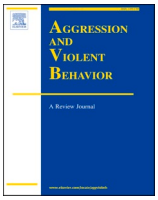
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Associations between maladaptive and adaptive emotion regulation strategies and aggressive behavior: A systematic review

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ABSTRACT

Aggression has been found to have negative consequences for the victims and the aggressors. The general aggression model explains the process that results in aggressive outcomes, and it emphasizes the role of emotion regulation. The purpose of this review was to systematically review available evidence on the relationship between the use of emotion regulation strategies and aggression. The Medline and PsycInfo databases were searched for articles in English and Spanish and 104 studies were identified. These studies examined associations between maladaptive and adaptive emotional regulation strategies with different types of aggressive behavior. Together, their results provide evidence that maladaptive strategies (e.g., rumination) were positively associated with aggression, while adaptive ones (e.g., mindfulness) were negatively associated. This relationship appears to be consistent across ages, populations, and types of aggression. Most of the studies explored the relationship between aggression and rumination, with several experimental and longitudinal studies supporting that this strategy leads to higher levels of aggression. However, most of the studies with adult samples used university participants, and only a few examined the simultaneous usage of adaptive and maladaptive strategies. Findings are discussed in relation to the general model of aggression and the clinical applications of emotion regulation strategies.

1. Introduction

Aggression is defined as any behavior with the proximate intention to cause harm to another individual who is motivated to avoid it (Anderson & Bushman, 2002). It is a common behavior that can be witnessed in daily life, in all types of cultures and historical moments (Severance et al., 2013), and is associated with negative consequences not only for the victims, but also for the aggressors.

Victims have been found to suffer from depressive symptoms, anxiety disorders, lower self-esteem, and stress-related problems (Björkqvist et al., 1994; Cava et al., 2010; Crick & Bigbee, 1998; O'Moore & Kirkham, 2001). Aggressors have shown psychosocial maladjustment, low academic performance, substance abuse, higher unemployment rates, poorer marital relations, and involvement in criminal behaviors (Alsaker & Olweus, 2002; Coccaro et al., 2009; Farrington, 1991; Moffitt, 2006; Ostrov & Godleski, 2009; Piquero et al., 2007). The effects of aggression on psychosocial adjustment and mental health outcomes highlight the importance of identifying variables that can increase or inhibit aggressive behavior.

The literature has explored the mechanisms to explain aggressive behavior from different classifications, depending on function, observational form or target. From a functional and motivational perspective literature has posit two types, proactive and reactive aggression (Dodge, 1991; Raine et al., 2006). Proactive aggression has been characterized as instrumental, organized and "cold-blooded" goal directed to get something, needless to involve increased physiological arousal and emotional response. In contrast, reactive aggression is conceptualized as fear-induced, irritable, and hostile affect-laden defensive response to provocation, and it is associated to reduced self-control and inhibitory functions. Reactive aggression is an overreaction to perceived threat or insult, accompanied by high physiological arousal and high intensity in the emotional response. Regulatory process of high state interne as emotion regulation would be especially involved in reactive aggression.

From an observational form view, aggression may be classified as physical, verbal and relational aggression (Björkqvist, 2001; Card et al., 2008; Coie & Dodge, 1998).

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Physical aggression includes behaviors enacted to harm others physically (e.g., hitting, biting, and kicking), verbal aggression includes actions to hurt another with spoken words (e.g., screaming and name calling) and relational aggression hurts individuals through aggressive action directed to manipulate and damage others relationships (e.g. gossips, rumours or exclusion of the victim from social groups). Also, depend on the target, aggression can be classified as direct or displaced aggression. Direct aggression involves situations when people are provoked, and in retaliation they inflict harm against the source of this provocation (Miller, 1941). Displaced aggression refers to situations when a person is provoked, is prevented from retaliating against the original provocateur, and subsequently aggresses against a seemingly innocent target (Denson et al., 2006).

There are numerous theories that explain aggressive behavior from different approaches: genetic and cognitive neuroscience (Baker et al., 2008; Blair, 2012; Panksepp, 2004; Raine, 2002), psychological basis focused on social information processing (Crick & Dodge, 1994) or morality perspective (Feshbach, 1971) and the study of developmental course of aggression (Farrington, 1991; Farrington et al., 2009). Some authors have proposed general metamodels to integrate the extensive literature of aggression in a unique integrative framework as I3 Model (Finkel, 2014) and General Aggression Model (Anderson & Bushman, 2002). On a hand, I3 Model explains aggressive behavior as a result from three processes: instigation, impellance, and inhibition. The Perfect Storm Theory posits that aggression is more likely when instigation and impellance variables are strong and inhibition is weak (for a review see Finkel & Hall, 2018). By the other hand, the General Aggression Model (GAM; Anderson & Bushman, 2002) is an integrative framework for domain-specific aggression theories. It includes situational, personological, and biological variables for explaining individual differences in processing that may give rise to aggressive behavior (DeWall et al., 2011). This metamodel provide a complete vision of the phenomenon of aggression due to include the specifically integration of different variables such as personality, biological, situational factors, cognition and emotion and processing information. The GAM postulates that situational factors (e.g., social stress, social rejection, provocation, frustration, etc.) interact with various personal factors (e.g., hostile attribution, moral justification of aggression, unstable high self-esteem, high trait anger, etc.) to create a specific internal state composed of thoughts (e.g., hostile thoughts), emotions (e.g., anger and general negative affect), and arousal (e.g., physiological activation). This internal state influences how an individual evaluates the situation and makes decisions, leading to behavior that is aggressive or pacific (Anderson & Bushman, 2002). The model represents a loop in which the final outcomes can influence the inputs, restarting the cycle.

The GAM emphasizes the importance of the internal emotional state and how it is regulated. Individuals who are unable to manage strong emotions may be overwhelmed by them during appraisal and decision-making processes, and therefore generate a smaller range of responses, most of which are related to their affective state (e.g., aggressive responses when they feel angry) (Lemerise & Arsenio, 2000). This perspective suggests that individual differences in how people regulate their own emotions may have a role in reducing and managing aggressive behavior.

1.1. Emotion regulation

There is lack of consensus regard Emotion Regulation (ER) definition (Tull & Aldao, 2015). One of the most commonly used by the scientific community is the definition offered by Gross (1998), refers to the processes by which we influence which emotions we have, when we have them, and how we experience and express them.

The research of emotion regulation has grown agglutinated in two board approaches (Tull & Aldao, 2015), emotion regulation as a general process composed by abilities, exploring the different abilities implies in the process such as emotional awareness, impulse control, emotional clarity (Gratz & Roemer, 2004; Hofmann & Kashdan, 2010) and the approach from the analysis of emotion regulation strategies in different steps of the process (Gross, 1998). Because we focused in GAM for aggression, an information processing model, in order to integrate both theoretical approaches in different fields, we focused on process model of emotion regulation, another information processing model.

From this last approach, the process model of ER explains how people regulate their emotions at different points. From the process model of ER (Gross, 1998, 2015), a relevant variable is the ER strategy, defined as any behavior or cognitive method that has a regulatory goal and modulates different aspects of the emotional experience (Gross, 2014; Gross & Jazaieri, 2014). Individuals might use a range of ER strategies at different points of the emotion process and Gross (1998, 2014) proposes five families of ER strategies: situation selection (approaching or avoiding some situations in order to regulate emotions), situation modification (intentional change or adjustment of a situation to modify its emotional impact), attentional deployment (selecting the aspects of the situation to focus on), cognitive change (modifying the meanings the person gives to the situation), and, finally, response modulation (the person attempts to influence the generated emotion to regulate it).

A question that research on ER has focused on is whether different strategies have different effects in terms of positive or negative outcomes. The literature has shown that ER strategies are not inherently maladaptive or adaptive, and it depends on contextual and personal factors (Aldao et al., 2015). The specific use of a strategy is not always effective. For instance, reappraisal of high-intensity emotions requires greater cognitive resources (Silvers et al., 2015) and in high intensity emotional context have been showed less effective than other strategies as distraction (Thiruchselvam et al., 2011). However, the literature on emotion regulation strategies has considered a functional differentiation of strategies based on their ability to facilitate adaptive versus maladaptive responding. Specifically, the habitual use of putatively maladaptive emotion regulation strategies, such as rumination or suppression, have been found to be consistently associated to negative outcomes (e.g., psychological disorders, aggression) whereas the habitual use of other strategies, such as reappraisal, are associated to positive ones (Aldao, 2012; Aldao et al., 2010; Aldao & Nolen-Hoeksema, 2012). From this perspective, the tendency of the individuals to use maladaptive or adaptive ER strategies may help us to explain aggression.

1.2. Emotion regulation and aggressive behavior

As mentioned above, from the GAM, emotion regulation can influence aggressive behavior through the regulation of anger (as the emotional state more linked to aggression) and other negative emotional states (Davey et al., 2005). It could be hypothesized that the use of maladaptive ER strategies to regulate these negative emotions could result in a more frequent aggressive behavior, whereas the use of adaptive ER strategies could act as a protective factor. A number of studies have tried to test these ideas, showing that individuals who tend to experience intense negative emotions and who are not able to regulate them show more aggressive behavior than people who display an effective emotion regulation (see Roberton et al., 2012 for a review). Of the different maladaptive and adaptive ER strategies that have been examined, rumination and emotion suppression, on the one hand, and reappraisal and mindfulness, on the other hand, have received special attention in the field of aggression. Next, we briefly expose each of them.

Rumination is considered a perseverative and intrusive cognitive process about a distressing occurrence; when the content is an anger-inducing event, it is called angry rumination (Denson, 2009) and it might be accompanied by angry feelings or retaliation thoughts (Sukhodolsky et al., 2001). Rumination is involved in the attention deployment step in the process model (Gross, 1998) because it locates the attention towards thoughts and feelings related to the anger-

inducing event, maintaining them, and leading to a higher use of aggressive behavior (Denson, 2009, 2013). For example, an individual keep thinking about events that angered him/her for a long time. On the other hand, expressive suppression is a strategy aimed to inhibit the behavioral expression of the emotion located in the response modulation step of the process model (Gross, 1998). Although this might be adaptive in the short term and in certain situations, it fails to reduce the internal emotional experience and the sympathetic nervous system activation (Gross, 1998, 2015), in part due to the ironic rebound effect (Wegner, 1994). For instance, if someone is very upset but decides to suppress the expression of that emotion, the negative internal state may become stronger and facilitate an aggressive response. Like rumination, it is considered a maladaptive strategy (Aldao et al., 2010).

Reappraisal refers to the transformation of the meaning or self-relevance of a situation to alter its emotional impact (Gross, 1998) that requires effortful cognitive processing (Denson & Fabiansson, 2011). It is a strategy involved in the cognitive change step in the process model (Gross, 1998). It is normally used to diminish the effects of negative emotions and has been found to be useful for this (Gross, 2015). For example, If I feel angry because I argued with a colleague for a collaborative job together, I may reappraise the situation and change mi view about the talk, maybe as an interesting and highly motivated response of my colleague, not as a unfair non-acceptation of my ideas, and then calm down my anger. Finally, mindfulness is described as an attentional process that brings awareness to moment-by-moment experience, and that is cultivated through meditation (Kabat-Zinn, 2003). According to Guendelman et al. (2017), mindfulness elicits a particular strategy called "mindful emotion regulation", that results in mindful mental states such as awareness and acceptance (Chambers et al., 2009); it can modulate any of the steps of the process model (Gross, 1998), and, like reappraisal, it is a strategy linked to lower levels of negative emotions. For instance, if my boss reprimanded me this morning, I may accept that I generated negative feelings about that moment and focus on my moment experience in the afternoon.

