# Language Processing in Alexithymia

**Chapter** · September 2018

DOI: 10.1017/9781108241595.008

# Chapter 6

## Language Processing in Alexithymia

Carlotta Welding and Dalya Samur

### Introduction

Language use provides insights into the way humans process information (Pennebaker, 2012). What we say, how we say it, and how we perceive the language produced by others reveals information about the manner in which we think and feel. Hence, studying language provides a window to various complex cognitive processes, including the processing of emotions (Wotschack & Klann-Delius, 2013).

In the 1970s, a small group of patients with classic psychosomatic diseases were observed to have constrictions in emotional functioning, in particular difficulty putting their feelings into words (Nemiah & Sifneos, 1970). Sifneos (1973) proposed the term 'alexithymia' to denote this specific difficulty. Nemiah, Freyberger, and Sifneos (1976) subsequently proposed the alexithymia construct to encompass not only difficulties identifying and describing emotional feelings, but also a reduced fantasy life, and a tendency to an externally oriented, operative thinking style. The deficit in the verbal expression of feelings in alexithymia is assumed to have its roots in an impairment in the mental representation and cognitive processing of emotions (Taylor, Bagby, & Parker, 1991). To understand the etiology of this impairment, we believe it is important to examine how individuals with high levels of alexithymia use language.

Each word that people know has its cognitive representation in their mental dictionary; this dictionary contains information about pronunciation and syntactic characteristics of each word, as well as the general meaning and individual connotations (Aitchison, 2012). These aspects together form concepts that are built on our unique experiences and thinking processes (Löbner, 2011). In the case of emotion words, the concepts are abstractions of scenes that an individual has experienced, including objects, persons, and feelings (Bucci, 1997). According to Bucci's (1997) multiple code theory, these emotional concepts are represented at symbolic and/or subsymbolic levels; the symbolic level involves images and linguistic information, while the subsymbolic level includes bodily sensations (see Chapters 1, 7, and 8). Immediately after an emotional episode, people initially process and represent the

activated emotions at the subsymbolic level. Within a short time, they direct their attention to the symbolic level, and the images and verbal encodings of emotions provide access to the internal world. Individuals who score high on measures of alexithymia seem to have problems in translating emotional experiences into words, which corresponds to a difficulty in the transition from subsymbolic to symbolic levels. The emotions remain represented to a large extent at the subsymbolic level and the individual's attention can easily become focused on bodily sensations. The limited verbal representation of emotions also restricts the individual's ability to communicate feelings to others.

In this chapter, we review published studies on the relation between alexithymia and verbal language production and language comprehension, as well as non-verbal language. To locate relevant studies, we conducted a literature search using Google Scholar with search terms such as language, language use, comprehension, word processing, and prosody together with alexithymia. Some of the identified articles were scanned for references to additional studies, which were then also reviewed. Although verbal language production and comprehension are tightly coupled, and the underlying mechanisms largely overlap, they are often referred to as separate processes (Harley, 2013). To study these two cognitive processes, researchers have relied on different sets of methods and designs. We have therefore divided our discussion of these two different but related cognitive processes into separate sections.

In the first section, we focus on the production of verbal language -- the stage of language processing in which one decides what to say, and then picks the right words to express these thoughts (Harley, 2013). A deficit in the verbalization of emotional feelings is a core component of the alexithymia construct. For our review we located 16 studies that investigated the influence of alexithymia on language production.

In the second section, we focus on comprehension, which is the process that integrates the form of a word with its individual meaning (Harley, 2013). Basic comprehension tasks include allocating attention and processing perceptual input such as recognition of written or spoken inputs. More complex systems require further executive memory processes such as retrieving word meanings and integrating the information provided by the last sentence read and the one provided by the previous sentences. Although one central feature of alexithymia involves impaired language production, it is equally important to examine whether comprehension skills are also impaired as such deficits impact communication as well as other abilities. We located 13 studies that investigated associations between alexithymia and the comprehension of emotional language.

In the third section of the chapter, we review several studies examining alexithymia and non-verbal language. Because our focus is on language in the sense of acoustic language, we exclude language systems like body language. Acoustic language, however, refers not only to verbal language, but also to non-verbal language, such as speech melody (prosody) and non-verbal emotional vocalisations (NEV), which consist of sounds that have meaning. We conclude the chapter with a discussion of the findings from the various studies, note some limitations of this research, and suggest some directions for future research.

Most of the studies we review measured alexithymia with self-report scales, either the *20-item Toronto Alexithymia Scale* (TAS-20) (Bagby, Parker, & Taylor, 1994) or the *Bermond-Vorst Alexithymia Questionnaire* (BVAQ) (Vorst & Bermond, 2001). Consistent with the view that alexithymia is a dimensional construct, we refer to individuals who score in the high range on these scales with the abbreviation HA (high alexithymia individuals), and individuals who score in the low range as LA (low alexithymia individuals). Descriptions of the TAS-20 and BVAQ are provided in Chapter 2.

**Language Production**

People differ in how they express their emotions; for example, whereas Mark cries or laughs easily, Susan articulates what she is feeling in an eloquent way; and Bob's face is devoid of any expression. Within the scope of this section, we focus on studies elaborating on how HA express their emotions *via* verbal language. We begin by briefly mentioning some early studies from the 1980s.

Psychiatrists working in the 1970s observed that patients with alexithymic characteristics tend to describe their dreams in a simpler and shorter way when compared to patients without such characteristics (Krystal, 1979). Later, Taylor, Doody and Newman (1981) investigated verbal expressiveness in psychoneurotic patients in comparison to patients with inflammatory bowel disease, and found that the latter had more difficulties in verbalizing emotions. These results were confirmed in a follow-up study (Taylor & Doody, 1982), which compared ulcerative colitis and Crohn´s disease patients separately with psychoneurotic patients. These were among the first studies that linked impaired language production to alexithymia. In the following paragraphs, we report results from more recent research on language production in alexithymia.

One common approach in contemporary research on emotional language production is to ask study participants to write a personal report, which is then analyzed for its emotional contents. Páez, Valesco, and Gonzalez (1999), for example, asked participants to write about a personal traumatic experience or about a recent social event. The written speech material was analyzed and rated by two judges with regard to the use of emotion words and to whether the content showed introspection and self-reflection. Only the Difficulty Describing Feelings (DDF) facet of alexithymia was related negatively to the proportion of positive emotion words and to the proportion of self-references. These results suggest that HA are less able to use emotion words when describing personal experiences compared to LA.

