



# Relationship between interoceptive accuracy, interoceptive sensibility, and alexithymia

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## ABSTRACT

Interoception is the ability to feel one's internal bodily sensations and it is related to emotional experience and the processing of emotional stimuli. Alexithymia is defined by difficulties in identifying and describing one's emotions and externally oriented thinking. Additionally, it is linked to impairments in emotional awareness and the regulation of emotions. It is largely assumed that alexithymia relates negatively both to subjective and objective interoception. However, evidence is scarce for the latter relation. The relationship between Interoceptive Accuracy (IAcc, as measured with the heartbeat tracking task), Interoceptive Sensibility (IS, self-report measure of interoception assessed via questionnaires), and alexithymia (i.e., TAS-20) was examined across ten studies (total  $N = 998$ ). Results showed a weak negative correlation between alexithymia and IS but no correlation between alexithymia and IAcc.

## 1. Introduction

Early theories of emotions already suggested that interoception, i.e., the ability to feel internal bodily sensations, is a central antecedent of the conscious experience of emotions (Damasio, 1994; James, 1884). Herbert, Herbert, and Pollatos (2011) report findings that confirm that higher abilities in interoception are associated with greater intensity of emotional experience. Moreover, interoception has been linked to more detailed processing of emotionally arousing stimuli (Pollatos, Herbert, Matthias, & Schandry, 2007). Consistent with this view, past research has assumed a negative association between interoception and alexithymia. In the present research, we conducted a more comprehensive empirical test of the latter association. In the Introduction, we define subjective and objective abilities in interoception, as well as alexithymia and the links between these three constructs. We then report and discuss results collected across ten studies.

### 1.1. Interoception

Two components of interoception are distinguished for the purpose of the present research; Interoceptive Sensibility (IS) and Interoceptive Accuracy (IAcc). IS is the subjective, self-reported, measure of interoception. It assesses via questionnaires to which extent individuals report to perceive their internal sensations, such as their heartbeats, hunger, or respiration. In contrast, IAcc refers to people's objective

ability in perceiving their internal (bodily) signals and states (Garfinkel, Seth, Barrett, Suzuki, & Critchley, 2015). The most widely used measure of IAcc is the heartbeat tracking task. In this task, individuals are asked to silently count their heartbeats, without taking their pulse. They are asked to do so for different time intervals (usually of 25, 35 and 45 s) and to report the number of counted heartbeats. Throughout the task, the actual number of heartbeats is recorded, allowing for performance measures and their further comparison to self-reported measures.

### 1.2. Alexithymia

Alexithymia is a personality construct that involves difficulties in identifying feelings, verbalizing them and an externally oriented thinking style. Alexithymia was originally introduced by Sifneos (1973) to indicate a group of cognitive and affective characteristics found in patients with psychosomatic disorders. This personality trait has been associated with a variety of somatic and psychiatric disorders, such as substance abuse disorders, posttraumatic stress disorder, somatoform disorders, panic disorder, depression, and eating disorders (Frewen, Dozois, Neufeld, & Lanius, 2008; Montebanacci et al., 2006; Taylor, Bagby, & Parker, 1999; Zackheim, 2007). Alexithymia is associated with deficits in the cognitive processing and regulation of emotions (Hsing, Hofelich Mohr, Brent Stansfield, & Preston, 2013; Lalouaux, Fantini, Lemaire, Luminet, & Larøi, 2015; Lane et al., 1996) and is

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related to poor emotional awareness (Da Silva, Vasco, & Watson, 2017; Lane, 2000).

### 1.3. Theoretical links between interoception and alexithymia

Early theoretical models of alexithymia implied deficits in interoception, both at the subjective and objective levels (Taylor et al., 1999). For instance, the presence of high alexithymia was found in patients with eating disorders who, according to classic conceptual models (Bruch, 1973), are characterized by interoceptive deficits. Likewise, the presence of alexithymia and low interoception is reported in depression (Honkalampi, Hintikka, Tanskanen, Lehtonen, & Viinamäki, 2000).

The association between alexithymia and interoception is also illustrated in the original construction of the TAS-20 (see Taylor et al., 1999, Chapter 3, p. 55). Five factors were initially involved, comprising a total of 41 items. A factor called “Difficulty in distinguishing between feelings and the bodily sensations that accompany states of emotional arousal” was originally included and, for the scale construction, four items were directly borrowed from the Interoceptive Awareness subscale of Eating Disorder Inventory (EDI; Garner, Olmstead, & Polivy, 1983). Even if later scale developments excluded these specific items, the original design of the TAS speaks to the conceptual link between alexithymia and interoceptive abilities.

More recent theoretical (Murphy, Brewer, Catmur, & Bird, 2017) and experimental (Brewer, Cook, & Bird, 2016; Herbert et al., 2011; Shah, Hall, Catmur, & Bird, 2016; Sowden, Brewer, Catmur, & Bird, 2016) work also relate alexithymia to poor interoception. As Murphy et al. (2017) recently noted: “alexithymia is a marker of atypical interoception” (p. 48). In addition to the studies mentioned above, neuropsychological research revealed the presence of a relationship between damages of the anterior insula and interoceptive impairment and alexithymia (e.g., Ibañez, Gleichgerrcht, & Manes, 2010). The anterior insula is a crucial brain area where interoceptive signals arising from the body merge, providing information on the bodily state. Insular cortex lesions can result in deficits in body awareness and difficulties in recognizing emotions.