1.3. Our review

Considering the GAM and Gross's ER model, a closer look at which ER strategies are associated with different types of aggressive behaviors may help us to gain a comprehensive understanding of aggression. Previous systematic reviews have examined the associations between related constructs to ER and aggression (e.g., emotional intelligence; García-Sancho et al., 2014; emotional and social information processing; Smeijers et al., 2020), or the effects of mindfulness interventions on violence (Gillions et al., 2019). Moreover, the literature about emotion regulation and intimate partner violence was systematic reviewed (Neilson et al., 2021) and meta-analysed (Maloney et al., 2023). However, to our knowledge, no previous works have reviewed the relationships between ER strategies and aggression.

Taking this into account, we conducted a systematic review of the literature on this relationship. Our main objective was to achieve a global vision of the current state of research about the relationship between maladaptive and adaptive ER strategies and different types of aggressive behavior (e.g., direct, relational, displaced aggression) among different populations and ages. The findings of this systematic review may be useful to develop a clear picture of the state of research, to incorporate new and futures lines of investigation, and to inform the implementation of emotion regulation interventions in clinical and forensic contexts.

2. Method

2.1. Data sources and search strategy

PsycINFO and Medline databases were carefully searched in November 2021, for articles in Spanish or English with no limit on the year of publication. The same terms were used for the title, abstract, and key words in both databases, with some additional or alternative terms regarding their characteristics (mesh and thesaurus terms). In PsycINFO, "agress*"; "aggressiveness"; "relational aggression"; "behavior problem"; or "violent behavior" were used to refer to aggressive behavior. In MEDLINE, "social behavior"; "problem behavior"; or "social problems" were included. Likewise, the general terms "emotional regulation"; "emotional regulation strategies"; "maladaptive emotion regulation"; "cognitive strategies"; "emotion recognition"; "emotion awareness" "emotional disturbances"; "emotion dysregulation"; "interpersonal emotion regulation"; as well as specific terms for each strategy, such as "mindfulness"; "reappraisal"; "rumination"; "angry rumination"; "suppression"; "problem solving"; "worry"; "acceptance"; "self-focused attention"; "self-blame"; "blame others"; "acceptance"; "experiential avoidance"; or "negative repetitive thinking" were used referring to emotion regulation strategies.

2.2. Inclusion and exclusion criteria

The first inclusion criterion was empirical articles, which implied excluding all systematic, meta-analysis, and theoretical reviews. We also excluded papers referring to intervention and programs. There was no exclusion criterion related to participant age. Included articles must evaluate a concrete emotion regulation strategy with valid instruments, which ruled out those that studied processes like emotional clarity or emotional perception, and general dysregulation. The evaluation of the aggression had to be based on the definition given by Anderson and Bushman (2002), that presupposes the proximate (immediate) intention to cause harm to another individual. We included articles that examined any specific types of aggression (e.g., verbal, physical, indirect sexual, displaced, reactive, proactive, or aggression) and articles assessing aggression in a general way (e.g., total aggression scores). However, papers focused on related variables, but not aggression, such as Machiavellianism (Christie & Geis, 1970) or hostility were excluded.

2.3. Literature searches

Database searches identified 1751 relevant studies: 760 in PsycINFO and 991 in MEDLINE. After removing 148 duplicates, 1603 potentially eligible articles remained. Two reviewers independently screened the articles by title and abstract information against the criteria mentioned. A third researcher was consulted to clarify the conflicts of eligibility. Most of the studies were excluded because they did not meet the criteria of evaluating aggression or specific emotion regulation strategies. There were a few studies that evaluated emotion regulation strategies in babies, but they were discarded because the strategies assessed were very distant from the ones included in the rest of the studies (Bozicevic et al., 2016; Calkins & Dedmon, 2000; Dollar & Stifter, 2012). Studies about experiential avoidance were excluded because the term were more linked to stress coping skills or psychosocial distress, which might be remotely related to emotion regulation but it doesn't focused on emotions per se. Moreover, some articles that explore the relationship between experiential avoidance and problematic behavior included other kind of behaviors apart from aggression, such as substance abuse, self-injury and binge eating. Regarding the term "acceptance", the search also yielded different topics that were not about emotion regulation strategies, such as peer acceptance or rejection among children and the influence on their behavior. This process left 107 possible candidates (see Fig. 1). After reading the full text, 78 articles were finally chosen.

3. Results

Some articles included more than one study, so there was a total of 104 studies, 62 cross-sectional, 29 experimental, and 13 longitudinal studies. Most of them were conducted with adult samples (mainly undergraduate students), 16 studies assessed the topic in adolescent

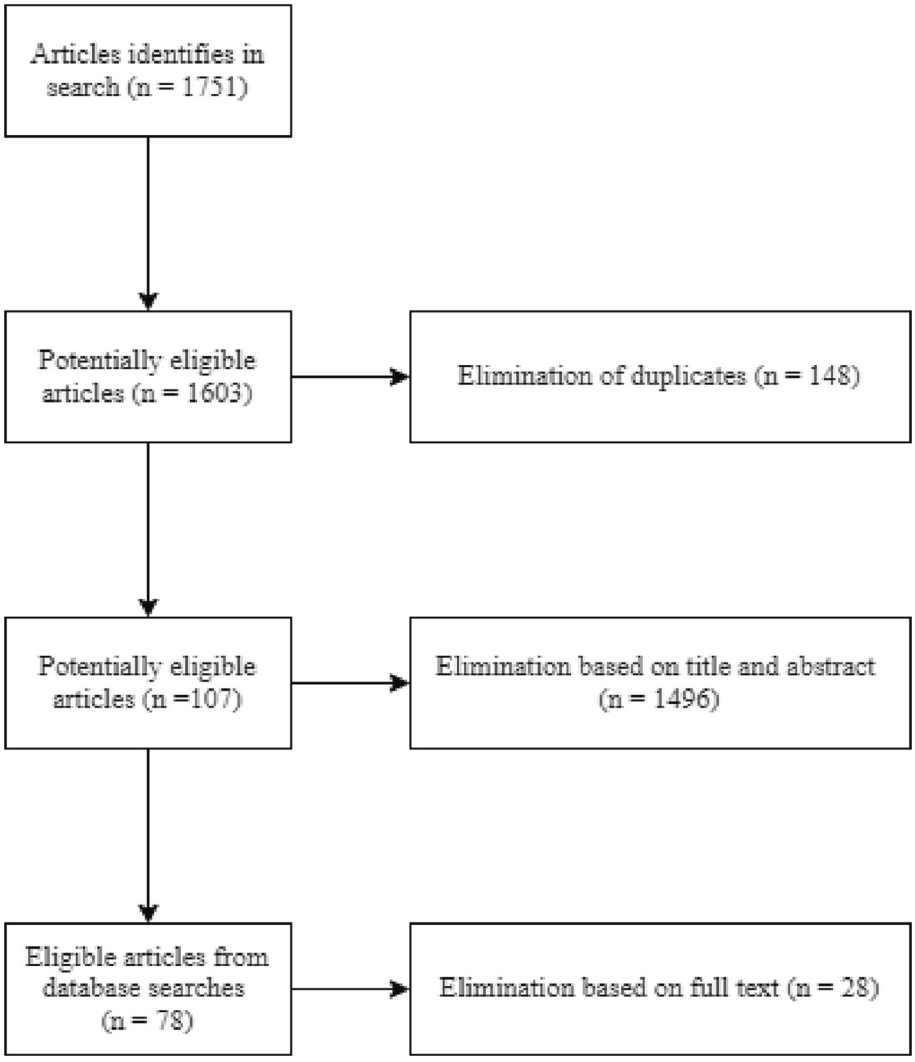


Fig. 1. Flowchart of articles selection.

populations, and three studies in a population of children.

Studies included in the research used a variety of scales and questionnaires to evaluate different types of aggression: overt aggression (physical and verbal), indirect or relational aggression, proactive (PA) and reactive aggression (RA), and triggered displaced aggression (TDA). More specific types of aggression were also evaluated, such as alcohol-related aggression, sexual dating violence, intimate partner aggression (IPA), anger expression in a sample of cyclists, or aggressive driving. Of these, the most used scale was the Buss and Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992) to evaluate physical and verbal aggression. Within experimental paradigms, physical aggression was evaluated mostly through the Taylor Competitive Task (Chester & Lasko, 2019; Taylor, 1967), using shocks or noises to attack the opponent; other paradigms such as the hot sauce paradigm, cold water, or voodoo task were also employed. To evaluate displaced or relational aggression, they utilized experimental tasks such as assessing the suitability of an assistant for a job position, the Tangram puzzle task, or prison sentencing.

Regarding ER, the two most investigated strategies were rumination (57 studies) and mindfulness (28 studies). Rumination was assessed as a trait or as a state. As a trait, the scale most used was the Anger Rumination Scale (ARS; Sukhodolsky et al., 2001), but other scales were also applied, like the Angry Rumination subscale of the Displaced Aggression Questionnaire (Denson et al., 2006), the Hostile Rumination Scale (HRS; Caprara, 1986) in adults populations, and the Children's Anger Rumination Scale (CARS; Smith et al., 2016) for children. General rumination was also measured with the subscale from the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001), Rumination and Reflection Questionnaire (Trapnell & Campbell, 1999), or the Intrusive Thoughts Scale (Thau & Mitchell, 2010). As a state, rumination was assessed using experimental manipulations such as writing an essay on the thoughts and feelings after a provocation, as well as thinking for a period of time about a provocative encounter; also using questionnaires such as the Thoughts About Opponent Questionnaire (TAO; Giancola & Corman, 2007).

Mindfulness was assessed from two perspectives: unidimensional, mostly by using The Mindfulness Attention and Awareness Scale (MAAS; Brown & Ryan, 2003; Brown et al., 2011) or Toronto Mindfulness Scale (TMS; Lau et al., 2006); or attending to different facets, using The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006). Some studies assessed mindfulness as state using experimental inductions like "the raisin-eating task" (Kabat-Zinn, 1990), focusing on sentences related to awareness or acceptance, or audios like the "Mindfulness of body and breath" (Williams & Penman, 2011).

Besides rumination and mindfulness, 19 studies focused on other strategies, such as reappraisal and suppression, worry, temporal distancing, or mood induction for emotion counterbalancing.

The results of the studies will be presented in six sections: the relationships between aggression and rumination in experimental studies (Table 1) and cross-sectional and longitudinal studies (Table 2),

Table 1
Experimental studies on the relationship between rumination and aggression types.