Wagner and Lee (2008) asked participants to select one personal negative event and one personal positive event and to write about them. The study was conducted in two phases: during the first phase, participants were alone in the room; during the second phase participants talked about their personal events, while a female experimenter was present. In the transcripts of the first phase, the authors found no relation between verbal expressiveness of emotions and alexithymia or any of its facets. However, when participants talked about personal matters in the presence of another person, the authors found that scores on the Difficulty Identifying Feelings (DIF) subscale of the TAS-20 were related negatively to the verbal expression of positive and negative emotions. These results suggest that deficits are limited to social contexts.

Similar results were obtained in another study in which participants had to communicate to another person the personal meaning they associated to a given stimulus, for example *telephone* (Kreitler, 2002). Each response was coded by applying the "meaning test" (Kreitler & Kreitler, 1976), which is a tool to assess the individual´s tendencies to use the following five different sets of meaning variables: "Meaning dimensions", "Types of relation", "Forms of relation", "Referent shifts" and "Forms of expression". By "Types of relation", for example, the author refers to the directness of the relation between the meaning value and the referent; e.g., an attributive type of relation would be found for "leaf – part of a tree". The responses were divided into meaning units and then characterized in terms of one meaning dimension, one type of relation, one form of relation, one referent shift, and one form of expression. The results showed that HA focused on different aspects than LA, such as concreteness and avoiding the internal world.

Smyth et al. (2002) asked participants to write on three consecutive days about their traumatic experience. The researchers coded the essays for how personal and emotional they

were, and for narrative structure. They concluded that HA did not respond differently than LA when they were asked to express their emotions in writing, which contrasts with the findings obtained by Paez et al. (1999).

In another study, instead of recounting personal traumas or a personal experience from the past, groups of HA and LA were asked to recount their dreams when awakened from REM sleep in a sleep lab and to rate the emotional valence of the dream experiences (Parker, Bauermann, & Smith, 2000). The authors found no group difference in the number of words participants used to describe their dreams, or in the emotional valence associated with the dream experiences. Two independent judges then rated the reports for overall fantasy content. The narrations produced by HA were rated as lower on that dimension than those produced by LA. These results suggest that while alexithymia is unrelated to the production of words or their emotional tone, it has a negative relation with the elaboration of an imaginary narrative.

Other studies used a semi-structured interview method to collect speech material. Meganck et al. (2009) conducted structured interviews with a sample of 50 psychiatric patients and analyzed the content of language production with the Linguistic Inquiry and Word Count (LIWC) program (Pennebaker, Francis, & Booth, 2001), a software that computes the percentage of words belonging to the following five broad categories: standard linguistic dimensions, psychological processes, relativity-related words, personal matters, and experimental dimensions. Meganck et al. focused on two categories belonging to the psychological processes dimension, namely “communication words” (including words such as conversation, talk, and discussion) and “references to others” (with items like them, us, colleague). They calculated a complexity score by dividing the number of words used from each category (“communication words” and “references to others”) against the total amount of words. The results showed that the TAS-20 total score and the DIF and Externally-Oriented Thinking (EOT) subscale scores correlated negatively with the level of complexity of communication words, suggesting that the higher the TAS-20 total score, the less participants used words like “conversation”, “talk” or “discussion”; however, the frequency of communication words was independent from TAS-20 scores. In addition, the EOT score was positively correlated with the frequency of references to others. Collectively, Meganck et al. (2009) argued that these results indicate that HA are able to talk about their relationships to others, but that their way of speaking about their interactions are less differentiated and less vivid than the way LA describe interpersonal relationships.

Jelinek et al. (2010) also used the LIWC program in a sample of trauma survivors with and without posttraumatic stress disorder (PTSD). Participants were asked to give a detailed narrative of their traumatic experience. The narratives were analyzed for emotional content, and the researchers found that the TAS-20 total score correlated negatively with the use of affective words in participants suffering from PTSD, but not in participants without PTSD. This result confirms a restricted emotional expressiveness in alexithymia as manifest by the use of a lower frequency of affective words in those with PTSD. In a study conducted by Vanheule, Meganck, & Desmet (2011), participants took part in a two-hour clinical interview that was afterwards analysed with the LIWC program. Only the EOT subscale was negatively related to LIWC categories (frequency and complexity of words belonging to the categories "social processes" (e.g. talk, us and friend) and "cognitive processes" (e.g. cause, know and ought)). But, contrary to the researchers' hypothesis, DIF was positively related to the frequency score for cognitive words. This suggests that HA may compensate for impaired emotional processing by redirecting their cognitive effort towards processing non-emotional material.

Wotschack and Klann-Delius (2013) did not use the LIWC program, but still obtained similar results. They investigated how alexithymia moderates language use and knowledge of emotion concepts in a healthy community sample. They conducted semi-structured interviews about various emotional topics, in which participants were asked to talk, for example about a personal positive or negative experience from their past. One of these interviews explicitly addressed the concept level of emotions. Here, participants were asked open questions such as: "What does *anger* mean to you?" Categories of answers provided by participants included paraphrasing the emotion word, giving synonyms, naming the physiological symptoms of having this emotion, or describing an episode which could typically evoke this given emotion. Transcripts were analyzed regarding the use of words referring to emotional states (i.e., words that denote an emotion, for example sad, fear), to ways of expressing emotions (e.g., physiological-expressive terms (for example cry, scream) or to illocutions (for example, oh God, Idiot!)). Similar to earlier studies, Wotschack and Klann-Delius (2013) calculated frequency scores for each word category. Results show that HA produced fewer types of emotion words and fewer synonyms for an emotion compared to LA, highlighting that alexithymia may be related to a reduced and less diverse vocabulary for both the semantic and the conceptual levels of emotions.

Other studies used controlled experimental paradigms by including the same set of items for all participants, such as pre-selected emotionally loaded pictures and videos, rather than relying on personal stories the participant spontaneously brings forward. Roedema and Simons (1999) used emotional pictures as stimuli to evoke emotions. Participants were asked to write a list of emotional adjectives describing their own feelings after seeing the stimuli. The experiment showed that HA provided fewer emotion-related words than LA to describe their response to the stimuli.

Luminet et al. (2004) had participants view an emotional video inducing sadness and asked them to recount the episode they found the most emotional. These verbal reports were analyzed by using a predefined list of emotion words. The study found that higher scores on the Verbalizing subscale of the BVAQ (which is related to the DDF facet of alexithymia) were related to less use of emotion words. The results remained unchanged after controlling for semantic abilities to produce emotion vocabulary. Thus, HA seem to have the same emotion vocabulary as LA and are also able to access it, but they use it less in affectively loaded situations.

