



## Language and alexithymia: Evidence for the role of the inferior frontal gyrus in acquired alexithymia

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### ABSTRACT

The clinical relevance of alexithymia, a condition associated with difficulties identifying and describing one's own emotion, is becoming ever more apparent. Increased rates of alexithymia are observed in multiple psychiatric conditions, and also in neurological conditions resulting from both organic and traumatic brain injury. The presence of alexithymia in these conditions predicts poorer regulation of one's emotions, decreased treatment response, and increased burden on carers. While clinically important, the aetiology of alexithymia is still a matter of debate, with several authors arguing for multiple 'routes' to impaired understanding of one's own emotions, which may or may not result in distinct subtypes of alexithymia. While previous studies support the role of impaired interoception (perceiving bodily states) in the development of alexithymia, the current study assessed whether acquired language impairment following traumatic brain injury, and damage to language regions, may also be associated with an increased risk of alexithymia.

Within a sample of 129 participants with penetrating brain injury and 33 healthy controls, neuropsychological testing revealed that deficits in a non-emotional language task, object naming, were associated with alexithymia, specifically with difficulty identifying one's own emotions. Both region-of-interest and whole-brain lesion analyses revealed that damage to language regions in the inferior frontal gyrus was associated with the presence of both this language impairment and alexithymia. These results are consistent with a framework for acquired alexithymia that incorporates both interoceptive and language processes, and support the idea that brain injury may result in alexithymia via impairment in any one of a number of more basic processes.

### 1. Introduction

Alexithymia is a sub-clinical condition characterised by a difficulty identifying and expressing one's emotions, accompanied by a pattern of externally oriented thinking (Taylor et al., 1991). The clinical significance of alexithymia is increasingly being appreciated, in part due to its high rates of co-occurrence with a wide range of psychiatric

conditions, including autism, eating disorders, schizophrenia, alcohol abuse and substance abuse (Bird and Cook, 2013; Eizaguirre et al., 2004; Pinard et al., 1996; Thorberg et al., 2009; van't Wout et al., 2007). An increased prevalence of alexithymia, relative to rates observed in the general population, is also seen in neurological conditions including Multiple Sclerosis (Chahraoui et al., 2008), Parkinson's Disease (Costa et al., 2010), and following traumatic brain injury (TBI)

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(Henry et al., 2006; Wood and Williams, 2007), providing evidence of “acquired alexithymia” following presumed typical development. Alexithymia has been found to increase the likelihood of a number of other socio-emotional deficits, including difficulties recognising emotions from both faces (Cook et al., 2013; Grynberg et al., 2012; although see McDonald et al., 2011) and voices (Heaton et al., 2012), reduced levels of empathy (Bird et al., 2010), and difficulties regulating one’s own emotion (Pandey et al., 2011). Alexithymia is also associated with impaired learning and decision-making (Bibby and Ferguson, 2011; Ferguson et al., 2009; Kano et al., 2011), increased self-harm (Norman and Borrill, 2015), and negatively impacts the effectiveness of most psychotherapy (Lumley et al., 2007; Mccallum et al., 2003).

While the impact of alexithymia on functioning and treatment efficacy is becoming better understood, the nature and aetiology of alexithymia in both clinical and non-clinical populations is still unclear. In particular, there has been a great deal of debate over whether alexithymia is a unitary construct, or whether subtypes of alexithymia exist. Several subtypes have been proposed –some defined by the form of alexithymic deficit, and others by aetiology. With regard to subtypes of form, much debate has centred around the question of whether some individuals with alexithymia are impaired in the affective and cognitive domain, while others are impaired in the cognitive domain only (Bermond, 1997; Parker et al., 1993), with current data suggesting alexithymia may be a unitary condition, at least in terms of its reportable behavioural characteristics (Bagby et al., 2009).

With respect to aetiological subtypes, while it has been argued that an interoceptive deficit may give rise to alexithymia over development (Brewer et al., 2015; Murphy et al., 2017a), and evidence of impaired interoception in alexithymic individuals supports this conjecture (Brewer et al., 2016; Gaigg et al., 2016; Herbert et al., 2011; Murphy et al., 2017a; Shah et al., 2016), interoceptive deficit may not be the only route by which one may develop alexithymia. Although data addressing the question of multiple aetiological routes to alexithymia is not plentiful, several authors have suggested such a possibility. For instance, Messina and colleagues argue that there may be “primary” and “secondary” forms of alexithymia, where primary alexithymia is a developmental condition and secondary alexithymia a reaction to trauma occurring later in life (Messina et al., 2014).

