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## EDITED BY

Athanasios Drigas,  
National Centre of Scientific Research  
"Demokritos," Greece

## REVIEWED BY

Eleni Mitsea,  
National Centre of Scientific Research  
"Demokritos," Greece  
Federico Bizzarri,  
University of Siena, Italy

## \*CORRESPONDENCE

Jerusalem Merkebu  
✉ Jerusalem.Merkebu.ctr@usuhs.edu

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# What is metacognitive reflection? The moderating role of metacognition on emotional regulation and reflection

Jerusalem Merkebu<sup>1\*</sup>, Anastasia Kitsantas<sup>2</sup>, Steven J. Durning<sup>1</sup>  
and Tinglan Ma<sup>1</sup>

<sup>1</sup>Center for Health Professions Education, Uniformed Services University of the Health Sciences, Bethesda, MD, United States, <sup>2</sup>College of Education and Human Development, George Mason University, Fairfax, VA, United States

**Introduction:** This paper explores the trilateral relationship among metacognition, emotional regulation, and reflection under the integrative framework of metacognitive reflection.

**Methods:** Data were gathered from undergraduate participants at a large state university on the East Coast ( $N = 493$ ). The quantitative data were derived from: the Metacognitive Awareness Inventory (MAI), the Self-Reflection and Insight Scale (SR-IS), and the Cognitive Reappraisal Scale (ERQ). Data analysis consisted of structural equation modeling (SEM) in which the associations between latent constructs were tested. Emotional regulation and metacognition were found to be positively and significantly related to the latent construct of reflection.

**Results:** SEM results indicated that emotional regulation (which emerged as the strongest predictor) together with metacognition predicted 52% of the variance in reflection. Moreover, the latent moderation model showed that metacognition significantly moderated the relationship between emotional regulation and reflection such that emotional regulation was a strong and positive predictor of reflection when students simultaneously showed high levels of metacognition. In contrast, emotional regulation did not significantly predict reflection for students with low levels of metacognition. The alternative model showed that emotional regulation also moderated the relationship between metacognition and reflection such that metacognition contributed to reflection the most when participants simultaneously showed high levels of emotional regulation.

**Discussion:** These findings suggest the interaction between metacognition and emotional regulation is critical in the gamut of reflection.

## KEYWORDS

reflection, metacognition, emotional regulation, metacognitive reflection, cognitive reappraisal

## 1. Introduction

Recently, [Schaepekens et al. \(2022\)](#) argued that "Research on reflection must deal with the paradox that every conceptualization of reflection is either too sharp or too broad" (p. 1). Previously, [Kirkham and Diamond \(2003\)](#) also asserted that "Reflection needs to be better operationalized; its components and the mechanism driving it better understood" (p. 474). The need to reconceptualize the dimensions comprising reflection

has been an important point of discussion in the broader literature (Edwards, 2017). The nature of reflection is complex, serving various functions, holding many attributes (i.e., philosophical, abstract, intentional, systematic), and ranging from content-based reflection to metacognitive reflection to intense and transformative levels of reflection (Grossman, 2009; Keestra, 2017). Thus, in this structural equation modeling study, we intentionally focus on one aspect of reflection: metacognitive reflection. However, what exactly comprises *metacognitive reflection* calls for conceptual clarity. In other words, what are the key factors that contribute to this type of reflection?

Recent trends in the literature reveal persistent use of the umbrella term *metacognitive reflection* when discussing metacognition, reflection, and/or emotion (Grossman, 2009; Gillon et al., 2012). In fact, a basic search of PsycInfo, Embase, and PubMed (March, 2022) with the search string: metacognitive reflection\*, after deduplication, resulted in 464 hits. The unclear overlap of these related constructs has been pervasively suggested in both clinical and nonclinical populations (Cacciamani et al., 2012; Casakin and Wodehouse, 2021). As implied by the term, researchers attempt to capture the naturally close and mutually complementary relationship between metacognition and reflection (Keestra, 2017). However, similar to Glava and Glava (2011), most researchers informally use the term metacognitive reflection without providing a clear definition. Cornoldi (1998) is among the few researchers who offer an explicit definition: “Metacognitive reflection is not only represented by its most evident, aware, verbalizable portion; it also includes a part not so easy to verbalize that refers to affective characteristics that include: intuitions, sensations, emotions, autobiographical memories, and self-evaluations” (p. 157). Similarly, Grossman (2009) proposed that on the continuum of reflection, metacognitive reflection considers the metacognitive role of feelings and emotions in reflection. As such, some consensus appears to be that an awareness of emotion is at the heart of metacognitive reflection (Cacciamani et al., 2012; Eichbaum, 2014; Bonfils et al., 2016; Moritz and Lysaker, 2018). Following this implication, we propose that the regulation of emotion (*via* cognitive reappraisal) deserves consideration in the evaluation of reflection.

The literature in this area provides theoretically diverse perspectives, with some arguing that metacognition exerts influence on or precedes reflection and vice versa; while others focus on the similarity of the constructs and allude to a bidirectional relationship (Siddiqui et al., 2020). A handful of qualitative studies also support the idea that developing or increasing levels of reflective awareness requires enhanced metacognitive monitoring (McAlpine and Weston, 2000; Larrivee, 2008; Whittaker and van Garderen, 2009; Sellars, 2012). By the same token, a significant association has been reported between metacognition and emotional regulation strategies (Quattrini et al., 2019; Pennequin et al., 2020).

Although independent lines of research have established the value of cognitive reappraisal (as a dimension of emotional regulation), metacognition, reflection, the interactions between metacognition and reflection (Lyons and Zelazo, 2011), metacognition and emotion (Efklides, 2006, 2011; Davis et al., 2010; Aloï et al., 2022), and emotion and reflection (Crane et al., 2019); the specific associations that exist between metacognition, emotional regulation, and reflection remain to be empirically

explored. Further, what factors contribute to reflection remain unclear. Given this gap in the literature, the present study sought to propose and test a structural model, which attempts to offer meaningful insights into the role of metacognition and emotional regulation on reflection.

Highlighting the interconnected nature of these constructs, this research attempts to provide a coherent view of the trilateral relationship among emotional regulation, metacognition, and reflection, under the framework of metacognitive reflection. There is not a single universally accepted definition for the terms *metacognition*, *reflection*, or *metacognitive reflection*. However, reflection is considered by many to be a larger and more holistic construct and has been linked to mindfulness, spiritual intelligence, faith, higher-level awareness, transcendence, moral consciousness, transformative learning, self-regulated learning, and reflexivity (Mezirow, 1994; Bleakley, 1999; Baumgartner, 2001; Cranton, 2002; De Nys, 2002; Branson, 2007; Korthagen and Vasalos, 2009; Travis and Shear, 2010; Hetzner et al., 2011; Smith, 2011). To that end, taking into keen consideration the positive relationship between metacognition and emotional regulation (Pennequin et al., 2020), this study seeks to shed light on the interaction between levels of metacognition and emotional regulation on levels of reflection. For instance, we examine if the interrelation between metacognition and emotional regulation contributes to a positive or high level of reflection. Examining the specific relationships among the aforementioned variables will advance the field by not only preventing confusion and the interchangeable use of these constructs, but also potentially by defining boundaries and helping to direct future research on one aspect of reflection (i.e., metacognitive reflection).

