.09; 158 female, 47 male, 9 non-binary, and 2 other). A hundred participants self-identified as White or European American (46.08%), 39 as Latino (17.97%), 28 as East/South/Southeast Asian or Asian American (12.90%), 24 as Bi-racial (11.06%), 16 as Black or African-American (6.78%), and 9 as other ethnicity groups (4.15%). Data from 45 participants were excluded because either they did not complete the experiment (8.47%) or their completion time was flagged by RStudio (12.29%). I used "boxplot.stat()$out" in R to identify the outliers of duration in completing the entire survey.

Procedure

Participants completed all tasks and measures via a Qualtrics online survey regardless of their assigned conditions. After indicating their willingness to participate in the study, participants were randomly assigned to either the no-prime or holistic-priming condition. They read an article about tornadoes or the butterfly effect (no-prime vs. holistic). In the no-prime condition, participants read an article about some facts about tornadoes; however, in the holistic priming condition, participants read an article about the butterfly effect. Participants then wrote two or three sentences to summarize the main theme of the article and rate the quality of the article.

Next, participants were additionally randomly assigned to either the time constraints or time-unconstrained condition (between-subjects design; 2 Priming: no-priming vs. holistic x 2 Time Pressure: time constraints vs. no time constraint). Participants in the time constraints condition were instructed to identify the murderers within a certain time. They received the following instruction:

In this research study, you will read four invented criminal cases. For each criminal case, you will read a description of a crime scene. After reading the description, you will be provided a cue about two suspects. You will read the two

suspects' profiles to identify which of them is more likely to have committed the crime. You need to indicate whether or not you need additional cues about suspects' profiles to identify the murderer. If you click "yes" to indicate that you need additional information, one more cue about two suspects will be provided. If you click "no", you will be guided to a separate section to identify the murderer and rate your confidence in identification. However, please keep in mind that you will only have 117 seconds per case.

In contrast, participants in the time-unconstrained condition had unlimited time. They received the following instruction:

In this research study, you will read four invented criminal cases. For each criminal case, you will read a description of a crime scene. After reading the description, you will be provided a cue about two suspects. You will read the two suspects' profiles to identify which of them is more likely to have committed the crime. You need to indicate whether or not you need additional cues about suspects' profiles to identify the murderer. If you click "yes" to indicate that you need additional information, one more cue about two suspects will be provided. If you click "no", you will be guided to a separate section to identify the murderer and rate your confidence in identification.

Importantly, participants were not provided with all suspects' cues at once. Instead, they had to indicate their needs for additional cues while reading the invented criminal cases. Participants were given a cue (e.g., blood type) and two suspects' profiles (e.g., B or O) and indicated whether they needed additional cues to identify the perpetrator. I provided the most diagnostic cue first based on the perceived cue rank measured in the Pilot Study. Participants indicated whether they needed more cues about suspects to identify the perpetrator. In this case, participants had one more

cue about the suspects if they said yes. If they said no, they decided who has committed the crime and rated their confidence in the decision. After identifying the murderers of the four criminal cases, participants rated 24 items from the Analysis-Holism Scale. Finally, they reported their demographic information and received a debriefing about the study.

Measures

Manipulation of Thinking Style. Participants were randomly assigned to either a no-prime[1] or holistic-prime condition (taken from Norenzayan and Lee, 2010). In the no-prime condition, participants read an article about some facts about tornadoes. In the holistic-prime condition, participants read an article about the butterfly effect written in scientific language. The article explains that the flapping of a butterfly's wings can cause a tornado in a remote place. After reading the assigned article, participants were instructed to summarize the main theme of the article in no more than three sentences and then rated the quality of the arguments[2] (1 = *very poor*, 10 = *Excellent*; Appendix D).

Identification Task. The identification task was adapted from Bröder and Schiffer (2003). Participants were provided suspect profiles and critical cues found at four murder crime scenes. Studies 1 and 2 used the same four criminal cases as in the pilot test. The criminal cases were presented in random order but in different sections. As in the Pilot Study, participants read a cover story for each criminal case, and they were provided a cue about two suspects. Participants needed only one cue to identify

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[1] Given the sample demographics (i.e., participants in the US), it was expected that this no-prime condition was akin to an analytic-prime condition. That is, participants were expected to adopt an analytic thinking strategy by default.

[2] The quality of the arguments differed between the holistic-prime condition (M = 6.75, SD = 1.74) and the no-prime condition (M = 6.03, SD = 1.82), $t(1, 215) = 2.97$, p = .003.

the murderer because two suspects have entirely different profiles. However, participants could request to have more cues about suspects to identify the perpetrator. The cues with the two suspects' profiles were presented in a fixed order; cues were presented from most to least important, based on the results of the Pilot Study. In other words, participants had one cue about two suspects along with a cover story, and then they had one more cue about the suspects upon their requests. If a participant requested no additional cues, their response was coded as 0. On the other hand, if a participant requested an additional cue, their response was coded as 1. Participants could request to have six cues at maximum. Hence, they could score 5 at maximum in each criminal case. They also identified which of the two suspects was more likely to have committed the crime after analyzing the provided cues about suspects, when comparing them with the cues found at the crime site.

Confidence in Identification. Participants rated their levels of confidence in identification on a 5-point Likert scale (0 = *not at all confident*, 1 = *a little confident*, 2 = *somewhat confident*, 3 = *quite a bit confident*, 4 = *extremely confident)*.

Thinking Style. Participants also rated 24 items from the Analysis-Holism Scale (Choi et al., 2007; Appendix E), ranging from -3 = *strongly disagree* to +3 = *strongly agree*. They completed six items measuring their beliefs of causality (e.g., "Everything in the universe is somehow related to each other"), six items measuring their attitudes toward contradiction (e.g., "It is more desirable to take the middle ground than go to extremes"), six items measuring their perceptions of change (e.g., "Every phenomenon in the world moves in predictable directions"), and six items measuring their locus of attention (e.g., "The whole, rather than its parts, should be considered in order to understand a phenomenon").

Results

Table 2

Descriptive Statistics in Study 1 (N = 191)

	Mean	Standard Deviation	Range
		Information Seeking	
Scenario 1	1.56	1.55	5
Scenario 2	1.85	1.41	5
Scenario 3	1.85	1.50	5
Scenario 4	1.40	1.31	5
		Confidence in Identification	
Scenario 1	2.70	0.96	4
Scenario 2	2.78	1.01	4
Scenario 3	2.64	1.05	4
Scenario 4	2.80	0.93	4
		Analysis-Holism Scale	
Unvalidated	0.79	0.43	2.38
Validated	0.67	0.49	3.07

Reliability and Validity of AHS.

Descriptive statistics is presented in Table 1. The overall alpha reliability of the Analysis-Holism Scale was .62 (.72 for the causality subscale, .62 for the attitudes toward contradiction subscale, .68 for the perception of change subscale, and .68 for the locus of attention). The model fit of 4-factor confirmatory factor analysis (CFA) for Analysis-Holism Scale was not significant, $X^2(246) = 459$, $p < .001$, CFI = .783, TLI = .757, SRMR = .09, RMSEA 90% CI [.05, .07], leading to conducting an

exploratory factor analysis (EFA) on the items.

The exploratory factor analysis with oblimin rotation on 24 items showed a significant Bartlett's test of sphericity, $X^2(276) = 1209$, $p < .001$, and a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.75 (see Table 3 for factor loadings and Table 4 for item reliability statistics). The exploratory factor analysis suggested a four-factor structure, while the fifth item in the locus of attention subscale did not load on any factor (Locus5), the sixth item in the locus of attention subscale (Locus6) did not load in the factor of locus of attention, and the fifth item in the perception of change (Change5) also did not load in the factor of perception of change. After dropping Locus5, a CFA 4-factor model still did not yield an acceptable fit, $X^2(224) = 425$, $p < .001$, CFI = .792, TLI = .765, SRMR = .09, RMSEA 90% CI [.05, .07], while the Locus6 had an insignificant factor loading ($p = .689$). A CFA 4-factor model by additionally dropping the item of Locus6 reported a poor fit, $X^2(203) = 347$, $p < .001$, CFI = .841, TLI = .819, SRMR = .08, RMSEA 90% CI [.05, .07]. Another model was still not a good fit, $X^2(183) = 279$, $p < .001$, CFI = .888, TLI = .871, SRMR = .07, RMSEA 90% CI [.04, .06] when excluding Locus5, Locus6, and Change5. Since the factor covariances (Table 5) showed that the factor of attitudes toward contradiction was not significantly related to the other factors and its Cronbach's alpha was the lowest among the four factors, I removed it and computed an additional confirmatory factor analysis of the 3-factor model. The results demonstrated that the 3-factor model without Locus5, Locus6, and Change5 had a good fit, $X^2(87) = 116$, $p = .021$, CFI = .957, TLI = .948, SRMR = .06, RMSEA 90% CI [.02, .06]. As a result, I excluded Locus5, Locus6, and Change5 and the attitudes toward contradiction subscale in further statistical analyses.

Table 3

Factor Loadings for the Analysis-Holism Scale (Study 1)

	Factor				
	1	2	3	4	Uniqueness
(Causality1) Everything in the universe is somehow related to each other.	0.716				0.498
(Causality2) Nothing is unrelated.	0.511				0.713
(Causality3) Everything in the world is intertwined in a causal relationship.	0.554				0.695
(Causality4) Even a small change in any element of the universe can lead to significant alterations in other elements.	0.564				0.669
(Causality5) Any phenomenon has numerous numbers of causes, although some of the causes are not known.	0.434				0.727
(Causality6) Any phenomenon entails a numerous number of consequences, although some of them may not be known.	0.511				0.732
(ATC1) It is more desirable to take the middle ground than go to extremes.				0.491	0.738

	Factor				
	1	2	3	4	Uniqueness
(ATC2) When disagreement exists among people, they should search for ways to compromise and embrace everyone's opinions.				0.591	0.612
(ATC3) It is more important to find a point of compromise than to debate who is right/wrong, when one's opinions conflict with other's opinions.				0.611	0.594
(ATC4) It is desirable to be in harmony, rather than in discord, with others of different opinions than one's own.				0.457	0.769
(ATC5r) Choosing a middle ground in an argument should be avoided.				0.380	0.778
(ATC6) We should avoid going to extremes.				0.311	0.880
(Change1r) Every phenomenon in the world moves in predictable directions.			0.471		0.741
(Change2r) A person who is currently living a successful life will continue to stay successful.			0.717		0.449

