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Cognitive-Emotional Processing in Alexithymia: An Integrative Review

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ABSTRACT

Alexithymia is a multifaceted personality construct characterised by difficulties identifying one's feelings and distinguishing them from bodily sensations, difficulties describing one's feelings to others, and an externally oriented cognitive style. Over the past 25 years, a burgeoning body of research has examined how alexithymia moderates processing at the cognition–emotion interface. We review the findings in five domains: attention, appraisals, memory, language, and behaviours. The preponderance of studies linked alexithymia with deficits in emotion processing, which was apparent across all domains, except behaviours. All studies on behaviours and a proportion of studies in other domains demonstrated emotional over-responding. Analysis at the facet level revealed deficits in memory and language that are primarily associated with externally oriented thinking, while over-responding was most often linked to difficulty identifying feelings and difficulty describing feelings. The review also found evidence for contextual modulation: The pattern of deficits and over-responding was not restricted to emotional contexts but also occurred in neutral contexts, and in some circumstances, emotional over-responding in alexithymia was beneficial. Taken together, this review highlights alexithymia as a central personality dimension in the interplay between cognition and emotion.

KEYWORDS:

Alexithymia, cognition, emotion, attention, appraisals, behaviors, memory, language – emotion regulation

Chris is fifty years old, divorced, has two adult children, and works as a civil engineer in a large technology company. Chris displays little emotion other than mild irritability. They have hypertension and has suffered from irritable bowel syndrome for over ten years. They show little insight into their feelings or inner life, and focus primarily on impersonal factors like the weather, their diet, or their job as potential causes of their physical problems. Chris sometimes reports a sense of inner emptiness and finds that they are about to cry, but cannot explain these behaviours. Chris mentions that they never experience pleasant emotions other than mild enjoyment when meeting with their children each week. They report having no noticeable feelings during their divorce four years earlier or after their brother's suicide the following year. Chris has only weak emotional connections with their few friends. They rarely recall their dreams and seldom experiences fantasies.

The above vignette describes a typical profile of the men and women who score high on alexithymia. Alexithymia is a multifaceted personality construct targeting socio-emotional competencies. Individuals scoring high on this construct have (a) difficulty identifying feelings and distinguishing feelings from bodily sensations of emotional arousal; (b) difficulty describing their feelings to others; (c) a restricted fantasy life; and (d) a cognitive style in which the focus of attention is external, with little interest for introspection or insight (e.g. Taylor et al., 2016). People scoring high on alexithymia can experience emotions and do get distressed by their emotions. Nevertheless, they lack adequate mental representations to experience them as identifiable and describable feelings (Taylor et al., 2016). Alexithymia therefore constitutes a vulnerability factor for both mental and somatic illnesses (e.g. Baudic et al., 2016; Porcelli et al., 2007; Tolmunen et al., 2010).

Over the last twenty-five years, many papers have examined the role of alexithymia in various aspects in the cognitive processing of emotion. Our goal in this article is to unlock this line of research for emotion researchers, by conducting a theoretically oriented review of alexithymia research. In what follows, we start by describing two different models of alexithymia: The first model regards alexithymia as a deficit in emotional processing, whereas the second model regards alexithymia as emotional over-responding. Next, we provide background on the early foci of research and its measurement. In the main section of the paper, we review evidence for the deficit and over-responding models of alexithymia in research on attention, appraisals, memory, language, and behaviour. Our review includes both a general assessment and an analysis at the level of alexithymia facets, a critical assessment of methodological factors and the role of context, the clinical significance of the results, and neuro-imaging findings. We finish with the implications of our findings for major emotion theories (attentional bias and control, appraisal, and emotion awareness).

1. Introduction

1.1. Deficit and "Over-responding" models

A fundamental unanswered question is under which circumstances alexithymia involves a deficit or an excess of emotional processing (i.e. "over-responding"). Since its inception, alexithymia has been viewed as a deficit in emotion identification and communication (Sifneos et al., 1977), and cognitive processing and regulation of emotions (Taylor, 2000). This view corresponds to the ability/ deficit hypothesis of alexithymia developed by Preece et al. (2017) in which they highlight that people with higher alexithymia scores have poorly organised, differentiated, and integrated emotional schemas, which means they are unable to focus on the most relevant aspects of their emotional responses or to make accurate interpretations of input information about emotions. In parallel, alexithymia has sometimes been conceptualised as a defensive reaction to overly intense feelings that we will refer to as over-responding (OR) for the remainder of this paper (e.g. Knapp, 1983; Marchesi et al., 2014). Preece et al. (2017) proposed that avoidance in alexithymia causes the individual to regress to operating at an earlier developmental level of information processing. These models are not mutually exclusive, with some authors adopting both the deficit and the defensive approaches (Krystal, 1982, 1988; McDougall, 1982–83; Nemiah, 1977; Preece et al., 2017). However, to date, no systematic efforts have been made to integrate these models and delineate the conditions that would produce deficits vs. over-responding. This is a major goal of this review. We further distinguish between over-responding that is detrimental to functioning and over-responding that is beneficial to functioning. To effectively draw these delineations, as well as contribute to their potential clinical applications, considering situational context is essential, such as whether effects occur under neutral and/or under emotional activation, and/or under pleasant or unpleasant conditions.

Another key focus of this paper is to examine the distinct role of alexithymia facets, rather than total alexithymia scores. Identifying the unique processes (e.g. attention, appraisals, memory, language, behaviours) that are particularly related to specific facet of alexithymia allows identification of which factors are the most related to individual vulnerabilities for mental and somatic outcomes. For the purposes of this paper, we consider the primary facets described in the literature, which are (a) difficulty identifying feelings (DIF), (b) difficulty describing feelings (DDF), and externally oriented thinking (EOT). Fantasising is sometimes included but is less emphasised in this review. Thus, if we take the example of mental and somatic outcomes, many studies evidence a positive association with DIF and DDF, but not with EOT (e.g. Hund & Espelage, 2006; Nowakowski et al., 2013). In contrast, higher EOT scores have been related to fewer intrusive thoughts (Luminet et al., 2004), reduced physiological reactivity after being exposed to films inducing sadness (Davydov et al., 2013), and reduced craving for alcohol (Luminet et al., 2016). These consequences could decrease mental and somatic vulnerabilities. We therefore predict that specific alexithymia facets affect some processes more than others, and might distinguish deficits vs. over-responding. DIF, reflecting deficits in emotion perception, is expected to mainly impact early emotion processing (e.g. attention) and emotion intensity. DDF, reflecting deficits in expressing and communicating emotion to others, is expected to impact later processing of emotion (e.g. memory, language) and interpersonal relationships. Finally, EOT is expected to reduce interpretation and elaboration of emotional information, leading mainly to deficits.

1.2. Early alexithymia research

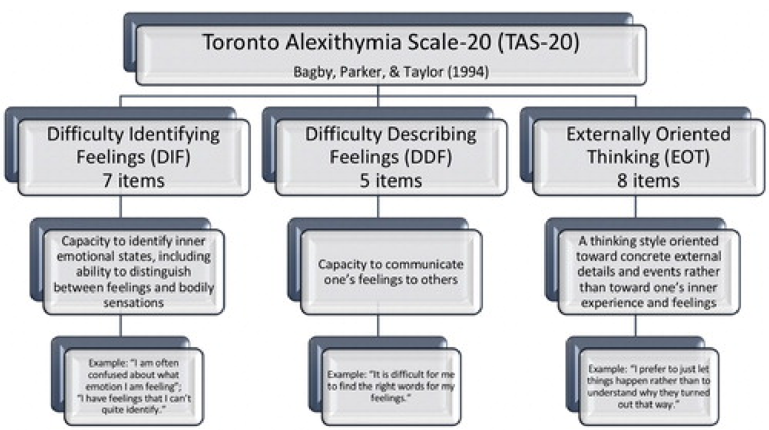
1.2.1. Early foci of alexithymia studies prior to the validated assessment

Early studies examined the relationship of HA with somatic illness (e.g. Parker et al., 1993a; Schmidt et al., 1993), suggesting vulnerability to illness in alexithymia through deficits in the cognitive processing of emotions (Taylor, 2000; Taylor et al., 1997) and the arrested development of affective regulation and interpersonal outcomes (e.g. Krystal, 1988). Other studies examined discordance (i.e. "decoupling") of physiological from cognitive-experiential components of emotional responses (e.g. Papciak et al., 1985), neurobiological bases of alexithymia (e.g. Hoppe & Bogen, 1977; Lane et al., 1998), and interventions aimed at reducing alexithymia (e.g. Beresnevaite, 2000). However, these studies, along with studies that attempted to address the cognition–emotion interface (Mann et al., 1994; Parker et al., 1993a, 1993b) had notable methodological weaknesses due to the lack of a valid instrument for measuring alexithymia.

1.2.3. The TAS-20 as a valid instrument to measure alexithymia

The Toronto Alexithymia Scale 20-item (TAS-20) was developed in the early 1990s in response to the limitations of existing alexithymia measures, including the earlier 26-item TAS (Taylor et al., 1985) and the Revised TAS (TAS-R, Taylor et al., 1992). The TAS-20, rated on five-point Likert scales, assesses three central components of the alexithymia construct: DIF, a difficulty identifying feelings and distinguishing between feelings and the bodily sensations of emotional arousal; DDF, a difficulty describing feelings to others; and EOT, an externally oriented style of thinking (see Figure 1). The threefold factor structure has good construct validity in clinical and non-clinical samples (Parker et al., 2003), which includes factorial validity; strong convergent/concurrent validity (e.g. negative correlations with psychological mindedness, need for cognition, and emotional intelligence (see Sekely et al., 2018a) and discriminant validity (e.g. no or low associations with Agreeableness or Conscientiousness); see Taylor, Bagby, & Luminet, 2000); good test-retest reliability for short (3 weeks) or long (6 months) intervals (Bagby et al., 1994a; Kojima et al., 2001); and good internal reliability for the total score, DIF and DDF, although somewhat lower for EOT. Measurement invariance was also demonstrated, including factorial invariance across clinical and nonclinical samples, and across different modes of administration of the scale (e.g. internet and pencil and paper) (e.g. Preece et al., 2018). Taxometric investigations indicate that the TAS-20 yields continuous scores rather than categorical scores, which supports the preference for considering alexithymia as a continuous dimension (Bagby et al., 2020).

Figure 1. Overview of the three facet scores, with example items, from the Toronto Alexithymia Scale-20 (TAS-20; Bagby et al., 1994).



To some readers, it might seem paradoxical to assess alexithymia with self-reports given that HA have difficulties accessing their internal world and can thus be unable to accurately report their emotional difficulties and evaluate their low awareness for emotional feelings (e.g. Muller et al., 2008). This is an important consideration, which has led to the recent development of a complementary multi-method approach to assess alexithymia, the Toronto Structured Interview for Alexithymia (TSIA) (e.g. Bagby et al., 2006; Sekely et al., 2018b). Studies using the TSIA have not yet been applied in the contexts we examine for this paper. Moreover, and importantly, studies have found a high overlap between the TAS-20 and the TSIA, despite their differences, both when considering the total and the factor scores (e.g. Bagby et al., 2006; Montebarocci & Surcinelli, 2018). Finally, concerns about using self-report measures are most relevant in very severe alexithymia. As such, the problem seems less relevant for the current review, in which the preponderance of the studies had moderate score ranges and most studies include normative samples, making the issue unlikely.

The TAS-20 further demonstrates independence from negative affect (e.g. psychological distress, medical/psychiatric symptoms), with relative stability over time despite score reductions associated with symptom reduction (e.g. Luminet et al., 2001; Luminet et al., 2007). Yet, due to shared variance of negative affect and alexithymia, covarying negative affect is valuable to discerning clear alexithymia effects (see the general discussion for a full development of the issue of overlap with negative and positive affect). Thus, the advent of the TAS-20 importantly allowed systematic study of the cognition–emotion interface in alexithymia. Although the overwhelming majority of studies included in this review report results based on the TAS-20, some used a different validated instrument, the BVAQ (Bermond et al., 2015). The BVAQ measures the three similar facets DIF, DDF, and EOT, as well as a difficulty with fantasising facet. Fantasising ability has often been considered a core aspect of the alexithymia construct. Yet, it is absent from the TAS-20 because the items designed to measure fantasising lacked clear validation due to their persistent correlation with social desirability and ability to experience emotion (Sekely et al., 2018a). In addition, the fantasising facet of the BVAQ tends to correlate highly with the EOT facet (Zech et al., 1999). The fantasising facet is hence less frequently investigated than DIF, DDF, and EOT. As such, it is not well represented in the studies evaluated in this review.

2. Alexithymia and the cognition–emotion interface: a review of 25 years of behavioural research

In this review, we adopt a framework that is loosely inspired by the modal model of emotion (e.g. Gross, 2014) toward examining evidence that alexithymia may have a moderating impact on five major processes of the cognition–emotion interface: (1) attention, (2) appraisals, (3) memory, (4) language, and (5) action tendencies and behaviours. For each section, we searched as comprehensively as possible, without setting the needed criteria for a systematic review, as that was not the goal of this paper. Specifically, we used major primary search engines (e.g. Google Scholar, Scopus, Web of Science) and prior review papers that included (a) empirical studies, (b) of these specific topics (including using major paradigms as search terms, such as “Stroop” for attention, etc.), (c) in the context of alexithymia. We do not claim to have exhaustively included all possible papers, but we endeavoured to be comprehensive and included every study found that fit this description.

We have limited the scope of the review primarily to behavioural outcomes, particularly response time and accuracy measures for conscious and automatic information processing, adding other outcomes where they help to clarify or interpret behavioural findings (e.g. psychophysiology, Panayiotou et al., 2018, 2021, this issue). For each section, we give a definition of the process under study. We then indicate why this process is critical for understanding the deficit vs. over-responding nature of HA responses. When necessary, we distinguish between sub-dimensions in the process under study and we hypothesise how it may be associated with total alexithymia scores and specific alexithymia factors. We conclude with a sub-section that (a) summarises the characteristics of the studies (such as their clinical/non-clinical nature or the type of emotion induction), (b) reports the proportion of studies that support deficits or OR (dysfunctional or functional), and (c) gives the proportion of studies that included control variables. We also complement the text with tables that give more detailed information about sample size and characteristics, alexithymia assessment and control, paradigms involved, results (with facet level findings when provided) and study implications (see Tables 1–5).

Table 1. Alexithymia and attention.