A smaller proportion of emotion words in the speech of HA was also reported by Tull, Medaglia, and Roemer (2005), who asked participants to talk about a distressing event in their past. These reports were coded for the frequency and number of different positive and negative emotion words used. Tull et al. found that HA produced a lower frequency of and fewer different positive emotion words. In addition, the DIF facet of alexithymia was associated positively with the frequency of negative emotion words used and negatively with the frequency and number of different positive emotion words used. This imbalance towards negative emotions versus positive emotions is likely to affect mood and emotion regulation abilities.

In sum, 14 out of the 15 studies that we reviewed found that alexithymia or one of its facets was related to lower verbal emotional expressiveness. Two central results emerged in multiple studies. First, HA have a lower frequency of emotion words in their speech and their emotion vocabulary is less complex (Jelinek et al., 2010; Luminet et al., 2004; Paez et al., 1999; Roedema & Simons, 1999; Tull et al., 2005; Vanheule et al., 2011 Wotschack & Klann-Delius, 2013). Second, HA have a more withdrawn communication style; they do not open up to others as much as LA (Kreitler, 2002; Wagner & Lee, 2008).

When we examine the results from the various studies, the role of the DIF, DDF, and EOT facets of alexithymia remains unclear. Whereas two studies reported positive associations between DDF and and verbal language production (Luminet et al., 2004; Paez et al., 1999), three reported that DIF was associated negatively with verbal emotional expressiveness (Meganck et al., 2009; Tull et al., 2005; Wagner & Lee, 2008). One would have expected DDF to be the facet most often involved in deficits in emotional expressiveness. However, the results suggest that the ability to identify emotional feelings and externally oriented thinking also contribute. Hence, it is important to consider all three facets when exploring the underlying mechanisms of language deficits in alexithymia.

There are several possible explanations for inconsistent findings across some of the studies. First, the dependent variables varied from emotion words in some studies (Luminet et al., 2004; Páez et al., 1999; Roedema & Simons, 1999) to social-relational words in other studies (Luminet, et al., 2004; Meganck et al., 2009; Páez et al., 1999; Roedema & Simons, 1999; Wotschack & Klann-Delius, 2013). Second, linguistic methodologies differed among studies. Whereas some studies relied on objective measures, such as counting the frequency and variety of predefined emotion words, other studies used more subjective assessment, such as ratings by external judges of vividness, fantasy, or expressiveness of the reports. Third, many of the studies did not control for depression or other co-morbidity factors, which leaves open the possibility that differences in results are at least partly attributable to third variables.

**Language Comprehension**

Language production and comprehension are two sides of the same coin – and both play a crucial role in understanding the underlying psycholinguistic mechanisms of alexithymia. However, the methodologies that are used to investigate them are completely different. Researchers have used various paradigms to investigate how HA perceive emotional language. Some of these paradigms are based on the measurement of word recognition; others investigate more complex processing, such as the ability to form a sentence. Whereas the first paradigm does not require the participants´ explicit attention, the latter requires an explicit decision making process. We reviewed 13 studies on verbal language comprehension, eight of which are on basic processing, and five on more complex processing.

The basic processing approach includes two main paradigms: Stroop-based paradigms and priming-based paradigms. The initial attempts to study language comprehension in

alexithymia were based on the Stroop paradigm. Participants were asked to name as quickly as possible the color of three kinds of words: neutral words, emotion-arousing words, and non-words. Researchers found that HA evidence longer reaction times (RTs) to name the color of the high arousal words than LA (Parker, Taylor, & Bagby, 1993). Pandey (1995) was able to replicate these results in a study that used the same experimental design. The findings indicate that attentional processes require longer time in HA when high arousal material is involved. Thus, HA may perceive high arousal emotional stimuli and are disturbed by them in such a way that they evidence longer RTs (Pandey, 1995). However, another study based on the same Stroop paradigm yielded opposite results (Sanchez & Serrano, 1997); HA took less time, rather than more time, to name the color of arousing stimuli than controls. Sanchez and Serrano (1997) interpret this result as an indication that HA are less able to recognise emotional stimuli and thus are less distracted by the emotionally arousing content of these stimuli. These contradictory results invite further comparison among the studies. First, the words included in all studies seem to be highly comparable, (e.g. AIDS); however, it is important to note that the three studies were conducted in different countries, namely Canada, India, and Spain. Individuals from different countries might have different reactions to the same set of words. Second, although the first two studies used threshold scores to define their sample at two levels (viz., alexithymic and non-alexithymic), the study by Sanchez and Serrano (1997) used three different levels instead of two. These differences might have played a role in determining the magnitude of the results. Given the contradictory results, it is difficult to draw definite conclusions; however, the Stroop-based experiments seem to be sensitive to relatively subtle methodological variations.

The basic processing of emotional language in alexithymia has also been investigated using priming paradigms. The affective priming paradigm examines whether the presentation of a first stimulus, the prime, affects the processing of another stimulus, the target (Herring et al., 2013). It is based on the assumption that information, which evokes affect, attracts attention. The task of participants is to evaluate targets, generally on their valence (positive vs. negative). Studies have typically shown that reaction times (RT´s) are slower when prime and target differ with regard to their valence, while RT´s are faster when the valence of the prime and the target is identical (as compared to when the prime was neutral).

One of the first studies conducted with the affective paradigm in alexithymia included two parts. In the first part, participants had to read aloud an emotion word as fast as possible after having been primed by a congruent word (either positive or negative emotion word). In

the second part, participants had to evaluate a given adjective as positive or negative after having been primed by either a positive or negative emotion word (Suslow, 1998). The researcher found that the DDF facet was related to facilitation based on negative stimuli. This means that people scoring higher on the DDF subscale of the TAS-20 showed enhanced perceptual sensitivity to negative material. On the other hand, the EOT and total alexithymia scores were correlated with facilitation based on positive stimuli. The fact that DDF has a facilitating effect in affective priming when negative items serve as primes might possibly be due to an association between DDF and a proneness to social shame.

In a mixed clinical and nonclinical sample (psychiatric patients and healthy individuals), Suslow et al. (2000) found that the DDF and DIF subscales of the TAS-20 correlated with a measure of shame anxiety, which is related to enhanced affective vigilance and feeling more dependent on other people´s opinions. The association between alexithymia and high sensitivity towards social signals could partly explain the facilitation effect by negative primes in affective priming driven by high levels of DDF. However, Suslow et al. (2001) were not able to replicate this facilitation effect in a subsequent study. In this study, HA processed the valence of stimuli, but showed reduced processing engagement towards negative verbal stimuli. Suslow and Junghanns (2002) also investigated priming tasks in which sentences that described an emotional situation or neutral filler situations served as primes. After having read those sentences, participants were presented with targets (emotion words or non-words) and had to decide whether it was a word or not. The results showed a negative priming effect in HA: they took longer in making lexical decisions to emotion words after having been presented a congruent emotional situation than after an incongruent emotional situation. This means that HA were impaired by congruent prime-target pairs.