	Factor				
	1	2	3	4	Uniqueness
(Change3r) An individual who is currently honest will stay honest in the future.			0.771		0.384
(Change4r) If an event is moving toward a certain direction, it will continue to move toward that direction.			0.474		0.657
(Change5) Current situations can change at any time.	0.449				0.718
(Change6r) Future events are predictable based on present situations.			0.321		0.842
(Locus1) The whole, rather than its parts, should be considered in order to understand a phenomenon.		0.593			0.628
(Locus2) It is more important to pay attention to the whole than its parts.		0.688			0.499
(Locus3) The whole is greater than the sum of its parts.		0.615			0.647
(Locus4) It is more important to pay attention to the whole context rather than the details.		0.743			0.384

	Factor				
	1	2	3	4	Uniqueness
(Locus5) It is not possible to understand the parts without considering the whole picture.					0.849
(Locus6) We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behavior.	0.484				0.671

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

Table 4

Item Reliability Statistics of the Analysis-Holism Scale (Study 1)

	Cronbach's α	McDonald's ω
Causality1	0.586	0.631
Causality2	0.580	0.630
Causality3	0.585	0.632
Causality4	0.585	0.629
Causality5	0.586	0.630
Causality6	0.594	0.637
ATC1	0.606	0.649
ATC2	0.579	0.630
ATC3	0.595	0.641
ATC4	0.597	0.643
ATC5r	0.610	0.621
ATC6	0.617	0.657
Change1r	0.611	0.648
Change2r	0.607	0.645
Change3r	0.606	0.644
Change4r	0.618	0.654
Change5	0.582	0.623
Change6r	0.632	0.670
Locus1	0.609	0.648
Locus2	0.619	0.657

	Cronbach's α	McDonald's ω
Locus3	0.611	0.650
Locus4	0.612	0.651
Locus5	0.586	0.633
Locus6	0.579	0.623

Table 5

Factor Covariances without Locus5, Locus6, and Change5 (Study 1)

	1.	2.	3.	4.
1. Causality	-			
2. Perception of Change	.04(0.48)	-		
3. Locus of Attention	.12(1.30)	-.47(-6.48)***	-	
4. Attitudes toward Contradiction	.17(1.74)	-.13(1.35)	.11(1.20)	-

Note. Estimates on the diagonal, z-values explained in parentheses, and ***$p < .001$.

Manipulation Check.

I computed an independent t-test to analyze the effect of thinking style priming on participants' Analysis-Holism full unvalidated scores. There was no difference in participants' Analysis-Holism scores between the holistic-primed group ($M = 0.78$, $SD = 0.43$) and the no-prime group ($M = 0.80$, $SD = 0.43$), suggesting that participants' thinking style did not change as a result of the priming condition, $t(189) = -0.40$, $p = .69$. There was no difference in participants' Analysis-Holism validated scores between the holistic-primed group ($M = 0.69$, $SD = 0.48$) and the no-prime group ($M = 0.66$, $SD = 0.51$), $t(189) = 0.43$, $p = .67$. Therefore, instead of using the priming condition, participants' Analysis-Holism scores were used to assess the relationships between thinking style and dependent variables in further statistical

analyses. To adjust these changes, I revised Hypothesis I(a) from "holistic-primed participants will seek more cues about the suspects than no-prime participants" to "participants who are relatively holistic thinkers will seek more cues about the suspects than those who are relatively analytic thinkers." I also revised Hypothesis I(c) from "time pressure will reduce the difference in the number of requested cues about suspects between no-prime participants and holistic-primed participants" to "time pressure will reduce the difference in the number of cues about suspects between holistic thinkers and analytic thinkers." Lastly, I revised Hypothesis II(a) from "no-prime participants will be more confident in their identification of the murderers than holistic-primed participants" to "participants who are relatively analytic thinkers will be more confident in their identification of the murderers than those who are relatively holistic thinkers." To ensure that the priming condition did not influence participants' information seeking and confidence in identification, I ran a generalized linear mixed-effects model and a linear mixed-effects model. Thinking style priming (0 = the holistic-prime condition, 1 = the no-prime condition) and time pressure (0 = the time constraints condition, 1 = the control condition) were two fixed effects, and story number (1 ~ 4) was a random effect. R codes are available in Appendix F. The results suggested that there was no significant main effect of thinking style priming (β = .05, z(759)= .65, p = .52) or of time pressure (β = .05, z(759)= .63, p = .53), along with an insignificant priming and time pressure interaction on the number of requested cues to identify murderers, β = -.05, z(759)= -.44, p = .66. The main effect of time pressure and the interaction effect of time pressure and thinking style priming on confidence in interpretation were not significant, β = 0.07, t(757) = 0.73, p = .47 and β = -0.09, t(757) = -0.60, p = .55, respectively. However, the main effect of thinking style priming was significant, (β =

0.225, $t(757) = 2.22$, $p = .03$), suggesting that participants in the no-prime condition were more confident in their identification than those in the holistic-prime condition.

Information Seeking and Confidence in Identification.

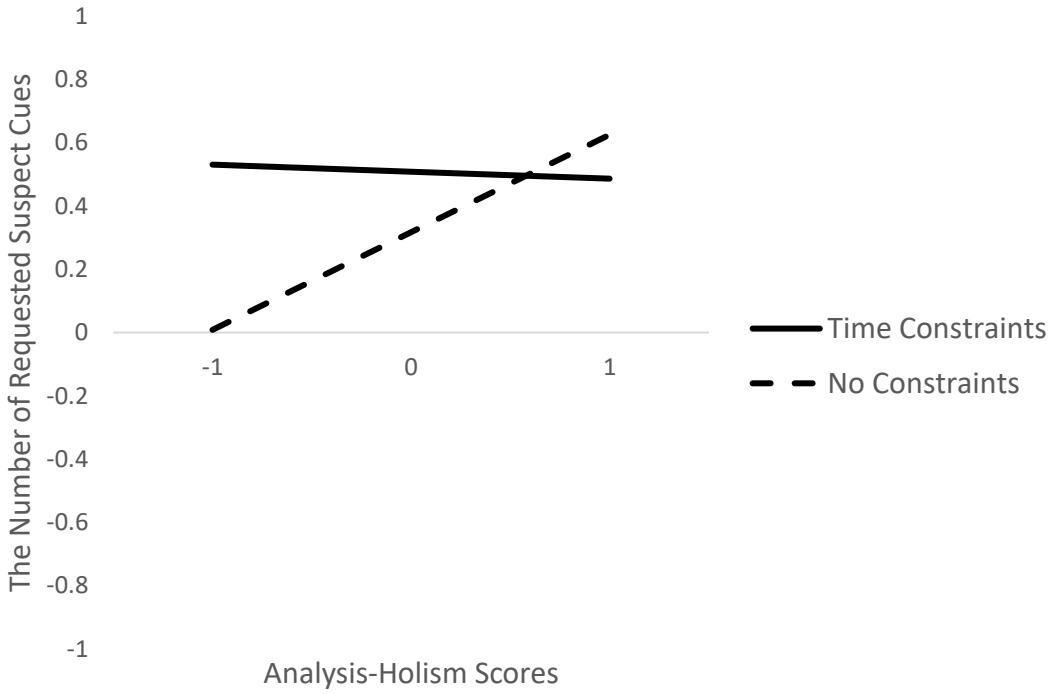
In a generalized linear mixed-effects model, scores on the Analysis-Holism Scale and time pressure were two fixed effects and story number was a random effect (Figure 1). The relation between participants' Analysis-Holism scores and the number of requested cues was not significant, $\beta = -.02$, $z(759) = -.27$, $p = .79$. The result pattern suggested that time pressure increased participants' needs for suspect profiles, $\beta = -.19$, $z(759) = -1.95$, $p = .05$, but not reaching the statistical threshold. The interaction of participant's Analysis-Holism scores and their assigned time constraints condition was significant, $\beta = 0.33$, $z(759) = 2.91$, $p = .004$, meaning that time constraints motivated participants with lower scores on the Analysis-Holism Scale to seek additional suspect cues, but participants with higher scores on the Analysis-Holism scale did not significantly differ depending on their assigned time constraints condition. More specifically, participants with high Analysis-Holism scores requested suspect cues in the time-unconstrained condition more than in the time constraints condition ($p = .01$), while participants with mean ($p = .59$) and low Analysis-Holism scores ($p = .11$) did not differ depending on their assigned time constraints condition (see Table 6 for regression results).

In another generalized linear mixed-effects model reflected that age had an impact on information seeking, $\beta = -.04$, $z(758) = -2.32$, $p = .02$, and an analysis of variance (ANOVA) comparing two models (with age and without age) was also significant. However, since the remaining statistical analyses did not yield a main effect of age on dependent variables, we removed age in further statistical analyses. In a moderated regression, the association between participants' Analysis-Holism scores

and the number of suspects cues requested by participants in the first criminal case presented to participants was not significant, $\beta = 0.66$, $t(187) = 0.26$, $p = .79$, and time constraints did not moderate the association, $\beta = -0.07$, $t(187) = -0.33$, $p = .74$. The interaction was also not significant, $\beta = 0.45$, $t(187) = 0.95$, $p = .35$.

Figure 1

Analysis-Holism Scores and Time Pressure Predicting Differences in Information Searching in Study 1



Note. Both x-axis and y-axis present z-scores.

In a linear mixed-effects model[3] (Figure 2), participants who were relatively holistic thinkers were more confident in their identification than those who were relatively analytic thinkers, $\beta = 0.46$, $t(757) = 4.40$, $p < .001$. Neither the main effect

[3] I used a generalized linear mixed-effects model to examine the relationships among participants' Analysis-Holism scores, time pressure, and the number of suspect cues requested by participants. Since the number of suspect cues was a count variable, a generalized linear mixed-effects model with Poisson distribution, which is designed to assess the frequency that occurred in a fixed interval of time, is more appropriate than a linear mixed-effects model which is designed to assess interval data.

of time pressure, β = 0.17, t(757)= 1.43, p = .15, nor the interaction of time pressure and participants' Analysis-Holism scores on confidence in identification was significant, β = -0.16, t(757)= -1.08, p = .28. In a moderated regression, the association between participants' Analysis-Holism scores and the number of suspects cues requested by participants in the first criminal case presented to participants was not significant, β = 0.73, t(187)= 3.39, p < .001. Time constraints did not moderate the association, β = 0.20, t(187)= 0.74, p = .46, and the interaction was also not significant, β = -0.26, t(187)= -0.86, p = .39.

