Pontifícia Universidade Católica
do Rio de Janeiro

Bruno Maciel de Carvalho Pinto Salles

Bridging The Gap Between Alexithymia and Socio-Emotional Impairments: Towards an Intervention Proposal

Tese de Doutorado

Thesis presented to the Programa de Pós-graduação em Psicologia of PUC-Rio in partial fulfillment of the requirements for the degree of Doutor em Psicologia.

Advisor: Prof. Daniel Correa Mograbi

Rio de Janeiro
April 2023

Bruno Maciel de Carvalho Pinto Salles

Bridging The Gap Between Alexithymia and Socio-Emotional Impairments: Towards an Intervention Proposal

Tese de Doutorado

Thesis presented to the Programa de Pós-graduação em Psicologia of PUC-Rio in partial fulfillment of the requirements for the degree of Doutor em Psicologia. Approved by the undersigned Examination Committee:

Prof. Daniel Correa Mograbi

Advisor

Departamento de Psicologia – PUC-Rio

Prof. Jesus Landeira-Fernandez

Departamento de Psicologia – PUC-Rio

Prof. Carlos Eduardo Nórte

UERJ - Universidade do Estado do Rio de Janeiro

Prof. Antonio Egidio Nardi

UFRJ - Instituto de Psiquiatria

Prof ª. Elodie Bertrand

Université Paris Cité, Institut de Psychologie

Rio de Janeiro
April 14, 2023

Bruno Maciel de Carvalho Pinto Salles

The author graduated in Psychology at the Pontifícia Universidade Católica do Rio de Janeiro (PUC-Rio) in 2015, completed his Master's Degree in Clinical Psychology at the PUC-Rio in 2018, and obtained the degree of Specialist in Cognitive Behavioral Therapy (CBT) at the PUC-Rio in 2022.

Bibliographic data

Salles, Bruno Maciel de Carvalho Pinto

Bridging the gap between alexithymia and socio-emotional impairments : towards an intervention proposal / Bruno Maciel de Carvalho Pinto Salles ; advisor: Daniel Correa Mograbi. – 2023.

254 f. : il. color. ; 30 cm

Tese (doutorado)–Pontifícia Universidade Católica do Rio de Janeiro, Departamento de Psicologia, 2023.

Inclui bibliografia

1. Psicologia – Teses. 2. Alexitimia. 3. Consciência emocional. 4. Proposta de intervenção. 5. Psicoeducação emocional. 6. Estudo de validação. I. Mograbi, Daniel Correa. II. Pontifícia Universidade Católica do Rio de Janeiro. Departamento de Psicologia. III. Título.

CDD: 150

Acknowledgments

First, I would like to thank my advisor Daniel Mograbi for his guidance, patience and for sharing his knowledge and experience with me. I am grateful to have him as my advisor and for the confidence in my work as a master's and doctorate advisor.

I also want to thank my girlfriend Gabrielly La-Cava, who has been the best thing that has happened to me in years and in my life. Her love, support and encouragement were essential for me to face difficulties and persist in my academic journey.

To my lab colleagues Wayson Maturana, Caio Lage, and Sabrina Lenzoni, I would like to express my gratitude for their friendship, collaboration, and teamwork. Especially to Wayson, thanks for sharing work, written articles, and academic anxieties with me. Your help and partnership were essential for the success of our projects.

To Eduardo Fernandes, my colleague who introduced me to DBT, I am very grateful for sharing his knowledge and encouraging me to explore this area. I specifically dedicate Article 3 of my thesis to you, which was a systematic review of the effectiveness of DBT for people with alexithymia. I also dedicate to Prof. Veruska Santos for participating in this article with me.

To Matheus Pedrosa, my brilliant colleague, thank you for working with me on an article and a book chapter. His enthusiasm and creativity are inspiring, and I am grateful to have him as a colleague and friend.

To colleagues Julia Freid, Sofia Latgé, Lucas Cruz, Vitória Velloso, Íris Bomilcar, Bheatrix Bienemann, Mari Ridolfi and the entire MograbiLab team, thank you for your love, friendship and support at all times. It is an honor to be part of such a talented and dedicated team.

And finally, to my parents, who were largely responsible for what I am today. Thank you for always supporting me and encouraging me to pursue my dreams. I am so grateful for all the love and dedication you have for me.

Again, to all of you, thank you very much. I am grateful to have had the opportunity to work with and learn from such talented and dedicated people. I hope to continue collaborating and maintaining this lasting friendship.

To PUC-Rio and CAPES for the aid granted, without which this work could not have been carried out

This study was financed in part by the Coordenação de Aperfeiçoaento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001

Abstract

Salles, Bruno Maciel de Carvalho Pinto; Mograbi, Daniel Correa (Advisor); **Bridging the gap between alexithymia and socio-emotional impairments: towards an intervention proposal**. Rio de Janeiro, 2023, 254p. Tese de Doutorado – Departamento de Psicologia, Pontifícia Universidade Católica do Rio de Janeiro

The current thesis aimed to establish a theoretical and empirical framework to develop intervention programs for alexithymia, a condition related to socio-emotional impairments. The thesis is comprised of four articles. Article 1 validated an adapted version of the Bermond–Vorst Alexithymia Questionnaire (BVAQ) for Brazilian Portuguese, showing that the TAS-20 and the BVAQ-BR measure different aspects of alexithymia. Article 2 validated the Interoceptive Accuracy Scale (IAS) adapted to Brazilian Portuguese, highlighting the negative correlation between interoceptive accuracy and alexithymia, and symptoms of ASD and dysphoric syndromes. Articles 1 and 2 provided reliable tools for assessing alexithymia and interoceptive accuracy in Brazil, showing their potential benefits in identifying risk factors for psychiatric disorders. Article 3 conducted a systematic review of the impact of DBT-based interventions on alexithymia, indicating the effectiveness of such interventions in improving emotional processing skills, although interventions incorporating principles from other treatments were more effective. Finally, Article 4 explored the relationship between alexithymia and empathy, revealing the multifaceted aspects of this relationship. The thesis proposes a robust framework to facilitate the development of intervention programs for alexithymia.

Keywords

Alexithymia; Emotional awareness; Emotional psychoeducation; Validation study

Resumo

Salles, Bruno Maciel de Carvalho Pinto; Mograbi, Daniel Correa; **Preenchendo a lacuna entre alexitimia e prejuízos socioemocionais: em direção a uma proposta de intervenção**. Rio de Janeiro, 2023, 254p. Tese de Doutorado – Departamento de Psicologia, Pontifícia Universidade Católica do Rio de Janeiro

A presente tese teve como objetivo estabelecer um quadro teórico e empírico para desenvolver programas de intervenção para a alexitimia, uma condição relacionada com prejuízos socioemocionais. A tese é composta por quatro artigos. O artigo 1 validou uma versão adaptada do Bermond–Vorst Alexithymia Questionnaire (BVAQ) para o português brasileiro, mostrando que o TAS-20 e o BVAQ-BR medem diferentes aspectos da alexitimia. O artigo 2 validou a escala de precisão interoceptiva (IAS) adaptada para o português brasileiro, destacando a correlação negativa entre a precisão interoceptiva e alexitimia, sintomas de TEA e síndromes disfóricas. Os artigos 1 e 2 forneceram ferramentas confiáveis para avaliar alexitimia e acurácia interoceptiva no Brasil, mostrando seus potenciais benefícios na identificação de fatores de risco para transtornos psiquiátricos. O artigo 3 realizou uma revisão sistemática do impacto das intervenções baseadas em DBT na alexitimia, indicando a eficácia de tais intervenções na melhoria das habilidades de processamento emocional, embora as intervenções que incorporam princípios de outros tratamentos tenham sido mais eficazes. Por fim, o Artigo 4 explorou a relação entre alexitimia e empatia, revelando os aspectos multifacetados dessa relação. A tese propõe uma estrutura robusta para facilitar o desenvolvimento de programas de intervenção para alexitimia.

Palavras-chave

Alexitimia; Consciência emocional; Psicoeducação emocional; Estudo de Validação

Table of contents

List of figures

List of tables

I. THEORETICAL BACKGROUND

1. Alexithymia

Alexithymia is a multifaceted condition that involves a range of cognitive and emotional challenges. People with alexithymia may experience difficulty recognizing and expressing their emotions, as well as understanding their physical sensations. This can be particularly challenging because people with alexithymia may lack the linguistic ability to describe their internal experiences, making it hard for them to communicate their emotions to others effectively. Additionally, these individuals may have reduced imaginative abilities and a tendency towards external thinking, which can create a barrier to connect with their inner emotional experiences. As a result, they may avoid discussing their emotions and feelings with others. Therefore, alexithymia is a complex construct that can have a significant impact on an individual's emotional well-being, social relationships, and overall quality of life (Kennedy & Franklin, 2002; Nemiah & Sifneos, 1970; Sifneos, 1973).

Although often classified as a subclinical condition, alexithymia has been linked to a range of physical and mental health issues including depression, panic disorder, eating disorders (EDs), and substance addiction (Bydlowski et al., 2005; de Timary et al., 2008; Galderisi et al., 2008; Haviland et al., 1994; Honkalampi et al., 2001). Furthermore, at least 50% of individuals with autism spectrum disorder (ASD) are estimated to have severe levels of alexithymia (Cook et al., 2013), which underscores the transdiagnostic risk and vulnerability factor of alexithymia and its impact on the treatment of various diseases (Pinna et al., 2020). High levels of alexithymia have been associated with poor treatment outcomes in patients with

eating disorders (Berardis et al., 2008), and individuals with alexithymia are more likely to experience severe anxiety and depression with reduced chances of recovery (Berardis et al., 2008; Güleç et al., 2013).

Prevalence studies have shown that alexithymia is highly prevalent, ranging from 7% to 13% in community samples, with clinical samples having even higher rates (McGillivray et al., 2017). However, recent research conducted in Brazil has revealed an even higher rate of alexithymia, with over 30% of the adult population showing high scores of alexithymia, as will be presented in Article 1 of this thesis. Despite being a risk factor and predictor of several diseases and the large number of people suffering from it, there is currently no standard treatment for this widespread condition. Therefore, the development of a treatment for alexithymia is crucial, given its negative impact on the health of this population.

In order to develop an effective treatment for alexithymia, it is crucial to first understand the associated impairments of this condition. Studies have demonstrated that alexithymia is linked to difficulties in emotional regulation, empathy, social interaction, and mentalizing (Di Tella et al., 2020; Grynberg et al., 2010; Guttman & Laporte, 2002; Pisani et al., 2011). Therefore, a treatment for alexithymia should be aimed at addressing these common symptoms and deficits in psychological constructs related to alexithymia. Emotion-focused therapy (EFT), cognitive-behavioral therapy (CBT), mindfulness-based interventions (MBIs), and Dialectical Behavior Therapy (DBT) have been proposed as promising treatment options for alexithymia (Cameron et al., 2014; Norman et al., 2019; Salles et al., 2022; Zamani et al., 2023). These treatments focus on improving emotional awareness, regulation, and expression, as well as empathy, social skills. By

addressing these impairments, it is possible to enhance the emotional well-being and quality of life of individuals with alexithymia.

1.1. Alexithymia impairments

Alexithymia has been characterized as a general failure of interoception, which refers to the sense of the internal state of the body (Brewer et al., 2016; Murphy, Brewer, et al., 2018). There is evidence that individuals with alexithymia have lower accuracy in detecting heartbeat sensations, indicating a problem with interoception (Herbert et al., 2011). Additionally, individuals with alexithymia showed reduced activation in brain regions associated with interoception and emotion processing (Longarzo et al., 2015). Research suggests that interoception plays a critical role in maintaining emotional awareness and regulation (Khalsa et al., 2018), and its impairment is believed to be central to the development of many psychiatric disorders (Brewer et al., 2016; Murphy, Catmur, et al., 2018). Therefore, it is likely that alexithymia is common in many disorders, at least partially, due to its association with impaired functioning of interoception (Brewer et al., 2016; Herbert et al., 2011; Longarzo et al., 2015; Shah et al., 2016).

Research also suggests that individuals with alexithymia have reduced social cognition, which is related to their impaired ability to empathize, recognize emotions, and regulate their own feelings (Di Tella et al., 2020; Delphine Grynberg et al., 2010; Guttman & Laporte, 2002). People with alexithymia appear to have difficulty with cognitive empathy, including taking other people's perspectives (Grynberg et al., 2010). Alexithymia is associated with impaired emotional perception, including slower appraisal and poorer recognition of facial expressions of emotion (Delphine Grynberg et al., 2014; Prkachin et al., 2009). These findings

support the claim that the ability to correctly identify one's own feelings is crucial in recognizing the emotions and feelings of others (Di Tella et al., 2020).

In addition to the cognitive dimension of empathy, alexithymia is also commonly associated with difficulties in affective empathy (Delphine Grynberg et al., 2010). Affective empathy refers to the ability to experience emotions that are congruent with another person's emotions, such as feeling sad when a friend shares a story about a personal loss. Several studies have shown that individuals with alexithymia have a reduced ability to be empathically affected by the emotional state of others (Goerlich-Dobre et al., 2015; Martínez-Velázquez et al., 2017; Moriguchi & Komaki, 2013). One study found that participants with alexithymia showed lower activity in the anterior insula, a brain region associated with affective empathy, when viewing pictures of emotional faces (Kano et al., 2003). Similarly, another study reported that individuals with alexithymia had decreased activity in the amygdala, another brain region involved in emotional processing, when viewing emotional faces (Kugel et al., 2008). These findings suggest that alexithymia may be associated with reduced activation in brain regions involved in affective empathy.

Furthermore, research has shown that alexithymia may lead to difficulties in regulating one's own emotions, which can in turn impact empathic responses (Preece et al., 2022; Swart et al., 2009). In several studies examining the relationship between alexithymia and emotional regulation, researchers found that individuals with alexithymia had poorer emotion regulation skills and were more likely to use maladaptive coping strategies, such as high avoidance and suppression and low cognitive reappraisal when dealing with negative emotions (Chen et al., 2011; Laloyaux et al., 2015; Samson et al., 2012, 2015; Swart et al., 2009; Wagner

& Lee, 2008). Alexithymia has also been found to predict reduced empathy, emotion recognition, and emotion regulation, even after controlling for dysphoric affect such as anxiety and depression (Di Tella et al., 2020; Delphine Grynberg et al., 2010)

The inability of individuals with alexithymia to regulate their own emotions and perceive others' feelings may also impact their capacity to experience prosocial feelings for others' negative emotions. Research has shown that people with alexithymia tend to experience personal distress rather than compassion when faced with others' emotional distress (Rebecca Brewer et al., 2019; Delphine Grynberg et al., 2010; Saito et al., 2016). Personal distress is defined as a negative emotional reaction to witnessing the distress of others, which can include feelings of discomfort, anxiety, and even distress (Decety & Lamm, 2013). This personal distress is thought to be a result of their difficulty in regulating their own emotions and responding appropriately to emotional situations (Delphine Grynberg & López-Pérez, 2018). Their inability to regulate their own emotions may also lead to an impaired ability to process emotional information, including the emotional cues of others, which further impacts their ability to experience empathy (Di Tella et al., 2020; Delphine Grynberg, Chang, et al., 2012; Van der Velde et al., 2013).

In addition, the lack of emotional awareness and regulation in individuals with alexithymia may also contribute to their difficulty in experiencing empathic concern, such as feelings of sympathy and compassion. A study by Swart et al. (2009) found that individuals with alexithymia had lower levels of empathic concern compared to controls, suggesting that their difficulty in regulating their own emotions may lead to a reduced capacity to experience and express concern for others. This is further supported by research that suggests that individuals with

alexithymia may have difficulty processing emotional information related to others, which can contribute to their inability to empathize with others (Lane et al., 2015). Thus, the lack of emotional awareness and regulation in individuals with alexithymia may have a negative impact on their ability to experience empathic concern, making it difficult for them to connect emotionally with others and to respond to others' emotional needs. Overall, the literature suggests that alexithymia is associated with both reduced cognitive and affective empathy, likely due to decreased activity in brain regions involved in emotional processing, and poor emotional regulation skills, which can lead to a reduced ability to experience feelings of empathy and compassion towards others.

Reduced empathy, emotion regulation and emotional awareness in individuals with alexithymia may have negative consequences on their well-being and social functioning, such as hinder their ability to form meaningful relationships and connect with others (Kennedy & Franklin, 2002b). Studies have shown that alexithymia is associated with a higher risk of loneliness, marital dissatisfaction, self-harm, and suicidal ideation (Hemming et al., 2019; Iskric et al., 2020; Morr et al., 2021; Panahi et al., 2018). For example, Frye-Cox and Hesse (2013) found that individuals with alexithymia reported significantly higher levels of loneliness compared to those without alexithymia. Iskric et al. (2020) also reported that alexithymia was significantly associated with self-harm behavior in adolescents. In addition, they also found that alexithymia was associated with higher rates of suicidal ideation among psychiatric patients (Iskric et al., 2020). Therefore, it is important to also address deficits of empathy, regulation and emotional awareness in individuals with alexithymia in order to improve their quality of life and social functioning.

1.2. The Current Thesis

A series of studies was conducted to provide theoretical and empirical bases for future interventions for alexithymia. The first step involved conducting validation studies of scales adapted to Brazilian Portuguese in order to measure alexithymia and interoception. The next step involved systematic reviews to examine the effects of DBT-based interventions in individuals with alexithymia, and to explore the multidimensional relationship between alexithymia and empathy. In the final part of this thesis, the main findings of the studies will be discussed.

The current thesis is organized into four articles: Firstly, a validation study of the Brazilian Portuguese version of the Bermond-Vorst Alexithymia Questionnaire (BVAQ-BR), which assesses cognitive and affective alexithymia, and explores the prevalence rate of individuals with high alexithymia in Brazil. Secondly, a validation study of the Brazilian Portuguese adaptation of the Interoceptive Accuracy Scale (IAS-BR), a self-report questionnaire of self-perceived interoceptive accuracy. Thirdly, a published systematic review of the effects of interventions based on Dialectical Behavior Therapy (DBT) on alexithymia. Lastly, a comprehensive systematic review of the effects of alexithymic symptoms on distinct components of empathy.

IV. OBJECTIVES

The present thesis will consist of three parts, in accordance with its theoretical framework. The first part will investigate the feasibility of using questionnaires translated into Brazilian Portuguese to measure alexithymia and related constructs. The second part will examine the clinical aspects of alexithymia by exploring the connections between alexithymia and socio-emotional impairments. The third part will discuss the key findings of the presented articles.

The initial section of the thesis will include two validation studies that aim to investigate the psychometric properties of Brazilian Portuguese adaptations of the following instruments:

- Article 1: The Bermond–Vorst Alexithymia Questionnaire (BVAQ), which measures both cognitive and affective alexithymia;
- Article 2: The Interoceptive Accuracy Scale (IAS), that measures self-perceived interoceptive accuracy.

The second part consists of two literature reviews, with the following objectives:

- Article 3: To investigate the current evidence on the effectiveness of DBT-based interventions in improving alexithymia.
- Article 4: To explore the effects of alexithymia symptoms on distinct components of empathy.

The third and last section of the thesis will conclude with general discussions about the main findings of the presented articles. Therefore, the general objective of the thesis is to establish theoretical and empirical bases for future alexithymia

interventions. Secondary objectives are to investigate the feasibility of using questionnaires adapted to Brazilian Portuguese to measure alexithymia and interoception, to examine the clinical aspects of alexithymia, exploring connections between this condition and socio-emotional impairments, and to carry out two literature reviews with the objective of investigating the effectiveness of DBT-based interventions to improve alexithymia and the effects of alexithymia symptoms on different components of empathy.

V. ARTICLES SECTION

Article 1

Salles, B. M., Maturana, W., Leon, A. P. R., Guimarães, M. S., Mograbi, D. C. (Manuscript submitted). The Bermond–Vorst Alexithymia Questionnaire: Psychometric properties of the Brazilian Portuguese version (BVAQ-BR).

The Bermond–Vorst Alexithymia Questionnaire: Psychometric properties of the Brazilian Portuguese version (BVAQ-BR)

Bruno M. Salles[1*], Wayson Maturana[1], Arthur P. R. Leon [1], Milena S. Guimarães[1], Daniel C. Mograbi[1,2]

1 – Department of Psychology, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil.

2 – Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom.

[*] Corresponding author. E-mail address: contact@brunosalles.com

Abstract

The term “alexithymia” refers to difficulties in comprehending and communicating emotions and is usually assessed with TAS-20, but this measure only evaluates cognitive aspects of this construct. In contrast, the Bermond-Vorst Alexithymia Questionnaire (BVAQ) evaluates both affective and cognitive dimensions, but there is no Brazilian-Portuguese version available. To address this issue, the current study analyzed data from 1285 participants to assess the psychometric properties of the Brazilian Portuguese translation of BVAQ (BVAQ-BR). Exploratory factor analysis revealed a five-factor solution and a second-order two-factor structure. BVAQ-BR scores was positively associated with dysfunctional beliefs about emotions, autism spectrum symptoms, and negative emotional syndromes (i.e., depression, anxiety, and stress), but negatively associated with emotional expressivity and interoceptive accuracy. The prevalence of alexithymia was 29.3% using TAS-20 in a reduced sample, and between 32.0% to 37.0% in the total sample using the cognitive dimension and BVAQ-BR total score, respectively. These findings suggest that BVAQ-BR has a factor structure akin to the original scale and demonstrates satisfactory psychometric properties. The introduction of this new tool may facilitate future research on alexithymia in Brazil and enable cross-cultural comparisons.

Keywords

Alexithymia; emotion; instrument validity; Bermond–Vorst Alexithymia Questionnaire; cross-cultural adaptation.

Introduction

Sifneos (1973) introduced the term "alexithymia" [from the Greek *a* (no) – *lexis* (words) – *thymos* (emotion); literally "no words for emotions"] to describe patients with psychosomatic disorders who experienced marked emotional constriction, had difficulty identifying and distinguishing their emotions from physical sensations, and struggled to verbalize their feelings (Sifneos, 1973, 1991). These patients also exhibited reduced imaginative capacities, a lack of dreams and fantasy life, and an externally-oriented thinking style that avoided inner experiences (Sifneos, 1973; Nemiah & Sifneos, 1970). Although initially associated with psychosomatic disorders, alexithymia has been linked to various physical and mental health issues. Research has shown that alexithymia is a transdiagnostic risk factor for several psychiatric conditions, including depression (Honkalampi et al., 2001), eating disorders (Bydlowski et al., 2005), panic disorder (Galderisi et al., 2008), alcohol abuse (de Timary et al., 2008), addiction of other substances (Haviland et al., 1994). It is estimated that at least 50% of individuals with autism are alexithymic (Cook et al., 2013a), and the lack of emotional awareness associated with alexithymia has been shown to impact quality of life and prevent connecting with others and forming close, meaningful relationships (Kennedy & Franklin, 2002b).

Although the efficacy of interventions to reduce alexithymia is still under debate, evidence has suggested that treatments targeting alexithymia symptoms can lead to improvement (Cameron et al., 2014). For example, a recent meta-analysis indicated that dialectical behavior therapy (DBT) interventions can enhance the ability of alexithymic individuals to identify emotional states and lead to a decrease in alexithymia symptoms (Salles et al., 2022). In addition, other therapies have

shown promising results in reducing alexithymia, such as cognitive-behavioral therapy (CBT) and mindfulness-based interventions (Byrne et al., 2010; Luminet et al., 2018). CBT helps individuals identify and challenge negative thoughts and behaviors that contribute to their emotional difficulties, while mindfulness-based interventions promote emotional awareness and acceptance. It is important to note that the effectiveness of these treatments may vary depending on the individual and the severity of their alexithymia, and more research is needed to determine the most effective interventions for this condition.

Recent research suggests that alexithymia is associated with atypical interoception, which has been explored in various studies (Brewer et al., 2016; Herbert et al., 2011; Longarzo et al., 2015; Shah et al., 2016), prompting claims that this impairment represents a core feature across psychiatric disorders (R Brewer et al., 2016; Murphy et al., 2018). Some authors argue that alexithymia can be partially characterized by a general failure of interoception (R Brewer et al., 2016; Murphy et al., 2018), which would explain its high prevalence in several disorders. Alexithymia is a subclinical condition that can be considered a relatively stable personality trait (Taylor et al., 1991) and is estimated to have a prevalence rate ranging from 7% to 13% in community samples, although it is higher in clinical samples (McGillivray et al., 2017).

The assessment of alexithymia has been aided by the development of various psychometric tools, with the Toronto Alexithymia Scale (TAS; Taylor et al., 1985) being the most commonly used. The initial version of the scale contained 26 items and aimed to measure four factors related to alexithymia, including difficulty identifying feelings, difficulty describing feelings, externally oriented thinking, and reduced daydreaming. However, the scale was later revised and shortened to the

TAS-20, a 20-item scale with a three-factor structure, focusing on identification, description, and thinking (Bagby et al., 1994). Although the TAS-20 is widely used and has shown strong psychometric properties, it has been criticized for not covering some of the affective dimensions emphasized by Nemiah and Sifneos (1970).

To address this limitation, the Bermond-Vorst Alexithymia Questionnaire (BVAQ; Vorst & Bermond, 2001) was developed aiming to capture both cognitive (i.e., the processing of emotions at a cognitive level) and affective (i.e., the level at which an individual subjectively experiences emotions) components of alexithymia. The 40-item BVAQ was designed to measure five aspects of alexithymia: (1) identifying; (2) verbalizing; (3) analyzing; (4) fantasizing; and (5) emotionalizing. The first three components refer to cognitive aspects, while the two last components assess affective features of alexithymia. Furthermore, the BVAQ is constructed to maintain an equal balance of negatively and positively keyed items across all subscales (Vorst & Bermond, 2001).

The impact of culture on alexithymia is thought to be significant, with higher levels of alexithymia found in the Chinese population compared to Western participants (Le et al., 2002). This cultural variation may be reflected in the factorial structure of alexithymia measures. Recent research on a Chinese sample revealed a six-factor solution for the BVAQ, in contrast to the original five factors, and five items had to be removed (Chinese 35-item BVAQ; Wang et al., 2021). In Latin American samples, the results have been mixed. While studies comparing English-speaking US-Anglo and US-Hispanic student samples found consistency in both the TAS and BVAQ (Culhane et al., 2009, 2011; Morera et al., 2005), research conducted with Peruvian, Mexican, and Chilean Spanish-speaking samples have

shown poorer fit indices for expected factors of alexithymia, particularly with translated versions of the TAS (de la Rubia, 2011; González-Arias et al., 2018; Loiselle & Cossette, 2016; Pérez-Rincón et al., 1997).

Efforts should be undertaken to assess the psychometric properties of BVAQ in different countries and languages, as discrepancies may stem from cultural influences on alexithymia. Although various versions of the TAS have been validated in Brazil, including TAS-20 (Wiethaeuper et al., 2005), TAS-26 (Yoshida, 2007) and TAS-26 for low-educated adults (Fortes et al., 2017), there is currently no Brazilian version of the BVAQ. To address the absence of a tool that measures both cognitive and affective dimensions of alexithymia in Brazilian Portuguese, the current study examined the psychometric properties of the BVAQ in a Brazilian sample. The BVAQ has been shown to be a reliable and valid measure of alexithymia in different languages, therefore, validating it in Brazilian Portuguese could be beneficial in both research and clinical settings to accurately identify and treat individuals with alexithymia in Brazil.

Methods

Participants and procedures

The study recruited 1285 participants from the general population in Brazil, who were invited to participate through emails and social networks like Facebook, Instagram, and WhatsApp. The questionnaires were made available online through the Gorilla Experiment Builder and Survey Monkey platforms. The participants were invited by the researchers and research assistants, and after being informed about the study's purpose, they completed an online informed consent form. The questionnaires were completed through a link that was sent to the participants via

email after they had provided informed consent. Table 1 shows the sociodemographic characteristics of the sample. The Federal University of Rio de Janeiro Ethics Committee approved the project (Research Ethics Committee number 27833119.9.0000.5582). All participants provided informed consent.

PLEASE INSERT TABLE 1 HERE

Measures

The Bermond-Vorst Alexithymia Questionnaire in Brazilian Portuguese (BVAQ-BR)

The BVAQ is a tool used to measure alexithymia, which consists of 40 items rated on a five-point Likert scale. The scale is divided into five subscales, each with eight items, designed to assess different aspects of alexithymia, including reduced ability to verbalize emotions, differentiate between or identify emotions, analyze emotions, fantasize, and experience emotional feelings. The subscales are evenly balanced between negative and positive items. Vorst and Bermond (2001) found that the subscales could be grouped into two higher-order factors: a cognitive component (including the Identifying, Verbalizing, and Analyzing subscales) and an affective component (including the Fantasizing and Emotionalizing subscales). The BVAQ-BR is the Brazilian Portuguese version of the scale, which was developed using an established scale adaptation method (Brislin, 1970). Two Brazilian Portuguese-speaking psychologists translated the English version, which was then back-translated by an independent native English speaker. Any discrepancies were discussed and resolved between the translators and the back-translator.

Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994)

The TAS-20 scale is widely recognized as the most commonly used tool to evaluate alexithymia (Bagby et al., 2020; Di Monte et al., 2020; Schroeders et al., 2021). This scale contains 20 items that assess three dimensions of alexithymia, including difficulty identifying feelings (identification), difficulty describing feelings (description), and externally-oriented thinking (thinking). While studies have reported good psychometric properties for the identification and description dimensions (for a review, see Schroeders et al., 2021), reliability of thinking dimension has been questioned (Kooiman et al., 2002). However, the ubiquity of TAS-20 in alexithymia research compels the use of this tool in the present study. Taylor et al. (2003) found good test-retest reliability and internal consistency of the scale, with Cronbach's alpha coefficient ≥ 0.70. We used the Brazilian version of the TAS-20 developed by Wiethaeuper et al. (2005), in which they demonstrated satisfactory psychometric properties, with alphas of 0.76 for the total scale and 0.70, 0.62 and 0.58 for the identification, description and thinking factors, respectively. In the current study, TAS-20 total score showed Cronbach's alpha = 0.84 – 0.87 and Omega = 0.85 – 0.88 (identification: Cronbach's alpha = 0.86 – 0.88 and Omega = 0.86 – 0.88; description: Cronbach's alpha = 0.76 – 0.80 and Omega = 0.76 – 0.81; thinking: Cronbach's alpha = 0.47 – 0.55 and Omega = 0.48 – 0.58).

Beliefs about Emotions Scale (BES; Rimes & Chalder, 2010)

The BES is a self-report questionnaire consisting of 12 items that assess beliefs about experiencing and expressing emotions (e.g., "It would be a sign of weakness to show my emotions in public."). Items are rated on a Likert-type scale of 0 to 6, with higher scores indicating more maladaptive beliefs. In the current

study the version validated by Mograbi et al. (2018) was used, with Cronbach's alpha of 0.86, comparable to those found in the original study (between 0.88 and 0.91; Rimes & Chalder, 2010). In the current study, the BES total score demonstrated high internal consistency, with a Cronbach's alpha range of 0.85 to 0.88 and Omega range of 0.86 to 0.89.

Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997)

The BEQ is a 16-item self-report questionnaire that assesses three dimensions of emotional expressivity: impulse strength (e.g., "I experience my emotions very strongly"); expression of negative emotions (e.g., "No matter how nervous or upset I am, I tend to keep a calm exterior"); and expression of positive emotions (e.g., "I laugh out loud when someone tells me a joke that I think is funny"). Each item was rated on a 7-point Likert scale, ranging from 1 = *strongly disagree* to 7 = *strongly agree*. High scores exhibit a high level of emotional expressivity. Gross & John (1997) reported alphas of 0.86 for the total BEQ and 0.70, 0.70, and 0.80 for the negative expressivity, positive expressivity, and impulse strength subscales, respectively. As there is no Brazilian version of the instrument, the same adaptation process used for the BVAQ-BR was employed. In the present study, the BEQ total score showed Cronbach's alpha values ranging from 0.81 to 0.84 and Omega values ranging from 0.81 to 0.85. The impulse strength subscale showed Cronbach's alpha values of 0.77 to 0.81 and Omega values of 0.76 to 0.82. The positive emotions subscale showed Cronbach's alpha values of 0.67 to 0.73 and Omega values of 0.67 to 0.75. The negative emotions subscale showed Cronbach's alpha values of 0.54 to 0.61 and Omega values of 0.53 to 0.64.