Vermeulen, Luminet, and Corneille (2006) extended the affective priming paradigm by using both facial expressions and words as primes as well as targets. The moderation of alexithymia on priming effects was specifically found when the prime was a schematic face expressing anger. In that specific case, no facilitation (when the target was a negative word) or inhibition (when the target was a positive word) were found. These results suggest a difficulty in processing the available emotional information in order to respond to behavioral demands, but only when the prime involves a highly salient and threatening information. A third experiment in the study showed also that the moderating impact of alexithymia occurs only when the anger prime is a face followed by a verbal target, but not when the angry prime is a word and the target a facial expression.

In another study, Vermeulen, Toussaint, and Luminet (2010) included emotional music as prime for recognition of neutral, joy, and anger words. The experiment consisted of a congruent run and an incongruent run. HA presented greater effect of congruency and incongruency in general, which means that they were more influenced by music as a cue than LA. Furthermore, in the angry condition, LA performed significantly better than HA. This result suggests a disturbed processing of angry emotional stimuli, which has been found in other studies as well (Meriau et al., 2006; Vermeulen et al., 2006; Vermeulen et al., 2008). The study extends these findings by observing that a discrete auditory presentation of angry music in the background is already sufficient to interfere with the encoding of words in HA. This supports the view that angry material disrupts the processing of emotional information in HA.

Similar to the results of the experiments based on the Stroop-paradigm, the results of priming based experiments on automatic verbal language comprehension in alexithymia are heterogeneous. While there is some evidence for impaired processing at a basic level (Suslow & Junghanns, 2002; Vermeulen et al., 2010), the findings are contradictory (Suslow et al., 2001). Furthermore, in one study alexithymia had a positive influence on priming effects (Suslow, 1998). In sum, research to date does not show a clear deficit in verbal emotional language comprehension at a basic processing level in alexithymia.

Researchers have also focused on paradigms based on complex or explicit processing. In this line of studies, participants are presented with an emotional stimulus and are expected to invest explicit cognitive effort. The tasks vary from matching the emotional stimuli to a given category to recall tasks for emotional stimuli. In two studies that used a matching task, participants were asked to match emotional stimuli, such as faces and words (nonverbal -- verbal) or sentences and words (verbal -- verbal) (Lane et al., 1996; Lane et al., 2000). The results showed that HA performed less well than LA on the matching tasks, which suggests that alexithymia may not only impair the processing of verbal information, but also affect situations that involve the matching of verbal with nonverbal information.

In recall-based memory tasks, the paradigms show more variation. As the studies on alexithymia and memory/executive functions are described fully in Chapter 5, we will only mention them briefly. Suslow et al. (2003) explored the role of valence by presenting words with a neutral, positive, or negative meaning and words describing positive and negative feeling states. While no differences were found regarding words describing feeling states, the authors found a negative correlation between the DIF subscale and the recall of positive non-

emotion words.

In another recall task, Luminet et al. (2006) presented positive and negative emotion words and neutral words to HA and LA, who then had to list as many words as they could recall from this list. Results indicated that HA have deficits processing emotion words at the semantic and the perceptual level; they seem to activate fewer specific conceptual details than LA when they process emotion words. This may be due to the fact that HA do not consider emotion words as conceptually more salient than neutral words. This hypothesis is supported by findings from other studies, which found that HA experience and evaluate emotional events or stimuli with lower intensity than LA (Friedlander et al., 1997; Luminet et al., 2004; Vanman, Dawson & Brennan, 1998).

The results from Luminet et al.'s (2006) study were replicated and extended in a follow-up study (Vermeulen & Luminet, 2009). Consistent with the previous findings, individuals scoring high on the DIF subscale of the TAS-20 had more difficulties remembering emotion words, whereas there was no association between DIF scores and memory rates of neutral words. Contrary to expectations, the total TAS-20 score was only slightly negatively correlated with memory performance for emotion words. The EOT subscale, however, correlated positively with recognition rates of emotion words (except for angry words), as well as of neutral words. Analyses showed that only the EOT items that relate to lack of interest in emotional introspection, rather than a focus on external thinking, showed this association. Therefore, these results could be explained by a lack of motivation for processing emotional information. In sum, the findings suggest that memory function in alexithymia depends on different emotive and cognitive mechanisms, which may be connected to different brain areas.

In contrast to the studies on basic processing reported earlier, the findings of studies on the complex processing of verbal emotional stimuli are more clear-cut. Four out of five studies found that alexithymia had a negative relation with matching or memory abilities (Lane et al., 1996; Lane et al., 2000; Luminet et al., 2006; Vermeulen & Luminet, 2009); only one study failed to find differences between HA and LA in the comprehension of verbal emotional stimuli (Suslow et al., 2003).

In sum, based on our review of the 13 studies on comprehension of verbal emotional information (including both basic processing and complex processing), we conclude that alexithymia seems to be correlated with deficits in processing tasks that require explicit effort,

such as memory and matching tasks. It should be noted, however, that all of the language comprehension studies used non-clinical samples. Therefore, further research with clinical samples is needed to understand the extent of any impairment related to language comprehension. In addition, as we observed in the studies on language production, many studies lack control variables; only six of the 13 studies report controlling for psychological health issues.

## Non-Verbal Language

Although clinicians and researchers are very interested in how individuals with high levels of alexithymia process verbal language, language goes beyond the verbal level. Non-verbal channels such as facial expressions, gestures, and speech melody also play an important role in communication, and may be affected by alexithymia. Indeed, in their early observational study, Nemiah and Sifneos (1970) reported a dull, lifeless, monotonous way of speaking of patients with alexithymic characteristics. There has been a substantial amount of research on alexithymia and facial expression of emotion, which is reviewed in Chapter 4. In this section we focus specifically on acoustic non-verbal language.

Not only *what* we say matters, but also *how* we say it transmits a central part of our communicational signals. Prosody (the melody of speech) plays a key role in communicating our emotions by accompanying the verbal information. Furthermore, non-verbal emotional vocalisations (NEV), such as the sound of laughing or crying, are also an essential part of the non-verbal communication system.

### Prosody

Emotional prosody is an important aspect of communication for understanding the emotional state of others. In order to successfully communicate, we need the ability to detect the emotional content of prosody correctly and to attach the adequate sound to what we say. Electrophysiological studies have shown that prosody is processed at an early stage during language production and language comprehension (Kotz & Paulmann, 2011), which reflects the close connection between prosody and inner processes like emotions.