Figure 2

Analysis-Holism Scores and Time Pressure Predicting Differences in Confidence in Identification in Study 1

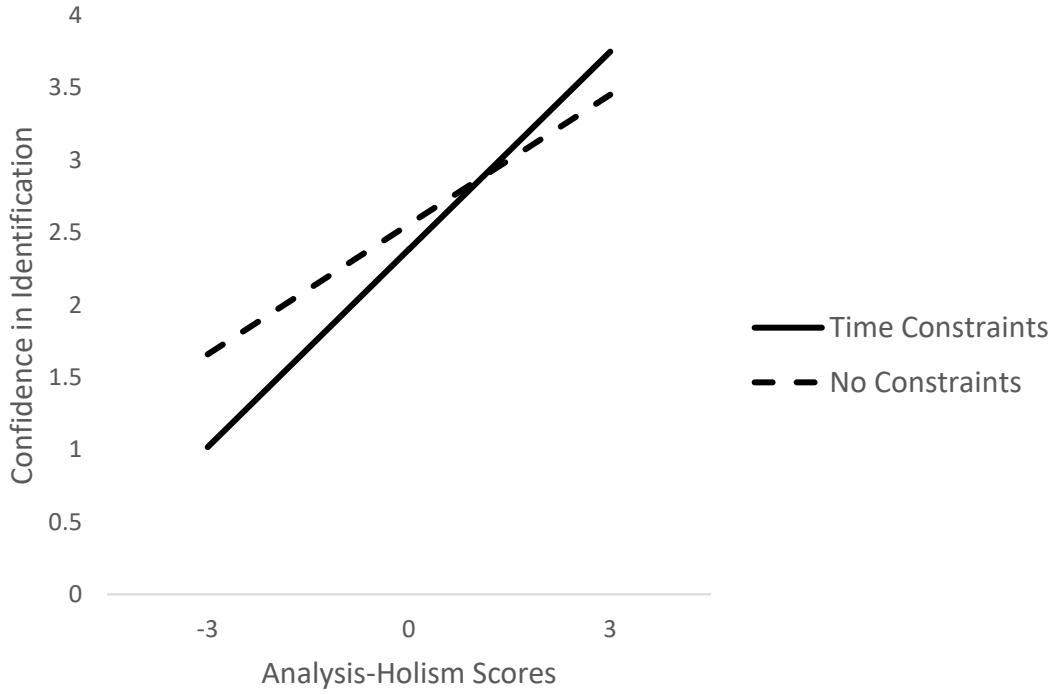


Table 6

Regression Table for Information Seeking and Confidence in Identification (Study 1)

		Estimate	Std. Error	*z*	*p*
Information Seeking	Low AHS	-0.13	0.08	-1.60	.11
	Mean AHS	0.03	0.06	0.54	.59
	High AHS	0.19	0.08	2.53	.01
		Estimate	Std. Error	*t*	*p*
Confidence in Identification	Low AHS	0.14	0.10	1.43	.15
	Mean AHS	0.07	0.07	0.94	.35
	High AHS	-0.01	0.10	-0.10	.92

Exploratory Analyses.

I further conducted two exploratory analyses to investigate whether participants' Analysis-Holism scores and time constraints were related to the susceptibility to the take-the-best heuristic and final identification. Since there is no research about cultural differences in the searching rule and the decision rule of the take-the-best heuristic, the analyses of participants' information searching and identification were computed as two exploratory analyses. I calculated the average percentage of participants who stopped at the first discriminating cue across the four crime scenarios. Then I computed a moderated regression to investigate the relationship between participants' Analysis-Holism scores and the percentage of stopping at the first cue, moderated by time pressure. Participants' scores on the Analysis-Holism Scale did not predict their susceptibility to the take-the-best heuristic, β = -.02, $t(213)$= -0.37, p = .71. Time pressure was also not related to participants' susceptibility to the take-the-best heuristic, β = .04, $t(757)$= 0.52, p = .60, when the interaction of participants' Analysis-Holism scores and time pressure was not significant, β = -.08, $t(757)$= -0.92, p = .36. Multiple chi-squares explored whether

time pressure had an effect on participants' identification of the murderers, and the results showed that participants did not differ in identification across the four scenarios, all *p*s > .05 (Table 7).

Table 7

The Number of Identification of the Murderers (Study 1)

		Time Pressure			
Scenario	Identification	Time Constraint	No Constraint	X^2	*p*
1	1	90	95	1.26	.262
	2	19	13		
2	1	103	104	0.400	.527
	2	6	4		
3	1	11	8	0.489	.484
	2	98	100		
4	1	6	8	0.325	.568
	2	103	100		

Discussion

Corresponding to the literature review in the earlier section, I expected that participants' Analysis-Holism scores and their assigned time pressure condition would be predictors of the amount of requested suspect profiles and levels of confidence. Although participants' thinking style did not predict their information seeking (Hypothesis I(a)), the main effect of time pressure displayed a trend that participants requested more suspect cues under time pressure than without time pressure, showing an opposite pattern to Hypothesis I(b) but not reaching the statistical threshold. In addition, time pressure influenced relatively analytic thinkers to a greater degree than relatively holistic thinkers. Time pressure decreased the differences in information seeking between relatively holistic and analytic thinkers, supporting Hypothesis I(c). In terms of confidence in interpretation, participants who scored higher on the Analysis-Holism Scale reported higher levels of confidence than those who scored

lower on the Analysis-Holism Scale regardless of time pressure, showing an opposite pattern of Hypothesis II(a). Lastly, there was no difference in levels of confidence between the time constraints condition and the time-unconstrained condition, not supporting Hypothesis II(b).

Taken together, the results testing Hypotheses I and II did not fully replicate past literature that decreased information-processing was associated with time pressure due to high costs (Galy et al., 2012; Rieskamp & Hoffrage, 2008; Sweller, 1994); and that analytic thinkers were more confident than holistic thinkers (Mann et al., 1998). However, the results replicated the findings of Li et al. (2015) that Hong Kong Chinese explored more information than European Canadians when there was no time pressure. Participants' thinking style did not predict their information seeking in the time constraints condition, but holistic thinking predicted increased information seeking in the time-unconstrained condition. Interestingly, participants in the time constraints condition tended to seek more cues about suspects than participants in the time-unconstrained condition. Perhaps time pressure motivated participants to seek more information because they wanted to integrate more cues to make accurate decisions within a limited time. In contrast, participants in the time-unconstrained condition had enough time to evaluate cue validity, so they needed fewer cues about suspects to identify murderers. On the other hand, thinking style predicted confidence in identification regardless of time pressure. Participants with a stronger holistic thinking reported higher confidence levels than those with a stronger analytic thinking. This might suggest that holistic thinkers tend to be more confident in their actual knowledge than analytic thinkers in a fact finding task.

Overall, Study 1 suggested a potential link among thinking style, time pressure, and information-processing. To further explore my model, I designed Study

2 to empirically replicate the link by manipulating accuracy motivation in Study 2. Specifically, Study 2 was designed to investigate another type of motivation in information-processing. People search for information when they are uncertain about their decisions (Fischer et al., 2008) and when they want to achieve their optimal accuracy goals (Chen et al., 1999; Chen et al., 1996). In other words, while time pressure might motivate people to engage in heuristic processing due to increased costs of processing additional information, accuracy motivation may motivate people to engage in systematic processing with an increased discrepancy between actual and desired knowledge.

Study 2

A breadth of research has suggested that accuracy-motivated people use systematic processing rather than heuristic processing (e.g., Chen et al., 1996; Cronley et al., 2010). Thus, this study aimed to assess the interaction of thinking style and accuracy motivation in information-processing by extending the findings of Study 1. More specifically, the present study investigated whether there is another variable which might mitigate the effects of thinking style on information seeking. On the one hand, I examined whether time constraints would make both types of cognitive thinkers use heuristic processing in Study 1. On the other hand, I examined whether accuracy motivation would make both types of cognitive thinkers use systematic processing in Study 2. In other words, I theorized that time pressure increases participants' reliance on heuristics because time constraints increase cognitive load, interfering with participants' motivation for information-processing. However, since accuracy motivation enhances participants' motivation, it will decrease participants' reliance on heuristics.

People engage in heuristic processing when they do not have time and energy

(Gigerenzer & Goldstein, 1999), but they engage in systematic processing when they demand to achieve their information-processing goals (Chaiken et al., 1989). For instance, people seek information to match their levels of actual and desired knowledge and to make final decisions in confidence (Chaiken, 1980). In this case, motivating participants to make accurate decisions might induce an imbalance between actual knowledge and desired knowledge, so they will systematically seek information regardless of their thinking styles. The following statements are Study 2's hypotheses:

Hypothesis III(a): Participants who are relatively holistic thinkers will seek more cues about the suspects than those who are relatively analytic thinkers.

Hypothesis III(b): Participants in the accuracy motivation condition will seek more cues about the suspects compared to those in the no-motivation condition.

Hypothesis III(c): Accuracy motivation will reduce the difference in the number of requested cues about suspects between analytic and holistic thinkers.

Hypothesis IV(a): Relatively analytic thinkers will be more confident in their identification of the murderers than relatively holistic thinkers.

Hypothesis IV(b): Participants in the accuracy motivation condition will be more confident in their identification of the murderers compared to those in the no-motivation condition.

Hypothesis IV(c): Although participants who are relatively holistic thinkers are less confident in their identification than those who are relatively analytic thinkers in the no-motivation condition, they will be confident in their identification of the murderers as analytic thinkers in the accuracy motivation condition.

Method

Participants

Two hundred and fifty participants (130 male, 111 female, 5 others, and 4 non-binary) indicated their participation after reading a description of Study 2 on Prolific online platform. As in Study 1, Prolific participants (*M*age = 38.2, *SD* = 13.7; ranging from 18 to 76 years old) were English-speakers and at least 18 years old. Upon their completion, Participants received $1.24 based on an hourly rate of $7.42. One hundred and sixty-two participants self-identified as White or European American (64.8%), 33 as East/South/Southeast Asian or Asian American (13.2%), 30 as Bi-racial (12%), 20 as Black or African-American (8%), 11 as Latino (4.4%), and 5 as other ethnicity groups (2%).

Procedure

In Study 2, participants completed the Analysis-Holism Scale before being randomly assigned to either the accuracy motivation condition or the no-motivation condition. The thinking style priming condition was removed due to its inefficiency in Study 1. Another reason why I moved the Analysis-Holism Scale forward to the accuracy motivation was to make participants' natural thinking style more salient. The present study used the manipulation of accuracy motivation used in Thompson et al. (1994). In the accuracy motivation condition, participants received the following instruction:

In this research study, you will be tested for how well you can process multiple types of evidence. You will read four invented criminal cases. For each criminal case, you will read a description of a crime scene. After reading the description, you will be provided a cue about two suspects. You will read the two suspects' profiles to identify which of them is more likely to have committed the crime.