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Collins and Bell (1997)	40 male students	Experimental: 2 (provocation, no provocation) × 2 (high dissipators-low ruminators, low dissipators-high ruminators)	Dissipation-rumination scale, (Caprara, 1986).	Physical -Human irritable aggression paradigm (Buss, 1961)	High ruminators were more aggressive than lower when provoked and displayed lower aggression when not provoked. No differences for low rumination level between provoked and unprovoked.
Bushman et al. (2005) Study 1	42 undergraduate students (29 women and 13 men).	Experimental: 3 (rumination, distraction, and positive mood) × 2 (trigger/no trigger)	Essay 25′ about themselves and how are they treated by others	Displaced aggression (TDA): evaluate the competence of the research assistant of the trigger for a job.	Rumination influenced aggression score after a trigger event vs no trigger When triggered, ruminative group was more aggressive than distraction and positive mood groups. Provocation-induced negative affect related to aggression for the ruminative group.
Study 2	347 undergraduate students (186 men and 161 women)	Experimental: 2 (rumination/distraction) × 2 (provocation/no) × 2 (triggered/no)	Essay 20′	Displaced aggression: hot sauce paradigm.	When provoked, those in the rumination condition were more aggressive than distraction after a trigger. No differences in aggression when no trigger. Negative affect mediated the relationship between rumination and TDA.
Study 3	85 participants (55 women and 30 men)	Experimental: 2 (rumination/no) × 2 (trigger/no)	3′ thought list task related to their essay and feedback during the period between sessions (8 h)	Displaced aggression: first trial reaction in Taylor Paradigm.	In the presence of a trigger, rumination group was more aggressive than no rumination. No relation in the absence of a trigger.
Verona (2005)	50 students (26 women, 24 men) Age: $M = 20$, $SD = 2.9$	Experimental: 2 contexts (distraction: stress-focused (SF) vs no distraction: confederate-focused (CF))	Rumination (RRQ)	Physical aggression (shock duration and intensity in the experimental paradigm)	Rumination predicted higher aggression when no stressful distraction. No relationship for the stressful distraction group. For women, rumination was related to aggression only in no stress context. For men, the relation was shown across both contexts, particularly when no stress context.
Vasquez et al. (2007)	60 undergraduate students (44 women and 16 men)	Experimental 2 (rumination, no) × 2 (trigger, no).	Essay about details, thoughts and feelings about a robbery clip, 20′.	Displaced aggression: decision about prison sentencing.	For the leader, the group that ruminated and had a trigger showed the highest prison sentence. The group that did not ruminate but had a trigger was more aggressive than the one that ruminated but did not have a trigger. However, there were no difference between the no rumination groups despite having a trigger or not.
Denson et al. (2009)	100 participants (53 women, 47 men) Age: $M = 20.37$, $SD = 2.65$	Experimental: 2 (alcohol/placebo condition) × 2 (rumination, distraction)	Rumination: Essay 20′ about their experience in the current study	Physical triggered displaced aggression with the hot sauce paradigm. Displaced Aggression (DAQ)	Ruminative group was more aggressive than no distraction. No interaction between DAQ and rumination. Psychopathic personality predicted triggered displaced aggression for the rumination group. DAQ predicted aggression under alcohol effects. No differences in inhibitory control for any variable and it was not related to triggered displaced aggression.
Borders and Giancola (2011)	516 healthy social drinkers (49 % men) Age: $M = 23.05$, $SD = 2.91$	Experimental: alcohol/placebo conditions.	Trait-rumination (DRS) State-rumination: Thoughts About Opponent (TAO)	Physical aggression (TAP)	Both types of rumination were related to aggression. There was an interaction between rumination and alcohol: drunk people with higher trait-rumination and state-rumination were more aggressive.

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Table 1 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Denson et al. (2011) Study 2	187 undergraduate students (equally distributed by gender) Age: $M = 19.02$, $SD = 1.5$	Experimental: 2 (provocation/no) × 2 (rumination/distraction)	Rumination: essay about their thoughts and feelings participating in the experiment, 20	Indirect aggression: evaluation of the experimenter to be hired for a job.	Rumination was related to relational aggression. The group that was provoked and ruminated showed higher aggression levels vs distraction. No differences in unprovoked. Self-control mediated the relation between rumination and aggression when provoked. In fact, those who were provoked and had to ruminate had the lowest self-control.
Study 3	93 participants (68 % women) Age: $M = 20.34$, $SD = 5.42$	Experimental	Trait angry rumination (DAQ) State Rumination: how much they thought about the provocation during aggression measurement	Indirect aggression: evaluation of the experimenter to be hired for a job.	Trait rumination correlated with aggression, as well as with state rumination and angry affect. State rumination also correlated with aggression, as well as angry affect. State rumination was a stronger predictor of aggression than trait rumination. State-rumination (not angry affect) mediated the effect of trait-rumination on aggression.
Pedersen et al. (2011) Study 3	100 undergraduate students (69 women, 31 men)	Experimental: 3 (provocation rumination/ self-rumination/distract) × 2 (trigger/no)	Provocation rumination: essay 20′ about the provocation Self-rumination: short questions about themselves and how they are treated by others	Physical displaced aggression: cold water distraction paradigm.	Rumination only had an effect when combined with trigger. Both ruminations differed from distraction, but not between them. Angry affect caused by the trigger mediated the relation between provocation-rumination and triggered displaced aggression. Angry affect and self-critical affect mediated the effect of self-rumination and triggered displaced aggression.
Vasquez et al. (2013) Study 1	342 students (171 women, 171 men)	Experimental: 2 (public provocation/no) × 2 (self-rumi/distraction) × 2 (trigger/no)	Rumination: essay 20′ about who they are and how they are treated by others	Displaced aggression: hot sauce paradigm	After a publicly provocation, the rumination group showed higher TDA after a trigger vs distraction, and no differences when no trigger.
Study 2	77 students (66 women, 11 men)	Experimental: 3 (public/private/no provocation) × 2 (rumi/ distraction) and trigger for all	Rumination: essay about their experience in the current study	Displaced aggression: cold-water paradigm.	The rumination group was more aggressive than distraction group in both provocative situations, although the effect was higher for the public provocation. No effect of rumination on aggression when no provocation. The rumination had an effect on the differences in negative affect when public or private provocations.
Study 3	172 students (135 women, 36 men)	Experimental: 2 (severe/moderated provocation) × 2 (rumination/distraction) × 2 (trigger/no)	Self-rumination: essay 20′ about who they were and how they were treated by others	Displaced aggression: hot sauce paradigm	After a trigger, the ruminative group that suffered a severe provocation displayed higher TDA.
Study 4	80 participants (59 women, 21 men)	Experimental: 2 (severe/moderated provocation) × 2 (rumination/distraction) × 2 (trigger/no)	Self-rumination: essay about themselves	Displaced aggression: recommendation of the assistant of the trigger for a job	Replication of the interaction between trigger, severe provocation, and rumination on displaced aggression. Negative affect to the trigger mediated the effect of provocation intensity on aggression, after controlling for rumination and its interaction with the intensity of the provocation.
Watkins et al. (2015)[a]	137 couples (68 women and 69 men)	Experimental: 2 (alcohol/placebo) × 3	Trait Angry Rumination (ARS) Experimental Rumination:	Intimate Partner Aggression (IPA), physical aggression (TAP)	When unprovoked, there was a main effect for rumination and an interaction: reappraisal was associated with less IPA for those in the alcohol-rumination

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Table 1 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
	Age: $M = 23.4$, $SD = 2.5$	(rumination, reappraisal/ no instruction)	think 2′ about an angry event with their partner and repeat in their mind.	First response: IPA without provocation. Second response: IPA when provoked.	group. Those lower in reappraisal in the alcohol-rumination group had the highest IPA. When there was a provocation, high trait rumination predicted IPA in the alcohol-rumination group and placebo-no instruction group.

Abbreviations: Aggression-ES, *The Aggression Experience Sampler Scale*, (Borah et al., 2021); ARS, *Anger Rumination Scale* (Sukhodolsky et al., 2001); AS, *Aggression Scale* (Isobe & Hishinuma, 2007); AQ, *The Aggression Questionnaire* (Buss & Perry, 1992); CARS, *Children's Anger rumination Scale*, (Sukhodolsky et al., 2001); CERQ, *The Cognitive Emotion Regulation Questionnaire* (Garnefski et al., 2002); CRQ, *Co-Rumination Questionnaire* (Rose, 2002); CRSS, *Children's Response Styles Scale* (Ziegert & Kistner, 2002); CRSQ, *The Children's Response Styles Questionnaire* (Abela et al., 2002); CSBS, *Child Social Behavior Scale—Teacher Report* (Crick, 1996); CTS2, *The Revised Conflicts Tactics Scale* (Straus et al., 1996); DAQ, *Displaced Aggression Questionnaire* (Denson et al., 2006); DDDI, *Dula's Dangerous Driving Index* (Dula & Ballard, 2003); DRS, *Dissipation-rumination Scale* (Caprara, 1986); ECIPQ, *European Cyberbullying Intervention Project Questionnaire* (Del Rey et al., 2015); EAS, *Explicit Aggression Scale* (Barnwell et al., 2006); HRS, *Hostile Rumination Scale* (Caprara, 1986); IAS, *Indirect Aggression Scale* (Forrest et al., 2005); ITS: *Intrusive thoughts scale* (Thau & Mitchell, 2010); OAB, *Online Aggressive Behavior Scale* (Zhao & Gao, 2012); PVAS, *Physical and Verbal Aggression Scale* (Caprara & Pastorelli, 1993); RPEQ, *Peer Experiences Questionnaire* (Prinstein et al., 2001); RAS, *The Relational Aggression Scale* (Voulgaridou & Kokkinos, 2018); RRQ, *Rumination-Reflection Questionnaire* (Trapnell & Campbell, 1999); RRS, *Rumination Scale of the Response Style Questionnaire* (Nolen-Hoeksema & Jackson, 2001); RTSQ, *The Ruminative Thought Style Questionnaire* (Brinker & Dozois, 2009); ROSS, *Rumination on Sadness scale* (Conway et al., 2000); RPQ, *The Reactive-Proactive Aggression Questionnaire* (Raine et al., 2006); SARI, *Sadness and Anger Rumination Inventory* (Peled & Moretti, 2007); SCORE, *Survey for Coping with Rejection Experiences* (Sandstrom, 2004); SDDS, *Supervisor-directed deviance scale* (Mitchell & Ambrose, 2007); SRASBM, *The self-report of aggression and social behavior measure* (Morales & Crick, 1998); STAXI, *Trait Anger Expression Inventory* (Spielberger, 2010); TAO, *Thoughts About Opponent Questionnaire* (Giancola, 2007); TAP, *Taylor Aggression Paradigm* (Taylor, 1967); TEAS, *The Explicit Aggression Scale* (Borders et al., 2007); TIMFA, *The integrated measurement framework of aggression* (Little et al., 2003); TRF, *Teachers Report Form* (Achenbach et al., 2002); TVSSI, *The Violence Scale and Severity Index* (Valdez-Santiago et al., 2006); YSR, *Youth Self-Report Form* (Achenbach et al., 2002); VAS, *self-report: three items of the Attitude Towards Violence Scale* (Caprara et al., 1990).

[a] Studies that measure two emotion regulation strategies that reappear in Tables 2, 3, 4 and Supplementary Tables 1 and 2.

mindfulness in experimental (Table 3) and cross-sectional and longitudinal studies (Table 4) and other strategies (Supplementary Tables 1 and 2). Five studies are placed repeatedly in several tables (e.g. Watkins et al., 2015) because they included the analysis of two different strategies. The tables describe the size and characteristics of the sample, the design type, the scales used to measure the ER strategies and aggression, and the main findings.

3.1. Relationships between rumination and aggression

Fifty-seven studies evaluated the relationship between rumination and aggression; 33 had a cross-sectional design, 16 experimental, and eight longitudinal; 43 were examined on adult samples, 11 on adolescents, and three on children (see Tables 1 and 2).

All the cross-sectional studies found a significant correlation between anger rumination and different aggression measures, except four studies (Casini et al., 2021; Liang et al., 2018; Mathieson et al., 2014; Pollack et al., 2021). Angry rumination was positively correlated to direct (physical and verbal) and indirect aggression in adult populations (e.g., García-Sancho et al., 2016; Study 2, Quan et al., 2019), adolescents (e.g., Kokkinos et al., 2021; Vasquez et al., 2012), and in children (Harmon et al., 2019; Smith et al., 2016), even after an exclusion experience (Goodman & Southam-Gerow, 2010), or imagining a humiliating scenario (Coleman et al., 2009). This result was also found in some specific populations, such as people with post-traumatic stress symptoms after COVID-19 (Celik et al., 2021), people with characteristics from the autism spectrum disorder (Pugliese et al., 2015), a clinical sample of adolescents (Peled & Moretti, 2007), incarcerated adolescents in a maximum security residence (Study 2, Smith et al., 2016), and multi-ethnic population (Borders & Liang, 2011); and with specific types of aggression, such as intimate partner aggression (IPA) (Hayes et al., 2021; Massa et al., 2019; Orozco-Vargas et al., 2021; Watkins et al., 2015), aggression in sports (Maxwell, 2004), or cyberaggression (Camacho et al., 2021).

