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Nicolas Vermeulen

Universite Catholique de Louvain

Irena Domachowska

Technische Universitat Dresden

Kristy A. Nielson

Marquette University, kristy.nielson@marquette.edu

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Memory and Executive Functions in Alexithymia

Nicolas Vermeulen, Irena Domachowska, and Kristy A. Nielson

Introduction

In their review of research on the alexithymia construct, Taylor and Bagby (2004) wrote positively about what they perceived was an increase in the number of studies exploring the construct using experimental design methodologies. In their earlier reviews of alexithymia research, Taylor and Bagby had also argued explicitly that the field needed to embrace an experimental approach as a way to supplement the measurement-based method, which at the time predominated the field (Taylor, 2000; Taylor, Bagby, & Parker, 1997). Since these calls for the use of more experimental designs, research using such investigative methods and strategies to explore the alexithymia construct has expanded greatly, including studies that examine the relation between alexithymia and impairments in emotional processing. Many of these studies adopted and employed widely used and validated techniques from cognitive psychology. These empirical investigations provided support for several earlier propositions that were thought to characterize the alexithymia construct. One earlier example of the use of an experimental approach to study alexithymia is a study by Lundh and Simonsson-Sarnecki (2002) who reported that participants who had high scores on a measure of alexithymia showed attentional biases toward illness-related words. Lundh and Simonsson-Sarnecki (2002) argued that this finding supported the view that the emotions of individuals who score in the high range on measures of alexithymia are not as well mentally represented and processed as those of individuals who do not score in this range. These results explain, at least in part, the tendency of individuals with high levels of alexithymia to focus on the somatic sensations that accompany emotional arousal and to misinterpret these as signs of a potential illness. Lundh and Simonsson-Sarnecki (2002) argued that when facing distressing events, such an attentional bias may direct

attentional focus of individuals with high levels of alexithymia on the somatic components of their emotional responses.

Our aim in this chapter is to review the results from both correlational and experimental studies examining memory and executive functioning processes in alexithymia, with an emphasis on the experimental studies. We selected papers in the main databases (PsycINFO and Scopus) for the period 1990–2016 that included alexithymia, memory, or executive functions in the title, the abstract, or the keywords. We examine two broad areas of research – memory functioning (both short and long term) and executive functioning (considered as a general construct). The majority of the studies in this area and which we review used samples of healthy volunteers (typically university students). Almost all of these studies assessed alexithymia with the self-report *20-Item Toronto Alexithymia Scale* (TAS-20) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994), which includes three subscales that assess the difficulty identifying feelings (DIF), difficulty describing feelings (DDF), and externally oriented thinking (EOT) facets of the construct (see Chapter 2). Throughout the chapter we use the abbreviations HA (high alexithymia individuals) to refer to individuals or study participants who score in the high range on measures of alexithymia, and LA (low alexithymia individuals) to refer to those who score in the low range. This chapter is intended to complement Chapter 4 in this volume, which addresses emotion knowledge and regulation. Both this chapter and Chapter 4 examine how alexithymia is related to or moderates the cognitive processing of emotional and non-emotional stimuli.

Memory Functioning and Alexithymia

Long-term memory comprises a declarative memory system and a procedural memory system. Declarative

memory encompasses semantic memory (e.g., what is the name of the current US president) and episodic memory, which includes autobiographical memory or memory of personal events (Burt, Kemp, & Conway, 2003). Most of the studies in alexithymia research examined episodic and autobiographic memory functioning. However, a few studies also assessed short-term memory, which is the capacity for maintaining the limited, current contents of memory over a brief period. This is distinguished from manipulating these contents, most commonly referred to as working memory, which will be considered under executive functions.

Memory Research in Alexithymia

The interest in memory functioning in alexithymia began some 20 years ago in France with a study by Jacob and Hautekeete (1998); these investigators employed a well-known, "classic" incidental memory task design in which participants are not explicitly oriented toward word memorization but are subsequently asked about what (i.e., incidentally) they remembered. The authors hypothesized that HA would be less able to incidentally memorize emotional information. The participants were first instructed to assess the emotional content of sentences. Next, participants were presented with 48 words (24 were part of the sentences in the first stage and 24 were new words) and asked to recognize as quickly as possible whether a word had been presented during the sentence assessment. On this recognition task, the two groups correctly recalled the same number of words. The authors also analyzed the type of errors such as omissions (old words not recognized) and false alarms (new words recognized mistakenly as old), and recognition time (i.e., time needed to take decisions). They found that HA took more time to recognize the words presented but committed fewer errors than LA. Analyses of response bias also revealed that HA responded significantly more often with "not presented before" to both old and new words. The tendency of HA to reject words more often than LA suggests that HA might need to recover more attributes of the words presented to make a recognition decision. This finding may be related to the idea that HA possess weak links between symbolic and subsymbolic representations of emotional experiences (Bucci, 1997).