Interoceptive Accuracy Scale (IAS; Murphy et al., 2020)

The IAS is a scale developed to measure physical sensations that have been associated with interoception, or the perception of internal bodily signals (Khalsa & Lapidus, 2016). These sensations have also been linked to activation in the insula, a brain area that plays a crucial role in interoceptive processing (Critchley & Harrison, 2013; Langer et al., 2010; Craig, 2002; Khalsa et al., 2018). The IAS consists of 21 items that assess self-perceived interoceptive accuracy, such as "I can always accurately perceive when I am hungry" or "I can always accurately perceive when I am hot/cold". Participants rate each item on a 5-point scale ranging from Strongly Agree (5) to Strongly Disagree (1), with scores ranging from 21-105. Higher scores indicate higher self-reported interoceptive accuracy. As there is no Brazilian version of the scale, the same adaptation process as the BVAQ-BR was used in this study. The IAS total score exhibited strong internal consistency with Cronbach's alpha = 0.89 and Omega = 0.88.

Autism-Spectrum Quotient (AQ-28; Baron-Cohen et al., 2001)

This is a self-report questionnaire designed to quantitatively assess autistic spectrum traits in adults. The brief version consists of 28 questions that measure social skills, attention switching, attention to detail, communication, and imagination. Each item is rated on a 4-point Likert scale, with responses collapsed into two categories ("agree" or "disagree") and assigned one point for each response. Hoekstra et al. (2011) reported acceptable internal consistency for the AQ-82, with Cronbach's alpha values ranging from 0.77 to 0.86 for the total scale, between 0.72 and 0.80 for social skills, between 0.54 and 0.62 for routine, between 0.47 and 0.59 for switching, between 0.68 and 0.75 for imagination, and between

0.67 and 0.73 for numbers/patterns. The Brazilian version of the AQ has been demonstrated to be a suitable instrument for assessing signs of autism spectrum in adults (do Egito et al., 2018; Alves et al., 2022), with Cronbach alpha values ranging from 0.76 to 0.87. In the current study, AQ-28 total score showed Cronbach's alpha = 0.69 – 0.73 and Omega = 0.57 – 0.72 (Social Skills: Cronbach's alpha = 0.70 – 0.75 and Omega = 0.71 – 0.78; Routine: Cronbach's alpha = 0.43 – 0.52 and Omega = 0.42 – 0.57; Switching: Cronbach's alpha = 0.46 – 0.55 and Omega = 0.47 – 0.60; Imagination: Cronbach's alpha = 0.60 – 0.66 and Omega = 0.59 – 0.68; Number/patterns: Cronbach's alpha = 0.66 – 0.72 and Omega = 0.65 – 0.74).

Depression, Anxiety and Stress Scale (DASS-21; Lovibond e Lovibond, 1995)

The DASS-21 is a 21-item short scale used to assess depression, anxiety, and stress, and is applicable in clinical and non-clinical settings, including with different age groups such as medical students (Jovanović et al., 2021; Moutinho et al., 2017). A validated Brazilian version of the scale was used in this study (Vignola & Tucci, 2014), which showed Cronbach alphas of 0.92 for depression, 0.90 for stress, and 0.85 for anxiety, similar to the original scale (0.91, 0.89, and 0.81 for depression, stress, and anxiety, respectively; Lovibond & Lovibond, 1995). In the current study, DASS-21 Depression showed Cronbach's alpha = 0.88 – 0.90 and Omega = 0.88 – 0.91; DASS-21 Anxiety showed Cronbach's alpha = 0.86 – 0.88 and Omega = 0.86 – 0.89; DASS-21 Stress showed Cronbach's alpha = 0.84 – 0.87 and Omega = 0.84 – 0.87.

Data analysis

In this study, the validity of the BVAQ-BR was investigated using exploratory factor analysis and correlations. To assess internal consistency,

Cronbach's alpha and McDonald's Omega were calculated for both the total scores and extracted factors. The Kaiser-Meyer-Olkin (KMO) test was used to evaluate the adequacy of the sample for factor analysis, with values equal to or above 0.60 considered satisfactory (Tabachnick & Fidell, 2001). Although the BVAQ factor structure was originally explored with principal component analysis (PCA), this procedure was not used in the present study because it inflates the variance estimates by failing to discriminate shared and unique variance (Costello & Osborne, 2005; Widaman, 2012), which tends to produce non-parsimonious results, based on superfluous constructs, with reduced or inadequate explanatory power (Patil et al., 2008). Furthermore, PCA is not considered a true factor analysis method, so there is no agreement among statistical theorists on when it should be used (Costello & Osborne, 2019; Jolliffe, 2005). Instead, we used a principal axis factoring (PAF) extraction method with an oblique factor rotation to obtain the most parsimonious simple structure due to the potential correlation between factors (Kieffer, 1998). Correlation between factors is expected in psychological constructs, since they are rarely divided into units that function independently of each other (Costello & Osborne, 2005). Considering that promax was recommended for large sample sizes (Field, 2013), this rotation method was employed.

To determine the number of factors for the BVAQ-BR, we used a combination of methods, including scree-plot examination, eigenvalue inspection, and parallel analysis (Hayton et al., 2016). To perform the parallel analysis, we used a syntax in the Statistical Package for the Social Sciences (SPSS), developed by O'Connor (2000). We allowed items with cross-loadings but removed items with loadings below 0.30 (Watkins, 2018), and considered factor loadings above 0.30 as

relevant (Costello & Osborne, 2019). We also investigated the presence of second-order factors using an exploratory factor analysis of the first factors obtained with PAF (promax). We expected two second-order factors, an affective dimension (Emotionalizing and Fantasizing) and a cognitive dimension (Identifying, Analyzing and Verbalizing), based on Vorst and Bermond's (2001) conceptualization of two dimensions of alexithymia.

To explore differences in the BVAQ and its subscales between different demographic groups, independent-samples t-tests were conducted for gender, White and non-White ethnicity, and participants with and without post-school qualifications. The relationship between BVAQ and age was investigated using Pearson's correlation. To examine the validity of the scale, Pearson's correlations were calculated between the BVAQ and its subscales and other questionnaires, including TAS-20, BES, BEQ, DASS-21, IAS, and AQ-28. Although the strength of association was of interest, statistical significance was set at $p < .001$ to minimize the likelihood of type I errors.

Participants were classified as either alexithymic or non-alexithymic based on the TAS-20 cutoff score of ≥ 61 (Bagby & Taylor, 2009; Bagby et al., 1994), which has been widely used in previous studies examining alexithymia prevalence in community samples (e.g., Franz et al., 2008; Joukamaa et al., 2003; Salminen et al., 1999). To determine cutoff scores for high alexithymia on the BVAQ-BR, the total score and cognitive dimension were analyzed, as the latter was expected to have greater correspondence with the TAS-20 factors. Receiver operating characteristic (ROC) analyses were conducted to identify the most appropriate cutoff scores (Fombonne & Fuhrer, 1991), and the area under the curve (AUC)

index was calculated. Cutoff scores for high alexithymia were selected based on the best balance between sensitivity and specificity.

Results

Exploratory factor analysis

The KMO analysis indicated good sampling adequacy for the 40-item version of the BVAQ (KMO = 0.89), and Bartlett's Test of Sphericity was significant ($\chi^2 = 14453.47$, df = 780, $p < .001$), indicating that the correlation matrix was suitable for factor analysis. After examining the scree plot, eigenvalues, and performing parallel analysis, a five-factor solution was chosen, which accounted for 34.8% of the variance. The pattern matrix results were used, as they are typically more conservative than the structure matrix (Brown, 2006; Hatcher, 1994). Table 2 depicts the pattern of rotated factor loadings for this solution. Two problematic items (4 and 10) were excluded from the scale. Item 10 did not meet the minimum loading criterion, and item 4 had positive and negative cross-loadings on two factors. After these exclusions, the 38-item version of the BVAQ had good internal consistency (α = .83; Omega = .77-.80). The mean of corrected item-total correlation coefficients was moderate (r = .30), with item 26 having the highest correlation coefficient (r = .56) and item 19 having the lowest (r = -.11). Item 19 was not removed since its exclusion did not improve the scale's internal

PLEASE INSERT TABLE 2 HERE

The PAF (promax) revealed that the first factor, with good internal consistency (α = .85; Omega = .84 – .87), explained 15.1% of the variance (eigenvalue = 6.0) and consisted of eight items (#1, 6, 11, 16, 21, 26, 31, and 36)

related to the ability to describe and communicate emotional reactions (Verbalizing). For instance, item 1: "I have difficulty expressing my feelings verbally." These items closely resemble the original structure of the BVAQ. The second factor, with good internal consistency (α = .76; Omega = .74 – .78), explained 8.9% of the variance (eigenvalue = 3.5) and included eight items (#3, 8, 13, 20, 28, 33, 38, and 40) related to the ability to identify emotions (Identifying). For example, item 33: "When I am hard on myself, it is unclear to me whether I am sad, afraid, or unhappy." Most items in this factor replicate the original structure of the scale, except for items 20 and 40, which were previously part of the Analyzing subscale.

The third factor, which accounted for 4.6% of the variance with an eigenvalue of 1.9, demonstrated good internal consistency (α = .79; Omega = .77 – .81). This factor was comprised of seven items (#7, 12, 17, 22, 27, 32, and 37) related to daydreaming, imagining, and fantasizing about fictional matters (Fantasizing). For instance, item 7 stated: “I have few daydreams and fantasies”. This factor replicated the original scale structure almost perfectly, with the exception of item 2. The fourth factor, which accounted for 3.2% of the variance with an eigenvalue of 1.3, showed good internal consistency (α = .71; Omega = .69 – .73) and included nine items (#5, 9, 15, 18, 23, 24, 25, 34, and 35) related to seeking explanations for emotional reactions (Analyzing); for example, item 25: “There is not much to understand as far as emotions are concerned”. However, the items included in the Analyzing factor had poor correspondence with the original scale structure, with only four items in agreement with the original scale (5, 15, 25, and 35), while three items originally from the Emotionalizing factor (9, 24, and 34) and two items from the Identifying factor (18 and 23) were also included. These

items in this factor indicate an apparent indifference to emotions and situations that evoke emotions.

The fifth factor, which accounted for 3.0% of the variance with an eigenvalue of 1.2, had poor to acceptable internal consistency (α = .58; Omega = .57 – .63). This factor consisted of six items (#2, 14, 19, 29, 30, and 39) related to the degree of emotional arousal in response to emotion-inducing events (Emotionalizing); for example, item 39: "When I see someone else sobbing heavily, I feel sadness well up inside me". The majority of items in this factor replicated the original scale structure, except for items 2 and 30 which were originally part of the Fantasizing and Analyzing factors, respectively.

In Table 3, the factor correlations and second-order factor structure based on the results of the exploratory analysis are presented. Our sample exhibited the expected structure of two factors, including a cognitive factor (F1) and an affective factor (F2). The Analyzing, Identifying, and Verbalizing subscales loaded on the cognitive factor, while the Emotionalizing and Fantasizing subscales loaded on the affective factor. The second-order factor structure explained 41% of the variance, with the cognitive dimension accounting for 27% and the affective dimension accounting for 14%.

PLEASE INSERT TABLE 3 HERE

Construct validity

Table 4 presents the correlations between the BVAQ-BR and the TAS-20, as well as several other constructs used to assess the validity of the BVAQ-BR. The results show that the total score of the TAS-20 was strongly correlated with the

BVAQ-BR. Furthermore, the cognitive dimension of the BVAQ-BR had an even stronger correlation with the TAS-20. Additionally, the Verbalizing, Identifying, and Analyzing subscales of the BVAQ-BR were strongly related to the corresponding factors of the TAS-20: Description, Identification, and Thinking, respectively. In terms of other constructs, we found positive associations between BVAQ-BR and symptoms of depression, anxiety, and stress (DASS-21), but only for factors in the cognitive dimension of alexithymia. These symptoms were negatively related to factors in the affective dimension of alexithymia. BES had a positive correlation with BVAQ-BR, indicating a relationship between beliefs about emotion and cognitive aspects of alexithymia, but not with the affective dimension. BVAQ-BR was negatively related to BEQ, suggesting that higher alexithymia trait is associated with lower emotional expressivity. BVAQ-BR and IAS had a negative correlation, indicating that lower interoceptive accuracy is related to higher alexithymia trait, particularly difficulty in identifying emotions. Autism-spectrum symptoms (AQ-28) were positively associated with alexithymia (BVAQ-BR), but only in cognitive terms, as they were unrelated to the affective dimension.

PLEASE INSERT TABLE 4 HERE

Sociodemographic characteristics

Differences between gender, educational level, ethnicity, and age in the BVAQ-BR were investigated. Men reported significantly more alexithymia ($t_{(1285)}$ = 3.76, $p < .001$; M = 93.87, SD = 17.87) than women (M = 90.06, SD = 18.07), especially in affective alexithymia ($t_{(1285)}$ = 6.82, $p < .001$; men: M = 32.36, SD =

8.57; women: M = 29.16, SD = 8.12), but not cognitive alexithymia ($t_{(1285)}$ = 0.69, p = .50). Participants with low educational qualifications had higher alexithymia scores ($t_{(1285)}$ = 7.83, p < .001; M = 99.17, SD = 18.27) than those with higher educational achievements (M = 89.70, SD = 17.50), but with the differences being driven by cognitively alexithymia ($t_{(1285)}$ = 8.65, p < .001; Low education: M = 68.45, SD = 15.70; High education: M = 59.23, SD = 15.52), but not affective alexithymia ($t_{(1285)}$ = 0.40, p = .66). Non-White participants reported greater alexithymia ($t_{(1285)}$ = -3.32, p < .001; M = 95.04, SD = 18.48) than White (M = 90.73, SD = 18.36), with differences being driven by affective alexithymia ($t_{(1285)}$ = -4.88, p < .001; Non-White: M = 31.89, SD = 8.40; White: M = 39.01, SD = 8.32), but there was no ethnic difference for cognitive alexithymia ($t_{(1285)}$ = -1.26, p = .21). Pearson correlations showed that age was unrelated to BVAQ-BR (r < .01), but increased cognitive alexithymia was associated with younger age (r = -.14), whereas increased affective alexithymia was associated with older age (r = .27).

In the study, 753 participants completed the TAS-20 out of a total sample of 1285. Of those 753 participants, 221 were classified as alexithymic (29.3%) using the TAS-20 cut-off score (≥ 61 for high alexithymia). The ROC curve analysis revealed an AUC index of 0.82 (SD = .02; p < .001) for the BVAQ-BR total score and 0.89 (SD = .01; p < .001) for its cognitive dimension, indicating that both measures are good predictors of alexithymia. The trade-off between sensitivity and specificity showed that a score of 98 on the BVAQ-BR total score (sensitivity = 74.2 and specificity = 77.8) and a score of 69 on its cognitive dimension of alexithymia (sensitivity = 76.0 and specificity = 84.6) were optimal. The prevalence of alexithymia in the total sample was 32% (n = 414) according to the cognitive dimension and 37% (n = 472) according to the BVAQ-BR total score.

Discussion

The current study aimed to assess the psychometric properties of the Brazilian version of the BVAQ. The study found that the internal consistency of the BVAQ-BR was good and comparable to the original scale (Vorst & Bermond, 2001). Exploratory factor analysis of the BVAQ-BR revealed a five-factor solution: Verbalizing, Identifying, Fantasizing, Analyzing, and Emotionalizing. In addition, the study results support a second-order two-factor structure (cognitive and affective dimensions) of the BVAQ-BR, indicating that the Brazilian version of the BVAQ has a factor structure similar to the original scale (Vorst & Bermond, 2001).

Despite some cross-loadings in our factor analysis, we decided to keep the items in the factor where they had the highest loading, and only two items were removed due to low loadings and a loss in internal consistency. Similar issues were found in other language adaptations of the BVAQ, with the Japanese version excluding 10 items due to low factor loadings and the Portuguese version having numerous items with cross-loadings and not reaching adequate loadings (Kashimura et al., 2011; Verissimo & Bermond, 2009). Recently, the Chinese version of the BVAQ had a different factor structure than the original scale, with six factors and five items excluded (Wang et al., 2021). Thus, cultural factors likely contribute to the observed differences between our Brazilian version and the original BVAQ.

As anticipated, the correlation between the total BVAQ and the TAS-20 scales was significant and comparable to the original study (Vorst & Bermond, 2001). Interestingly, the cognitive dimension of the BVAQ had even stronger correlations with the TAS-20 total score, indicating that it closely measures the same construct as the TAS-20 (Vorst & Bermond, 2001). In addition, we observed that each BVAQ

factor had its highest correlation with the corresponding TAS-20 factor. However, the TAS-20 total score had no association with the BVAQ Fantasizing factor and a negative correlation with the Emotionalizing factor, which suggests that the TAS-20 mainly evaluates the cognitive dimension of alexithymia and not the affective dimension (as assessed by the BVAQ). Thus, our findings suggest that the TAS-20 only measures the cognitive aspects of alexithymia, whereas the BVAQ captures both cognitive and affective dimensions of the construct.

To further evaluate the validity of the BVAQ, we examined its relationship with other constructs. Consistent with previous research indicating a connection between alexithymia and negative emotional response tendencies, such as depression, anxiety, and stress (Espina Eizaguirre et al., 2004; Fietz et al., 2018; Gao et al., 2018; Hamaideh, 2018; Nezhad et al., 2017; Obeid et al., 2019), our study also found a positive correlation between alexithymia and symptoms of these dysphoric syndromes. Several studies have suggested that higher levels of alexithymia are related to more negative beliefs (e.g., avoidance of intimacy and irrational beliefs; Ipekci & Turan, 2020; Zakiei et al., 2021) and fewer positive beliefs (e.g., beliefs about the beneficial effects of social sharing of emotion; Sánchez et al., 2013). In our study, dysfunctional beliefs about experiencing and expressing emotions were positively associated with alexithymia, but only with the cognitive dimension of alexithymia, which pertains to the conscious interpretation of emotions.

In line with previous research (Kinnaird et al., 2019; Poquérusse et al., 2018), our study confirmed a positive association between alexithymia and autism spectrum symptoms, with the cognitive dimension of alexithymia being particularly related to difficulties in verbalizing, identifying, and analyzing emotions, which are

commonly observed in individuals with autism (Ziermans et al., 2019). Our results also replicated previous findings (R Brewer et al., 2016; Shah et al., 2016; D. Trevisan et al., 2019), demonstrating a negative relationship between alexithymia and interoceptive accuracy. Additionally, our findings supported previous studies linking alexithymia with low emotional expressivity and suppression strategies (Chen et al., 2011; Laloyaux et al., 2015b; Samson et al., 2012, 2015b; Swart et al., 2009a; Wagner & Lee, 2008), showing that individuals with higher levels of alexithymia tend to express their emotions less in overt behavior.

Previous studies have identified gender differences in alexithymia (de Vroege et al., 2018; Müller et al., 2004; Vorst & Bermond, 2001b; Wang et al., 2021), with men expected to exhibit greater alexithymia due to social norms that restrict emotional expression in men (Levant et al., 1992, 2009). Consistent with this, our study found that males had higher alexithymia scores than female participants. Our results also support Vorst and Bermond's (2001) findings that there is no gender difference in the cognitive dimension of alexithymia, but women have lower scores in affective alexithymia, suggesting that women may be more emotionally sensitive.

Age was another individual difference that we found to be associated with alexithymia, consistent with previous studies (Müller et al., 2004; Vorst & Bermond, 2001b). Specifically, we found that increasing age was associated with higher scores on the affective dimension of alexithymia, indicating reduced inner experience in older individuals compared to younger ones. In contrast, younger age was associated with higher scores on the cognitive dimension of alexithymia, indicating reduced ability to interpret and communicate emotions in younger individuals compared to older ones.

This study is the first to provide data on the prevalence of alexithymia in Brazil, using both the TAS-20 and the BVAQ. According to TAS-20 cut-off scores, the prevalence rate was 29.3%, while the BVAQ-BR total score yielded a rate of 37%. These rates suggest a substantially higher prevalence of alexithymia in Brazil than in other countries. For example, studies in Finland (Joukamaa et al., 2003; Salminen et al., 1999) found prevalence rates of 7.1% to 12.8%, while rates in Germany (Franz et al., 2008) and Australia (McGillivray et al., 2017) were 10.0% and 12.0%, respectively. Notably, Brazil has been identified as a world leader in anxiety and depression rates (de Souza & Machado-De-Sousa, 2017). In a survey conducted by the World Health Organization (WHO, 2017), Brazil had the highest prevalence of anxiety disorders and was ranked fifth for rates of depression, both of which are commonly associated with high alexithymia. Therefore, the high prevalence of alexithymia found in the present study is consistent with the high rates of mental disorders in the Brazilian population relative to other countries. One limitation of the study is that psychiatric diagnostic data were not collected, which means that the higher prevalence of alexithymia in the Brazilian population could be due to the inclusion of individuals with mental health conditions. Future research could investigate differences in the prevalence of alexithymia between healthy individuals and those diagnosed with a mental health condition in Brazilian community samples.

Consistent with previous research (Landazabal, 2013; Lane et al., 1998; Leweke et al., 2012; Mattila et al., 2006; Pasini et al., 1992; Salminen et al., 1999), our study found that individuals with lower educational levels had higher levels of alexithymia. Specifically, we found that the higher the educational level, the lower the alexithymia trait, and that there was no difference in educational level on the

affective dimension of alexithymia. The effect of educational level on alexithymia was limited to the Verbalizing, Identifying, and Analyzing subscales, suggesting that education only influences the cognitive aspects of alexithymia.

Studies have also found ethnic differences in alexithymia, with increased alexithymia reported in minority groups (S. Brown et al., 2018; Kamm et al., 2016; Lumley et al., 2005). This may reflect social disparities and poorer access to educational and information resources, as previous research from our group has indicated increased dysfunctional beliefs about emotion in non-White individuals (Mograbi et al., 2018). Consistent with these findings, we found greater traits of alexithymia in non-White compared to White participants. However, our sample was mostly White and university students (or people with higher educational levels), which is a limitation of the study. Therefore, our findings should be interpreted with caution for minority groups and people with reduced educational levels. Despite this limitation, the BVAQ-BR had satisfactory psychometric properties, which will allow for future investigations of alexithymia (both cognitive and affective) in Brazilian culture, in addition to facilitating cross-cultural comparisons.

Conflict of interest

The authors declare no conflict of interests.

References

Alves, A. L. C., de Paula, J. J., de Miranda, D. M., & Romano-Silva, M. A. (2022). The Autism Spectrum Quotient in a sample of Brazilian adults: analyses of normative data and performance. *Dementia e Neuropsychologia*, *16*(2), 244–248. https://doi.org/10.1590/1980-5764-DN-2021-0081

Bagby, M., & Taylor, G. (2009). Measurement and validation of the alexithymia construct. In *Disorders of affect regulation: Alexithymia in medical and psychiatric illness* (pp. 46–66). Cambridge University Press. https://doi.org/10.1017/cbo9780511526831.006

Bagby, R. M., Parker, J. D. A., & 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*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (2020). Twenty-five years with the 20-item Toronto Alexithymia Scale. *Journal of Psychosomatic Research*, *131*(December 2019), 109940. https://doi.org/10.1016/j.jpsychores.2020.109940

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger Syndrome/High-Functioning Autism, Males and Females, Scientists and Mathematicians. *Journal of Autism and Developmental Disorders*, *31*(1), 5–17. https://doi.org/10.1023/A:1005653411471

Brewer, R., Cook, R., science, G. B.-R. S. open, & 2016, undefined. (2016). Alexithymia: a general deficit of interoception. *Royalsocietypublishing.Org*, *3*(10). https://doi.org/10.1098/rsos.150664

Brown, S., Fite, P. J., Stone, K., Richey, A. L., & Bortolato, M. (2018). Associations between emotional abuse and neglect and dimensions of alexithymia: The moderating role of sex. *Psychological Trauma : Theory, Research, Practice and Policy*, *10*(3), 300. https://doi.org/10.1037/TRA0000279

Bydlowski, S., Corcos, M., Jeammet, P., Paterniti, S., Berthoz, S., Laurier, C., Chambry, J., & Consoli, S. M. (2005). Emotion-processing deficits in eating disorders. *International Journal of Eating Disorders*, *37*(4), 321–329. https://doi.org/10.1002/EAT.20132

Cameron, K., Ogrodniczuk, J., & Hadjipavlou, G. (2014). Changes in alexithymia following psychological intervention: A review. *Harvard Review of Psychiatry*, *22*(3), 162–178. https://doi.org/10.1097/HRP.0000000000000036

Chen, J., Xu, T., Jing, J., & Chan, R. C. K. (2011). Alexithymia and emotional regulation: A cluster analytical approach. *BMC Psychiatry*, *11*(1), 1–6. https://doi.org/10.1186/1471-244X-11-33/TABLES/2

Cook, R., Brewer, R., Shah, P., & Bird, G. (2013). Alexithymia, Not Autism, Predicts Poor Recognition of Emotional Facial Expressions. *Psychological Science*, *24*(5), 723–732. https://doi.org/10.1177/0956797612463582

Costello, A. B., & Osborne, J. (2019). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research, and Evaluation*, *10*(1), 7. https://doi.org/https://doi.org/10.7275/jyj1-4868

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis.

Practical Assessment, Research and Evaluation, *10*(7), 7. https://doi.org/https://doi.org/10.7275/jyj1-4868

Craig, A. D. (2002). How do you feel? Interoception: The sense of the physiological condition of the body. *Nature Reviews Neuroscience*, *3*(8), 655–666. https://doi.org/10.1038/nrn894

Critchley, H. D., & Harrison, N. A. (2013). Visceral Influences on Brain and Behavior. *Neuron*, *77*(4), 624–638. https://doi.org/10.1016/J.NEURON.2013.02.008

Culhane, S. E., Morera, O. F., Watson, P. J., & Millsap, R. E. (2009). Assessing measurement and predictive invariance of the toronto alexithymia scale-20 in U.S. Anglo and U.S. hispanic student samples. *Journal of Personality Assessment*, *91*(4), 387–395. https://doi.org/10.1080/00223890902936264

Culhane, S. E., Morera, O. F., Watson, P. J., & Millsap, R. E. (2011). The bermond-vorst alexithymia questionnaire: A measurement invariance examination among U.S. Anglos and U.S. Hispanics. *Assessment*, *18*(1), 88–94. https://doi.org/10.1177/1073191110387509

de la Rubia, J. M. (2011). Factor structure and reliability of TAS-20 in Mexican samples. In *Hispanic Psychology in the 21st Century* (pp. 363–376). Nova Science Publishers, Inc.

de Souza, I. M., & Machado-De-Sousa, J. P. (2017). Brazil: World leader in anxiety and depression rates. *Revista Brasileira de Psiquiatria*, *39*(4), 384. https://doi.org/10.1590/1516-4446-2017-2300

de Timary, P., Luts, A., Hers, D., & Luminet, O. (2008). Absolute and relative stability of alexithymia in alcoholic inpatients undergoing alcohol withdrawal: Relationship to depression and anxiety. *Psychiatry Research*,

157(1–3), 105–113. https://doi.org/10.1016/J.PSYCHRES.2006.12.008

de Vroege, L., Emons, W. H. M., Sijtsma, K., & van der Feltz-Cornelis, C. M. (2018). Psychometric properties of the Bermond-Vorst Alexithymia Questionnaire (BVAQ) in the general population and a clinical population. *Frontiers in Psychiatry*, *9*(APR), 111. https://doi.org/10.3389/FPSYT.2018.00111/BIBTEX

Di Monte, C., Renzi, A., Paone, E., Silecchia, G., Solano, L., & Di Trani, M. (2020). Alexithymia and obesity: Controversial findings from a multimethod assessment. *European Review for Medical and Pharmacological Sciences*, *24*(2), 831–836. https://doi.org/10.26355/eurrev_202001_20066

do Egito, J. H. T., Ferreira, G. M. R., Gonçalves, M. I., & Osório, A. A. C. (2018). Brief Report: Factor Analysis of the Brazilian Version of the Adult Autism Spectrum Quotient. *Journal of Autism and Developmental Disorders*, *48*(5), 1847–1853. https://doi.org/10.1007/S10803-017-3424-6/TABLES/3

Espina Eizaguirre, A., Ortego Saenz de Cabezón, A., Ochoa de Alda, I., Joaristi Olariaga, L., & Juaniz, M. (2004). Alexithymia and its relationships with anxiety and depression in eating disorders. *Personality and Individual Differences*, *36*(2), 321–331. https://doi.org/10.1016/S0191-8869(03)00099-0

Fietz, J., Valencia, N., & Silani, G. (2018). Alexithymia and autistic traits as possible predictors for traits related to depression, anxiety, and stress: A multivariate statistical approach. *Journal of Evaluation in Clinical Practice*, *24*(4), 901–908. https://doi.org/10.1111/JEP.12961

Fombonne, E., & Fuhrer, R. (1991). Sensitivity, specificity and predictive values of psychiatric measures. *Encephale*, *17*(2), 73–77.

https://doi.org/10.2/JQUERY.MIN.JS

Fortes, T. R., Bordin, I. A. S., & Semer, N. L. (2017). Toronto Alexithymia Scale: Adaptation of the Brazilian Version to Low-Educated Adults. *Paidéia (Ribeirão Preto)*, *27*(67), 100–109. https://doi.org/10.1590/1982-43272767201712

Franz, M., Popp, K., Schaefer, R., Sitte, W., Schneider, C., Hardt, J., Decker, O., & Braehler, E. (2008). Alexithymia in the German general population. *Social Psychiatry and Psychiatric Epidemiology*, *43*(1), 54–62. https://doi.org/10.1007/S00127-007-0265-1/TABLES/6

Galderisi, S., Mancuso, F., Mucci, A., Garramone, S., Zamboli, R., & Maj, M. (2008). Alexithymia and Cognitive Dysfunctions in Patients with Panic Disorder. *Psychotherapy and Psychosomatics*, *77*(3), 182–188. https://doi.org/10.1159/000119738

Gao, T., Li, J., Zhang, H., Gao, J., Kong, Y., Hu, Y., & Mei, S. (2018). The influence of alexithymia on mobile phone addiction: The role of depression, anxiety and stress. *Journal of Affective Disorders*, *225*, 761–766. https://doi.org/10.1016/J.JAD.2017.08.020

Garaigordobil Landazabal, M. (2013). Sexism and alexithymia: Correlations and differences as a function of gender, age, and educational level. *Anales de Psicología, ISSN 0212-9728, ISSN-e 1695-2294, Vol. 29, Nº. 2, 2013, Págs. 368-377*, *29*(2), 368–377. https://dialnet.unirioja.es/servlet/articulo?codigo=4228068&info=resumen&idioma=ENG

González-Arias, M., Martínez-Molina, A., Galdames, S., & Urzúa, A. (2018). Psychometric properties of the 20-Item Toronto Alexithymia Scale in the

chilean population. *Frontiers in Psychology*, *9*(JUN), 963. https://doi.org/10.3389/FPSYG.2018.00963/BIBTEX

Gross, J. J., & John, O. P. (1997). Revealing Feelings: Facets of Emotional Expressivity in Self-Reports, Peer Ratings, and Behavior. *Journal of Personality and Social Psychology*, *72*(2), 435–448. https://doi.org/10.1037/0022-3514.72.2.435

Hamaideh, S. H. (2018). Alexithymia among Jordanian university students: Its prevalence and correlates with depression, anxiety, stress, and demographics. *Perspectives in Psychiatric Care*, *54*(2), 274–280. https://doi.org/10.1111/PPC.12234

Haviland, M. G., Hendryx, M. S., Shaw, D. G., & Henry, J. P. (1994). Alexithymia in women and men hospitalized for psychoactive substance dependence. *Comprehensive Psychiatry*, *35*(2), 124–128. https://doi.org/10.1016/0010-440X(94)90056-N

Hayton, J. C., Allen, D. G., & Scarpello, V. (2016). Factor Retention Decisions in Exploratory Factor Analysis: a Tutorial on Parallel Analysis: *Https://Doi.Org/10.1177/1094428104263675*, *7*(2), 191–205. https://doi.org/10.1177/1094428104263675

Honkalampi, K., Hintikka, J., Laukkanen, E., & Viinamäki, J. L. H. (2001). Alexithymia and Depression: A Prospective Study of Patients With Major Depressive Disorder. *Psychosomatics*, *42*(3), 229–234. https://doi.org/10.1176/APPI.PSY.42.3.229

Ipekci, B., & Turan, N. (2020). Dysfunctional relationship beliefs as gendered predictors of alexithymia in Turkish cultural context. *Https://Doi.Org/10.1080/03069885.2020.1860189*.

https://doi.org/10.1080/03069885.2020.1860189

Jolliffe, I. (2005). Principal Component Analysis. *Encyclopedia of Statistics in Behavioral Science*. https://doi.org/10.1002/0470013192.BSA501

Joukamaa, M., Kokkonen, P., Veijola, J., Läksy, K., Karvonen, J. T., Jokelainen, J., & Järvelin, M. riitta. (2003). Social situation of expectant mothers and alexithymia 31 years later in their offspring: A prospective study. *Psychosomatic Medicine*, *65*(2), 307–312. https://doi.org/10.1097/01.PSY.0000030389.53353.BC

Jovanović, V., Gavrilov-Jerković, V., & Lazić, M. (2021). Can adolescents differentiate between depression, anxiety and stress? Testing competing models of the Depression Anxiety Stress Scales (DASS-21). *Current Psychology*, *40*(12), 6045–6056. https://doi.org/10.1007/s12144-019-00540-2

Kamm, S. G., Sepulveda, E., Brosig, B., Kamm, S. G., Sepulveda, E., & Brosig, B. (2016). Adolescent Alexithymia Research: Indigenous Sample Compared to Hispanic Sample in Southern Chile. *Psychology*, *7*(7), 992–1003. https://doi.org/10.4236/PSYCH.2016.77100

Kashimura, M., Ogawa, T., Vorst, H. C. M., & Bermond, B. (2011). Psychometric properties of the Bermond-Vorst Alexithymia Questionnaire in Japanese. *Japanese Psychological Research*, *53*(3), 302–311. https://doi.org/10.1111/J.1468-5884.2011.00472.X

Kennedy, M., & Franklin, J. (2002). Skills-based Treatment for Alexithymia: An Exploratory Case Series. *Behaviour Change*, *19*(3), 158–171. https://doi.org/10.1375/BECH.19.3.158

Khalsa, S. S., Adolphs, R., Cameron, O. G., Critchley, H. D., Davenport, P. W.,

Feinstein, J. S., Feusner, J. D., Garfinkel, S. N., Lane, R. D., Mehling, W. E., Meuret, A. E., Nemeroff, C. B., Oppenheimer, S., Petzschner, F. H., Pollatos, O., Rhudy, J. L., Schramm, L. P., Simmons, W. K., Stein, M. B., … Zucker, N. (2018). Interoception and Mental Health: A Roadmap. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, *3*(6), 501–513. https://doi.org/10.1016/J.BPSC.2017.12.004

Khalsa, S. S., & Lapidus, R. C. (2016). Can interoception improve the pragmatic search for biomarkers in psychiatry? *Frontiers in Psychiatry*, *7*(JUL), 121. https://doi.org/10.3389/FPSYT.2016.00121/BIBTEX

Kieffer, K. M. (1998). Orthogonal Versus Oblique Factor Rotation: A Review of the Literature Regarding the Pros and Cons. *Paper Presented at the Annual Meeting of the Mid-South Educational Research Association (27th, New Orleans, LA, November 4-6, 1998).*, 1–32.