To date, only one study has investigated relations between alexithymia and the production of prosody. Ohuayoun et al. (1998) asked HA and LA to read aloud sentences with emotional content and measured the fundamental frequency of the speech material. The

fundamental frequency is – next to intensity (how loud the voice is) and the speech rate (how fast a person speaks) – one of the main markers to describe prosody and it reflects how high or low the tone of the voice is. The experiment consisted of two runs: one with and one without emotional priming. In the priming run, an emotional reminiscence task preceded the emotional content reading task. The results showed that HA spoke with a narrower range in their fundamental frequency when there was no priming. When participants were primed, there was no group difference regarding fundamental frequency. According to Ouhayoun et al. this indicates that HA need a stronger emotional impulse to vary their fundamental frequency than LA. This suggests that if HA receive some kind of external help, they may be able to compensate for their deficit in a way that their prosody is no longer different from the prosody of LA.

Several studies have focused on the relation between alexithymia and the comprehension of prosody. The central question here is whether the deficits of HA are limited to the semantic level, or whether HA also experience difficulty in understanding the emotional content of prosody. One of the first studies that addressed this question used behavioral measurements and required participants to listen to sentences involving emotional content (happy, sad, angry, anxious), which were spoken with incongruent emotional prosody (happy, sad, angry, anxious) (Swart, Kortekaas, & Aleman, 2009). In the prosody condition, participants had to attend to the affective tone of voice and ignore the incongruent affective semantic content. In the semantic condition, participants had to focus on the affective semantic content while ignoring the affective tone of voice. The emotion labels from which the participants could chose (fear, anger, happiness, sadness) were presented on a screen. The results revealed no significant differences between HA and LA in reaction time and accuracy, but there was a trend for HA to react slower than LA in the prosodic task. Even though this result did not reach significance, this observation lends some support for the hypothesis that HA have more difficulty understanding subtler, more implicit emotional signals. Moreover, the failure of the group difference to reach a level of significance might be explained by the task. Participants were free to choose one among four emotions; the matching task was possibly biased, as participants could merely avoid unwanted emotions. Perhaps a study with more difficult matching tasks might yield significant results.

Two other studies used electrophysiological measurements, electroencephalography (EEG) or event-related potentials (ERP), to investigate the association between alexithymia and the comprehension of prosody. Because these studies are reviewed in Chapter 14, we only

summarize them briefly here. In the first study, Goerlich et al. (2011) used an affective priming paradigm and measured amplitudes of N400, an ERP component indicative of individual senstitivity to affective incongrence. TAS-20 scores correlated negatively with N100 amplitudes in response to affectively incongruent music and speech prosody, suggesting that alexithymia is associated with reduced sensitivity to the emotional qualities of speech and music at a neurophysiological level. In the second study, Goerlich, Aleman, and Martens (2012) assessed alexithymia with the BVAQ, which provides separate scores for cognitive and affective dimensions of alexithymia (see Chapter 2), and investigated the impact of both dimensions on electrophysiological responses to emotional speech. Implicit and explicit tasks were included in the study. Although no difference between HA and LA was found on both tasks at the behavioral level, differences were observed at the neurophysiological level with the affective dimension seeming to influence the perception of emotional prosody at later processing stages than the cognitive dimension. It must be noted, however, that the distinction between cognitive and affective dimensions of alexithymia is controversial and not widely accepted (e.g., Bagby et al., 2009). Whereas the cognitive dimension assessed with the BVAQ corresponds closely with the three-factor model of alexithymia assessed with the TAS-20, the affective dimension is comprised of emotionalizing and fantasizing abilities. A recent factor analytic study found that emotionalizing and fantasizing did not form part of the latent structure of alexithymia (Preece et al., 2017); in addition, a network analysis of a large BVAQ data set failed to support emotionalizing as a distinct component of the alexithymia construct, and items assessing fantasizing were particularly weak within the network (Watters et. al., 2016; see also Chapters 13 and 14).

Finally, in a follow-up study, which is mentioned briefly in Chapter 13, Goerlich-Dobre et al. (2013) used functional magnetic resonance imaging (fMRI) to investigate the perception of emotional prosody in alexithymia. Participants listened to pseudo words, which were spoken with angry, surprised, and neutral prosody, and had to match the stimulus to one of these three emotions. As in the earlier study, there were both explicit and implicit tasks, and no differences between HA and LA were found at the behavioral level. However, the neurophysiological responses of HA showed significantly different patterns than those of LA; irrespective of the task, higher alexithymia scores correlated with a diminished neural response of the right superior temporal gyrus and the bilateral amygdalae. Goerlich-Dobre et al. (2013) considered these findings consistent with the results of their electrophysiological

studies, and further evidence that alexithymia is associated with a blunted neural response to speech prosody.

In sum, the research studies on the comprehension of prosody seem to indicate that alexithymia does not influence the ability to recognize or match emotional prosody, but there are significant differences between HA and LA in their neurophysiological responses to emotional prosody. The emotional processing deficit in HA seems to occur at a very early point in processing of information; because it is not evident at the behavioral level, it is thought to be rather subtle and HA may compensate for it on an overt level. Nonetheless, even at a subtle level, Goelrich et al. (2012) suggest that the deficit may potentially contribute to problems in social communication.

**Nonverbal emotional vocalizations**

Nonverbal emotional vocalizations (NEV) are a part of the non-verbal linguistic system, because they communicate meaning. Laughing or crying, for example, are ways of expressing emotions without using words. In a study with a sample of high-functioning patients with autistic spectrum disorder (ASD) and intelligence-matched controls, Heaton et al. (2012) used a set of stimuli consisting of vocal recordings of actors expressing six basic emotions (e.g., laughing vocalisations for happiness). After having heard a stimulus, participants were asked to select the emotion word that described the vocalisation. In both the ASD group and the control group, HA had significantly more difficulty matching NEV to emotion words than LA.

These findings are consistent with results from a similar study investigating relations between alexithymia and the comprehension of nonverbal emotional vocalisations (e.g. laughter, sigh, groan) (Bayot et al., 2014). The authors found that the level of alexithymia was related negatively to the matching performance of nonverbal signals of negative emotions (disgust, anger, fear, sadness); however, for positive emotions, accuracy rates of the matching performance were not significantly different between HA and LA. Matching sad vocalisations was especially difficult for HA.