Study	**Sample size & characteristics**	**Alexithymia measures/ controls**	**Attention measures**	**Results (Total/Facets (if specified))**	**Implications**
Brandt et al. (2015)	89; 60% F M_{age}=32; M_{TAS} =42; M_{OAS}=41	TAS-20 (C, OAS) Controls(**1**): depression (BDI), positive/negative affect (PANAS), symptoms (SOMS)	**Affective priming** Faces (angry, happy, & neutral) and words (positive, negative, neutral & illness) as both primes and targets	HA<LA: TAS-20 related to faster RTs for illness words primed with positive and negative faces.	HA = <u>Deficit</u> [↓] in automatic attention to affect.
Coffey et al. (2003)	129; 58%F M_{age} = 19; M_{TAS} = 46	TAS-20 (C) w/facets Controls (**2**): emotional intelligence (TMMS); mood (MAS); extraversion, neuroticism (NEO; likened to positive/negative affect)	**Emotional Stroop** Positive, negative, and neutral words	HA<LA: Stroop interference positively related to 'attention to emotion' factor, which was negatively associated with EOT.	HA (EOT)= <u>Deficit</u> [↓] in attention to emotion.
Fujiwara (2018)	76 LA (M_{TAS}=42), 62% F, M_{age}=20; 73 HA (M_{TAS}=67), 52% F, M_{age}=19	TAS-20 (D) Controls(**1**): depression, anxiety (DASS-21)	**Eye-tracking** Eye movements recorded whilst participants judged the ratio of emotions in a set of blended faces	HA=LA: accuracy, face task. HA<LA: dwell time, eyes. HA<LA: HA fewer errors related to eye dwell time.	HA= <u>Deficit</u> [↑] in attention to eyes, but this led to more accurate performance.
Galderisi et al. (2008)	28 PD, 68% F, M_{age}=31, M_{TAS}=57; 32 HC, 59% F, M_{age}=28, M_{TAS}=39	TAS-20 (C) Controls(**1**): depression (HRSD), anxiety (HRSA, SCRAS), IQ (WAIS-R)	**Emotional Stroop** Positive, neutral, panic-related and threat words	No association between TAS scores and Stroop RTs.	*No alexithymia effect* on attention to words.
Grynberg et al. (2014)	<u>Study 1</u>: 41, 73% F, M_{age}=22; M_{TAS}=46 <u>Study 2:</u> 68, 79% F, M_{age}=22, M_{TAS}=44	TAS-20 (C) w/facets Controls(**2**): positive/ negative affect (PANAS)	**Rapid Serial Visual presentation (RSVP)** <u>Study 1</u>: T1 targets: faces (fear, pain, happy, neutral). T2 targets: neutral	HA>LA: (DDF, Study 1[#]; EOT, Study 2) associated with increased delay following T1 before T2 targets can be accurately detected, but only	HA (DDF & EOT) = <u>OR</u> [↓] to threat. HA associated with prolonged processing of negative affect.

			scenes. Distractors: neutral faces. Study 2: T1 targets: faces (fear, anger, neutral); T2: as study 1.	when T1=faces of negative affect.	
Hsing et al. (2013)	115, 57% F, M_{age}=19, Mdn_{TAS} =47 56 HA 59 LA	TAS-20 (D) Controls(**2**): depression (BDI), anxiety (STAI), verbal IQ (ERVT)	**Emotional Stroop** Task required classifying adjectives as angry or sad; images of sad, angry or neutral faces were superimposed, varying in display time (primes)	HA=LA: classification of adjectives and faces (presented alone). HA>LA: slower responding overall, and to sad words with sad (congruent) and angry (incongruent) primes. HA>LA (trend): when affect controlled, lower IQ HA had greater Stroop interference.	HA = OR [↓] greater distraction from negative faces with sad target words. HA: *no deficit* in overall Stroop interference, or categorising isolated verbal, nonverbal stimuli.
Liossi et al. (2009)	15 CH, 60% F, M_{age}=33, M_{TAS}=50 18 HC, 72% F M_{age}=30, M_{TAS}=41	TAS-20 (C) Controls: none	**Visual Probe Task** Pain words paired with neutral words, presented for short (500ms) or long (1250ms) durations before probe onset	TAS-20 not associated with probe RTs under any condition.	*No alexithymia effect* on attention to pain words.
Lundh and Simonsson-Sarnecki (2002)	120, 52% F, M_{age}=37, M_{TAS}=39 20 HA (>49) 20 LA (<31)	TAS-20 (C, D) Controls(**2**): somatic anxiety (KSP), health (HQL-I)	**Emotional Stroop** Illness-related, negative, and neutral words	HA=LA, no alexithymia correlations in total sample. HA>LA, HA had greater Stroop interference to unmasked illness words than masked negative words[#].	HA= OR [↓] to illness words.
Mueller et al. (2006)	45, 67% F, M_{age}=45, M_{TAS}=54 Psychiatric inpatient sample	TAS-20 (D), OAS Controls(**2**): depression (BDI), anxiety (STAI, ASI), traits (NEO) symptoms (SCL-90)	**Emotional Stroop** Positive, negative, neutral, and body-related words	HA<LA: HA had reduced interference from negative and body words[#].	HA=Deficit [↓] in responding to negative and body words.

Pandey (1995)	12 HA (M_{TAS}=66) 12 LA (M_{TAS}=36) 0% F, M_{age}=NR (undergraduates)	TAS-20 (D) Controls: None	**Emotional Stroop** Baseline (nonword, OOOOO), neutral and emotionally arousing (sexual) words	HA>LA: HA exhibited greater Stroop interference for arousing words.	HA= <u>OR</u> [↓] to arousing words.
Sharpe et al. (2016)	52, 100% F M_{age}=22, M_{TAS}=45 Eating disorder sample	TAS-20 (C) Controls(**2**): depression (BDI), anxiety (STAI), symptoms (EDI)	**Eye-tracking** Free viewing of happy and angry faces paired with neutral faces	HA=LA; TAS-20 not related to attention bias metrics.	*No alexithymia effect* on attention to faces.
Suslow (1998)	32, 59% F, M_{age}=27, M_{TAS}=39	TAS-20 (C) w/facets Controls: none	**Affective Priming** Positive and negative words primed with positive, negative, or neutral words	HA (DDF): greater priming facilitation, negative prime-targets. HA (EOT): greater priming facilitation, positive prime-targets.	HA (DDF & EOT) =<u>OR</u> [↑] in automatic attention to affective primes.
Suslow and Junghanns (2002)	31, 52% F, M_{age}=26, Mdn_{TAS}=39 15 HA (M_{TAS}=51) 16 LA (M_{TAS}=30)	TAS-20 (C, D) w/facets Controls: none positive/ negative affect measured (DES) but did not analyse because no group difference	**Affective Priming** Neutral, emotional, and non-words primed with congruent or incongruent situational scenarios	Lexical decision times for emotional words: HA: congruent > incongruent LA: congruent < incongruent DIF associated with reduced situation priming	HA (DIF)=<u>Deficit</u> [↓] in automatic attention towards the emotional primes
Vermeulen et al. (2006)	<u>Study 1:</u> 64, 61% F, M_{age}=20, M_{TAS}=50 <u>Study 2:</u> 58, 84% F, M_{age}19, M_{TAS}=49 <u>Study 3:</u> 60, 75% F, M_{age}=21, M_{TAS}=47	TAS-20 (C) Controls(**1**): Negative affect (NAS; Study 1,3), anxiety (STAI, Study 2,3), depression (ZDS; Study 2,3)	**Affective Priming** <u>Study 1:</u> Targets: words (positive, negative, neutral). Primes: words (positive, negative, neutral) and faces (happy, threat, neutral) <u>Study 2:</u> As Study 1 plus sad faces and words <u>Study 3:</u> As Study 2, plus face targets (happy, sad, angry, disgusted)	HA<LA; HA correlated with reduced priming from angry schematic faces (Study 1, 2, 3). HA=LA; face priming by verbal stimuli did not correlate with alexithymia.	HA=<u>Deficit</u> [↓] in automatic attention to angry faces. *No alexithymia effect* in attention to emotional words.

Vermeulen et al. (2019)	55, NR % F, M_{age}=22, Mdn_{TAS}=45 27 HA (M_{TAS} =53) 28 LA (M_{TAS} =38)	TAS-20 (D) Controls: None	**Rapid Serial Visual presentation (RSVP)** Task with relaxation and exercise conditions T1 targets: neutral words T2 targets: neutral and low or high arousal words Distractors: random symbols	HA<LA. For T2 target accuracy, HA exercise= relaxation and no difference by target category, while LA exercise>relaxation, with high arousal>low arousal or neutral targets.	HA=Deficit [↓] in attention to arousing stimuli. HA= Deficit [↓] in attentional benefit of situational arousal.
Wiebe et al. (2017)	99, 63% F, M_{age}=24, M_{TAS}=41	TAS-20 (C) w/facets Controls(**1**): depression (BDI), anxiety (STAI), IQ (WAIS-R), sex	**Eye-tracking** Free viewing of pictures (positive, neutral, threat-relevant, depression-relevant) presented in a 2x2 grid.	HA<LA (EOT). HA had reduced dwell time on depression-relevant images.	HA (EOT)= Deficit [↓] in strategic attentional processing of negative images.

Notes**.** All studies used non-clinical samples (unless otherwise stated); TAS-20: Toronto Alexithymia Scale 20 Items (C-continuous, D-dichotomous, OAS-Observer Alexithymia Scale); DIF: Difficulty Identifying Feelings subscale of the TAS-20; DDF: Difficulty Describing Feelings subscale from the TAS-20; EOT: Externally Oriented Thinking subscale of the TAS-20; LA: Low Alexithymia Scorers; HA High Alexithymia Scorers; F=Female; CH=chronic headache; HC=healthy controls; PD=panic disorder; M_{TAS}= mean (Mdn=median) TAS-20 total score; M_{age}=mean (Mdn=median) age (years); NR=not reported; ns=not significant; OR=over-responding; [↓]=detrimental effect of HA; [↑]=potentially beneficial effect of HA; (**1**)results reported effects after affect variables controlled; (**2**)results reported indicating separable or unique effect of controls; (**3**)negative affect control reduced alexithymia effect.
Instruments: ASI = Anxiety Sensitivity Index; BDI=Beck Depression Inventory; BVAQ = Bermond-Vorst Alexithymia Questionnaire; ERVT=The Extended Range Vocabulary Test; DAS-21=Depression, Anxiety and Stress Scale; DES = Differential Emotions Scale; HQL-I= Health and Quality of Life Interview; EDI=Eating Disorders Inventory; HRSA=Hamilton Anxiety Rating Scale; HRSD =Hamilton Rating Scale for Depression; KSP = Karolinska Scales of Personality; MAS=Mood Awareness Scale; NAS = Negative Affectivity Schedule; NEO = The NEO Five-Factor Inventory (60 items); PANAS=positive and negative affect scale; SCRAS =Sheehan Clinician Rated Anxiety Scale; SCL-90=90-item Symptom Checklist Revised; SOMS=Screening for Somatoform Symptoms; STAI=State Trait anxiety Inventory; TMMS= Trait Meta Mood Scale; WAIS-R= Wechsler Adult Intelligence Scale (verbal); ZDS=Zung Depression scale.

Table 2. Alexithymia and appraisals.

Study	Sample Size & Characteristics	Alexithymia Measures/Controls	Appraisal Measures	Results (Total/Facets (if specified))	Implications

Aaron et al. (2018)	108, 67% F, M_{age}=19, M_{TAS}=46	TAS-20(C); w/facets Controls: none	Valence Presented 14 video clips eliciting discrete emotion states (anger, amusement, contentment, disgust, fear, sadness, surprise). Primary, secondary emotions (open-ended) assessed: emotional granularity (fine-grained emotional distinctions) and dialecticism (recognising concurrent pleasant and unpleasant states)	HA<LA (DDF): reduced emotional granularity, only for negative videos. HA<LA (EOT): reduced dialecticism, only for negative videos.	HA (DDF, EOT): Deficit [↓]. HA had reduced ability to for fine and gross distinctions of negative situations. Unpleasantness reduced in negative context. *No effect*: pleasantness in positive context.
de Timary et al. (2008)	28, 0% F, M_{age}=21, M_{TAS}=48	TAS-20(C); w/facets Controls: none	Stress anticipation, response Ps exposed to stressful task (TSST), measured effects of anticipatory appraisals on cortisol response	HA>LA (DDF): cortisol response, stress anticipation. HA=LA: stress exposure and recovery.	HA (DDF): OR [↓] Stronger stress response when appraising potential threat.
Fantini-Hauwel et al. (2015)	225, 69% F M_{age}=21, M_{TAS}=49	TAS-20(C); w/facets Controls(1): sex; negative, positive frequency (when predicting intensity; vice versa)	Valence Measured overall affect intensity (AIM; positive, negative subscales) and affect frequency (PANAS) without manipulation or reference to emotional events	(1) HA>LA (DIF): higher positive intensity. (2) HA<LA (DDF): lower positive intensity. (3) HA>LA (DIF): higher negative frequency.	HA (DDF): Deficit [↓] positive intensity. HA (DIF): OR [↓] higher positive intensity and greater negative frequency.
Koven (2014)	96, 59% F, M_{age}=19, M_{TAS}=46	TAS-20(D) Controls(2): negative affect (POMS), anhedonia (CRSPAS)	Valence Ps viewed appetitive and aversive words and pictures	HA<LA: appetitive words and pictures rated less positively. HA=LA: aversive word and picture ratings.	HA: Deficit [↓] Pleasantness decreased in positive contexts. *No effect*: unpleasantness in negative context.
Larwood et al. (2021) (this issue)	162, 56% F, M_{age}=21, M_{TAS}=54	TAS-20(C) Controls(2): depression (DASS).	Valence Ps listened to ten 15 sec musical pieces (happy, sad, tender, angry, fearful), listed emotion word conveyed by music.	HA=LA: number of emotion words generated. HA<LA: sad, angry, fearful music judged more neutral. HA=LA: happy, tender.	HA: Deficit [↓] negative stimuli. Unpleasantness reduced, negative context. *No effect*: pleasantness, positive context.

Luminet et al. (2000)	Study 1: 99, 86% F, M_{age}=20, M_{DDF}=23, M_F=16 Study 2: 101, 74% F, M_{age}=22, M_{DDF}=22, M_F=17	BVAQ(C); w/facets Controls(1): Emotional intensity event; Neuroticism and Extraversion (NEO PI-R)	Valence Measured rumination and social sharing for recent (3 months, Study 1; 6 months Study 2) negative and positive autobiographical events	HA<LA (DF): less rumination about positive, but not negative events. HA<LA (DDF): less sharing with others, lower emotional involvement in sharing for negative, but not positive events.	HA (DF, DDF): Deficit [↓] Decreased unpleasantness in negative context (DDF) Decreased pleasantness in positive context (DF)
Luminet et al. (2004)	50, 44% F, M_{age}=64, M_{BVAQ}:NR	BVAQ(C); w/facets Controls: gender, age, health status	Valence, familiarity, importance Measured familiarity, importance, emotional reactions to sad movie	HA<LA (EOT): lower unpleasantness. HA<LA (DDF): lower familiarity. HA<LA (EOT): lower importance.	HA (DDF, EOT): Deficit [↓] potentially due to avoidance. Decreased unpleasantness in negative contexts (EOT, DDF).

Notes. All studies used non-clinical samples. TAS-20=Toronto Alexithymia Scale 20; BVAQ=Bermond Vorst Alexithymia Questionnaire (DF=difficulty fantasising); C=continuous, D=dichotomous; DDF=difficulty describing feelings; DIF=difficulty identifying feelings; EOT=externally oriented thinking; F=Female; M_{TAS}= mean TAS-20 total score; M_{DIF}= mean DIF factor; M_{DDF} = mean DDF factor; M_{EOT}= mean EOT factor; M_F= mean difficulty fantasising factor; M_{age}=mean (Mdn=median) age (years); Ps=participants; OR=over-responding; [↓]=detrimental effect of HA; [↑]=potentially beneficial effect of HA; NR=not reported; (**1**)results reported effects after affect variables controlled; (**2**)results reported indicating separable or unique effect of controls; (**3**)negative affect control reduced alexithymia effect.
Instruments: AIM= Affect Intensity Measure; CRSPAS= Chapman Revised Social and Physical Anhedonia Scales; DASS= Depression, Anxiety and Stress Scale; NEO PI-R = NEO Personality Inventory-Revised; PANAS= Positive Affectivity Negative Affectivity Schedule; POMS= Profile of Mood States; STAI= State-Trait Anxiety Inventory (S=State; T=Trait); TSST= Trier Social Stress Test; Zung= Zung depression questionnaire.

Table 3. Alexithymia and memory.

Study	**Sample Size & characteristics**	**Alexithymia measures/ controls**	**Memory measures**	**Results (Total/Facets (if specified))**	**Implications**
Correro et al. (2021) (this issue)	Exp. 1: 296, 73% F, M_{age}=20, M_{TAS}=45 Exp. 2: 139, 67%	TAS-20(C), w/facets Screened: intact cognition	**Neutral Words, Narratives** Exp. 1: neutral word list (*d*', 60 min delay).	Exp. 1: HA<LA; EOT and DIF predicted memory, but EOT fully mediated DIF.	HA: Deficit [↓], poorer memory (EOT) and executive function (cognitive control) (DIF) in *neutral context*.

	F, 18–89 yrs, M_{TAS}=43 Exp. 3: 121, 67% F, 18–92 yrs, M_{TAS}=41	Controls (all exp.)(**4**): age, sex, anxiety (BSI.BAI), depression (BSI/BDI)	Exp. 2: EF battery. Exp. 3: EF; memory: WMS-III (neutral story; 30-min delay).	Exp. 2: HA<LA: DIF predicted EF. Exp. 3: HA<LA: DIF predicted EF; EOT predicted memory; moderation: poor EF + EOT = poor memory.	Executive function interacts with EOT [↓] to influence memory.
DiStefano and Koven (2012)	12 LA (M_{TAS}=46), 12 HA (M_{TAS}=63) 18–22 yrs 75% F	TAS-20(D) Controls: none	**Neutral Words, Faces, Narratives, Scenes** WMS-III (neutral), immediate, 30-min delay; verbal: words, story; visual: faces, social scenes.	HA=LA verbal, immediate and delayed; HA<LA visual, immediate and delayed	HA: <u>Deficit</u> [↓], visual memory (not verbal) in *neutral* context.
Donges and Suslow (2015)	40, 100% F, M_{age}=23, M_{TAS}=35	TAS-20(C), w/facets Controls(**2**): vocab (MVT), anxiety (STAI-T), depression (BDI) Correlational analysis.	**Emotive Faces** Intentional encoding of faces (angry, fearful, happy, neutral). 30 min delayed recognition.	HA<LA (DDF): DDF inversely correlated with angry, fearful hits; HA=LA: happy, neutral	HA (DDF): <u>Deficit</u> [↓] emotive face memory (anger, fear).
Dressaire et al. (2015)	Exp. 1 (negative words): 60, 50% F, 35–99 yrs, M_{TAS}=52 Exp. 2 (neutral words): 60, 50% F, 35–98 yrs, M_{TAS}= 51	TAS-20(C), w/facets Controls(**1**): age, anxiety and depression (HADS)	**Neutral, Emotive Words** <u>Directed forgetting</u> (list method); 1 min retrieval delay. Exp. 1: negative words Exp. 2: neutral words	Exp. 1 (negative): HA<LA (EOT); HA predicted poorer recall, greater false memory; Exp. 2 (neutral): HA<LA (EOT); EOT correlated with poorer retrieval; HA>LA (DIF); DIF predicted *better* recall.	HA (EOT): <u>Deficit</u> [↓] *negative*; *neutral* (ns)*;* HA (EOT): <u>OR</u> [↓] false negative memory (cognitive control *deficit*); HA (DIF): <u>OR</u> [↑] *neutral*.