Kinnaird, E., Stewart, C., & Tchanturia, K. (2019). *Investigating alexithymia in autism: A systematic review and meta-analysis*. https://doi.org/10.1016/j.eurpsy.2018.09.004

Laloyaux, J., Fantini, C., Lemaire, M., Luminet, O., & Larøi, F. (2015). Evidence of Contrasting Patterns for Suppression and Reappraisal Emotion Regulation Strategies in Alexithymia. *Journal of Nervous and Mental Disease*, *203*(9), 709–717. https://doi.org/10.1097/NMD.0000000000000353

Lane, R. D., Sechrest, L., & Riedel, R. (1998). Sociodemographic correlates of alexithymia. *Comprehensive Psychiatry*, *39*(6), 377–385. https://doi.org/10.1016/S0010-440X(98)90051-7

Langer, N., Beeli, G., & Jäncke, L. (2010). When the Sun Prickles Your Nose: An EEG Study Identifying Neural Bases of Photic Sneezing. *PLOS ONE*, *5*(2),

e9208. https://doi.org/10.1371/JOURNAL.PONE.0009208

Le, H. N., Berenbaum, H., & Raghavan, C. (2002). Culture and Alexithymia : Mean Levels, Correlates, and the Role of Parental Socialization of Emotions. *Emotion*, *2*(4), 341–360. https://doi.org/10.1037/1528-3542.2.4.341

Levant, R. F., Hall, R. J., Williams, C. M., & Hasan, N. T. (2009). Gender Differences in Alexithymia. *Psychology of Men and Masculinity*, *10*(3). https://doi.org/10.1037/a0015652

Levant, R. F., Hirsch, L. S., Celentano, E., & Cozza, T. M. (1992). The Male Role: An Investigation of Contemporary Norms. *Journal of Mental Health Counseling*, *14*(3), 325–337.

Leweke, F., Leichsenring, F., Kruse, J., & Hermes, S. (2012). Is Alexithymia Associated with Specific Mental Disorders. *Psychopathology*, *45*(1), 22–28. https://doi.org/10.1159/000325170

Loiselle, C. G., & Cossette, S. (2016). Cross-Cultural Validation of the Toronto Alexithymia Scale (TAS-20) in U.S. and Peruvian Populations: *Http://Dx.Doi.Org/10.1177/136346150103800305*, *38*(3), 348–362. https://doi.org/10.1177/136346150103800305

Lumley, M. A., Radcliffe, A. M., Macklem, D. J., Mosley-Williams, A., Leisen, J. C. C., Huffman, J. L., D'Souza, P. J., Gillis, M. E., Meyer, T. M., Kraft, C. A., & Rapport, L. J. (2005). Alexithymia and Pain in Three Chronic Pain Samples: Comparing Caucasians and African Americans. *Pain Medicine*, *6*(3), 251–261. https://doi.org/10.1111/J.1526-4637.2005.05036.X

Martínez Sánchez, F., Blanco Larrieux, M. L., Páez Rovira, D., & Costa Ball, D. (2013). Beliefs about the effects of social sharing of emotion in alexithymia. *Psicothema (Oviedo)*, 179–184.

Mattila, A. K., Salminen, J. K., Nummi, T., & Joukamaa, M. (2006). Age is strongly associated with alexithymia in the general population. *Journal of Psychosomatic Research*, *61*(5), 629–635. https://doi.org/10.1016/J.JPSYCHORES.2006.04.013

McGillivray, L., Becerra, R., & Harms, C. (2017). Prevalence and Demographic Correlates of Alexithymia: A Comparison Between Australian Psychiatric and Community Samples. *Journal of Clinical Psychology*, *73*(1), 76–87. https://doi.org/10.1002/JCLP.22314

Mograbi, D. C., Indelli, P., Lage, C. A., Tebyriça, V., Landeira-Fernandez, J., & Rimes, K. A. (2018). Cross-cultural adaptation and validation of the Brazilian version of the Beliefs about Emotions Scale. *Trends in Psychiatry and Psychotherapy*, *40*(1), 21–28. https://doi.org/10.1590/2237-6089-2017-0064

Morera, O. F., Culhane, S. E., Watson, P. J., & Skewes, M. C. (2005). Assessing the reliability and validity of the Bermond-Vorst Alexithymia Questionnaire among U.S. Anglo and U.S. Hispanic samples. *Journal of Psychosomatic Research*, *58*(3), 289–298. https://doi.org/10.1016/J.JPSYCHORES.2004.09.001

Moutinho, I. L. D., De Castro Pecci Maddalena, N., Roland, R. K., Lucchetti, A. L. G., TibiriçÁ, S. H. C., Da Silva Ezequiel, O., & Lucchetti, G. (2017). Depression, stress and anxiety in medical students: A cross-sectional comparison between students from different semesters. *Revista Da Associacao Medica Brasileira*, *63*(1), 21–28. https://doi.org/10.1590/1806-9282.63.01.21

Müller, J., Bühner, M., & Ellgring, H. (2004). The assessment of alexithymia:

psychometric properties and validity of the Bermond–Vorst alexithymia questionnaire. *Personality and Individual Differences*, *37*(2), 373–391. https://doi.org/10.1016/J.PAID.2003.09.010

Murphy, J., Brewer, R., Hobson, H., Catmur, C., & Bird, G. (2018). Is alexithymia characterised by impaired interoception? Further evidence, the importance of control variables, and the problems with the Heartbeat Counting Task. *Biological Psychology*, *136*, 189–197. https://doi.org/10.1016/J.BIOPSYCHO.2018.05.010

Murphy, J., Brewer, R., Plans, D., Khalsa, S. S., Catmur, C., & Bird, G. (2020). Testing the independence of self-reported interoceptive accuracy and attention. *Quarterly Journal of Experimental Psychology*, *73*(1), 115–133. https://doi.org/10.1177/1747021819879826

Nemiah, J. C., & Sifneos, P. E. (1970). Psychosomatic Illness: A Problem in Communication. *Psychotherapy and Psychosomatics*, *18*(1–6), 154–160. https://doi.org/10.1159/000286074

Nezhad, S., Rad, M., Farrokhi, N., … F. V.-A. of T., & 2017, undefined. (2017). The relationship of alexithymia with depression, anxiety, stress, and fatigue among people under addiction treatment. *Researchgate.Net*. https://doi.org/10.4103/ATMPH.ATMPH_589_17

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments, & Computers 2000 32:3*, *32*(3), 396–402. https://doi.org/10.3758/BF03200807

Obeid, S., Haddad, C., Akel, M., Fares, K., Salameh, P., & Hallit, S. (2019). Factors associated with the adults' attachment styles in Lebanon: The role of

alexithymia, depression, anxiety, stress, burnout, and emotional intelligence. *Perspectives in Psychiatric Care*, *55*(4), 607–617. https://doi.org/10.1111/PPC.12379

Pasini, A., Chiaie, R. D., Seripa, S., & Ciani, N. (1992). Alexithymia as related to sex, age, and educational level: Results of the Toronto Alexithymia Scale in 417 normal subjects. *Comprehensive Psychiatry*, *33*(1), 42–46. https://doi.org/10.1016/0010-440X(92)90078-5

Patil, V. H., Singh, S. N., Mishra, S., & Todd Donavan, D. (2008). Efficient theory development and factor retention criteria: Abandon the "eigenvalue greater than one" criterion. *Journal of Business Research*, *61*(2), 162–170. https://doi.org/10.1016/j.jbusres.2007.05.008

Pérez-Rincón, H., Cortés, J., Ortíz, S., Peña, J., Ruíz, J., & Díaz-Martínez, A. (1997). Validacion y estandarizacion de la version espanola de la Escala Modificada de Alexitimia de Toronto. *Salud Mental*, *20*(3), 30–34.

Poquérusse, J., Pastore, L., Dellantonio, S., & Esposito, G. (2018). Alexithymia and Autism Spectrum Disorder: A Complex Relationship. *Frontiers in Psychology*, *0*(JUL), 1196. https://doi.org/10.3389/FPSYG.2018.01196

Salles, B. M., Maturana de Souza, W., Dos Santos, V. A., & Mograbi, D. C. (2022). Effects of DBT-based interventions on alexithymia: a systematic review. *Cognitive Behaviour Therapy*, *00*(00), 1–22. https://doi.org/10.1080/16506073.2022.2117734

Salminen, J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of alexithymia and its association with sociodemographic variables in the general population of finland. *Journal of Psychosomatic Research*, *46*(1), 75–82. https://doi.org/10.1016/S0022-3999(98)00053-1

Samson, A. C., Hardan, A. Y., Podell, R. W., Phillips, J. M., & Gross, J. J. (2015). Emotion Regulation in Children and Adolescents With Autism Spectrum Disorder. *Autism Research*, *8*(1), 9–18. https://doi.org/10.1002/AUR.1387

Samson, A. C., Huber, O., & Gross, J. J. (2012). Emotion regulation in Asperger's syndrome and high-functioning autism. *Emotion*, *12*(4), 659–665. https://doi.org/10.1037/A0027975

Schroeders, U., Kubera, F., & Gnambs, T. (2021). The Structure of the Toronto Alexithymia Scale (TAS-20): A Meta-Analytic Confirmatory Factor Analysis. *Assessment*. https://doi.org/10.1177/10731911211033894

Shah, P., Hall, R., Catmur, C., & Bird, G. (2016). Alexithymia, not autism, is associated with impaired interoception. *Cortex*, *81*, 215–220. https://doi.org/10.1016/J.CORTEX.2016.03.021

Sifneos, P. E. (1991). Affect, emotional conflict, and deficit: An overview. *Psychotherapy and Psychosomatics*, *56*(3), 116–122. https://doi.org/10.1159/000288543

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with feelings: Characterization of trait Alexithymia on emotion regulation strategies and cognitive-emotional processing. *PLoS ONE*, *4*(6). https://doi.org/10.1371/journal.pone.0005751

Taylor, G. J., Ryan, D., & Bagby, R. M. (1985). Toward the Development of a New Self-Report Alexithymia Scale. *Psychotherapy and Psychosomatics*, *44*(4), 191–199. https://doi.org/10.1159/000287912

Taylor, Graeme J., Michael Bagby, R., & Parker, J. D. A. (1991). The Alexithymia Construct: A Potential Paradigm for Psychosomatic Medicine. *Psychosomatics*, *32*(2), 153–164. https://doi.org/10.1016/S0033-

3182(91)72086-0

Trevisan, D., Altschuler, M., … A. B.-J. of A., & 2019, undefined. (2019). A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility. *Psycnet.Apa.Org*. https://doi.org/10.1037/abn0000454.supp

Verissimo, R., & Bermond, B. (2009). Cross-cultural psychometric assessment of the Bermond-Vorst alexithymia questionnaire. *Acta Médica Portuguesa*, *22*(6), 767–772. https://doi.org/10.20344/AMP.1734

Vignola, R. C. B., & Tucci, A. M. (2014). Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. *Journal of Affective Disorders*, *155*(1), 104–109. https://doi.org/10.1016/J.JAD.2013.10.031

Vorst, H. C. M., & Bermond, B. (2001a). Validity and reliability of the Bermond-Vorst Alexithymia Questionnaire. *Personality and Individual Differences*, *30*(3). https://doi.org/10.1016/S0191-8869(00)00033-7

Vorst, H. C. M., & Bermond, B. (2001b). Validity and reliability of the Bermond–Vorst Alexithymia Questionnaire. *Personality and Individual Differences*, *30*(3), 413–434. https://doi.org/10.1016/S0191-8869(00)00033-7

Wagner, H., & Lee, V. (2008). Alexithymia and individual differences in emotional expression. *Journal of Research in Personality*, *42*(1), 83–95. https://doi.org/10.1016/J.JRP.2007.04.001

Wang, Z., Wang, T., Goerlich, K. S., Pitliya, R. J., Bermond, B., Aleman, A., Xu, P., & Luo, Y. (2021). Psychometric Properties of the Chinese Bermond–Vorst Alexithymia Questionnaire: An Exploratory Structural Equation Modeling Study: *Https://Doi.Org/10.1177/1834490921991429*, *15*.

https://doi.org/10.1177/1834490921991429

Watkins, M. W. (2018). Exploratory Factor Analysis: A Guide to Best Practice: *Https://Doi.Org/10.1177/0095798418771807*, *44*(3), 219–246. https://doi.org/10.1177/0095798418771807

WHO. (2017). Depression and other common mental disorders: global health estimates. *World Health Organization*, 1–24. https://apps.who.int/iris/handle/10665/254610

Widaman, K. F. (2012). Common factors versus components: Principals and principles, errors and misconceptions. In *Factor Analysis at 100: Historical Developments and Future Directions* (pp. 177–204). Routledge. https://doi.org/10.4324/9780203936764

Wiethaeuper, D., Balbinotti, M. A. A., Pelisoli, C., & Barbosa, M. L. L. (2005). Estudos da consistência interna e fatorial confirmatório da Escala Toronto de Alexitimia-20 (ETA-20). *Revista Interamericana de Psicología = Interamerican Journal of Psychology, ISSN 0034-9690, Vol. 39, Nº. 2, 2005, Págs. 221-230*, *39*(2), 221–230. https://dialnet.unirioja.es/servlet/articulo?codigo=2988616&info=resumen&idioma=POR

Yoshida, E. M. P. (2007). Validade da Versão em Português da Toronto Alexithymia Scale-TAS em Amostra Clínica. *Psicologia: Reflexão e Crítica*, *20*(3), 389–396. https://doi.org/10.1590/S0102-79722007000300006

Zakiei, A., Karami, J., Alikhani, M., Ghasemi, S. R., & Gilan, N. R. (2021). The relationship between alexithymia, irrational beliefs, positive and negative emotions with mental disorders. *Hormozgan Medical Journal*, *18*(5), 392–402. https://hmj.hums.ac.ir/Article/87720

Ziermans, T., Bruijn, Y. de, Dijkhuis, R., Autism, W. S.-, & 2019, undefined. (2019). Impairments in cognitive empathy and alexithymia occur independently of executive functioning in college students with autism. *Journals.Sagepub.Com*, *23*(6), 1519–1530. https://doi.org/10.1177/1362361318817716

Tables

Table 1. Sociodemographic characteristics of the sample.

	N = 1285 *n* (%) or *M* (*SD*) / range
Gender	
Men	549 (42.7%)
Woman	736 (57.3%)
Age	27.7 (8.8) / 18-65
Educational level	
Higher [a]	1015 (79.0%)
Lower [b]	270 (21.0%)
Ethnicity	
White	822 (64.0%)
Non-White	463 (36.0%)

Note. *N* = total sample. *n* = partial sample. *M* = mean. *SD* = standard deviation.
[a] with post-school qualifications. [b] without post-school qualifications.

Table 2. Factor Loadings for the items of the BVAQ-BR

Item	Description	Factors				
		I^{V}	II^{I}	III^{F}	IV^{A}	V^{E}
26	*When I am upset by something, I talk with others about my feelings.*	**.82**	-.04	.00	.01	.05
6	*I like to tell others about how I feel.*	**.78**	-.03	.00	-.09	.13
11	Even with a friend, I find it difficult to talk about my feelings.	**.75**	-.03	-.04	.09	-.08
36	When I talk to people, I prefer to talk about daily activities rather than about my emotions.	**.60**	-.14	.06	.11	-.07
21	People often say that I should talk more about my feelings.	**.54**	-.07	-.01	.13	-.13
1	I find it difficult to express my feelings verbally.	**.53**	.14	-.04	.11	-.11
31	*I can express my feelings verbally.*	**.53**	.27	-.02	-.01	.02
16	*When I want to express how unhappy I feel, I find it easy to find the right words.*	**.36**	**.31**	.02	-.19	-.04
3	*When I am upset, I know whether I am afraid or sad or angry.*	-.08	**.63**	-.06	-.13	.04
28	*When I feel unhappy, I know whether I am afraid or dejected or sad.*	.01	**.62**	-.02	-.04	.02
38	*When I am in a sunny mood, I know whether I am enthusiastic or cheerful or elated.*	-.03	**.61**	-.03	-.01	.06
13	*When things get to be a bit overwhelming, I usually understand why.*	.04	**.61**	.05	-.04	-.05
20	*When I feel uneasy, I try to find out why I feel that way.*	.07	**.56**	.03	.05	.26
40	*When I am nervous, I want to know exactly where that feeling comes from.*	.02	**.55**	-.04	.04	**.40**
4	When something unexpected happens, I remain calm and unmoved.	.05	**-.37**	-.08	.26	**.33**
33	[illegible]en I am hard on myself, it remains unclear to me whether I'm sad, afraid or unhappy.	-.09	**.34**	.04	.25	-.26
8	[illegible]en I am tense, it remains unclear from which of my feelings this comes.	.00	**.33**	.01	.25	-.19
22	[illegible]rdly ever fantasize.	-.02	-.07	**.76**	.16	-.06
17	[illegible]ve little interest in fantasies and weird stories.	.01	-.02	**.64**	.07	-.10
27	*[illegible]e to think up unusual imaginative stories.*	.03	.01	**.62**	-.15	.04
7	[illegible]ve few daydreams and fantasies.	.05	-.15	**.60**	.10	.00
32	[illegible]nk that fantasizing about imaginary things or events is a waste of time.	-.01	-.01	**.53**	.20	-.06
12	*[illegible]en use my imagination.*	-.05	.21	**.51**	-.02	.13
37	*[illegible]n I don't have much to do, I daydream.*	.00	-.03	**.46**	-.16	.15
24	[illegible]n when others are wildly enthusiastic about something, I remain unmoved.	.08	-.09	-.02	**.58**	.15
25	[illegible]re is not much to understand as far as emotions are concerned.	-.01	.07	.13	**.53**	.07
9	[illegible]en I see somebody crying uncontrollably, I remain unmoved.	-.10	-.11	-.10	**.53**	**.39**
35	I find it strange that others analyze their emotions so often.	.08	-.01	.15	**.48**	.09
34	I accept disappointments without emotion.	.00	-.19	.02	**.46**	**.31**
18	When I feel good, it remains unclear as to whether I am cheerful or elated or happy.	-.01	.24	.02	**.41**	-.09
23	I do not know what's is on my mind.	.01	**.33**	-.02	**.36**	-.16
5	I hardly ever consider my feelings	.23	.09	.03	**.36**	.13
15	When I feel uncomfortable, I will not trouble myself even more by asking myself why.	.06	-.04	-.01	**.36**	.14
39	*When I see someone else sobbing heavily, I feel sadness well up inside me.*	-.05	-.01	-.07	.21	**.61**
29	*Unexpected events often overwhelm me with emotion.*	.02	.06	.04	.17	**.56**
14	*When friends around me argue violently, I become emotional.*	-.02	.02	-.07	.29	**.45**
19	*Often emotions well up inside me unexpectedly.*	.04	-.06	.12	-.25	**.45**
2	*Before I fall asleep, I imagine all kinds of events, encounters and conversations.*	-.07	.06	.29	-.07	**.36**
30	*I think that you should keep in tune with your feelings.*	.01	.25	-.01	.20	**.35**
10	*You should try to figure out feelings.*	-.04	.14	.07	.01	.23

Eigenvalue	6.0	3.5	1.9	1.3	1.2
Variance (%)	15.1	8.9	4.6	3.2	3.0
Cronbach's alpha	0.85	0.76	0.79	0.71	0.58

Note. Factor loadings obtained with principal axis factoring (promax rotation). Highest item loading in bold. Reverse-coded items in italic. Underlined items contain cross-loadings. [V] Verbalizing. [I] Identifying. [F] Fantasizing. [A] Analyzing. [E] Emotionalizing.

Table 3. Correlations between the first-order factors of the five-factor model and second-order factor loadings

BVAQ-BR and Subscales	BVAQ-BR Estimated inter-factor correlations						Second-order factor loadings	
	Total	Verbal	Identify	Fantasy	Analyze	Emotion	F1[C]	F2[A]
BVAQ-BR Total								
Verbalizing	**.75**						**.70**	.02
Identifying	**.60**	**.44**					**.63**	-.22
Fantasizing	**.42**	.00	**-.10**				.02	**.50**
Analyzing	**.75**	**.48**	**.39**	**.11**			**.69**	.19
Emotionalizing	**.32**	.01	**-.16**	**.31**	**.09**		-.01	**.62**

Note. Bold faced indicates $p < .001$. [C] Cognitive dimension. [A] Affective dimension.

Table 4. Pearson correlations for investigating the convergent and discriminant validity of the BVAQ-BR

Validation constructs	BVAQ-BR						Dimensions	
	Total	Verbal	Identify	Fantasy	Analyze	Emotion	Cognitive	Affective
TAS-20 total [a]	**.62**	**.66**	**.65**	-.05	**.57**	**-.23**	**.80**	**-.16**
Description	**.61**	**.79**	**.52**	-.06	**.46**	**-.17**	**.76**	**-.13**
Identification	**.38**	**.41**	**.64**	**-.17**	**.43**	**-.38**	**.60**	**-.32**
Thinking	**.39**	**.31**	**.16**	**.14**	**.36**	**.13**	**.35**	**.17**
DASS-21 [b]								
Depression	**.49**	**.30**	**.39**	**-.13**	**.35**	**-.36**	**.43**	**-.27**
Anxiety	**.18**	**.20**	**.31**	**-.12**	**.32**	**-.36**	**.35**	**-.27**
Stress	**.13**	**.22**	**.35**	**-.15**	**.23**	**-.42**	**.32**	**-.32**
Beliefs [c]	**.35**	**.37**	**.25**	-.04	**.42**	-.07	**.44**	-.07
Expressivity [d]	**-.43**	**-.38**	.02	**-.19**	**-.30**	**-.46**	**-.30**	**-.37**
Interoception [e]	**-.16**	**-.16**	**-.32**	**.10**	**-.11**	.07[†]	**-.24**	**.11**
Autism-spectrum [f]	**.41**	**.46**	**.35**	-.01	**.36**	-.11[†]	**.50**	-.06

Note. Bold faced indicates $p < .001$. [†] $p < .05$. [a] The 20-Item Toronto Alexithymia Scale. [b] Depression Anxiety and Stress Scale. [c] Beliefs about Emotions Scale (BES). [d] Berkeley Expressivity Questionnaire (BEQ). [e] Interoception Accuracy Scale (IAS). [f] Autism-Spectrum Quotient (AQ-28).

Article 2

Salles, B. M., Maturana, W., Guimarães, M. S., Leon, A. P. R., Mograbi, D. C. (Manuscript submitted). The Interoceptive Accuracy Scale: Validation of a Brazilian Portuguese Version (IAS-BR).

The Interoceptive Accuracy Scale: Validation a Brazilian Portuguese Version (IAS-BR)

Bruno M. Salles[1*], Wayson Maturana[1], Milena S. Guimarães[1], Arthur P. R. Leon[1], Daniel C. Mograbi[1,2]

1 – Department of Psychology, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil.

2 – Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom.

[*] Corresponding author. E-mail address: contact@brunosalles.com

Abstract

Interoception refers to the ability to accurately perceive internal bodily states. This can be measured both objectively, through performance on interoceptive tasks, and subjectively, through self-reported confidence in perceiving interoceptive signals. The Interoceptive Accuracy Scale (IAS) was recently developed to assess the latter. In this study, data was collected from 1,082 participants to evaluate the psychometric properties of a Brazilian Portuguese version of the IAS (IAS-BR). The validity of this new tool was explored through its correlations with measures of alexithymia (Toronto Alexithymia Scale, TAS-20; and Bermond-Vorst Alexithymia Questionnaire, BVAQ), autism spectrum symptoms (Autism-Spectrum Quotient, AQ-28), beliefs about emotions (Beliefs about Emotions Scale, BES), emotion expressivity (Berkeley Expressivity Questionnaire, BEQ) and negative emotional states (Depression, Anxiety and Stress Scale; DASS-21). The results showed that the IAS-BR had a three-factor solution and was negatively correlated with measures of alexithymia, autism spectrum symptoms, and negative emotional states. Men self-reported higher confidence in interoceptive accuracy than women. Although the factor structure of the IAS-BR was similar to the original scale, it was not identical. Nevertheless, the IAS-BR demonstrated satisfactory psychometric properties and can now be used to assess interoceptive accuracy in Brazilian samples and investigate cross-cultural comparisons.

Keywords: Interoceptive Accuracy Scale (IAS); psychometrics; interoceptive accuracy; body signals; scale adaptation

Introduction

Interoception refers to perceptive feedback from the body including visceral sensations such as hunger, thirst, temperature, respiratory, and cardiac signals (Berntson & Khalsa, 2021). Contemporary definitions have expanded the term “interoception” to include bodily signals that are not entirely internal (e.g. sensual or affective touch, tickling, taste, and muscle effort) but that are connected within the insula and anterior cingulate cortex (ACC), which are collectively called the "interoceptive cortex" (Craig, 2002; Löken et al., 2009; Wilson et al., 2002). Research interest in interoception has increased in recent years across a variety of disciplines and have mostly involved investigations of how interoception contributes to typical cognition (i.e., the accurate perception and functioning of the body's internal sensing mechanisms) and the potential clinical impact of atypical interoceptive ability (Brewer et al., 2021). Interoceptive accuracy has been linked to healthy cognitive processes, such as learning (Katkin et al., 2001), decision making (Herman et al., 2021), and emotional processing (Füstös et al., 2013; Schuette et al., 2021; Zamariola et al., 2019).

Evidence supporting the role of interoception in healthy cognition highlights the potential relevance of atypical interoception to psychopathology. The term "atypical interoception" includes both high and low levels of atypical interoception. Certain conditions have been associated with atypically low interoceptive sensitivity, such as feeding and eating disorders (Jenkinson et al., 2018; Martin et al., 2019), autism (Hatfield et al., 2019; Nicholson et al., 2019), and alexithymia (Gaggero et al., 2021; Murphy et al., 2018), while atypically high interoception has been found in panic disorder and anxiety syndromes (Ehlers, 1993; Krautwurst et al., 2016; Paulus & Stein, 2006).

Interoceptive Taxonomy

The most common taxonomy divides interoception into three distinct dimensions: (a) interoceptive accuracy, which is evaluated by individual differences in interoceptive ability as measured objectively (e.g., heartbeat counting or detection tasks; Desmedt et al., 2022; Schandry, 1981; Whitehead et al., 1977); (b) interoceptive sensibility, which concerns an individual's belief in their own interoceptive ability, gauged subjectively (e.g., with self-report questionnaires or ratings of confidence in interoceptive accuracy); and (c) interoceptive awareness, a metacognitive construct measured by examining the correspondence between objective interoceptive accuracy and subjective interoceptive sensibility.

Murphy et al. (2018, 2019) proposed a modification to this three-dimensional model of interoception, arguing instead for a 2 × 2 factorial model in which the first factor refers to *what* is assessed: interoceptive accuracy versus interoceptive attention, and the second factor distinguishes *how* interoception is measured: self-reported beliefs versus objective performance. In this model, measures of interoceptive ability can be grouped into four broad types: (a) objectively measured interoceptive accuracy (e.g., heartbeat tracking); (b) self-reported perceptions of interoceptive accuracy; (c) objectively measured interoceptive attention); and (d) self-reported perceptions of interoceptive attention. According to Murphy et al. (2018, 2019), this model refines the categorization of individual differences in interoception.