In sum, results on non-verbal language comprehension in alexithymia suggest that HA have deficits, which may not always be apparent behaviorally, but physiological markers indicate a blunted response to non-verbal emotional stimuli. Only one study could be found about prosody production in alexithymia, which showed impairment in expressing emotions prosodically in HA. More studies are needed in this area, especially on non-verbal language

production.

## Discussion and Future Directions

Verbal and non-verbal language enables humans to communicate their inner thoughts and feelings to others and to also understand the utterances of others. This interaction eventually forms an active communication, which is central to social life. Unfortunately, not everyone is equally skilled in linguistic communication. For the most part, the findings from the empirical studies we reviewed support the observations of many clinicians that individuals with high levels of alexithymia have deficits in verbally expressing their feelings and reading the emotions that others express both verbally and non-verbally.

All but one of the studies on language production support Nemiah and Sifneos's (1970) original observation that verbal expressiveness of emotions is impaired in alexithymia. This effect can be defined by a lower frequency and a lower complexity of emotion words. However, these results were sometimes obtained only with the DDF subscale of the TAS-20 (Luminet et al., 2004; Paez et al., 1999) rather than with total alexithymia scores, although two studies also underlined the role of the DIF facet (Meganck et al., 2009; Wagner & Lee, 2008). Clearly the ability to describe feelings to others is contingent on being able to first identify and name feelings and to differentiate among different feelings. Future studies could further explore these abilities by assessing alexithymia with the *Toronto Structured Interview for Alexithymia* (TSIA; Bagby et al., 2006), or the *modified Beth Israel Hospital Questionnaire* (modified BIQ; Taylor, Bagby, & Parker, 1997) which involves a semi-structured interview. These methods of assessment are likely to yield more detailed information about respondents' abilities to both identify and communicate feelings than items on self-report scales.

The studies addressing language comprehension at a basic processing level have yielded inconsistent findings. By contrast, studies that measured more complex mechanisms, such as identifying and/or remembering emotional stimuli, more consistently found deficits in HA (Lane et al., 1996; Lane et al., 2000; Luminet et al., 2006; Vermeulen & Luminet, 2009). The differences observed in the results between basic and complex tasks might be due to motivational differences. In complex tasks, unlike basic tasks, the respondent is expected to exert a certain level of cognitive effort, and the level of this is dependent on the subjective motivation of the respondent. Hence, it is possible that HA might be less motivated to process

verbal emotional stimuli, and take longer time compared to LA.

The findings from the processing of non-verbal language indicate that alexithymia not only affects the processing of emotional information, but also the processing of socially relevant information, like the information that is transmitted via the sound of the human voice. Although results from the electrophysiological studies suggest that the prosody impairment associated with alexithymia is rather subtle and not evident behaviorally, on the behavioral tasks involving NEV, HA performed less well than LA. There is a need for more prosody studies.

While our review offers converging evidence for impaired language processing in alexithymia, it also highlights some limitations of the research and inconsistencies among the studies. One limitation is that the majority of the studies were conducted with healthy participants, which limits the generalizability of the results to clinical populations. Moreover, only about 50% of the studies controlled for potential confounding variables, such as depression or mood. Implementing such controls is essential for isolating the effects driven by alexithymic characteristics.

Another limitation is that most studies were conducted in laboratories, where the tasks had to be completed individually; only a few studies included an element of communicative skills. Wagner and Lee (2008) found that emotional expressiveness was reduced when another person was present in comparison to when the participants were alone in the room, and there is evidence from other studies that alexithymia is associated with impaired emotional expressiveness when emotions refer to the self or others, but not when participants produce emotion words without a specific context (Luminet et al., 2004; Paez et al., 1999). Because most language use is communicative and involves other people, it would be important to extend the research into communicative settings. For example, one could examine the content of shared narratives produced by HA in response to a variety of instructions in different social settings.

The studies in our review relied exclusively on self-report scales to assess alexithymia, rather than multiple methods, which is another limitation. Future studies could also administer the TSIA (Bagby et al., 2006), which has the added benefit of providing samples of speech as it requires respondents to give examples when they answer each of the interview questions. Recording the responses would provide data that could be useful for prosody studies.

For the investigation of language comprehension, the current research findings suggest

that emotional language processing deficits in alexithymia are more likely to be detected by tasks that involve cognitive processes of higher order, such as memory (Luminet et al., 2006; Vermeulen & Luminet, 2009). Memory tasks include a range of semantic integration processes that are not employed in simple labeling tasks. Tasks requiring mental imagery might also be useful since forming a mental image of an event or a fictional story is powerful in emotional contexts and may even evoke emotions (Holmes & Mathews, 2010). Such tasks could be especially daunting for HA because of a limited capacity to use their imagination and create fantasies. Indeed, in a recent study, alexithymia was linked with mentalizing deficits, which relate the ability to imagine the mental state of others, and these deficits were associated with lower reading frequency (Samur, Luminet, & Koole, 2017). Considering higher-order skill- and motivational-based explanations for deficits in language comprehension might thus be a useful approach in future research.

Given that the ability to find words to label and communicate emotional feelings seems to be impaired in alexithymia, a potentially fruitful line of research would be to investigate relations between early affect development and the acquisition of language. It is now well known, for example, that the related capacities of symbolization and mentalization begin to be acquired during infancy and early childhood and that their development and role in affect regulation are profoundly influenced by the parents' responsiveness and the quality of the child's attachment relationships. In a longitudinal study across four time points between 17 and 36 months, insecurely attached and disorganized children showed a delay in developing mentalizing language to express emotions and other inner states (Lemche et al., 2004). In contrast, securely attached children rapidly acquired emotion, physiology, cognition and emotion-regulatory language. Lemche et al. (2004) suggested that because of the developmental delay in acquiring a vocabulary essential for successful emotion regulation, the insecurely attached children in the study might be prone to manifesting alexithymic characteristics later in life. More longitudinal studies of this kind would help to understand better the connection between alexithymia and the development of internal state language in early life.

For clinical purposes, it would important to develop ways for improving the emotional language processing of HA (Samur et al., 2013). One way might be to modify some of the emotion processing tasks used in the experimental studies. For example, HA could be taught to better recognize facial expressions of emotion and to improve their memory skills. As HA tend to have a way of speaking that may seem inanimate to others (Kreitler, 2002; Meganck et

al., 2009), they could be taught to use more complex emotion words and/or metaphors (Samur et al, 2013). Furthermore, encouraging HA to read fiction could improve their understanding and use of emotional language, and also improve their mentalizing skills (Samur et al., 2017). As noted by Krystal (1982-83), however, there is a risk that HA might learn to use emotion words in a superficial way that is based on inferences rather than the actual awareness of an affective experience. Writing may also improve language production and comprehension, and written disclosure is known to have beneficial effects in alexithymia (Horneffer & Chan, 2009; Smyth et al., 2002; Solano et al., 2003).