## 2. Literature review

### 2.1. Reflection

There is no single operational definition of reflection (Fat’hi and Behzadpour, 2011; Schaepkens et al., 2022). Despite persistent ambiguity, the general consensus among scholars appears to be that reflection is an ongoing, systematic, disciplined, back-and-forth cognitive activity of observing, questioning, analyzing, and refining thoughts/actions to gain clarity in understanding and achieve productive outcomes (Dewey, 1933; Killion and Todnem, 1991; Bright, 1996; Cole and Knowles, 2000; Osterman and Kottkamp, 2004; Fat’hi and Behzadpour, 2011; Schaepkens et al., 2022). Reflection has been considered higher-level thinking (Lasley, 1992), cognitive risk-taking (Schon, 1983), and disciplined thinking balancing paucity and redundancy (Dewey, 1933). Reflective thinking is a tool for posing thoughtful and significant questions to enhance the quality of decisions (Schon, 1992; Robinson et al., 2001).

Deviating from the natural inclination to promote or advocate one’s agenda, reflective thinking through questioning primarily seeks to explore alternative assumptions and perspectives (Schon, 1992; Marquardt and Waddill, 2004). Accordingly, Cooper and Larrivee (2006) suggested that reflection is exploration for the purpose of understanding. As a result, one’s intrinsic orientation is transformed from certainty to curiosity. One assumption of

reflective thinking is that by operating in a mode of protracted inquiry, one will unearth blind and/or opaque spots in their understandings (Dewey, 1933). Engaging in a cycle of open discovery helps to bring to light the hidden structure of one's thinking, lying beneath the realm of consciousness. At a minimum, reflection serves as a tool for exposing subconscious or unconscious mental models. As such, Kim (1999) avowed that this process emancipates us from deception. Relatedly, Dewey declared that when a reflective stance is assumed, individuals are aware of limitations, lack of understanding, and partial absences that exist even as they strive to make meaning. Shapiro and Reiff (1993) proposed that once hidden theories are discovered, this revelation forms the basis for considering alternative perspectives.

One of the fundamental assumptions of reflective thinking is that all ideas are subject to questioning, and none are exempt (Cole and Knowles, 2000; Schön, 2017). Not only does this mode of thinking encourage the bringing to light of embedded assumptions, but it also requires critically challenging any established (possibly tacit) beliefs. This phenomenon is particularly relevant in what Morgan (2011) referred to as psychic prisons or favored ways of thinking that become traps. Correspondingly, Dewey (1933) stated, "Thought can more easily traverse an unexplored region than it can undo what has been so thoroughly done as to be ingrained in unconscious habit" (p. 121).

## 2.2. Metacognition

In alignment with work on the quality of thought, Flavell (1979) first operationalized metacognition as a construct through a model of cognitive monitoring with four distinct types of metacognitive processes: metacognitive knowledge, metacognitive experiences, tasks or goals, and strategies or activities. Flavell's groundbreaking model explored the complex dimensions of metacognition. Metacognition has been broadly defined as "thinking about thinking," or "cognition about cognition" (Flavell, 1979; Dimmitt and McCormick, 2012). Dinsmore et al. (2008) and Schunk (2008) discussed how this intricate construct has contributed to chaos in terminology. Similarly, Veenman et al. (2006) conducted a comprehensive literature review that revealed the prevalent terms used to capture the various dimensions of metacognition. Metacognition (defined only 33% of the time) and self-regulation were consistently used interchangeably or were greatly associated. Efklides (2008) highlights that metacognition is a multifaceted meta-level phenomenon. Similarly, in their theoretical exploration of the pillars of metacognition, Drigas and Mitsea (2020) propose that, "in a state of awareness, we notice sensations, thoughts and feelings in a reflective way and metacognition depends on our ability to monitor, control and adapt our thoughts and emotions, [reflectively] recognizing and discriminating between functional and dysfunctional mental or emotional states facilitate the flexible modification of thought and behavior in the face of novel demands (p. 6)." In this sense, the expansion of metacognitive monitoring also meant enhancing the process of learning and decision-making (Flavell, 1979). The role of metacognition in enhancing learning, behavior, and the quality of decisions has been supported by empirical evidence across diverse disciplines (e.g., Efklides, 2006; Concina, 2019; Matsumoto-Royo and Ramírez-Montoya, 2019; Yanqun, 2019).

## 2.3. Metacognition and reflection

Describing metacognitive reflection as the conscious and deliberate reflective consideration of one's mental processes, Hargis and Marotta (2011) recorded eight different types of classes (psychology, mathematics, political science, engineering, education, dance, computer science, and business law) using flip cameras, and used the recordings to gain metacognitive insight into learning and teaching processes. Analyses revealed that reflective activity is associated with increased student engagement and metacognition as students reflected on each other's work. Furthermore, among faculty, this experience was found to bolster further metacognitive-induced reflection about teaching and learning (Hargis and Marotta, 2011).

Similarly, Rimor and Kozminsky (2003) sought to investigate the metacognitive processes of students who reflected on their learning experiences. The authors asked 24 ninth-grade history students to conduct research over a 5-month period on modern Israeli society using various data sources, and to produce a paper based on their investigation. Students' metacognitive activities included data searching, data sorting inquiries, project writing, construction of computerized databases, and weekly written reflections on these experiences. Rimor and Kozminsky analyzed the students' reflections using content analysis based on Flavell's (1979) model of metacognition and identified 18 subcategories of personal, task, and strategy insights gained by students. Additionally, different dominating dimensions of metacognition and patterns of reflection were revealed among students. Rimor and Kozminsky (2003) concluded that encouraging students to foster metacognitive abilities increases their engagement in reflection. Corroborating this idea, Lin (2001) proposed the need to nurture a habit of reflection by reconceptualizing metacognition as a natural part of daily activity.

In another study, Granville and Dison (2005) sought to delineate reflection and metacognitive reflection. They found that the quality and level of reflection were heavily influenced by a student's decision to remain engaged. When asked to reflect generally about courses, participants showed low levels of reflection, whereas when they were given in-depth long-term research projects, they demonstrated rich reflection. Learners moved on a continuum from thinking to task-related reflection, self-reflection, and finally to metacognitive reflection (Granville and Dison, 2005). Similarly, Philip (2006) supported the view that the deliberate act of reflecting on what was learned significantly contributes to making sense of the learning, why it was learned, and how that particular increment of learning was facilitated. This research suggests that the intricate relationship between metacognition and reflection contributes to in-depth learning.