In a later investigation, Lundh et al. (2002) analyzed whether the time necessary to recollect

autobiographical memories was influenced by alexithymia. Participants completed the *Autobiographical Memory Test* (Williams & Broadbent, 1986), in which five positive and five negative words (e.g., successful, angry, sorry) were presented one by one to the participants. For each word, participants had 60 seconds to recollect the first memory of a situation in which this emotion was experienced. Based on the idea that HA are often unable to link feelings with memories (Taylor, Bagby, & Parker, 1997), the authors assumed that a high level of alexithymia would be associated with difficulty in producing autobiographical memories. No significant correlations between the time to recollect emotional memories and alexithymia for TAS-20 total scale and subscale scores were found, failing to support the hypothesis of an autobiographical memory deficit in HA. This interpretation of the results could be explained by the methodologically unorthodox manner in which recollection was measured (i.e., recall latency). Most researchers use memory content, such as the number of details recalled or the level of accurate recall or recognition rather than latency needed to complete recall, as the outcome or dependent variable. A second methodological concern with this study is that many of the participants produced low scores on the TAS-20 (mean $M = 39.6$; $SD = 8.0$), while there were very few high scorers (only 12.5% of the sample scoring higher than 50). The absence of an "alexithymia effect" is thus likely best attributed to restricted range of variability.

The Memory of Emotion and Illness-related Words

In the past 10 years, several studies have explored episodic memory abilities and their relations with alexithymia. In those studies, emotional, illness-related, and neutral materials were considered. Some studies assumed that HA would show an overall deficit in recalling emotional information (Luminet et al., 2006; Vermeulen & Luminet, 2009; Vermeulen, Toussaint, & Luminet, 2010); others specifically hypothesized a deficit for illness-related words (Meltzer & Nielson, 2010). Luminet et al. (2006) used the depth of processing manipulation, with the assumption that deep processing leads to better memory performance. In the perceptual condition (shallow level of processing), participants had to decide whether each of the 18 presented words (6 neutral,

6 positive, 6 negative) was written in small, medium, or large font. In the semantic condition (deep level of processing), participants had to estimate whether the proposed definition of the word was correct. Next, participants had first to complete a surprise recall task. For each word recalled, participants were asked to decide whether the recall was associated with a “remember” or a “know” state of consciousness or simply a “guess”. A “remember” response was defined as having a specific memory of the time the word appeared on the screen (such as a specific thought associated with the word or the feeling state experienced when viewing the word). A “know” response was defined as just knowing the word was there but without the ability to provide any further detail related to it. “Guess” answers were situations in which people thought it was plausible that the word was presented but without any degree of certainty. Response times to words during encoding were also collected. For the memory task, there was a significant interaction effect for alexithymia (HA/LA) and the type of words (emotional [positive and negative]/neutral). For the neutral words, no differences between the HAs and LAs was found, but the HA had a lower rate of recall for positive and negative emotional words relative to the LA. These effects occurred independently of the depth of processing. Concerning the consciousness of the recall, HA reported a lower proportion of “remember” answers, while there was no difference in the “know” condition. The lower proportion of “remember” responses supports the idea that HA have difficulty with consciously recollecting aspects of what they experienced at the time the stimuli were presented. A deficit in the ability to consciously access emotional and meaningful material may render the regulation of intense emotional states more difficult for HA as the ability to represent emotions symbolically, notably through language, and to link them meaningfully with past emotional experiences, facilitates the modulation of such states (Bucci, 1997; Taylor, 2000). Importantly, the effects found in the study by Luminet et al. (2006) were still significant once positive and negative affect, dispositional optimism, and anxiety were introduced as covariates.

Other research confirmed the negative influence of alexithymia and particularly the DIF facet on memory during a free (surprised) recall task and a recognition task (Vermeulen & Luminet, 2009). As in the study by Luminet et al. (2006), the depth of

processing was manipulated. Sixty-five participants were assigned to either a “perceptual” task or a “semantic” task. In the perceptual condition, participants indicated whether the vowel-consonant sequences corresponded to the letter organization of a word, while in the semantic condition, participants evaluated whether the word was part of the emotional domain. The partial correlations controlling for negative affect and anxiety showed that only the DIF subscale of the TAS-20 correlated negatively with the memory performances for emotional words (joy, disgust, and anger). No correlations were found for neutral words.