Jacob and Hautekeete (1998)	21 LA (TAS-26<62) 24 HA (TAS-26>74) ~90% F, 18–22 yrs	TAS-26 (French; D) Controls(**1**): anxiety (non-standard), depression (BDI)	**Neutral, Emotive Words** Incidental learning, sentence game (phrase substitution, w/tone (negative, positive, neutral)). Immediate recognition (old/new).	HA>LA: slower response time HA<LA: errors (*more* correct rejections, not more hits). HA=LA: positive>negative >>neutral.	HA: <u>Deficit</u> [↓] in decision time only, not memory; HA: <u>OR</u> [↑]; fewer errors (rigorous decision criterion, greater need for cues).
Luminet et al. (2006)	42 HA (TAS>56), 40 LA (TAS<40) 56% F, age NR (undergraduates)	TAS-20(D), w/facets Controls(**2**): positive/ negative affect (PANAS), optimism (LOT-R), depression (ZSDS)	**Neutral, Emotive Words** Incidental word learning (positive, negative, neutral), R/K paradigm, retrieval delay, 1-min w/distraction.	HA<LA: R (confident), poorer positive (total, all facets) and negative (DIF), whether shallow or deep processing. HA=LA for recall, K (familiarity), Neutral.	HA: <u>Deficit</u> [↓], conscious access to emotional words (*positive*: DIF, DDF, EOT; *negative*: DIF).
Lundh et al. (2002)	Exp. 1: 88, 76% F, M_{age}=29, M_{TAS}=40	TAS-20(C), w/facets Controls: none	**AMT** (positive, negative prompts).	HA=LA; No correlation of TAS-20 (total or facets) with latency or retrieval of positive or negative memories.	Alexithymia *did not contribute to* retrieval time or memory.
Meltzer and Nielson (2010)	42 LA (TAS<43) 43 HA (TAS>42) 69% F, M_{age}=19	TAS-20(D) Controls: none	**Neutral, Emotive Words** Incidental learning (word rating); positive, negative, neutral, illness words. Recall delay, 45 min.	HA<LA: negative recall HA>LA: illness recall, HA>LA: neutral recall (trend).	HA: <u>Deficit</u> [↓], *negative*; HA: <u>OR</u> [↓], *illness,* possibly pre-occupation, salience of illness
Muir et al. (2017)	185, 92% F, 18–36 yrs, M_{TAS}=49	TAS-20(C), w/facets Controls: none	**AMT** (negative, positive, neutral memory probes); Fading of Affect Bias (FAB, over time,	HA<LA (total score only) FAB; HA: greater positive fading, less negative fading. No effects were	HA: <u>OR</u> [↓] less affect fading; due to greater positive fading, negative persistence (*negative* salience).

			negative> positive fading).	significant with TAS subscales.	
Nielson and Meltzer (2009)	30 LA (TAS<38), 67% F 30 HA (TAS>53), 57% F Age NR (undergraduates)	TAS-20(D) Controls(**4**): vocab. (WAIS-R), stress (PSS), depression (BDI), anxiety (BAI)	**Neutral Words** Intentional learning, word list (neutral) followed by arousing or neutral video. Retrieval delay 24-hrs (surprise).	HA<LA: immediate recall HA<LA subjective arousal HA=LA physiological arousal HA=LA 24 hr recall, arousal condition (deficit direction).	HA: Deficit [↓] of arousal appraisal and immediate memory of *neutral* stimuli; *No effect*: delayed memory.
Ridout et al. (2021) (this issue)	Exp. 1: 39, 100% F, M_{age}=20, M_{TAS}=40 Exp. 2: 38, 100% F, M_{age}=20, M_{TAS}=42	TAS-20(C), w/facets Controls(**1**): age, depression (HADS), anxiety (HADS)	**Neutral, Emotive Faces, Scenes** Emotion identification (angry, sad, happy, neutral), intentional learning. R/K paradigm, retrieval delay: 5 min. Exp. 1: faces. Exp. 2: social videos.	Exp. 1: HA=LA emotion identification; HA<LA (DDF): *d'*, angry; HA>LA (DIF): *d'*, sad; Exp. 2: HA<LA (DIF, EOT); HA predicted poorer emotive memory (DIF, EOT: hits; DIF: R, anger and happy); HA>LA (DIF); HA predicted better neutral familiarity (K).	HA: Deficit [↓], *anger* (faces, DDF; videos, DIF, EOT) and *happy* videos (DIF, EOT); HA: OR (DIF) [↓], *better* retrieval of *sad* faces; HA: OR (DIF) [↑], greater familiarity of *neutral* videos.
Senior et al. (2020)	83, 87% F, M_{age}=20, M_{TAS}=46	TAS-20 (C), w/facets Controls(**2**): depression (HADS), anxiety (HADS) Correlational analysis.	**Emotive Faces** Affect matching, short-term memory (faces; anger, disgust, fear, happy, sad, surprise, neutral), with RM (25% increased / decreased expression intensity) during match decisions.	HA<LA (Total), accuracy; HA<LA (DIF), errors, forward cond. HA>LA (DIF), response time, forward cond. HA<LA (EOT): RM effect (forward > backward; fear, happy), except reduced in HA trend, *p*=.07. (Note accuracy >95%).	HA (total): Deficit [↓], accuracy; HA (DIF): Deficit [↓], slower RT; HA (EOT): Deficit [↓], RM effect HA (DIF): OR [↑], *reduced* errors to forward trials, possible benefit RM perception.
Suslow et al. (2003)	30, 50% F, M_{age}=36, M_{TAS}=38	TAS-20 (C), w/facets	**Neutral, Emotive Words**	HA>LA (DIF): DIF positively correlated	HA (DIF): OR [↓], more intrusion errors in recall, positive stimuli.

		Controls(**2**): depression (BDI), vocab. (WAIS-R) Correlational analysis	Incidental memory, pair evaluation (positive, negative adjective targets; positive, negative, neutral noun distractors). Immediate free recall.	with intrusions to positive distractors. HA=LA, positive, negative targets, and neutral distractors.	HA: Emotional valence less salient, poorer memory organization.
Takahashi et al. (2015)	Exp. 1: 15 LA (TAS<52), 53% F, M_{age}=21; 15 HA (TAS>60), 73% F, M_{age}=20 Exp. 2: 8 LA (TAS<52), 63% F, M_{age}=21; 8 HA (TAS>60), 63% F, M_{age}=20	TAS-20(D) Controls: none	**Neutral, Emotive Faces** Visual STM; search and change detection of abstract faces. Exp 1: montage, encoding v. storage; happy, angry. Exp. 2: probed single item (storage v. retrieval); happy, angry, neutral.	Exp. 1: HA=LA in search and change detection response time; HA<LA in change accuracy (*d'*) for happy, and within HA, happy<angry; storage effect, not encoding. Exp. 2: HA=LA (happy, angry; neutral presented but not probed); no effect on retrieval.	HA <u>Deficit</u> [↓], *happy* accuracy only, via immediate memory storage. No effect on response speed. Note: face stimuli were not realistic.
Terock et al. (2019)	Exp. 1: 1980, 53% F, M_{age}=55, M_{TAS}=45 Exp. 2: 3799, 51% F, M_{age}=51, M_{TAS}=42	TAS-20(C), w/facets Controls(**1**): age, sex, education, lifetime major depression (MCIDI)	**Neutral Words** Intentional neutral word list learning, multiple trials; Delay interval: immediate, 20-min;	Exp. 1: HA<LA (EOT, DIF): poorer immediate, delayed recall predicted by EOT, with DIF to lesser degree. Exp. 2: HA<LA (EOT): replicated Exp. 1, trend only at delayed recall.	HA (EOT) <u>Deficit</u> [↓], immediate, delayed word memory for *neutral* words in neutral context.
Vermeulen (2021) (this issue)	Exp. 1: 44, 66% F, M_{age}=21, M_{TAS}=45 Exp. 2: 44, 75% F, M_{age}=21, M_{TAS}=48	TAS-20(C), w/facets Controls(**1**): age, sex,	**Neutral, Emotive Words** Verbal STM (auditory); 20 6-item lists; positive,	Exp. 1 (pure): HA< LA (TAS-total, EOT); EOT predicted poorer positive, negative recall (neutral-trend);	HA: <u>Deficit</u> [↓] (EOT *negative, positive,* and *neutral* (trend) stims; DDF *positive* stims) when <u>contextually cohesive</u>. No effect in mixed context.

		positive/negative affect (PANAS)	negative, neutral. Exp. 1: pure lists (one word valence type/list) Exp 2: mixed lists	HA<LA (DDF); DDF predicted poorer positive recall. Exp. 2 (mixed): HA=LA;.	
Vermeulen and Luminet (2009)	65, 83% F, M_{age}=19, M_{TAS}=48	TAS-20(C), w/facets Controls(**1**): anxiety (STAI-S); positive/negative affect (PANAS)	**Neutral, Emotive Words** Incidental learning; word evaluation task of neutral, joy, disgust, and anger words (shallow or deep processing). Surprise immediate (Remember/ Know) retrieval.	HA<LA (DIF); DIF associated with poorer emotion word memory (R); HA>LA (EOT) *better* memory, all categories, via emotional introspection EOT items, not external thinking items.	HA (DIF): <u>Deficit</u> [↓], emotive words; emotion regulation difficulty, lack of motivation for emotion processing; HA (EOT): <u>OR</u> [↑], improved all categories.
Vermeulen et al. (2010)	55 LA (TAS<47), 73% F, M_{age}=22 52 HA (TAS>48), 67% F, M_{age}=21	TAS-20(D) Controls(**1**): positive/ negative affect (PANAS)	**Neutral, Emotive Words** Incidental learning; word evaluation task of neutral, joy, disgust, and anger words (shallow or deep processing) with happy or sad background music. Surprise immediate (Remember/ Know) retrieval.	HA>LA: Congruent music facilitated word processing, deep condition. HA<LA anger word retrieval, overall memory w/ angry music. HA>LA congruence effect (happy music: joy>anger; angry music: anger>joy). HA=LA: processing time.	HA <u>Deficit</u> [↓], anger. HA <u>OR</u> [↑], *congruence effect*; matching context provided support for memorising, retrieving anger and joy words.

Notes. All studies used non-clinical samples; TAS-26: Toronto Alexithymia Scale 26 Items; TAS-20: Toronto Alexithymia Scale 20 Items (C-continuous, D-dichotomous); DIF: Difficulty Identifying Feelings subscale of the TAS-20; DDF: Difficulty Describing Feelings subscale from the TAS-20; EOT: Externally Oriented Thinking subscale of the TAS-20; LA: Low Alexithymia Scorers; HA High Alexithymia Scorers; F=Female; *d'*= d-prime, recognition sensitivity (accuracy); EF=executive functioning; K= 'know' response (familiarity in recognition); M_{TAS}= mean TAS-20 total score; M_{age}=mean age (years); NR=not reported; ns=not significant; OR=over-responding; R= 'remember' response (confident retrieval in recognition); RM= representational momentum, perceptual extrapolation in direction of an implied trajectory; STM=short-term memory; [↓]=detrimental effect of HA; [↑]=potentially beneficial effect

of HA; (**1**)results reported effects after affect variables controlled; (**2**)results reported indicating separable or unique effect of controls; (**3**)negative affect control reduced alexithymia effect; (**4**)affect variables left out of analysis as they did not correlate with DV.
Instruments: AMT=Autobiographical Memory Test; BAI=Beck Anxiety Inventory; BDI= Beck Depression Inventory; BSI=Brief Symptom Inventory; HADS=Hospital Anxiety and Depression Scale; KS*P*=Karolinska Scales of Personality (Trait); LOT-R=Life Orientation Test-Revised; MCIDI=Munich Composite International Diagnostic Interview; MVT=Multiple-choice Vocabulary Test; PANAS=Positive Affectivity Negative Affectivity Schedule; PSS=Perceived Stress Scale; SPM=Raven's Standard Progressive Matrices; STAI=State-Trait Anxiety Inventory (S=State; T=Trait); WAIS-R=Wechsler Adult Intelligence Scale-Revised (vocabulary subtest); WMS-III=Wechsler Memory Scale-III; ZSDS=Zung Self-rating Depression Scale.

Table 4. Alexithymia and language.

Study	**Sample Size & Characteristics**	**Alexithymia Measures/ Controls**	**Language Measures**	**Results (Total/Facets (if specified))**	**Implications**
Camia et al. (2020)	4 LA, 75% F, M_{age}=50, M_{TAS}=44; 4 HA, 25% F, M_{age}=43, M_{TAS}=64 Chronic alcoholism sample	TAS-20 (D) Controls: none	**Expressive: Autobiographical Narratives** Qualitative narrative analysis (LIWC) of personal events (TSIA); 6 yes/no questions per TAS-20 facet, with elaboration using personal examples.	HA=LA: specificity HA>LA: personalisation, concreteness, avoidance. HA<LA: coherence, affect ratio (HA: positive> negative), elaboration (context, feelings, interpretation).	HA <u>Deficit</u> [↓] in language expression, particularly negative processing; reflected personalised but low quality, unelaborated, concrete, avoidant approach.
Edwards et al. (2020)	96; 76% F, M_{age}=21, M_{TAS}=44	TAS-20(C) w/facets Controls(**1**): positive/ negative affect (PANAS)	**Expressive: Autobiographical Narratives** Narrative analysis of 6 probed personal events (5 min; 3 negative and 3 neutral or positive). Linguistic analysis (LIWC). Uncorrected correlations.	HA<LA (DIF, DDF): less positive language. HA>LA (DIF, DDF): more negative language, more self-focus, and stronger emotion-situation correspondence.	HA (DIF, DDF) <u>Deficit</u> [↓] in positive expression. HA (DIF, DDF) OR [↓] More negative language and perseveration on self-relevance (salience) in emotive context.