You need to indicate whether or not you need additional cues about suspects' profiles to identify the murderer. If you click "yes" to indicate that you need additional information, one more cue about two suspects will be provided. If you click "no", you will be guided to a separate section to identify the murderer and rate your confidence in identification. Research suggests your ability to make this kind of judgment is associated with your social IQ, and your accuracy on this task is the focus of this study.

In the control condition, participants received the following instruction:

In this research study, you will simply be helping us to pilot test some materials that we may want to use later in other experiments. You will read four invented criminal cases. For each criminal case, you will read a description of a crime scene. After reading the description, you will be provided a cue about two suspects. You will read the two suspects' profiles to identify which of them is more likely to have committed the crime. You need to indicate whether or not you need additional cues about suspects' profiles to identify the murderer. If you click "yes" to indicate that you need additional information, one more cue about two suspects will be provided. If you click "no", you will be guided to a separate section to identify the murderer and rate your confidence in identification. Your accuracy of identification indicates nothing about your personality, but it helps us examine how well we constructed this study.

The remaining procedure was the same as in Study 1. Participants indicated their needs for additional cues about suspects and their confidence levels in identification when reading four criminal cases. They also reported their demographic information at the end of the survey.

Results

Table 8

Descriptive Statistics in Study 2 (N = 250)

	Mean	Standard Deviation	Range
		Information Seeking	
Scenario 1	1.50	1.59	5
Scenario 2	1.50	1.54	5
Scenario 3	1.94	1.55	5
Scenario 4	1.44	1.52	5
		Confidence in Identification	
Scenario 1	2.72	0.95	4
Scenario 2	2.70	0.82	4
Scenario 3	2.56	1.00	4
Scenario 4	2.73	0.89	4
Validated	0.76	0.64	3.77

Descriptive statistics is presented in Table 8. Because holistic thinkers tend to integrate information more than analytic thinkers in decision-making, I predicted that participants who scored high on the Analysis-Holism Scale would seek more cues about suspects than those who scored low on the Analysis-Holism Scale. I also predicted that the results would suggest a significant main effect of accuracy motivation on information seeking. Encouraging to strive for high accuracy will encourage participants to engage in systematic processing regardless of their natural thinking style. Lastly, I predicted that there would be a significant interaction of

thinking style and accuracy motivation on information seeking. Although relatively holistic thinkers would request more suspect profiles than relatively analytic thinkers in the no-motivation condition, the link between scores on the Analysis-Holism Scale and information seeking would not be significant in the accuracy motivation condition. In other words, accuracy motivation would reduce the difference in information seeking between holistic thinkers and analytic thinkers. I further predicted that participants who were relatively analytic thinkers would report higher confidence than those who were relatively holistic thinkers. The main effect of accuracy motivation would also be significant. Specifically, participants in the accuracy motivation condition would report higher confidence levels than those in the no-motivation condition. Lastly, accuracy motivation would boost the confidence levels of holistic thinkers more than of analytic thinkers.

Reliability and Validity of AHS.

The overall alpha reliability of the Analysis-Holism Scale was .72 (.73 for the causality subscale, .68 for the attitudes toward contradiction subscale, .70 for the perception of change subscale, and .76 for the locus of attention). A 4-factor confirmatory factor analysis of the Analysis-Holism Scale did not show a good fit, $X^2(246) = 637$, $p < .001$, CFI = .742, TLI = .710, SRMR = .09, RMSEA 90% CI [.07, .09], leading to conducting an exploratory factor analysis on the items.

The exploratory factor analysis with oblimin rotation on 24 items showed a significant Bartlett's test of sphericity, $X^2(276) = 1679$, $p < .001$, and a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.729 (see Table 9 for factor loadings and Table 10 for item reliability statistics). The results suggested a six-factor structure, while the sixth item in the perception of change subscale did not load on any factor (Change 6). After dropping the items which loaded on the fifth and sixth factors, a

CFA 4-factor model still did not yield an acceptable fit, $X^2(113) = 227$, $p < .001$, CFI = .891, TLI = .876, SRMR = .07, RMSEA 90% CI [.05, .08]. The factor covariances (Table 11) demonstrated that the factor of perception of change had the lowest factor covariances with the other factors, it was removed in further statistical analyses. An additional confirmatory factor analysis of the 3-factor model yielded a good fit, $X^2(62) = 82.6$, $p = .041$, CFI = .975, TLI = .969, SRMR = .05, RMSEA 90% CI [.008, .06].

Table 9

Factor Loadings of the Analysis-Holism Scale (Study 2)

	Factor						
	1	2	3	4	5	6	Uniqueness
(Causality1) Everything in the universe is somehow related to each other.		0.929					0.131
(Causality2) Nothing is unrelated.		0.553					0.618
(Causality3) Everything in the world is intertwined in a causal relationship.		0.695					0.507
(Causality4) Even a small change in any element of the universe can lead to significant alterations in other elements.		0.393					0.713
(Causality5) Any phenomenon has numerous numbers of causes, although some of the causes are not known.					0.562		0.623

	Factor						
	1	2	3	4	5	6	Uniqueness
(ATC1) It is more desirable to take the middle ground than go to extremes.				0.368		0.507	0.534
(ATC2) When disagreement exists among people, they should search for ways to compromise and embrace everyone's opinions.				0.781			0.370
(ATC3) It is more important to find a point of compromise than to debate who is right/wrong, when one's opinions conflict with other's opinions.				0.711			0.434
(ATC4) It is desirable to be in harmony, rather than in discord, with others of different opinions than one's own.				0.453			0.753
(ATC5r) Choosing a middle ground in an argument should be avoided.				0.305			0.841

	Factor						
	1	2	3	4	5	6	Uniqueness
(ATC6) We should avoid going to extremes.						0.891	0.211
(Change1r) Every phenomenon in the world moves in predictable directions.			0.450				0.681
(Change2r) A person who is currently living a successful life will continue to stay successful.			0.738				0.456
(Change3r) An individual who is currently honest will stay honest in the future.			0.533				0.672
(Change4r) If an event is moving toward a certain direction, it will continue to move toward that direction.			0.640				0.592
(Change5) Current situations can change at any time.					0.396		0.684
(Change6r) Future events are predictable based on present situations.			0.333				0.799

	Factor						
	1	2	3	4	5	6	Uniqueness
(Locus1) The whole, rather than its parts, should be considered in order to understand a phenomenon.	0.755						0.388
(Locus2) It is more important to pay attention to the whole than its parts.	0.791						0.318
(Locus3) The whole is greater than the sum of its parts.	0.527						0.628
(Locus4) It is more important to pay attention to the whole context rather than the details.	0.817						0.353
(Locus5) It is not possible to understand the parts without considering the whole picture.	0.376						0.682
(Locus6) We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behavior.					0.418		0.782

Note. 'Minimum residual' extraction method was used in combination with a "oblimin" rotation.

Table 10

Item Reliability Statistics of the Analysis-Holism Scale (Study 2)

	Cronbach's α	McDonald's ω
Causality1	0.701	0.732
Causality2	0.712	0.740
Causality3	0.703	0.734
Causality4	0.699	0.731
Causality5	0.703	0.732
Causality6	0.702	0.732
ATC1	0.704	0.735
ATC2	0.696	0.727
ATC3	0.699	0.729
ATC4	0.707	0.736
ATC5r	0.712	0.742
ATC6	0.704	0.735
Change1r	0.723	0.749
Change2r	0.710	0741
Change3r	0.725	0.750
Change4r	0.719	0.748
Change5	0.702	0.732
Change6r	0.731	0.755
Locus1	0.695	0.725
Locus2	0.704	0.733

	Cronbach's α	McDonald's ω
Locus3	0.706	0.735
Locus4	0.700	0.731
Locus5	0.693	0.725
Locus6	0.705	0.734

Table 11

Factor Covariances without Causality5&6, ATC1&6, Change5&6, and Locus6

	1.	2.	3.	4.
1. Causality	-			
2. Perception of Change	-.21(-2.77)**	-		
3. Locus of Attention	.23(3.30)***	-.10(-1.19)	-	
4. Attitudes toward Contradiction	.29(4.05)***	-.16(-2.00)*	.30(4.05)***	-

Note. Estimates on the diagonal, z-values explained in parentheses, and *p < .05, **p <.01, ***p < .001.

Information Seeking and Confidence in Identification.

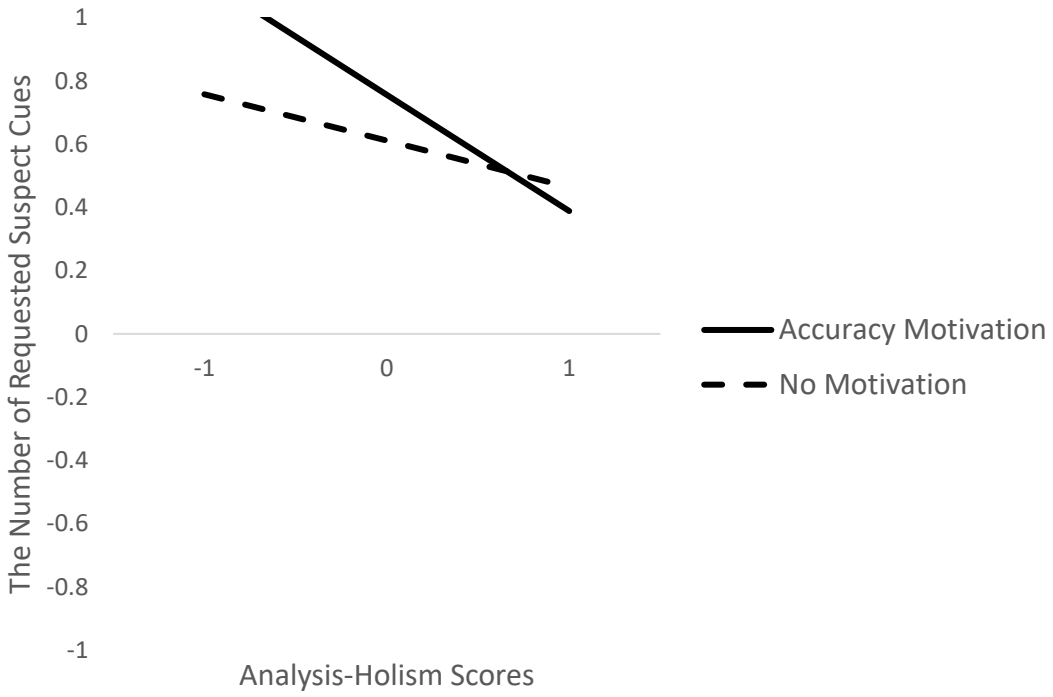
Similar to Study 1, participants' scores on the Analysis-Holism Scale[4] and their accuracy motivation condition (0 = accuracy motivation, 1 = no motivation) were two fixed effects, and story number (1 ~ 4) was a random effect in a generalized linear mixed-effects model (Figure 3). While thinking style did not predict information seeking in Study 1, it predicted an opposite pattern of Hypothesis III(a) in Study 2. Participants who scored high on the Analysis-Holism Scale requested fewer