Arguing from a different perspective, Meltzer and Nielson (2010) hypothesized that alexithymia, given its association with functional somatic symptoms, might increase the personal relevance of illness-related words, which, in turn, would lead to a specific memory bias for illness words. To this end, Meltzer and Nielson (2010) categorized a sample of students into separate groups of HA and LA, and required them to rate neutral, positive, negative, and illness words on different Likert scales involving valence, arousal, and dominance. At encoding, which involved incidental rather than intentional learning because the task required rating rather than remembering words, alexithymia group category did not affect ratings of the words. However, 45 minutes later, unexpected recall of the rated words was completed and showed that the group of HA recalled more illness-related words such as “burn, pain, tumor” and fewer general negative words such as “rejected, fear, violent”. These results suggest that the deficit observed in long-term memory abilities for HA would be restricted to specific emotion categories related to their preoccupation for illnesses.

The Role of Context and Memory Control

In support of the incidental learning effects reported by Meltzer and Nielson (2010), Vermeulen, Toussaint, and Luminet (2010) also investigated whether incidental emotional musical activation (happy or angry music) during encoding could influence the effects of alexithymia on recognition rates. Neutral, joy, and anger words were used. The procedure was similar to the study by Vermeulen and Luminet (2009), with music played discretely in the background as the primary difference. The musical selections were chosen to induce either anger or joy and were

expected to influence the encoding of words, similarly to affective priming studies, leading to facilitation when congruent with the words and inhibition when incongruent with the words. Memory testing consisted of a surprise recognition task with a remember/know paradigm. The findings showed that HA recognized fewer emotion words than LA; no difference was observed for neutral words. In the anger music condition, HA recognized significantly fewer words than LA, whereas no difference between LA and HA appeared in the happy music condition. In addition, a three-way interaction involving music, alexithymia level, and words showed that HA recognized more joy words than anger words in the happy music condition, and more anger words than joy words in the angry music condition. These results support a memory congruency effect in HA, suggesting that for HA, a congruent emotional context provides a valuable support for memorizing stimuli related to the same emotional category. Of importance, Vermeulen et al. (2010) also analyzed the behavioral findings related to the encoding of words. The results showed that music facilitated the semantic processing of words belonging to the same emotion category in HA but not in LA. Moreover, correlational analyses showed that alexithymia was negatively associated with memory performances for anger words in both music conditions. But in the happy music condition, DIF was positively associated with recognition rates of joy words, indicating that HA could benefit from a positive congruent context. The authors proposed that attentional focus was responsible for the findings, an interpretation consistent with the idea that salience influences memory in alexithymia (Meltzer & Nielson, 2010). Specifically, Vermeulen et al. (2010) proposed that while HA did not control the emotional context, it seems that LA may more easily inhibit the emotion conveyed by the music. In other words, HA are more primed or influenced by the musical background because they processed it, while LA are less primed by this background because they inhibited its content.

Recent research also examined the influence of alexithymia on inhibition of unwanted memory in younger and older adults (Dressaire et al., 2015). Two directed forgetting task experiments were conducted, one with negative words and the other with neutral words, where participants were asked during encoding to forget the first half and to remember the second half of a list of words. In terms of recalling

wanted items, both greater age and higher alexithymia scores independently led to poorer recall of negative, but not neutral words. Moreover, greater age and higher alexithymia scores also independently led to a greater rate of intrusions of unwanted (i.e., to-be-forgotten) negative words, but not neutral words. Thus, the results suggested that by impairing recall of needed negative information and impairing the ability to withhold or forget unwanted negative information, alexithymia influences not only memory but also the more general process of cognitive control. This control, however, was not a function of age, and furthermore, it was significantly related to the EOT facet of alexithymia, with higher EOT scores predicting poorer cognitive control.