Jakobson and Pearson (2021) (this issue)	70, 51% F, M_{age}=21, M_{TAS}=47	TAS-20(C) w/facets Controls: sex, verbal IQ (WASI)	**Receptive: Social Inference** Social video vignettes (neutral), infer speaker intentions (literal, sarcastic, jocular, white lies) with or w/o verbal context.	HA>LA (DDF): *better* accuracy when no context. HA>LA (DIF): *slower* on non-literal exchanges when no context.	HA (DIF) <u>Deficit</u> [↓], via response time and when no context available. HA (DDF) <u>OR</u> [↑], *better* accuracy when no context.
Jelinek et al. (2010)	N_{PTSD}= 25, 64% F M_{age}=41, M_{TAS}=54; $N_{nonPTSD}$= 54, 48% F M_{age}=39, M_{TAS}=44 Trauma sample	TAS-20 (C) Controls: none	**Expressive: Autobiographical Narratives** Interview about trauma experience, analysed with LIWC.	HA=LA: no correlation with affect word use in full sample or non-PTSD. HA<LA: negative correlation in those with PTSD.	HA <u>Deficit</u> [↓] in language expression. Reduced emotional expression discussing trauma in HA with PTSD.
Kreitler (2002)	100, 50% F, M_{age}=23, M_{TAS}=55	TAS-20 (C) w/facets Controls: none	**Expressive: Autobiographical Narratives (neutral)** The Meaning Test; Communicate personal meaning of a 11 probe words (e.g. “telephone”) to another person (i.e. neutral context).	HA>LA: concrete, simple, visual, externalized. (DIF: concreteness; DDF: avoidance of emotion (perceived, experienced); EOT: concrete, externalized).	HA (DIF, DDF, EOT) <u>Deficit</u> [↓] in *general* language expression qualitatively poorer (*neutral* context).
Luminet et al. (2004)‡	50, 44% F, M_{age}= 64, M_{BVAQ}= NR	BVAQ (C) w/facets (independent, as TAS-20) Controls: age, sex, health status	**Expressive: Emotional Narrative** Emotional video (sad), re-exposure 2d later, recount most emotional part; lexical task (bird names, emotion words). Scored emotion word content/frequency.	HA=LA: no correlation with emotion or neutral word frequency HA<LA (DDF): negatively correlated with emotion word frequency about film.	HA (DDF) <u>Deficit</u> [↓] in language expression. HA have sufficient emotion vocabulary, access, but use it less in emotional situations.
Meganck et al. (2009)	50, 62% F, M_{age}= 42 M_{TAS}= 60	TAS-20 (C) w/facets Controls(**1**):	**Expressive: Autobiographical**	HA=LA: word frequency HA<LA (DIF, EOT) lower	HA (DIF, EOT) <u>Deficit</u> [↓] in language expression. HA

	Psychiatric inpatient sample	positive/ negative affect (PANAS)	**Narratives** Interview using CDI (2 hr; covering complaints, relationships, work/school, symptoms, etc. and follow-up probes). Used LIWC analysis of communication word frequency, complexity.	complexity HA>LA (EOT) more references to others v. self.	(EOT) <u>OR</u> [↓] more other-focused. HA discussions had reduced vividness, differentiation and self-disclosure.
Paez et al. (1999)	Exp. 3: 70 (via Exp. 1, 2); ≈65% F; M_{age}≈19; Md_{DDF}=12	TAS-20 (D)-DDF, median split. Controls: none PPSS, positive/ negative affect (PANAS) measured but did not analyse because no group difference	**Expressive: Autobiographical Narratives** Expressive writing about traumatic or social event.	HA<LA: emotion words, esp. positive; introspection, self-reference. HA>LA: inhibition.	HA (DDF) <u>Deficit</u> [↓] in language expression. Intensive writing was *beneficial* relative to brief writing.
Parker et al. (2000)	8 LA, 50% F, M_{TAS}=31; 8 HA, 50% F, M_{TAS}=66; Age: NR (undergraduates)	TAS-20 (D) Controls: none	**Expressive: Autobiographical Narratives** Sleep study; dream recounting upon awakening from REM (dream) sleep.	HA=LA: valence of dreams, number of words. HA<LA: fantasy content	HA <u>Deficit</u> [↓] in language expression, specifically in elaboration and imagination.
Roedema and Simons (1999)	31 LA, 48% F, M_{TAS}<52; 34 HA; 56%; M_{TAS}>72; Age: NR (undergraduates)	TAS-26 (D) Controls: none	**Expressive: Autobiographical Narratives** Emotional slides; ratings, psychophysiological measures. Subjects wrote adjectives to	HA<LA emotion words.	HA <u>Deficit</u> [↓] in language expression.

			describe how the slide made them feel.		
Samur et al. (2021) (this issue)	Online: 541, 55% F, M_{age}=36, M_{BVAQ}=100; Lab: 55, 55% F, M_{age}=22, M_{BVAQ}=100	BVAQ/subscores (Cognitive, aka TAS-20 total; Affective (DF)= emotionalising, fantasising) Controls: none	**Receptive: Narrative Engagement** Ss read fictional narrative, with either 1^{st}- or 3rd-person perspective. Narrative engagement measured using TS.	HA<LA: (Total, DF): negatively correlated with narrative engagement. HA<LA (DF): effect of perspective (engagement 1^{st} > 3rd) in LA, not in HA.	HA (Total, DF) <u>Deficit</u> [↓] in narrative processing, even w/ 1st person perspective. Developmental role in empathy, perspective-taking.
Smyth et al. (2002)	39_{asthma}, 73% F, M_{age}≈41 32_{RA}, 71%F, M_{age}≈51 Overall, M_{TAS}=44	TAS-20 (C) Controls: none	**Expressive: Autobiographical Narratives** Writing on 3 consecutive days (20 min ea.) about traumatic experience, coded for personal, emotional content and narrative structure.	HA=LA: No correlation with personal, emotional expression, change in positive or negative affect after writing; or narrative structure.	HA: no effect.
Tull et al. (2005)	541; 67% F, M_{age}=27, M_{TAS}=46	TAS-20 (C) w/facets Controls(**1**): negative affect (PANAS)	**Expressive: Autobiographical Narratives** 5-min interview about distressing past event, linguistic analysis with LIWC.	HA<LA (DIF): negative correlation with frequency, variety of positive words. HA>LA (DIF): *positive* correlation with frequency of negative words.	HA (DIF) <u>Deficit</u> [↓] in positive expression; may reflect reduced positive vocabulary store/access. HA (DIF): <u>OR</u> [↓] negative expression; may reflect mood and emotion regulation ability.
Vanheule et al. (2011)	32, 63% F, M_{age}=43, M_{TAS}=56 Mental health outpatient sample	TAS-20 (C) w/facets Controls(**1**): depression (BDI)	**Expressive: Autobiographical Narratives** Clinical interview (2hr); narrative analysis (LIWC) for frequency, complexity (diversity) of	HA>LA (DIF): *more* cognitive words (CI incl. 0). HA<LA (EOT): *fewer* cognitive words (CI incl. 0), *fewer, less complex* social words, *less complex* cognitive words.	HA (EOT) <u>Deficit</u> [↓] in language expression. Reduced social word use, diversity of expression (i.e. social detachment, impaired cognitive processing).

			cognitive and social word use.		
Wagner and Lee (2008)	Exp. 1: 55, 100% F, M_{age}=20, M_{TAS}=47 Exp. 2: 54, 100% F, M_{age}=21, M_{TAS}=50	TAS-20 (C) w/facets Controls: none	**Expressive: Autobiographical Narratives** Oral narrative of a personal positive and negative event (w/ or w/o female experimenter present). Correlational analysis.	Exp. 1: HA<LA (DIF): less positive expression in positive context. HA< LA (DIF, EOT): less negative expression in negative context. Exp. 2: HA<LA; Replicated Exp. 1; social context, ns.	HA (DIF, EOT) <u>Deficit</u> [↓] in language expression congruent with context (DIF both positive, negative; EOT negative, may be mediated by DIF).
Wotschack and Klann-Delius (2013)	52 LA, 42% F, M_{age}=34; M_{TAS}=38; 50 HA; 42%; M_{age}=36; M_{TAS}=68	TAS-20 (D) Controls: none	**Expressive: Autobiographical Narratives** Interviews on positive, negative personal experiences (emotion word cues, autobiographical narratives, pictures, LEAS).	HA<LA: types of emotion words, emotion synonyms, fewer symptomatic and physiological words.	HA <u>Deficit</u> in [↓] language expression. Suggested reduced, less diverse semantic and conceptual vocabulary for emotion.

Notes. All studies used non-clinical samples except as noted; BVAQ: Bermond-Vorst Alexithymia Questionnaire (DF=difficulty fantasising); TAS-26: Toronto Alexithymia Scale 26 Items; TAS-20: Toronto Alexithymia Scale 20 Items (C-continuous, D-dichotomous); DIF: Difficulty Identifying Feelings subscale of the TAS-20; DDF: Difficulty Describing Feelings subscale from the TAS-20; EOT: Externally Oriented Thinking subscale of the TAS-20; LA: Low Alexithymia Scorers; HA High Alexithymia Scorers; ‡=study appears in more than one table and section of the paper; F=Female; M_{TAS}= mean TAS-20 total score; M_{age}=mean age (years); *d'*= d-prime, recognition sensitivity (accuracy); PTSD=post-traumatic stress disorder; RA=rheumatoid arthritis; NR=not reported; ns=not significant; OR=over-responding; CI=Confidence Interval (contains 0=low confidence of true significance); [↓]=detrimental effect of HA; [↑]=potentially beneficial effect of HA; (**1**)results reported effects after affect variables controlled; (**2**)results reported indicating separable or unique effect of controls; (**3**)negative affect control reduced alexithymia effect.
Instruments: BDI= Beck Depression Inventory; CDI=Clinical Diagnostic Interview; LEAS= Levels of Emotional Awareness Scale; LIWC= Linguistic Inquiry Word Count; PANAS=Positive Affectivity Negative Affectivity Schedule; PPSS=Pennebaker Physical Symptoms Scale; TSIA=Toronto Structured Interviews for Alexithymia; TS=Transportation Scale; WASI= Wechsler Abbreviated Scale of Intelligence-2nd Ed. (vocabulary, similarities subtests).

Table 5. Alexithymia, action tendencies and behaviours.

Study	**Sample size & characteristics**	**Alexithymia measures/controls**	**Action tendencies/ behaviours measures**	**Results (Total/Facets (if specified))**	**Implications**
Edwards and Wupperman (2017)	96, 76% F, Mdn_{age}=20, M_{TAS}=44	TAS-20(C) Controls: none	**Aggression** Self-reported impulsive aggression (IPAS), emotion regulation (DERS)	HA>LA: HA positively correlated wtih agression, which was mediated by emotion dysregulation.	HA: <u>OR</u> [↓] Poor access to emotion information produces emotion dysregulation in HA, predisposing them to acts of impulsive aggression.
Gvirts and Dery (2021) (this issue)	116, 65% F, M_{age}=24, M_{TAS-20}=46	TAS-20(C, D), w/facets Controls: none	**Social agreement** Videogame where Ps unaware whether playing with a bot (who acts rationally, always seeks consensus), or with other Ps.	HA<LA (EOT): HA had impaired ability to reach social agreement; evident when group harmony is low but not when group harmony is high.	HA (EOT): <u>Deficit</u> [↓] for interpersonal functions. Possibly due to low reliance on reward from social interactions.
Laloyaux et al. (2015)	<u>Study 1</u>: 255, 69% F, M_{age}=20; M_{TAS-20}=49 <u>Study 2</u>: 1111, 50% F, M_{age} = 41, M_{BVAQ}=106	Study 1: TAS-20(C); w/facets Study 2: BVAQ(C); w/facets Controls: age, education	**Emotion regulation** Used the ERQ; with reappraisal and suppression dimensions.	HA>LA (DDF): greater use of emotional suppression in HA; HA=LA: reappraisal	HA (DDF): <u>OR</u> [↓] excessive use of emotional suppression.
Panayiotou et al. (2015)	<u>Study 1</u> (HC): 205, 79% F, M_{age}=21, M_{TAS}=53 <u>Study 2</u> (anxiety sample): 163, 37% F, M_{age}=30; M_{TAS}=56	TAS-20(C), w/facets Controls: none	**Experiential avoidance** Self-report measures of psychosomatic symptoms (PHQ-15), depression (BDI), and experiential avoidance (AAQ)	HA>LA (DIF,DDF): positive correlation w/symptoms (Study 1), depression (Study 2); mediated by experiential avoidance. DIF reduced with depression treatment (Study 2); mediated by reduced experiential avoidance.	HA (DIF, DDF): <u>OR</u> [↓] (somatic symptoms, depression); mediated by experiential avoidance. Alexithymia change (DIF) with treatment due to change in experiential avoidance.

Teten et al. (2008)	38, 8% F, M_{age}=59, M_{TAS}=63 Trauma sample	TAS-20(C) Controls: none	**Aggression** Measured impulsive aggression (IPAS), verbal/physical aggression (BPAQ), empathic concern (IRI)	HA>LA: HA predicted higher impulsive agression (R^2 = .10)	HA: <u>OR</u> [↓] HA results in greates impulsive aggression, but not general aggression.
Velotti et al. (2016)	HC: 617, 46% F, M_{age}=37, M_{TAS}=43 Inpatient psychiatric sample: 257, 50% F, M_{age}=44, M_{TAS}=55	TAS-20(C) Controls(**2**): age, sex depression (BSI)	**Aggression** Measured aggression (AQ), emotion dysregulation (DERS), impulsivity (BIS-11)	HA>LA: HA positively correlated with aggression (both samples), which was mediated by emotion dysregulation (both samples), and impulsivity (only HC).	HA: <u>OR</u> [↓] emotion dysregulation responsible for the role of HA in aggression.
Venta et al. (2013)	64, 59% F, M_{age}=16, HA: M_{TAS}=71, LA: M_{TAS}=45 Psychiatric inpatient sample	TAS-20(D) Controls: none (age, sex, verbal IQ were comparable)	**Experiential avoidance** Examined self-reported emotion regulation (DERS), experiential avoidance (AFQ-Y)	HA>LA: HA positively associated with emotion dysregulation, which was mediated by experiential avoidance in this adolescent inpatient sample.	HA: <u>OR</u> [↓] HA exhbit emotion dysregulation, due to experiential avoidance.

Notes. All studies used non-clinical samples except as noted. TAS-20: Toronto Alexithymia Scale 20 Items (C-continuous, D-dichotomous); DIF: Difficulty Identifying Feelings subscale of the TAS-20; DDF: Difficulty Describing Feelings subscale from the TAS-20; EOT: Externally Oriented Thinking subscale of the TAS-20; BVAQ: Bermond Vorst Alexithymia Questionnaire (C-continuous, D-dichotomous); LA: Low Alexithymia Scorers; HA High Alexithymia Scorers; F=Female; M = Male; M_{TAS}= mean TAS-20 total score; M_{age}=mean age (years; Mdn=median); HC=healthy controls (community sample); OR=over-responding; Ps = Participants; [↓]=detrimental effect of HA; [↑]=potentially beneficial effect of HA; (**1**)results reported effects after affect variables controlled; (**2**)results reported indicating separable or unique effect of controls; (**3**)negative affect control reduced alexithymia effect.

Instruments: AAQ= Acceptance and Action Questionnaire (II); AFQ-Y= Questionnaire for Youth; AQ= Aggression Questionnaire; BIS-11=Barratt Impulsiveness Scale-11; BDI= Beck Depression Inventory(II); BPAQ= verbal and physical aggression, Buss–Perry Aggression Questionnaire; BSI=Brief Symptom Inventory; DERS= Difficulties in Emotion Regulation Scale; ERQ= Emotion Regulation Questionnaire; IPAS= Impulsive-Premeditated Aggression Scale (Impulsive Aggression Subscale); IRI= Interpersonal Reactivity Index; PHQ-15= Patient Health Questionnaire-15.

Early research in personality employed a primarily categorical approach, comparing mean differences between groups based on clinical cutoffs or median splits. There has since been a shift toward a continuous/dimensional approach, using correlations and regression to test the moderating impact of alexithymia. We view a continuous approach as preferred as it more accurately and sensitively considers behavioural and cognitive differences across individuals. We endeavour to report the approach used (see tables), but for synthesis, have used "HA" to refer to those with high(er) alexithymia scores, and "LA" to refer to those with low(er) scores, regardless of approach.

2.1. Attention

Attention involves alerting, orienting, and executive control that manages the focus, selection, and direction of one's limited pool of cognitive resources (Petersen & Posner, 2012). It involves orienting towards stimuli in the environment and the selection of certain stimuli, over others, for further processing or action. It includes both early processes (e.g. orienting, priming) that occur automatically and without awareness or intention, and later processes that require conscious and intentional effort (e.g. selecting and maintaining information in awareness). Emotional events capture attention more readily than do non-emotional stimuli, even when task irrelevant. They can also interrupt ongoing non-emotional processing, leading to slower responding or poorer accuracy. The influence of alexithymia on attention is of central importance, because biases during the early stage of processing can influence subsequent processing, such as appraisal and memory (see sections 2.2 and 2.3). Specifically, emotional stimuli are thought to bias competition for attentional priority through heightened salience, exhibiting influence across the continuum from early automatic processing to later controlled processing (Yiend, 2010).

To the extent that alexithymia is a deficit in emotion processing (Taylor, 2000), where emotion is thought to be a less salient aspect of alexithymic individuals' mental life, we would expect HA to show impaired attentional processing of affective stimuli. Moreover, although emotional reactions occur, high EOT has been conceptualised as a deficit in the ability to attend to such emotional reactions (Preece et al., 2017). As such, we would specifically predict under-responding to emotional stimuli linked to the EOT facet. We found 16 papers (19 studies) that examined the influence of alexithymia on attention (see Table 1). Most of these (n=16) examined early, automatic processing of emotional stimuli, though work has begun to investigate later, controlled attentional processing.

Attentional processing in alexithymia has focused primarily on early, automatic orienting and priming. Emotional Stroop tasks have been common, where emotional and non-emotional words are presented, with participants asked to report the ink colour of the words, but to ignore their meaning. One emotional Stroop study found no relationship between alexithymia and colour-naming times (Galderisi et al., 2008) and another found no bias toward threat stimuli (i.e. pain) in a dot-probe paradigm (Liossi et al., 2009). Yet, others have demonstrated slowed colour-naming of threat words (Pandey, 1995; Parker et al., 1993b) and illness words (Lundh & Simonsson-Sarnecki, 2002), indicative of an attention bias for threat in HA. Similarly, attention was biased in HA toward distracting negative faces on a face-word variant of the emotional Stroop task (Hsing et al., 2013). However, these studies did not control for negative affect (NA), which has been linked to an attention bias towards threat (MacLeod, 2019). Studies that incorporated such controls showed reduced emotion interference in those with HA (Coffey et al., 2003; Mueller et al., 2006), suggesting that individuals with higher alexithymia scores have a deficit in the automatic processing of affect.