Measuring Interoceptive Abilities

To measure perceived interoceptive accuracy, Murphy et al. (2020) developed the Interoceptive Accuracy Scale (IAS). The IAS is a trait-based scale

assessing global (rather than domain-specific) interoceptive accuracy. The IAS may be best explained by quoting directly from its authors, Murphy et al. (2020), including the specific mention of relevant reference sources they cited: “The IAS was constructed to include a number of items referring to physical sensations that have either been described as interoceptive (Khalsa et al., 2018; Khalsa & Lapidus, 2016) or are associated with activation in the insula (e.g., Critchley & Harrison, 2013; Langer et al., 2010; Mazzone et al., 2007) – a brain region commonly associated with the processing of interoceptive signals (e.g., Craig, 2002; Khalsa et al., 2018).” (p. 118). The IAS has shown good internal consistency, and factor analysis presented a two-factor solution for it reflecting: (a) the perception of interoceptive signals, and (b) signals that may be difficult to perceive using interoceptive information alone (e.g., bruising), or socially unacceptable bodily functions (e.g., flatulence). Of note, however the authors suggested that the reliability of this factorial structure requires further scrutiny (Murphy et al., 2020).

In terms of convergent and divergent validity, the IAS was shown to be highly correlated with other interoceptive accuracy questionnaires (Interoceptive Confusion Questionnaire - ICQ; Brewer et al., 2016) and to have no relationship with a self-reported interoceptive attention measure (Body Perception Questionnaire - BPQ; Porges, 1993). Murphy et al. (2020) also found that IAS-measured self-reported interoceptive accuracy predicted objectively measured interoceptive accuracy. Furthermore, lower IAS self-reported interoceptive accuracy scores were associated with higher alexithymia scores, regardless of respondents’ levels of depression and anxiety (Murphy et al., 2020).

Research on interoception measurement has also explored cross-cultural differences in interoception (Ma-Kellams, 2014). For example, Ma-Kellams et al.

(2012) found that East Asians reported greater discrepancies between their perceived and actual body states compared to European Americans. In another study, West Africans were also less able to accurately identify interoceptive cues compared to European Americans (Chentsova-Dutton & Dzokoto, 2014). More recently, a study that assessed the validity of a Japanese translation of an interoceptive sensitivity questionnaire (MAIA; Mehling et al., 2012) found a notable difference in the factorial structure of the original English version when administered to a Japanese participant group, leading the authors to eliminate several items and reduce the number of factors from 8 to 6. They attributed this difference to possible translation issues and cultural variations in the perception of bodily sensations (Shoji et al., 2018).

Present Study

In the context of this prior research, we undertook in this study to systematically translate and adapt the Interoceptive Accuracy Scale (IAS) into Brazilian Portuguese (IAS-BR), while investigating the psychometric properties of the adapted instrument. To the best of our knowledge, this is the first adaptation of the IAS into a language other than English. The IAS-BR can facilitate further research exploration of potential cross-cultural differences in interoception in regions of the developing world. By making the IAS-BR available, we aim to encourage and support research on interoception in regions where Portuguese is spoken and to contribute to the understanding of interoception in different cultures.

Method

Participants and Procedures

Our respondent sample consisted of 1,082 participants, including 601 females and 481 males (aged 18–65, $M = 28.2$, $SD = 8.9$), from the general Brazilian population, recruited via emails and social networks (e.g., Facebook, Instagram, and WhatsApp), and invited to respond individually to online questionnaires through the Survey Monkey software platform. After receiving an explanation of the purpose of the study, participants completed an online informed consent form and then completed the questionnaires through a link sent by email. The project was approved by the Federal University of xxxx Ethics Committee (Research Ethics Committee number 27833119.9.0000.5582). All participants provided informed consent.

[PLEASE INSERT TABLE 1 HERE]

Measures

The Brazilian Portuguese Version of the Interoception Accuracy Scale (IAS-BR)

IAS items are related to interoception, which corresponds to bodily feedback sensations (Khalsa & Lapidus, 2016; Khalsa et al., 2017) with connections within the insula and anterior cingulate cortex (Critchley & Harrison, 2013; Langer, Beeli, & Jäncke, 2010; Mazzone, et al., 2007; Berntson & Khalsa, 2021; Khalsa et al., 2017). Questionnaire items prompt respondents to focus on self-perceived interoceptive accuracy (e.g., “I can always accurately perceive when I am hungry” or “I can always accurately perceive when I am hot/cold.” The IAS includes 21 items rated from Strongly Agree (“5”) to Strongly Disagree (“1”), with total scores ranging from 21-105. Higher scores indicate greater self-reported interoceptive accuracy.

We developed our Brazilian version (IAS-BR) following the established method for scale adaptation (Brislin, 2016). First, two Brazilian Portuguese-speaking experts fluent in English translated the English version of the scale. Then, one independent native English speaker back-translated this version into English. Any discrepancies between the English and Brazilian versions were discussed and resolved between the translators and the back-translator.

Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994)

The TAS-20 is commonly considered the most widely used scale to assess alexithymia (Bagby et al., 2020; Di Monte et al., 2020; Schroeders et al., 2021). It includes 20 items assessing three dimensions of alexithymia: (a) difficulty identifying feelings (DIF), (b) difficulty describing feelings (DDF), and (c) externally-oriented thinking (EOT). International studies have provided support for good DIF and DDF psychometric properties (for a review, see Schroeders et al., 2021). While the reliability of EOT has been described as doubtful (Kooiman et al., 2002), the ubiquity of TAS-20 in alexithymia research compelled the use of this tool in the present study.

Taylor et al. (2003) found good test-retest reliability and internal consistency of the scale, with Cronbach's alpha coefficient ≥ 0.70. We used the Brazilian version of the TAS-20 developed by Wiethaeuper et al. (2005), in which they demonstrated satisfactory psychometric properties, with alphas of 0.76 for the total scale and 0.70, 0.62 and 0.58 for the DIF, DDF and EOT factors, respectively. In the current study, TAS-20 total score showed Cronbach's alpha = 0.84 – 0.87 and Omega = 0.85 – 0.88 (TAS-DIF: Cronbach's alpha = 0.86 – 0.88 and Omega =

0.86 – 0.88; TAS-DDF: Cronbach's alpha = 0.76 – 0.80 and Omega = 0.76 – 0.81; TAS-EOT: Cronbach's alpha = 0.47 – 0.55 and Omega = 0.48 – 0.58).

Bermond-Vorst Alexithymia Questionnaire (BVAQ; Vorst & Bermond, 2001)

The BVAQ, also used to assess alexithymia, comprises 40 items with five-point Likert rating scales. It consists of five subscales (eight items each), one for each of the following domains of alexithymia difficulties: (a) Verbalizing – measuring the ability to verbalize emotions; (b) Identifying - the ability to differentiate between or identify emotions; (c) Analyzing - the ability to analyze emotions or externally oriented thinking; (d) Fantasizing – the ability to fantasize; and (e) Emotionalizing - the capacity to experience emotional feelings. In addition, Vorst and Bermond (2001) revealed two higher-order orthogonal factors: a Cognitive dimension (including "Identifying", "Verbalizing", and "Analyzing" subscales), and an Affective dimension (including "Fantasizing" and "Emotionalizing").

Vorst and Bermond (2001) found satisfactory psychometric properties for the BVAQ, with Cronbach's alphas of 0.85 for its full scale, 0.88 for Verbalizing, 0.81 for Analyzing, 0.81 for Identifying, 0.83 for Fantasizing, 0.70 for Emotionalizing, 0.88 for the cognitive component, and 0.78 for the affective component of alexithymia. As there is no Brazilian version of this instrument, we adapted a Brazilian version, following the same steps as described above for translating and back-translating the IAS-BR. In the current study, the Cronbach's alpha for the total BVAQ score ranged from 0.81 – 0.84 and the Omega ranged from 0.77 – 0.80 (Verbalizing: Cronbach's alpha = 0.84 – 0.86 and Omega = 0.84 – 0.87; Identifying: Cronbach's alpha = 0.74 – 0.78 and Omega = 0.74 – 0.78;

Analyzing: Cronbach's alpha = 0.68 – 0.73 and Omega = 0.69 – 0.73; Fantasizing: Cronbach's alpha = 0.77 – 0.80 and Omega = 0.77 – 0.81; Emotionalizing: Cronbach's alpha = 0.55 – 0.62 and Omega = 0.57 – 0.63; BVAQ-Cognitive: Cronbach's alpha = 0.86 – 0.88 and Omega = 0.86 – 0.88; and BVAQ-Affective: Cronbach's alpha = 0.74 – 0.78 and Omega = 0.74 – 0.78).

Depression, Anxiety and Stress Scale - Short Form (DASS-21; Lovibond & Lovibond, 1995)

The DASS-21 a 21-item short scale assessing depression, anxiety, and stress that is easy to apply in both clinical and non-clinical settings. It is suitable for use in different age groups, including medical students (Jovanović et al., 2021; Moutinho et al., 2017). We used a version validated to the Brazilian context (Vignola & Tucci, 2014), in which Cronbach alphas were 0.92 for depression, 0.90 for stress, and 0.85 for anxiety (alphas similar to the original version of the scale: 0.91, 0.89 and 0.81 for depression, stress and anxiety, respectively; Lovibond & Lovibond, 1995). In the current study, DASS-21 Depression showed Cronbach's alpha = 0.88 – 0.90 and Omega = 0.88 – 0.91; DASS-21 Anxiety showed Cronbach's alpha = 0.86 – 0.88 and Omega = 0.86 – 0.89; DASS-21 Stress showed Cronbach's alpha = 0.84 – 0.87 and Omega = 0.84 – 0.87.

Autism-Spectrum Quotient (AQ-28; Baron-Cohen et al., 2001; Hoekstra et al., 2011)

This is a self-report questionnaire for continuous and quantitative assessment of autistic spectrum traits in adults (Baron-Cohen et al., 2001). The brief version contains 28 questions, covering social skills, routine, attention switching, imagination, and number/patterns (Hoekstra et al., 2011). Each item has four

possible responses (“definitely agree,” “slightly agree,” “slightly disagree,” “definitely disagree”), with items scored dichotomously (i.e., by collapsing “definitely agree” and “slightly agree” into “agree” and “slightly disagree” and “definitely disagree” into “disagree”), with one point assigned or not assigned for each response.

Hoekstra et al. (2011) found Cronbach's alpha values that indicate acceptable internal consistency for the AQ-82 (between 0.77 and 0.86 for total scale), between 0.72 and 0.80 for Social Skills, between 0.54 and 0.62 for Routine, between 0.47 and 0.59 for Switching, between 0.68 to 0.75 for Imagination and 0.67 and 0.73 for Numbers/Patterns. The Brazilian version of the AQ has been shown to be an adequate instrument for the evaluation of signs compatible with the autism spectrum in adults (do Egito et al., 2018; Alves et al., 2022), with Cronbach alphas between 0.76 and 0.87. In the current study, AQ-28 total score showed Cronbach’s alpha = 0.69 – 0.73 and Omega = 0.57 – 0.72 (Social Skills: Cronbach’s alpha = 0.70 – 0.75 and Omega = 0.71 – 0.78; Routine: Cronbach’s alpha = 0.43 – 0.52 and Omega = 0.42 – 0.57; Switching: Cronbach’s alpha = 0.46 – 0.55 and Omega = 0.47 – 0.60; Imagination: Cronbach’s alpha = 0.60 – 0.66 and Omega = 0.59 – 0.68; Number/patterns: Cronbach’s alpha = 0.66 – 0.72 and Omega = 0.65 – 0.74).

Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997)

The BEQ (Gross & John, 1997) includes 16 items measuring three dimensions of emotional expressivity: impulse strength (e.g., “I experience my emotions very strongly”); expression of negative emotions (e.g., “No matter how nervous or upset I am, I tend to keep a calm exterior”); and expression of positive

emotions (e.g., “I laugh out loud when someone tells me a joke that I think is funny”). Each item was rated on a 7-point Likert scale, ranging from 1 = *strongly disagree* to 7 = *strongly agree*. High scores exhibit a high level of emotional expressivity. Gross and John, 1997 found alphas of 0.86 for the total BEQ and 0.70, 0.70 and 0.80 for the negative expressivity, positive expressivity and impulse strength subscales, respectively. As there is no Brazilian version for this instrument, adaptation followed the same steps described for the BVAQ-BR. In the current study, BEQ total score showed Cronbach’s alpha = 0.81 – 0.84 and Omega = 0.81 – 0.85 (Impulse Strength: Cronbach’s alpha = 0.77 – 0.81 and Omega = 0.76 – 0.82; Positive Emotions: Cronbach’s alpha = 0.67 – 0.73 and Omega = 0.67 – 0.75; Negative Emotions: Cronbach’s alpha = 0.54 – 0.61 and Omega = 0.53 – 0.64).

Beliefs about Emotions Scale (BES; Rimes & Chalder, 2010)

The BES (Rimes & Chalder, 2010) is a 12-item self-report scale that measures beliefs about the experience and expression of emotions (e.g., “It would be a sign of weakness to show my emotions in public.”). Items are rated on a Likert-type scale of 0 to 6, with higher scores indicating more maladaptive beliefs. In the current study the version validated by Mograbi et al. (2018) was used, with Cronbach's alpha of 0.86, comparable to those found in the original study (between 0.88 and 0.91; Rimes & Chalder, 2010). In the current study, BES total score showed Cronbach’s alpha = 0.85 – 0.88 and Omega = 0.86 – 0.89.

Data Analysis

To examine the validity of the IAS-BR, we conducted exploratory factor analysis to identify its factors and we correlated with other instruments to affirm its concurrent validity. In addition, we calculated Cronbach's alpha and McDonald's

Omega for the full scale and its factors to investigate its internal item internal consistency. For the exploratory factor analysis, we used the Kaiser-Meyer-Olkin (KMO) test. KMO values equal to or above 0.60 are assumed to be satisfactory for performing and interpreting a factor analysis solution (Tabachnick & Fidell, 2001). Although the IAS factor structure was originally explored with principal component analysis (PCA), we did not this procedure because it inflates the variance estimates by failing to discriminate shared and unique variance (Costello & Osborne, 2005; Widaman, 2012), which tends to produce non-parsimonious results, based on superfluous constructs, with reduced or inadequate explanatory power (Patil et al., 2008).

Furthermore, PCA is not considered a true factor analysis method, so there is no agreement among statistical theorists on when it should be used (Costello & Osborne, 2019; Jolliffe, 2005). Instead, we used a principal axis factoring (PAF) extraction method with an oblique factor rotation to obtain the most parsimonious structure due to the potential correlation between factors (Kieffer, 1998). Correlation between factors is expected in psychological constructs, since they are rarely divided into units that function independently of each other (Costello & Osborne, 2005). Since promax was recommended for large sample sizes (Field, 2013), this rotation method was employed.

We used an examination of screeplot, inspection of eigenvalues and parallel analysis to determine the number of factors. We used the Statistical Package for the Social Sciences (SPSS) to perform the parallel analysis (O'Connor, 2000). We considered factor loadings above .30 relevant (Costello &. Osborne, 2005). We calculated independent-samples *t*-tests to explore differences in the IAS-BR between gender, white and non-white ethnicity, and participants with and without

post-school qualifications. We investigated the relationship between IAS-BR and age with Pearson's product-moment correlations. Validation of the scale was explored with Pearson's correlations between the IAS-BR with other questionnaires described above. For convergent validity, we expected that increased self-reported interoceptive accuracy (IAS-BR) would significantly correlate ($p < 0.05$) with decreased alexithymia (TAS-20 and BVAQ), emotional distress (DASS-21) and autism spectrum symptoms (AQ-28). To test discriminant validity, we expected that IAS-BR would not be significantly related ($p > 0.05$) with emotional expressivity (BEQ) and beliefs about emotions (BES).

Results

Exploratory Factor Analysis

The KMO analysis revealed a value of 0.91, indicating very good sampling adequacy and that the correlation matrix was suitable for factor analysis (Bartlett's Test of Sphericity: $\chi^2 = 7283.54$, $df = 210$, $p < 0.001$). Examination of scree plot, inspection of eigenvalues and parallel analysis led to a three-factor solution that accounted for 38.67% of the variance. Table 2 depicts the pattern of rotated factor loadings for this three-factor solution. Cronbach's alpha for the full scale was very high ($\alpha = 0.89$; $Omega_{total} = 0.88$), indicating very good internal item consistency. The mean of corrected item-total correlation coefficients was moderate (r = 0.50), ranging from r = 0.59 for item #17 ("I can always accurately perceive when I am in pain") to r = 0.29 for item #18 ("I can always accurately perceive when my blood sugar is low"). As removal of item #18 would not increase internal consistency of the scale, the item was not removed.

[PLEASE INSERT TABLE 2 HERE]

According to PAF (promax), the first factor was responsible for 29.2% of the variance with an eigenvalue of 6.1, and it yielded very good internal item consistency (α = 0.85). This factor consisted of eleven items (#1, 2, 3, 4, 5, 6, 7, 11, 12, 15, and 17) reflecting the perception of interoceptive signals (e.g., item 1: "I can always accurately perceive when my heart is beating fast"). The second factor also had good internal consistency (α = 0.80) explaining 5.5% of the variance (eigenvalue of 1.2), and incorporated five items (#8, 9, 10, 13, and 14) associated with perturbations of bodily functions that index interoceptive accuracy for socially unacceptable behavior (e.g., item 14: "I can always accurately perceive when I am going to burp").

Finally, the third factor explained 4% of the variance with an eigenvalue of 0.8 and had good internal consistency (α = 0.71). This factor consisted of five items (#16, 18, 19, 20, and 21) that measure the perception or interpretation of tactile signals (e.g., item 19: "I can always accurately perceive when someone is touching me affectionately rather than non-affectionately") and/or signals that may be difficult to perceive using interoceptive information alone (e.g., item 18: "I can always accurately perceive when my blood sugar is low.").

Construct Validity

We examined the correlations between IAS-BR and alexithymia (TAS-20 and BVAQ). Although the BVAQ was weakly associated with IAS-BR and its factors, the TAS-20 was shown to be more strongly related to them, suggesting that higher alexithymia traits are associated with lower interoceptive accuracy (Table

3). The cognitive dimension of the BVAQ was related to reduced interoceptive accuracy, whereas the affective dimension of the BVAQ had close to a negligible association with interoceptive accuracy. Increased depression, anxiety and stress were negatively related to the IAS-BR, indicating that reduced interoceptive accuracy was associated with increased symptoms of these affective syndromes. Autism spectrum symptoms were negatively associated with the IAS-BR, showing that the presence of more symptoms of autism was linked to lower interoceptive accuracy. IAS-BR was not significantly correlated with BEQ or BES, which implies that emotional expressivity and beliefs about emotions are not related to perceived interoceptive accuracy.

[PLEASE INSERT TABLE 3 HERE]

Sociodemographic Variables

Student *t* tests showed a significant difference between gender in the IAS-BR ($t_{(1082)} = 3.16$, $p = .002$), with males reporting higher interoceptive accuracy ($M = 85.45$, $SD = 11.62$) than females ($M = 83.30$, $SD = 10.69$). This same pattern was found for the factors interoceptive signals ($t_{(1082)} = 3.21$, $p < .001$) and unacceptable bodily functions ($t_{(1082)} = 3.37$, $p < .001$); thus, males reported greater perception of interoceptive signals ($M = 47.93$, $SD = 6.37$) and socially unacceptable disturbances in bodily functions ($M = 21.38$, $SD = 3.44$) than did females ($M = 46.71$, $SD = 6.05$, and $M = 20.67$, $SD = 3.43$, respectively). There was no significant difference between males ($M = 16.15$, $SD = 4.00$) and females ($M = 15.92$, $SD = 3.86$) on the tactile signal factor ($t_{(1082)} = 0.94$, $p = .348$. There was no significant race difference in the responses from White ($M = 84.60$, $SD = 10.68$) and non-White participants

(M = 85.57, SD = 11.78) in the IAS-BR ($t_{(1082)}$ = -1.10, p = .271). There were also no significant differences in factors related to interoceptive signals ($t_{(1082)}$ = -1.44, p = .149), unacceptable bodily functions ($t_{(1082)}$ = -1.02, p = .308), and tactile signals ($t_{(1082)}$ = -.05, p = .957) between White (M = 47.19, SD = 5.86; M = 21.06, SD = 3.36; M = 16.35, SD = 3.94; respectively) and non-White participants (M = 47.91, SD = 5.88; M = 21.33, SD = 3.34; M = 16.34, SD = 3.80; respectively).

In terms of educational level, there was no significant difference between participants without post-school qualifications (M = 84.74, SD = 11.41) and those with higher educational achievements (M = 84.14, SD = 11.10) in the IAS-BR ($t_{(1082)}$ = .71, p = .478). There were also no significant differences in factors related to interoceptive signals ($t_{(1082)}$ = .87, p = .398), unacceptable bodily functions ($t_{(1082)}$ = .56, p = .573), and tactile signals ($t_{(1082)}$ = .15, p = .882) between participants without post-school qualifications (M = 47.58, SD = 6.42; M = 21.10, SD = 3.58; M = 16.06, SD = 4.00; respectively) and those with higher educational achievements (M = 47.17, SD = 6.17; M = 10.95, SD = 3.42; M = 16.01, SD = 3.90; respectively). Pearson correlations showed that age had a weak positive correlation with the total IAS-BR (r = .11, p < .001), as well as with the interoceptive signals (r = .13, p < .001) and unacceptable bodily functions factors (r = .09, p = .005), but not with the factor referring to tactile signals (r = .05, p = .114).

Discussion

In the present study, we adapted the IAS into a Brazilian version (IAS-BR) and assessed its psychometric properties. The IAS-BR showed good internal consistency (α = 0.89), slightly higher than the original scale (α = 0.88 for the IAS; Murphy et al., 2020). Our exploratory factor analysis revealed a three-factor

solution, with the first factor measuring the perception of interoceptive signals, the second factor reflecting perturbations in bodily functions that are socially unacceptable, and the third factor related to the perception or interpretation of tactile signals and signals that may be difficult to perceive using interoceptive information alone.

This factor structure differs from the original scale, which had shown a two-factor solution. However, the second factor in the original scale included both socially unacceptable bodily function disturbances, and signals that may be challenging to perceive using interoceptive information alone (which corresponds to our factor 2 and 3, respectively). In the IAS-BR, these two facets of the second factor of the original scale were divided into two distinct factors. In our study, tactile signals may have been separated into an individual factor due to cultural differences (e.g., anecdotally, Brazilians are believed to place great emphasis on interpersonal touch; Caesar, 2011).

Construct Validity

Our study examined the construct validity of the IAS-BR by correlating it with other instruments measuring different constructs. Although the correlations were generally weak, they were in the expected direction. Our results align with previous studies that have found a negative association between interoceptive accuracy and alexithymia (Brewer et al., 2016; Shah et al., 2016; Trevisan et al., 2019). as evidenced by the negative correlations between the IAS-BR and the BVAQ and TAS-20. Our results corroborate previous findings showing a lower association between interoception measures and the BVAQ, compared to the TAS-20 (e.g., Carre et al., 2022). These different results in interoceptive accuracy

between the alexithymia scales may be because the TAS-20 only measures cognitive aspects of alexithymia, while the BVAQ covers both cognitive and affective aspects of alexithymia.

In a recent cross-cultural study, the IAS was negatively correlated with the TAS-20 and the cognitive dimension of the BVAQ, but had no association with the affective dimension of the BVAQ (Gaggero et al., 2021). Our study replicates previous research, since we found the cognitive dimension of the BVAQ to have a strong association with IAS, while its association with the affective dimension of the BVAQ was close to negligible. This suggests that self-perceived interoceptive accuracy may be more influenced by cognitive aspects of alexithymia, such as difficulty identifying and verbalizing emotions, than by affective aspects, such as low emotional arousal or ability to fantasize. However, future studies should investigate whether these findings also apply to objective measures of interoception.

Overall, our results provide further support for the negative association between interoceptive accuracy and alexithymia, with the cognitive aspect of alexithymia playing a more significant role in self-perceived interoceptive accuracy. These findings may have important implications for interventions aimed at improving interoception in individuals with alexithymia. Future research should explore the potential impact of cognitive and affective aspects of alexithymia on interoceptive accuracy in objective measures, such as heartbeat counting tasks.

Research has shown that ASD individuals commonly have difficulty in interoception (DuBois et al., 2016; Palser et al., 2020). Indeed, our study showed a negative relationship between IAS-BR and ASD symptoms. Our study also found

a correlation between negative emotions and reduced interoceptive accuracy, an evidence aligned with past findings (Eggart et al., 2019; Limmer et al., 2015; Marschner et al., 2015). Interestingly, emotional expressivity and beliefs about emotions were not related to perceived interoceptive accuracy in this study. These results are consistent with previous research (e.g., Lischke et al., 2020; Schaan et al., 2019; Schuette et al., 2021; but see Füstös et al., 2013), which also found no significant relationship between interoceptive accuracy and emotion regulation strategies that involve managing emotional expressivity (suppression), or adaptive beliefs in dealing with emotions (reappraisal).

Several studies have consistently found that men are more accurate than women in detecting physiological cues such as blood pressure levels, heart rate and blood glucose levels (Ferentzi et al., 2021; Grabauskaitė et al., 2017; Ludwick-Rosenthal & Neufeld, 1985; Montoya et al., 1993; Roberts & Pennebaker, 1995). In our study, we also found that men reported higher confidence in their interoceptive accuracy than women. Interestingly, this gender difference disappeared in relation to the tactile signals factor, which refers to cues that are difficult to interpret using interoceptive information alone. Pennebaker and Roberts (1992) proposed that women used situational (external) cues to define their feelings to compensate for their inability to perceive interoceptive signals, perhaps explaining why women reported similar interoception accuracy to men for identifying tactile signals, which involve not only interoceptive cues but also tactile and visual information.

In addition to gender, age is another individual difference that may impact interoceptive accuracy. Recent studies have found that cardiac interoceptive accuracy on objective tasks decreased with age (Khalsa et al., 2009; Nusser et al.,

2020). Furthermore, previous research has shown that the perception of other interoceptive signals such as taste (Stevens et al., 1995), thirst (Silver, 1990), pain (Gagliese, 2009) and temperature (Clark & Mehl, 1971), tends to become less accurate as people age. However, we found a positive association between age and IAS-BR, indicating that as people age, their confidence and belief in their interoceptive accuracy increases. It is important to note that the IAS scale measures beliefs and confidence in interoceptive accuracy, not performance in accurately perceiving interoceptive signals. Despite previous findings that objective interoceptive accuracy decreases with age, Nusser et al. (2020) supported our findings as they reported that older participants tend to be more confident in their ability to accurately count their heartbeats.

Limitations and Directions for Further Research

One limitation of our study is that we did not include a clinical sample, which may limit the generalizability of our findings to the general population. While we did collect information on participants' ethnicity and educational level, our sample was predominantly composed of white university students or individuals with higher educational levels future studies are encouraged to examine the validity of the IAS-BR across diverse gender and age groups and to consider how individual differences related to ethnicity and sociodemographic factors might impact responses. Furthermore, internet surveys are susceptible to self-selection bias (Bethlehem, 2010; Winship & Mare, 1992). Since a web survey is self-administered, researchers do not control who completes the questionnaire (Winship & Mare, 1992). Despite our relatively large sample size, our findings may not

represent the broader general population, particularly individuals without internet access.

Conclusion

The psychometric properties of the newly developed IAS-BR suggest that it is a reliable tool for investigating self-reported interoceptive accuracy in Brazilian cultures, as well as for facilitating cross-cultural comparisons in future research.