The magnitude of the relationship between rumination and aggression was found to vary depending on the type of rumination. For example, anger ruminations (using ARS) had moderated correlations with physical and verbal aggression (Anestis et al., 2009), whereas general rumination (e.g., RRQ or CERQ) was weakly (Borders et al., 2007; Borders et al., 2010) or not associated with some aggression measures (e.g., Anestis et al., 2009; Pollack et al., 2021), and depressive rumination (e.g., RSQ) was not significantly associated with relational aggression (Mathieson et al., 2014). Finally, co-rumination (rumination or excessive discussion of problems with a close relationship; Rose, 2002) was weakly associated with aggressive behavior (Tompkins et al., 2011).

The results from experimental studies were consistent with what was found in cross-sectional ones: rumination was positively associated with higher levels of aggressive behavior. This relationship is present among different types of experimental paradigms like physical aggression, relational aggression, or triggered displaced aggression. The main relevant results were that individuals who reported higher levels of rumination showed higher physical aggression after a provocation (e.g., Bushman et al., 2005; Collins & Bell, 1997; Denson et al., 2011; Vasquez et al., 2013) and displaced aggression after a trigger (e.g., Pedersen et al., 2011; Vasquez et al., 2007), even 8 h after the provocative event (Bushman et al., 2005). The association between rumination and aggression was not significant when there was a distraction, even a stressful one (Verona, 2005) consisting of a blast of compressed air administered to the throat.

The eight longitudinal studies supported the aforementioned results, and all of them found rumination predicted different types of aggression in the long term (with follow-up periods from 35 days to 2 years) (Camacho et al., 2021; Caprara et al., 2007; Caprara et al., 2014; Li et al., 2021; McLaughlin et al., 2014; Wang et al., 2020).

Some experimental studies also found an interaction with alcohol-use in predicting physical aggression (Borders & Giancola, 2011), IPA (Watkins et al., 2015), and relational aggression (Denson et al., 2011). Denson et al. (2011) found that self-control mediated the relationship between provocation, rumination, and relational aggression, but Denson et al. (2009) found no differences in inhibitory control between alcohol/placebo or rumination groups, and it was not related to TDA. Related to this, Hasegawa et al. (2021) found that rumination has a stronger correlation with response inhibition than with attentional inhibition. Rumination was also found to mediate the relationship between different variables, such as metacognitive beliefs (Salguero et al., 2020),

Table 2
Cross-sectional and longitudinal studies on the relationship between rumination and aggression types.

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Maxwell (2004)	305 competitive athletes (151 female) Age: *M* = 21.54, *SD* = 2.71	Cross-sectional	Anger Rumination (ARS)	Aggressive acts in sports (scale created by the author)	Anger rumination positively predicted aggressive behavior. Provocation accounted for the greatest proportion of unique variance.
Borders et al. (2007)	285 participants (28 % male) Age: *M* = 19.81, *SD* = 2.69	Cross-sectional	Rumination (RRQ)	Alcohol-related aggression and hostility: (EAS) Dispositional aggression (AQ)	Rumination was positively associated with dispositional aggression, alcohol-related hostility, and aggression. After controlling for dispositional aggression, rumination did not predict alcohol-related aggression, only alcohol-related hostility. However, those who usually ruminated and drank heavily were more likely to report aggressive behavior.
Peled and Moretti (2007)	121 adolescents from clinical population (65 women, 56 men) Age: *M* = 15.18, *SD* = 1.43 59 % behavior problem, 42 % for marijuana dependence, 36 % for alcohol dependence, 24 % for major depressive disorder, and 15 % for generalized anxiety disorder.	Cross-sectional	Sadness Rumination (ROSS) Anger rumination (ARS) Rumination (DRS)	Overt aggression (physical and verbal) and relational aggression (TIMFA)	Anger rumination predicted overt and relational aggression. Sadness rumination was negatively related to overt aggression. Anger and anger rumination were independent predictors of relational and overt aggression. Both ruminations correlated, although it was higher for girls.
Anestis et al. (2009)	200 undergraduate students (68.5 % women, 31.5 % men) Age: *M* = 18.32, *SD* = 1.09	Cross-sectional	Anger rumination (ARS) Subscale of rumination (CERQ)	Physical and verbal aggression (AQ)	Anger rumination was related to physical and verbal aggression. It also predicted both types of aggression. General rumination was not correlated with physical or verbal aggression. However, after controlling for anger rumination, it predicted physical aggression. Other covariables (i.e., negative urgency, sex) predicted physical and verbal aggression.
Coleman et al. (2009)	96 male participants Age: *M* = 32.4, *SD* = 10.6	Cross-sectional with time-lapse (1 week)	Rumination (DRS)	Aggressive intentions (Likert scale) after imagining a humiliating scenario.	Rumination was positively related to the intention to aggress after imagining a humiliating scenario and after recalling it one week later. Rumination fully mediated the relationship between the perception of privilege to aggress and delayed aggression intentions.
Borders et al. (2010) Study 1[a]	464 students (66.6 % women) Age: *M* = 19.7	Cross-sectional	Rumination (RRQ)	Physical and verbal aggression (AQ)	Rumination positively correlated with both aggression types. Rumination only mediated the relationship between mindfulness, anger, and hostility, but no mediation found for physical and verbal aggression.
Study 2[a]	211 participants with greater exposure to and knowledge about mindfulness (60 % women) Age: *M* = 31.8, *SD* = 11.8	Cross-sectional	Rumination (RRQ)	Physical and verbal aggression (AQ)	Rumination was only positively related to verbal aggression. Rumination fully mediated the relationship between mindfulness and verbal aggression (as well as hostility and anger). It didn't predict nor mediate physical aggression.

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Table 2 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Goodman and Southam-Gerow (2010)	79 children (31 % boys) Age: $M = 9.5$, $SD = 1.9$	Cross-sectional	Ruminative coping and positive reappraisal coping (SCORE)	Aggressive coping (SCORE)	Rumination showed a positive association with aggressive coping in both peer-rejection scenarios. The correlation was stronger in the context of being excluded from a group activity.
Borders and Liang (2011)	304 participants (77.6 % female, 21.1 % male, and 0.3 % trans) 170 ethnic minority 134 white people. Age: $M = 20$	Cross-sectional	Anger Rumination (ARS)	Physical and verbal aggression (AQ)	Rumination was associated with aggressive behaviors in all participants. For minorities, rumination fully mediated the effect of perceived ethnic discrimination on verbal aggression, anger, and hostility but partially on physical aggression.
Tompkins et al. (2011)	146 teenagers (69 % girls) Age: $M = 16.84$, $SD = 1.09$	Cross-sectional	Co-Rumination (CRQ)	Aggressive behavior (YSR) Teacher Report Form (TRF)	Co-rumination was positively associated with self-reported aggressive behavior, but not with teachers' report. No gender differences in externalizing behaviors.
Vasquez et al. (2012)	310 teenagers belonging or affiliated to a gang (185 boys, 125 girls) Age: 13–16.	Cross-sectional	Anger rumination (ARS)	Triggered Displaced Aggression (DAQ) Physical aggression: (AQ)	Rumination was related to physical aggression and TDA. Differences between genders in the effect of rumination and affiliation on triggered displaced aggression (stronger in boys with high rumination and affiliation levels). Rumination partially mediated the relationship between affiliation and triggered displaced aggression. Affiliation, physical trait aggression, and rumination were predictors of triggered displaced aggression after controlling for other factors, with rumination explaining 10 % of variance.
Mathieson et al. (2014)	499 teenagers (51 % women) Age: $M = 13.4$	Cross-sectional	Sadness Rumination (RRS)	Relational aggression (CSBS)	Rumination was not associated with relational aggression. Rumination moderated the association between relational aggression and depressive symptoms: for those with low rumination, relational aggression was negatively associated with depressive symptoms. When high rumination, there was a positive relationship.
Peters et al. (2015)[a]	823 participants (70.6 % women) Age: $M = 19.25$, $SD = 2.51$	Cross-sectional	Angry Rumination (ARS)	Physical and verbal aggression (AQ)	Rumination was related to both types of aggression, and it mediated their relationship with the three components of mindfulness (no judge, no react and act with awareness). Rumination explained part of the relationships of no judge and aggression types.
Pugliese et al. (2015)	948 students with some characteristics associated with the autism spectrum disorder (ASD) (73 % women)	Cross-sectional	Angry Rumination (ARS)	Physical and verbal aggression (AQ)	Rumination was positively correlated with physical and verbal aggression. Rumination mediated the relation between social anxiety and aggression measures. ASD characteristic moderated the relation between rumination and physical aggression. Also, an item related to repetitive thinking moderated the relation with verbal aggression.

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Table 2 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
García-Sancho et al. (2016)	243 participants (52 men and 191 women) Age: *M* = 21.78, *SD* = 4.38	Cross-sectional	Angry rumination (DAQ)	Physical and verbal aggression (AQ) Indirect aggression (IAS)	Angry rumination was positively related to the three types of aggression. No gender differences in the correlations. Rumination mediated the relation between ability emotional intelligence and aggression types.
Smith et al. (2016) Study 1	254 children (50.4 % girls) Age: *M* = 10.62, *SD* = 1.78	Cross-sectional	Angry rumination (CARS)	Direct and relational aggression: peer sociometric measure and teachers' evaluations (CSBS)	Rumination was found to be correlated to both types of aggression across ages and gender in a population of children, rated by peers and teachers. Rumination also predicted the aggression data rated from teachers and peers, after controlling for sex, age, and family income.
Study 2	119 male teenagers incarcerated in a maximum security residential facility for juvenile offenders Age: *M* = 16.74, *SD* = 0.98	Cross-sectional	Angry rumination (CARS)	Aggressive behaviors: the number of behavioral write-ups for rule violations while incarcerated during 5 months.	Angry rumination was positively associated with the first aggression measure, but not with the aggressive behavior during the next 4 months. Angry rumination and trait anger predicted the initial levels of aggression The hypothesis that high angry rumination coupled with high trait anger would be associated with the greatest increases in aggression over time was not supported, the aggressive behavior was elevated and stable during time.
Suhr (2016)	262 participants (27 % men) Age: *M* = 22.19, *SD* = 6.92	Cross-sectional	Angry Rumination (ARS)	Aggressive driving (DDDI)	Angry rumination positively correlated with aggressive driving. Trait driving anger had a partial indirect effect on aggressive driving through anger rumination.
Fresnics and Borders (2017)[a]	201 participants (78 % women, 21 % men, 1 % transgender) Age: *M* = 19.48, *SD* = 1.47	Cross-sectional	Angry Rumination (ARS)	Aggression (TEAS)	Angry rumination was positively associated with aggression. It also mediated the association between self-compassion and less anger and aggression, controlling for mindfulness. It did not mediate the association between mindfulness and aggression after controlling for self-compassion.
Liang et al. (2018) Study 3[a]	204 participants (49 % men) Age: *M* = 37, *SD* = 9.15	Cross-sectional	Rumination (ITS)	Relational aggression (SDDS)	The interaction between hostility towards the supervisor and rumination level had no effect on relation aggression. Mindfulness awareness was negatively associated with rumination. Rumination didn't mediate the relationship between mindfulness and relational aggression.