Affective priming tasks provide an alternative way to examine early attention processes. They do so by asking subjects to respond to a target stimulus that is briefly preceded by another stimulus, known as the "prime". Prime-target pairs either have congruent valence, which facilitates accuracy and response speed, or incongruent valence, which slows response times and reduces target accuracy. In HA, Suslow (1998) reported greater facilitation of congruent prime-target pairs with greater DIF (positive pairs) and EOT (negative pairs), suggesting enhanced automatic processing of emotion in HA. However, when negative affect was controlled, other studies instead showed reduced emotional priming in HA. For example, Suslow and Junghanns (2002) found HA had reduced priming (interference) from incongruent verbal primes. Over three experiments, Vermeulen et al. (2006) reported reduced priming (both facilitation and interference) from angry face primes in HA. Finally, Brandt et al. (2015) reported that when categorising illness words, HA exhibited reduced interference from positive and negative primes. Taken together, when negative affect is controlled, the findings in early attention processing support the deficit model of alexithymia (Taylor, 2000), with also some evidence supporting the role of EOT in this deficit (Coffey et al., 2003), in line with the attention-appraisal model (Preece et al., 2017).

Another way to examine early attentional processing that allows for processing both early and later aspects of attention is the so-called "attentional blink" (AB). The AB is the phenomenon that one fails to detect, or identify, the second of two targets when it occurs close in time to the first target. The Rapid Serial Visual Presentation (RSVP) task used to assess AB therefore presents a stream of rapidly presented stimuli, requiring participants to detect two targets (T1, T2) within that stream. Longer ABs indicate prolonged T1 processing, while shorter ABs indicate enhanced T2 detection. Grynberg et al. (2014) reported that DDF (study 1) and EOT (study 2) were linked to longer ABs when negative faces were presented at T1. In contrast, Vermeulen et al. (2019) reported that arousing T2 stimuli produced shorter ABs, and that T2 detection was enhanced if arousal was induced through exercise prior to the task. Yet, this effect only occurred in LA, suggesting that HA have a deficit in attention to arousing stimuli. Together, these findings suggest a different profile for HA depending on the phase of attention processing. Specifically, HA exhibit a deficit in automatically orienting towards threat, but prolonged processing of threat (over-responding) during the conscious maintenance phase of attention.

An additional approach to examining both early and later influences on attention is through eye-tracking. Using tracking technology, variations in eye movements, such as speed of movement, duration of fixations, pattern of visual search and even frequency or pattern of blinking can be assessed to understand the individual's attention to the environment. Few studies have yet been done in alexithymia, but the existing results focus on later attentional processes and amplify findings with other approaches. One study reported no contribution of alexithymia to eye-tracking metrics during free-viewing of emotional and neutral faces (Sharpe et al., 2016). In contrast, Fujiwara (2018) reported that HA spent less time looking (i.e. dwell time) at the eye-region of faces that had blended emotions, particularly those with faces featuring anger. Interestingly, attending to the eyes improved emotion recognition judgments in LA, but it impaired in HA (i.e. deficit). Wiebe et al. (2017) included a facet-level analysis, reporting that dwell time was reduced for depression-relevant images in those with higher EOT, suggesting a specific EOT-related deficit in attention processing for such images. Thus, as with early attention studies focused on orientation and priming, these studies examining the later maintenance phase of attention are also consistent with an alexithymia deficit model (Taylor, 2000) and the attention-appraisal model (Preece et al., 2017).

2.1.1. Summary

We found 19 studies in 16 papers examining the influence of alexithymia on attention were reviewed. Only two studies used clinical samples; 17 of 19 (90%) employed normative (*n*=5) and student samples (*n*=12), thereby focusing findings on young subjects (mean age range=19-45 yrs, median of means=25 yrs). Most studies investigated attention for words (*n*=10, 53%) or faces (*n*=6, 32%), while one (5%) examined affective images. The majority (12/19, 63%) controlled for negative affect, with two of these studies also controlling for positive affect. Eight studies (42%) examined the results before and after controlling for mood and the majority of these (5/8, 63%) reported no change in results following control for affect.

The weight of the evidence (10/19 studies, 53%; Table 1) suggests alexithymia is linked to deficits in early, automatic attention to affect, as well as later, controlled attention. These findings are consistent with Taylor's (2000) deficit view of alexithymia. Furthermore, although most studies examined the total TAS-20 score or dichotomous groups, evidence is emerging linking attentional deficits to specific facets of alexithymia. Consistent with the attention-appraisal model of alexithymia (Preece et al., 2017), EOT was most frequently reported (Coffey et al., 2003; Wiebe et al., 2017).

Four of the six studies that reported over-responding to emotional stimuli in alexithymia (67%) did not control for negative affect. However, Grynberg et al. (2014) did so and reported prolonged attentional processing of threatening faces linked to EOT (study 1) and DDF (study 2), which was inconsistent with either the deficit (Taylor, 2000) or attention-appraisal models (Preece et al., 2017). However, the rapid serial visual presentation task might be better characterised as measuring stimulus appraisal (T1, emotional faces) rather than prolonged processing of threat. Thus, their findings could be interpreted as due to slowed appraisal, thereby consistent with the appraisal element of the attention-appraisal model (Preece et al., 2017; see also section 2.2.).

2.2. Appraisals

Appraisals are a person's subjective evaluation of the personal significance of a situation, object, or event (Scherer, 1999). Experienced feelings are continually modified because appraisals may change in relevance and intensity over time depending on personal meaning, such as values, beliefs, goals, and experiences (Ellsworth & Scherer, 2003). Different models have been proposed, including the following dimensions: valence, importance, familiarity, novelty/expectedness, agency/intentionality, coping potential/power, goal conduciveness, fairness, and compatibility with social standards and norms (for a review, see Scherer, 2019). In their recent model, Preece et al. (2017) suggested that difficulties in the appraisal stage of emotion processing might be a central feature of alexithymia. HA have under-developed emotion schemas (e.g. Luminet et al., 2006; Lundh et al., 2002; Suslow & Junghanns, 2002; Vermeulen et al., 2006) leading to increased difficulty interpreting patterns of input in a sufficiently differentiated way. Thus, they evaluate their emotional states in a diffuse manner ("I am feeling bad") rather than in a specific manner ("I am feeling angry").

Among the various appraisal dimensions, alexithymia research has only substantively examined valence. Valence is the degree to which a situation is evaluated as potentially agreeable/pleasant or disagreeable/unpleasant. Importantly, although alexithymia scores are moderately inflated by negative affect, alexithymia is largely independent of it, as demonstrated by the relative stability of alexithymia scores even in situations of strong psychological distress (e.g. Luminet et al., 2001, 2007; see section 1.2.3.). Although HA may be impaired in their ability to experience, elaborate, and express subjective feelings, they are still able to feel pleasantness or unpleasantness. However, their distress may not be expressed through language, but by other channels such as somatic sensations or symptoms, or impulsive behaviours (see section 2.5).

Our first prediction was that individuals with high alexithymia scores would experience negative events as more unpleasant, especially as HA is linked to difficulties in differentiating somatic arousal and experienced feelings. We also predicted that HA scorers would appraise positive events as being less pleasant, given the association between alexithymia and anhedonia, which suggests individuals with HA have a limited capacity to experience positive emotions (Krystal, 1988). Because alexithymia correlates with other personality dimensions (e.g. positively with neuroticism, negatively with extraversion and openness; Luminet et al., 1999), control over NA and PA is important. This was accomplished by six out of eight (75%) of the valence studies (see Table 2). Because of the lack of literature on types and intensity of appraisals and alexithymia, we also considered how initial valence of events can affect long-term emotional reactions such as social sharing of emotion and rumination.

We found a total of seven papers (eight studies) addressing appraisal. Two papers examined the early processing of emotion. One showed that high alexithymia scores were linked to reduced unpleasantness ratings in response to negative stimuli (Luminet et al., 2004), whereas the other reported that alexithymia was not linked to appraisals of aversive stimuli but was associated with diminished responsivity to appetitive words and pictures (Koven, 2014). Regarding later processing of emotion, individuals with poorer fantasy scores[1] ruminated less after positive events, and those with higher DDF scorers had deficits in sharing emotions in a negative context (Luminet et al., 2000). Deficits of emotional responding in HA would appear to occur only under specific valence conditions. These results have important implications for psychological adaptation. Thinking about positive events from the past can increase the availability of positive memories, which then increases positive mood. By not benefitting from the protective effect of positive rumination, HA may be more impacted by thoughts generated after a negative event. Furthermore, as verbal disclosure of negative events is related to positive health outcomes (e.g. Pennebaker & Smyth, 2016), it is possible that individuals with HA experience less mitigation of health impacts through disclosure.

The distinction between affect intensity (i.e. magnitude of individuals' experiences of emotional responses; Larsen, 1985) and affect frequency (i.e. how often mood states are experienced in a particular period) is another dimension to consider. Regarding positive emotion intensity, Fantini-Hauwel et al. (2015) found a dissociation, with DDF linked to lower intensity and DIF with higher intensity. This highlights the importance of considering the alexithymia facets separately. Furthermore, while high positive frequency is considered healthy, high positive intensity is related to psychological dysfunctions, such as bipolar disorders (Diener et al., 1985a, 1985b). DIF was also related to a higher frequency of experiencing negative affect, which is likely to have deleterious effects on mood regulation.

Aaron et al. (2018) used a more refined method to examine how alexithymia moderates the appraisal process, distinguishing emotional granularity, the ability to make fine-grained distinctions between emotional experiences (Barrett et al., 2001), and emotional dialecticism, one's tendency to simultaneously recognise pleasant and unpleasant states (Bagozzi et al., 1999). High alexithymia was linked to reduced emotional granularity (DDF) and dialecticism (EOT) in response to negative videos. Specifically, individuals with higher DDF used a smaller set of adjectives to describe their emotional reactions and those with higher EOT experienced fewer pleasant states concurrently with unpleasant ones. Reduced granularity of negative emotions in HA was previously suggested by Erbas et al. (2014). Finally, Larwood et al. (2021, this issue) examined the influence of alexithymia on the appraisal of emotions in musical extracts, and reported that HA assessed negative musical emotions (sad, angry, fearful) as more neutral than LA, but appraisal of positive musical emotions (happy, tender) was not linked to alexithymia, highlighting again that HA is related to a mitigation of the valence of stimuli.

Regarding other appraisals, Luminet et al. (2004) found deficits for importance (EOT) and familiarity (DDF). The first result suggests that HA is related to reduced interest and concern for emotional topics, but reduced familiarity indicates a greater discomfort in dealing with affective themes in those with HA. The latter finding supports the hypothesis that HA would also result in avoidance of negative situations. Early clinical evidence indicated that HA experience elevated discomfort during social interaction, thereby avoiding social relationships (Nemiah & Sifneos, 1970; Sifneos et al., 1977). Finally, anticipatory appraisals, which are measured before people are exposed to stressful situations were considered in one study (de Timary et al., 2008). Higher DDF was related to elevated cortisol at baseline, but no alexithymia factor was related to cortisol secretion during stress exposure or during recovery, suggesting that alexithymia modulates anticipation of stress rather than the stress response.

2.2.1. Summary

Most of the literature on appraisal and alexithymia has examined valence. After unpleasant situations, almost all studies showed a deficit in emotional responding rather than the predicted over-responding. Importantly, the results were not modified when controlling for negative affect. The driving factors were consistently DDF and EOT, while the only finding for greater reactivity towards negative situations was found with DIF. Regarding the moderating impact of alexithymia in pleasant situations, fewer studies are available, which corresponds to the general lack of attention to positive context in the emotion research domain. Two studies, which controlled for positive affect, found decreased ratings of positivity. HA also involved alterations in importance and familiarity appraisals, and stress anticipation. In their model, Preece et al. (2017) predicted that DIF and DDF are the main driving factors of the appraisal stage, which is only partially supported in our data where DDF and EOT were the significant factors associated to appraisals.

Among the seven papers reviewed, all (100%) involved non-clinical samples, with six (86%) of them with a student population and one examining older adults. Five of the papers (71%) used controls for negative affect. Participants were primarily exposed to emotional materials (i.e. emotive video, pictures, music; four papers, 57%), with other approaches characterising one paper each (social stress task, autobiographical rumination task, affect intensity ratings with no manipulation). Six (86%) found evidence for deficits, one (14%) found dysfunctional over-responding, and one found both, strongly suggesting an overall pattern of deficit in HA. DDF and EOT seem to be the driving factors, although the number of studies that examined how alexithymia factors are related to appraisals dimensions is very limited. This is a clear priority for future research.

2.3. Memory

Just as emotion perception and responses are influenced by people’s appraisals of the experience, memory is influenced by individual differences in how events are experienced (Kensinger, 2009). Memory is the encoding of our experiences, which we retrieve to guide our future thoughts, decisions and actions. Encoding, which is the formation of initial memory traces, is assessed by short-term testing and is influenced by stimulus perception and attention (Levine & Edelstein, 2009). Encoding processes in turn influence memory storage and what is later retrieved. Emotion evokes physiological and subjective experiences that can both contribute to a memory advantage for emotive memoranda and contexts (e.g. LaBar & Cabeza, 2006). Ultimately, emotion influences memory priority by triggering salience or top-down goals (Mather & Sutherland, 2011). However, what constitutes “priority” is influenced by individual differences in the appraisal of and response to emotion. At the facet-level, EOT is associated with both inhibited arousal responding (Davydov et al., 2013) and impaired emotional appraisal (section 2.2). Thus, we would predict deficits of both short-term and delayed emotive memory in HA, particularly associated with EOT.

We found 18 papers with 24 studies that specifically examined memory performance in alexithymia (Table 3). The earliest study, examining incidental learning of emotion words, found longer decision times and *fewer* recognition errors in HA, but no difference in memory accuracy (Jacob & Hautekeete, 1998). Superficially, fewer errors appeared beneficial, but the effect was due to better *distractor rejection*, while acceptance of targets was actually poorer in HA. Thus, HA had a more conservative style, rejecting both targets and distractors, thereby hinting at a memory deficit in HA. Furthermore, although few studies have examined processing time, others have not replicated longer memory processing time in HA (Lundh et al., 2002; Vermeulen et al., 2010).

Since 1998, all but one paper (Lundh et al., 2002) has reported some form of memory deficits in HA (94%); only half also examined TAS-20 facets (Table 3). When the context is emotive (most papers), memory deficits in alexithymia at immediate testing have been typically shown for emotive but not neutral memoranda. This finding is apparent across intentional and incidental learning paradigms, nearly all of which used verbal stimuli.

For example, poorer memory was found in HA for emotive words (e.g. negative, positive), with no effect for neutral words (Luminet et al., 2006; Meltzer & Nielson, 2010; Vermeulen & Luminet, 2009). One paper instead reported elevated intrusion errors (over-responding to positive distractors; Suslow et al., 2003). These effects were isolated to confident "remember" responses versus familiarity (Luminet et al., 2006), and specifically to DIF (Suslow et al., 2003; Vermeulen & Luminet, 2009). In contrast, other papers have isolated emotive memory deficits in HA to EOT. Directed forgetting, where subjects learn certain lists or items while forgetting others, showed greater EOT associated with deficits in memory for negative wanted items and over-responding via greater intrusion of negative unwanted items (i.e. false memory; Dressaire et al., 2015). Another paper showed memory deficits with EOT for negative and positive items in "pure" (single valence) but not mixed-valence lists (Vermeulen, 2021, this issue). These papers suggest pervasive interference with emotive links to conscious memory in alexithymia (Bucci, 1997; Taylor, 2000), thereby interfering with internal cognitive control and producing a more conservative acceptance criterion, perhaps due to difficulty managing uncertainty and motivation to process emotion (Vermeulen & Luminet, 2009).

Papers examining non-verbal emotive memory in alexithymia have typically been consistent with verbal studies, including deficits in immediate and delayed memory for faces and social scenes or interactions (DiStefano & Koven, 2012; Donges & Suslow, 2015; Ridout et al., 2021, this issue) and memory for change of facial expression (happy; Takahashi et al., 2015). Some face memory effects were specific to anger and/or fear rather than happy or neutral (Donges & Suslow, 2015; Ridout et al., 2021, this issue); these were notably attributable to DDF. In contrast, deficits for social interactions in video stimuli were associated with DIF and EOT (Ridout et al., 2021, this issue). One paper produced a paradoxical *benefit*: increasing the intensity of facial expressions should produce greater errors in subsequent matching comparisons than for reduced intensity (i.e. representational momentum). However, fewer errors (over-responding) resulted in HA (total score) due to reduced intensity sensitivity (Senior et al., 2020).