[4] There was no significant difference in the Analysis-Holism scores between SONA participants (M = 0.67, SD = 0.49; Study 1) and Prolific participants (M = 0.76, SD = 0.64; Study 2), $t(439) = -1.63$, p = .103.

cues about suspects than those who scored low on the Analysis-Holism Scale, β = -.37, $z(995)$= -6.84, $p < .001$. Participants in the accuracy motivation condition also requested more suspect cues than those in the no-motivation condition, β = -.15, $z(995)$= -2.05, p = .04, supporting Hypothesis III(b). Hypothesis III(c) about the interaction of thinking style and accuracy motivation was partially supported, β = .22, $z(995)$= 2.86, p = .004. Unlike what Hypothesis III(c) predicted, accuracy motivation motivated participants who scored low on the Analysis-Holism Scale to seek additional cues. More specifically, participants with high Analysis-Holism scores in the no motivation condition requested suspect cues more than those in the accuracy motivation condition, p = .03. However, there was no significant difference between the accuracy motivation and the no motivation condition for participants with low Analysis-Holism scores (p = .07) and mean Analysis-Holism scores (p = .64; see Table 12 for regression statistics). In a moderated regression on participants' number of requested suspects cues to identify the murderer in the first presented criminal case, the results suggested that participants' scores on the Analysis-Holism Scale was negatively correlated with their information seeking, β = -0.62, $t(246)$= -2.84, p = .005. Accuracy motivation increased information seeking, β = -0.66, $t(246)$= -2.16, p = .03, and the interaction was not significant, β = .59, $t(246)$= 1.90, p = .058.

Figure 3

Analysis-Holism Scores and Accuracy Motivation Predicting Differences in Information Searching in Study 2



Note. Both x-axis and y-axis present z-scores.

In a linear mixed-effects model examining the relationships among participants' Analysis-Holism Scores, accuracy motivation, and confidence in identification, the results displayed opposite patterns of Hypothesis IV(a) and Hypothesis IV(b) (Figure 4). Participants who scored high on the Analysis-Holism Scale reported higher levels of confidence than those who scored low regardless of accuracy motivation, $\beta = 0.13$, $t(993) = 2.10$, $p = .04$. Accuracy motivation decreased participants' levels of confidence, $\beta = 0.25$, $t(993) = 2.84$, $p = .005$, while the interaction of thinking style and accuracy motivation was not significant, $\beta = -0.03$, $t(993) = -0.38$, $p = .70$. In a moderated regression on participants' levels of confidence to identify the murderer in the first presented criminal case, the results suggested that participants' scores on the Analysis-Holism Scale was not related with their

confidence in identification, $\beta = 0.15$, $t(246) = 1.17$, $p = .244$. Accuracy motivation also did not predict participants' levels of confidence, $\beta = 0.19$, $t(246) = 1.05$, $p = .30$, and the interaction was not significant, $\beta = -0.06$, $t(246) = -0.33$, $p = .74$.

Figure 4

Analysis-Holism Scores and Accuracy Motivation Predicting Differences in Confidence in Identification in Study 2

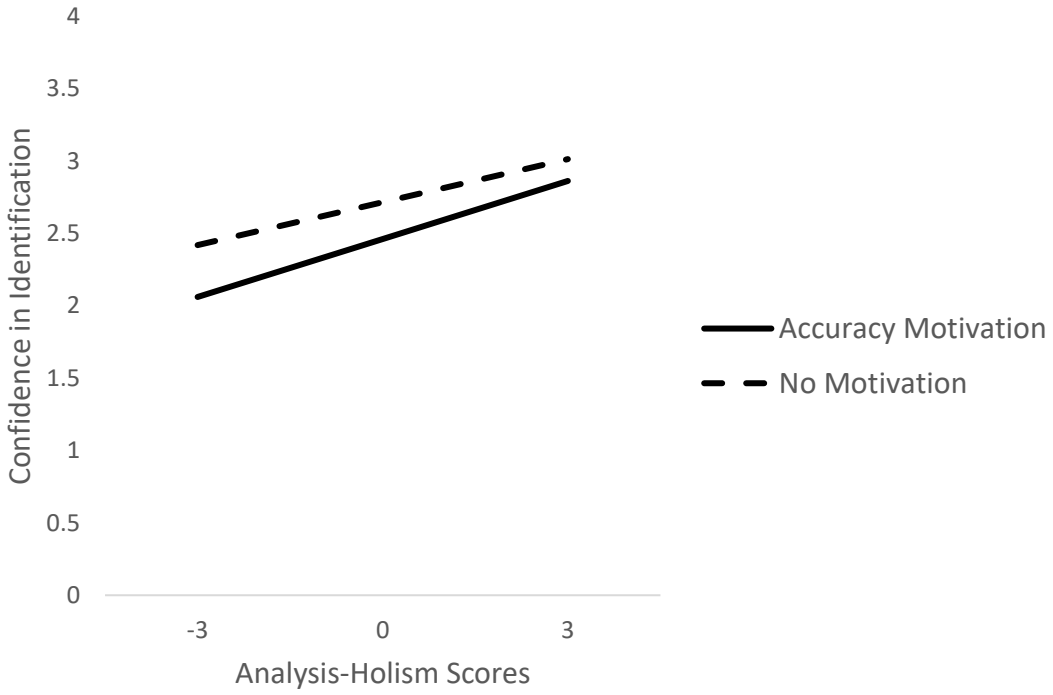


Table 12

Regression Table for Information Seeking and Confidence in Identification (Study 2)

		Estimate	Std. Error	*z*	*p*
Information Seeking	Low AHS	-0.12	0.06	-1.83	.07
	Mean AHS	0.02	0.05	0.46	.64
	High AHS	0.16	0.08	2.17	.03
		Estimate	Std. Error	*t*	*p*
Confidence in Identification	Low AHS	0.25	0.08	3.08	.00
	Mean AHS	0.23	0.06	3.97	.00
	High AHS	0.21	0.08	2.53	.01

Exploratory Analyses.

An exploratory moderated regression was computed to investigate the relationships among participants' scores on the Analysis-Holism Scale, accuracy motivation, and the percentage of stopping at the first cue. The sole significant finding was that participants' Analysis-Holism scores predicted their susceptibility to the take-the-best heuristic, $\beta = .11$, $t(246) = 2.59$, $p = .01$, suggesting that relatively holistic thinkers were more likely to stop at their first cue to identify murderers. Neither the results of moderated effect of accuracy motivation, $\beta = 0.06$, $t(246) = 0.92$, $p = .36$, nor the interaction of participants' Analysis-Holism scores and accuracy motivation was significant, $\beta = -0.05$, $t(246) = -0.83$, $p = .41$. Multiple chi-square analyses explored whether time constraints had an effect on participants' identification of the murderers, and the results suggested that participants did not differ in identification across the four scenarios, all *p*s > .05 (Table 13).

Table 13

Descriptive Statistics of Identification of Murderers (Study 2)

Scenario	Identification	Motivation		X^2	*p*
		Accuracy Motivation	No Motivation		
1	1	113	110	0.374	.541
	2	12	15		
2	1	120	121	0.115	.734
	2	5	4		
3	1	9	10	0.057	.811
	2	116	115		
4	1	5	4	0.115	.734
	2	120	121		

Discussion

Study 2 investigated the relationships among thinking style, accuracy

motivation, and information-processing by extending the findings of Study 1. I predicted that holistic thinkers would be more likely to seek additional cues than analytic thinkers. I also predicted that making accurate identification would motivate participants to seek more cues about suspects, amplifying the difference in information seeking between holistic thinkers and analytic thinkers. Another prediction was that holistic thinkers would be less confident in their identification. Accuracy motivation would increase participants' levels of confidence, specifically boosting holistic thinkers' confidence more than analytic thinkers' confidence.

Hypothesis III was about the link between thinking style and accuracy motivation on information seeking. Contradicting Hypothesis III(a), participants who scored high on the Analysis-Holism Scale sought fewer cues about suspects than those who scored low on the Analysis-Holism Scale, suggesting that relatively holistic thinkers tended to engage in decreased information seeking than relatively analytic thinkers. This finding did not replicate previous findings that holistic thinkers seek and integrate more information than analytic thinkers (Choi & Nisbett, 1998; Morris & Peng, 1994). On the other hand, participants in the accuracy motivation condition sought more cues about suspects than those in the no-motivation condition, supporting Hypothesis III(b). The interaction of thinking style and accuracy motivation was also significant, partially supporting Hypothesis III(c). Accuracy motivation motivated relatively analytic thinkers but not relatively holistic thinkers to engage in increased information seeking. However, accuracy motivation amplified the differences in information seeking between relatively holistic and analytic thinkers, showing an opposite pattern of Hypothesis III(c).

Hypothesis IV concerned the relationships among thinking style, accuracy motivation, and confidence in identification. Similar to in Study 1, participants who

scored high on the Analysis-Holism Scale reported higher levels of confidence than those who scored low on the Analysis-Holism Scale regardless of accuracy motivation, displaying an opposite pattern of Hypothesis IV(a). In other words, holistic thinkers tended to be more confident in their identification of murderers than analytic thinkers. Interestingly, participants in the no-motivation condition also reported higher confidence levels than those in the accuracy motivation, showing an opposite pattern of Hypothesis IV(b). It is possible that accuracy motivation increased the discrepancy between actual knowledge and desired knowledge, decreasing participants' confidence in their identification. The insignificant interaction of thinking style and accuracy motivation did not support Hypothesis IV(c) that accuracy motivation would amplify the difference in confidence of identification between holistic and analytic thinkers.

In sum, these results extended the link between thinking style and information-processing examined in Study 1. Similar to time pressure, accuracy motivation influences how people seek and process information. A consistent positive correlation between holistic thinking and confidence in identification was found in Studies 1 and 2, indicating that holistic thinkers were more confident in their identification than analytic thinkers regardless of situational factors.

General Discussion

Key Findings and Hypotheses

Hypothesis I

Hypothesis I predicted that compared to those who scored low on the Analysis-Holism Scale, participants who scored high on the Analysis-Holism Scale would be more likely to request additional cues about suspects to identify a murderer in each of four invented criminal cases. I also predicted that participants in the time

constraints condition would seek fewer cues than those in the time-unconstrained condition. Specifically, time pressure would eliminate the difference in the number of suspect cues requested by participants. The results of a linear mixed-effects model indicated that holistic and analytic thinkers did not differ in information seeking, not supporting Hypothesis I(a). However, although the difference was not statistically significant, the pattern of results reflected that participants in the time constraints condition sought more suspect cues than those in the time-unconstrained condition, displaying an opposite pattern of Hypothesis I(b). In other words, time pressure increased participants' information seeking. The interaction of thinking style and time pressure was significant, supporting Hypothesis I(c). Participants who were relatively analytic thinkers were more likely to request more cues in the time constraints condition than in the time-unconstrained condition. However, time pressure did not influence relatively holistic thinkers on information seeking.