Overall, the present chapter highlights the contributions of a language-based approach in the field of alexithymia research. We believe that a language-based approach has considerable potential for advancing understanding of the mechanisms underlying the emotional processing deficits in alexithymia. This may ultimately lead to the development of better ways for helping people to express and communicate their feelings through language.

**References**


Aitchison, J. (2012). *Words in the Mind: An Introduction to the Mental Lexicon*. West Sussex: John Wiley & Sons.

Bagby, R. M., Parker, J. D., and Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale--I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research,* **38**, 23-32.

Bagby, R.M., Quilty, L.C., Taylor, G.J., et al. (2009). Are there subtypes of alexithymia? *Personality and Individual Differences*, **47**, 413-418.

Bagby, R.M., Taylor, G.J., Parker, J.D.A., et al. (2006). The development of the Toronto Structured Interview for Alexithymia: Item selection, factor structure, reliability and concurrent validity. *Psychotherapy and Psychosomatics*, **75,** 25-39.

Bayot, M., Pleyers, G., Kotsou, I., et al. (2014). Joint effect of alexithymia and mood on the categorization of nonverbal emotional vocalizations. *Psychiatry Research,* **216**, 242-247.

Bucci, W. (1997). *Psychoanalysis and Cognitive Science: A Multiple Code Theory*. New York: Guilford Press.

Friedlander, L., Lumley, M. A., Farchione, T., et al. (1997). Testing the alexithymia hypothesis: Physiological and subjective responses during relaxation and stress. *The Journal of Nervous and Mental Disease*, **185**, 233-239.

Goerlich, K. S., Aleman, A., and Martens, S. (2012). The sound of feelings: electrophysiological responses to emotional speech in alexithymia. *PloS One,* **7**, e36951.

Goerlich, K. S., Witteman, J., Aleman, A., et al. (2011). Hearing feelings: Affective categorization of music and speech in alexithymia, an ERP study. *PloS One,* **6**, e19501.

Goerlich-Dobre, K. S., Witteman, J., Schiller, N. O., et al. (2013). Blunted feelings: Alexithymia is associated with a diminished neural response to speech prosody. *Social Cognitive and Affective Neuroscience*, **9**, 1108-1117.

Harley, T. A. (2013). *The Psychology of Language: From Data to Theory*. New York: Psychology Press.

Heaton, P., Reichenbacher, L., Sauter, D., et al. (2012). Measuring the effects of alexithymia on perception of emotional vocalizations in autistic spectrum disorder and typical development. *Psychological Medicine,* **42**, 2453-2459.

Herring, D. R., White, K. R., Jabeen, et al. (2013). On the automatic activation of attitudes: A quarter century of evaluative priming research. *Psychological Bulletin*, **139**, 1062-1089.

Holmes, E. A. and Mathews, A. (2010). Mental imagery in emotion and emotional disorders. *Clinical Psychology Review,* **30**, 349-362.

Horneffer, K. J. and Chan, K. M. (2009). Alexithymia and relaxation: Considerations in optimising the emotional effectiveness of journaling about stressful experiences. *Cognition and Emotion*, **23**, 611-622.

Jelinek, L., Stockbauer, C., Randjbar, S., et al. (2010). Characteristics and organization of the worst moment of trauma memories in posttraumatic stress disorder. *Behaviour Research and Therapy*, **48**, 680-685.

Kotz, S. A. and Paulmann, S. (2011). Emotion, language, and the brain. *Language and Linguistics Compass,* **5**, 108-125.

Kreitler, S. (2002). The psychosemantic approach to alexithymia. *Personality and Individual Differences,* **33**, 393-407.

Kreitler, H. and Kreitler, S. (1976). *Cognitive Orientation and Behavior*. Michigon: Springer Publishing Company.

Krystal, H. (1979). Alexithymia and psychotherapy. *American Journal of Psychotherapy*, **33**, 17-31.

Krystal, H. (1982-83). Alexithymia and the effectiveness of psychoanalytic treatment. *International Journal of Psychoanalytic Psychotherapy*, **9**, 353-378.

Lane, R. D., Lee, S., Reidel, R., et al. (1996). Impaired verbal and nonverbal emotion recognition in alexithymia. *Psychosomatic Medicine,* **58**, 203-210.

Lane, R. D., Sechrest, L., Riedel, R., et al. (2000). Pervasive emotion recognition deficit common to alexithymia and the repressive coping style. *Psychosomatic Medicine,* **62**, 492-501.

Lemche, E., Klann-Delius, G., Koch, R., et al. (2004). Mentalizing language development in a longitudinal attachment sample: Implications for alexithymia. *Psychotherapy and Psychosomatics,* **73**, 366-374.

Löbner, S. (2011). Concept types and determination. *Journal of Semantics,* **28**, 279-333.

Luminet, O., Rimé, B., Bagby, R. M., et al. (2004). A multimodal investigation of emotional responding in alexithymia. *Cognition and Emotion,* **18**, 741-766.

Luminet, O., Vermeulen, N., Demaret, C., et al. (2006). Alexithymia and levels of processing: Evidence for an overall deficit in remembering emotion words. *Journal of Research in Personality,* **40**, 713-733.

Meganck, R., Vanheule, S., Inslegers, R., et al. (2009). Alexithymia and interpersonal problems: A study of natural language use. *Personality and Individual Differences,* **47**, 990-995.

Mériau, K., Wartenburger, I., Kazzer, P., et al. (2006). A neural network reflecting individual differences in cognitive processing of emotions during perceptual decision making. *Neuroimage*, **33**, 1016-1027.

Nemiah, J. C. and Sifneos, P. E. (1970). Psychosomatic illness: A problem in communication. *Psychotherapy and Psychosomatics,* **18**, 154-160.

Nemiah J.C., Freyberger, H., and Sifneos, P.E. (1976). Alexithymia: A view of the psychosomatic process. In O.W. Hill (Ed.), *Modern Trends in Psychosomatic Medicine*, vol. 3, pp. 430-439. London: Butterworths.

Ouhayoun, B., Lauret, B., Brillaud, L., et al. (1998). 581 Hypoprosody among alexithymic subjects: An index of relative hypoactivity of the right hemisphere in alexithymia? *International Journal of Psychophysiology,* **30**, 221-222.

Páez, D., Velasco, C. and González, J. L. (1999). Expressive writing and the role of alexythimia as a dispositional deficit in self-disclosure and psychological health. *Journal of Personality and Social Psychology,* **77**, 630.