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Study	Sample	Design	ERS scale	Aggression type	Summary of results
Harmon et al. (2019)	254 children (50.4 % girls) Age: $M = 10.61$, $SD = 1.78$	Cross-sectional	Angry rumination (CARS) Sadness Rumination (CRSS)	Overt, relational, and total aggression: peer-nomination procedure	Angry rumination was positively associated with aggressive and depressive symptoms, whereas sadness rumination was only positively associated with depressive symptoms. Angry rumination positively predicted aggressive and depressive symptoms even after controlling for sadness rumination. Sadness rumination was only associated with depressive symptoms, and negatively predicted aggression only after the addition of anger rumination. The interaction between both ruminations negatively predicted aggression.
Massa et al. (2019)	271 participants (36.6 % women) Age: $M = 33.5$, $SD = 10.73$	Cross-sectional	Rumination (RRQ)	Intimate Partner Aggression (CTS2)	Rumination was positively associated with intimate partner aggression perpetration. High levels of trait rumination moderated the indirect effect of negative cognitions on aggression through anger/hostility.
Quan et al. (2019) Study 2	437 participants (70.7 % women) Age: $M = 20.79$, $SD = 1.07$	Cross-sectional	Angry Rumination (ARS)	Physical and verbal aggression (AQ)	Angry rumination was positively associated with aggression. It also mediated the relationship between hostile attribution and aggressive behavior.
Salguero et al. (2020)	947 participants 314 Australian (80.6 % women) Age: $M = 35.49$, $SD = 13.32$ 633 Spanish (56.9 % women) Age: $M = 36.62$, $SD = 13.36$	Cross-sectional	Angry Rumination (ARS)	Displaced aggression (DAQ)	There was a positive correlation between angry rumination and displaced aggression (stronger for Spanish population). Metacognitive beliefs were also correlated with rumination for both populations. Rumination mediated the relation between metacognition beliefs and DA tendency.
Celik et al. (2021)	714 participants with post-traumatic stress symptoms after COVID-19 (176 men, 533 women) Age: $M = 25.16$, $SD = 9.34$)	Cross-sectional	Rumination (RTSQ)	Aggression: (Aggression-ES)	Rumination positively correlated with aggression. A serial mediating effect was also found: rumination and post-traumatic stress symptoms mediated the relationship between intolerance to uncertainty and aggression.
Kokkinos et al. (2021)	1020 adolescents (504 women) Age: $M = 12.7$, $SD = 1.3$	Cross-sectional	Angry Rumination (SARI)	Relational Aggression: direct, indirect, proactive, and reactive (RAS)	Angry rumination was positively correlated with all types of relational aggression. It also mediated the relationship between anger and all forms of relational aggression.
Casini et al. (2021)	445 participants (327 women, 118 men) Age: $M = 23.29$, $SD = 3.38$	Cross-sectional	Rumination (CERQ)	Aggression (BTQ)	Rumination didn't correlate with aggressive behavior. Rumination was associated with withdrawal and partially mediated the relationship between anxiety about rejection and withdrawal.

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Study	Sample	Design	ERS scale	Aggression type	Summary of results
Hasegawa et al. (2021)[a]	230 participants (81 men, 132 women) Age: $M = 19.76$, $SD = 1.44$	Cross-sectional	Sadness Rumination (RRS)	Physical and verbal Aggression (AS)	There was a positive association between ruminative responses and aggressive behavior. Response inhibition was more strongly correlated with rumination than attentional inhibition. Response inhibition impairments were positively related to aggressive behavior.
Hayes et al. (2021)	147 participants (110 women) Age: $M = 18.86$, $SD = 1.17$	Cross-sectional	Sadness Rumination (RRS)	Physical and relational aggression in peer and dating relationships (SRASBM)	Rumination was only associated with relational aggression in dating relationships for women.
Orozco-Vargas et al. (2021)[a]	838 participants, (385 men and 435 women) Age: $M = 32.57$, $SD = 8.49$	Cross-sectional and predictive design	Rumination (CERQ)	Intimate partner violence (TVSSI) Family of origin violence (CTS2)	For both women and men, intimate partner violence was positively associated with rumination. Family of origin violence was positively related to rumination only for women. Maladaptive emotion regulation strategies like rumination mediated the correlation between the family of origin violence and intimate partner violence.
Pollack et al. (2021)	202 participants Age: $M = 19.48$, $SD = 1.42$	Cross-sectional	Rumination (RRQ)	Alcohol-related aggression (EAS)	Rumination was not associated with alcohol-related aggression.
Zheng et al. (2021)	595 participants (387 women) Age: $M = 19.59$, $SD = 1.4$	Cross-sectional	Angry Rumination (ARS)	Online Aggressive Behavior (OAB)	Angry rumination was positively associated with OAB. It also mediated the relationship between online violent video games usage and OAB. This mediating effect was moderated by levels of self-control: for those with low levels, anger rumination was associated with OAB.
Caprara et al. (2007)	500 pre-adolescents (249 men, 251 women) Age: Time 1: $M = 12.5$ Time 2: $M = 14.5$ Time 3: $M = 16.5$ Time:4: $M = 18.5$ Time 5: $M = 20.5$	Longitudinal: 5 times, every 2 years	Hostile Rumination (HRS)	Physical and Verbal Aggression Scale (PVAS; VAS)	High hostile rumination was associated with physical and verbal aggression for pre-adolescents for men and women. It also correlated with violence in teenagers. Four hostile rumination trajectories and profiles were found and predicted different outcomes: - High hostile rumination trajectory only predicted violence. - Medium declining hostile rumination trajectory was negatively linked with verbal aggression and violence. - Low hostile rumination trajectory was negatively linked with verbal aggression and violence. - Increasing hostile rumination trajectory predicted all three measures (physical, verbal, and violence)
Caprara et al. (2014)	341 teenagers (52 % women) Age: $M = 17$, $SD = 0.81$	Longitudinal (4 times, 2 years interval) Peer-rating: closed-friends also complete the questionnaires	Hostile Rumination (HRS)	Aggression (VAS)	Hostile rumination and moral disengagement mediated the relationship between irritability and aggressive behavior. Specifically, moral disengagement mediated the relation between hostile rumination and aggression. Those who had high rumination levels and disengaged from the morality of the act showed higher aggressive behavior.

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Study	Sample	Design	ERS scale	Aggression type	Summary of results
McLaughlin et al. (2014)	1065 teenagers (51.2 % boys) Age: $M = 12.2$, $SD = 1$	Longitudinal (four months interval between time 1 and 2; 3 months interval between time 2 and 3)	Rumination (CRQS)	Aggression, Peer Experiences Questionnaire (RPEQ)	Rumination was positively associated with aggressive behavior across time. Rumination mediated the relationship between aggressive behavior and anxiety symptoms for boys. It also mediated the association between depressive and anxiety symptoms and aggressive behavior for boys.
Eisenlohr-Moul et al. (2016)[a]	86 students, 43 heterosexual couples unmarried. Age: $M = 19.66$, $SD = 2.82$	Longitudinal: daily measures for 35 days.	Trait angry rumination (DAQ) Daily rumination: 3 items from same scale	Daily measures: Tendency to aggress, 2 items from physical and verbal aggression (AQ) Aggressive behavior: Voodoo doll task Anger expression (STAXI)	State anger rumination positively predicted all aggression measures: anger expression, voodoo, physical and verbal aggression. The relationships of acting with awareness and no judging components with aggression were mediated by rumination and anger intensity. No judging mediating effects were only significant for women.
Wang et al. (2020) Study 1	600 participants (46 % men) Age: $M = 20.13$, $SD = 1.03$	Longitudinal study: 2 measures between 6 months.	Angry Rumination (ARS)	Reactive and proactive aggression: (RPQ)	Rumination correlated with all measures of aggression, in both times. Rumination predicted reactive aggression, but not proactive aggression.
Study 2	437 participants (130 men, 307 women) Age: $M = 20.05$, $SD = 1.12$	Longitudinal Moderated role of considering future consequences (the CFC Scale (CFCS; Strathman et al., 1994): Future ones (CFC-F) or Immediate ones (CFC-I)).	Angry Rumination (ARS)	Reactive and proactive aggression: (RPQ)	Rumination correlated with proactive aggression and reactive aggression. Rumination also predicted both types of aggression. CFC-F predicted RA and PA. CFC-I moderated the relation between rumination and proactive aggression: In those with medium-high CFC-I, angry rumination could predict PA over time.
Li et al. (2021)	T1: 2339 adolescents (1279 boys) T2: 2152 teenagers (1170 boys) Age: $M = 13.26$, $SD = 0.69$	Longitudinal: 1 year gap.	Sadness and Angry Rumination (SARI)	Relational Aggression (CSBS)	Both types of rumination positively correlated with relational aggression in times 1 and 2. Also, there were no gender differences in anger rumination, but girls showed higher sadness rumination levels. Both ruminations mediated the positive association between peer victimization and relational aggression after one year. There were gender differences: sadness rumination mediation was significant only for boys, whereas anger rumination mediation was significant for girls.

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Table 2 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Camacho et al. (2021)	3017 adolescents (participation: 59 % all waves, 22 % three waves, 11 % two waves, 7 % one wave) Wave 1: 2790 adolescents, (49 % girls) Age: *M* = 13.15, *SD* = 1.09 Wave 2: 2553 adolescents, (50 % girls) Age: *M* = 13.61, *SD* = 1.13 Wave 3: 2362 adolescents (51 % girls) Age: *M* = 14.03, *SD* = 1.05 Wave 4: 2361 teenagers (50 % girls) Age: *M* = 14.55, *SD* = 1.06	Longitudinal (4 measures/ waves, 6-month intervals)	Angry Rumination (ARS)	Cyberbullying and cyberaggression (ECIPQ)	Anger rumination was positive related to cyberaggression transversally. Anger rumination predicted later cybervictimization and cyberaggression. However, cyberaggression neither predicted later anger rumination nor cybervictimization. Cybervictimization mediated the association between anger rumination and cyberaggression.

Abbreviations: Aggression-ES, *The Aggression Experience Sampler Scale*, (Borah et al., 2021); ARS, *Anger Rumination Scale* (Sukhodolsky et al., 2001); AS, *Aggression Scale* (Isobe & Hishinuma, 2007); AQ, *The Aggression Questionnaire* (Buss & Perry, 1992); BTQ, *Behavioral Tendencies Questionnaire* (adapted version from Allen & Leary, 2010); CARS, *Children's Anger rumination Scale*, Sukhodolsky et al., 2001); CERQ, *The Cognitive Emotion Regulation Questionnaire* (Garnefski et al., 2002); CRQ, *Co-Rumination Questionnaire* (Rose, 2002); CRSS, *Children's Response Styles Scale* (Ziegert & Kistner, 2002); CRSQ, *The Children's Response Styles Questionnaire* (Abela et al., 2002); CSBS, *Child Social Behavior Scale—Teacher Report* (Crick, 1996); CTS2, *The Revised Conflicts Tactics Scale* (Straus et al., 1996); DAQ, *Displaced Aggression Questionnaire* (Denson et al., 2006); DDDI, *Dula's Dangerous Driving Index* (Dula & Ballard, 2003); DRS, *Dissipation-rumination Scale* (Caprara, 1986); ECIPQ, *European Cyberbullying Intervention Project Questionnaire* (Del Rey et al., 2015); EAS, *Explicit Aggression Scale* (Barnwell et al., 2006); HRS, *Hostile Rumination Scale* (Caprara, 1986); IAS, *Indirect Aggression Scale* (Forrest et al., 2005); ITS: *Intrusive thoughts scale* (Thau & Mitchell, 2010); OAB, *Online Aggressive Behavior Scale* (Zhao & Gao, 2012); PVAS, *Physical and Verbal Aggression Scale* (Caprara & Pastorelli, 1993; RPEQ, *Peer Experiences Questionnaire* (RPEQ; Prinstein et al., 2001); RAS, *The Relational Aggression Scale* (Voulgaridou & Kokkinos, 2018); RRQ, *Rumination-Reflection Questionnaire* (Trapnell & Campbell, 1999); RRS, *Rumination Scale of the Response Style Questionnaire* (Nolen-Hoeksema & Jackson, 2001); RTSQ, *The Ruminative Thought Style Questionnaire* (Brinker & Dozois, 2009); ROSS, *Rumination on Sadness scale* (Conway, 2000); RPQ, *The Reactive-Proactive Aggression Questionnaire* (Raine et al., 2006); SARI, *Sadness and Anger Rumination Inventory* (Peled & Moretti, 2007); SCORE, *Survey for Coping with Rejection Experiences* (Sandstrom, 2004); SDDS, *Supervisor-directed deviance scale* (Mitchell & Ambrose, 2007); SRASBM, *The self-report of aggression and social behavior measure* (Morales & Crick, 1998); STAXI, *Trait Anger Expression Inventory* (Spielberger, 2010); TAO, *Thoughts About Opponent Questionnaire* (Giancola, 2007); TAP, *Taylor Aggression Paradigm* (Taylor, 1967); TEAS, *The Explicit Aggression Scale* (Borders et al., 2007); TIMFA, *The integrated measurement framework of aggression* (Little et al., 2003); TRF, *Teachers Report Form* (Achenbach et al., 2002); TVSSI, *The Violence Scale and Severity Index* (Valdez-Santiago et al., 2006); YSR, *Youth Self-Report Form* (Achenbach et al., 2002); VAS, *self-report: three items of the Attitude Towards Violence Scale* (Caprara et al., 1990).