Hypothesis II

Hypothesis II predicted whether thinking style and time pressure would predict participants' levels of confidence in identification. I hypothesized that participants who scored low on the Analysis-Holism Scale would report higher levels of confidence than those who scored high on the Analysis-Holism Scale (Hypothesis II(a)). I also hypothesized that participants in the time-unconstrained condition would report higher levels of confidence in identification than those in the time constraints condition (Hypothesis II(b)). However, a linear mixed-effects model suggested an opposite pattern of the link between thinking style and levels of confidence, while time pressure had no influence. Interestingly, analytic thinkers were less likely to report high levels of confidence than holistic thinkers, suggesting that analytic thinkers tend to be less confident in their identification than holistic thinkers.

Hypothesis III

Hypothesis III was a twin of Hypothesis I, but it predicted accuracy motivation rather than time pressure. Hypothesis III asked whether thinking style and accuracy motivation might predict information seeking. The expected answer was that holistic thinkers would be more likely to request additional cues about suspects than analytic thinkers (Hypothesis III(a)). In addition, accuracy motivation would shrink the difference between holistic thinkers and analytic thinkers (Hypothesis III(c)), while it would motivate participants to seek more suspect cues regardless of their thinking style (Hypothesis III(b)). The results showed that relatively holistic thinkers tended to request fewer cues about suspects than relatively analytic thinkers, showing an opposite pattern of Hypothesis III(a). This holds an interesting theoretical implication that holistic thinking does not simply refer to a "more complicated or effortful" cognition than analytic thinking. Participants in the accuracy motivation condition also requested fewer suspect cues compared to those in the no-motivation condition, supporting Hypothesis III(b). Interestingly, accuracy motivation only motivated relatively analytic thinkers to search for additional cues. Relatively holistic thinkers did not differ in information seeking between the accuracy motivation condition and the no motivation condition. In other words, accuracy motivation amplified the differences in information seeking, showing an opposite pattern of Hypothesis III(c).

Hypothesis IV

Hypothesis IV partially predicted the relationship between thinking style and information processing which was moderated by another situational factor: accuracy motivation. I predicted that holistic thinking would be negatively correlated with levels of confidence (Hypothesis IV(a)), where accuracy motivation would increase

confidence (Hypothesis IV(b)), especially of holistic thinkers (Hypothesis IV(c)). The interaction of thinking style and accuracy motivation was not significant, not supporting Hypothesis IV(c). However, as in Study 1, there was a significant result showing an opposite pattern of Hypothesis IV(a). Participants who were relatively holistic thinkers were more confident in their identification than others who were relatively analytic thinkers. Participants in the no-motivation condition also reported higher confidence levels than those in the accuracy motivation, showing an opposite pattern of Hypothesis IV(b). In other words, holistic thinking was positively linked to confidence in identification, but accuracy motivation decreased participants levels of confidence.

Exploratory Analyses

In both Studies 1 and 2, I further explored whether thinking style and situational factors (i.e., time pressure and accuracy motivation) were linked to the susceptibility to the take-the-best heuristic and final identification. I used the average percentage of participants who stopped at the first suspect cue as the susceptibility to the take-the-best heuristic, and I also compared the percentages of final identification between groups regardless of their thinking style. In Study 1, holistic thinkers were less likely to stop at the first cue than analytic thinkers, and participants in the time-unconstrained condition were less likely to commit the take-the-best heuristic compared to those in the time constraints condition. In Study 2, while the link between thinking style and the susceptibility to the take-the-best heuristic was not replicated, participants in the accuracy motivation condition were less likely to stop at the first suspect cue compared to those in the no-motivation condition. Situational factors were not associated with participants' final identification, suggesting that participants did not differ in the identification of murderers based on their cognitive

load. In sum, the only clear evidence is that situational factors influence people's heuristic use. Time pressure may motivate people to engage in heuristic processing, whereas accuracy motivation motivates people to engage in systematic processing.

Evaluation and Implication of Theoretical Model

The hypotheses tested to examine the interaction of thinking style and situational factors (i.e., time pressure and accuracy motivation) on information-processing were inconsistent with the theoretical model and current literature. Interestingly, significant results suggested some opposite patterns to my hypotheses. Holistic thinking was less likely to motivate participants to seek additional information, while increasing their confidence levels. In addition, both time pressure and accuracy motivation seemed to motivate participants to seek additional information, but accuracy motivation also decreased participants' levels of confidence in identification. Accuracy motivation could have reminded participants of the importance of accuracy, perhaps making them less confident than not-motivated participants. What can be gathered is that, generally, a single situational factor might be insufficient to motivate people to engage in either heuristic processing or systematic processing. For example, time pressure seems to motivate people to use effortless information-processing, because it increases cognitive load with high costs (Rieskamp & Hoffrage, 2008; Sweller, 1994). However, Galy et al. (2012) argued that time pressure itself might not induce increased cognitive load. If so, the identification task was so easy that participants did not feel pressure to identify murderers within a limited time. In this sense, increasing the difficulty of the identification task or combining manipulations of accuracy motivation and time pressure might influence how people seek and process information.

As a reminder, past literature has demonstrated that holistic thinkers tend to

seek peripheral information in addition to central information. Holistic thinkers believe that peripheral information is informative (Choi et al., 2003; Dogruel, 2018; Owe et al., 2013), whereas analytic thinkers pay attention to core information only (Liang et al., 2014). Holistic thinkers are also less confident in their decision-making ability than analytic thinkers (Mann et al., 1998). In turn, holistic thinkers are less susceptible to heuristics in decision-making (Cheek & Norem, 2017; Spina et al., 2010), implying that they might be more likely to use effortful information-processing than analytic thinkers. However, I found opposite patterns to these previous findings. Compared to relatively analytic thinkers, relatively holistic thinkers were less likely to seek out additional information (only in Study 2), and they were more confident in their identification of murderers (only in Study 1). There are a few possible explanations for the opposite result patterns. First, it is possible that relatively holistic thinkers were not curious as relatively analytic thinkers. Similar to levels of confidence (Chaiken & Ledgerwood, 2012), curiosity influences the discrepancy between actual and desired knowledge (Loewenstein, 1994). Holistic thinking decreases curiosity to obtain detailed knowledge, inhibiting holistic thinkers to be aware of the information gap between actual knowledge and desired knowledge (Li & Yu, 2015). In other words, holistic thinking reduces people's curiosity, so holistic thinkers have a false belief that they have reached the desired sufficiency threshold in a fact finding. The sufficiency threshold is the point where people are confident with their current motives, so the discrepancy between actual and desired levels of judgmental confidence plays a crucial role in the direction of information-processing (Chaiken et al., 1989; Eagly & Chaiken, 1993). Similarly, the first suspect cue was salient enough for both analytic and holistic thinkers to identify murderers. The differences in information-processing between holistic and analytic thinkers do not

emerge when conflicting information is not salient (Choi & Nisbett, 1998; Krull et al., 1999). Widening the gap might increase the likelihood of using systematic processing, whereas shrinking the gap may increase the likelihood of using heuristics processing (e.g., the take-the-best heuristic). Another possibility is that past literature investigated the differences in information-processing between analytic and holistic thinkers by asking participants to make causal attributions. Relatively holistic thinkers sought and integrated additional contextual information (Choi et al., 2003), because they perceived contexts as influential on one's cognition and behavior (Markus & Kitayama, 1991). On the other hand, the identification of murderers was a problem-solving task rather than a person perception task. In sum, relatively holistic thinkers might not be curious to seek additional suspect cues as they would in person perception tasks, whereas relatively analytic thinkers were interested in solving the criminal cases, being motivated to seek out more suspect cues.

Limitations and Future Directions

The findings of these studies should be interpreted with cautious due to several study limitations. The manipulation of time pressure was not powerful enough to make a difference in reaction time between the time constraints group and the time-unconstrained group (p = .88). The manipulation of accuracy motivation might also not be powerful enough to motivate people to make "accurate" decisions. Hence, I had no evidence to argue against past literature that time pressure will motivate people to engage in heuristic processing, whereas accuracy motivation will motivate people to engage in systematic processing. Adding a clock to the screen or designing a lab study to verbally instruct participants of time constraints may strengthen the time manipulation. Telling participants that they would get their test results at the end of the study may strengthen the manipulation of accuracy motivation.

Another limitation is that the identification task required a decision-making process which differs from the one measured in past research. Researchers often investigate cultural differences in information-processing by asking participants to complete a causal attribution task. In contrast, the identification task used in Studies 1 and 2 is a type of problem-solving, asking participants to solve criminal cases based on cues found at the site and suspect profiles. The causal attribution task is a type of person perception, asking people to attribute behaviors and cognitions to causal factors. Because holistic thinkers believe that contexts influence people's cognitions and behaviors (Markus & Kitayama, 1991), they seek and integrate contextual information (e.g., situational factors) more than analytic thinkers (Choi et al., 2003). They also might be motivated to use systematic processing because they want to maintain positive social relationships (Markus & Kitayama, 1991). Therefore, asking participants to attribute the intentions of murderers or sentence the murderers might motivate holistic thinkers to seek more information than analytic thinkers.

Future studies should also include conflicting suspect cues because research has demonstrated that East Asians tend to seek more conflicting information than Westerners, whereas Westerners seek more supporting information (Kastenmüller et al., 2010). Thus, it is possible that relatively analytic thinkers were more motivated to seek cues than relatively holistic thinkers in Study 2, because they needed supporting information to make their final identification. Including conflicting suspect cues may also increase the task difficulty, allowing future researchers to capture the differences between the two cognitive styles.

Conclusion

To conclude, I found interesting results showing opposite patterns to my theoretical model. Results suggest that thinking style and cognitive load might

motivate people to engage in either heuristic or systematic processing depending on cognitive tasks. Understanding information-processing is important because we seek and process information not only in professional settings but also in social settings. Specifically, we should investigate how people's natural thinking style motivates them to engage in certain types of information-processing. This is not because there is an absolutely accurate thinking style or information-processing. In contrast, the two cognitive styles and the dual process of information-processing have their advantages and disadvantages. Living in this interconnected society, each decision made by a person or a group has an impact on others. Therefore, the investigation of the link between thinking style and information-processing will eventually help us eliminate sociocultural problems, such as stereotyping and discriminating against others.