To summarize the studies reviewed thus far, there is evidence that a high level of alexithymia, especially the DIF facet, influences memory performance. Several conclusions can be made: (1) memory for neutral stimuli appears unaltered; (2) processing time for both encoding and retrieval appears unaltered; (3) memory accuracy deficits could be at least partly driven by encoding alterations (Vermeulen et al., 2010); and (4) context and salience, including the ability to inhibit intrusive or unwanted information (Dressaire et al., 2015), appear quite influential to what HA encode and remember. Together, these four influences can either enhance or disrupt memory. Specifically, a positive context, at least when induced by music, may provide contextual cues used by HA and employed by them to assist their memory performance. However, given their tendency toward a focus on external events rather than internal experiences, environmental, situational, and task contexts should be considered when evaluating cognitive performance in HA. From a conceptual perspective, the findings of these studies support Bucci's (1997) explanation that emotive situations and stimuli can evoke subsymbolic processing that is dissociated from verbal symbolic representations in HA, whereby physiological activation may occur without cognitive activation.

Short-term Memory

Some studies have explored memory functioning concurrently for both immediate (short term) and delayed intervals (long term) and included visual or face stimuli. Some authors conducted a non-emotional neuropsychological assessment of LA and

HA using the *Wechsler Memory Scale-III* (DiStefano & Koven, 2012). This scale includes eight subscales assessing logical (verbal story), verbal (word pairs), facial (visual, non-emotional), and family pictures (visual scenes) memory; each subscale was used to assess immediate and delayed memory. Both groups had similar IQ, but the level of anxiety was higher in the group of HA. On the assessments of memory functioning, verbal subscales (words and story) were comparable between the alexithymia groups, but the LA performed better than the HA on the immediate and delayed visual memory subscales. Although the sample was small, and anxiety differences were not considered in the analyses, the results suggest a lack of influence of alexithymia for non-emotional verbal material, but a poorer ability of HA to encode and retain socially oriented memoranda such as non-emotional faces and pictures of social interactions.

Whereas DiStefano and Koven (2012) examined only neutral verbal and visual stimuli, other researchers examined short-term memory for visual stimuli with emotional tone, namely facial expressions (Takahashi, Hirano, & Gyoba, 2015). Comparing a total of 23 HA and 23 LA selected from a larger sample, Takahashi and colleagues used different designs to independently examine the stages of visual short-term memory. Participants completed a visual search task (encoding; Exp. 1a: comparing facial expressions in a crowd) and a change detection task (storage; Exp. 1b: comparing emotions in two consecutive crowds). The results showed that HA were as competent as LA at detecting emotional similarities/differences in crowds (Exp. 1a), but HA were significantly less accurate than LA when comparing crowds from memory (i.e., when two subsequent crowds were separated by 2 seconds, Exp. 1b). The results of these experiments support the conclusion that HA are equally able to detect emotional changes as LA, but later storage of emotional values, in this case facial expression, is hampered by alexithymia.

Memory and Interoceptive Sensitivity

In addition to examining the stage of memory processing affected by alexithymia, it is important to explore the role of interoceptive sensitivity (i.e., the subjective capacity to feel the inner body) in memory functioning (see Chapter 17). In a study that assessed these issues simultaneously, Nielson and Meltzer (2009) screened 361 healthy university student

volunteers, and selected 30 HA and 30 LA based on scores in the top and bottom quintiles of the TAS-20. The participants were asked to repeat aloud 30 neutral words and to intentionally try to remember them. Following this encoding stage, participants completed an immediate recall test. This was followed by a 5-minute rest period to measure baseline heart rate (HR) and electrodermal activity (EDA). They then watched a quasi-randomly assigned video clip that was either neutral (tooth brushing) or arousing (oral surgery), and subjective emotional intensity ratings were taken before and after viewing the video. Four groups were compared: (1) neutral video, low alexithymia; (2) neutral video, high alexithymia; (3) arousing video, low alexithymia; (4) arousing video, high alexithymia. The four groups were comparable demographically and on measures of depression, anxiety, and vocabulary, as well as baseline HR and EDA. Subjective ratings showed a significant response to the arousal video in LA but not in HA. However, both alexithymia groups exhibited comparable increases in physiological response to arousal via HR and EDA. HA recalled significantly fewer words overall at immediate recall (33.9%) than LA (39.4%), which was prior to the manipulation, suggesting generally poorer encoding or immediate retrieval in HA. The participants returned 24 hours later to an unexpected recognition memory test, where the 30 test items were interspersed among 110 foil items. With immediate recall as a covariate in the analysis, delayed recognition was enhanced in both the LA and HA who had seen the arousing video the day before, relative to those who saw the neutral video. Thus, although immediate memory for these neutral words was generally poorer in HA, arousal induced after learning enhanced long-term retrieval in both alexithymia groups. This occurred despite the lack of subjective awareness of arousal in HA, reinforcing that the physiological response to arousal, rather than the perception of arousal, is critical to memory modulation.