Cacciamani et al. (2012) measured metacognitive reflection by inviting a group of undergraduate students in post-secondary education settings, both online and in the classroom, to engage in a metacognitively reflective activity by answering specific questions concerning their created knowledge and use of strategies. The reflective questions, which authors described as metacognitive by default, were presented at two points—in the middle and at the end of the task. Only one of seven discussion groups participated in the metacognitive discussions. The results indicated that those who were engaged in the metacognitive reflection space made

up 56% of those with advanced epistemic agency. Cacciamani et al. (2012) contended that metacognitive reflection enhances knowledge-building activities by orienting individuals to deeply evaluate problems.

In their qualitative study, McAlpine et al. (1999) reported that professors operated at various levels of metacognitive reflection to improve instruction. They interviewed six exemplary university professors and analyzed hours of videotaped classes. Professors consistently attended to and monitored over 74% of student cues and, in response to the cues, modified or changed their methods of instruction by 52% and their content by 43% to improve learning. Professors' metacognitive reflections revealed that they strategically reflected on and tracked learning goals by reflectively attending to student participation, student understanding, method, and content. Based on the findings, the authors constructed an integrated metacognitive model of reflection (McAlpine et al., 1999).

Similarly, Bormotova (2010) found that entering freshman, when provided with prompts about their reading and writing experiences, responded with both general and metacognitive reflection, noting that "the borderline between metacognitive and general reflection is quite vague" (p. 46). Participants were able to perceive the value of metacognitive reflection for successful learning. This research articulated that metacognitive reflection is a type of expertise that can be developed and nurtured by providing the necessary support for learners (Bormotova, 2010).

## 2.4. Emotional regulation and reflection

According to theories of emotion, cognitive reappraisal has been delineated as the best emotional regulation strategy for both naturally occurring and situationally induced emotions that impact decision-making (Panno et al., 2013). Cognitive reappraisal is defined as an antecedent emotional regulation strategy that changes the course of potential emotional responses by productively reframing the meaning of an experience (Heilman et al., 2010). Tsai and Lau (2013) also highlight the value of regulating emotions when reflecting upon negative personal experiences. The term *appraisal theory* is attributed to Lazarus (1966), who pioneered the notion that the dynamic nature of appraisal obliges reappraisal of one's schema as new information becomes available. The benefits and pitfalls of emotions as they enter into the cognitive processes have been discussed by many researchers (Heilman et al., 2010; Tsai and Lau, 2013). For instance, positivity and negativity bias can occur as a result of heightened emotion (Petty and Briñol, 2015). Previous research has also suggested that emotions shape both the content and depth of thought processing *via* reappraisal. Through the cognitive reappraisal dimension, emotions serve to broaden action and the decision repertoire (Cavanaugh et al., 2007).

A major premise in the present study is that metacognitive reflection is composed of mental content and processes (Verplanken et al., 2007). In light of this distinction, Verplanken et al. (2007) contended that metacognitive content, which comprises emotions, is distinct from metacognitive processes (i.e., the metacognitive dimension) involved in reflecting upon content. For instance, negative reflection is framed as a dysfunctional mental habit wherein an individual is likely to perseverate over undesirable attributes and maintain a destructive cognitive space

that fuels negative emotions. The researchers highlighted that emotional content and habitual metacognitions are ultimately linked to decisions of self-worth. One of the critical arguments of Verplanken et al. (2007) is that habitual cognitive habits and thoughts are exposed through metacognitive reflection.

## 2.5. Link between metacognition and emotional regulation

Flavell (1979) proposed the idea that metacognitive experiences include an emotional dimension. He contended that these experiences occur before, after, or during a cognitive activity and may be ephemeral or lengthy, simple or intricate. Novel or arduous tasks, weighty situations, and critical decisions that require conscientious pre- and post-evaluations are likely to arouse metacognitively driven quality control (Flavell, 1979). Following this line of work, Efklides (2006) argued that metacognition and emotions play a significant role in the self-regulation of behavior by impacting top-down and bottom-up processes. Metacognitive experiences include the emotions that participants are aware of when task processing (Efklides, 2006). Efklides's (2011) formulation of the Metacognitive Affective Model demonstrated the significant impact of emotions on metacognition; as negative emotions increased, participants reported feelings of difficulty. Likewise, metacognition had a significant impact on affect, influencing causal attributions, achievement emotions, and reflections of self-concept. This evidence provides the basis for the predictive ability of metacognition and emotion as well as the interaction of both on self-regulation, which is a cyclical process governed by reflection (Efklides, 2006; Efklides et al., 2017).

Recent research has abandoned the notion that one can assess the self and situations with complete indifference, as cognition and emotion are interdependent (Storbeck and Clore, 2007). In view of this perspective, metacognition and emotion occur in unison to chronically direct reflection inward in order to inspect and examine the self attentively (Trapnell and Campbell, 1999; Fisher, 2018). Eichbaum (2014) contended that metacognition is a complex interplay of cognition and emotion. Due largely to the impulsive and unstable nature of emotions, healthy emotional reappraisal necessitates metacognition structures that are reflectively charged (Kruger and Dunning, 1999; Steinberg, 2007). However, because of the high level of cognitive effort required, engagement in metacognitive reflection is often abandoned. For this reason, the quality of metacognitive reflection is often superficial, self-absorbed, and not viewed as a priority (Dearnley and Matthew, 2007).

Exploring the relationship between metacognition and emotion, Tajrishi et al. (2011) conducted a correlational study with 300 university students. The results showed that four out of the five dimensions of metacognition had significant positive correlations with negative emotions. Similarly, Spada et al. (2008) used survey research methods to explore the relationship among metacognition, perceived stress, and emotion in 420 participants. Results revealed that metacognition positively and significantly correlated with negative emotion and stress. In addition, metacognition moderated the relationship between negative emotion and perceptions of stress. The authors suggested that individual differences in



metacognition are relevant to understanding the link between negative emotion and perceptions of stress. This line of thought suggests that the moderating impact of metacognition on emotion and negative reflections is worthy of consideration.

Individuals who engage in metacognitive reflection have the capacity to pause and think, which bolsters their ability to effectively regulate their emotions and shift to seek understanding of holistic alternatives. Such individuals demonstrate thoughtful reflection that allows them to expand their thinking in light of new evidence (Stahl and Pry, 2005; Efklides, 2011). Further, Drigas and Mitsea's (2020) expand upon metacognitive attention and observation "as a prerequisite for emotional regulation and emotional awareness. Specifically, it means improvement of the emotional regulation processes since we learn pay attention to emotional responses, filtering emotional states and taking into consideration all possible aspects of emotional experience. Highly [reflective] individuals are said to be "in tune" with their emotions and capable of regulating them" (p. 8). Thus, it's predicted that metacognition and emotional regulation (*via* cognitive reappraisal) are likely to interact and work in relation to each other as important constructs in the gamut of reflection.

## 2.6. The present study

Reconciling various lines of research and extending previous work by Efklides (2006) and Verplanken et al. (2007), the present study investigates what metacognitive reflection looks like in relation to emotional regulation and metacognition under the psychological structure of reflection; thereby exploring the specific associations among metacognition, reflection, and emotional regulation. The first objective of this study is to measure the extent to which metacognition and emotional regulation predict reflection. A second objective of this study is to explore the interaction effects between levels of metacognition and emotional regulation on levels of reflection. To our knowledge, this is the first research study that attempts to provide a coherent view of the trilateral relationship, employing the metacognitive reflection framework, among emotional regulation (*via* cognitive reappraisal), metacognition, and reflection by examining specific associations.