Some instances of better memory in HA have appeared alongside deficits, though not all these effects were beneficial. Specific findings include fewer errors in HA (Jacob & Hautekeete, 1998), which Senior et al. (2020) link to DIF; and better memory for emotive or neutral memoranda associated with DIF (sad, Ridout et al., 2021; neutral, Dressaire et al., 2015; Ridout et al., 2021) or EOT (Vermeulen & Luminet, 2009). It is possible that negative affect contributed to better sad face memory through salience (context congruency), though depression covariance analysis decreased this likelihood. Yet, in support of the salience explanation and indicating detrimental over-responding, HA had better memory for illness words (via preoccupation), despite poorer memory for other negative words (Meltzer & Nielson, 2010). Similarly, while Fading Affect Bias predicts that negative memories fade more over time than positive memories, the effect was opposite in HA, with positive memories fading more and negative memories fading less (Muir et al., 2017). Thus, HA experiencing negative emotion as more negative, along with reduced intensity of positive emotion (Krystal, 1988), may inadvertently protect negative memory salience over time as positive memories fade. Finally, despite generally reduced emotive memory, Vermeulen et al. (2010) found HA-specific context effects with improved joy word retrieval when encoding was accompanied by happy background music, and anger word retrieval with angry music. These results implicate a role for cognitive control in alexithymia, showing that setting a congruent context can be beneficial in helping HA better process and later retrieve emotive information.

Although memory studies in alexithymia typically reported no effects on neutral stimuli, most employed an emotionally charged context. However, as learning context critically influences memory (e.g. Smith, 1994), we must also ask whether alexithymia influences genuinely neutral memory. Seven papers have addressed this question. Two of them (29%) reported *better* immediate memory (beneficial over-responding) for neutral stimuli via DIF (Dressaire et al., 2015; Ridout et al., 2021), although one also reported a negative correlation with EOT (Dressaire et al., 2015). The other five papers (71%) reported a neutral memory deficit attributable to EOT for immediate memory (DiStefano & Koven, 2012; Nielson & Meltzer, 2009; Terock et al., 2019; Vermeulen, 2021) and delayed memory (Correro et al., 2021; DiStefano & Koven, 2012; Terock et al., 2019). Correro et al. (2021, this issue) further found DIF contributed to poorer executive functioning, which interacted with EOT to impair memory. Importantly, emotion typically triggers physiological reactivity, rumination, and attentional shifts from external to internal thoughts (Luminet et al., 2004). However, EOT reduces translation of these external cues to internal cues in all contexts. We suspect that, because EOT impairs emotional appraisal (see section 2.2. on Appraisal) and inhibits arousal responses and processing concomitant with internally directed cognition (Davydov et al., 2013), the fundamental processes for establishing priority in memory (Mather & Sutherland, 2011) are disadvantaged by EOT even in neutral contexts.

The majority of memory studies tested retention within one minute after encoding (67%; see Table 3). Testing was delayed five minutes in one study (5%; Ridout et al., 2021), and 20 min to 24 h in five studies (28%; Correro et al., 2021; DiStefano & Koven, 2012; Meltzer & Nielson, 2010; Nielson & Meltzer, 2009; Terock et al., 2019). Arguably, nuanced long-term memory assessment requires a sufficient delay to allow for some consolidation to occur. Indeed, all neutral memoranda studies with 20–60 min delays showed an HA deficit (EOT; Correro et al., 2021; DiStefano & Koven, 2012; Terock et al., 2019), while one study showed no effect after 24 hrs despite an immediate retrieval deficit (Nielson & Meltzer, 2009). Long-term retrieval with mixed stimuli instead saw a deficit for negative words, but over-responding to illness words and neutral words (Meltzer & Nielson, 2010). Alongside an immediate memory deficit in neutral but not mixed contexts (EOT; Vermeulen, 2021), and enhanced happy or angry memory within matching musical backgrounds (Vermeulen et al., 2010), these studies suggest context dependency, likely interacting with appraisal tendencies, are impactful on encoding and retrieval in HA. However, not enough is yet known about storage influences in alexithymia (see Takahashi et al., 2015).

2.3.1. Summary

All the 18 memory papers (including 24 studies; Table 3) reviewed examined normative samples, mostly using young adults (typically college students). Six out of these 18 papers (33%) examined middle aged to older adults or compared older adults with young adults (range=18-99 yrs). The vast majority of papers (12/18, 67%) used emotional and/or neutral words or narratives as memoranda, while five (28%) used emotional and/or neutral faces or scenes, and two (11%) used autobiographical memory tests. Twelve of the 18 papers (67%) controlled for negative affect (four also controlled positive affect); none reported that affect contributed to prediction of memory outcomes, though results were not commonly compared with and without inclusion. However, it should be noted that in most of these studies, affect correlated with alexithymia, but not necessarily with the memory metrics. Importantly, affect control is of no value if it does not correlate with the outcome measures (see discussion section for a detailed elaboration on the conditions for affect control).

Taken together, 15 of 18 papers (83%) demonstrated that memory is poorer in HA, particularly for emotional stimuli and even for neutral stimuli in neutral contexts. Of the seven studies (39%) examining only the TAS-total score, *all* (100%) showed memory deficits, while three (43%) reported in addition over-responding to salient content, including one showing context congruence effects can be beneficial (i.e. functional over-responding). Eleven of the 18 papers (61%) examined TAS-20 facets. DIF contributed to memory or cognitive control deficits in five papers (45%) and over-responding in five papers; OR was dysfunctional (more intrusion of affective memories) in two papers (18%), and OR was beneficial in three papers (memory was better for neutral stimuli or fewer errors in HA; 27%). DDF was linked to memory deficits in four papers (36%), two for positive stimuli and two for anger or fear; it was not associated with over-responding. Overall, differences were isolated to specific retrieval (e.g. recall, “remember”) rather than familiarity (e.g. “know”) and were associated with poorer cognitive control and greater influences of salience and context on HA, suggesting the influence of early appraisal tendencies on later memory processes. Finally, EOT was the primary contributor to memory deficits

(7/11 studies, 64%), with also dysfunctional over-responding in one study (i.e. increased false memory; 9%) and functional over-responding in one study (9%); the stimulus type that was influenced differed across paradigms. Thus, an externally oriented thinking style seems particularly detrimental to memory across paradigms, likely due to reduced cues that are needed to establish priority in memory. Studies that use a facet level analysis while specifically interrogating cognitive control within memory paradigms, as well as studies manipulating of memory priority, are particularly important future directions.

2.4. Language

Language, verbal and non-verbal, is a structured form of communication that allows people to share inner thoughts and feelings and to understand the utterances of others. These are central aspects of social life. Language furthermore reveals much about cognition, as it relies on the integrity of the range of cognitive processes and in turn, influences and shows how we feel, remember and think. Many emotion theories, from nativist to constructionist, attribute some role for language in emotion processing (Hobson et al., 2019) and include its role in the development and adaptation of emotion concepts and schemas and emotion regulation (Hoemann & Feldman Barrett, 2019). These schemas then afford the ability to identify emotion when it occurs, and to communicate it to others. Language also pervades most aspects of cognition. Certainly, any task using verbal stimuli and/or requiring a verbal response is founded in language. That said, herein we examine “language” only in its receptive and expressive capacities, without consideration of non-verbal cues, influences of verbal tasks (e.g. appraisal, attention, memory), or emotion schemas (i.e. concept formation), because empirical alexithymia research has not yet addressed these areas.

The importance of language to alexithymia is evident in its very definition. For example, difficulty identifying feelings suggests difficulty translating sensations (i.e. sub-symbolic representations) into concepts (i.e. symbolic representations), which can then limit ability to describe feelings due to poor symbolic representations. Indeed, other reviews have addressed these concepts about language disturbances in alexithymia (see Welding & Samur, 2018), with one review further postulating “the language hypothesis of alexithymia” (Hobson et al., 2019). Given the important relationship between language development and emotional-social development (e.g. Izard et al., 2011), and the under-development of emotion schemas evident in HA through attention, memory (e.g. Luminet et al., 2006; Vermeulen et al., 2006) and appraisal (see section 2.2. on Appraisal and Preece et al., 2017), we would predict significant deficits in language expression and reception for emotive contexts in HA, particularly related to DDF and DIF.

There is a good deal of overall consistency across studies that examine language expression and reception in alexithymia, showing a general pattern of deficits (Table 4). We found 16 papers; all but one (Smyth et al., 2002) evidence some form of language deficit in alexithymia. All but two of these asked subjects to write or speak about their emotional experiences. Consistently, they report HA have reduced emotional expression, including fantasy content of dreams (Parker et al., 2000), frequency of emotion words and descriptions used in speech or writing (Jelinek et al., 2010; Luminet et al., 2004 (DDF); Paez et al., 1999; Roedema & Simons, 1999; Tull et al., 2005 (DIF); Vanheule et al., 2011; Wotschack & Klann-Delius, 2013), reduced complexity of emotion vocabulary or expression (Meganck et al., 2009 (DIF, EOT); Vanheule et al., 2011 (EOT; DIF (only positive)); Wotschack & Klann-Delius, 2013), and a less open communication style (Kreitler, 2002; Wagner & Lee, 2008). This was most evident when people were trying to verbalise intense or traumatic experiences (Paez et al., 1999 (DDF); Jelinek et al., 2010; though see Smyth et al., 2002). The samples for these papers ranged from normative to clinical. Notably, although few employed controls for comorbidities such as affect or depression (25%), those that did so still found language deficits in alexithymia.

No clear pattern emerged about which facet(s) of alexithymia are most relevant to language. Only 8 papers examined facets rather than the total score; one examined only DDF. All three facets were associated with deficits: DIF in six studies (75%) (Edwards et al., 2020; Jakobson & Pearson, 2021; Kreitler, 2002; Meganck et al., 2009; Tull et al., 2005; Wagner & Lee, 2008), DDF in four studies (50%) (Edwards et al., 2020; Kreitler, 2002; Luminet et al., 2004; Paez et al., 1999), and EOT in five studies (62.5%) (Kreitler, 2002; Meganck et al., 2009; Samur et al., 2021, this issue; Vanheule et al., 2011; Wagner & Lee, 2008). DDF was associated with *better* performance in one study (Jakobson & Pearson, 2021, this issue), as was DIF in another, but the confidence interval included zero suggesting an unreliable effect (Vanheule et al., 2011). Indeed, a large study that examined writing about a distressing past event while controlling for negative affect showed that DIF was associated with a deficit of positive expression, but greater negative expression (Tull et al., 2005). This finding fits with appraisal and memory studies associating DIF with over-responding to negative material, even after controlling for negative affect (see sections 2.2. on Appraisal, and 2.3. on Memory). The only language expression study to examine neutral, everyday topics, found all three facets significantly predicted general deficits in language expression (Kreitler, 2002). This finding too is consistent with recent studies showing alexithymia deficits (typically EOT) in memory for neutral material (section 2.3. on Memory). These findings support our predictions, suggesting that the under-developed emotion schemas that influence attention, memory, and appraisal further influence language expression, resulting in deficits (Preece et al., 2017; Taylor, 2000). This was apparent in emotive contexts and may be most associated with DIF, but limited work suggested deficits in neutral contexts as well.

Studies of language reception (i.e. comprehension) per se in alexithymia are scarce. Two new papers, however, both in this issue, do explicitly examine it. Jakobson and Pearson (2021, this issue) presented videos of neutral vignettes with subjects required to infer speaker intentions as literal or non-literal; half provided contextual assistance while half did not. No alexithymia effects were apparent when context was included. Without context, HA had slower decision time (DIF), but *better* accuracy (DDF). As DDF and DIF are associated with ease of excitation and lowered sensory thresholds, it was concluded that heightened engagement in HA when context is lacking could improve performance (DDF), but retard decision-making (DIF). Paradoxically, this could impair performance in more emotionally charged displays. Similarly, fictional first – or third-person narratives showed impaired language comprehension in HA (emotionalising/fantasising) through low narrative engagement (Samur et al., 2021; this issue). Specifically, HA were unable to benefit from the “support” of first-person narratives, perhaps due to difficulty with perspective-taking, or mentally simulating another’s world. These findings correspond with HA having poorer mental imagery ability (e.g. Davydov et al., 2013; Luminet et al., 2004) and difficulty with empathy (e.g. Grynberg et al., 2018). These context effects also reinforce a difficulty processing non-verbal and abstract cues in HA, highlighting the importance of providing concrete, verbal cues and context during interactions.

2.4.1. Summary

Of the 16 language papers reviewed, nine (56%) had samples with average ages from 30s to 60s; samples were older than typical college-aged samples. Four studies (25%, all with samples older than college age) included clinical samples. Fourteen of 16 papers (87.5%) involved language expression and 100% of these used a narrative approach, with all but one (93%) employing an autobiographical emotive paradigm; the other was neutral. Two papers (12.5%) measured receptive language, which examined social inference and engagement.

The literature is quite consistent in showing a deficit in language expression, and in two new papers, reception, in alexithymia. All but one of 16 papers (94%) showed a deficit characterised by reduced complexity, a less open style, and reduced emotional content in HA. Control over mood or affect was rare four studies controlled NA (25%), two also controlled PA (12.5%), but deficits were not mitigated by such controls. Furthermore, the effects were strongest under higher intensity conditions. Three papers (19%) also evidenced dysfunctional over-responding with more negative language (DIF, DDF) or more outward focus (EOT). Few studies have directly examined language comprehension (reception; only two papers herein (12.5%)), but these also are indicative of

HA deficits, particularly when no context is available, although one of them showed functional over-responding to inferences when no context was available (DDF). Specific facet distinctions, however were not forthcoming in this review. Despite ten papers (63%) investigating the TAS-20 facets, the findings were relatively equivocal. DIF was associated with deficits most frequently, in six papers (60%), and also with over-responding in two papers (20%). By comparison, DDF was linked to deficits in four papers (40%) and over-responding in two papers (20%), while EOT was associated with deficits in five papers (50%) and over-responding in one paper (10%)

2.5. Action tendencies and behaviours

Emotions are connected with actions and behaviours. Due to socialisation and normative constraints, emotions rarely lead to observable behaviours (e.g. verbal or physical aggression while experiencing anger), but the potential exists and is captured by action tendencies or action readiness (e.g. antagonism; Frijda et al., 1989). Action tendencies represent urges to carry out certain behaviours when experiencing emotion. For example, when experiencing intense anger, a will toward physical or psychological aggression is automatically activated. Action tendencies therefore involve inhibition capacities to prevent external behaviours from occurring.

Emotions provide individuals with necessary information to guide, control, and regulate their behaviours. Any restricted access to emotional information is likely to result not only in dysregulated emotional responses, but also in behavioural responses. Clinical studies showed that HA manifest their emotions more often in actual behaviours, while not necessarily feeling them mentally (e.g. MacLean, 1949; Vanheule, 2008), which led many to suggest that HA may attempt to regulate emotional states behaviourally, rather than cognitively, resulting in impulsive behaviours such as substance abuse or eating disorders (Morie & Ridout, 2018; Taylor et al., 1997). Examining behavioural reactions in contrast with cognitive processes could therefore highlight some important dissociations. That is, we might expect dominance of dysfunctional over-responding for behaviours, in contrast with the dominance of deficits that was found across the four cognitive processes we investigated in the previous sections. One caveat is that this section does not address the domain of facial expressions and emotional expressivity. This was thoroughly reviewed by Grynberg et al. (2012), showing that alexithymia was associated with impaired perceptual abilities and deficits in labelling emotional facial expressions, but only among those with clinical disorders.

Surprisingly, no studies yet directly examined whether and how alexithymia may moderate the type and intensity of action tendencies (see Table 5). We can therefore only focus on actual behaviours, with a set of seven (with nine studies) coherent papers examining actual behaviours. Of these seven papers, six (86%) demonstrated over-responding, indicative of elevated rates of behaviours such as aggression. HA was related to higher scores for impulsive aggression (Edwards & Wupperman, 2017; Teten et al., 2008; Velotti et al., 2016), with emotion dysregulation being a potential explanatory factor (Edwards & Wupperman, 2017; Velotti et al., 2016). Alexithymia characteristics may facilitate aggressive behaviours by limiting the cognitive and affective resources that are necessary to turn down distressing emotions and to inhibit impulsive action, suggesting deficient emotion regulation abilities. Unfortunately, none of these studies controlled for NA or examined the role of alexithymia facets.