In another study, researchers evaluated the role of interoception and alexithymia in autobiographical memory using the well-known fading of affect bias (FAB), which is the typical trend in humans to observe a greater reduction of negative memories and a reduced fading of positive memories over time (Muir, Madill, & Brown, 2017). In other words, humans tend to forget more their negative past, favoring recollection of positive events. FAB is

theoretically related to emotion regulation capacity and functions as a self-protective process by reducing intensity of negative experiences and increasing and maintaining intensity of the positive past. In this experiment, participants recalled three positive and three negative memories from their recent past (7 days to 12 months), and completed the TAS-20 and the *Multidimensional Assessment of Interoceptive Awareness* (MAIA; Mehling et al., 2012). For each memory, participants were asked to rate intensity valence (from +3, extremely pleasant, to -3, extremely unpleasant) at the time the experience originally happened and also currently, as they recalled it. FAB was computed by subtracting valence intensity ratings at recall from intensity ratings during original occurrence. The FAB was present in 52% of the recalled events, 41% of the memories showed fixed effects (i.e., no change), and 7% showed increased intensity. Alexithymia was negatively and weakly associated with interoceptive awareness ($r = -0.17$), but both constructs influenced the FAB. A first finding was that the FAB was lower with higher TAS-20 scores, indicating that with greater alexithymia, positive affect faded more and negative affect faded less. A second finding was that the FAB was greater with higher interoceptive awareness scores. Because both predictors were not included in the same statistical model, it remains unclear whether alexithymia influences FAB when controlling for interoceptive abilities. In those with TAS-20 scores reaching a clinical threshold of 61, the FAB effect disappeared, with pleasant and unpleasant affect fading to the same extent. Importantly, influences of alexithymia and interoceptive awareness on the FAB, regardless of direction, were driven by modification to the intensity of positive past events. In contrast, the intensity of negative events played little role in FAB modification. These results can be linked to findings of reduced intensity ratings for positive emotional experience in HA (Fantini-Hauwel, Luminet, & Vermeulen, 2015).

Summary of Memory Studies

In sum, except for the study by Lundh et al. (2002), the research studies on memory have consistently shown that alexithymia has a detrimental effect on memory functioning for emotional material. This was found using different tasks, types of memoranda, encoding or retrieval conditions, and dependent variables. Several general observations can be made:

(1) alexithymia typically did not alter the processing of non-emotional or non-social material, suggesting that deficits in memory functioning in HA are not attributed to a general memory deficit (although see Nielson & Meltzer, 2009); (2) higher levels of alexithymia hamper memory of all types of emotions; (3) this effect seems to be related to alexithymia itself and not to alternative variables such as anxiety or depression; (4) context and salience of memoranda are particularly influential to memory, and in particular encoding processes, with higher levels of alexithymia. The bulk of the findings further suggest that a difficulty associating words with emotions may particularly burden the process of encoding and retrieval for emotive information. Processing would therefore be hindered for the cognitive interpretations of emotions relative to sensory and external experiences related to them. As such, mechanisms of cognitive control during encoding would be particularly burdened where later retrieval of emotive situations or stimuli is important. In the next section we examine the role of cognitive control in alexithymia.

Executive Functions and Alexithymia

Executive functions (also known as cognitive control) are responsible for what is mostly associated with “smart behaviors”, i.e., the ability to consider many options and choose the most appropriate one, the ability to inhibit inappropriate impulses and concentrate attention on the goal-relevant information, and the ability to dynamically adjust behavior to a changing environment. Executive functions can be best conceptualized as a set of cognitive processes that are necessary for the control of goal-oriented behavior (see Diamond, 2013 for a review). To achieve a goal, executive functions control other cognitive processes, such as memory and attention by reorienting attention to goal-relevant stimuli. Cognitive control is also necessary to inhibit unwanted, impulsive responses that serve short-term pleasure or goals, and instead activate behaviors serving long-term goals. Executive functions develop across the lifespan, with most functions continuing to develop until late adolescence. Factors such as a stimulating environment have been shown to positively influence the development of executive functions, whereas factors such as brain traumas and substance abuse have detrimental effects (Stuss, 1992). Deficits in executive functioning have been found in a variety of disorders,

including depression (Fossati, Ergis, & Allilaire, 2001), antisocial behavior (Morgan & Lilienfeld, 2000), and eating disorders (Kemps et al., 2006).