Although each of these constructs have been extensively studied either independently or in some combination, it is not understood how metacognition interrelates with emotional regulation to predict reflection. Examining the latent interaction and directional associations among the aforementioned variables will advance the field by potentially defining boundaries and offering greater conceptual clarity to direct future research. Specifically, exploring the latent interaction is crucial for understanding the role metacognition plays in the association between emotional regulation and reflection, and vice versa. The moderating role of metacognition may be of particular importance here too, as it was found to moderate the relationship between emotional awareness and reflectivity of self-esteem (Bonfils et al., 2018), and between negative emotions and global reflections of stress (Spada et al., 2008). In fact, Bonfils et al. (2018) state that metacognitive self-reflectivity allows an individual to reappraise an experience and helps them to modify emotional distress. Finally, Quattrini et al.

(2019) found that the capacity to regulate and manage emotions increases with the increasing of metacognition; thus, taking it one step further, we propose this relationship is strictly connected to reflection. Taken together, this study rigorously explores: (1) How are metacognition and emotional regulation associated with reflection? and (2) Does metacognition moderate the relationship between emotional regulation and reflection? We expected to see that metacognition has a direct, positive effect on reflection (H1), and that emotional regulation (*via* cognitive reappraisal) has a direct, positive effect on reflection (H2). We also expected to see that metacognition interacts with emotional regulation to predict high levels of reflection (H3).

## 3. Materials and methods

### 3.1. Participants

The 493 undergraduate participants in the present study represented freshmen (30%), sophomores (22%), juniors (25%), and seniors (18%). Most were 18 to 24 years old (84%), white (73%), and science, technology, engineering, and mathematics majors (66%). There were more women (63%) than men (37%). Participants were asked to indicate if they engaged in specific types of cognitive, metacognitive, or reflective activity. Responses showed that 2.7% engaged in prayer/mediation; 4.7%, to do lists; 2.5%, group discussions; 1.4%, notes/voice notes; 1%, journaling; 0.8%, walking; and 4.1%, exercising. Further, 42.9% engaged in at least two of these methods, and 39.8% engaged in at least three. As shown in Table 1, 87.8% engaged in these activities at least once a week, and the majority considered the activities to be of great value.

### 3.2. Measures

Three instruments with validity evidence were used to collect data on the main constructs. In addition, demographic questions were asked as well as questions related to students' levels of engagement in reflection.

#### 3.2.1. Metacognitive awareness inventory

Developed by Schraw and Dennison (1994), this 52-item questionnaire has excellent psychometric properties, with internal consistency ranging from 0.88 to 0.93. The items consist of a 5-point scale ranging from "always true" to "always false." Examples of items include "I consciously focus my attention on important information," and "I find myself pausing regularly to check my comprehension." This instrument serves to identify individuals with high metacognitive aptitude. The Cronbach's alpha for this sample was 0.90.

#### 3.2.2. Emotional regulation questionnaire

To measure the emotional regulation dimension of thought reappraisal, the Cognitive Reappraisal subscale of the Emotional Regulation Questionnaire was used (Gross and John, 2003). The subscale has six items on a 7-point Likert scale (from 1, "strongly disagree," to 7, "strongly agree"); sample items include "When I want to feel less negative emotion, I change the way I'm thinking

about the situation,” and “I control my emotions by changing the way I think about the situation I’m in.” This questionnaire possesses good psychometric properties (Gross and John, 2003). The Cronbach’s alpha for the sample of the present study was 0.94.

### 3.2.3. Self-reflection and insight scale

This 20-item scale was used to measure participants’ propensity to engage in reflection (Grant et al., 2002). Items included both positive (engagement) statements and negative (lack of engagement) statements, such as “I am very interested in examining what I think about,” “I don’t often think about my thoughts,” “I am usually aware of my thoughts,” and “I don’t really think about why I behave in the way that I do.” Participants responded to items using a 5-point Likert scale, from 1, “strongly disagree,” to 5, “strongly agree.” The Cronbach’s alpha for this sample was 0.83.

## 3.3. Procedures

The study was approved by the university’s institutional review board. Overall, the large state university website reported having 30,000 undergraduate degree seeking students and 11 colleges. Emails were sent out to faculty and colleagues across colleges, soliciting participation to various department list serves with a survey link. No selection criteria were imposed. Relying on convenient sampling, survey emails were distributed to approximately 1,100 undergraduate students in the college of humanities, social sciences, education, and human development with 493 returned, a response rate of 45%. A power analysis indicated that a sample size of at least 400 participants would be sufficient to detect significant effects with a power of 0.90 for the detection of a moderate or large effect size according to Cohen (1977). The alpha level used for this analysis was  $p < 0.05$ . Thus, in accordance with statistical guidelines, this sample size was deemed appropriate given the number of variables, significant  $\alpha < 0.05$ , and a statistical power exceeding the recommended 0.80 (Fitzner and Heckinger, 2010).

## 3.4. Data analysis

We first performed data screening for skewness and kurtosis and computed descriptive statistics (means, standard deviations, correlations) of all variables. Following that, we estimated in Mplus 8.0 a measurement model of the key constructs included in this study (Figure 1). This model included latent emotional regulation, metacognition, and reflection. In this model, (a) latent metacognition was indicated by four composites of procedural knowledge: comprehension monitoring, information management strategies, and debugging strategies, (b) latent emotional regulation was indicated by six raw items, and (c) latent reflection was indicated by three subscale composites of engagement in reflection, need for reflection, and insight. Due to the large number of raw items in the constructs of metacognition (26 items) and reflection (20 items), we used the composite subscale scores suggested by the literature for estimating the baseline model as well as all subsequent models. The model fit was evaluated according to Hu and Bentler’s (1998) criteria which included the chi-square

statistics, comparative fit index (CFI), the root means square residual error of approximation (RMSEA), and the Standardized Root Mean Square (SRMR). A CFI value of  $\geq 0.95$ , RMSEA value of  $\leq 0.06$ , and SRMR value of  $\leq 0.08$  would indicate a good fit (Hu and Bentler, 1998). Hu and Bentler (1998) recommended that researchers should combine SRMR with another fit index (e.g., CFI or RMSEA) for indication of model fit. We then added structural paths to the measurement model to test if emotional regulation and metacognition predicted reflection (Figure 2, top panel). Gender, age, ethnicity, year in college, major, and GPA were included as covariates.

TABLE 1 Participant demographic and reflection characteristics.