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Appendix A - Four Invented Criminal Cases

1. A famous singer was found dead at home. *A Chanel handbag* was found next to the body. There was a kitchen knife with what appeared to be the murderer's blood. As a result of the blood test, it turned out to be *Type B*. In the bathroom, there were *an unfinished Marlboro cigarette butt* on the floor and *some used condoms*, which contained both the perpetrator's and the victim's bodily secretions, in the trash can. [76 words]
2. A body was found on the mountain behind the house. *Several used Camel cigarette butts* at the crime site. Another footprint was also found that did not belong to the victim. The footprint was about *11.5 inches* in size. Next to the body, there was the victim's handbag which appeared to have been *rummaged* by somebody. Crucially, there was also *flesh* underneath the fingernails of the body that seemed to belong to the murderer. [75 words]
3. A body was found in a crashed car. *Several Dunhill cigarette butts* were found at a location far from the scene of the incident. Additionally, *a coffee cup* the victim drank and *a short strand of hair* that appeared to belong to the perpetrator were found in the car. It looked like the victim fall into sleep soon after they drank the coffee. Lastly, *a packaged proposal ring* was found in the trunk. [74 words]
4. A music student was found hanging in their apartment. *Rock music* played loudly in the apartment; however, the victim did not like rock music. There was a broken wine glass and one of the broken pieces of glass had blood stains and *a partial fingerprint* that was not the victim's. The blood type turned out to be *O*. When inspecting the location of the flatware on the table, the perpetrator was determined to be *left-handed*. [76 words]

Appendix B – Suspects Profiles

1.

	Suspect A	Suspect B
Blood Type	B	O
Condom	Identified	No
Handbag	Chanel	Burberry
Cigarette	Marlboro	Camel
Perfume	Dior	Yves Saint Laurent
Car	Porsche	BMW

2.

	Suspect A	Suspect B
New Wound	Yes	No
Crime History	Robbery	No
Shoe Size	11.5	10.5
Cigarette	Camel	No
Mobile Device	iPhone	Samsung
Hobby	Hiking	Biking

3.

	Suspect A	Suspect B
Hair Style	Long	Short
Recent Shopping List	Multivitamin	Botulinum Toxin
Cigarette	Memphis	Dunhill

Relationship with the Victim	Colleague	Romantic Partner
Favorite Coffee	Espresso	Americano
Mobile Device	iPhone	Samsung

4.

	Suspect A	Suspect B
Blood Type	AB	O
Fingerprint	No	Identified
Left-handed	No	Yes
Music Preference	Classic	Rock
Coffee	Heavy Drinker	Allergic
Car	Mercedes Benz	Honda

Appendix C – Pilot Test

Survey Flow

Block: Information Sheet (1 Question)

BlockRandomizer: 4 -

Standard: Scenario 1 (5 Questions)

Standard: Scenario 2 (5 Questions)

Standard: Scenario 3 (5 Questions)

Standard: Scenario 4 (5 Questions)

Standard: Demographic (6 Questions)

Standard: Debriefing (0 Questions)

Page Break

Start of Block: Information Sheet

End of Block: Information Sheet

Start of Block: Scenario 1

Story 1 A famous singer was found dead at home. A Chanel handbag was found next to the body. There was a kitchen knife with what appeared to be the murderer's blood. As a result of the blood test, it turned out to be Type B. In the bathroom, there were an unfinished Marlboro cigarette butt on the floor and some used condoms, which contained both the perpetrator’s and the victim’s bodily secretions, in the trash can.

Rank1 Please rank these cues according to their importance, with 1 being the most important and 6 being the least important. What do you need to know about suspects

to identify the murderer of this murder case?

_____ Blood Type (1)

_____ Condom (2)

_____ Handbag (3)

_____ Cigarette (4)

_____ Perfume (5)

_____ Car (6)

Cues1 The table below shows the characteristics of two suspects in the case.

	Suspect A	Suspect B
Blood Type	B	O
Condom	Identified	No
Handbag	Chanel	Burberry
Cigarette	Marlboro	Camel
Perfume	Dior	Yves Saint Laurent
Car	Porsche	BMW

Identification1 Which of the two suspects is more likely to have committed the crime?

- ○ Suspect A (1)
- ○ Suspect B (2)

Confidence1 How confident are you?

- ○ not at all confident (1)
- ○ a little confident (2)
- ○ somewhat confident (3)
- ○ very confident (4)
- ○ extremely confident (5)

End of Block: Scenario 1

Start of Block: Scenario 2

Story 2 A body was found on the mountain behind the house. Several used Camel cigarette butts at the crime site. Another footprint was also found that did not belong to the victim. The footprint was about 11.5 inches in size. Next to the body, there was the victim's handbag which appeared to have been rummaged by somebody. Crucially, there was also flesh underneath the fingernails of the body that seemed to belong to the murderer.

Rank2 Please rank these cues according to their importance, with 1 being the most important and 6 being the least important. What do you need to know about suspects

to identify the murderer of this murder case?

_____ New Wound (1)

_____ Crime History (2)

_____ Shoe Size (3)

_____ Cigarette (4)

_____ Mobile Device (5)

_____ Hobby (6)

Cues2 The table below shows the characteristics of two suspects in the case.

	Suspect A	Suspect B
New Wound	Yes	No
Crime History	Robbery	No
Shoe Size	11.5	10.5
Cigarette	Camel	No
Mobile Device	iPhone	Samsung
Hobby	Hiking	Biking

Identification2 Which of the two suspects is more likely to have committed the crime?

- Suspect A (1)
- Suspect B (2)

Confidence2 How confident are you?

- ○ not at all confident (1)
- ○ a little confident (2)
- ○ somewhat confident (3)
- ○ very confident (4)
- ○ extremely confident (5)

End of Block: Scenario 2

Start of Block: Scenario 3

Story 3 A body was found in a crashed car. Several Dunhill cigarette butts were found at a location far from the scene of the incident. Additionally, a coffee cup the victim drank and a short strand of hair that appeared to belong to the perpetrator were found in the car. It looked like the victim fall into sleep soon after they drank the coffee. Lastly, a packaged proposal ring was found in the trunk.

Rank3 Please rank these cues according to their importance, with 1 being the most important and 6 being the least important. What do you need to know about suspects

to identify the murderer of this murder case?

_____ Hair Style (1)

_____ Recent Shopping List (2)

_____ Cigarette (3)

_____ Relationship with the Victim (4)

_____ Favorite Coffee (5)

_____ Mobile Device (6)

Cues3 The table below shows the characteristics of two suspects in the case.

	Suspect A	Suspect B
Hair Style	Long	Short
Recent Shopping List	Multivitamin	Botulinum Toxin
Cigarette	Memphis	Dunhill
Relationship with the Victim	Colleague	Romantic Partner
Favorite Coffee	Espresso	Americano
Mobile Device	iPhone	Samsung

Identification3 Which of the two suspects is more likely to have committed the crime?

- ○ Suspect A (1)
- ○ Suspect B (2)

Confidence3 How confident are you?

- ○ not at all confident (1)
- ○ a little confident (2)
- ○ somewhat confident (3)
- ○ very confident (4)
- ○ extremely confident (5)

End of Block: Scenario 3

Start of Block: Scenario 4

Story 4 A music student was found hanging in their apartment. Rock music played loudly in the apartment; however, the victim did not like rock music. There was a broken wine glass and one of the broken pieces of glass had blood stains and a partial fingerprint that was not the victim's. The blood type turned out to be O. When inspecting the location of the flatware on the table, the perpetrator was determined to be left-handed.

Rank4 Please rank these cues according to their importance, with 1 being the most important and 6 being the least important. What do you need to know about suspects

to identify the murderer of this murder case?

_____ Blood Type (1)

_____ Fingerprint (2)

_____ Left-handed (3)

_____ Music Preference (4)

_____ Coffee (5)

_____ Car (6)

Cues4 The table below shows the characteristics of two suspects in the case.

	Suspect A	Suspect B
Blood Type	AB	O
Fingerprint	No	Identified
Left-handed	No	Yes
Music Preference	Classic	Rock
Coffee	Heavy Drinker	Allergic
Car	Mercedes Benz	Honda

Identification4 Which of the two suspects is more likely to have committed the crime?

- Suspect A (1)
- Suspect B (2)

Confidence4 How confident are you?

- not at all confident (1)
- a little confident (2)
- somewhat confident (3)
- very confident (4)
- extremely confident (5)

End of Block: Scenario 4

Start of Block: Demographic

gender identity Which of the following do you identify with most?

- Female (1)
- Cis female (2)
- Trans female (3)
- Male (4)
- Cis male (5)
- Trans male (6)
- Non binary (7)
- Not listed (specify): (8) _____

hispanic Are you Hispanic in origin?

- ○ No (1)
- ○ Yes (2)

racial identity Which of the following describe(s) you? (Select all that apply)

- ☐ Alaskan Native/American Indian/Indigenous (1)
- ☐ Black/African (2)
- ☐ East Asian (3)
- ☐ LatinX (4)
- ☐ Middle Eastern/North African (5)
- ☐ Native Hawaiian/Pacific Islander (6)
- ☐ South Asian/Southeast Asian (7)
- ☐ White (8)
- ☐ Not listed (specify): (9) _____

age Age (in years)

_____

first language First/main language:

_____

nationality Nationality:

_____

End of Block: Demographic

Start of Block: Debriefing

Appendix D – Manipulation of Thinking Style

Participants will be randomly assigned to either the holistic-priming condition or the control condition. Participants in both conditions will write two or three sentences to summarize the assigned article and rate the quality of the argument ranging from 1 = *very poor* to 10 = *very good*.

Instruction [before reading the article]:

Below you will be presented with an article to read. You will be asked to briefly summarize the article and rate its argument quality.

The Butterfly Effect [the holistic condition]

Is it truly possible that a simple flap of a butterfly's wing in one part of the world could eventually result in a disastrous hurricane halfway across the globe? Although it sounds extraordinary that the root cause of a devastating storm could be traced back to an event as seemingly insignificant as the wing-flapping of an insect, this is precisely what a growing number of scientists are inclined to believe (Gelman & Maccoby, 1986). Generally speaking, the butterfly effect is the phenomenon that small variations of the initial condition of a system may produce large variations in the long term behavior of the system, just as a single movement of a butterfly's wing could evolve to a storm at a remote location that would otherwise fail to present.