[a] Studies that measure two emotion regulation strategies that reappear in Tables 1, 3, 4, and in Supplementary Tables 1 and 2.

usage of violent video games (Zheng et al., 2021), or mindfulness (Eisenlohr-Moul et al., 2016), and aggression measures.

3.2. Relationships between mindfulness and aggression

Twenty-eight studies examined the relationship between mindfulness and aggression; 20 were cross-sectional studies, four experimental, and four longitudinal. Only one study was conducted on a sample of adolescents (see Tables 4 and Supplementary Table 1).

Cross-sectional studies assessing mindfulness from a unidimensional framework found, generally, that higher levels of mindfulness were associated to lower levels of different types of aggressive behavior (e.g., physical, verbal, intimate-partner aggression), with magnitude of correlations varying from moderate to weak. Regarding the components of mindfulness, studies also found a negative association between them and types of aggression. Not judging and acting with awareness were the two components most frequently investigated and linked to different forms of aggressive behavior, especially physical and verbal aggression (e.g., Peters et al., 2015), but also psychological aggression (Brem et al., 2019), antisocial behaviors (Velotti et al., 2016), or dating violence (Hesse et al., 2019; Ngo et al., 2018; Shorey et al., 2014). Other components of mindfulness, like self-compassion, self-distancing, not reacting, and describing, also negatively correlated with aggressive behaviors (e.g., Fresnics & Borders, 2017; Velotti et al., 2016).

The four experimental studies also supported the negative association between mindfulness and aggression. Heppner et al. (2008) observed that the participants who were rejected but received a mindfulness induction had similar physical aggressive levels to the group that was accepted by their peers. After a provocation, individuals who took a self-distancing perspective showed lower aggression levels afterwards (Mischkowski et al., 2012). In another study (Liang et al., 2018), those that received instructions to focus on awareness statements had the lowest physical aggression levels, followed by the acceptance and control group. Yusainy and Lawrence (2015) found that mindfulness had a moderating effect on the relationship between ego-depletion and physical aggression, although this was true only when there was no provocation or low-moderated provocations.

Four studies assessed the relationship between mindfulness and aggression across time, three in adults, and one in adolescents. Liang et al. (2018; Study 2b) found that low levels of mindfulness awareness moderated the relationship between daily hostility and relational aggression perpetration to a supervisor, whereas mindfulness acceptance did not have an impact. Eisenlohr-Moul et al. (2016) also found that trait and daily measured state mindfulness components negatively predicted aggressive behaviors. In another study with women, no judging negatively predicted both physical and psychological aggression, whereas acting with awareness only predicted psychological aggression (Hesse et al., 2019). Finally, Calvete et al. (2021) found a weak negative association between dispositional mindfulness facets and cyberaggression in adolescents, except for observing and non-reacting.

3.3. Relationships between other emotion regulation strategies and aggression

Nineteen studies (some of them previously exposed) reported results about other ER strategies, mainly, reappraisal (5 studies) and

Table 3
Experimental studies on the relationship between mindfulness and aggression types.

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Heppner et al. (2008) Study 2[a]	57 students (32 men, 28 women)	Experimental: 3 (acceptance, rejection, and mindfulness-rejection)	Mindfulness (RET)	Physical aggression (TAP)	Those that participated in the mindfulness manipulation had lower levels of aggression after a rejection compared to those only rejected. There were similar aggression levels when accepted and mindfulness after rejection.
Mischkowski et al. (2012) Study 2	86 participants (35 % men) Age: $M = 21$, $SD = 2.4$	Experimental 3 (self-immersed/ self-distanced perspective/control)	Self-distancing (observer perspective and distance)	Aggressive behavior through a reaction time competition: intensity and duration of the noise blast of the first trial	Those who took a self-distancing perspective after a provocation showed lower aggressive behavior afterwards.
Yusainy and Lawrence (2015)	110 participants (58 women) Age: $M = 19.52$, $SD = 2.03$	Experimental: 2 (ego-depletion/no) × 2 (mindfulness/no)	Mindfulness induction (TMS)	Physical aggression (TAP)	There were no differences across all types of provocation. When no provocation or lower/moderated provocations, mindfulness had a moderating effect on the link between ego-depletion and aggression: those depleted under mindfulness induction were less aggressive than depleted-no mindfulness. This was no significant for high provocations. Those with higher self-control in the handgrip task were less aggressive in the no provocation condition.
Liang et al. (2018) Study 1	101 participants (48 % men) Age: $M = 37$, $SD = 10.67$	Experimental: 3 (awareness, acceptance, and control)	Mindfulness induction: reading and focusing on sentences related to each condition	Aggression: Voodoo doll task	Participants in the awareness condition reported the lowest aggression, followed by mindful acceptance and control. There were no differences between acceptance and control, and awareness and acceptance, although the effect size of acceptance-control was considerable.

Abbreviations: BPAQ, *The Aggression Questionnaire*, (Buss & Perry, 1992); CADRI, *Conflict in Adolescent Dating Relationships Inventory*, (Wolfe et al., 2001); CAX, *Cycling Anger Expression Inventory*, (Møller & Haustein, 2017); CQ, *Cyberbullying Questionnaire*, (Calvete et al., 2010); CTS-2, *Revised Conflict Tactics Scale*, (Straus et al., 1996); EAS, *The Explicit Aggression Scale*, (Borders et al., 2007); FFMQ, *The Five Facet Mindfulness Questionnaire*, (Baer et al., 2006); FFMQ-A-SF, *Self-report Five-Facet Mindfulness Questionnaire-Adolescents-Short Form*, (Cortazar et al., 2019); FMI, *Short form of the Freiburg Mindfulness Inventory*, (Walach et al., 2006); MAAS, *Mindful attention awareness scale*, (Brown & Ryan, 2003); MCMI-III, *Millon Clinical Multiaxial Inventory-III*, (Zennaro et al., 2008); MIPQ, *Mindfulness in Parenting*, (McCaffrey et al., 2017); PAI, *Personality Assessment Inventory*, (Morey, 1991); PHLMS, *Philadelphia Mindfulness Scale* (Cardaciotto et al., 2008); RET, *Raisin-Eating Task*, (Kabat-Zinn, 1990); RPEQ, *Revised Peer Experiences Questionnaire*, (Prinstein et al., 2001); SCS, *Self-Compassion Scale*, (Neff, 2003); SDDS, *Supervisor-Directed Deviance Scale*, (Mitchell & Ambrose, 2007); STAXI, *State Trait Anger Expression Inventory*, (Spielberger, 2010); TAP, *Taylor Aggression Paradigm* (Taylor, 1967); TMS, *Toronto Mindfulness Scale*, (Lau et al., 2006); TVSSI, *The Violence Scale and Severity Index*, (Valdez-Santiago et al., 2006) VDT, *Voodoo doll task*, (DeWall et al., 2013).

[a] Studies that measure two emotion regulation strategies that reappear in Tables 1, 2, 4, Supplementary Tables 1 and 2.

suppression (4 studies) which are usually studied together (5 studies). Other strategies assessed were emotional inexpressivity, experiential avoidance, mood induction (inspired by Chinese traditional medicine), worry, and temporal distancing. Nine studies were cross-sectional, nine experimental, and one longitudinal (see Supplementary Tables 1 and 2).

Studies examining reappraisal found mixed results. In general, reappraisal is negatively associated with aggressive behavior, such as physical aggression, proactive and reactive relational aggression, cyberbullying, or IPA (e.g., Juang et al., 2016; Kokkinos & Voulgaridou, 2017; Orozco-Vargas et al., 2021). However, Casini et al. (2021) found no significant correlation between adaptive strategies (such as positive reappraisal) and aggression, except for positive refocusing. Kokkinos et al. (2019) did not find a correlation with reactive relational aggression. In an experimental design, mitigating information after a provocation was associated with lower relational aggression compared to those that did not receive it (Barlett & Anderson, 2011). When unprovoked, reappraisal was negatively associated with IPA in the group who had consumed alcohol and ruminated (Watkins et al., 2015). Nevertheless, Stappenbeck and Fromme (2014) found that sober participants with higher reappraisal levels showed higher aggression intentions than those in alcohol and placebo conditions. Jiang et al. (2018) conducted an fMRI study and only found differences at the neural level: the reappraisal group after a high provocation had a lower activation of the left insula, right MFG, and cuneus, and higher activation of the caudate during the decision phase.

Temporal distancing is a strategy similar to reappraisal, which refers to the reinterpretation of an emotional event by focusing on the impact it will have in the future, allowing the person to take a psychological distance to it. Ahmed et al. (2018) studied its association to reactive and proactive aggression in an experimental study with a sample in transition to adulthood. They found a negative correlation with reactive aggression when participants used the temporal distancing strategy. They also observed that those with high reactive aggression projected themselves less far into the future.

Regarding suppression, it was conceptualized as "surface acting" (the suppression of facial expression), thought suppression, or suppression of emotional expression. The results are also mixed. In general, it is found to be positively associated to aggressive behavior such as displaced aggression (Scott et al., 2015) or proactive relational aggression (Kokkinos & Voulgaridou, 2017). However, Cheavens et al. (2005) found a weak positive association between thought suppression and aggressive behavior. In another study, whereas denigration was related to physical aggression for those who had low reappraisal and high suppression levels, suppression was not correlated to aggression (Juang et al., 2016). Participants with high levels of "surface acting" showed a moderating effect on the relationship between hostility and relational aggression towards a supervisor (Liang et al., 2018). In a sample of men, Berke et al. (2020) observed that suppression was positively correlated to physical

Table 4
Cross-sectional and longitudinal studies on the relationship between mindfulness and aggression types.