Demographics	Final sample (N = 493)	
	N	%
<b>Gender</b>		
Male	183	37.4%
Female	306	62.6%
<b>Class level</b>		
Freshman	99	29.9%
Sophomore	73	22.1%
Junior	81	24.5%
Senior	60	18.1%
<b>Ethnicity</b>		
Caucasian	174	73.4%
Hispanic	124	4.5%
African American	58	4.2%
Asian/Pacific Islander	66	6.1%
Native American	1	1.6%
Other	30	6.6%
<b>Major field</b>		
Social sciences	100	23.3%
Science, technology, engineering, and math	285	66.4%
Hospitality service industry	43	10.0%
Law	1	0.2%
<b>Reflection value</b>		
Some value	55	11.7%
Great value	200	42.6%
Very significant	133	28.3%
I can’t imagine living a life without reflection	82	17.4%
<b>Frequency of metacognitive activity</b>		
More than once a day	130	26.9%
At least once a day	171	35.4%
Once a week	123	25.5%
Once a month	33	6.8%
Biannually	10	2.1%
Annually	16	3.3%

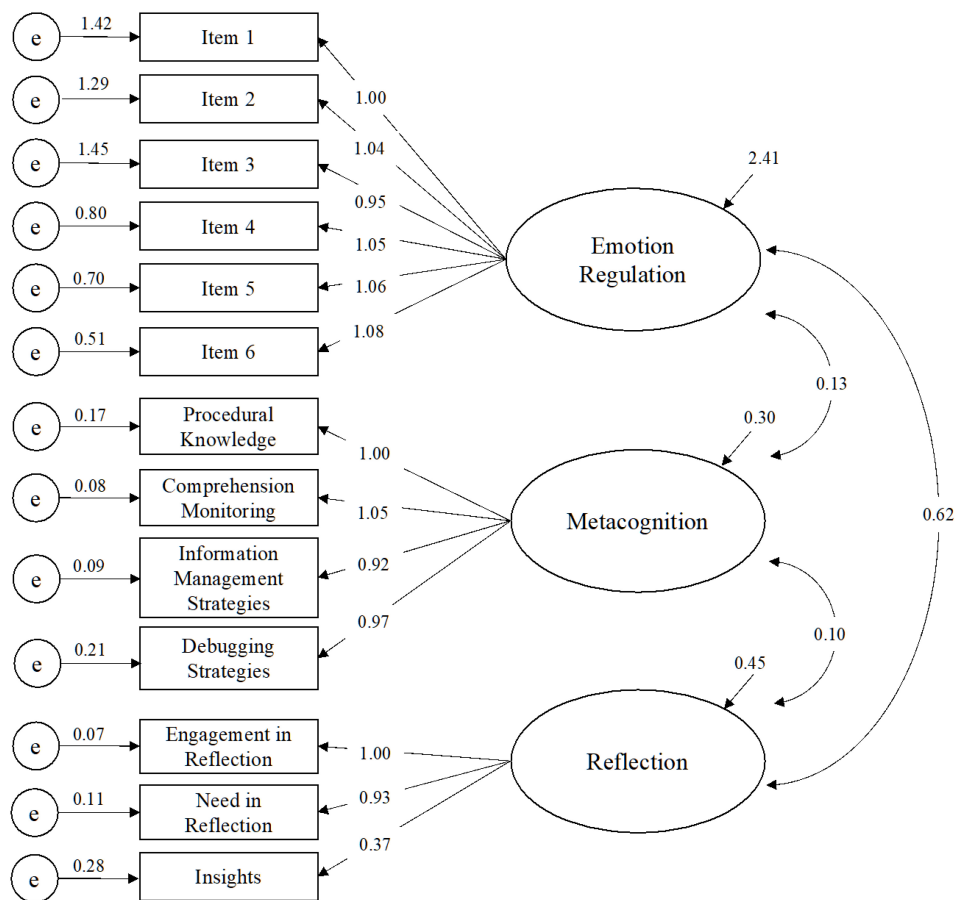


FIGURE 1  
Measurement model of the key constructs. Unstandardized coefficients are presented.

To examine whether or not metacognition moderates the effect of emotional regulation on reflection, we specified a latent interaction model with the latent moderated structural equations (LMS) method (Klein and Moosbrugger, 2000; Sardeshmukh and Vandenberg, 2017). Given that the latent interaction models were specified within the LMS framework (Klein and Moosbrugger, 2000; Maslowsky et al., 2015), conventional SEM fit indices (e.g., CFI, RMSEA, SRMR) are not available. Thus, the model that included CFA and structural paths served as the baseline model. Upon the establishment of a well-fitted baseline model, the moderating effects of coping strategies were examined by estimating the interaction term between emotional regulation and metacognition (Figure 2, bottom panel). Significant interaction terms were interpreted by plotting the simple slopes based on high (1 SD above mean) and low (1 SD below mean) levels of a predictor and moderator (Aiken et al., 1991).

## 4. Results

### 4.1. Preliminary analyses

Descriptive statistics for all variables are presented in Table 1. All variables had less than 5% missing data and the skewness

and kurtosis were below two, indicating that the data were normally distributed. The missing percentage for each variable was reported in Table 1. We conducted Little's Missing Completely at Random (MCAR) test and missing completely at random assumption was met,  $\chi^2(3,729) = 3126.76$ ;  $p = 1.00$ . Thus, Full Information Maximum Likelihood (FIML) estimation was used to handle missing data in subsequent SEM estimations. As shown in Table 2, all correlations among metacognition, reflection, and emotional regulation scales were statistically significant. The strongest relationship emerged between emotional regulation and reflection,  $r(493) = 0.54$ ,  $p < 0.01$ . Metacognition and reflection were weakly related,  $r(493) = 0.25$ ,  $p < 0.01$ , as were emotional regulation and metacognition,  $r(493) = 0.12$ ,  $p < 0.01$ .

### 4.2. Measurement model

We first estimated the measurement model as depicted in Figure 1. The model fit for the baseline unconditional model where no indicators were set to be correlated was acceptable, with  $\chi^2(62) = 4609.88$ ,  $p < 0.001$ , CFI = 0.963, RMSEA = 0.074 [90% CI = 0.064 to 0.085], SRMR = 0.041. Model fit indices suggest correlations between two pairs of items under the latent construct of emotional regulation. We evaluated the item contents and determined the two correlations between items made practical

TABLE 2 Descriptive statistics and bivariate correlations for study variables.