The butterfly effect first came to attention in 1961. Edward Lorenz, a meteorologist and mathematician, was testing a mathematical model for weather prediction with a computer when he stumbled upon some startling results. Based on the very same mathematical model he used, he noticed the second run of his simulation data to be completely different from that in the first run. Much to his

surprise, he found out the cause of the data discrepancy was due to a seemingly neglectable change in the initial numbers he entered into the model: In the first run, the initial values were six decimal places in length. In the second run, Lorenz decided to reduce the decimal places to three because as a mathematician, he knew better than anyone that the actual difference between the two values was less than 1/10000. But as the model showed, the small variation he made to the initial condition (the initial numbers) actually swayed the subsequent events from its predicted trend, thus producing an entirely different outcome (Haslam, Rothschild, & Ernst, 2000; Gelman & Maccoby, 1986).

Scholars in different academic areas are well aware of the implication of the butterfly effect. While empirical evidence is still emphasized, scientists are now more open to the position that an event, however trivial it is, has the potential to lead to a consequential outcome after a long chain of causality (Haslam et al., 2000). For example, a recent report from the U.S. Geological Survey (USGS) department provided supporting evidence from a moderate tsunami that occurred near the Southwest area of Alaska on 31st October, 2007.

It was reported that the tsunami observed was actually associated with the increased coastal activity at Kamchatka Peninsula, Russia—a group of islands located at the opposite end across the ocean (USGS, 2007). Another implication of the butterfly effect is that when explaining an event, one should not easily dismiss a potential cause that has not yet been observed or identified. Just as a simple movement of a butterfly is capable of inducing a giant tornado, it is not at all surprising to have causes which exist outside of our rational expectation.

Facts About Tornadoes [the no-prime condition]

The word “tornado” is an altered form of the Spanish word tronada, which

means “thunderstorm.” This in turn was taken from the Latin tonare, meaning “to thunder.” It most likely reached its present form through a combination of the Spanish tronada and tornar (“to turn”); however, this may be a folk etymology. Tornadoes are also commonly referred to as twisters. Although tornadoes have been observed on every continent except Antarctica, most occur in the United States. They also commonly occur in southern Canada, south-central and eastern Asia, east-central South America, Southern Africa, northwestern and central Europe, Italy, western and southeastern Australia, and New Zealand.

Most tornadoes take on the appearance of a narrow funnel, a few hundred yards (a few hundred meters) across, with a small cloud of debris near the ground. However, tornadoes can appear in many shapes and sizes. In addition, tornadoes may be obscured completely by rain or dust. These tornadoes are especially dangerous, as even experienced meteorologists might not spot them.

One of the most persistent myths associated with tornadoes is that opening windows will lessen the damage caused by the tornado. While there is a large drop in atmospheric pressure inside a strong tornado, it is unlikely that the pressure drop would be enough to cause the house to explode. Some research indicates that opening windows may actually increase the severity of the tornado’s damage. Regardless of the validity of the explosion claim, time would be better spent seeking shelter before a tornado than opening windows. A violent tornado can destroy a house whether its windows are open or closed.

Another commonly held belief is that highway overpasses provide adequate shelter from tornadoes. On the contrary, a highway overpass is a dangerous place during a tornado. In the Oklahoma Tornado Outbreak of May 3, 1999, three highway overpasses were directly struck by tornadoes, and at all three locations there was a

fatality, along with many life-threatening injuries. The small area under the overpasses created a kind of wind tunnel, increasing the wind's speed, making the situation worse. By comparison, during the same tornado outbreak, more than 2000 homes were completely destroyed, with another 7000 damaged, and yet only a few dozen people died in their homes.

Instruction [after reading the article]:

Now, sum up the main theme of the article, in no more than 2-3 sentences.

Now please rate the quality of the article.

Very poor									**Excellent**
1	2	3	4	5	6	7	8	9	10

Appendix E – The Analysis-Holism Scale (Choi et al., 2007)

Ranging from -3 = *strongly disagree* to +3 = *strongly agree*

* Reverse coded items

Instruction:

Please indicate the extent to which you disagree versus agree with each of the following statements.

Factor 1: Causality

1. Everything in the universe is somehow related to each other.
2. Nothing is unrelated.
3. Everything in the world is intertwined in a causal relationship.
4. Even a small change in any element of the universe can lead to significant alterations in other elements.
5. Any phenomenon has numerous numbers of causes, although some of the causes are not known.
6. Any phenomenon entails a numerous number of consequences, although some of them may not be known.

Factor 2: Attitude Toward Contradictions

7. It is more desirable to take the middle ground than go to extremes.
8. When disagreement exists among people, they should search for ways to compromise and embrace everyone's opinions.
9. It is more important to find a point of compromise than to debate who is right/wrong, when one's opinions conflict with other's opinions.
10. It is desirable to be in harmony, rather than in discord, with others of different

opinions than one's own.

11. Choosing a middle ground in an argument should be avoided.*
12. We should avoid going to extremes.

Factor 3: Perception of Change

13. Every phenomenon in the world moves in predictable directions.*
14. A person who is currently living a successful life will continue to stay successful.*
15. An individual who is currently honest will stay honest in the future.*
16. If an event is moving toward a certain direction, it will continue to move toward that direction.*
17. Current situations can change at any time.
18. Future events are predictable based on present situations.*

Factor 4: Locus of Attention

19. The whole, rather than its parts, should be considered in order to understand a phenomenon.
20. It is more important to pay attention to the whole than its parts.
21. The whole is greater than the sum of its parts.
22. It is more important to pay attention to the whole context rather than the details.
23. It is not possible to understand the parts without considering the whole picture.
24. We should consider the situation a person is faced with, as well as his/her personality, in order to understand one's behavior.

Appendix F – R codes

```
library("readr")

library("lme4")

library("nlme")

library("ggplot2")

library("tableone")

library("dplyr")

library("psych")


#import the data

raw.data <- read.csv("C:/Users/LG/Desktop/School/Dissertation/Data/Study 1/Raw

Data.csv")

data <- read_csv("C:/Users/LG/Desktop/School/Dissertation/Data/Study

1/Scenarioes.csv")


as.factor(raw.data$Time)


#identifying reaction Time outliers

boxplot.stats(raw.data$Duration)$out


#reliablity

Causality <- raw.data %>% select(c("Causality1":"Causality6"))

ATC <- raw.data %>% select(c("ATC1":"ATC6"))

Change <- raw.data %>% select(c("Change1r":"Change6r"))

Locus <- raw.data %>% select(c("Locus1":"Locus6"))
```

```
alpha(Causality)

alpha(ATC)

alpha(Change)

alpha(Locus)


# Descriptive statistics

summary(CreateTableOne(data = data, strata = "Information"))


# general mixed model vs Poisson glmer, AHS Time Interaction

Information_seeking.AHS1 <- lme(Information ~ AHS + Time + AHS * Time,

random = ~1 |Scenario|ID, data = data, method = "REML")


# Nested using Information

Information_seeking.AHS2 <- glmer(Information ~ AHS + Time + AHS * Time +

(1|Scenario), data = data, family = poisson(link = "log"))

summary(Information_seeking.AHS2)


# Nested Information Including Age

Information_seeking.AHS3 <- glmer(Information ~ AHS + Time + Age + AHS *

Time + (1 | Scenario), data = data, family = poisson(link = "log"))

summary(Information_seeking.AHS3)


anova(Information_seeking.AHS2, Information_seeking.AHS3)
```

```
cor(data$Age, data$AHS)
summary(lm(AHS ~ Age, data = data))

####
# Nested using Confidence as dependent variable
Confidence.AHS2 <- lme(Confidence ~ AHS + Time + AHS * Time, random = ~1
|Scenario, data = data, method = "REML")
summary(Confidence.AHS2)

# Nested Confidence include Age
Confidence.AHS3 <- lme(Confidence ~ AHS + Time + Age + AHS * Time, random =
~1 |Scenario, data = data, method = "REML")
summary(Confidence.AHS3)

anova(Confidence.AHS2, Confidence.AHS3)

### Priming and Time interaction
# Information seeking
Information_seeking <- glmer(Information ~ Priming * Time + (1 |Scenario), data =
data, family = poisson(link = "log"))
summary(Information_seeking)

# Confidence Identification
Confidence_identification <- lme(Confidence ~ Priming * Time, random = ~1
|Scenario, data = data, method = "REML")
```

```
summary(Confidence_identification)


#Confidence as a predictor?
summary(glmer(Information ~ Confidence + AHS * Time + (1|Scenario),
                        data = data , family = poisson(link = "log")))


# Plot interaction based on hand computed slope, line 1 is b0+ b1x, line 2 is (b0 + b2)
+ (b1 + b3)x
# AHS * Time on information
AHS_Time_Information <- ggplot(data,
             aes(x = AHS,
                    y = Information,
                    col = Time,
                    )) +
   xlim(-1,1)+
   ylim(-1,1)+
   #geom_point() +
   geom_abline(aes(intercept = 0.50871,
                              slope = -0.0222,
                              col = (Time = 0))) +
   geom_abline(aes(intercept = 0.31692,
                              slope = 0.30852,
                              col = (Time = 1)))
print(AHS_Time_Information)
```

```
# AHS * Time on confidence
AHS_Time_Confidence <- ggplot(data,
                              aes(x = AHS,
                                  y = Confidence,
                                  col = Time,
                              )) +
  xlim(-3,3)+
  ylim(0,4)+
  #geom_point() +
  geom_abline(aes(intercept = 2.3832000,
                  slope = 0.4553765,
                  col = (Time = 0))) +
  geom_abline(aes(intercept = 2.5549082,
                  slope = 0.2989535,
                  col = (Time = 1)))
print(AHS_Time_Confidence)

# Priming * Time
Priming_Time_Interaction <- ggplot(data,
        aes(x = Priming,
            y = Confidence,
            col = Time,
            )) +
  xlim(-1,1)+
  ylim(-1,1)+
```

```
    #geom_point() +
    geom_abline(aes(intercept = 0.46484,
                    slope = -0.05176,
                    col = (Time = 0))) +
    geom_abline(aes(intercept = 0.41445,
                    slope = 0.46869,
                    col = (Time = 1)))


#exploratory analyses
##information seeking
TTB <- raw.data %>% select("S1_Cue", "S2_Cue", "S3_Cue", "S4_Cue")
TTB$TTB <- rowSums((TTB <1))
TTB$TTB.P <- TTB$TTB/4
TTB$Time <- raw.data$Time
TTB$AHS <- raw.data$AHS


summary(lm(TTB.P ~ AHS * Time, data = TTB))


ggplot(TTB, aes(AHS, TTB.P, color = factor(Time))) +
    geom_point() +
    geom_smooth(method = "lm", se = FALSE) +
    scale_color_manual(name = "Time", labels = c("Time Constraints", "No Time
Constraints"), values = c("#FF6666", "#6666FF")) +
    theme_classic()
```