One strategy to address this possibility is to examine co-occurring deficits in alexithymic individuals; different patterns of co-occurring deficits may suggest different aetiologies. For example, work suggests that alexithymia following HIV infection may be distinct from that found in healthy individuals. Specifically, in patients infected with HIV (which is associated with widespread neurological deterioration and disruption to brain functioning even in the early stages of disease progression; Ernst et al., 2002; Jernigan et al., 1993; Thompson et al., 2005), levels of alexithymia were related to performance on tests of attention, executive function and visuospatial ability, whereas alexithymia severity was unrelated to these factors in healthy control participants (Bogdanova et al., 2010).

### 1.1. The role of language in alexithymia

While it is somewhat intuitive that general cognitive factors such as attention and executive function may impact upon alexithymia, and previous study of alexithymia has highlighted the importance of interoception, it is even more intuitive that language impairment is likely to lead to alexithymia, particularly following organic or traumatic brain injury. Given that “alexithymia” is literally translated as “no words for feelings”, and core components are a difficulty identifying (i.e. *labelling*) and *expressing* these feelings to others, it is logical that impairment of language function following brain injury would lead to alexithymia. Such a hypothesis was discounted early in alexithymia research however, based on the finding that alexithymic individuals show emotion processing deficits on nonverbal as well as verbal tasks (Lane et al., 1996; Wagner and Lee, 2008). This interpretation ignores, however, the

pervasive effects of language on seemingly “nonverbal” tasks, and the fact that tasks that do not use linguistic stimuli can still be affected by language processes. While theorists have argued that language processes have an influential role on many perceptual and cognitive tasks (Lupyan, 2012), with regard to emotion, it is thought that verbal labels are likely to contribute to the development of clearly defined emotional categories (see Barrett et al., 2007), and may be used even in non-verbal tasks, such as when one is required to match visual emotional stimuli. Indeed, such an effect was demonstrated by Lindquist et al. (2006), who showed that when access to emotional verbal labels was disrupted using a technique known as semantic satiation, participants were slower and less accurate when required to judge whether two faces depicted the same emotion (a task where verbal labelling of emotion was not explicitly required). Other studies have also shown effects of verbal processing on emotion categorization tasks that do not explicitly require verbal labelling of emotions (Roberson and Davidoff, 2000; Roberson et al., 2010). Further support for the role of language in the alexithymia deficit seen on ‘non-verbal’ emotional tasks is provided by the finding that, in some samples but not all, the facial emotion recognition deficit observed in alexithymic individuals can be completely explained by differences in verbal IQ. For example, in one such study, the effect of alexithymia on the recognition of facial expressions of emotion was found to be no longer significant after verbal IQ was statistically controlled for (Montebarocci et al., 2011; see also Hsing et al., 2013).

While the relationship between language and alexithymia has received limited direct study, available evidence supports the notion that language processes contribute to alexithymia. In a study of 59 post-war veterans, alexithymia was found to be associated with measures of verbal performance (Lamberty and Holt, 1995). Furthermore, Henry et al. (2006) assessed verbal fluency and alexithymia in patients with TBI and found that difficulty identifying feelings, one of the three core features of alexithymia, was correlated with performance on fluency tasks, such that greater difficulty with identifying feelings was related to poorer fluency. While suggestive, fluency measures tap a range of executive processes and therefore the relationship between difficulty identifying feelings and verbal fluency provides only limited evidence for the role of language functioning in alexithymia. Nonetheless, in a subsequent investigation by Wood and Williams (2007), verbal abilities (measured using vocabulary, verbal similarities, and comprehension tasks) were significantly poorer in patients who were alexithymic than in those who were not.

Developmental investigations have also suggested links between language and alexithymia, as early delays in speech development are associated with alexithymia later in life (Karukivi et al., 2012; Kokkonen et al., 2003). Importantly, these relationships are observed with *general* language skills; suggesting that links between alexithymia and language are not limited to language for emotions or internal states. Alexithymia itself has not been studied in children with language impairment. Nonetheless, these children do show worse emotion regulation abilities, reduced emotional well-being, and impairments on emotion processing tasks such as those requiring the recognition of emotional facial expressions, or inference of the emotional states of others from non-facial cues (Botting and Conti-Ramsden, 2008; Ford and Milosky, 2003; Fujiki et al., 2002; Merckenschlager et al., 2012; Nelson et al., 2011). These difficulties are consistent with elevated rates of alexithymia in this population. Relatedly, children with language impairment have shown deficits on a task comparable to the ‘non-verbal’ emotion task employed by Lane et al. (1996) on which alexithymic adults are impaired. Ford and Milosky (2003) presented children with scenarios (in verbal only format, visual only, and in combined verbal and visual format) and asked what the character in the scenario would feel. Children with language impairment made more errors on the task than their age-matched peers, and were more likely to report that the character would feel an emotion with a valence opposite to the correct emotion (e.g. responding that a character would feel happy instead of angry), regardless of the mode of presentation.

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