	Descriptive statistics		Bivariate correlations													
	M	SD	Percent missing	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.18	0.48	5.5	-	-0.14*	0.35**	-0.11*	0.09*	0.05	0.08	0.11*	0.08	-0.02	-0.04	-0.04	0.02
2	2.84	0.91	34.1		-	-0.04	0.38**	-0.03	0.08	-0.04	-0.1*	0.01	0.31**	0.29**	0.33**	0.14**
3	2.48	1.27	33.1			-	-0.04	0.11*	0.08	0.07	0.11*	0.12*	0.11*	0.08	0.09	0.07
4	3.80	1.66	1.6				-	0.12**	0.14**	0.13**	0.08	0.08	0.54**	0.52**	0.55**	0.28**
5	3.77	0.56	2.8					-	0.82**	0.9**	0.91**	0.81**	0.25**	0.23**	0.15**	0.23**
6	3.73	0.68	3						-	0.73**	0.65**	0.59**	0.27**	0.23**	0.15**	0.27**
7	3.72	0.64	2.8							-	0.75**	0.65**	0.28**	0.27**	0.19**	0.23**
8	3.74	0.59	2.8								-	0.69**	0.2**	0.18**	0.11*	0.18**
9	3.93	0.7	2.8									-	0.15**	0.14**	0.08	0.15**
10	3.31	0.54	1.8										-	0.89**	0.85**	0.71**
11	3.30	0.72	1.8											-	0.81**	0.4**
12	3.38	0.71	1.8												-	0.32**
13	3.27	0.58	1.8													-

Variable no. 4, 5, and 10 are means of full scales (boldfaced), No. 6–9 are subscale means of Metacognition, and No. 11–13 are subscale means of Reflection. \* $p < 0.05$ , \*\* $p < 0.01$ , and \*\*\* $p < 0.001$ .

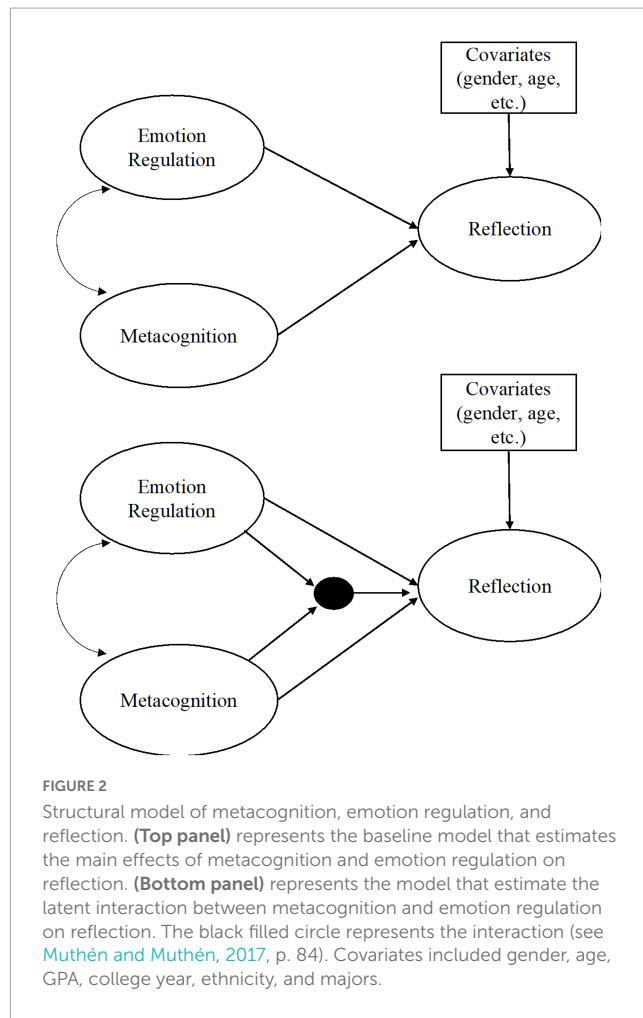


FIGURE 2 Structural model of metacognition, emotion regulation, and reflection. (Top panel) represents the baseline model that estimates the main effects of metacognition and emotion regulation on reflection. (Bottom panel) represents the model that estimate the latent interaction between metacognition and emotion regulation on reflection. The black filled circle represents the interaction (see Muthén and Muthén, 2017, p. 84). Covariates included gender, age, GPA, college year, ethnicity, and majors.

sense (e.g., the wordings are almost identical across the two items except for one wording: “When I want to feel more positive emotion, I change the way I’m thinking about the situation.” “When I want to feel more negative emotion, I change the way I’m thinking about the situation.”). After the within-construct items were allowed to be correlated, the model fit greatly improved and fit the data well,  $\chi^2(59) = 147.429, p < 0.001, CFI = 0.980, RMSEA = 0.055$  [90% CI = 0.044 to 0.067], SRMR = 0.04. All factor loadings were significant at the  $p < 0.001$  level.

### 4.3. Structural model

Next, we added the structural paths to the baseline model between the three latent constructs to estimate the latent correlations between emotional regulation, metacognition, and reflection (Figure 2, top panel). The structural model fit the data well,  $\chi^2(59) = 147.429, p < 0.001, CFI = 0.980, RMSEA = 0.055$  [90% CI = 0.044 to 0.067], SRMR = 0.04. Then, we estimated the same model in which gender, ethnicity, age, year in college, major, and GPA were controlled as covariates (conditional model). The conditional model fit the data well,  $\chi^2(159) = 349.71, p < 0.001, CFI = 0.960, RMSEA = 0.049$  [90% CI = 0.042 to 0.056], SRMR = 0.04. The latent construct of reflection was significantly predicted by both the latent construct of metacognition ( $b = 0.24$ ,



SE = 0.05,  $p < 0.001$ ), and the latent construct of emotional regulation ( $b = 0.20$ , SE = 0.02,  $p < 0.001$ ). A significant correlation was found between metacognition and emotional regulation ( $r = 0.12$ ,  $p = 0.004$ ). This model explained 46% of the total variance in reflection. Unstandardized path coefficients of this model are provided in [Table 3](#).

#### 4.4. Moderation of metacognition

The LMS approach was adopted to examine the interaction effects of emotional regulation and metacognition on reflection (Maslow et al., 2015). Given that the baseline structural model fit the data well (fit indices mentioned above), we proceeded with a model that included the interaction term between emotional regulation and metacognition (Figure 2, bottom panel). Unstandardized path coefficients and total  $R^2$ s for each model are presented in [Table 3](#). In the latent moderation model, reflection was significantly predicted by metacognition ( $b = 0.22$ , SE = 0.04, Standardized  $\beta = 0.34$ ,  $p < 0.001$ ), emotional regulation ( $b = 0.24$ , SE = 0.02, Standardized  $\beta = 0.37$  vs. 0.34  $p < 0.001$ ), and the interaction between the two constructs ( $b = 0.22$ , SE = 0.03, Standardized  $\beta = 0.33$ ,  $p < 0.001$ ). Together, this model explained 52% of the total variance in reflection. Results showed a significant interaction between emotional regulation and metacognition. As depicted in [Figure 3A](#), simple slopes revealed that prediction of emotional regulation to reflection was the strongest for students with the highest levels of metacognition ( $b = 0.52$ , SE = 0.05,  $p < 0.001$ ), followed by weaker associations for students with moderate levels of metacognition ( $b = 0.25$ , SE = 0.03,  $p < 0.001$ ), in contrast to students with the lowest levels of metacognition ( $b = -0.03$ , SE = 0.04,  $p = 0.37$ ). An alternative presentation of this interaction effect is also shown in [Figure 3B](#). Simple slopes revealed that the association between metacognition and reflection was the strongest for students with a high level of emotional regulation ( $b = 0.57$ , SE = 0.04,  $p < 0.001$ ), followed by weaker associations for students with a moderate level of emotional regulation ( $b = 0.28$ , SE = 0.03,  $p < 0.001$ ), in contrast to students with a low level of emotional regulation ( $b = -0.001$ , SE = 0.04,  $p = 0.97$ ).