References

Alves, A. L. C., de Paula, J. J., de Miranda, D. M., & Romano-Silva, M. A. (2022). The Autism Spectrum Quotient in a sample of Brazilian adults: analyses of normative data and performance. *Dementia e Neuropsychologia*, *16*(2), 244–248. https://doi.org/10.1590/1980-5764-DN-2021-0081

Bagby, R. M., Parker, J. D. A., & 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*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (2020). Twenty-five years with the 20-item Toronto Alexithymia Scale. *Journal of Psychosomatic Research*, *131*(December 2019), 109940. https://doi.org/10.1016/j.jpsychores.2020.109940

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger Syndrome/High-Functioning Autism, Males and Females, Scientists and Mathematicians. *Journal of Autism and Developmental Disorders*, *31*(1), 5–17. https://doi.org/10.1023/A:1005653411471

Berntson, G. G., & Khalsa, S. S. (2021). Neural Circuits of Interoception. *Trends in Neurosciences*, *44*(1), 17–28. https://doi.org/10.1016/J.TINS.2020.09.011

Bethlehem, J. (2010). Selection bias in web surveys. *International Statistical Review*, *78*(2), 161–188. https://doi.org/10.1111/j.1751-5823.2010.00112.x

Brewer, R, Cook, R., science, G. B.-R. S. open, & 2016, undefined. (2016). Alexithymia: a general deficit of interoception. *Royalsocietypublishing.Org*, *3*(10). https://doi.org/10.1098/rsos.150664

Brewer, Rebecca, Murphy, J., & Bird, G. (2021). Atypical interoception as a common risk factor for psychopathology: A review. *Neuroscience & Biobehavioral Reviews*, *130*, 470–508. https://doi.org/10.1016/J.NEUBIOREV.2021.07.036

Brislin, R. W. (2016). Back-Translation for Cross-Cultural Research:

Http://Dx.Doi.Org/10.1177/135910457000100301, *1*(3), 185–216. https://doi.org/10.1177/135910457000100301

Carre, A., Shankland, R., & Flaudias, V. (2022). *Measuring alexisomia and its relation to alexithymia using the Body Awareness Questionnaire*. 1–14. https://doi.org/10.21203/rs.3.rs-1432122/v1

Chentsova-Dutton, Y. E., & Dzokoto, V. (2014). Listen to your heart: The cultural shaping of interoceptive awareness and accuracy. *Emotion*, *14*(4), 666–678. https://doi.org/10.1037/A0036193

Clark, W. C., & Mehl, L. (1971). Thermal pain: A sensory decision theory analysis of the effect of age and sex on d', various response criteria, and 50% pain threshold. *Journal of Abnormal Psychology*, *78*(2), 202–212. https://doi.org/10.1037/H0031800

Costello, A. B., & Osborne, J. (2019). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research, and Evaluation*, *10*(1), 7. https://doi.org/https://doi.org/10.7275/jyj1-4868

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, *10*(7), 7. https://doi.org/https://doi.org/10.7275/jyj1-4868

Craig, A. D. (2002). How do you feel? Interoception: The sense of the physiological condition of the body. *Nature Reviews Neuroscience*, *3*(8), 655–666. https://doi.org/10.1038/nrn894

Critchley, H. D., & Harrison, N. A. (2013). Visceral Influences on Brain and Behavior. *Neuron*, *77*(4), 624–638. https://doi.org/10.1016/J.NEURON.2013.02.008

Desmedt, O., van Den Houte, M., Walentynowicz, M., Dekeyser, S., Luminet, O., & Corneille, O. (2022). How Does Heartbeat Counting Task Performance Relate to Theoretically-Relevant Mental Health Outcomes? A Meta-Analysis. In *Collabra: Psychology* (Vol. 8, Issue 1). University of California Press. https://doi.org/10.1525/collabra.33271

Di Monte, C., Renzi, A., Paone, E., Silecchia, G., Solano, L., & Di Trani, M. (2020). Alexithymia and obesity: Controversial findings from a multimethod assessment. *European Review for Medical and Pharmacological Sciences*, *24*(2), 831–836. https://doi.org/10.26355/eurrev_202001_20066

do Egito, J. H. T., Ferreira, G. M. R., Gonçalves, M. I., & Osório, A. A. C. (2018). Brief Report: Factor Analysis of the Brazilian Version of the Adult Autism Spectrum Quotient. *Journal of Autism and Developmental Disorders*, *48*(5), 1847–1853. https://doi.org/10.1007/S10803-017-3424-6/TABLES/3

DuBois, D., Ameis, S. H., Lai, M. C., Casanova, M. F., & Desarkar, P. (2016). Interoception in Autism Spectrum Disorder: A review. *International Journal of Developmental Neuroscience*, *52*, 104–111. https://doi.org/10.1016/J.IJDEVNEU.2016.05.001

Eggart, M., Lange, A., Binser, M. J., Queri, S., & Müller-Oerlinghausen, B. (2019). Major Depressive Disorder Is Associated with Impaired Interoceptive Accuracy: A Systematic Review. *Brain Sciences 2019, Vol. 9, Page 131*, *9*(6), 131. https://doi.org/10.3390/BRAINSCI9060131

Ehlers, A. (1993). Interoception and panic disorder. *Advances in Behaviour Research and Therapy*, *15*(1), 3–21. https://doi.org/10.1016/0146-6402(93)90001-I

Ferentzi, E., Geiger, M., Mai-Lippold, S. A., Köteles, F., Montag, C., & Pollatos, O. (2021). Interaction Between Sex and Cardiac Interoceptive Accuracy in Measures of Induced Pain. *Frontiers in Psychology*, *0*, 4098. https://doi.org/10.3389/FPSYG.2020.577961

Freedman, A., Hu, H., Liu, I. T. H. C., Stewart, A. L., Adler, S., & Mehling, W. E. (2021). Similarities and Differences in Interoceptive Bodily Awareness Between US-American and Japanese Cultures: A Focus-Group Study in Bicultural Japanese-Americans. *Culture, Medicine and Psychiatry*, *45*(2), 234–267. https://doi.org/10.1007/S11013-020-09684-4/TABLES/4

Füstös, J., Gramann, K., Herbert, B. M., & Pollatos, O. (2013). On the embodiment of emotion regulation: interoceptive awareness facilitates reappraisal. *Social Cognitive and Affective Neuroscience*, *8*(8), 911–917.

https://doi.org/10.1093/SCAN/NSS089

Gaggero, G., Bizzego, A., Dellantonio, S., Pastore, L., Lim, M., & Esposito, G. (2021). Clarifying the relationship between alexithymia and subjective interoception. *PLoS ONE*, *16*(12 December), e0261126. https://doi.org/10.1371/journal.pone.0261126

Gagliese, L. (2009). Pain and Aging: The Emergence of a New Subfield of Pain Research. *The Journal of Pain*, *10*(4), 343–353. https://doi.org/10.1016/J.JPAIN.2008.10.013

Grabauskaitė, A., Baranauskas, M., & Griškova-Bulanova, I. (2017). Interoception and gender: What aspects should we pay attention to? *Consciousness and Cognition*, *48*, 129–137. https://doi.org/10.1016/J.CONCOG.2016.11.002

Gross, J. J., & John, O. P. (1997). Revealing Feelings: Facets of Emotional Expressivity in Self-Reports, Peer Ratings, and Behavior. *Journal of Personality and Social Psychology*, *72*(2), 435–448. https://doi.org/10.1037/0022-3514.72.2.435

Hatfield, T. R., Brown, R. F., Giummarra, M. J., & Lenggenhager, B. (2019). Autism spectrum disorder and interoception: Abnormalities in global integration? *Autism*, *23*(1), 212–222. https://doi.org/10.1177/1362361317738392

Herman, A. M., Esposito, G., & Tsakiris, M. (2021). Body in the face of uncertainty: The role of autonomic arousal and interoception in decision-making under risk and ambiguity. *Psychophysiology*, *58*(8), e13840. https://doi.org/10.1111/PSYP.13840

Hoekstra, R. A., Vinkhuyzen, A. A. E., Wheelwright, S., Bartels, M., Boomsma, D. I., Baron-Cohen, S., Posthuma, D., & Van Der Sluis, S. (2011). The construction and validation of an abridged version of the autism-spectrum quotient (AQ-short). *Journal of Autism and Developmental Disorders*, *41*(5), 589–596. https://doi.org/10.1007/s10803-010-1073-0

Jenkinson, P. M., Taylor, L., & Laws, K. R. (2018). Self-reported interoceptive deficits in eating disorders: A meta-analysis of studies using the eating disorder inventory. In *Journal of Psychosomatic Research* (Vol. 110, pp. 38–

45). Elsevier. https://doi.org/10.1016/j.jpsychores.2018.04.005

Jolliffe, I. (2005). Principal Component Analysis. *Encyclopedia of Statistics in Behavioral Science*. https://doi.org/10.1002/0470013192.BSA501

Jovanović, V., Gavrilov-Jerković, V., & Lazić, M. (2021). Can adolescents differentiate between depression, anxiety and stress? Testing competing models of the Depression Anxiety Stress Scales (DASS-21). *Current Psychology*, *40*(12), 6045–6056. https://doi.org/10.1007/s12144-019-00540-2

Katkin, E. S., Wiens, S., & Öhman, A. (2001). Nonconscious fear conditioning, visceral perception, and the development of gut feelings. *Psychological Science*, *12*(5), 366–370. https://doi.org/10.1111/1467-9280.00368

Khalsa, S. S., Adolphs, R., Cameron, O. G., Critchley, H. D., Davenport, P. W., Feinstein, J. S., Feusner, J. D., Garfinkel, S. N., Lane, R. D., Mehling, W. E., Meuret, A. E., Nemeroff, C. B., Oppenheimer, S., Petzschner, F. H., Pollatos, O., Rhudy, J. L., Schramm, L. P., Simmons, W. K., Stein, M. B., … Zucker, N. (2018). Interoception and Mental Health: A Roadmap. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, *3*(6), 501–513. https://doi.org/10.1016/J.BPSC.2017.12.004

Khalsa, S. S., & Lapidus, R. C. (2016). Can interoception improve the pragmatic search for biomarkers in psychiatry? *Frontiers in Psychiatry*, *7*(JUL), 121. https://doi.org/10.3389/FPSYT.2016.00121/BIBTEX

Khalsa, S. S., Rudrauf, D., & Tranel, D. (2009). Interoceptive awareness declines with age. *Psychophysiology*, *46*(6), 1130–1136. https://doi.org/10.1111/J.1469-8986.2009.00859.X

Kieffer, K. M. (1998). Orthogonal Versus Oblique Factor Rotation: A Review of the Literature Regarding the Pros and Cons. *Paper Presented at the Annual Meeting of the Mid-South Educational Research Association (27th, New Orleans, LA, November 4-6, 1998).*, 1–32.

Krautwurst, S., Gerlach, A. L., & Witthoft, M. (2016). Interoception in pathological health anxiety. *Journal of Abnormal Psychology*, *125*(8), 1179–1184. https://doi.org/10.1037/abn0000210

Langer, N., Beeli, G., & Jäncke, L. (2010). When the Sun Prickles Your Nose: An EEG Study Identifying Neural Bases of Photic Sneezing. *PLOS ONE*, *5*(2), e9208. https://doi.org/10.1371/JOURNAL.PONE.0009208

Limmer, J., Kornhuber, J., & Martin, A. (2015). Panic and comorbid depression and their associations with stress reactivity, interoceptive awareness and interoceptive accuracy of various bioparameters. *Journal of Affective Disorders*, *185*, 170–179. https://doi.org/10.1016/J.JAD.2015.07.010

Lischke, A., Pahnke, R., Mau-Moeller, A., Jacksteit, R., & Weippert, M. (2020). Sex-Specific Relationships Between Interoceptive Accuracy and Emotion Regulation. *Frontiers in Behavioral Neuroscience*, *14*(June), 1–8. https://doi.org/10.3389/fnbeh.2020.00067

Löken, L. S., Wessberg, J., Morrison, I., McGlone, F., & Olausson, H. (2009). Coding of pleasant touch by unmyelinated afferents in humans. *Nature Neuroscience*, *12*(5), 547–548. https://doi.org/10.1038/nn.2312

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U

Ludwick-Rosenthal, R., & Neufeld, R. W. J. (1985). Heart beat interoception: A study of individual differences. *International Journal of Psychophysiology*, *3*(1), 57–65. https://doi.org/10.1016/0167-8760(85)90020-0

Ma-Kellams, C. (2014). Cross-cultural differences in somatic awareness and interoceptive accuracy: A review of the literature and directions for future research. *Frontiers in Psychology*, *5*(DEC), 1379. https://doi.org/10.3389/FPSYG.2014.01379/BIBTEX

Ma-Kellams, C., Blascovich, J., & McCall, C. (2012). Culture and the body: East-West differences in visceral perception. *Journal of Personality and Social Psychology*, *102*(4), 718–728. https://doi.org/10.1037/A0027010

Marschner, L., Pannasch, S., Schulz, J., & Graupner, S. T. (2015). Social communication with virtual agents: The effects of body and gaze direction on attention and emotional responding in human observers. *International Journal*

of Psychophysiology, *97*(2), 85–92. https://doi.org/10.1016/j.ijpsycho.2015.05.007

Martin, E., Dourish, C. T., Rotshtein, P., Spetter, M. S., & Higgs, S. (2019). Interoception and disordered eating: A systematic review. In *Neuroscience and Biobehavioral Reviews* (Vol. 107, pp. 166–191). Pergamon. https://doi.org/10.1016/j.neubiorev.2019.08.020

Mazzone, S. B., McLennan, L., McGovern, A. E., Egan, G. F., & Farrell, M. J. (2007). Representation of capsaicin-evoked urge-to-cough in the human brain using functional magnetic resonance imaging. *American Journal of Respiratory and Critical Care Medicine*, *176*(4), 327–332. https://doi.org/10.1164/rccm.200612-1856OC

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLOS ONE*, *7*(11), e48230. https://doi.org/10.1371/JOURNAL.PONE.0048230

Mograbi, D. C., Indelli, P., Lage, C. A., Tebyriça, V., Landeira-Fernandez, J., & Rimes, K. A. (2018). Cross-cultural adaptation and validation of the Brazilian version of the Beliefs about Emotions Scale. *Trends in Psychiatry and Psychotherapy*, *40*(1), 21–28. https://doi.org/10.1590/2237-6089-2017-0064

Montoya, P., Schandry, R., & Müller, A. (1993). Heartbeat evoked potentials (HEP): topography and influence of cardiac awareness and focus of attention. *Electroencephalography and Clinical Neurophysiology/Evoked Potentials Section*, *88*(3), 163–172. https://doi.org/10.1016/0168-5597(93)90001-6

Moutinho, I. L. D., De Castro Pecci Maddalena, N., Roland, R. K., Lucchetti, A. L. G., TibiriçÁ, S. H. C., Da Silva Ezequiel, O., & Lucchetti, G. (2017). Depression, stress and anxiety in medical students: A cross-sectional comparison between students from different semesters. *Revista Da Associacao Medica Brasileira*, *63*(1), 21–28. https://doi.org/10.1590/1806-9282.63.01.21

Murphy, J., Brewer, R., Hobson, H., Catmur, C., & Bird, G. (2018). Is alexithymia characterised by impaired interoception? Further evidence, the importance of control variables, and the problems with the Heartbeat Counting Task.

Biological Psychology, *136*, 189–197. https://doi.org/10.1016/J.BIOPSYCHO.2018.05.010

Murphy, J., Brewer, R., Plans, D., Khalsa, S. S., Catmur, C., & Bird, G. (2020). Testing the independence of self-reported interoceptive accuracy and attention. *Quarterly Journal of Experimental Psychology*, *73*(1), 115–133. https://doi.org/10.1177/1747021819879826

Murphy, J., Catmur, C., & Bird, G. (2019). Classifying individual differences in interoception: Implications for the measurement of interoceptive awareness. *Psychonomic Bulletin and Review*, *26*(5), 1467–1471. https://doi.org/10.3758/s13423-019-01632-7

Nicholson, T., Williams, D., Carpenter, K., & Kallitsounaki, A. (2019). Interoception is Impaired in Children, But Not Adults, with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *49*(9), 3625–3637. https://doi.org/10.1007/s10803-019-04079-w

Nusser, L., Pollatos, O., & Zimprich, D. (2020). Age-Related Effects on Interoceptive Accuracy, General Interoceptive Sensibility, and Specific Interoceptive Sensibility. *European Journal of Health Psychology*, *27*(4), 154–170. https://doi.org/10.1027/2512-8442/A000060

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments, & Computers 2000 32:3*, *32*(3), 396–402. https://doi.org/10.3758/BF03200807

Palser, E. R., Fotopoulou, A., Pellicano, E., & Kilner, J. M. (2020). Dissociation in How Core Autism Features Relate to Interoceptive Dimensions: Evidence from Cardiac Awareness in Children. *Journal of Autism and Developmental Disorders*, *50*(2), 572–582. https://doi.org/10.1007/S10803-019-04279-4/TABLES/4

Patil, V. H., Singh, S. N., Mishra, S., & Todd Donavan, D. (2008). Efficient theory development and factor retention criteria: Abandon the "eigenvalue greater than one" criterion. *Journal of Business Research*, *61*(2), 162–170. https://doi.org/10.1016/j.jbusres.2007.05.008

Paulus, M. P., & Stein, M. B. (2006). An Insular View of Anxiety. In *Biological Psychiatry* (Vol. 60, Issue 4, pp. 383–387). Elsevier. https://doi.org/10.1016/j.biopsych.2006.03.042

Pennebaker, J. W., & Roberts, T.-A. (1992). Toward a His and Hers Theory of Emotion: Gender Differences in Visceral Perception. *Journal of Social and Clinical Psychology*, *11*(3), 199–212. https://doi.org/10.1521/JSCP.1992.11.3.199

Porges, S. (1993). Body perception questionnaire. *Laboratory of Developmental Assessment, University of Maryland*.

Rimes, K. A., & Chalder, T. (2010). The Beliefs about Emotions Scale: Validity, reliability and sensitivity to change. *Journal of Psychosomatic Research*, *68*(3), 285–292. https://doi.org/10.1016/J.JPSYCHORES.2009.09.014

Roberts, T. A., & Pennebaker, J. W. (1995). Gender Differences In Perceiving Internal State: Toward A His-And-Hers Model Of Perceptual Cue Use. *Advances in Experimental Social Psychology*, *27*(C), 143–175. https://doi.org/10.1016/S0065-2601(08)60405-0

Schaan, L., Schulz, A., Nuraydin, S., Bergert, C., Hilger, A., Rach, H., & Hechler, T. (2019). Interoceptive accuracy, emotion recognition, and emotion regulation in preschool children. *International Journal of Psychophysiology*, *138*(September 2018), 47–56. https://doi.org/10.1016/j.ijpsycho.2019.02.001

Schandry, R. (1981). Heart Beat Perception and Emotional Experience. *Psychophysiology*, *18*(4), 483–488. https://doi.org/10.1111/j.1469-8986.1981.tb02486.x

Schroeders, U., Kubera, F., & Gnambs, T. (2021). The Structure of the Toronto Alexithymia Scale (TAS-20): A Meta-Analytic Confirmatory Factor Analysis. *Assessment*. https://doi.org/10.1177/10731911211033894

Schuette, S. A., Zucker, N. L., & Smoski, M. J. (2021). Do interoceptive accuracy and interoceptive sensibility predict emotion regulation? *Psychological Research*, *85*(5), 1894–1908. https://doi.org/10.1007/s00426-020-01369-2

Shah, P., Hall, R., Catmur, C., & Bird, G. (2016). Alexithymia, not autism, is

associated with impaired interoception. *Cortex*, *81*, 215–220. https://doi.org/10.1016/J.CORTEX.2016.03.021

Shoji, M., Mehling, W. E., Hautzinger, M., & Herbert, B. M. (2018). Investigating multidimensional interoceptive awareness in a Japanese population: Validation of the Japanese MAIA-J. *Frontiers in Psychology*, *9*(OCT), 1855. https://doi.org/10.3389/FPSYG.2018.01855/BIBTEX

Silver, A. J. (1990). Aging and risks for dehydration. *Cleveland Clinic Journal of Medicine*, *57*(4), 341–344. https://doi.org/10.3949/CCJM.57.4.341

Stevens, J. C., Cruz, L. A., Hoffman, J. M., & Patterson, M. Q. (1995). Taste Sensitivity and Aging: High Incidence of Decline Revealed by Repeated Threshold Measures. *Chemical Senses*, *20*(4), 451–459. https://doi.org/10.1093/CHEMSE/20.4.451

Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics 4th ed.* Needham Heights, MA: Allyn and Bacon.

Trevisan, D. A., Altschuler, M. R., Bagdasarov, A., Carlos, C., Duan, S., Hamo, E., Kala, S., McNair, M. L., Parker, T., Stahl, D., Winkelman, T., Zhou, M., & McPartland, J. C. (2019). A meta-analysis on the relationship between interoceptive awareness and alexithymia: Distinguishing interoceptive accuracy and sensibility. *Journal of Abnormal Psychology*, *128*(8), 765–776. https://doi.org/10.1037/ABN0000454

Vignola, R. C. B., & Tucci, A. M. (2014). Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. *Journal of Affective Disorders*, *155*(1), 104–109. https://doi.org/10.1016/J.JAD.2013.10.031

Vorst, H. C. M., & Bermond, B. (2001). Validity and reliability of the Bermond-Vorst Alexithymia Questionnaire. *Personality and Individual Differences*, *30*(3). https://doi.org/10.1016/S0191-8869(00)00033-7

Whitehead, W. E., Drescher, V. M., Heiman, P., & Blackwell, B. (1977). Relation of heart rate control to heartbeat perception. *Biofeedback and Self-Regulation*, *2*(4), 371–392. https://doi.org/10.1007/BF00998623

Widaman, K. F. (2012). Common factors versus components: Principals and principles, errors and misconceptions. In *Factor Analysis at 100: Historical Developments and Future Directions* (pp. 177–204). Routledge. https://doi.org/10.4324/9780203936764

Wiethaeuper, D., Balbinotti, M. A. A., Pelisoli, C., & Barbosa, M. L. L. (2005). Estudos da consistência interna e fatorial confirmatório da Escala Toronto de Alexitimia-20 (ETA-20). *Revista Interamericana de Psicología = Interamerican Journal of Psychology, ISSN 0034-9690, Vol. 39, Nº. 2, 2005, Págs. 221-230*, *39*(2), 221–230. https://dialnet.unirioja.es/servlet/articulo?codigo=2988616&info=resumen&idioma=POR

Wilson, L. B., Andrew, D., & Craig, A. D. (2002). Activation of spinobulbar lamina I neurons by static muscle contraction. *Journal of Neurophysiology*, *87*(3), 1641–1645. https://doi.org/10.1152/JN.00609.2001

Winship, C., & Mare, R. D. (1992). Models for Sample. *Annual Reviews*, *18*, 327–350.

Zamariola, G., Frost, N., Oost, A. Van, Corneille, O., & Luminet, O. (2019). *Relationship between interoception and emotion regulation: New evidence from mixed methods*. https://doi.org/10.1016/j.jad.2018.12.101

Tables

Table 1. Participants Sociodemographic Characteristics

Characteristics	**N = 1082** **Mean (SD) /n (%)**
Gender	
Men	481 (44.5%)
Woman	601 (55.5%)
Age	28.2 (8.9) / 18 - 65
Educational level	
Higher [a]	867 (80.1%)
Lower [b]	215 (19.9%)
Ethnicity (mv = 415)	
White	411 (61.6%)
Non-White	256 (38.4%)

Note. *N* = total sample. *n* = partial sample. *M* = mean. *SD* = standard deviation. [a] with post-school qualifications. [b] without post-school qualifications. mv = missing values

Table 2. Factor Loadings for the Items of the IAS-BR

Item	Description	Factors I	Factors II	Factors III	Communalities
4	I can always accurately perceive when I am thirsty	**.77**	-.07	-.08	.48
2	I can always accurately perceive when I am hungry	**.75**	-.15	-.08	.40
3	I can always accurately perceive when I am breathing fast	**.60**	-.10	.09	.34
5	I can always accurately perceive when I need to urinate	**.60**	.12	-.10	.41
6	I can always accurately perceive when I need to defecate	**.59**	.15	-.06	.45
17	I can always accurately perceive when I am in pain	**.49**	.07	.16	.41
15	I can always accurately perceive when my muscles are tired/sore	**.46**	.10	.13	.37
12	I can always accurately perceive when I am sexually aroused	**.43**	.26	-.05	.37
1	I can always accurately perceive when my heart is beating fast	**.42**	-.09	.14	.20
7	I can always accurately perceive when I encounter different tastes	**.37**	.17	.11	.32
11	can always accurately perceive when I am hot/cold	**.37**	.30	-.03	.36
10	can always accurately perceive when I am going to cough	-.08	**.78**	.01	.54
9	can always accurately perceive when I am going to sneeze	.00	**.74**	-.07	.54
13	can always accurately perceive when I am going to pass wind	.00	**.71**	-.02	.50
14	can always accurately perceive when I am going to burp	-.06	**.70**	.03	.45
8	can always accurately perceive when I am going to vomit	.09	**.38**	.10	.26
21	can always accurately perceive when something is going to be chy	-.09	.01	**.74**	.51
18	can always accurately perceive when my blood sugar is low	-.01	-.11	**.57**	.27
20	I can always accurately perceive when something is going to be ticklish	-.04	.12	**.57**	.39
16	I can always accurately perceive when I am going to get a bruise	.05	.03	**.55**	.35
19	I can always accurately perceive when someone is touching me affectionately rather than non-affectionately	.23	.00	**.36**	.51
Eigenvalue		6.1	1.2	0.8	
Variance (%)		29.2%	5.5%	4.0%	
Cronbach's Alpha		0.85	0.80	0.71	
McDonald's Omega		0.85	0.80	0.72	

Note. Factor loadings obtained with principal axis factoring (promax rotation). Highest item loading in bold. Underlined items contain cross-loadings.

Table 3. Pearson correlations between IAS-BR and construct validation measures

	The Interoception Accuracy Scale (IAS-BR)			
Validation constructs	Total	Interoceptive Signals	Bodily Functions	Tactile Signals
IAS-BR Total				
Interoceptive Signals	**.90**			
Bodily Functions	**.79**	**.60**		
Tactile Signals	**.73**	**.43**	**.43**	
DASS-21[a]				
Depression	**-.16**	**-.18**	-.09[†]	-.10[†]
Anxiety	**-.15**	**-.15**	-.12[†]	**-.07**
Stress	**-.18**	**-.18**	**-.14**	-.11[†]
Alexithymia				
TA 20 [b]	**-.26**	**-.22**	**-.17**	**-.16**
BV Q [c]	**-.16**	**-.16**	**-.10**	**-.11**
B AQ-Cognitive [d]	**-.24**	**-.26**	**-.14**	**-.16**
B AQ-Affective [e]	**.11**	**.11**	.05	.07
Autism pectrum [f]	**-.27**	**-.30**	**-.16**	**-.16**
Expres ity [g]	.06	.07	.04	.04
Belief	-.03	-.07	-.01	.03

Note. E faced indicates $p < .001$. [†] $p < .05$. [a] Depression, Anxiety and Stress Scale. [b] Toronto Alexithymia Scale. [c] Bermond-Vorst Alexith ia Questionnaire. [d] BVAQ Cognitive Dimension. [e] BVAQ Affective Dimension. [f] Autism-Spectrum Quotient (AQ-28). [g] Berkele Expressivity Questionnaire (BEQ). [h] Beliefs about Emotions Scale (BES).

Article 3

Salles, B. M., Maturana, W., Dos Santos, V. A, Mograbi, D. C. (2022). Effects of DBT-based interventions on alexithymia: a systematic review. *Cognitive Behaviour Therapy*, 1-22. https://doi.org/10.1080/16506073.2022.2117734

Effects of DBT-based Interventions on Alexithymia:

A Systematic Review

Bruno M. Salles[1], Wayson Maturana[1], Veruska A. Santos[1], Daniel C. Mograbi[1,2*]

1 – Department of Psychology, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil.

2 – Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom.

* Corresponding author. E-mail address: daniel.mograbi@kcl.ac.uk

Abstract

While dialectical behavior therapy (DBT) appears effective for some psychiatric conditions commonly associated with alexithymia, it is unclear whether DBT improves difficulties experienced by alexithymic individuals. This review investigated the current evidence on the effectiveness of DBT-based interventions in improving alexithymia. A qualitative synthesis of studies that investigated the efficacy of DBT on self-reported alexithymia was performed, identifying eligible studies using EBSCO/Essentials, Google Scholar, PubMed, Web of Science, and PsychINFO databases. Eight studies were identified. Overall, the results were inconclusive due to the heterogeneity of the studies but suggest that DBT-based interventions may be associated with self-reported decreases in alexithymia and increases in the ability to identify emotional states. The literature is limited by significant methodological problems, such as the low number of controlled trials, small samples, and high variability between DBT programs, which increases the risk of bias across study outcomes. More research is needed to reach conclusions regarding the effectiveness of DBT in improving alexithymia. Future studies should conduct randomized controlled trial designs (primarily with active treatment control conditions), greater standardization of DBT-based interventions, and a more in-depth examination of the level of participant involvement in long-term DBT-based interventions may help to understand whether DBT improves alexithymia difficulties.

Keywords: dialectical behavior therapy; DBT; alexithymia; systematic review; psychotherapy

Introduction

Alexithymia [from the Greek a (not) – lexis (words) – thymos (emotion); "no words for emotions"] is a term developed by Sifneos (1973) to describe patients who have psychosomatic disorders with marked restriction in the experience of emotions, difficulties in identifying and distinguishing their feelings from physical sensations and a particular struggle to find appropriate words to verbalize what they feel. These patients also have reduced imaginative abilities, presenting a paucity of dreams and fantasy life, as well as an external-oriented thinking style with marked avoidance of inner experiences (Nemiah & Sifneos, 1970; Sifneos, 1973). Alexithymia has prevalence rates ranging from 7% to 13% in community samples, although it is estimated to be several times higher in clinical samples (McGillivray et al., 2017).

Although originally described in patients with psychosomatic disorders, research has shown that alexithymia is found in a variety of physical and mental health problems, thus constituting a transdiagnostic risk factor for several psychiatric conditions, such as depression (Hemming et al., 2019), eating disorders (ED) (Berkovskaya et al., 2020), panic disorder (Šago et al., 2020), abuse of alcohol (Linn et al., 2021), dependence on other substances (Honkalampi et al., 2022). It is estimated that at least 50% of individuals with autism are alexithymic (Berthoz & Hill, 2005; Hill et al., 2004; Lombardo et al., 2007). Additionally, the lack of emotional awareness associated with alexithymia has been shown to affect quality of life and prevent connecting with others and forming close and meaningful relationships (Kennedy & Franklin, 2002).

There is evidence that alexithymia is linked to psychopathological symptoms because alexithymia impairs people's ability to regulate their emotions (Preece et

al., 2022). Indeed, research has consistently shown that highly alexithymic individuals tend to use more avoidant and maladaptive emotion regulation strategies, such as high suppression and low cognitive reappraisal (Chen et al., 2011; Laloyaux et al., 2015; Samson et al., 2012, 2015; Swart et al., 2009; Wagner & Lee, 2008) – (dys)regulation profiles also commonly found in psychopathologies (e.g., depression and anxiety; Sheppes et al., 2015). At least partially, alexithymia has been also characterized as a general failure of interoception (Brewer et al., 2016; Murphy et al., 2018). Impaired interoception is argued to represent a central impairment in all psychiatric disorders (Brewer et al., 2016; Murphy et al., 2018). Therefore, evidence suggests that alexithymia is prevalent in several disorders also because of its link with atypical interoception (Brewer et al., 2016; Herbert et al., 2011; Longarzo et al., 2015; Shah et al., 2016).

There has been debate as to whether alexithymia is an enduring personality trait or a circumstantial phenomenon, with absolute or relative stability (Cameron et al., 2014). Although alexithymia appears to be a relatively stable feature, evidence has suggested that it can be modified with psychological intervention (Cameron et al., 2014). Psychotherapy is expected to help patients with alexithymia develop some ability to recognize their feelings and communicate them to others, and to use emotional information to guide adaptive behavior (Ogrodniczuk et al., 2011). Nevertheless, patients with high alexithymic traits can be particularly challenging to psychotherapeutic treatment, as their inability to communicate emotions can induce negative reactions in therapists (Ogrodniczuk et al., 2011). A recent systematic review found that high alexithymia predicts less favorable outcomes in the treatment of mental disorders (Pinna et al., 2020). For example, a study showed that difficulty identifying emotions in alexithymic patients with ED

was a significant predictor of poor outcome in a range of therapeutic interventions (Speranza et al., 2011), whereas another found that lower levels of alexithymia at baseline were predictive of a higher probability of patients achieving recovery from ED after psychoeducational outpatient group treatment (Balestrieri et al., 2013). Similar unfavorable outcomes have been found in alexithymics with other pathologies, such as mood disorders (Ogrodniczuk et al., 2004), post-traumatic stress disorder (Löf et al., 2018), and somatoform disorders (Bach & Bach, 1995). A number of studies have shown that alexithymia, not autism spectrum disorder (ASD), predicts several socio-emotional impairments in individuals with autism, such as social isolation, atypical eye contact, impaired interoception, and abnormal emotional processing (Bird & Cook, 2013; Cook et al., 2013; Cuve et al., 2021; Gerber et al., 2019; Shah et al., 2016; Trevisan et al., 2016). In addition, alexithymia seems to be related to greater severity of anxiety disorders (Berardis et al., 2008), and to contribute to the emergence of somatic symptoms in depression, particularly following childhood trauma (Güleç et al., 2013).

A systematic review found greater reductions in alexithymia in psychological interventions that directly targeted alexithymia symptoms, such as poor fantasy and attention to internal experiences, difficulty identifying and differentiating feelings and bodily sensations, inability to express emotions, reduced emotion regulation, and interpersonal problems (Cameron et al., 2014). For example, Levant et al. (2009) found a significant reduction in alexithymia after participants joined a psychoeducational group including interventions on dysfunctional emotion beliefs, developing a vocabulary of emotions, learning to read others' emotions, identifying feelings or bodily sensations, and practical emotional experiencing exercises. In addition, Melin et al. (2010) observed that participants significantly reduced

alexithymia, mainly in terms of difficulties in identifying feelings and describing feelings, after undergoing a psychological intervention of 8 weekly training sessions designed to identify, differentiate, and verbally express emotions and associated bodily sensations. Although to date there is no gold standard intervention to treat alexithymia, evidence has suggested that therapeutic approaches aimed at emotional aspects, such as third-wave cognitive-behavioral therapies (CBT) (Kahl et al., 2012) that include mindfulness and emotional psychoeducation interventions (e.g., Dialectical Behavior Therapy - DBT; Linehan, 2014), hold promise for ameliorating deficits presented in alexithymic patients (Cameron et al., 2014; Norman et al., 2019).

DBT is a third-wave CBT intervention with the potential to improve emotional processing skills in alexithymia – mainly through mindfulness and emotion regulation modules, which encourage patients to get in touch with their feelings in order to identify, describe, and regulate them (Linehan, 2014). DBT is expected helps individuals learn to understand their emotions by exploring links between triggering events, thoughts, physical sensations, action tendencies and expressive behaviors. Thus, individuals may develop alternative ways of processing their emotions rather than engaging in dysregulated behaviors (Linehan, 2014). DBT has been shown to be effective in treating clinical populations who experience reduced emotion awareness and emotional dysregulation, such as borderline personality disorder (Kliem et al., 2010), bulimia nervosa (Safer et al., 2001), binge-eating disorder (Telch et al., 2001), problem gambling (Christensen et al., 2013), and substance use disorders (Dimeff & Linehan, 2008) – psychiatric conditions commonly associated with alexithymia (Luminet et al., 2018; Pinna et al., 2020).

Researchers have suggested that DBT-based interventions could also help individuals with high levels of alexithymia (Fink et al., 2010; Greene et al., 2020; Swannell et al., 2012), particularly in improving emotion identification and awareness (Brown et al., 2018). For example, one case study found improvements in alexithymia levels after a patient underwent 10 sessions of DBT-based intervention with mindfulness and emotion regulation skills training (Frye & Spates, 2012). DBT is especially listed for alexithymia because it helps patients learn to identify and describe their emotions (Brown et al., 2018; Greene et al., 2020) – a difficulty particularly found in alexithymic individuals (Bagby et al., 1994). In addition, people with high levels of alexithymia may benefit from learning and training emotion regulation strategies provided by DBT-based interventions (Fink et al., 2010; Swannell et al., 2012). However, highly alexithymic individuals may avoid DBT group training because of their concerns about social interactions (Panayiotou et al., 2020), which can substantially compromise their adherence to DBT treatment.