One potential explanation for these findings is the tendency of HA to avoid linking available input information about the stimulus (i.e. the emotion) to their emotion schemas Preece et al. (2017). One specific aspect of avoidance, experiential avoidance, might be as a central process involved in HA. Experiential avoidance, encompassing both avoidance and escape behaviours, consists of two related aspects: (a) desire to disconnect from aversive private experiences, and (b) actions taken to alter aversive experiences or their eliciting sources (Hayes et al., 1996). Experiential avoidance is associated with a wide range of psychopathologies (e.g. Kashdan & Rottenberg, 2010; Kingston et al., 2010); in contrast engaging fully in one's current activity, is linked to well-being and psychological adjustment (Ciarrochi et al., 2011). An initial paper supported the mediating role of experiential avoidance in the association between alexithymia and difficulties regulating one's emotions (Venta et al., 2013). Two other studies supported the assumption that experiential avoidance mediates the association between alexithymia and psychosomatic and depressive symptoms (Panayiotou et al., 2015).

Experiential avoidance overlaps with other pathogenic constructs such as avoidant coping, thought suppression, stress intolerance and anxiety sensitivity; these constructs are close to the emotion regulation strategy of suppression. In two studies, Laloyaux et al. (2015) found a strong positive association between alexithymia total scores (and its facets) and suppression, while for reappraisal, there was a negative correlation of smaller magnitude. Notably, during suppression a person attempts to down-regulate emotion-expressive behaviours and change the behavioural response to the event (John & Gross, 2004), which results in decreased positive, but not negative, emotion experience (Gross & John, 2003). In contrast, reappraisal modifies emotional responding by altering one's way of thinking during an experience (Webb et al., 2012), which effectively reduces negative emotions and increases positive emotions (Gross & John, 2003). The strong tendency for HA to use suppression as an emotion regulation strategy could thus be an explanatory process for the decreased level of pleasantness observed for positive events (see section 2.2 on Appraisal).

One limitation of these studies is their rather static approach to the role of avoidance by using cross-sectional designs. Studies adopting a more dynamic view, such as assessing flexibility to switch between confrontation and avoidance across situations, have suggested HA lack flexibility in response to threat. The reduced priming effects for HA after exposure to threatening information (Vermeulen et al., 2006, see attention section) suggest that avoidance responses can occur at a very early stage of information processing. This early avoidance orientation can later have deleterious effects for interpersonal relations. For instance, Luminet et al. (2011) found HA had reduced ability to recognise threatening stimuli, which can then increase the risk of responding inappropriately or without due caution in interpersonal situations.

Another promising approach to examine behavioural tendencies in more dynamic situations is the one developed by Gvirts and Dery (2021, this issue), who considered social alignment, the tendency to align with other members of the group in terms of thoughts, emotions, and behaviours. They examined consensus-reaching as a cognitive dimension of social alignment, and found that EOT was associated with an impaired ability to reach agreements, in some cases to minimise conflicts, and in others because of lower reliance on the rewarding sensation associated with social alignment.

2.5.1. Summary

We could not find studies investigating how alexithymia can moderate action tendencies, despite the importance of this construct in the cognitive processing of emotions. When turning to actual behaviours, seven papers describing nine studies were evaluated; four with clinical samples (44%) and five with normative samples (56%) (all but one used college students), some as controls for clinical samples. Only one paper, using a psychiatric inpatient sample, controlled for negative affect (14%). The findings converged showing across six papers (8/9 studies, 89%) that HA is related to a higher proneness for aggression, and particularly its impulsive dimension, which points to detrimental over-responding to emotion. Regarding explanatory processes, several studies showed that HA use more dysfunctional strategies (suppression, experiential avoidance, emotion dysregulation) when exposed to emotion that can explain this higher propensity for aggression. When a facet level analysis was available, DIF and DDF were the factors involved in over-responding, while EOT was the factor involved for the only study suggesting deficits.

3. Discussion

Alexithymia is a multi-faceted personality trait that involves difficulties in emotion processing that elevates risk for mental and somatic disorders. In this paper, we considered how, since the 1990s, alexithymia can be validly measured, and that over the last 25 years, the number of studies examining the cognitive processing of emotional information has rapidly grown. We reviewed the results of these studies across five major domains (attention, appraisals, memory, language, and behaviour). Using this process-oriented framework, we considered whether alexithymia, and more specifically the different alexithymia facets, can modulate emotion processing in the direction of deficits or over-responding across these domains.

In the discussion, we first summarise the main results for each domain. We then take a more general perspective, examining how alexithymia and the three specific facets are related to the deficit vs. over-responding models. We then turn to the issue of covariates, in particular negative and positive affect, and review current approaches to alexithymia, offering concrete recommendations for improvement through a process-oriented approach. Finally, we integrate our findings briefly with existing neuro-imaging research and clinical implications, and finally position them with respect to several major emotion theories (attention bias and control, appraisal, awareness) to consider important future directions.

3.1. Overview of the results using total alexithymia scores

Nearly half of the papers we reviewed examined only the total alexithymia score, although the proportion varied by domain, with more papers using only the total score to examine attention (69%) and behaviours (57%), than language (38%), memory (33%), or appraisal (29%). Regarding attention, only half of the studies supported the deficit hypothesis, which occurred to affect at both the early attention stage and in the later, controlled attention stage (see Table 6).

Table 6. Frequencies of primary findings from the papers reviewed tallied across domains, for alexithymia total vs. facet scores, supporting deficits vs. over-responding.

	TAS-20		**Facet-Level Analysis**					
	Total Only		**DIF**		**DDF**		**EOT**	
	Deficit	**OR+/-**	**Deficit**	**OR+/-**	**Deficit**	**OR+/-**	**Deficit**	**OR+/-**
<u>Cognitive</u>								
Attention (n=16*)	5/11	3/11	1/5	0/5	0/5	2/5	2/5	2/5
Appraisal (n=7*)	2/2	0/2	0/5	1/5	4/5	1/5	3/5	0/5
Memory (n=18)	6/6	4/6	5/12	5/12	4/12	0/12	7/12	2/12
Language (n=16)	6/6	0/6	6/10	2/10	4/10	2/10	5/10	1/10
Total (n=57*)	19/25 (76%)	7/25 (28%)	12/32 (38%)	8/32 (25%)	12/32 (38%)	5/32 (16%)	17/32 (53%)	5/32 (16%)
<u>Behavioural</u> (n=7)	0/4 (0%)	4/4 (100%)	0/3 (0%)	1/3 (33%)	0/3 (0%)	2/3 (67%)	1/3 (33%)	0/3 (0%)

Notes. OR -: over-responding with detrimental effect of HA. OR+: over-responding with beneficial effect of HA. *One paper (Luminet et al., 2004) appears in two domains and is counted twice. Percentage is not absolute; some studies produced no findings, others produced more than one primary finding, resulting in final percentages that may not tally to 100%.

Among the studies that supported the over-responding model, greater distraction from negative faces when processing emotion words and greater interference when processing illness or arousing words were identified. Further investigations need to clarify whether this is due to prolonged attentional processing of threat, or to a longer processing time needed to appraise emotional stimuli. For appraisals, the studies (2/2) pointed to a deficit in valence in both negative and positive contexts, suggesting that both negative and positive stimuli are evaluated as less intense in HA. The few studies looking at other types of appraisals also support the deficit hypothesis. Caution is needed, however, because of the small number of studies examining this domain. Memory has been more extensively examined. Within this larger sample of studies, all of them (6/6; 100%) support the deficit hypothesis.

Two studies also demonstrated functional over-responding, one in which there were fewer errors in alexithymia, and one particularly important that showed context congruence effects can be beneficial for HA, leading to facilitated retrieval for positive information (see section 3.4, clinical significance). The dominance is even more striking when examining language, with 100% (6/6) of studies supporting deficits, while none supporting over-responding. The findings include mainly language expression with evidences for reduced complexity, a less open style, and reduced emotional content. Yet, two new studies that examined language comprehension also supported the deficit hypothesis. In contrast, studies examining behaviours in response to emotional situations show exclusively dysfunctional over-responding (4/4), with a tendency for HA to display impulsive aggression. The few studies that examined mediation processes suggest that suppression, experiential avoidance, and emotion dysregulation might play a role in the link between alexithymia and aggressive behaviours. To conclude, when examining only total alexithymia score, 19 of 25 (76%) papers examining the four cognitive processes found support for the deficit model. Conversely, all four papers (100%) examining behaviour supported dysfunctional over-responding.

3.2. Overview of the results regarding alexithymia facets

Studies considering total alexithymia scores supported a broad pattern of deficits. Is the same pattern observed when examining alexithymia facets? A glance at Table 6 suggests a different pattern. While EOT offers a pattern similar to the total alexithymia score, with the majority of papers supporting deficits, results for DIF and DDF indicate a much smaller prevalence of deficits and greater representation of over-responding. To gain a better appreciation of these patterns, we will briefly overview the results obtained for each process, distinguishing by alexithymia facet and deficits vs. over-responding.

For attention, the facets have been too little studied and the results fail to convey a clear pattern upon which to draw conclusions. In appraisal, most studies observed deficits under negative valence due to DDF and EOT. Yet, one study related DIF to over-responding, which could suggest some dissociations between facets. Furthermore, this possibility supports the value of facet level analysis, as total alexithymia scores do not reveal such patterns. In memory, all three facets contributed to deficits, but EOT was the primary contributor, with memory deficits for both emotive and neutral stimuli. This was explained by a reduced need for cues to establish priority in memory. Memory deficits were also associated with DDF in four studies, half for positive and half for negative stimuli, and with DIF specifically for retrieval (“remember”), rather than familiarity of emotive stimuli, reflective of cognitive control failures, as well as for over-responding, both functional (reduced errors, better neutral memory) and dysfunctional (intrusion of affective memories). For language, the findings did not implicate a particular facet; DIF, DDF and EOT were all associated with deficits in emotional expression; DIF was particularly linked to reduced positive expression, and EOT to reduced self-reference and linguistic complexity. Two papers also associated DIF and DDF with over-responding in use of negative language.

This brief overview highlights that EOT is a central facet involved in emotion deficits, as we had hypothesised in the introduction. However, contrary to our expectations, DIF was not particularly related to early emotion processing such as attention or appraisal, nor was DDF the facet most associated with later processing, such as memory or language. The number of available studies using a facet approach is small, which precludes strong conclusions. We can, however, conclude that analysis at the facet level provides a finer-tuned process-oriented approach that is crucial to understanding the nature of dysregulated processing of information related to personality traits (Quirin et al., 2020; Robinson et al., 2019). Disentangling specific deficit effects from detrimental over-responding at the facet level is also particularly important for designing future interventions toward reducing alexithymia. This disentanglement might also contribute to work toward further refinements of the TAS-20 itself.

The influence of the EOT facet seems distinct from the influence of DIF and DDF. As such, incorporating all facets into a total score may mask more complex relationships of alexithymia facets with cognition and emotion, leading to overly simplistic conclusions and false negative findings. It is also important to consider the risk of false positive findings. Analyses using the TAS-20 total score involve only one measure, while a facet analysis involves three measures. Three measures increase the opportunity to find effects, but could do so at the expense of more false positives. It is therefore crucial to prevent this issue by avoiding multiple separate analyses.

The three alexithymia facets are best incorporated into the same model (e.g. regression) to examine the effect of each while holding the others constant. Several studies in this review, including some in this issue (e.g. Correro et al., 2021; Ridout et al., 2021; Vermeulen, 2021) used this approach, showing important differences between the facets. Indeed, intercorrelations amongst the facets were not high enough to surpass the 0.80 threshold for serious concern about multicollinearity (Field, 2009). Thus, facet effects are robust enough to survive this conservative analytic approach.

Although the question of total alexithymia vs. factor scores remains undecided, psychometric analyses can further evaluate whether factor scores provide unique information over the total score (e.g. bifactor modelling, which tests the commonality among and unique contributions of the facets, Reise, 2012). Indeed, Bagby et al. (2019) found a majority of the TAS-20 variance was reflective of a single construct, concluding that total scores are little influenced by unknown admixtures of subscale multidimensionality. Yet, EOT was acknowledged as a somewhat separate construct from what the total scores assesses. Thus, for clinical assessment, the TAS-20 total scores are likely best, but for research purposes, the facet approach seems more advisable.

One challenge for future studies will be to use more dynamic analyses, toward determining when and under which circumstances deficits (particularly via EOT) switches to increased dysfunctional over-responding in handling particularly negative emotions (especially via DIF). It is unknown how these facet-level contributions correspond across processing levels, such as feed-forward effects resulting from priority to salient material. Studies have not yet tracked such effects across the processing domains or over time.

Another challenge will be to disentangle amongst deficit explanations those related to salience (mainly DIF/DDF) and those related to avoidance (mainly EOT). Importantly, results at the facet level diverged by valence type. For deficit effects, DIF was notable for negative emotion, DDF for positive emotion, and EOT for neutral stimuli. For functional over-responding, DIF was related to better processing of neutral information, but no facet was specific for emotional material. A valence-by-facet analysis is therefore also required in future studies, including a systematic assessment for the processing of neutral information. This approach might be facilitated by a recently developed alexithymia scale, the Perth Alexithymia Questionnaire, which simultaneously assesses impairments in emotion processing for both positive and negative affect, while existing instruments only consider impairments of negative affect perception and experience (Preece et al., 2018). The latter analyses could provide needed evaluation of the attention-appraisal model (Preece et al., 2017), which postulates that higher EOT scores would contribute to difficulties focusing attention on emotions, while higher DIF and DDF scores would contribute to difficulties at the appraisal stage of emotion processing. There are insufficient data to currently evaluate these assumptions, although its predictions for the involvement of EOT in attention and DDF in appraisal (though not DIF), appear supported by our review.

3.3. Critical assessment of alexithymia research and directions for improvement

3.3.1. The role of affect in alexithymia research

Those with higher alexithymia often exhibit elevated negative affect, including mood (e.g. depression, anxiety) and trait (e.g. neuroticism, depression and anxiety), along with reduced positive affect (e.g. Luminet et al., 1999; Taylor & Bagby, 2013). Thus, alexithymia is not related to overall decreased affective responses, but rather to a dissociation between elevated distress and reduced experience of positive affect. Negative and positive affect instead represent distinct dimensions that can result from alexithymia (e.g. confusion about feelings increasing negative affect) or contribute to it (e.g. frequent negative mood might increase difficulty identifying precise feelings). As such, is control over affect necessary to accurately measure the specific contribution of alexithymia (total score or facets) to outcome variables? If so, how would this be best accomplished?

Covarying negative and positive affect can importantly reveal the effects of alexithymia on dependent variables after isolating the influence of affect. Yet, this approach is typically undertaken when affect correlates with alexithymia or to ostensibly control group differences. However, covariance analysis is only effective when the covariate correlates with an outcome; otherwise it would remove variance shared with alexithymia without achieving control of “background noise” (Miller & Chapman, 2001). We therefore recommend reporting negative and positive affect ratings and their correlations with alexithymia and outcome variables. Analyses should be shown with and without covariates (when appropriate), which would reveal whether alexithymia results are or are not changed. If the results are unchanged, confident conclusions could be drawn. If instead the results are altered, more cautious conclusions or nuanced follow-up analyses are indicated. Mediation models, particularly with bootstrapping (see Hayes, 2013; Preacher & Hayes, 2008), and structural equation modelling in such cases can better isolate the contributions of both predictors and covariates. Thus, multiple hypothesis-driven models and paths can be tested (e.g. from affect to alexithymia facets, with separate paths from affect to/from alexithymia to outcome(s)), with clarity about which path(s) best fit the data.

Our review revealed considerable variability in analytic approaches used to address positive and negative affect. This prevents firm conclusions from the current literature about the role of NA/PA in alexithymia. Considering only the 63 unique papers reviewed (76 experiments), 26 (41%) lacked controls and 4 (6%) only controlled for non-emotional variables such as IQ. Of the 33 that controlled for affect, 11 papers (33%) controlled for both NA and PA, while 22 (67%) controlled only for NA. Furthermore, 17 of these papers (51%) only reported the final results after controls were applied, while 14 (42%) reported results with and without control, or reported whether controls altered the results (see Tables 1–5). Notably, two papers (6%) specifically documented that affect correlated only with alexithymia but not with the dependent measures and thus, left these variables out of the analyses (e.g. Correro et al., 2021, this issue; Nielson & Meltzer, 2009). Moreover, of the 33 papers examining affective controls, 29 (87.9%) showed that controls had no meaningful effect on alexithymia in the analysis, as they explained very little variance (see Correro et al., 2021; Grynberg et al., 2014; see also, Suslow & Donges, 2017). Only four papers found reduced alexithymia effects after controlling affect ratings (Grynberg et al., 2014; Lundh & Simonsson-Sarnecki, 2002; Mueller et al., 2006; Suslow et al., 2003); three were in the domain of attention, suggesting attention is most vulnerable or perhaps most sensitive to such effects. However, all four studies had small samples, leaving some question about remaining power to detect effects after controls. Indeed, despite moderate inflation of TAS-20 by anxiety or depression, the available evidence supports alexithymia as a stable personality trait, rather than simply a reflection of distress or illness severity (e.g. Luminet et al., 2001, 2007). Thus, while statistically controlling for negative and positive affect may be important in some cases, it is unlikely to greatly influence study outcomes.