## 5. Discussion

The results of this study revealed several things about a proposed trilateral relationship among emotional regulation, reflection, and metacognition. Our findings supported the idea that both metacognition and emotional regulation significantly contribute to reflection. Of greatest significance, metacognition moderates the relationship between emotional regulation and reflection. The interactions also reveal that the path from emotional regulation to reflection is strongest for participants with higher levels of metacognition. Finally, 52% of the variance in reflection was explained by emotional regulation, metacognition, and the interaction between the two. Of the two, emotional regulation *via* cognitive reappraisal emerged as the strongest predictor of reflection. The patterns observed in this study can be interpreted at multiple levels.

First, this study demonstrates that the presence of both metacognition and emotional regulation play a critical role in

TABLE 3 Unstandardized path coefficients (and standard errors) of the latent interaction model predicting reflection.

	Structural model N = 493	Latent interaction model N = 493
Gender (1 = Male; 2 = Female)	-0.11 (0.05)	-0.11 (0.04)*
Age	-0.07 (0.06)	-0.13 (0.04)*
GPA	0.05 (0.04)	0.05 (0.03)
<b>Ethnicity (Reference = White)</b>		
Hispanic	-0.23 (0.11)	-0.12 (0.08)
Black	-0.16 (0.08)	-0.16 (0.06)*
Asian	-0.26 (0.08)*	-0.27 (0.06)*
Other	-0.01 (0.10)	-0.07 (0.07)
<b>Field (Reference = Social science)</b>		
Science and engineering	-0.07 (0.08)	-0.03 (0.06)
Industry service	-0.29 (0.11)*	-0.27 (0.08)*
College year	0.07 (0.03)	0.12 (0.03)*
Metacognition	0.25 (0.05)**	0.23 (0.03)**
Emotion regulation	0.20 (0.02)**	0.26 (0.03)**
Metacognition*emotion regulation	-	0.26 (0.03)**
Total $R^2$	0.46**	0.52**

We applied Bonferroni correction to control for the inflation of type one error rate; therefore, only  $p$ -values less than 0.01 were noted the asterisk sign (\* $p < 0.01$  and \*\* $p < 0.001$ ).

enhancing reflection. As anticipated, moderation results confirmed that high levels of metacognition and emotional regulation predicted higher reflective engagement. The association between emotional regulation and reflection was the strongest when students simultaneously showed a high level of metacognition. In contrast, the same link was not significant for students with low a level of metacognition. Thus, the role of metacognition is more profound when individuals reflectively engage in higher levels of emotional regulation. The alternative model showed that emotional regulation also moderated the relationship between metacognition and reflection such that metacognition contributed to reflection the most when participants simultaneously showed high levels of emotional regulation. This finding is in line with the integrative theories of metacognitive reflection, where individuals reflectively monitor thoughts and regulate emotions in order to achieve meaningful insight into the self, others, and larger complex contexts (Moritz and Lysaker, 2018; Kolavarambath et al., 2020; Lysaker et al., 2020). This points to the possibility that cognition about cognition and reappraisal of cognition are mutually beneficial and synergistic mechanisms that successfully maximize reflection. Overall, these findings suggest that the interaction between metacognition and emotional regulation is critical in the gamut of reflection.

Interestingly, metacognition may be conceived as a catalyst that serves as a gateway for engagement in emotional regulation and overall reflection. This is in accordance with Zimmerman's (2002) model of self-regulatory processes, where the self-monitoring dimension of metacognition comes before the self-reflection

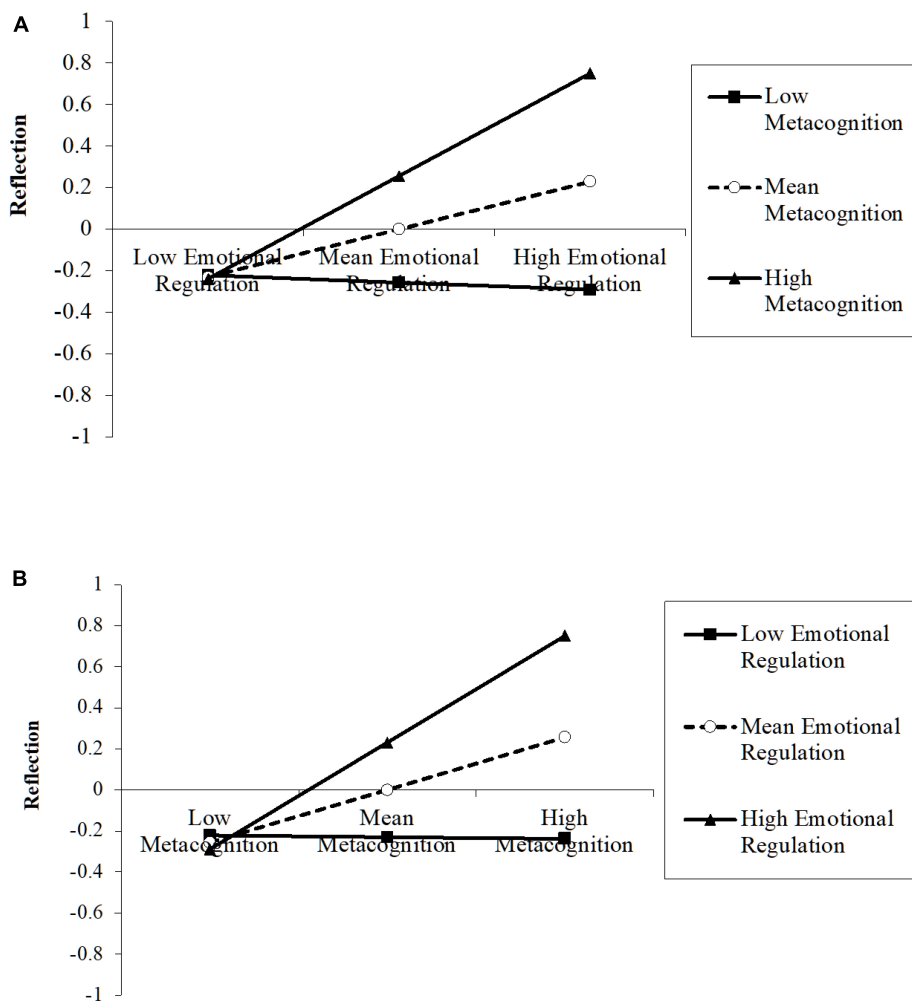


FIGURE 3

The interaction between metacognition and emotional regulation on reflection. Panel (A) shows the moderation role of metacognition and panel (B) shows the moderation role emotional regulation.

phase. As such, metacognition is perhaps best conceptualized as a fundamental construct that has important ramifications for engagement in reflection rather than being conflated with reflection. Such an understanding extends our orientation of the interconnected components of metacognition and moves the field forward (Veenman et al., 2006). The results of this study support the need to pay attention to the diverse metacognitive and emotional regulation layers at work in reflection. While there is no compelling need to create a new definition, it is critical to clearly define and delineate the construct of metacognitive reflection and acknowledge the overlap of these inherently related constructs (i.e., metacognition and emotional regulation) that contribute to form the trilateral dimension of one type of reflection, perhaps best conceptualized as metacognitive reflection.