One of the theoretical models that attempts to categorize executive functions is a classification system proposed by Miyake et al. (2000). According to their model, executive functions can be classified into related, but separable functions: inhibition, updating, and shifting. The inhibition functions are used to filter distractions and to prevent dominant or automatic responses; the updating functions are used for monitoring the environment and adjusting the contents of working memory in the context of changing rules or conditions; the shifting functions are used to flexibly switch between responses or to shift to a new response to fit a new rule.

Because executive functions involve a heterogeneous set of skills, it is important to define which functions are most affected by alexithymia. However, even though alexithymia and general executive functioning has been investigated more extensively in recent years, the specific association with cognitive control has received limited attention. Here we present an overview of the research articles currently available. We chose articles reporting studies that used standard measurements of executive functions with neutral content, rather than adapted tasks with emotional content. Even though the latter is more common (e.g., a Stroop task with emotion words), we excluded those measures to avoid confounding difficulties related to the processing of emotional content with deficits in executive functions.

Empirical Investigations of Alexithymia and Executive Functions

The most broadly used test for executive functions is the *Wisconsin Card Sorting Test* (WCST; Puente, 1985), in which participants are instructed to match stimulus cards with one of four category cards, while the sorting rule changes during the course of the task. The only feedback that participants receive is whether there was a correct match (i.e., the rule was properly inferred). Furthermore, the sorting rule changes repeatedly during the course of the task without warning. Thus, after every rule change, participants first make mistakes due to applying the old rule, until they decipher the new rule based on the feedback. The task measures how well participants adapt to the new rule, and therefore, it requires executive functions.

Zhu et al. (2006) investigated the association between alexithymia and executive functions as measured by performance on the WCST. Participants were categorized into groups of LA and HA based on their TAS-20 scores. The group of LA performed significantly better than the group of HA: they made more correct responses and fewer perseveration errors, i.e., failures to adapt to the sorting rule change. These results suggest that alexithymia is related to poorer executive functioning abilities.

Henry et al. (2006) investigated alexithymia and executive functions in healthy controls and individuals who had suffered a traumatic brain injury (TBI). Executive functions were measured using an alternating semantic-phonemic verbal fluency task in which participants are asked to alternately produce words either belonging to a certain category (e.g., "clothing") or beginning with a certain letter (e.g., "R"). Verbal fluency is a well-validated measure of executive functioning as it requires verbal retrieval and recall, self-initiated effortful control and self-monitoring (Henry & Crawford, 2004). Additionally, the alternating between semantic and phonemic fluency allowed measuring mental flexibility, which is one of the defining characteristics of executive functions. Participants with TBI had poorer fluency performance than controls, greater depression, poorer quality of life, and higher levels of alexithymia. Importantly, the DIF facet of alexithymia was associated with all fluency measures across the full sample, and in the TBI individuals and controls separately. Furthermore, using the full sample, DIF contributed uniquely to predicting variance in fluency performance after controlling for depression and anxiety (which also predict performance). Thus, greater DIF was associated with poorer fluency. The authors hypothesized that cognitive and emotional control processes recruit similar areas of the prefrontal cortex so that external damage of those areas would lead to a deficit in both cognitive and emotional deficits, as observed in HA.

In a more recent study, some authors used a battery of neuropsychological tests to examine executive functions in a normative sample comprising young and old adults who also completed the TAS-20 (Correro II et al., 2016). Five independent cognitive domain scores were produced from a principal component analysis of all tests in the battery: visuospatial memory and attention, word memory, narrative memory, executive functions/processing speed, and verbal fluency. Four hierarchical regression

models were used (one for the TAS-20 and one for each cognitive domain) to examine first whether age and sex predict alexithymia scores, followed by adding independent prediction of TAS-20 scores by each domain component. Age, but not sex, was a significant predictor of the DDF factor scores. Importantly, executive functions added further significant independent prediction of DDF scores. The neuropsychological tests that loaded significantly on the executive function/processing speed component were Trail-making A and B, Symbol-Digit Modalities Test, and Category Fluency. These tasks involve searching and tracking multiple relevant targets, resisting related but incorrect targets, and speed of processing. No other models reached significance, although, similar to the study by Henry et al. (2006), there was a trend for letter (phonemic) fluency to predict DIF scores. This study further supports the view that executive functions are compromised in HA. Specifically, although older adults had lower DDF scores than young adults, suggesting improvement with advancing age, poorer executive functioning performance (specifically for abstract and speeded tasks) was associated with higher DDF scores regardless of age. These findings are also consistent with the theoretical proposal (Bucci, 1997) that alexithymia involves a lack of sufficient connections between subsymbolic and symbolic representations of emotions, thereby limiting the ability to verbally identify and describe emotional feelings (see Chapters 1 and 8).