Although DBT is promisingly helpful for difficulties experienced by alexithymic individuals, empirical evidence on its effectiveness for alexithymia is still diffuse in the literature. In fact, to our knowledge, there is no systematic review assessing the effects of DBT-based interventions on alexithymia. Bringing together the findings on the issue is critical to clarifying whether DBT-based interventions may be indicated to treat alexithymia. Due to this gap in the literature, the present study aimed to carry out a systematic review of DBT-based interventions in alexithymia, regardless of sample characteristics (e.g., presence or absence of clinical diagnosis, gender, age, or any other demographic aspect).

Method

Search strategy

The systematic review was conducted according to the PRISMA statement (Moher et al., 2011). PUBMED, Google Scholar, EBSCO (Essentials), Web of Science, and PsychINFO were searched from inception until April 2022 with the following terms: “alexithymia” AND ("DBT" OR "Dialectical Behavior Therapy" OR "Dialectical Behavioral Therapy" OR "Dialectical Behaviour Therapy"). Advanced search was used in EBSCO (Essentials) to filter results with the term "alexithymia" in the abstract.

Eligibility

This review included studies of DBT-based interventions with psychiatric or non-clinical samples. Inclusion criteria were 1) full text available in English, 2) published in a peer-reviewed journal, 3) reporting a comparison of mean total alexithymia scores, 4) explicitly describing the intervention as based on DBT. No exclusion criteria were set regarding age, diagnosis, or other participant demographics.

Selection

The selection process is summarized in Figure 1. After excluding duplicates and non-articles (e.g., book chapters, dissertations, theses, etc.), the remaining studies had their abstracts screened. Abstracts that reported non-empirical studies (e.g., theoretical research, reviews, etc.), non-intervention studies (e.g., correlational research), or not available in English were excluded. Full texts were evaluated, excluding those that did not meet the inclusion criteria described.

PLEASE INSERT FIGURE 1 HERE

Data extraction

The following data were extracted from the 8 articles that met the inclusion criteria: (a) authors, (b) year of publication, (c) study location, (d) study design, (e) sample characteristics (sample size, gender, age, and recruitment), (f) participant inclusion/exclusion criteria, (g) assessment tool of alexithymia, (h) delivery and format of DBT intervention, (i) intervention provided to the comparison group (j) diagnostic assessment tools, (k) diagnosis, (l) findings. Effect sizes (Cohen's *d*) were calculated by dividing the difference between the group means by the combined standard deviation where this information was available.

Quality Assessment

Assessment of methodological quality and risk of bias was performed on the included studies based on the "Checklist for Assessing the Quality of Quantitative Studies" (Kmet et al., 2004). Items were scored depending on the degree to which specific criteria were met ("yes" = 2, "partial" = 1, "no" = 0). For criteria in which some study scored, studies that did not include that feature were penalized with a score of zero. Items not applicable in any of the reviewed studies were marked as "n/a" and were excluded from the total quality score calculation. A summary score was calculated for each article by adding the total score obtained on the relevant items and dividing by the total possible score [i.e.: 28 – (number of "n/a" x 2)]. The total scores of the articles were then converted into a percentage of meeting the criteria for all evaluated items. Higher percentages represent a stronger methodological quality. Good quality was defined as percentages greater than or

equal to75%; fair quality was defined as percentages of at least 55%; poor quality was defined as those with scores below 55%. A second rater (WM) independently assessed the eight studies using quality criteria to verify agreement. The checklist and ranking procedure were discussed before rankings were made to ensure consistency in the interpretation of checklist items. Inter-rater reliability for the quality scores of these eight articles was calculated and resulted in an almost perfect agreement (Kappa = 0.96). Remaining disagreements were resolved through discussion to determine a final rating.

Results

Rating of study quality

Overall, the methodological quality of the studies included in the review ranged from fair to good, with scores ranging from 63% to 83% (*m* = 73.5%, *SD* = 0.08) on the "Checklist for assessing the quality of quantitative studies" (Kmet et al., 2004, see Appendix A). Three studies were rated fair and five good quality. Higher quality studies involved randomized controlled trials, with detailed samples and adequate measurement. Common limitations among studies that impacted their quality rating included: absence of a control condition, insufficient sample size, and inappropriate statistical analysis methods.

Summary of included studies

A summary of the eight included studies is provided in Table 1. Studies were conducted between 2002 and 2022. Five studies were conducted in Europe (62.5%): France (*k* = 1), Sweden (*k* = 2), and Italy (*k* = 2); and three studies were performed in North America (37.5%): United States (*k* = 2) and Canada (*k* = 1).

PLEASE INSERT TABLE 1 HERE

Assessment of Alexithymia

The majority of studies employed the Toronto Alexithymia Scale 20 items (TAS-20; Bagby et al., 1994). It includes 20 items assessing three dimensions of alexithymia: difficulty identifying feelings (e.g., *"When I am upset. 1 don't know if 1 am sad, frightened, or angry"*), difficulty describing feelings (e.g., *"It is difficult for me to find the right words for my feelings"*), and externally-oriented thinking (e.g., *"I prefer talking to people about their daily activities rather than their feelings"*). One study applied the Eight-item General Alexithymia Factor Score (GAFS-8; Bemmouna et al., 2021), a non-validated adapted version of the TAS-20 with only 8 items.

Sample Characteristics

A total of 1148 participants were included, aged between 11 and 64 years. The mean age of the 8 samples was 27.89 years. The sample size was between 7 and 894 (median = 29.5 participants). Two studies (Holmqvist Larsson, Andersson, et al., 2020; Reilly et al., 2022) examined alexithymia outcomes in adolescents and adults. However, the sample of parents in the study conducted by Larsson, Andersson et al. (2020) did not undergo the DBT-based intervention, so this adult sample was not considered in the present review. Six studies examined alexithymia only in adults. Three samples included only female participants, while two samples included exclusively male participants. Although the criteria of the current review do not exclude articles with non-clinical samples, all studies included had samples with some diagnosis.

Clinical Diagnosis

Two studies included a mixed-diagnosis group of patients with EDs (Holmqvist Larsson, Lowén, et al., 2020; Reilly et al., 2022). One study recruited adults with autism spectrum disorders (ASD) (Bemmouna et al., 2021), and another included patients with borderline personality disorder (BPD) (McMain et al., 2013). One treatment included only women with post-traumatic stress disorder (PTSD) (Cloitre et al., 2002). Two studies investigated mentally ill inmate offenders (Bianchini et al., 2019; Lagrotteria et al., 2019). A further study recruited a sample of adolescents with multiple diagnoses (Holmqvist Larsson, Andersson, et al., 2020).

Study Designs

Three of the studies reviewed were controlled trials. Two studies (66.7%) used a treatment as usual (TAU) control design, while one study (33.3%) used a waiting list (WLC) design. Five included studies had single-group designs (i.e., without a control condition). McMain et al. (2013) reported only the results of the entire sample (without differentiating those who were treated with DBT and GPM), which made it impossible to compare treatments on the outcome of alexithymia. Four studies (50.0%) were described as pilot or feasibility studies.

Treatment Conditions

Among the DBT interventions, four of the included studies (Bemmouna et al., 2021; Bianchini et al., 2019; McMain et al., 2013; Reilly et al., 2022) implemented a standard DBT treatment protocol (including ongoing individual

psychotherapy, phone coaching, and DBT therapist consultation, in addition to the group skills-training component) as part of their treatment program. Half of the studies (k = 4) delivered all four DBT modules (i.e., mindfulness, emotion regulation, distress tolerance and interpersonal effectiveness) as part of treatment. One study was unclear which DBT modules were used (Lagrotteria et al., 2019). In Reilly et al. (2022), adolescent participants received a blend of DBT and family-based treatment. Bemmouna et al. (2021) made slight adaptations to better accommodate autistic patients (e.g., maintain visual, auditory, and temperature stable environment; reductions in text and more illustrations; and brief activity on social anxiety in the first session). In Bianchini et al. (2019), participants in the DBT intervention group also received treatment as usual, which could include antipsychotic medications. Participants in the study conducted by McMain et al. (2013) were treated with DBT or GPM (an outpatient treatment with individual psychodynamic therapy, case management, and symptom-targeted medication management), however, participants from both treatments were later regrouped into a single sample, making it impossible to compare effectiveness between groups.

Three studies used interventions merely based on the principles of DBT together with other treatments. For example, the intervention used by Holmqvist Larsson, Lowén et al. (2020) and Holmqvist Larsson, Andersson, et al. (2020) was based on DBT and Emotion Regulation Group Therapy (ERGT), Unified Protocol (UP), and Acceptance and Commitment Therapy (ACT). Furthermore, Cloitre et al. (2002) used an intervention based on generic DBT and cognitive behavioral therapy (CBT) strategies. There was high variability in the duration of DBT-based interventions provided, ranging from interventions with sessions over 5 weeks to sessions delivered over 12 months. The number of sessions delivered in the 8

studies ranged from 5 to over 100 (counting individual and group therapy sessions), with session duration ranging from 1h to 2h15. Three studies (37.5%) included a follow-up period to evaluate the results. The duration of this follow-up varied across studies from 1-month post-intervention to 24 months post-intervention.

Synthesis of Findings on Alexithymia (see Table 2)

Pre- to Post-Treatment Effects

Among the eight studies included, six of them (75.0%) reported reductions in alexithymia measures after DBT intervention. Overall, within-group TAS-20 total score effect sizes when examining the effectiveness of DBT intervention ranged from d = 0.09 to 1.07 (trivial to large), indicating high variability in alexithymia outcomes. Included studies with control condition showed mixed results in alexithymia outcomes. One study with women diagnosed with PTSD found no pre-to-midtreatment changes in TAS-20 total score between WLC and DBT-based intervention, but showed mid-to-posttreatment reductions in alexithymia after DBT-based intervention (Cloitre et al., 2002). A study with inpatient forensic patients found no pre-to-posttreatment changes in alexithymia after DBT treatment compared to TAU (Bianchini et al., 2019). Another study of inmates with mental illness found a pre-to-posttreatment changes in alexithymia with DBT intervention in comparison with TAU (Lagrotteria et al., 2019). The between-group effect sizes of the TAS-20 total score in the 3 studies with a comparison group ranged from d = 0.07 to 0.91, indicating null to large effects. Among the included studies with single-group designs (k = 4), three reported significant improvements in alexithymia immediately after DBT intervention. It is noteworthy that among these studies, the only one that found no changes in alexithymia after DBT treatment had

a very small sample (n = 7) and used a non-validated adapted version of the TAS-20 with only 8 items (Bemmouna et al., 2021).

PLEASE INSERT TABLE 2 HERE

DBT Standard vs. DBT-based Interventions

Among the included studies, five implemented a purely DBT treatment, with four following standardized DBT protocols. The within-group effect sizes of the TAS-20 total score in those studies where this information was available to be calculated ranged from d = 0.09 to 0.63 (trivial to medium), indicating high variability in the results. Among these studies in which the intervention was purely DBT, only two were controlled trials. They presented between-group effect sizes on the TAS-20 total score ranging from d = 0.07 to 0.91 (trivial to large). Regarding the three studies with interventions purely based on DBT principles (along with other treatments), the within-group effect sizes ranged from d = 0.57 to 1.07 (medium to large). Among them, only one compared the intervention with a control condition (WLC), demonstrating an effect size of TAS-20 total score of d = 0.73, indicating a large effect size.

Pretreatment to Follow-up Effects

Of the three studies that included follow-up outcomes, two study studies reported alexithymia outcome. One study (Bemmouna et al., 2021) found no significant difference in alexithymia at post-treatment or after follow-up (4 months). Another study (Reilly et al., 2022) found improvements in alexithymia at

post-treatment and at follow-up (24 months), however, means and standard deviations were not provided to calculate the effect size.

Treatment Effects for Specific Samples

The two studies that investigated the efficacy of DBT in samples with EDs demonstrated significant improvement in alexithymia after treatment (Reilly et al., 2022; Larsson, Lowén et al., 2020), with a within-group effect size of $d = 0.75$ for EDs samples – means and standard deviations were not provided by Reilly et al. (2022) to calculate effect sizes. One study with a very small sample of individuals with autism found no change in alexithymia after DBT treatment (Bemmouna et al., 2021). Another study (McMain et al., 2013) with a BPD sample did not report TAS-20 total score, but found significant improvements in the ability to identify feelings (TAS-DIF; $d = 0.51$) comparing before and after DBT treatment, although not in other aspects of alexithymia, such as the ability to describe feelings (TAS-DDF) and externally oriented thinking (TAS-EOT). Two studies investigated the effectiveness of DBT in inmates with mental illness. One of them examined male inmates with BPD and showed no significant difference in alexithymia (Bianchini et al., 2019). Another (Lagrotteria et al., 2019) had a sample of inmates with mixed diagnoses (e.g., BPD, antisocial personality disorder, schizophrenia, bipolar disorder, etc.) and found improvements in alexithymia after treatment with DBT compared with TAU ($d = 0.91$). A study of women with PTSD (Cloitre et al., 2002) found statistically significant reductions in TAS-20 total score after DBT-based intervention compared with WLC ($d = 0.73$). Finally, a study of adolescents with mixed diagnoses (Larsson, Andersson, et al., 2020) found significantly reduced

alexithymia measures after DBT-based intervention, with a within-group effect size of $d = 0.57$.

Sample Size Comparison

Two of the included studies had very small samples ($n \leq 10$) in DBT treatment conditions, with both showing no statistically significant change in alexithymia. Among those with larger samples ($n \geq 15$) that underwent DBT treatment, all studies ($k = 6$) found significant improvements in alexithymia, with effect sizes within-group of TAS-20 total score ranging from $d = 0.57$ to 1.07 (medium to large), and effect sizes between-group ranging from $d = 0.73$ to 0.91, indicating a large effect size of DBT treatment compared to control conditions among larger samples.

Discussion

Since its inception, DBT has been investigated to treat a variety of psychiatric conditions (e.g., BPD, suicidal behavior, EDs, and substance abuse disorders), generally showing promising results (see Bedics, 2020). Although these disorders are commonly associated with alexithymia (Pinna et al., 2020), to date no study has reviewed the effectiveness of DBT-based interventions to ameliorate alexithymia deficits. The current review systematically reviewed the current literature to address this empirical gap. The review identified 8 studies that provided inconclusive evidence on the effectiveness of DBT in the treatment of alexithymia, relative to treatment as usual or waitlist control designs.

Several methodological limitations that hamper the reliability of studies and their results in the literature that examines this research question could be observed.

The major shortcomings found in the present review were the low number of controlled trials (k = 3), very small samples in some studies, few studies with follow-up measures (k = 2), and the high variability in the nature of DBT interventions delivered, which limits the replicability of the studies.

Interpretation of Outcomes

The large variability in treatment effects of DBT in reducing alexithymia is indicative of the high variability in study design and methodologies examined in this review. These investigated the effectiveness of treatment in clinical or forensic inpatient settings with adults and adolescents ranging in diagnoses such as depression, anxiety disorders, schizophrenia, antisocial personality disorder, ASD, BPD, PTSD, etc. The DBT interventions appeared to be relatively efficient in treating alexithymia for most diagnoses, except for samples with ASD and BPD. However, the low efficacy of DBT treatment in these samples can be explained by the small number of participants. For example, a study with an ASD sample (Bianchini et al., 2019) had only 10 subjects participating in DBT treatment, which may explain the lack of statistically significant changes in alexithymia in this group. Indeed, samples with smaller sample sizes found no difference in alexithymia, while studies with more robust samples showed large within-group effect sizes in improving alexithymia among those who underwent DBT treatment. Future research should incorporate larger samples to arrive at statistically significant results to reach any conclusion as to the effectiveness of DBT in alexithymia. None of the reviewed studies consisted of non-clinical samples, since all participants were diagnosed with some pathology. Therefore, it is unclear whether DBT principles

can be used to improve alexithymia in non-clinical samples, an issue that may be resolved by further investigations.

Furthermore, it is difficult to draw any firm conclusions about the effectiveness of DBT in improving alexithymia as there was high variability in the interventions delivered. Five studies in this review delivered purely DBT interventions, with within-group effect sizes ranging from trivial to medium. The between-group effect sizes of these studies ranged from trivial to large, indicating highly variable results when purely DBT treatment is compared with control conditions. The three studies with interventions merely based on DBT principles had within-group effect sizes ranging from medium to large, with the only one of these studies having a control condition presenting a large effect size. These results may suggest that interventions merely based on DBT, which also implement principles of other treatments (such as ACT, CBT, and ERGT), are more effective in treating alexithymia than those purely DBT. However, the high variability of effect sizes and samples (in terms of age and diagnosis) makes it difficult to establish a firm judgment about which type of intervention is most promising for alexithymia. Understanding the critical components of DBT skills training (e.g., conducting studies with replicable interventions) is critical to developing a consensus in the literature on the ideal and critical principles of DBT to achieve significant improvement in alexithymia. It is possible that the mindfulness and emotion regulation components of DBT could be useful for alexithymics to get in touch with their emotions and associated physical sensations, as well as identify, describe, and regulate their feelings. DBT also includes an interpersonal effectiveness module, which may help highly alexithymic individuals overcome some of their difficulties in dealing with other people. However, the usual

discomfort of alexithymics with social interactions may decrease their adherence to training groups (Panayiotou et al., 2020), thus limiting the success of group-based DBT interventions. Exploring which aspects of alexithymia are linked to negative treatment outcomes, including worse prognosis and low treatment adherence, may be important in tailoring interventions to specific patient groups. In addition, future research should focus on investigating which components of DBT are especially effective in improving alexithymia difficulties (as well as related constructs, such as interoception and emotion regulation), and which aspects of the intervention may challenge the permanence of alexithymic patients in treatment (e.g., group meetings).

In the current systematic review, most studies had a single-group design, which may overinflate the relative effectiveness of the DBT intervention. In addition, among studies with comparison groups, the control condition was often not described in detail. For example, one study (Lagrotteria et al., 2019) used supportive psychotherapy and non-specific skills grouping, making it unclear whether these procedures are covered by DBT modules or not. Therefore, evidence for between-group effects of the DBT for alexithymia should be viewed with caution as it is based on a limited number of studies. Future research aimed at improving alexithymia should conduct randomized controlled trials comparing the effectiveness of DBT interventions compared to other more detailed standardized treatments. From the studies reviewed, it is uncertain how much participants were engaged in the intervention, to understand a possible moderating effect in improving difficulties related to alexithymia. The effectiveness of DBT may be underestimated in the current review simply because alexithymic individuals did not commit to participating in sessions or practicing skills outside the session.

Additionally, more research is needed with longer follow-up of results, as only two of the studies in the current review reported follow-up outcomes. Given the complex and relatively stable nature of alexithymia, more research is needed to understand how improvement in alexithymia-related difficulties develops over time after DBT treatment.

Limitations

A meta-analysis was not considered appropriate for this review due to the limited number of studies (mainly randomized controlled trials) and observed heterogeneity in the DBT interventions delivered. To increase the quality of the studies included in the review, the current systematic review is limited to articles published in the literature in peer-reviewed journals, thus excluding dissertations, theses, and book chapters. Therefore, there may have been more studies eligible for inclusion that were not considered.

The current review was limited to self-report measures. With the exception of one, all other studies reviewed used TAS-20 to assess alexithymia. The TAS-20 is the most widely used measure of alexithymia, although this tool has some noteworthy limitations. One of these limitations is an inherent bias for any self-report measure of alexithymia. Highly alexithymic people may not be able to assess their own deficits reliably or accurately on a self-report scale (Taylor & Bagby, 2013). To address this potential shortcoming, some authors suggest the application of clinician-rated instruments such as the Toronto Structured Interview for Alexithymia (Bagby et al., 2006). However, these instruments have their own limitations, such as costly conduction in large samples, training of interviewers,

high dependence on the quality of the interviewer-patient interaction, etc. (Cameron et al., 2014).

The TAS-20 has also been criticized for exclusively measuring cognitive factors, thus underestimating emotional aspects of alexithymia (Vorst & Bermond, 2001). The BVAQ-40 is an alternative instrument to the TAS-20, typically used by researchers interested in assessing both cognitive and affective components of alexithymia (Goerlich & Aleman, 2018). However, the very claim of an affective component of alexithymia is still a matter of debate among scholars on the subject (Bagby et al., 2007; Goerlich, 2018; Preece et al., 2017). In addition, the validity of the alexithymia construct can be better clarified. Is alexithymia basically the result of a general failure of interoception? What exactly is the link between alexithymia and emotion regulation in affective disorders? Some efforts have been made to understand the relationship and differences between alexithymia and related concepts (Preece et al., 2022; Brewer et al., 2016; Murphy et al., 2018). Future work may explore whether potential reductions in alexithymia after treatments are accompanied by improvements in other overlapping constructs.

Finally, the specificity of the TAS-20 has been challenged by psychiatric comorbidities (e.g., depression) that can interfere with outcomes, as negative affects linked to a critical appraisal of one's own abilities, which can lead to high self-reported alexithymia (de Groot et al., 1995; Subic-Wrana et al., 2005). Using negative affects as covariates in research may allow for a better understanding of changes in alexithymia over the course of treatments. However, only two studies in the current review analyzed covariates that could be confounding due to their links with alexithymia (McMain et al., 2013; Reilly et al., 2022). Future studies may perform analyzes controlling for relevant covariates (e.g., symptoms of depression

and anxiety) to rule out the hypothesis that improvements in alexithymia were not solely due to a decrease in overall negative affect.

Conclusion

The current systematic review evaluated the empirical literature on the effectiveness of DBT interventions in reducing alexithymia. Although our results indicate that DBT-based interventions do improve alexithymia, the literature is currently inconclusive as to the effectiveness of DBT for alexithymia relative to other existing psychological treatments. While there is some promise, to draw conclusions about the effects of DBT interventions on alexithymia, future studies should: (a) target larger samples to achieve potentially statistically significant results; (b) investigate improvements in alexithymia in non-clinical samples; (c) explore which DBT components are most effective in alleviating alexithymia difficulties, and which are detrimental to treatment adherence in alexithymic individuals; (d) understand which alexithymia traits may interfere with the success of DBT and treatments in general; (e) identify whether reductions in alexithymia after interventions are accompanied by improvements in other overlapping constructs; (f) conduct randomized controlled trials to compare the effectiveness for alexithymia of DBT interventions compared to other standardized treatments; (g) perform follow-up explorations to understand how improvements in alexithymia develop over time after DBT treatment; and (h) perform analyzes to control for confounding covariates of alexithymia (e.g., negative affects).

Disclosure of Interest

The authors declare no conflict of interests.

References

Bach, M., & Bach, D. (1995). Predictive Value of Alexithymia: A Prospective Study in Somatizing Patients. *Psychotherapy and Psychosomatics*, *64*(1), 43–48.

Bagby, R. M., Parker, J. D. A., & 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*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bagby, R. M., Taylor, G. J., Parker, J. D. A., & Dickens, S. E. (2006). The Development of the Toronto Structured Interview for Alexithymia: Item Selection, Factor Structure, Reliability and Concurrent Validity. *Psychotherapy and Psychosomatics*, *75*(1), 25–39. https://doi.org/10.1159/000089224

Bagby, R. M., Taylor, G. J., Quilty, L. C., & Parker, J. D. A. (2007). Reexamining the Factor Structure of the 20-Item Toronto Alexithymia Scale: Commentary on Gignac, Palmer, and Stough. *Https://Doi.Org/10.1080/00223890701629771*, *89*(3), 258–264. https://doi.org/10.1080/00223890701629771

Balestrieri, M., Isola, M., Baiano, M., & Ciano, R. (2013). Psychoeducation in binge eating disorder and EDNOS: A pilot study on the efficacy of a 10-week and a 1-year continuation treatment. *Eating and Weight Disorders*, *18*(1), 45–51. https://doi.org/10.1007/s40519-013-0014-2

Bedics, J. (2020). *The Handbook of Dialectical Behavior Therapy: Theory, Research, and Evaluation*. Academic Press.

Bemmouna, D., Coutelle, R., Weibel, S., & Weiner, L. (2021). Feasibility, Acceptability and Preliminary Efficacy of Dialectical Behavior Therapy for Autistic Adults without Intellectual Disability: A Mixed Methods Study. *Journal of Autism and Developmental Disorders*, 1–18. https://doi.org/10.1007/s10803-021-05317-w

Berardis, D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C.,

Valchera, A., Marilde, C., Salerno, R., & Ferro, F. (2008). The Impact of Alexithymia on Anxiety Disorders: a Review of the Literature. *Current Psychiatry Reviews*, *4*(2), 80–86. https://doi.org/10.2174/157340008784529287

Berkovskaya, M. A., Tarasenko, A. A., Fadeev, V. V., & Gurova, O. Y. (2020). [Alexithymia and its relation with eating disorders and obesity]. *Problemy Endokrinologii*, *66*(2), 42–48. https://doi.org/10.14341/PROBL12416

Berthoz, S., & Hill, E. L. (2005). The validity of using self-reports to assess emotion regulation abilities in adults with autism spectrum disorder. *European Psychiatry*, *20*(3), 291–298. https://doi.org/10.1016/J.EURPSY.2004.06.013

Bianchini, V., Cofini, V., Curto, M., Lagrotteria, B., Manzi, A., Navari, S., Ortenzi, R., Paoletti, G., Pompili, E., Pompili, P. M., Silvestrini, C., & Nicolò, G. (2019). Dialectical behaviour therapy (DBT) for forensic psychiatric patients: An Italian pilot study. *Criminal Behaviour and Mental Health*, *29*(2), 122–130. https://doi.org/10.1002/cbm.2102

Bird, G., & Cook, R. (2013). Mixed emotions: the contribution of alexithymia to the emotional symptoms of autism. *Translational Psychiatry 2013 3:7*, *3*(7), e285–e285. https://doi.org/10.1038/tp.2013.61

Brewer, R., Cook, R., science, G. B.-R. S. open, & 2016, undefined. (2016). Alexithymia: a general deficit of interoception. *Royalsocietypublishing.Org*, *3*(10). https://doi.org/10.1098/rsos.150664

Brown, T. A., Avery, J. C., Jones, M. D., Anderson, L. K., Wierenga, C. E., & Kaye, W. H. (2018). The Impact of Alexithymia on Emotion Dysregulation in Anorexia Nervosa and Bulimia Nervosa over Time. *European Eating Disorders Review*, *26*(2), 150–155. https://doi.org/10.1002/erv.2574

Cameron, K., Ogrodniczuk, J., & Hadjipavlou, G. (2014). Changes in alexithymia following psychological intervention: A review. *Harvard Review of Psychiatry*, *22*(3), 162–178. https://doi.org/10.1097/HRP.0000000000000036

Chen, J., Xu, T., Jing, J., & Chan, R. C. K. (2011). Alexithymia and emotional

regulation: A cluster analytical approach. *BMC Psychiatry*, *11*(1), 1–6. https://doi.org/10.1186/1471-244X-11-33/TABLES/2

Christensen, D. R., Dowling, N. A., Jackson, A. C., Brown, M., Russo, J., Francis, K. L., & Umemoto, A. (2013). A Proof of Concept for Using Brief Dialectical Behavior Therapy as a Treatment for Problem Gambling. *Behaviour Change*, *30*(2), 117–137. https://doi.org/10.1017/BEC.2013.10

Cloitre, M., Koenen, K. C., Cohen, L. R., & Han, H. (2002). Skills training in affective and interpersonal regulation followed by exposure: A phase-based treatment for PTSD related to childhood abuse. *Journal of Consulting and Clinical Psychology*, *70*(5), 1067. https://doi.org/10.1037/0022-006X.70.5.1067

Cook, R., Brewer, R., Shah, P., & Bird, G. (2013). Alexithymia, not autism, predicts poor recognition of emotional facial expressions. *Psychological Science*, *24*(5), 723–732. https://doi.org/10.1177/0956797612463582

Cuve, H. C., Castiello, S., Shiferaw, B., Ichijo, E., Catmur, C., & Bird, G. (2021). Alexithymia explains atypical spatiotemporal dynamics of eye gaze in autism. *Cognition*, *212*(April). https://doi.org/10.1016/j.cognition.2021.104710

de Groot, J. M., Rodin, G., & Olmsted, M. P. (1995). Alexithymia, depression, and treatment outcome in bulimia nervosa. *Comprehensive Psychiatry*, *36*(1), 53–60. https://doi.org/10.1016/0010-440X(95)90099-H

Dimeff, L. A., & Linehan, M. M. (2008). Dialectical Behavior Therapy for Substance Abusers. *Addiction Science & Clinical Practice*, *4*(2), 39. https://doi.org/10.1151/ASCP084239

Fink, E. L., Anestis, M. D., Selby, E. A., & Joiner, T. E. (2010). Negative urgency fully mediates the relationship between alexithymia and dysregulated behaviours. *Personality and Mental Health*, *4*(4), 284–293. https://doi.org/10.1002/pmh.138

Gerber, A. H., Girard, J. M., Scott, S. B., & Lerner, M. D. (2019). Alexithymia – Not autism – is associated with frequency of social interactions in adults. *Behaviour Research and Therapy*, *123*(January), 103477.

https://doi.org/10.1016/j.brat.2019.103477

Goerlich, K. S. (2018). The multifaceted nature of alexithymia - A neuroscientific perspective. *Frontiers in Psychology*, *9*(AUG), 1614. https://doi.org/10.3389/FPSYG.2018.01614/BIBTEX

Goerlich, K. S., & Aleman, A. (2018). Neuroimaging Studies of Alexithymia. In *Alexithymia*. Cambridge University Press. https://doi.org/10.1017/9781108241595.015

Greene, D., Boyes, M., & Hasking, P. (2020). The associations between alexithymia and both non-suicidal self-injury and risky drinking: A systematic review and meta-analysis. *Journal of Affective Disorders*, *260*, 140–166. https://doi.org/10.1016/j.jad.2019.08.088

Güleç, M. Y., Altintaş, M., Inanç, L., Bezgin, Ç. H., Koca, E. K., & Güleç, H. (2013). Effects of childhood trauma on somatization in major depressive disorder: The role of alexithymia. *Journal of Affective Disorders*, *146*(1), 137–141. https://doi.org/10.1016/j.jad.2012.06.033

Hemming, L., Haddock, G., Shaw, J., & Pratt, D. (2019). Alexithymia and its associations with depression, suicidality, and aggression: An overview of the literature. *Frontiers in Psychiatry*, *10*(APR), 203. https://doi.org/10.3389/FPSYT.2019.00203/BIBTEX

Herbert, B. M., Herbert, C., & Pollatos, O. (2011). On the Relationship Between Interoceptive Awareness and Alexithymia: Is Interoceptive Awareness Related to Emotional Awareness? *Journal of Personality*, *79*(5), 1149–1175. https://doi.org/10.1111/J.1467-6494.2011.00717.X

Hill, E., Berthoz, S., & Frith, U. (2004). Brief Report: Cognitive Processing of Own Emotions in Individuals with Autistic Spectrum Disorder and in Their Relatives. *Journal of Autism and Developmental Disorders*, *34*(2).