Second, the findings of this study suggest that emotional regulation, emerging as a strongest predictor, might be partly metacognitive and largely reflective. This is particularly interesting as the reappraisal dimension, going beyond the metacognitive, transforms into reframing and reinterpreting one's schema in a manner that is inherently reflective. Cognitive neuroscience studies by Füstös et al. (2013) employing electroencephalography

found that an individual's ability to successfully regulate emotion requires interoceptive awareness. The researchers provided neuroanatomical evidence that sensitivity to one's internal emotional state and the reciprocal interaction among mind, cognition, and affect is an important criterion for emotional regulation. This perspective pertains to a higher-level reflective awareness of the cognitive, emotional, and physiological components mediating emotional experiences (Damasio, 1996; Füstös et al., 2013). This interpretation is further supported by Herbert et al. (2011), who empirically verified that interoceptive awareness depicts heightened consciousness of emotional experiences and overall internal visceral processes and is negatively linked to alexithymia (generally characterized by externally oriented thinking that is oblivious to emotions and emotional stimuli). Perhaps, emotional regulation *via* cognitive reappraisal is governed by internally oriented thinking that is inherently reflective.

Finally, our findings suggest that metacognition and emotional regulation do not work alongside each other or as separate entities. Rather, they work in relation to each other to predict high levels of reflection. We note the importance of the interrelation between

metacognition and emotional regulation. Without a high level of metacognition, it is less likely that a strong emotional regulation will contribute to high levels of reflection process. Likewise, without a strong emotional regulation, it is less likely that metacognition will contribute to reflection.

This study finds strong support for the predictive links among metacognition, emotional regulation, and reflection. It can be expected that metacognition and emotional regulation play an essential role in engagement in reflection. This is in accordance with Hudlicka's (2005) study that models the interaction between metacognition and emotion. The metacognition, emotional regulation, and reflection systems are related in such a convoluted manner that none can be neglected in the discussion of the metaprocesses governing the spectrum of reflection. The findings of this study illustrate the value of this triarchic framework in an undergraduate student population. More specifically, Gutierrez de Blume and Montoya (2021) state that students reported higher metacognitive scores across the social sciences including education and psychology where reflection is promoted in abundance. Metacognitive reflection is, in essence, the space of cognitive integration where metacognition, emotional regulation, and reflection become structurally integrated (Veenman et al., 2006; Gutierrez de Blume and Montoya, 2021). This part of the relationship is largely abstract and conceptual. Nonetheless, the constructs forming metacognitive reflection are clearly interdependent.

## 5.1. Theoretical implications

Building on previous work (e.g., Verplanken et al., 2007; Efklides, 2008) this study aims to move the discussion forward by highlighting the interaction between metacognition and emotional regulation within the broader context of reflection. Additionally, based on prior theory and research, as well as the findings of this study, perhaps when individuals cross the threshold from more superficial to deeper levels of cognition—metacognition—to reflection, we come into a space where we can begin to effectively regulate our emotions, allowing us to engage in deeper levels of reflection where awareness and novel insight emerge (El-Dib, 2007; Carroll, 2010a,b). Metacognitive reflection can be conceived as a whole-person perspective that intentionally considers both metacognitive and emotional structures in the gamut of reflection. An important consequence of the trilateral dimension of metacognitive reflection could potentially be a reflective space where regulation of emotion leads to a shift in perspective (Arnon-Ribinfeld et al., 2018)—a space that promotes internal work, starting from the basic content-based to more in-depth and intensive metacognitive levels, reflectively suspending preconceived notions and recognizing the need for authentic regulation of emotion (Grossman, 2009; Davis et al., 2010).

## 5.2. Limitations and future directions

Overall, while this work has begun to disentangle the trilateral relationship between emotional regulation, metacognition, and reflection, it is not without limitations. Although the current model

has explained 52% of the variance in reflection, there is still 48% of the variance that remain unexplained. This was expected as a number of key variables well established in the cognitive and affect literature (e.g., self-regulation, motivation) were not included in the present study. Further, while the current study focused on these trilateral process variables, additional research to explore the complexity of metacognitive reflection is needed using participants at different stages of their development. It should be noted that the framework offered in this study focuses predominantly on undergraduate students in the social sciences, which limits the external validity of the findings.

This article fills a gap in the literature by beginning to examine characteristics of the trilateral relationship among emotional regulation, metacognition, and reflection. What may not be clear is how metacognitive or emotional regulation processes carry over to impact engagement in reflection. As such, it would be a fruitful endeavor for research to examine this trilateral relationship in relation to cognitive load levels (e.g., high, mid, and low), types of emotions, self-regulation, with various age groups/periods of development, and to employ mixed-methods strategies to understand how participants experience this phenomenon. This could potentially be attributed to freeing working memory capacity and reducing cognitive load (Young et al., 2014). Further, considering the trilateral nature of emotional regulation, metacognition, and reflection, establishing initiatives to improve only one of these variables is an incomplete strategy.

Moreover, there is a need to explicitly and thoughtfully assess the intermingled nature of emotive, metacognitive, and reflection dimensions by employing an integrative review of the literature. To fully exploit the potential of metacognitive reflection calls for efforts such as reviewing the plethora of literature in these distinct fields, constructing interviews relying on maximum-variation sampling to gather data from a heterogeneous sample, using a mixed-methods approach, creating an interdisciplinary research team, collecting substantial data, and the like. Future reviews focused on reflection and emotion could embark on this complex and uncharted territory of metacognitive reflection.

## 6. Conclusion

This article is a first attempt to integrate the metaprocesses that govern reflection by empirically incorporating metacognition and emotional regulation *via* cognitive reappraisal. Oh (1999) lucidly stated, "One way to refine a theory is to consider new variables, within the established framework, that are potentially powerful in explaining as well as predicting individual behavior" (p. 68). Similarly, Forestier et al. (2021) highlighted that accurately accounting for the dynamic and multicomponent nature of a psychological phenomenon necessitates a more integrative theoretical approach. Metacognitive reflection allows for the amalgamation of these variables into a unified framework by highlighting the trilateral nature of one type of reflection: *metacognitive reflection*. This study brings to the forefront the notion of reflectively reappraising one's cognitions in relation to metacognition, as well as the conceptual and synergistic interrelation among the constructs, in the hope of presenting a more coherent view of the mechanisms comprising metacognitive reflection.

## Data availability statement

The raw data supporting by the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by George Mason University IRB. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

JM full development of narrative and manuscript. AK refining narrative and methods. SD contributed to the narrative and discussion refinement. TM took lead on conducting SEM. All authors contributed to the development and refinement of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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