Another important role of executive functions is “cognitive conflict processing”. To pursue goal-oriented behavior, one must be able to detect and successfully resolve conflicts, such as choosing between antagonistic action tendencies when one of the responses needs to be inhibited. One of the tasks measuring error processing is the *Attention Network Test* (ANT; Fan et al., 2002). The ANT measures three separate attention systems – alerting, orienting, and conflict – and has been shown to have good test–retest reliability and validity (Fan et al., 2002). Efficiency of the error processing network is examined by asking participants to indicate the direction of the central arrow (left/right) that is surrounded by congruent, incongruent, or neutral distracters. Zhang et al. (2011) used the ANT to explore potential deficits of executive functions in HA. Four hundred students completed the TAS-20, and those with the highest and lowest scores participated in the study, resulting

in a final sample of 63 participants. The selected participants did not have any neurological damage or psychiatric disorders. Zhang and colleagues found that HA had significantly higher conflict scores, as indicated by slower responses and lower accuracy on the conflict (incongruent) trials. No significant differences were found in the orienting and alerting attention systems, or in the overall reaction times and accuracy, indicating a selective impairment in conflict processing. As conflict processing is one core function of executive control, this finding provides further evidence of an association between alexithymia and impaired executive functioning, and is also consistent with altered frontal lobe functioning in alexithymia (see Chapter 13).

We have thus far described experiments measuring executive functions in the laboratory environment. Standardized tests, such as the fluency task or the *Wisconsin Card Sorting Test*, assess isolated and specific components of executive functions over a short period of time. However, everyday situations require dynamic and simultaneous activation of different functions. For example, long-term planning and successful decision-making demand interactions between working memory, behavioral inhibition, error monitoring, and flexibility. Therefore, a central issue is to examine how well deficits in executive functions identified in the laboratory translate into cognitive difficulties in daily life. To address this, Koven and Thomas (2010) administered the *Behavior Rating Inventory of Executive Function – Adult Version* (BRIEF-A; Roth, Isquith, & Gioia, 2005), which is a self-assessment measure of problem-solving demands with high ecological validity (Vriezen & Pigott, 2002), and also assessed alexithymia and closely related constructs using the TAS-20, the *Mood Awareness Scale* (MAS; Swinkels & Giuliano, 1995), and the *Trait Meta-Mood Scale* (TMMS; Salovey et al., 1995). The MAS includes two subscales – Mood Monitoring and Mood Labeling. The TMMS includes three subscales that assess Attention to Feelings (e.g., “I pay a lot of attention to how I feel”), Clarity of Feelings (e.g., “I am usually very clear about my feelings”), and Mood Repair (e.g., “When I become upset, I remind myself of all the pleasures in life”), which are hypothesized as main competencies in emotional intelligence (Mayer & Salovey, 1997). Previous research findings suggest that alexithymia overlaps conceptually with the mood awareness and emotional intelligence constructs (Coffey, Berenbaurn,

& Kerns, 2003; Salovey, Woolery, & Mayer, 2001). Therefore, to identify specific facets of alexithymia, a principal component analysis of all items from the test battery was conducted. This yielded two specific factors: Emotional Clarity, which measures the ability to identify and label emotions, and Emotional Monitoring, which captures the ability to perceive and control one's emotions.¹ The results showed that only Emotional Clarity correlated with dysfunctional executive functioning in everyday life. Specifically, lower Emotional Clarity predicted worse performance in self-reported set shifting, inhibition, emotional control, self-monitoring, task initiation, task monitoring, working memory, and planning. Emotional Monitoring only showed a significant correlation with self-reported emotional control, which is not surprising given the conceptual overlap between those two constructs.

Summary and Discussion of Executive Functions Studies

The findings from the studies reviewed in this section show that HA manifest impaired executive performance, both in laboratory settings (Henry et al., 2006; Zhang et al., 2011; Zhu et al., 2006) and in everyday life (Koven & Thomas, 2010). There is some evidence that the DIF and DDF facets of alexithymia may be more predictive than global alexithymia in examining associations between alexithymia and executive functions. Specifically, DIF was associated with verbal fluency and DDF with tasks that measure processing speed and abstraction.