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Heppner et al. (2008) Study 1	175 students (43 men, 132 women) Age: $M = 18.9$, $SD = 1.17$	Cross-sectional	Dispositional Mindfulness (MAAS)	Physical and verbal aggression (BPAQ)	Mindfulness negatively correlated with total AQ and verbal aggression. There was no relation between mindfulness and physical aggression. It also correlated negatively with hostile attribution, anger, and retaliation.
Borders et al. (2010) Study 1[a]	464 students (66.6 % women) Age: $M = 19.7$	Cross-sectional	Dispositional Mindfulness (MAAS)	Physical and verbal aggression (BPAQ)	Mindfulness was related to less rumination and less aggressive behavior (physical and verbal) Rumination only mediated the relationship between mindfulness, anger, and hostility, no mediation found for physical and verbal aggression.
Study 2[a]	211 participants with greater exposure to and knowledge about mindfulness (60 % women) Age: $M = 31.8$, $SD = 11.8$	Cross-sectional	Dispositional Mindfulness (MAAS)	Physical and verbal aggression (BPAQ)	Mindfulness was again related to less physical and verbal aggression.
Gallagher et al. (2010)	167 men Age: $M = 26.35$, $SD = 4.94$	Cross-sectional	Dispositional Mindfulness (MAAS)	Intimate partner sexual coercion/aggression (CTS-2)	Mindfulness was negatively associated with intimate partner sexual aggression. Lower mindfulness levels also predicted higher sexual aggression. Mindfulness had a negative moderating effect in alcohol quantity consumption but not in frequency: those with lower mindfulness who heavily consumed alcohol reported more sexual aggression.
Shorey et al. (2014)	481 women Age: $M = 18.58$, $SD = 1.28$	Cross-sectional.	Mindfulness (FFMQ)	Intimate partner physical and psychological aggression (CTS-2)	Mindfulness facets were separately correlated with physical and psychological aggression, especially no reaction, no judging, and acting with awareness. Anger management mediated the relation between mindfulness and both aggression types. Specifically, negative attributions, and escalating strategies components.
Peters et al. (2015)[a]	823 participants (70.6 % women) Age: $M = 19.25$, $SD = 2.51$	Cross-sectional	Mindfulness (FFMQ)	Physical and verbal aggression (BPAQ)	No judging was related to verbal and physical aggression. It could also predict both types of aggression. Act with awareness was also related to both types, although it only predicted verbal aggression.
Shorey, Anderson, et al. (2015)	116 men in residential substance use treatment Age: $M = 41.55$, $SD = 11.02$ Clinical population: 54.3 % alcohol dependence, 17.2 % opioid dependence, and 5.2 % polysubstance dependence	Cross-sectional	Dispositional mindfulness (MAAS)	Physical and verbal aggression (PAI)	Mindfulness was negatively associated with physical and verbal aggression. It was associated with verbal aggression after controlling for age, drug, and alcohol use, but not physical aggression. Mindfulness explained a little amount of variance for both types.
Shorey, Elmquist, et al. (2015)	137 women in residential substance use treatment Age: $M = 49.95$, $SD = 11.43$ Clinical population: 51 % alcohol dependence, 23.3 % opioid dependence, 17 % others, 8.7 % polysubstance dependence	Cross-sectional	Dispositional mindfulness (MAAS)	Physical and verbal aggression (PAI)	Mindfulness was negatively associated with aggression in a population of women. It could also predict both types of aggression after controlling for other variables. Alcohol and drugs use were not related to aggression when mindfulness entered. The variance explained by mindfulness was small.
Gao et al. (2016)	300 male USA students. Age: 18–20 1516 Chinese students (512 women). Age: $M = 18.3$	Cross-sectional	Dispositional mindfulness (MAAS)	Physical and verbal aggression (BPAQ)	Mindfulness was negatively associated with physical and verbal aggression in both populations and gender. In Chinese population, the prediction was higher for girls.

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Table 4 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Fresnics and Borders (2017)[a]	201 participants (78 % women, 21 % men 1 % transgender) Age: $M = 19.48$, $SD = 1.47$	Cross-sectional	Self-Compassion (SCS) Mindfulness (FMI)	Aggression (EAS)	Self-compassion and mindfulness were negatively associated with aggression. Self-compassion negatively predicted aggression after controlling for mindfulness.
Velotti et al. (2016)	83 incarcerated men Age: $M = 38.41$, $SD = 10.83$ 26.5 % had a diagnosis of anti-social personality disorder (ASPD). No psychotic or alcohol and drugs use in 3 months.	Cross-sectional	Mindfulness (FFMQ)	Physical and verbal aggression (BPAQ) Anti-social personality disorder (MCMI-III)	No judge, no react, and act with awareness were related to ASPD traits and physical aggression. High levels of mindfulness also played a moderator role in the association between physical aggression and ASPD. When lower levels, the association wasn't significant, but act with awareness and the interaction with physical aggression remained significant in predicting ASPD.
Brem et al. (2019)	203 women Age: $M = 19.16$, $SD = 2.22$	Cross-sectional	Dispositional mindfulness (MAAS)	Physical aggression (CTS-2)	Mindfulness levels were negatively correlated with physical aggression perpetration. Controlling for the effect of alcohol use, there was a positive relationship between infidelity perception and aggression for low and moderated mindfulness levels.
Liang et al. (2018) Study 2a	342 participants (46 % men) Age: $M = 36$, $SD = 9.45$	Cross-sectional	Mindfulness awareness (MAAS) Mindfulness acceptance (PHLMS)	Relational aggression (SDDS)	Those with low awareness level showed a stronger relationship between hostility and relational aggression. No interaction with mindful acceptance.
Study 3[a]	204 participants (49 % men) Age: $M = 37$, $SD = 9.15$	Cross-sectional	Mindfulness awareness (MAAS)	Relational aggression (SDDS)	The moderated effect of mindful awareness found in previous studies was mediated by surface acting; no evidence was found for the mediating role of rumination.
Ngo et al. (2018)	735 participants (270 women, 465 men) Age: $M = 21.5$, $SD = 2.3$	Cross-sectional	Mindfulness (FFMQ)	Physical dating violence and sexual dating violence (CTS-2)	There were differences in total mindfulness score between people that committed sexual dating violence and physical dating violence, who reported less scores than those who didn't aggress. This was also true for specific components: no judging, acting with awareness, describing, and no reacting. Sexual dating violence and physical dating violence were predicted by total mindfulness, no judgment, and act with awareness. There were two interactions with these facets and physical dating violence: non-judging × gender (significant effect of low vs high only in women) and acting aware × alcohol (low alcohol consumption showed a significant effect of low vs high acting aware).
Brem et al. (2019)	203 women. Age: $M = 19.16$, $SD = 2.22$	Cross-sectional	Dispositional mindfulness (FFMQ)	Physical and psychological aggression (CTS-2)	Physical aggression was negatively related to describing, acting with awareness, and no judging. Psychological aggression was only related to acting with awareness. Distress tolerance mediated the relationship between no judging and no reacting and both types of aggression.

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Table 4 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Garofalo et al. (2020)	397 offenders men. Age: M = 40.26, SD = 11.96 324 community men. Age: M = 37.84, SD = 12.06	Cross-sectional	Mindfulness (FFMQ)	Physical and verbal aggression (BPAQ)	Mindfulness facets were generally negatively related to aggression types in both samples. Emotion dysregulation (DERS) mediated the relation between mindfulness facets and physical aggression in the offenders' sample (partially in the case of no judging and verbal aggression). In the community sample, it also mediated the relationship between mindfulness facets and both aggressions (partially in the case of describing and verbal aggression).
Johnson and Moore (2022)	604 participants (80 % women) Age: M = 38.8	Cross-sectional	Mindfulness (FFMQ)	Intimate Partner Aggression: threatening behavior, emotional relational aggression, and verbal abuse (CADRI)	Negative urgency mediated the relationship between observing and describing facets of mindfulness and intimate partner aggression. Stress-mindset (attitude towards stress) moderated the mediating relationship in those facets: those with a negative stress-mindset were more likely to perpetrate intimate partner aggression resulting from impulsivity influenced by decreased mindfulness.
Stephens et al. (2020)	583 participants (68 % men and 32 % women) Age: M = 42.5, SD = 11.9	Cross-sectional	Mindfulness (MAAS)	Physical and verbal aggression in cyclists (CAX)	Mindfulness was negatively related to physical and verbal aggression in the context of cycling.
Orozco-Vargas et al. (2021)[a]	838 participants, (385 men and 435 women) Age: 18–57, M = 32.57, SD = 8.49	Cross-sectional and predictive design	Mindfulness (FFMQ)	Intimate partner violence: psychological, physical, severe physical, and sexual violence (TVSSI) Family of origin violence (CTS-2)	For both women and men, intimate partner violence was negatively associated with mindfulness. For men, family of origin violence was negatively associated with mindfulness. Maladaptive emotion regulation strategies like rumination mediated the correlation between the family of origin violence and intimate partner violence.
Eisenlohr-Moul et al. (2016)[a]	86 students, 43 heterosexual couples unmarried. Age: M = 19.66, SD = 2.82	Longitudinal: daily measures during 35 days.	Trait and daily mindfulness (FFMQ)	Daily measures (BPAQ) Aggressive behavior (VDT) Anger expression (STAXI)	Acting with awareness predicted all aggression measures in its state and trait form. No judging predicted anger expression and physical aggression in both of its forms (state and trait). No reacting predicted physical, voodoo, and verbal aggression in both of its forms.
Liang et al. (2018) Study 2b	82 participants (44 % men) Age: M = 39, SD = 10.26	Longitudinal (5 daily diary measures)	State mindfulness awareness (MAAS) State mindfulness acceptance (PHLMS)	Relational aggression (SDDS)	Low levels of mindful awareness moderated the relationship between hostility and relational aggression. It was not significant for those with high levels. No interaction with mindful acceptance.
Hesse et al. (2019)	381 women. Age: M = 18.9, SD = 1.41	Longitudinal: 3 months between measures	Mindfulness (FFMQ)	Physical and psychological aggression (CTS-2)	No judging was negatively related to both types of aggression in both times. It also predicted both aggressions in time 2. Acting with awareness was only negatively related to psychological aggression. Those considered physical aggression perpetrators scored lower in no reacting and no judging. Psychological aggression perpetrators showed lower no judging, no reacting, and acting with awareness levels.

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Table 4 (*continued*)

Study	Sample	Design	ERS scale	Aggression type	Summary of results
Calvete et al. (2021)	779 teenagers (55.5 % girls) Grade 8: 128 Grade 9: 156 Grade 10: 64 Age: $M = 14.37$, $SD = 0.96$ 346 parents (80.2 % women) 96.9 % biological parents, 1.7 % adoptive parents, 1.3 % foster parents	Longitudinal study (2 measures, 1 year gap)	Mindful parenting (MIIPQ) Child dispositional mindfulness (FFMQ-A-SF)	Aggressive behavior and victimization (RPEQ) Cyberbullying (CQ)	Teenagers' dispositional mindfulness facets were negatively related to aggressive behavior in both times, except observing and non-reacting that were not significantly related at time 1. There was also a negative correlation between mindful discipline and aggressive behavior one year later. The children with a judgmental observing profile (high observing but low acting with awareness and non-judging) who received a mindful discipline showed lower aggressive behavior.

Abbreviations: BPAQ, *The Aggression Questionnaire*, (Buss & Perry, 1992); CADRI, *Conflict in Adolescent Dating Relationships Inventory*, (Wolfe et al., 2001); CAX, *Cycling Anger Expression Inventory*, (Møller & Haustein, 2017); CQ, *Cyberbullying Questionnaire*, (Calvete et al., 2010); CTS-2, *Revised Conflict Tactics Scale*, (Straus et al., 1996); EAS, *The Explicit Aggression Scale*, (Borders et al., 2007); FFMQ, *The Five Facet Mindfulness Questionnaire*, (Baer et al., 2006); FFMQ-A-SF, *Self-report Five-Facet Mindfulness Questionnaire-Adolescents-Short Form*, (Cortazar et al., 2019); FMI, *Short form of the Freiburg Mindfulness Inventory*, (Walach et al., 2006); MAAS, *Mindful attention awareness scale*, (Brown & Ryan, 2003); MCMI-III, *Millon Clinical Multiaxial Inventory-III*, (Zennaro et al., 2008); MIPQ, *Mindfulness in Parenting*, (McCaffrey et al., 2017); PAI, *Personality Assessment Inventory*, (Morey, 1991); PHLMS, *Philadelphia Mindfulness Scale* (Cardaciotto et al., 2008); RET, *Raisin-Eating Task*, (Kabat-Zinn, 1990); RPEQ, *Revised Peer Experiences Questionnaire*, (Prinstein et al., 2001); SCS, *Self-Compassion Scale*, (Neff, 2003); SDDS, *Supervisor-Directed Deviance Scale*, (Mitchell & Ambrose, 2007); STAXI, *State Trait Anger Expression Inventory*, (Spielberger, 2010); TAP, *Taylor Aggression Paradigm* (Taylor, 1967); TMS, *Toronto Mindfulness Scale*, (Lau et al., 2006); TVSSI, *The Violence Scale and Severity Index*, (Valdez-Santiago et al., 2006) VDT, *Voodoo doll task*, (DeWall et al., 2013).