3.3.2. Moving from correlational to causal interpretations

One major domain of improvement would be to move alexithymia research from predominantly correlational designs to designs that permit interpretation regarding the causal direction of relationships. Firstly, given that alexithymia has been explained as resulting from arrested emotional development (e.g. Lane & Schwartz, 1987; Taylor, 2000; Taylor et al., 2016), longitudinal studies are needed to evaluate emotional abilities from very early childhood to adulthood. Yet, these critically important studies do not yet exist. Indeed, longitudinal studies in alexithymia are scarce, with only two primary sets existing. The first study examined vulnerability for somatic diseases, showing that alexithymia predicts long-term health risks independently from other risk factors (Kauhanen et al., 1996; Tolmunen et al., 2010). The second study examined the course of chronic or acute stress, concluding that although alexithymia increases with distress, it also has relative stability over time (e.g. de Timary et al., 2008; Luminet et al., 2001; Luminet et al., 2007). These sets of studies further highlight the need to better discern how and under what circumstances deficits dominate, versus when over-responding occurs (see Preece et al., 2017).

In addition to longitudinal studies of emotional development, investigations of early emotion processing is needed to capture precisely how early deficits in processes such as attention and appraisal might lead to or trigger later processes, such as over-responding behaviours (e.g. aggression). Although memory deficits are noted for negative emotion stimuli in alexithymia, salience effects on early processing are thought to underlie the over-responding to meaningful stimuli such as illness words (e.g. Meltzer & Nielson, 2010), but few studies have disentangled these effects. Isolating early triggers would allow systematic study of the underlying mechanisms that lead to such downstream effects.

Causal interpretations of alexithymia also require the incorporation of experimental manipulations of emotional context and emotional intensity. Such study designs are still rare in alexithymia research, but highly insightful. One study showed the irrelevance of level of processing at encoding (i.e. perceptual vs. semantic) in HA; memory for emotive stimuli was equally deficient in both conditions (Luminet et al., 2006). Another study highlighted a difficulty of inhibiting irrelevant information in HA by manipulating task demands (remember vs. forget); HA exhibited deficits of remembering when processing negative information, but over-responding when required to forget (Dressaire et al., 2015). Similarly, physiological reactivity is often measured in alexithymia, but rarely is this manipulated along with measuring cognitive outcome variables. One such study found HA and LA had comparable physiological response and long-term memory enhancement when arousal was induced after learning, despite the lack of subjective arousal response and poorer immediate recall in HA (Nielson & Meltzer, 2009). This finding suggests that memory deficits in high alexithymia may occur at the encoding stage, rather than consolidation stage, fitting with the idea that early processing influences are responsible for downstream effects. Across all domains we examined, context and affect manipulations would greatly enrich our understanding of the conditions under which alexithymia produces deficits, over-responding, or nil effects.

In the studies that we reviewed, normative samples with moderate TAS-20 scores predominated. Few clinical studies examining the cognition–emotion interface is detrimental to a full understanding of alexithymia. Yet, more important perhaps is the clear indication of dysfunction in higher alexithymia even in normative samples. We would expect greater degrees of alexithymia severity would further amplify these dysfunctions. This highlights the importance of considering alexithymia when studying precisely how emotion and cognition interface, and further invites the longitudinal study of origins and outcomes in clinical cases.

3.4. The clinical significance of emotion and its impact on emotion regulation

In this review, alexithymia was linked to deficits of emotion processing in multiple domains, but it was also linked to over-responding to emotion. In most cases, over-responding was maladaptive. These findings are consistent with evidence that alexithymia predicts reduced effectiveness of psychotherapies based on insight, self-awareness, and client-therapist rapport (Ogrodniczuk et al., 2018), with DIF (Terock et al., 2015) and DDF (Leweke et al., 2009) in particular predicting poorer outcomes. Alexithymia also predicts reduced benefits of emotion rehearsal, including disclosure of emotion (Pennebaker & Smyth, 2016), via DDF (Paez et al., 1999). Thus, reducing emotion dysfunction in HA, even in those with modest alexithymia severity seems of paramount importance.

Cognition may be an important target in the therapeutic process in alexithymia as alexithymia has been shown to mediate treatment success among those with poor emotion processing (Sugiura, 2007). Because emotion processing biases in HA occur during early automatic processing, addressing them will be challenging. Fortunately, directed interventions have been found successful in reducing early attention biases to threat in anxiety disorders (MacLeod, 2019). Thus, it might be useful as an intervention to focus HA on the emotional aspects of their environment, as well as to elucidate the role of attention deficits in alexithymia.

Problems with emotion regulation are central to many forms of psychopathology (Sheppes et al., 2015). HA is linked to maladaptive emotion regulation strategies, such as suppression (e.g. Laloyaux et al., 2015), specifically via the DDF facet. Given the strong links between alexithymia and psychopathology (Honkalampi et al., 2018; Morie & Ridout, 2018), it is plausible that alexithymia might underpin, or at least contribute to, emotion dysregulation in psychiatric patients. Indeed, Clyne et al. (2010) demonstrated that alexithymia-specific training toward improving emotion recognition and attention to emotional reactions was more effective for binge eating disorder than cognitive–behavioural therapy or antidepressants alone. Alexithymia, particularly DIF, is linked to experiential avoidance, which mediates the link between alexithymia and difficulties regulating emotion (e.g. Venta et al., 2013), depression, and somatic symptoms (Panayiotou et al., 2015). Thus, interventions targeting experiential acceptance, improving affect labelling, and linking labels to visceral sensations might improve emotion regulation and reduce psychopathology in HA (Preece et al., 2017). Finally, effective methods are needed to assist HA to effectively process, encode, and retrieve autobiographical memories, particularly for positive events, which one study suggested might be achieved through inducing emotionally positive non-verbal contexts, such as using music (Vermeulen et al., 2010).

3.5. Neural correlates of the foundations of alexithymia

This review illuminated appraisal and attention deficits in emotion processing that may contribute to memory, language and behaviour effects in HA. These conclusions are complemented by neuroimaging findings. Specifically, impaired automatic processing of emotive stimuli in HA, particularly for threat-related and negative stimuli, have been reported corresponding to reduced activity in the amygdala, insula, precuneus, anterior cingulate, posterior cingulate, and prefrontal cortex (see Goerlich, 2018; Goerlich & Aleman, 2018). Given that reduced awareness of emotion occurs at the most fundamental perceptual levels, this may generate multiple downstream effects on physiological responding, emotional appraisal, decision-making, actions, memory, and language (Goerlich, 2018). Furthermore, this review illuminated deficits of cognitive control (e.g. executive functioning) in HA (see in particular Correro et al., 2021, this issue) that are consistent with dysfunction particularly in the prefrontal cortices (Hogeveen et al., 2016; Williams & Wood, 2010). A small but notable literature reinforces dysfunction of cognitive control, linking HA to excessive perseverative errors, impaired switching of task demands, and difficulty inhibiting irrelevant information (see Vermeulen et al., 2018).

Dysfunction of cognitive control and prefrontal regions is consistent with the difficulty HA have in linking concrete bodily experiences of emotions with symbolic and sub-symbolic representations (Bucci, 1997), which impairs using those experiences to form images and use words to reflect upon and communicate subjective experience (Taylor & Bagby, 2013). These effects, and more atypical findings of over-responding in HA (e.g. Meltzer & Nielson, 2010; Ridout et al., 2021; Vermeulen et al., 2010), are furthermore consistent with HA dysfunctions in self-referential processes and perhaps hyperactive salience effects, not restricted to emotion processing. Similar effects are evident in studies tapping the salience network (anterior insula, dorsal anterior cingulate cortex), default-mode network connectivity (a broad network most active during rest (Raichle, 2015), semantic processing (Binder & Desai, 2011)), and interhemispheric information transfer (see Goerlich & Aleman, 2018). Indeed, EOT may be particularly relevant as it appears to reduce the ability to detect and utilise necessary cues for establishing cognitive priority, even in neutral contexts. Systematic studies that integrate these approaches, use sensitivity and response bias metrics in analysis and seek to tease apart encoding from later memory stages will help characterise downstream effects of attention and appraisal in HA.

3.6. Integration between alexithymia research and emotion science

There are several emotion-theoretical frameworks that can help to contextualise the findings of this alexithymia review and the facet-specific effects. We discuss three general frameworks: (1) attentional bias and control; (2) appraisal; and (3) awareness. For each framework, we underscore important interpretations of the current findings in alexithymia, provide guidance for the issues, and directions to be addressed in future research.

3.6.1. Attentional bias and control

Emotion influences attentional processing across the continuum from early automatic (orientation) to later controlled processing (maintenance, avoidance) by biasing competition for attentional priority through heightened salience (Yiend, 2010). Attentional bias theory, indeed has shown salience effects can reduce or enhance processing. In anxiety disorders, salient threat-relevant stimuli are given preference in early and late processing phases (MacLeod, 2019), but they are also used to strategically avoid threat during later processing to regulate mood (Cisler & Koster, 2010). In alexithymia, elevated negative affect and reduced positive affect (e.g. Luminet et al., 1999; Taylor & Bagby, 2013) suggests that attention would be biased towards negative stimuli and/or away from positive stimuli. Several studies did report an attention bias to threat, such as to illness-related stimuli. This may be related to anxiety, but only one study controlled for negative affect (Grynberg et al., 2014). Indeed, the primary finding was instead reduced attentional processing of emotional stimuli during early and late processing, which might be due to emotion having reduced salience in alexithymia; thus, it does not capture attention.

Neuroimaging studies in HA are consistent with this explanation, demonstrating reduced amygdala activation to masked emotional faces (Recker et al., 2010) and reduced early visual evoked responses (P1) to emotional pictures (Pollatos & Gramann, 2011). Yet, some of these findings, particularly those associated with later attentional processing, might instead represent strategic avoidance of emotion. As HA exhibit poorly differentiated interpretations of emotion stimuli due to under-developed emotion schemas (e.g. Luminet et al., 2006), they experience diffuse and ambiguous emotional states and might strategically avoid processing emotional stimuli to avoid activating these states.

Attentional control theory (Eysenck et al., 2007) can also be related to alexithymia findings. It proposes that anxiety impairs executive function, resulting in more stimulus-driven ("bottom-up") processing and reduced "top-down" cognitive control of attention. There is evidence of deficient cognitive control in HA (see Correro et al., 2021, in this issue; Vermeulen et al., 2018), which could account for salience-related biases, while EOT might explain the predominant findings of attention deficits. Although a minority of studies took a facet-level approach, those that did so most often implicated EOT in attentional deficits in HA, supporting the importance of attentional control in alexithymia.

3.6.2. Appraisal

The emotion process approach of Scherer and Moors (2019) examines how the appraisal process produces differential outcomes for action tendencies, facial and vocal expressions, or bodily reactions, which then influence how feelings are categorised and labelled. This is a particularly valuable framework for clearly needed future alexithymia research evaluating appraisal during experimental emotion manipulations, particularly because HA are prone to aggression – and avoidance-related action tendencies during emotional situations.

To more closely link appraisals and action tendencies, Scherer and Moors (2019) indicate that inducing novel/unexpected situations increase approach action tendencies (orientation/exploration), together with immediate shift in attention (Brosch et al., 2013). Within negative stimuli, those that cause goal conflict instigate behavioural adjustments to increase effort to overcome conflict, as well as to avoid subsequent conflict. Finally, while other agency can increase the tendency to aggress, mitigating information providing evidences for circumstances-agency can reduce aggression tendencies. Based on our review, we predict that HA will moderate those effects with less attention shift in novel/unexpected situations, failure to adjust behaviours when confronted with conflict stimuli, and failure to show reduced aggression after receiving mitigating information.

Therefore, future studies should combine a process-oriented framework, together with a multi-level measurement approach (Scherer, 2019). This proposal can be linked with the already observed deficits in emotional granularity and in emotional dialecticism (see Section 2.2. on Appraisal). These steps, integrating cognitive processes and behavioural tasks (Robinson et al., 2019) will afford subtle indices of the key components of HA emotion deficits at the appraisal level.

3.6.3. Emotion awareness

Our assessment of alexithymia through the cognition–emotion interface is also consistent with emotion awareness theories, in particular the "three-process model" (Smith et al., 2018), which proposes three separate but interrelated neuro-cognitive processes that contribute to emotional knowledge and awareness. In the first process, internal emotion concept formation and access to emotion concepts in memory, is disrupted in alexithymia. Indeed, HA have impaired ability to access, communicate, and assimilate cognitive meanings of emotions into personal concepts and representations (particularly via DIF). Thus, having weak emotion concepts contributes to poorer verbal representations of emotions, and hinders the ability to connect experiences, thoughts, and memories, which is needed for effective emotion responding and communication with others.

Second, the three-process model proposes that appropriate emotion responding and emotion knowledge and awareness require generation of and response to physiological reactions to emotion (e.g. arousal). As our review showed, HA have difficulty detecting the cues needed to set cognitive priority (via EOT), deficits of emotional appraisal (via DDF), and particularly with negative emotion, elevated experiential avoidance, feelings of threat, and impulsive aggression (via DIF). Thus, HA are impaired in using physiological responses to emotions in conjunction with knowledge and experience to be able to understand and communicate about emotional experiences.

Finally, the three-process model proposes the importance of cognitive control over emotive states, through attention, working memory, and approach-avoidance strategies. Supporting the model, a dominant theme throughout this review is altered cognitive control in alexithymia, including prolonged automatic attention to negative and arousing stimuli (via DDF and EOT), a preference to avoid conscious attention and engagement with internal events, particularly when emotive (via EOT), and even generalised deficits of cognitive control (DIF-EOT interaction; e.g. Correro et al., 2021, this issue; Vermeulen et al., 2018).

Taken together, this review supports each part of the three-process model, indicating the value of this framework to guide future research in HA. As such, joint cognitive–behavioural studies that intentionally evaluate the three-process model would allow systematic testing of these dissociations. Such studies would delineate under what conditions underlying HA processes are outcomes of initial emotion dysregulation, dysfunctional avoidance strategies, or impulse control failure leading secondarily to suppression and experiential avoidance toward regulating emotions.

4. Conclusions

In the present article, we examined, for the first time, a long-standing unresolved contradiction between claims that alexithymia is related to emotion deficits versus other claims of emotional “over-responding” resulting from defensive reactions against experiencing overly intense feelings. Several conclusions emerge from our examination. First, we highlighted evidence that over-responding, while typically maladaptive (e.g. increased recall of illness words), can sometimes be beneficial (e.g. better positive memory in positive context). Second, although the existing literature explains alexithymia as always related to emotional contexts, our review uniquely delineated that there are clear patterns of deficits and over-responding in neutral contexts as well. This is essential for both clarifying cognitive-emotional functioning in alexithymia, and for guiding interventions. Third, our analysis of studies using the total score versus those examining the specific alexithymia facets revealed a facet-process relationship that underscores the importance of facet analysis. For example, deficits were predominant in cognitive processes, which had particularly clear links to early processes such as attention and appraisal that may have down-stream effects on other processes and behaviours. In contrast, behaviours such as impulsive aggression were tied to dysfunctional over-responding. These findings in alexithymia importantly highlight the importance of emotion processing even in normative populations. The vast majority of the studies included in this review employed participants without a diagnosable disorder. Thus, even those with no particular disorder can exhibit meaningful dysfunctions of emotion processing that influence functioning across the continuum of cognitive and behavioural functioning.

With this review we used alexithymia to draw attention to fundamental issues that personality traits offer to emotion research. Having limited or weak verbal representations of emotions increases the burden on attentional and memory processes, hindering the ability to connect to external and sensory experiences and make effective responses to them. Similarly, deficits in verbally elaborating feelings and an externally orienting style hinders connecting feelings to thoughts, memories and goals. This, in turn, impacts upon understanding of one’s own emotion states and ability to communicate them with others (e.g. Barrett et al., 2007). These are furthermore foundational to developing appropriate emotion schemas and lexicon (Frijda, 1986; Lieberman et al., 2011) and effective interpersonal relationships (Izard et al., 2011). Altered automated processing and over-responding, particularly when intense, salient, or negative experiences are encountered, also contribute to difficulty in emotion processing, perhaps fostering negative feedback loops that reinforce threat anticipation, contributing overall to reduced emotion processing. The present review thus highlights the importance of alexithymia as a fundamental personality dimension in understanding the interplay between cognition and emotion.

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Notes

1 This particular study used the BVAQ instead of the TAS-20. The BVAQ scale involves a facet assessing poor fantasy life, which is closely related to externally oriented thinking (EOT).

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