Holmqvist Larsson, K., Andersson, G., Stern, H., & Zetterqvist, M. (2020). Emotion regulation group skills training for adolescents and parents: A pilot study of an add-on treatment in a clinical setting. *Clinical Child Psychology and Psychiatry*, *25*(1), 141–155. https://doi.org/10.1177/1359104519869782

Holmqvist Larsson, K., Lowén, A., Hellerstedt, L., Bergcrona, L., Salerud, M., & Zetterqvist, M. (2020). Emotion regulation group skills training: A pilot study of an add-on treatment for eating disorders in a clinical setting. *Journal of Eating Disorders*, *8*(1), 141–155. https://doi.org/10.1186/s40337-020-00289-1

Honkalampi, K., Jokela, M., Lehto, S. M., Kivim, M., Aki, €, & Virtanen, M. (2022). Association between alexithymia and substance use: A systematic review and meta-analysis. *Scandinavian Journal of Psychology*. https://doi.org/10.1111/SJOP.12821

Kahl, K. G., Winter, L., & Schweiger, U. (2012). The third wave of cognitive behavioural therapies: What is new and what is effective? *Current Opinion in Psychiatry*, *25*(6), 522–528. https://doi.org/10.1097/YCO.0b013e328358e531

Kennedy, M., & Franklin, J. (2002). Skills-based Treatment for Alexithymia: An Exploratory Case Series. *Behaviour Change*, *19*(3), 158–171. https://doi.org/10.1375/BECH.19.3.158

Kliem, S., Kröger, C., & Kosfelder, J. (2010). Dialectical behavior therapy for borderline personality disorder: A meta-analysis using mixed-effects modeling. *Journal of Consulting and Clinical Psychology*, *78*(6), 936–951. https://doi.org/10.1037/A0021015

Kmet, L. M., Lee, R. C., & Cook, L. S. (2004). *Standard quality assessment criteria for evaluating primary research papers from a variety of fields*. HTA Initiative.

Lagrotteria, B., Nicolò, G. A., Paoletti, G., Bianchini, V., Bilotta, E., Fedele, C., Silveri, L., Foroni, B., & Marconi, M. (2019). Impulsivity and violent behavior: the employment of dialectical behavior therapy in a forensic setting. *Rassegna Italiana Di Criminologia*, 77–84.

Laloyaux, J., Fantini, C., Lemaire, M., Luminet, O., & Larøi, F. (2015). Evidence of Contrasting Patterns for Suppression and Reappraisal Emotion Regulation Strategies in Alexithymia. *Journal of Nervous and Mental Disease*, *203*(9), 709–717. https://doi.org/10.1097/NMD.0000000000000353

Levant, R. F., Hall, R. J., Williams, C. M., & Hasan, N. T. (2009). Gender Differences in Alexithymia. *Psychology of Men and Masculinity*, *10*(3). https://doi.org/10.1037/a0015652

Linehan, M. M. (2014). *DBT skills training manual*. Guilford Publications.

Linn, B. K., Zhao, J., Bradizza, C. M., Lucke, J. F., Ruszczyk, M. U., & Stasiewicz, P. R. (2021). Alexithymia disrupts emotion regulation processes and is associated with greater negative affect and alcohol problems. *Journal of Clinical Psychology*, *77*(12), 2915–2928. https://doi.org/10.1002/JCLP.23279

Löf, J., Clinton, D., Kaldo, V., & Rydén, G. (2018). Symptom, alexithymia and self-image outcomes of Mentalisation-based treatment for borderline personality disorder: A naturalistic study. *BMC Psychiatry*, *18*(1), 1–9. https://doi.org/10.1186/s12888-018-1699-6

Lombardo, M. V., Barnes, J. L., Wheelwright, S. J., & Baron-Cohen, S. (2007). Self-Referential Cognition and Empathy in Autism. *PLOS ONE*, *2*(9), e883. https://doi.org/10.1371/JOURNAL.PONE.0000883

Longarzo, M., D'Olimpio, F., Chiavazzo, A., Santangelo, G., Trojano, L., & Grossi, D. (2015). The relationships between interoception and alexithymic trait. The Self-Awareness Questionnaire in healthy subjects. *Frontiers in Psychology*, *6*, 1149. https://doi.org/10.3389/FPSYG.2015.01149/BIBTEX

Luminet, O., Bagby, R. M., & Taylor, G. J. (2018). *Alexithymia: Advances in Research, Theory, and Clinical Practice*. Cambridge University Press. https://play.google.com/books?id=AvxsDwAAQBAJ

McGillivray, L., Becerra, R., & Harms, C. (2017). Prevalence and Demographic Correlates of Alexithymia: A Comparison Between Australian Psychiatric and Community Samples. *Journal of Clinical Psychology*, *73*(1), 76–87. https://doi.org/10.1002/JCLP.22314

McMain, S., Links, P. S., Guimond, T., Wnuk, S., Eynan, R., Bergmans, Y., & Warwar, S. (2013). An exploratory study of the relationship between changes in emotion and cognitive processes and treatment outcome in borderline personality disorder. *Psychotherapy Research*, *23*(6), 658–673.

https://doi.org/10.1080/10503307.2013.838653

Melin, E. O., Thulesius, H. O., & Persson, B. A. (2010). Affect School for chronic benign pain patients showed improved alexithymia assessments with TAS-20. *BioPsychoSocial Medicine*, *4*(1), 1–10. https://doi.org/10.1186/1751-0759-4-5/TABLES/5

Moher, D., Altman, D. G., Liberati, A., & Tetzlaff, J. (2011). PRISMA statement. *Epidemiology*.

Murphy, J., Brewer, R., Hobson, H., Catmur, C., & Bird, G. (2018). Is alexithymia characterised by impaired interoception? Further evidence, the importance of control variables, and the problems with the Heartbeat Counting Task. *Biological Psychology*, *136*, 189–197. https://doi.org/10.1016/J.BIOPSYCHO.2018.05.010

Nemiah, J. C., & Sifneos, P. E. (1970). Psychosomatic Illness: A Problem in Communication. *Psychotherapy and Psychosomatics*, *18*(1–6), 154–160. https://doi.org/10.1159/000286074

Norman, H., Marzano, L., Coulson, M., & Oskis, A. (2019). Effects of mindfulness-based interventions on alexithymia: A systematic review. *Evidence-Based Mental Health*, *22*(1), 36–53. https://doi.org/10.1136/ebmental-2018-300029

Ogrodniczuk, J. S., Piper, W. E., & Joyce, A. S. (2004). Residual symptoms in depressed patients who successfully respond to short-term psychotherapy. *Journal of Affective Disorders*, *82*(3), 469–473. https://doi.org/10.1016/j.jad.2004.03.007

Ogrodniczuk, J. S., Piper, W. E., & Joyce, A. S. (2011). Effect of alexithymia on the process and outcome of psychotherapy: A programmatic review. *Psychiatry Research*, *190*(1), 43–48. https://doi.org/10.1016/J.PSYCHRES.2010.04.026

Panayiotou, G., Leonidou, C., Constantinou, E., & Michaelides, M. P. (2020). Self-Awareness in alexithymia and associations with social anxiety. *Current Psychology*, *39*(5), 1600–1609. https://doi.org/10.1007/s12144-018-9855-1

Pinna, F., Manchia, M., Paribello, P., & Carpiniello, B. (2020). The impact of alexithymia on treatment response in psychiatric disorders: A systematic review. *Frontiers in Psychiatry*, *11*, 311. https://doi.org/10.3389/fpsyt.2020.00311

Preece, D. A., Mehta, A., Becerra, R., Chen, W., Allan, A., Robinson, K., Boyes, M., Hasking, P., & Gross, J. J. (2022). Why is alexithymia a risk factor for affective disorder symptoms? The role of emotion regulation. *Journal of Affective Disorders*, *296*(January 2021), 337–341. https://doi.org/10.1016/j.jad.2021.09.085

Preece, D., Becerra, R., Allan, A., Robinson, K., & Dandy, J. (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. https://doi.org/10.1016/J.PAID.2017.08.003

Reilly, E. E., Brown, T. A., Arunagiri, V., Kaye, W. H., & Wierenga, C. E. (2022). Exploring changes in alexithymia throughout intensive dialectical behavior therapy for eating disorders. *European Eating Disorders Review*. https://doi.org/10.1002/erv.2887

Safer, D. L., Telch, C. F., & Agras, W. S. (2001). Dialectical behavior therapy for bulimia nervosa. *American Journal of Psychiatry*, *158*(4), 632–634. https://doi.org/10.1176/APPI.AJP.158.4.632/ASSET/IMAGES/LARGE/J118T1.JPEG

Šago, D., Babić, G., Bajić, Ž., & Filipčić, I. (2020). Panic Disorder as Unthinkable Emotions: Alexithymia in Panic Disorder, a Croatian Cross-Sectional Study. *Frontiers in Psychiatry*, *11*, 466. https://doi.org/10.3389/FPSYT.2020.00466/BIBTEX

Samson, A. C., Hardan, A. Y., Podell, R. W., Phillips, J. M., & Gross, J. J. (2015). Emotion Regulation in Children and Adolescents With Autism Spectrum Disorder. *Autism Research*, *8*(1), 9–18. https://doi.org/10.1002/AUR.1387

Samson, A. C., Huber, O., & Gross, J. J. (2012). Emotion regulation in Asperger's syndrome and high-functioning autism. *Emotion*, *12*(4), 659–665.

https://doi.org/10.1037/A0027975

Shah, P., Hall, R., Catmur, C., & Bird, G. (2016). Alexithymia, not autism, is associated with impaired interoception. *Cortex*, *81*, 215–220. https://doi.org/10.1016/J.CORTEX.2016.03.021

Sheppes, G., Suri, G., & Gross, J. J. (2015). Emotion regulation and psychopathology. *Annual Review of Clinical Psychology*, *11*(December 2014), 379–405. https://doi.org/10.1146/annurev-clinpsy-032814-112739

Sifneos, P. E. (1973). The Prevalence of 'Alexithymic' Characteristics in Psychosomatic Patients. *Psychotherapy and Psychosomatics*, *22*(2–6), 255–262. https://doi.org/10.1159/000286529

Speranza, M., Loas, G., Guilbaud, O., & Corcos, M. (2011). Are treatment options related to alexithymia in eating disorders? Results from a three-year naturalistic longitudinal study. *Biomedicine and Pharmacotherapy*, *65*(8), 585–589. https://doi.org/10.1016/j.biopha.2010.01.009

Subic-Wrana, C., Bruder, S., Thomas, W., Lane, R. D., & Köhle, K. (2005). Emotional awareness deficits in inpatients of a psychosomatic ward: A comparison of two different measures of alexithymia. *Psychosomatic Medicine*, *67*(3), 483–489. https://doi.org/10.1097/01.PSY.0000160461.19239.13

Swannell, S., Martin, G., Page, A., Hasking, P., Hazell, P., Taylor, A., & Protani, M. (2012). Child maltreatment, subsequent non-suicidal self-injury and the mediating roles of dissociation, alexithymia and self-blame. *Child Abuse and Neglect*, *36*(7–8), 572–584. https://doi.org/10.1016/j.chiabu.2012.05.005

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with Feelings: Characterization of Trait Alexithymia on Emotion Regulation Strategies and Cognitive-Emotional Processing. *PLOS ONE*, *4*(6), e5751. https://doi.org/10.1371/JOURNAL.PONE.0005751

Taylor, G. J., & Bagby, R. M. (2013). Psychoanalysis and Empirical Research: The Example of Alexithymia. *Journal of the American Psychoanalytic Association*, *61*(1), 99–133. https://doi.org/10.1177/0003065112474066

Telch, C. F., Agras, W. S., & Linehan, M. M. (2001). Dialectical behavior therapy for binge eating disorder. *Journal of Consulting and Clinical Psychology*, *69*(6), 1061–1065. https://doi.org/10.1037/0022-006X.69.6.1061

Trevisan, D. A., Bowering, M., & Birmingham, E. (2016). Alexithymia, but not autism spectrum disorder, may be related to the production of emotional facial expressions. *Molecular Autism*, *7*, 46. https://doi.org/10.1186/s13229-016-0108-6

Vorst, H. C. M., & Bermond, B. (2001). Validity and reliability of the Bermond–Vorst Alexithymia Questionnaire. *Personality and Individual Differences*, *30*(3), 413–434. https://doi.org/10.1016/S0191-8869(00)00033-7

Wagner, H., & Lee, V. (2008). Alexithymia and individual differences in emotional expression. *Journal of Research in Personality*, *42*(1), 83–95. https://doi.org/10.1016/J.JRP.2007.04.001

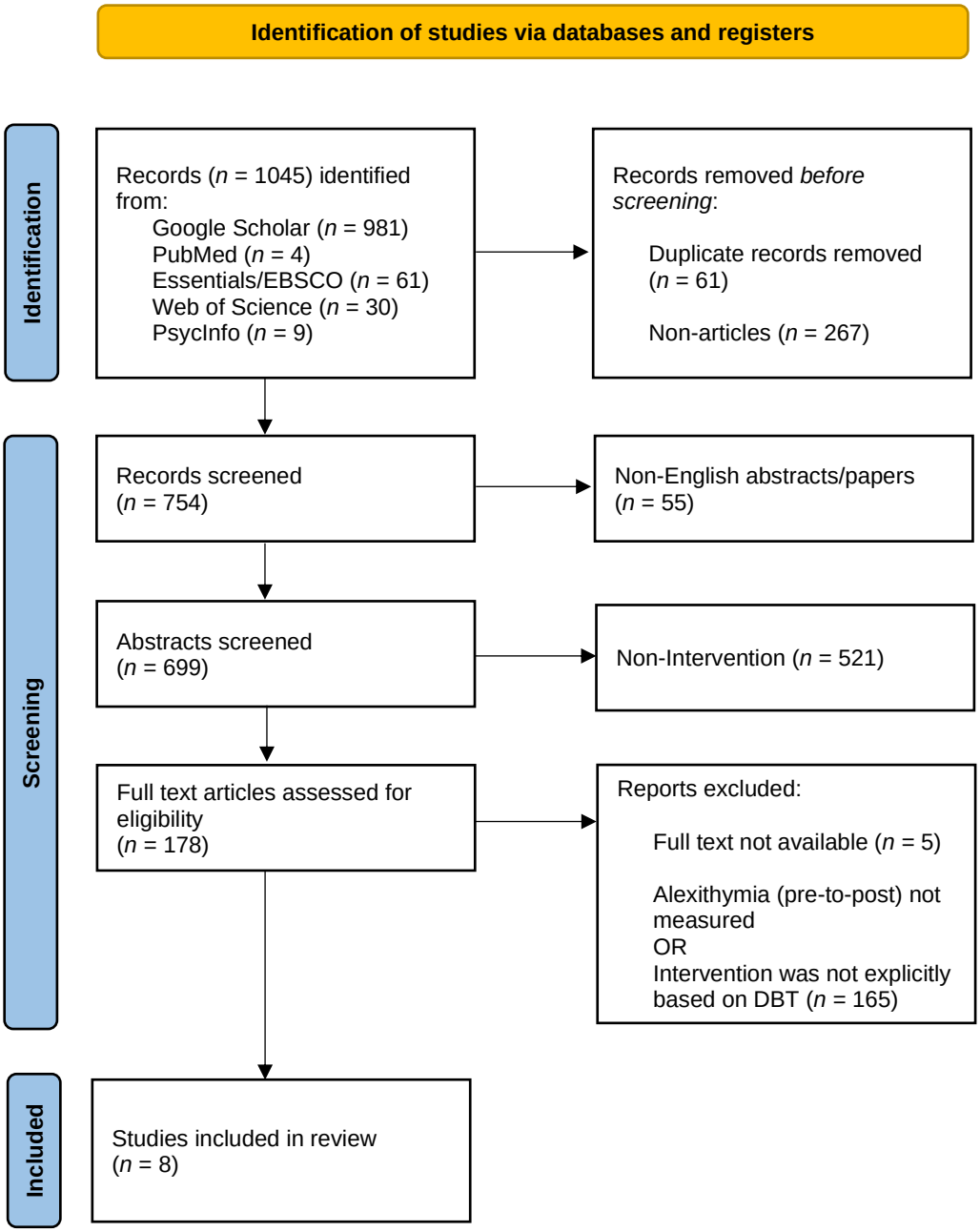

Figure 1. Flow diagram of study selection process.

Table 1. Study Characteristics Sample

Study	Sample	Inclusion or Exclusion Criteria	DBT Intervention	Control Condition	Alexithymia Assessment	Results
Reilly et al., (2022) USA	*N* = 894 (91% female) Adult: (*n* = 512) Adolescent: (*n* = 382) *M* age = 21.76 years Outpatients with mixed diagnoses of EDs.	**(I)** Participants enrolled in a PHP of EDs. **(E)** None listed.	**Delivery:** 10h of treatment per day, for 6 days a week (*m* = 83.27 days). **Format:** Individual therapy, phone coaching, consultation meetings, and DBT skills groups (all 4 modules).	None	TAS-20 Baseline, 1-month post-treatment, 6-12-24-month follow-up	Even after controlling for relevant covariates, there were significant decreases in alexithymia from intake to discharge and discharge to follow-up.
Bemmouna et al., (2021) France	*N* = 7 (43% female) Adult sample *M* age = 27.71 years Outpatients with ASD.	**(I)** Previous diagnoses of ASD. **(E)** Absence of ID.	**Delivery:** 2h15 weekly skills training group session; weekly 1-h individual therapy session; and weekly 2h therapist consultation. **Format:** Individual therapy, phone coaching, consultation meetings, and DBT skills groups (all 4 modules).	None	Adapted TAS: GAFS-8 items Baseline, post-treatment, 4-month follow-up	Alexithymia is the only dimension that did not show statistically significant improvement following DBT neither post-treatment nor at follow-up.
Larsson, Lowén et al., (2020) Sweden	*N* = 29 (100% female) Adult sample *M* age = 21.41 years Outpatients with mixed diagnoses of EDs.	**(I)** Meet DSM-V criteria for ED with difficulties with emotion regulation. **(E)** Psychosis or mania, drug or alcohol abuse, or severe suicidality.	**Delivery:** Five 2h weekly sessions in a group setting. **Format:** Group intervention, based on treatment principles from DBT and ERGT, UP, and ACT.	None	TAS-20 Baseline, post-treatment	Alexithymia showed significant improvement after treatment.
Larsson, Andersson e (2020) Sweden	Adolescent: (*n* = 20) 100% female *M* age = 15.95 years Outpatient with mixed diagnoses.	**(I)** Ongoing treatment for at least one psychiatric diagnosis and had moderate to severe functional impairment. **(E)** Psychosis or mania, drug or alcohol abuse, severe anorexia, ID or ASD.	**Delivery:** Five 2h weekly sessions of emotion regulation skills training in groups. **Format:** Group intervention, based on treatment principles from DBT and ERGT, UP, and ACT.	None	TAS-20 Baseline, post-treatment	For adolescents, measures of alexithymia were significantly reduced.
Lagrotteria e (2019) Italy	*N* = 30 (Age and gender not informed) DBT: (*n* = 15) Control: (*n* = 15) Forensic psychiatric inpatients.	**(I)** IQ > 70; past history of impulsive and aggressive behaviors; significant score at TAS-20; personal initiative to the DBT group. **(E)** None listed.	**Delivery:** 1h group sessions for 12 months. **Format:** Skills training only in group format (unspecified modules).	**TAU:** Supportive psychotherapy and nonspecific skills group.	TAS-20 Baseline, post-treatment	Interaction effect between TAS-20 and the DBT experimental group. This treatment was more effective in improving alexithymia in the experimental group than in the control group.
Bianchini et al., (2019) Italy	*N* = 21 (100% male) DBT: (*n* = 10) Control: (*n* = 11) Adult sample *M* age = 41.79 years Forensic psychiatric inpatients with BPD.	**(I)** Meet criteria for BPD; History of violence to others. **(E)** Cognitive deficit (QI < 70); comorbid neurological diseases.	**Delivery:** 12 months of weekly 1h sessions of individual therapy and 2h weekly group sessions. **Format:** Individual therapy, coaching meetings, and group skills training (all 4 modules).	**TAU:** Usual REMS treatments alone.	TAS-20 Baseline, post-treatment	There were no significant differences between groups in alexithymia scores.
McMain et al., (2013) Canada	*N* = 80 (84% female) Adult sample *M* age = 32.60 years Outpatients with BPD.	**(I)** Meet criteria for BPD; history of at least 2 suicidal behaviors or non-suicidal self-injurious behavior. **(E)** Substance dependence, PD, BD, delirium, dementia, or mental retardation.	**Delivery:** 12 months of individual therapy (1h/week), group skills training (2h/week), telephone coaching (24/7), and consultation meetings (2h/week). **Format:** Individual therapy, phone coaching, DBT therapist consultation, and group skills training (all 4 modules).	None	TAS-20 Baseline, post-treatment	Significant increased ability to identify feelings (TAS-DIF). Non-significant changes in TAS-DDF, and TAS-EOT.

Cloitre et al., (2002) USA	*N* = 58 (100% female) DBT: (*n* = 31) Control: (*n* = 27) Adult sample *M* age = 34 years Outpatients with PTSD.	**(I)** Meet criteria for PTSD and trauma history. **(E)** Substance-dependence disorder; BPD diagnosis; recent hospitalization; thought disorder.	**Delivery:** 16 sessions delivered over a 12-week period with 1h or 1.5h sessions. **Format:** Intervention group sessions based on DBT and CBT strategies.	**WLC:** 12 weeks and monitored weekly by 15-minute phone sessions.	TAS-20 Baseline, mid-treatment, post-treatment	Non-significant pre-to-midtreatment improvements in the TAS–20 and significant mid-to-posttreatment improvements in the TAS–20 after intervention.

Note: EDs = eating disorders; DBT = dialectical behavior therapy; TAS-20 = Toronto Alexithymia Scale; ASD = autism spectrum disorder; IQ = intelligence quotient; ID = intellectual disability; GAFS-8 = Eight-item General Alexithymia Factor Score; ERGT = emotion regulation group therapy; UP = unified protocol; ACT = acceptance and commitment therapy; BPD = borderline personality disorder; TAU = treatment as usual; REMS = *Residenze per la Esecuzione della Misura di Sicurezza*; DIF = difficulties identifying feelings; DDF = difficulties describing feelings; EOT = externally oriented thinking; PTSD = post-traumatic stress disorder; CBT = cognitive behavioral therapy; WLC = waitlist control.

Table 2. Study Outcomes at Post-Treatment and Follow-Up on Alexithymia as a Function of DBT Treatment

Study	Pre-post DBT treatment: Within-group effect sizes (Cohen's *d*)	F/U DBT treatment: Within-group effect sizes (Cohen's *d*)	Between-treatment group comparisons
Reilly et al., (2022)	Means and standard deviations not provided.	Means and standard deviations not provided.	N/A
Bemmouna et al., (2021)	*ns* (*d* = 0.30)	*ns* (*d* = 0.66)	N/A
Larsson, Lowén et al., (2020).	TAS-20 (Total): *d* = 0.75	N/A	N/A
Larsson, Andersson et al., (2020)	Adolescent sample TAS-20 (Total): *d* = 0.57 TAS-20 (DDF): d = 0.54 TAS-20 (DIF): *d* = 0.48 TAS-20 (EOT): *d* = 0.52	N/A	N/A
Lagrotteria et al., (2019)	TAS-20 (Total): *d* = 0.63	N/A	Significant group differences found at post-treatment. Participants in the DBT intervention reported a significantly reduced total TAS-20 score compared to the control TAU condition (*d* = 0.91)
Bianchini et al., (2019)	TAS-20 (Total): *ns* (*d* = 0.09) TAS-20 (DIF): *ns* (*d* = 0.17) TAS-20 (DDF): *ns* (*d* = 0.00) TAS-20 (EOT): *ns* (*d* = 0.25)	N/A	TAS-20 (Total): *ns* (*d* = 0.07) TAS-20 (DIF): *ns* (*d* = 0.18) TAS-20 (DDF): *ns* (*d* = 0.03) TAS-20 (EOT): *ns* (*d* = 0.18)
McMain et al., (2013)	TAS-20 (DIF): *d* = 0.51 TAS-20 (DDF): *ns* (*d* = 0.25) TAS-20 (EOT): *ns* (*d* = 0.19)	N/A	N/A
Cloitre et al., (2002)	TAS-20 (Total): *d* = 1.07	N/A	Significant group differences found at post-treatment. Participants in the DBT intervention reported a significantly reduced total TAS-20 score compared to the control waitlist condition (*d* = 0.73)

Appendix A: Quality ratings outcome.

	Items of the "Checklist for assessing the quality of quantitative studies" (Kmet et al., 2004)															
Study	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**	**Q12**	**Q13**	**Q14**	**Total**	**Hit %**
Reilly et al., (2022)	2	1	2	2	0	n/a	n/a	2	2	2	2	2	1	2	20/24	83%
Bemmouna et al., (2021)	2	1	2	2	0	n/a	n/a	0	0	2	2	0	2	2	15/24	63%
Larsson, Lowén et al., (2020)	2	1	2	2	0	n/a	n/a	2	1	2	2	0	2	2	18/24	75%
Larsson, Andersson et al., (2020)	2	1	2	2	0	n/a	n/a	2	1	2	2	0	2	2	18/24	75%
Lagrotteria et al., (2019)	2	2	2	0	0	n/a	n/a	2	1	1	2	0	2	1	15/24	63%
Bianchini et al., (2019)	2	2	2	1	1	n/a	n/a	2	1	0	2	0	1	2	16/24	67%
McMain et al., (2013)	2	1	2	2	0	n/a	n/a	2	2	2	2	2	1	2	20/24	83%
Cloitre et al., (2002)	1	2	2	2	1	n/a	n/a	2	1	2	2	0	2	2	19/24	79%

Note. Good quality was defined as percentages ≥75%; fair quality was defined as percentages of at least 55%; poor quality was defined as those with scores below 55%. Q1: Question or objective sufficiently described?; Q2: Design evident and appropriate to answer study question?; Q3: Method of subject selection (and comparison group selection, if applicable) or source of information/input variables (e.g., for decision analysis) is described and appropriate; Q4: Subject (and comparison group, if applicable) characteristics or input variables/information (e.g., for decision analyses) sufficiently described?; Q5: If random allocation to treatment group was possible, is it described?; Q6: If interventional and blinding of investigators to intervention was possible, is it reported?; Q7: If interventional and blinding of subjects to intervention was possible, is it reported?; Q8: Outcome and (if applicable) exposure measure(s) well defined and robust to measurement/misclassification bias? Means of assessment reported?; Q9: Sample size appropriate?; Q10: Analysis described and appropriate?; Q11: Some estimate of variance (e.g., confidence intervals, standard errors) is reported for the main results/outcomes (i.e., those directly addressing the study question/objective upon which the conclusions are based)?; Q12: Controlled for confounding?; Q13: Results reported in sufficient detail?; Q14: Do the results support the conclusions?.

Article 4

Salles, B. M., Maturana, W., Mograbi, D. C. (Manuscript submitted). Exploring the Multidimensional Relationship between Alexithymia and Empathy: A Systematic Review

Exploring the Multidimensional Relationship between Alexithymia and Empathy: A Systematic Review

Bruno M. Salles[1*], Wayson Maturana[1], Daniel C. Mograbi[1,2]

1 – Department of Psychology, Pontifical Catholic University of Rio de Janeiro (PUC-Rio), Brazil.

2 – Institute of Psychiatry, Psychology & Neuroscience, King's College London, United Kingdom.

[*] Corresponding author. E-mail address: contact@brunosalles.com

Abstract

Alexithymia is a condition characterized by marked socioemotional impairment that frequently co-occurs in conditions related to reduced empathy, such as autism spectrum disorder. Despite numerous studies exploring the relationship between alexithymia and empathy, the results are often inconclusive. As empathy is a multidimensional construct, deficits in specific components of empathy may be more pronounced in individuals with alexithymia than generalized deficits. To investigate this issue, a systematic review was conducted to evaluate the effects of alexithymia on different components of empathy, which were categorized into trait- and state-empathy domains, and further subdivided into cognitive empathy, affective empathy, empathic concern, and personal distress. Reviewing 83 publications, deficits in trait mature empathy components (including cognitive empathy, affective empathy, and empathic concern) were consistently linked to increased alexithymia symptoms, particularly externally oriented thinking. On the other hand, increased trait personal distress was mainly associated with higher levels of overall alexithymia and language-related difficulties, such as identifying and describing feelings. Due to the limited number of studies, no robust conclusions could be drawn regarding the relationship between alexithymia and state empathy. These findings underscore the importance of assessing specific empathy components when investigating the relationship between alexithymia and individual differences in empathy. Furthermore, viewing alexithymia as a unifactorial construct may obscure more intricate relationships between alexithymic traits and different empathy components.

Keywords: Alexithymic, Empathy Deficits, Systematic Review, Personal Distress, Compassion, Perspective-taking, Emotion Contagion

Introduction

Alexithymia is personality trait characterized by a marked difficulty in recognizing and verbally describing one's feelings, as well as a concrete style of thinking (R. M. Bagby, Parker, et al., 1994). Despite being considered subclinical, alexithymia is a transdiagnostic risk factor commonly found in several diseases, such as depression (Hemming et al., 2019), eating disorders (Berkovskaya et al., 2020), panic disorder (Šago et al., 2020), abuse of alcohol (Linn et al., 2021), substance dependence (Honkalampi et al., 2022). Alexithymia frequently co-occurs with autism, with an estimated 50% of individuals with autism spectrum disorder (ASD) meeting the criteria for high alexithymia (Berthoz & Hill, 2005; Hill et al., 2004; Lombardo et al., 2007), compared to less than 10% in the general population (Salminen et al., 1999). While difficulties in social interaction are often thought to be key features of ASD (Mul et al., 2018), there is considerable heterogeneity in social competence among individuals with ASD (Bird & Cook, 2013). Since people with alexithymia also experience reduced connection with others and struggle to form close, meaningful relationships (Kennedy & Franklin, 2002b), it is reasonable to assume that alexithymic traits contribute to some extent to ASD symptoms.

Indeed, studies have consistently shown that alexithymia, rather than ASD, predicts socioemotional deficits in individuals with autism, including poor emotion recognition, atypical eye contact, and reduced empathy (Bird et al., 2010, 2011; Cook et al., 2013; Cuve et al., 2021; see also Bird & Cook, 2013). While there is evidence of a negative association between alexithymia and empathy, with some studies reporting reduced empathy in those with alexithymia (Lyvers et al., 2020; Chalah et al., 2020), other studies have found no effect (Mayer et al., 1990; Paricio

et al., 2020; Ricciardi et al., 2015). These inconsistencies may be explained by differences in measures and components of empathy.

Empathy is a complex construct that encompasses multiple facets and processes, and can be distinguished in terms of durability: trait or state (Hall & Schwartz, 2019). Trait empathy reflects an individual's inherent tendency to be empathetic, whereas state empathy refers to more transient and context-dependent forms of empathy that are induced by specific situations or stimuli (Donaldson et al., 2022; Song et al., 2019). In addition to durability, empathy can be classified into two main components: affective empathy (AE), which pertains to experiencing vicarious emotions for others, and cognitive empathy (CE), which involves recognizing and comprehending others' feelings and perspectives (Donaldson et al., 2022; Hall & Schwartz, 2019). AE is further divided into two subtypes: personal distress (PD) and empathic concern (EC). PD involves sharing the emotional state of another, often described as emotional contagion, but it can lead to experiencing self-directed discomfort when exposed to others' distress. In contrast, EC involves exhibiting compassionate and prosocial emotions towards others, particularly when they are in distress (Hall & Schwartz, 2019). It is worth mentioning that mature empathy involves a balance of cognitive empathy, affective empathy, and empathic concern, where individuals use cognitive empathy to understand the other's perspective, experience affective empathy to feel their emotions, and are motivated by empathic concern to act in a way that helps them (Davis, 1983; Decety & Jackson, 2004). This balanced approach allows individuals to be compassionate and supportive while avoiding personal distress and emotional contagion.

Given the multidimensional nature of empathy, individuals with alexithymia may experience impairment in some empathy components but not others.

Nevertheless, to date, there has been no systematic review examining the relationship between alexithymia and the various dimensions of empathy. To address this gap in the literature, the present study aims to conduct a comprehensive review of the association between different facets of empathy and alexithymia, without regard to participant characteristics such as clinical diagnosis, gender, age, or any other demographic features.