[a] Studies that measure two emotion regulation strategies that reappear in Tables 1, 2, 3, and Supplementary Tables 1 and 2.

aggression and alcohol-related aggression, as well as with drinking frequency and holding on to masculinity norms. However, Stappenbeck and Fromme (2014) found that participants who experienced more emotional arousal and who had high suppression showed lower intentions of aggression compared to those who had lower arousal.

Related to this strategy, Tull et al. (2007) found that emotional inexpressivity and experiential avoidance were weakly and positively associated with aggressive behavior in a sample of men exposed to interpersonal violence.

Two studies focused on mood induction, a strategy presented as an alternative to the incapacity of using higher-cognitive processes to regulate emotions under stress, and it refers to the Chinese traditional medicine claims that emotions promote and counteract each other. Thus, fear would promote anger and sadness would counteract it. Zhan et al. (2015) tried to test this theory by conducting an experiment in which after a provocation, the sample was induced to fear, sadness, or neutral mood, and they observed the effect on aggression. They found that the sadness group showed lower levels of physical aggression in the Taylor Paradigm, and there were no differences between the fear and neutral groups. In another study, Zhan et al. (2017) compared this strategy with reappraisal under stress and no stress situations. They found that the sadness group showed lower levels of physical aggression compared to reappraisal and neutral.

Finally, two studies examined the relationship with worry and found that this strategy did not correlate with any aggressive measure in adults (Blain-Arcaro & Vaillancourt, 2016; Hasegawa et al., 2021).

4. Discussion

The aim of this systematic review was to explore the literature that examined the relationship between ER strategies and types of aggressive behavior. One hundred and four studies, 57 dedicated to rumination, 28 to mindfulness, and 19 to other strategies (such as reappraisal and suppression), were identified. Overall, these studies showed that ER strategies were associated to aggression. Moreover, this general finding was consistent among the different populations studied, different study designs (cross-sectional, experimental, and longitudinal), and for different types of aggression. More specifically, the reviewed studies found that maladaptive ER strategies, such as rumination and suppression, were positively associated to aggression, whereas adaptive ER strategies, such as mindfulness and reappraisal, were negatively associated.

Individuals who show higher levels of trait or state rumination tend to use different forms of aggressive behavior more frequently. This result is consistent in populations that differed in ages, clinical diagnoses, and cultures, and is supported by cross-sectional, experimental, and longitudinal studies. Of the different types of rumination, angry rumination was explored by numerous studies, suggesting the relevance to study a specific type of rumination regarding the study of aggressive behaviors. On the other hand, experimental studies highlighted that a stronger association between rumination and aggression was consistently found after a provocation or a trigger, and that, for those under alcohol effects, high trait and state levels of rumination predicted different types of aggression. Moreover, rumination mediated the relationship between other variables (e.g., perceived discrimination, metacognitive beliefs) and aggression, including some facets of mindfulness. These results can be understood within the framework of GAM (Anderson & Bushman, 2002). According to the GAM, rumination would augment negative affect and angry feelings, that in turn activate the cognitions and negative reactions of the associative network related to a provocation (Berkowitz, 2012); this would prime reactivity to a trigger and augment the probability of aggressive retaliation. In addition, rumination is an ER strategy that requires the change of attention to manage the intensity of the anger experience, suppress angry thoughts, and inhibit aggressive impulses, processes that consume self-control resources (Denson et al., 2011), so it leaves the appraisal processing with less cognitive resources for self-control, enhancing the probability of aggressive outcomes when a subsequent triggering event appears.

In contrast to rumination, mindfulness was found to be negatively related to different types of aggression across populations, cultures, and genders; however, the magnitude of the correlations was weaker than those related to rumination. Non-judging and acting with awareness were the two components most investigated, and both were associated to lower levels of aggression in different samples (e.g., community and offender samples), as well as with cyberaggression. Moreover, this result was supported by experimental and longitudinal studies. Given that mindfulness is suggested to be composed by different components, its regulating effect could be applied to different points of the GAM. For example, the describing, observing, and awareness components might help to detach and attenuate the intensity or duration of the internal

affect from a provocative situation. Mindfulness can also contribute through the appraisal and decision-making processes, as it proposes a non-judgmental, and non-reactive manner to approach the experience. Specifically, non-judging and acting with awareness may contribute to soften the interpretation of the provocative information, such as the intention, and may also influence the reappraisal process of GAM, where motives and consequences are re-evaluated before deciding. Once this strategy is integrated into the individual's own regulation strategies, it can also be considered a personal factor or trait that will accompany the individual in every confrontation. In accordance with this, two studies found an association between mindful discipline in the family context and lower levels of aggression (Orozco-Vargas et al., 2021).

Other strategies (reappraisal, suppression, mood induction, and temporal distancing) were also related to different types of aggression, but with some mixed results. Generally, reappraisal and temporal distancing (considered as a form of reappraisal) were negatively associated with aggression, although some studies failed to find a significant association (e.g., Casini et al., 2021; Kokkinos et al., 2019), and one found that those with high levels of reappraisal who did not consume alcohol showed higher aggression intentions than those in the alcohol and placebo conditions (Stappenbeck & Fromme, 2014). According to the GAM, this strategy would mainly impact the cognitive processing of the information before deciding the behavioral outcomes, as they imply changing the meaning and interpretation that one can give to a conflict situation. In the long term, their effect could also be integrated in the schema the person activates when confronting a situation. Stappenbeck and Fromme (2014) argue, in explaining their results, that alcohol might have primed attention towards emotional cues to use reappraisal to compensate the effects of alcohol; thus, individuals with good appraisal skills who did not receive alcohol might not have perceived the necessity to use it. However, the associations between reappraisal and aggression under alcohol effect is controversial, and others theories as the alcohol myopia theory proposes that alcohol has an effect on attention that causes people to focus their attention on the most salient features of a situation, and to ignore more peripheral features, becoming more difficult the cognitive processing needed to use an effective reappraisal (Giancola et al., 2010). On the other hand, Casini et al. (2021) suggest that rejection sensitivity may have impeded functional emotion regulations to act prosocially. More investigation is needed to clarify these hypotheses.

On the contrary, suppression and similar strategies (such as experiential avoidance or suppression of facial expression) were generally positively associated with aggression. These strategies are applied once the emotional response is enacted, which may be useful in the very immediate moments of the situation. However, since they bottle up the emotions, it fails to reduce the internal emotional experience and arousal, which will progressively increase leading to an increased activation of negative affect and the sympathetic nervous system. Nevertheless, the small number of studies does not allow to elaborate further conclusions and more investigation is needed.

In sum, the results of this review suggest that trait measures of strategies and the use of them in experimental studies are associated to aggression. In relation to trait measures, these dispositional variables to engage in these strategies would not be necessarily involved in a provocation situation where the individual use that specific strategy for manage the anger with a consequent effect on aggression. We must be cautious with the results, the dispositional use of strategies such as mindfulness, reappraisal or rumination may have a direct or indirect effect on anger management and aggression. Regard the experimental studies, the results of these studies suggest that ER strategies may play a key role throughout the process that results in aggressive behavior.

Attending to the GAM (Anderson & Bushman, 2002), the specific use of a strategy may influence in the proximate episodic factors and processes in different stages like the internal state or the appraisal processes, having an impact on attention or the significance that is given to external and internal information. They may also promote or interfere with the cognitive resources needed in the decision process to lead to the behavioral outcome. For instance, under a provocation situation, the use of angry rumination may maintain or increase the angry emotion and facilitate an aggression response. These strategies may be especially relevant to explain part of the process in the reactive aggression type. In addition, the results about trait measures of strategies may be integrated into GAM in distal factors. For instance, the frequency use of rumination might integrate into the personal schemas and scripts, thus contributing from the very beginning of the process in the interaction between person and situation factors in the facilitation or prevent from negative internal states and aggressive responses. Considering the direction of the correlations found in the review, the probability of aggressive outcomes would be diminished when implementing adaptive strategies (e.g., reappraisal or mindfulness) and would be increased when using maladaptive strategies (e.g., suppression and rumination).

4.1. Limitations of the included studies

There are some limitations regarding the literature reviewed. Most of the studies used university samples in which the mean age was mainly above 25 years old, and it might not be representative of the adult population. There were more cross-sectional studies than experimental and longitudinal, and this was also true for each strategy. However, the strategy of rumination demonstrates more results with 16 experimental and eight longitudinal studies. Most of the studies on mindfulness were cross-sectional, which does not allow one to draw causal conclusions about the topic. Furthermore, the usage of self-reported scales is always at risk of being biased by social desirability, principally in relation to the aggression measures. Besides, the use of trait measures obstructs the association between the specific use of a strategy to deal with angry feelings in a provocation situation. More investigation with experimental measures of aggressive behavior is required. Likewise, few studies were found related to reappraisal and suppression, as well as other strategies, so more investigation is needed to accurately clarify their relationship with aggression.

As limitation of the present research, the review allows one to collect the studies published so far, but the lack of meta-analytic prevent to infer the magnitude of the associations.

4.2. Future research and clinical applications

People use different strategies to regulate their emotions, so it would be interesting to explore the interaction between the simultaneous usage of adaptive and maladaptive strategies, and the effect this might have on aggressive behavior. For example, whether using rumination might lead to the use of other maladaptive strategies, or whether mindfulness might help to diminish the use of maladaptive strategies.

Despite all this, clarifying the effect that ER strategies can exert on the apparition of aggressive behaviors is relevant because it can guide clinical applications that already employ these strategies to adapt to problematic behaviors related to aggression. For example, many psychological treatments that include interventions in emotion and emotion regulation, such as cognitive-behavioral therapy, acceptance and mindfulness-based therapies, emotion-focused therapy, or emotion regulation therapy, may be served with evidence to help patients with anti-social personality disorder or dealing with problems in aggression management. It can contribute to the design of interventions in the context of incarceration, reformatory, and penitentiary institutions, to target individual aspects that might help their reintegration in society. In addition, this knowledge can be of great value to the design of prevention programs in schools and contexts that are at risk of developing aggressive problems.

Moreover, future research would quantitatively review the literature in a meta-analysis and quantify the relationship between aggression and different types of emotion regulation strategies.

4.3. Conclusions

In conclusion, this review gathers evidence about the relationship between adaptive and maladaptive emotion regulation strategies and different types of aggressive behaviors across a variety of context, cultures, and populations. This contributes to unfolding different pathways that can progressively lead to prevention and intervention actions that target social problems derived from aggression.

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CRediT authorship contribution statement

Maria Luisa Navas-Casado: Writing – original draft, Visualization. **Esperanza García-Sancho:** Methodology, Writing – original draft, Writing – review & editing, Visualization. **José M. Salguero:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

All the authors have no competing interests.

Data availability

No data was used for the research described in the article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.avb.2023.101845.

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