Pandey, R. (1995). Stroop interference effect of emotion-arousing words in alexithymia. *Journal of the Indian Academy of Applied Psychology,* **21**, 21-28.

Parker, J., Taylor, G., and Bagby, M. (1993). Alexithymia and the processing of emotional stimuli: An experimental study. *New Trends in Experimental and Clinical Psychiatry,* **9**, 9-14.

Parker, J. D., Bauermann, T. M., and Smith, C. T. (2000). Alexithymia and impoverished dream content: Evidence from rapid eye movement sleep awakenings. *Psychosomatic Medicine,* **62**, 486-491.

Pennebaker, J. W., Francis, M. E., and Booth, R. J. (2001). Linguistic Inquiry and Word Count: LIWC 2001. *Mahwah: Lawrence Erlbaum Associates*.

Pennebaker, J. W. (2012). *Opening Up: The Healing Power of Expressing Emotions*. New York: Guilford Press.

Preece, D., Becerra, R., Allan, A., et al. (2017). Establishing the theoretical components of alexithymia via factor analysis: Introduction and validation of the attention-appraisal model of alexithymia. *Personality and Individual Differences*, **119**, 341-352.

Roedema, T. M. and Simons, R. F. (1999). Emotion-processing deficit in alexithymia. *Psychophysiology,* **36**, 379-387.

Samur, D., Tops, M., Schlinkert, C., et al. (2013). Four decades of research on alexithymia: Moving toward clinical applications. *Frontiers in Psychology*, **4,** 1-4.

Samur, D., Luminet, O., and Koole, S. L. (2017). Alexithymia predicts lower reading frequency: The mediating roles of mentalising ability and reading attitude. *Poetics.*

Sanchez, F. and Serrano, J. (1997). Influence of the alexithymia level in the emotional stimuli processing in a Stroop colour-naming task. *PSICOTHEMA,* **9**, 519-527.

Sifneos, P. E. (1973). The prevalence of 'alexithymic'characteristics in psychosomatic patients. *Psychotherapy and Psychosomatics,* **22**, 255-262.

Smyth, J. M., Anderson, C. F., Hockemeyer, J. R., et al. (2002). Does emotional non-expressiveness or avoidance interfere with writing about stressful life events? An analysis in patients with chronic illness. *Psychology and Health,* **17**, 561-569.

Solano, L., Donati, V., Pecci, F., et al. (2003). Postoperative course after papilloma resection: Effects of written disclosure of the experience in subjects with different alexithymia levels. *Psychosomatic Medicine*, **65**, 477-484.

Suslow, T. (1998). Alexithymia and automatic affective processing. *European Journal of Personality,* **12**, 433-443.

Suslow, T., Donges, U. S., Kersting, A., et al. (2000). 20-Item Toronto Alexithymia Scale: Do difficulties describing feelings assess proneness to shame instead of difficulties symbolizing emotions?. *Scandinavian Journal of Psychology*, **41**, 329-334.

Suslow, T. and Junghanns, K. (2002). Impairments of emotion situation priming in alexithymia. *Personality and Individual Differences,* **32**, 541-550.

Suslow, T., Junghanns, K., Donges, U.S., et al. (2001). Alexithymia and automatic processing of verbal and facial affect stimuli. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition,* **20**, 297-324.

Suslow, T., Kersting, A., and Arolt, V. (2003). Alexithymia and incidental learning of emotional words. *Psychological Reports*, **93**, 1003-1012.

Swart, M., Kortekaas, R., and Aleman, A. (2009). Dealing with feelings: Characterization of trait alexithymia on emotion regulation strategies and cognitive-emotional processing. *PloS One,* **4**, e5751.

Taylor, G.J., Bagby, R.M., and Parker, J.D.A. (1997). *Disorders of Affect Regulation. Alexithymia in Medical and Psychiatric Illness*. Cambridge: Cambridge University Press.

Taylor, G. and Doody, K. (1982). Psychopathology and verbal expression in psychosomatic and psychoneurotic patients. *Psychotherapy and Psychosomatics,* **38**, 121-127.

Taylor, G., Doody, K., and Newman, A. (1981). Alexithymic characteristics in patients with inflammatory bowel disease. *The Canadian Journal of Psychiatry*, **26**, 470-474.

Taylor, G. J., Bagby, R. M., and Parker, J. D. (1991). The alexithymia construct: A potential paradigm for psychosomatic medicine. *Psychosomatics,* **32**, 153-164.

Tull, M. T., Medaglia, E., and Roemer, L. (2005). An investigation of the construct validity of the 20-Item Toronto Alexithymia Scale through the use of a verbalization task. *Journal of Psychosomatic Research*, **59**, 77-84.

Vanheule, S., Meganck, R., and Desmet, M. (2011). Alexithymia, social detachment and cognitive processing. *Psychiatry Research*, **190**, 49-51.

Vanman, E. J., Dawson, M. E., and Brennan, P. A. (1998). Affective reactions in the blink of an eye: Individual differences in subjective experience and physiological responses to emotional stimuli. *Personality and Social Psychology Bulletin*, **24**, 994-1005.

Vermeulen, N. and Luminet, O. (2009). Alexithymia factors and memory performances for neutral and emotional words. *Personality and Individual Differences,* **47**, 305-309.

Vermeulen, N., Luminet, O., and Corneille, O. (2006). Alexithymia and the automatic processing of affective information: Evidence from the affective priming paradigm. *Cognition & Emotion,* **20**, 64-91.

Vermeulen, N., Luminet, O., De Sousa, M. C., et al. (2008). Categorical perception of anger is disrupted in alexithymia: Evidence from a visual ERP study. *Cognition and Emotion*, **22**, 1052-1067.

Vermeulen, N., Toussaint, J., and Luminet, O. (2010). The influence of alexithymia and music on the incidental memory for emotion words. *European Journal of Personality,* **24**, 551-568.

Vorst, H. C. and Bermond, B. (2001). Validity and reliability of the Bermond–Vorst alexithymia questionnaire. *Personality and Individual Differences,* **30**, 413-434.

Wagner, H. and Lee, V. (2008). Alexithymia and individual differences in emotional expression. *Journal of Research in Personality,* **42**, 83-95.

Watters, C.A., Taylor, G.J., Quilty, L.C., et al. (2016). An examination of the topology and measurement of the alexithymia construct using network analysis. *Journal of Personality Assessment*, **98**, 649-659.

Wotschack, C. and Klann-Delius, G. (2013). Alexithymia and the conceptualization of emotions: A study of language use and semantic knowledge. *Journal of Research in Personality,* **47**, 514-523.