All of the studies described here rely on cross-sectional data, and longitudinal studies have not been conducted. Therefore, little is known about the direction of causality of the observed effects, namely, which deficit occurs first – a general deficit in executive functions that impairs the ability to regulate emotions, or an inability to identify, describe, and understand emotional feelings that causes high baseline arousal, which then impairs executive functions. An important task for future research is to establish

the direction of causality. Neuroimaging studies might provide more support for the dominant hypothesis that there is a structural and functional overlap in emotional and cognitive processing and that dysfunctions in specific regions of the brain would adversely affect both types of processing, as suggested by a study on individuals with traumatic brain injury (Henry et al., 2006).

Conclusions and Perspectives

This chapter highlights a few points of consistency across the limited number of studies examining relations between alexithymia and general memory and executive functioning. The findings are based primarily on small experimental studies, highlighting the need for larger-scale studies of diverse general memory and executive functioning in relation to alexithymia. Yet, there is an overall pattern consistent with both memory and executive functioning deficits in alexithymia that are not attributable to anxiety or depression. Memory effects, both short and long term, are principally found for emotive stimuli of both positive and negative valence, and they appear at the encoding stage, suggesting that attention and encoding processes are specifically altered in HA. Limited or weak verbal representations of emotions may add burden to attention and encoding processes by hindering the ability to connect external and sensory experiences with cognitive appraisals of emotions. Moreover, recall and recollection are particularly biased in alexithymia, specifically related to DIF, toward information that is personally salient in the current context (e.g., illness-related words vs. general emotion words), or contextually dependent (e.g., angry words over joy words when angry background music sets the context). As such, negative emotional contexts may be particularly detrimental to memory performance, while positive contexts may be useful in drawing out the best memory performance in HA. Indeed, providing a contextual cue at encoding, such as a musical cue, might help HA to better encode emotional information in order to reduce the deficit in memory functioning for affective events. This latter point suggests a new line of research that could aim at examining the way clinicians and practitioners might provide support to HA in order to better process, encode, and retrieve (personal) emotional events (see Chapter 12). Thus, contextual cues need further investigation to enhance our understanding of how

¹ For comparison reasons and to keep it consistent with reports of other studies using only the TAS-20, we report that the DIF and DDF factors of the TAS-20 loaded significantly on the Emotional Clarity factor (-0.85 and -0.80 respectively); the EOT factor of the TAS-20 loaded on the Emotional Monitoring factor (-0.71).

they influence memory storage and retrieval, as well as how they might be used as potential interventional strategies in HA.

Given the context and salience effects and their influence on attention and encoding in alexithymia, it is helpful to emphasize the theoretical proposal that HA have difficulty linking the concrete bodily experiences of emotions with symbolic representations of those experiences in cognitive schemas (Bucci, 1997). Thus, there is difficulty transforming the meaning of bodily experiences into images and words, which are necessary for self-reflection and for the verbal communication of subjective experience (Taylor & Bagby, 2013). Executive functioning ability is essential to this process. Perhaps not surprisingly, the studies we reviewed show evidence of an emerging picture of a generalized deficit in executive functions in HA, specifically in cognitive control processes. Specifically, the limited literature in alexithymia to date suggests a pattern including greater difficulty inhibiting unwanted or irrelevant information, difficulty and slower performance in tracking and switching between abstract and categorical task conditions, and making perseverative errors. Relatedly, prefrontal lobe injury is associated with the development of alexithymia (Williams & Wood, 2010) and with executive dysfunction (Hogeveen et al., 2016). Each of these concerns would be expected to have a direct

impact on memory functioning. It therefore appears reasonable to conclude that the memory impairments associated with alexithymia may be secondary to deficits in attention and cognitive control processes. Larger, hypothesis-driven studies are needed that concurrently examine various aspects of memory and executive functioning processes, which would allow predictive and latent variable models, to help to explain and disentangle these functions and their respective relationships with alexithymia. Studies combining these cognitive variables with other approaches such as neuroimaging could also more clearly pinpoint dysfunction and facilitate the development of interventions. Finally, future alexithymia research using longitudinal studies and comparing different clinical populations would help toward developing better causal models of factors contributing to alexithymia, which could lead to the development of more effective interventions. It has been suggested that executive functions may be a mediator of psychotherapeutic success for individuals with poor clarity of emotions (Sugiura et al., 2007). As alexithymia has been shown to decrease the effectiveness of psychotherapies based on insight, self-awareness, and client-therapist rapport (see Chapter 12), interventions that focus on improving executive and other cognitive functions might prove more effective.

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