Finally, another theoretical argument supporting the assumed negative link between alexithymia and interoception is the presence of alexithymia in different physical and psychiatric disorders, i.e., diabetes, obesity, eating disorders, and depression, in which low interoceptive abilities are also reported (e.g., Cochrane, Brewerton, Wilson, & Hodges, 1993; Herbert & Pollatos, 2014; Honkalampi et al., 2000; Pinna et al., 2011; Pollatos et al., 2008). Alexithymia and impaired interoception might be related to eleven disorders and symptoms highlighted in Caspi and colleagues' p-factor model: dependence from alcohol, cannabis, hard drugs, tobacco, conduct disorders, major depression, generalized anxiety disorder, fears and phobias, obsessive-compulsive disorder, mania, and positive and negative schizophrenia symptoms.

### 1.4. Empirical links between interoception and alexithymia

Whereas both original and contemporary work confidently point to a theoretical link between interoception and alexithymia, empirical evidence for such association, however, is scarce and points to opposite directions. A co-occurrence of high alexithymia and high interoception has been reported in the literature. Specifically, anxiety may be characterized by high alexithymia and high interoceptive accuracy (Domschke, Stevens, Pfeleiderer, & Gerlach, 2010). Interpretation of the latter association, however, is mitigated by the use of a heartbeat tracking task for assessing IAcc. Anxious individuals are highly focused on changes in their heartbeats to detect signals of alarm. Therefore, they may be good heartbeat perceivers, but this interoceptive advantage may not extend to other bodily sensations.

It is also worth underling that no relationship between alexithymia

and IAcc was observed by Bornemann and Singer (2017). These authors found no correlation between the heartbeat tracking task and the TAS-20 at baseline. A significant negative relationship was only detected after a 9 months of contemplative mental training, which increased IAcc and decreased alexithymia.

Turning to supportive evidence, a study by Brewer et al. (2016) found alexithymia to be related to poor IS ( $r = 0.43$ ,  $p < 0.001$ ), assessed using two newly developed questionnaires (i.e., the Interoceptive Confusion Questionnaire and the State–Emotion Similarity Questionnaire). Studies by Herbert et al. (2011) and Shah et al. (2016) found alexithymia to be negatively correlated with IAcc, as measured by the heartbeat tracking task ( $r = -0.37$ ,  $p < 0.01$  and  $r = -0.36$ ,  $p = 0.025$  respectively). These supportive studies, however, present limitations, including the use of non-validated questionnaires and in some cases of very low sample sizes (only 38 participants in Shah et al., 2016).

Given the widespread assumption for a strong negative relation between interoception and alexithymia, and considering the important theoretical and practical implications of such association, it is most surprising that only a few empirical studies addressed this question. Of note too, and perhaps even more important, to the best of our knowledge, no prior study explored this association using both objective and subjective measures of interoception. Considering the paucity of empirical data available, we decided to proceed to a more comprehensive and rigorous test of how both subjective and objective interoception is empirically linked to alexithymia. We did so by using larger samples and validated measures. Following previous theorization, we hypothesized a negative correlation (i) between alexithymia and interoceptive accuracy, as measured via the heartbeat tracking task, and (ii) between alexithymia and interoceptive sensibility, assessed with three different validated questionnaires. As a second step, we conducted regression analyses in order to explore the independent contributions of IAcc and IS to alexithymia.

## 2. Method

### 2.1. Participants

All participants were students at two Belgian Universities, one in the French-speaking part and one in the Dutch-speaking part of the country. They were all recruited using a Facebook page dedicated to paid studies at the Psychology research institute or using advertisements at the Faculty. All participants were tested one-by-one. Table 1 provides an overview of the descriptive statistics of the sample and measures used in each study. The studies received the approval from the Ethics Committee of both research institutes.

### 2.2. Material and measures

#### 2.2.1. Heartbeat tracking task

Participants' heart rate was assessed using the Polar Watch RS800CX heart monitor (which derives heart rate from the placement of the wrists on electrode areas) or via ECG measurement (NeXus-10, Mind Media B.V.). Polar products have been used in previous studies, showing excellent validity and reliability in measuring heart rate and R-R interval data (e.g. Kingsley, Lewis, & Marson, 2005; Nunan et al., 2008; Quintana, Heathers, & Kemp, 2012; Weippert et al., 2010). Following the well-validated Mental Tracking Method by Schandry (1981), data were recorded during three randomly presented time intervals (25 s, 35 s, 45 s), each separated by a pause of 20 s. The software Polar ProTrainer5 or custom made R-peak detection Matlab scripts were used to extract the actual number of heartbeats. One acoustic start cue was presented at the beginning of each time interval and another acoustic stop cue indicated the end of the interval. Throughout the experiment, they were instructed to silently count their own heartbeats. At the end of each time interval, participants were asked to verbally report how

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