Method

Search strategy

The systematic review followed the guidelines of the PRISMA statement (Moher et al., 2011) and used the following databases: Web of Science, Wiley Online Library, Cochrane Library, Embase, PubMed, EBSCO host (Discovery Service), and PsychINFO (PsycNET) from their inception until September 2022. The search terms used were "alexithymia" and "empathy". Advanced search options were used when available to filter results by abstract, English language, and peer-reviewed studies. Only studies that explicitly assessed empathy using a valid measure were included in the review, and the names of all empathy measures used are reported in Table 1 for trait empathy measures and Table 2 for state empathy measures.

PLEASE INSERT TABLE 1 HERE

Measures of Theory of Mind (ToM), such as the Reading the Mind in the Eyes Task (Baron-Cohen et al., 2001), were not included in this review because it is still unclear whether ToM and empathy are part of the same construct or independent constructs (Dvash & Shamay-Tsoory, 2014; Kanske et al., 2015,

2016). Additionally, a recent systematic review has already explored the relationship between alexithymia and ToM (Pisani et al., 2021). The current review accepted any alexithymia measure for inclusion.

PLEASE INSERT TABLE 2 HERE

Eligibility and Selection

This review aimed to include studies that investigated the linear relationship between variables of interest, such as correlations between measures of alexithymia and empathy, or group comparisons (e.g., t-tests comparing high versus low/non-alexithymic individuals on measures of empathy). To be eligible for inclusion, studies had to meet the following criteria: 1) full text available in English, 2) published in a peer-reviewed journal, and 3) include a correlation or group comparison with measures of both alexithymia and empathy. There were no exclusion criteria based on age, diagnosis, or other participant demographics. The selection process is illustrated in Figure 1. After removing duplicates and non-articles (e.g., book chapters, dissertations, theses, etc.), the remaining studies were screened based on their abstracts.

Non-English abstracts/papers, unsuitable articles (e.g., commentary, review, case report, register of controlled trial, or animal sample), and studies that did not measure alexithymia or empathy were excluded. The full texts of the remaining studies were then evaluated, and those that did not meet the inclusion criteria were also excluded. Before examining the research on the relationship between empathy and alexithymia, this review provides a classification of the measures and tasks used to assess empathy, as well as a description of the questionnaires used to quantify

alexithymia. The measurement scales and tasks were independently reviewed by the authors, and any disagreements were resolved through discussion.

PLEASE INSERT FIGURE 1 HERE

Empathy components

In this section, we provide an overview of the measures used to assess empathy included in this review. First, we categorized them into measures that assess trait empathy (measures of propensity or disposition to be empathetic) and state empathy (objective or performance-based measures of empathy). Second, both trait and state empathy measures were subcategorized into cognitive empathy, affective empathy, and empathic concern. "Personal distress" was only categorized in terms of trait, as no state personal distress test was found. Therefore, trait empathy has been subdivided into the following categories: [1] trait overall empathy (T-OE); [2] trait cognitive empathy (T-CE); [3] trait affective empathy (T-AE); [4] trait empathic concern (T-EC); and [5] trait personal distress (T-PD) (Table X). State empathy was subdivided into: [6] state overall empathy (S-OE); [7] state cognitive empathy (S-CE); [8] state affective empathy (S-AE); and [9] state empathic concern (S-EC) (Table Z). Therefore, the empathy construct was broken down into 9 key categories. Across the 83 studies that met inclusion criteria, 22 measures of empathy were employed.

Alexithymia components

After reporting the measures used to assess empathy, we will now describe the measures used to estimate alexithymia. Six different measures of alexithymia were used in the 83 studies that met the inclusion criteria. Despite this, most studies used the TAS-20 (Bagby et al., 1994) to assess alexithymia. Alexithymia was

evaluated in general terms: [1] overall alexithymia, and in the following alexithymic symptoms: [2] difficulty identifying feelings (DIF), [3] difficulty describing feelings (DDF), and [4] externally oriented thinking (EOT). The first two symptoms are language-related impairments because the individual struggles to label and verbalize emotions. The last alexithymic symptom refers to a particular cognitive style more focused on concrete issues than affective ones.

Results

Summary of included studies

A summary of the 83 included studies is provided in Appendix A and Appendix B. Studies were conducted between 1990 and 2022. Twenty-nine studies were conducted in Europe (34.94%), fifteen were conducted in Asia (18.07%), eleven were conducted in North America (USA and Canada; 13.25%), seven studies were conducted in Latin America (8.43%) and two studies were conducted in Oceania (2.41%).

Sample Characteristics

A total of 28,035 participants were included, aged between 8 and 71 years. The sample size was between 30 and 7,584 (median = 160 participants). Most studies (k = 79) examined the relationship between empathy and alexithymia in adults (95.2%). The remaining four studies used samples from children and/or adolescents (4.8%). Five studies included only female participants, while four samples exclusively included male participants. Fifty-seven studies exclusively used healthy samples (e.g., general population, undergraduate students, employees, school students, etc.), while twenty-six studies used samples with at least one diagnosis (see below).

Clinical Diagnosis

Eight studies recruited participants with autism spectrum disorder (ASD), six with adult samples and two with children and adolescents. Three studies included patients with eating disorders (EDs), with two examining exclusively at anorexia nervosa (AN) (Kerr-Gaffney et al., 2020; Beadle et al., 2013). Velotti et al (2019) used a sample of inmates for violent crimes with traits of antisocial personality

disorder (APD). Khosravani et al. (2020) investigated patients with asthma. One study compared healthy adults with adults with alcohol use disorder (AUD) (Maurage et al., 2011). Two studies compared high and low alexithymia in patients with major depressive disorder (MDD) and healthy controls (Banzhaf et al., 2018; Hoffmann et al., 2016). Multiple sclerosis patients were used in two studies (Gleichgerrcht et al., 2015; Chalah et al., 2020). Ricciardi et al. (2015) recruited patients with Parkinson's Disease (PD). Patients with social anxiety disorder (SAD) were used in one study (Bayraktutan et al., 2020). Two studies investigated patients with traumatic brain injury (TBI) (Neumann et al., 2014; Williams & Wood, 2010). One study examined people with low and high alexithymia with AN, borderline personality disorder (BPD), and healthy controls (Guttman & Laporte, 2002).

The relationship between Empathy and Alexithymia

For each measure, we initially reported studies examining this relationship in healthy subjects, followed by studies that included clinical samples. Then, we detailed the results of studies using the multidimensional approach to empathy, starting with domains (trait- vs. state- empathy). In each domain, we divided these findings into the following categories: (1) cognitive empathy, (2) affective empathy, (3) empathic concern, and (4) personal distress.

Findings by measures of trait empathy

Findings of the Interpersonal Reactivity Index (IRI)

The IRI is a self-reported measure of general empathic disposition consisting of 28 items. It assesses two cognitive (IRI-PT: perspective-taking and IRI-FA: fantasy) and two affective (IRI-EC: empathic concern and IRI-PT: personal distress) factors of empathy (Davis, 1983). Responses are given on a 5-point Likert

scale, with each factor containing seven items. The higher the score of the described factor, the higher the empathic disposition of the individual.

The IRI was the most widely used measure of empathy in the studies reviewed, with 43 (51.8%) out of 83 studies using it to measure empathy in multiple dimensions. Some studies only assessed T-OE (*k* = 10; Lyvers et al., 2020; Hoffmann et al., 2016; Zhang et al., 2022; Gleichgerrcht et al., 2015; Tremblay et al., 2021; Teten et al., 2008; Martínez-Velázquez et al., 2020; Önal et al., 2021; Shalev & Uzefovsky, 2020; Redondo et al., 2018), while others investigated different categories of trait empathy (*k* = 33; e.g., Banzhaf et al., 2018; Guttman & Laporte, 2002; Grynberg et al., 2010). Only a few examined a single IRI factor, such as Zhang et al. (2020) and Teten et al. (2008), who explored only the IRI-EC, and Romero-Martínez (2021) and Brett et al. (2022), who measured only IRI-PD.

Among the nine studies conducted with healthy participants that investigated the relationship between IRI total score and the total score of the 20-item version of the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994)–the most widely used self-report scale to measure alexithymia–, six studies reported a negative association between T-OE and overall alexithymia. Consistent with these findings, Zhang et al. (2022) observed a negative correlation between IRI total score and TAS-20 total score in a large sample of participants (N = 888). This is in line with similar results reported in other large (Redondo et al., 2018; Shalev et al., 2020) and smaller (Martínez-Velázquez, 2020; Sonnby-Borgström, 2009) studies, suggesting that higher levels of alexithymia are associated with lower levels of trait empathy.

Tremblay et al. (2021) reported no relationship between IRI total score and TAS-20 total score in their first study, but found a negative correlation between T-OE and overall alexithymia in their second study. Lyvers et al. (2020) found no

relationship between overall alexithymia and T-OE. In a study with only male participants, Önal et al. (2021) found an unexpected positive relationship between IRI total score and TAS-DIF. No study with an exclusively clinical sample investigated the relationship between total scores of IRI and TAS-20. However, a study with a mixed sample of patients with multiple sclerosis (MS) and healthy subjects found a strong negative correlation ($r = -0.68$) between IRI total score and TAS-20 total score (Gleichgerrcht et al., 2015).

In 25 studies on healthy individuals, the effects of alexithymia on different factors of the Interpersonal Reactivity Index (IRI) were examined. All 19 studies that investigated IRI factors related to cognitive empathy found a connection with alexithymia (e.g., Lee et al., 2020; Hao et al., 2020). However, results varied between IRI-FA and IRI-PT. Grynberg et al. (2010) observed that IRI-PT was negatively correlated with TAS-20 total score, a pattern also found in ten other studies with healthy subjects (Martingano et al., 2022; Herrero-Fernández et al., 2022; Himichi et al., 2021; Gleichgerrcht & Decety, 2013; Eddy & Hansen, 2021; Karras et al., 2022; Lyvers et al., 2017; Diotaiuti et al., 2021; Patil & Silani, 2014; Sonnby-Borgström, 2009). In six studies, people with high alexithymia had lower IRI-PT scores compared to those with low alexithymia (Martínez-Velázquez et al., 2017; Gleichgerrcht & Decety, 2013; Moriguchi et al., 2007; Alkan Härtwig et al., 2020; Nam et al., 2020; Patil & Silani, 2014), suggesting that increased alexithymia leads to a decrease in perspective-taking in healthy individuals. In studies exclusively focused on clinical samples, Silani et al. (2018) reported a negative correlation between IRI-PT and TAS-20 total score in individuals with ASD.

In studies that combine clinical and healthy individuals, the results regarding the effects of overall alexithymia on perspective-taking are less conclusive, as four

out of seven studies reported effects. For example, Guttman and Laporte (2002) observed higher IRI-PT in people with low alexithymia than in those with high alexithymia in a sample combining healthy women and women who had BPD or AN, a result similar to that found by Banzhaf et al. (2018) and Hoffmann et al. (2016) with MMD patients and healthy controls. On the other hand, Santiesteban et al. (2021) found that overall alexithymia (TAS-20 total) was significantly correlated with reduced perspective-taking disposition (IRI-PT) in healthy individuals and those with ASD. However, other studies have reported no effects of overall alexithymia on perspective-taking disposition in samples composed of healthy individuals and individuals with ASD (Zıvralı Yarar et al., 2021; McKenzie et al., 2022) and EDs (Brewer et al., 2019).

It is possible that not all symptoms of alexithymia have an impact on perspective-taking. In healthy individuals, Grynberg et al. (2010) found no association between IRI-PT and TAS-DIF, even after controlling for depression, and also with TAS-DDF after controlling for anxiety. Similarly, Lyvers et al. (2018) and Diotaiuti et al. (2021) found that reduced IRI-PT was only related to TAS-EOT. Neumann et al. (2014) also observed a negative association between IRI-PT and TAS-EOT in patients with traumatic brain injury. These findings suggest that perspective-taking may be more uniformly influenced by EOT than by other alexithymia symptoms. However, this hypothesis is contradicted by two studies with both clinical and healthy participants that found a negative relationship between IRI-PT and all TAS-20 factors, one involving BPD (Flasbeck et al., 2017) and the other involving ASD (Santiesteban et al., 2021).

The findings on the relationship between alexithymia and the tendency to fantasize are less consistent. While some studies found a negative correlation

between overall alexithymia and IRI-FA in healthy samples (Alkan Härtwig et al., 2020; Eddy et al., 2021; Sonnby-Borgström, 2009), others found no significant association in mixed clinical and healthy samples (Banzhaf et al., 2018; Zıvralı Yarar et al., 2021; Guttman & Laporte, 2002). Santiesteban et al. (2021) reported that overall alexithymia was associated with reduced IRI-PD in both healthy and ASD populations, while Brewer et al. (2019) found that individuals with low alexithymia had better ability to fantasize (IRI-FA) than those with high alexithymia in a study of healthy women and those with EDs.

However, when individual symptoms of alexithymia were considered, the findings were more consistent. Eight studies on healthy subjects showed a negative correlation between IRI-FA and TAS-EOT (Grynberg et al., 2010; Martingano et al., 2022; Lyvers et al., 2018; Herrero-Fernández et al., 2022; Trentini et al., 2022; Lyvers et al., 2017; Diotaiuti et al., 2021; Lee et al., 2020). A study of healthy subjects and those with ASD found that reduced IRI-FA correlated with all TAS-20 factors (Santiesteban et al., 2021). Another study with combining women with BPD and healthy controls found that reduced IRI-FA was only significantly related to TAS-EOT (Flasbeck et al., 2017). Moreover, Grynberg et al. (2010) found that TAS-EOT was the only alexithymia factor that consistently related to IRI-FA after controlling for anxiety and depression. These results suggest that EOT may have a stronger influence on the tendency to fantasize than other symptoms of alexithymia.

In healthy samples, 14 out of 18 studies reported that overall alexithymia predicts less T-EC (Grynberg et al., 2010; Martingano et al., 2022; Silani et al., 2008; Himichi et al., 2021; Gleichgerrcht & Decety, 2013; Moriguchi et al., 2007; Alkan Härtwig et al., 2020; Zhang et al., 2020; Teten et al., 2008; Eddy & Hansen, 2021; Lyvers et al., 2017; Diotaiuti et al., 2021; Patil, & Silani, 2014; Sonnby-

Borgström, 2009). Silani et al. (2008) found a very strong negative correlation ($r = -0.85$, $p < 0.01$) between TAS-20 and IRI-EC in healthy subjects, although caution is needed due to the small sample size (n = 15). Similar but more moderate findings were reported in larger samples (e.g., Lyvers et al., 2017; Gleichgerrcht et al., 2013; Himichi et al., 2021). In clinical samples, two studies examining IRI-EC found a negative effect of overall alexithymia on T-EC (Guttman & Laporte, 2002; Silani et al., 2008). However, Butero et al. (2022) found no relationship between overall alexithymia and IRI-EC in children with ASD. Four studies with mixed full samples reported that higher TAS-20 total scores led to lower IRI-EC (Zıvralı Yarar et al., 2021; Santiesteban et al., 2021; Brewer et al., 2019; McKenzie et al., 2022).

Not all factors of alexithymia were consistently related to IRI-EC. Lyvers et al. (2018), Grynberg et al. (2010), Butera et al. (2022), and Herrero-Fernández et al. (2022) found no significant relationship between difficulty in identifying feelings (TAS-DIF and AQC-I) and T-EC. However, Grynberg et al. (2010) observed a negative relationship between TAS-DIF and IRI-EC after controlling for anxiety. Lyvers et al. (2018), Diotaiuti et al. (2021), and Butera et al. (2022) found no relationship between IRI-EC and difficulty in describing feelings (TAS-DDF and AQC-C). Butera et al. (2022) found that IRI-EC was negatively related to DDF (AQC-C) but not DIF (AQC-I) in children with ASD. A study of healthy adults and those with ASD, IRI-EC was negatively correlated with all TAS-20 factors (Santiesteban et al., 2021). However, Flasbeck et al. (2017), a study of healthy women and those with BPD, found that only TAS-EOT was significantly negatively associated with IRI-EC. These findings suggest that T-EC is influenced heterogeneously by different symptoms of alexithymia. Notably, all eight studies that investigated TAS-EOT found a negative relationship with IRI-EC, leading to

the inference that T-EC is more affected by EOT than by other symptoms of alexithymia.

In 18 studies that investigated the relationship between alexithymia and IRI-PD, with one exception (Sonnby-Borgström, 2009), all studies found that alexithymia had an effect on healthy samples, predicting greater rather than less PD (Grynberg et al., 2010; Martingano et al., 2022; Himichi et al., 2021; Gleichgerrcht & Decety, 2013; Eddy & Hansen, 2021; Butera et al., 2022; Brett & Maybery, 2022; Karras et al., 2022; Romero-Martínez et al., 2021; Diotaiuti et al., 2021; Patil & Silani, 2014). Several studies reported a positive correlation between overall alexithymia (TAS-20 total and AQC-Total) and IRI-PD, such as Grynberg et al. (2010), Brett et al. (2022), and Patil and Silani (2014). For instance, with a sample of physicians, Gleichgerrcht and Decety (2013) showed that participants with high and moderate alexithymia reported greater IRI-PD when compared with those with low alexithymia. Likewise, Beadle et al. (2013) found a significant relationship between overall alexithymia and increased T-PD in women with AN, and Butera et al. (2022) found a marked relationship between overall alexithymia and IRI-PD in children and adolescents with ASD.

Although TAS-EOT was unanimously influential on other IRI factors, EOT was the only TAS-20 factor that was unrelated to IRI-PD in some studies, at least with healthy samples (Trentini et al., 2022; Diotaiuti et al., 2021). This may indicate that language-related symptoms of alexithymia (i.e., DIF and DDF), are more likely to increase unpleasant experiences of PD than EOT. However, there are also some findings that suggest a different pattern of association, such as the study by Zıvralı Yarar et al. (2021), who found similar T-PD between people with high and low alexithymia. Overall, these results suggest that alexithymia has a significant impact

on IRI-PD in healthy samples and that language-related symptoms of alexithymia may have a more substantial effect on unpleasant experiences of PD than EOT.

Findings of the Empathy Quotient (EQ)

The EQ is a self-report questionnaire comprising 60 items, including 40 empathy-related questions and 20 fillers, that assesses cognitive empathy, emotional reactivity, and social skills across three dimensions of empathy. Respondents answer questions on a 4-point Likert scale, with higher scores indicating higher levels of empathy. The EQ has demonstrated good internal consistency, construct validity, and test-retest reliability in several studies (Baron-Cohen & Wheelwright, 2004; Lawrence et al., 2004). In the present review, the EQ was the second most frequently used measure of empathy, employed in 14 studies (16.9%).

Out of the nine studies that examined the correlation between TAS-20 total score and EQ total score in typical individuals, eight studies indicated that increased alexithymia was associated with a decrease in emotional intelligence (T-OE) (Schimmenti et al., 2019; Vellante et al., 2013; Redondo & Herrero-Fernández, 2018; Swart et al., 2009; Preti et al., 2011; Shalev & Uzefovsky, 2020; Zhao et al., 2018; Goerlich et al., 2017). For example, Vellante et al. (2013) reported a negative relationship between EQ total score and TAS-20 total score. In large samples ($N \geq 433$), Schimmenti et al., (2019), Shalev and Uzefovsky (2020), and Redondo and Herrero-Fernández (2018) found that increased TAS-20 total score was associated with decreased EQ total score, a result also observed by Preti et al. (2011) and Goerlich et al. (2017) in smaller samples. Swart et al. (2009) reported that individuals with low alexithymia had higher EQ total score than those with high alexithymia.

Regarding clinical samples, out of four studies, two studies found the effect of alexithymia on EQ total score (Chalah et al., 2020; Velotti et al., 2019). In a sample of patients with multiple sclerosis, individuals with low alexithymia had higher EQ total score than those with high alexithymia (Chalah et al., 2020). Velotti et al. (2019) found that increased TAS-20 total score was significantly correlated with reduced EQ total score in inmates for violent crimes with antisocial personality disorder. Kiliç et al. (2020) found no correlation between TAS-20 total score and EQ total score, nor a significant difference between alexithymic and non-alexithymic women with borderline personality disorder. Similarly, Ricciardi et al. (2015) reported no significant correlation between EQ total score and TAS-20 total score in either patients with Parkinson's Disease or their partners. In a combined sample of individuals with social anxiety disorder and healthy controls, those with low alexithymia had higher EQ total score than individuals with high alexithymia (Bayraktutan et al., 2020). However, Marauge et al. (2011) found no significant association between EQ total score and TAS-20 total score in individuals with alcohol use disorder. In four studies with healthy individuals, EQ total score was also negatively related to all TAS-20 factors (Schimmenti et al., 2019; Redondo & Herrero-Fernández, 2018; Zhao et al., 2018; Goerlich et al., 2017).

All four studies examining T-CE (EQ-CE) in healthy individuals found a significant negative correlation with TAS-20 and all its factors (Schimmenti et al., 2019; Redondo & Herrero-Fernández, 2018; Preti et al., 2011; Goerlich et al., 2017). However, a study of individuals with AUD and healthy controls found no significant correlation between TAS-20 total score and EQ-CE or EQ-SS (Maurage et al., 2011). Similarly, all four investigations with EQ-ER (a measure of T-AE) reported a negative correlation with TAS-20 and all its factors in typical individuals

(Schimmenti et al., 2019; Redondo & Herrero-Fernández, 2018; Preti et al., 2011; Goerlich et al., 2017). The only exception was found by Redondo and Herrero-Fernández (2018), where there was no significant correlation between EQ-ER and TAS-DIF. The combined healthy and AUD sample of Maurage et al. (2011) also reported a negative association between EQ-ER and TAS-20 total score.

Findings of the Cognitive and Affective Empathy scale (QCAE)

The QCAE is a self-reported empathy measure, with two subscales measuring cognitive empathy and three measuring affective empathy. The cognitive empathy subscales are perspective-taking and online simulation, while the affective empathy subscales are emotional contagion, proximal responsivity, and peripheral responsivity. Perspective-taking (QCAE-PT) involves spontaneously putting yourself in the point of view of others, while online simulation (QCAE-OS) involves the effortful attempt to understand another person's feelings, mainly with the intention of making future decisions involving others. Emotional contagion (QCAE-EC) corresponds to the automatic mirroring of other people's feelings. Proximal responsivity (QCAE-PRO) refers to emotional involvement in relation to the feelings of people in close social contexts, whereas peripheral responsivity (QCAE-PER) is defined by the emerging emotional response to more detached situations. Each subscale measures different aspects of empathy and is rated on a 4-point Likert scale. Higher scores indicate greater empathy. The internal consistency of the subscales is good, and the QCAE has been found to have good convergent validity (Reniers et al., 2010).

Among the reviewed studies, the QCAE was a widely used measure of trait empathy (k = 9; 10.8%). In healthy samples, Shah et al. (2019) reported a negative correlation between TAS-20 total score and QCAE total score. Stivaleti

Colombarolli et al. (2019) found a similar result in a study of 850 participants, with increased TAS-20 total score and all TAS-20 factors correlating with decreased QCAE total score. Di Girolamo et al. (2019) reported that QCAE total score was correlated with TAS-DDF and TAS-EOT, but not with TAS-DIF. Except for one study (Grzegorzewski et al., 2019), all remaining eight studies reported that alexithymia had a reducing effect on cognitive empathy disposition (QCAE-CE) in typical individuals. Stinson et al. (2022) found that increased TAS-20 total score correlated with reduced QCAE-CE in a study of 824 healthy individuals, a result also found in other large samples (Stivaleti Colombarolli et al., 2019; MacDonald & Price, 2017; Shah et al., 2019; Brett & Mayery, 2022; Li et al., 2022). Shah et al. (2019) found evidence that this negative relationship between TAS-20 total score and QCAE-CE persists even after controlling for gender and age. Grzegorzewski et al. (2019) found no correlation between TAS-20 total score and QCAE-CE in healthy women, but did observe a negative relationship in women with BDP in a smaller sample. Mul et al. (2018) observed that QCAE-CE was significantly higher in people with low alexithymia (both healthy and with ASD) than in those with high alexithymia with ASD. Stivaleti Colombarolli et al. (2019) reported a negative relationship between QCAE-CE and all TAS-20 factors, a finding that was also observed by Di Girolamo et al. (2019), except for TAS-DIF, which did not significantly correlate with QCAE-CE.

Among typical individuals, there is limited evidence for the effects of alexithymia on affective empathy disposition (QCAE-AE). While Shah et al. (2019) found a negative correlation between QCAE-AE and TAS-20 total score, six studies did not find any significant correlation between these measures (Li et al., 2022; MacDonald & Price, 2017; Grzegorzewski et al., 2019; Brett & Maybery, 2022;

Stivaleti Colombarolli et al., 2019; Di Girolamo et al., 2019), even after controlling for gender and age (Brett & Maybery, 2022). Stivaleti Colombarolli et al. (2019) observed a negative correlation between QCAE-AE and TAS-DIF and TAS-EOT, while Di Girolamo et al. (2019) found no relationship between QCAE-AE and any TAS-20 factor. Mul et al. (2018) reported that individuals with alexithymia and ASD had significantly lower QCAE-AE than those without alexithymia. In contrast, Grzegorzewski et al. (2019) found no significant relationship between QCAE-AE and TAS-20 total score in women with BDP. Stinson et al. (2022) combined proximal and peripheral responsivity to represent general emotional responsivity to others and found a negative correlation with TAS-20 total score, while Stivaleti Colombarolli et al. (2019) found a negative correlation between TAS-20 total score and both proximal and peripheral responsivity, as well as with TAS-DDF and TAS-EOT factors. However, Di Girolamo et al. (2019) did not find any correlation between proximal or peripheral responsivity and any TAS-20 factor. Mixed findings were reported regarding the effects of alexithymia on emotional contagion of QCAE (QCAE-EmCon, which is counted as a measure of T-PD). Stivaleti Colombarolli et al. (2019) reported negative associations between QCAE-EmCon and TAS-20 total score and all TAS-20 factors, while Stinson et al. (2022) did not find any significant relationship between QCAE-EmCon and TAS-20 total score. Di Girolamo et al. (2019) revealed a significant association between decreased QCAE-EmCon and TAS-DIF, but no correlation between QCAE-EmCon and TAS-DDF and TAS-EOT.

Findings of the Basic Empathy Scale (BES) and BES in Adults (BES-A)

The BES is a 20-item self-report measure of empathy, which is divided into factors of cognitive empathy and affective empathy (D. Jolliffe & Farrington,

2006). Each item is rated on a 5-point Likert scale, and the total score can range from 20 to 100. The BES has been validated for use in adolescents, children, and adults, and has satisfactory evidence of construct validity and internal consistency, with Cronbach's alpha values of 0.79 for cognitive empathy and 0.85 for affective empathy. An adult version, the Basic Empathy Scale in Adults (BES-A), has also been developed. The BES-A is a 20-item self-report measure of empathy that can be divided into 2 factors (affective empathy and cognitive empathy) or 3 factors (cognitive empathy, emotional contagion, and emotional disconnection). Each item is rated on a 5-point Likert scale. Cronbach's alpha values for the 3-factor model were 0.69 for cognitive empathy, 0.72 for emotional contagion, and 0.69 for emotional disconnection. For the 2-factor model, Cronbach's alpha values were 0.71 for cognitive empathy and 0.84 for affective empathy (Carré et al., 2013).

In six reviewed studies, the BES and BES-A were utilized to evaluate trait empathy. Results showed that in healthy individuals, only one out of three studies found a relationship between TAS-20 total score and BES total score. Al Aïn et al. (2013) reported that increased TAS-20 total score was linked to decreased BES total score in healthy adults. Additionally, BES total score and BES cognitive empathy (BES-CE) were negatively associated with TAS-DDF and TAS-EOT, but not with TAS-DIF in healthy adults (Al Aïn et al., 2013). However, no significant correlation was found between BES total score and TAS-20 total score in healthy children and adolescents by Paricio et al. (2020) and Sen Demirdogen et al. (2022). Only TAS-EOT was negatively correlated with BES total score in Sen Demirdogen et al. (2022). In patients with asthma, Khosravani et al. (2020) found that those with high alexithymia had lower scores on BES total compared to individuals with low alexithymia.

Sen Demirdogen et al. (2022) discovered a significant relationship between BES-CE and TAS-20 total score as well as all its factors in healthy children and adolescents. Furthermore, a negative correlation was observed between BES-CE and all TAS-20 factors in healthy adults (Jonason & Krause, 2013). However, BES-CE did not significantly correlate with any factor on the TAS-20 in adults with asthma, even after controlling for age, gender, educational level, and asthma severity (Khosravani et al., 2020). Carré et al. (2013) found that T-CE was negatively associated with TAS-20 total score, TAS-DIF and TAS-DDF, but not with TAS-EOT in healthy individuals. Moreover, BES affective empathy (BES-AE) was negatively related to TAS-20 total score and TAS-20 factors (with the exception of TAS-DIF) in healthy children and adolescents (Sen Demirdogen et al., 2022). In healthy adults, Al Ain et al. (2013) reported that BES-AE was negatively related to TAS-DDF and TAS-EOT, but not to TAS-DIF and TAS-20 total score. Jonason and Krause (2013) observed a significant association of reduced BES-AE only with increased TAS-EOT. However, Khosravani et al. (2020) found the opposite result in adults with asthma, as BES-AE did not significantly correlate only with TAS-EOT, even after controlling for age, gender, education, and asthma severity. Additionally, Carré et al. (2013) reported that T-PD did not significantly correlate with TAS-20 total score and its factors, except for TAS-DIF, which was negatively associated with BES-A.

Findings of trait empathy measures used in few studies

In this same section, some measures of trait empathy were grouped due to their low frequency in the reviewed studies. Among them is the Questionnaire Measure of Emotional Empathy (QMEE), a 33-item measure of affective empathy

that evaluates an individual's capacity to experience others' emotional states vicariously (Mehrabian & Epstein, 1972). The QMEE was only used in two studies, both with healthy adults. In undergraduate students, Mayer et al. (1990) did not find a significant correlation between QMEE total score and TAS-20 total score. Similarly, Demers & Koven (2015) reported no significant association between QMEE total score and TAS-20 total score in undergraduate students. Nonetheless, they did find a negative correlation between QMEE total score and TAS-DIF and TAS-EOT (but not with TAS-DDF), indicating that lower levels of T-AE were linked to greater DIF and EOT (Demers & Koven, 2015).

Morice-Rama et al. (2018) used the Short-French Toronto Empathy Questionnaire (f-JSPE; Hojat et al., 2001), a 20-item scale measuring physician empathy in medical education and patient care, to evaluate T-OE in general practice residents, and found a negative correlation with the TAS-20 total score. Lyvers et al. (2020) used the Toronto Empathy Questionnaire (TEQ; Spreng et al., 2010), a 16-item self-report measure of empathy, to assess T-OE in healthy individuals and found a significant negative correlation between TAS-20 total score and TEQ total score. A short French version of the TEQ (short-FTEQ; Karras et al., 2020) was used in a study to investigate the relationship between T-OE and alexithymia, and it was shown that reduced short-FTEQ was significantly correlated with increased TAS-20 total score (Williams & Wood, 2010). They also investigated T-AE using the Balanced Emotional Empathy Scale (BEES; Mehrabian, 1996), which measures dispositional affective empathy and evaluates how much individuals experience the emotions of others or respond less to the emotional experiences of others. In their study with patients with TBI, the authors found that a lower BEES total score was associated with a higher TAS-20 total score, as well as with TAS-DDF and TAS-

EOT, but not with TAS-DIF. In healthy controls, they also found a negative correlation between BEES total score and TAS-20 total score, as well as with all its factors, particularly with TAS-EOT.

Aslan et al. (2021) investigated empathy in healthy individuals using the Empathy Tendency Scale (ETS; Dökmen, 1988), a 20-item scale designed to measure empathic potential in daily life activities. They found that a lower ETS total score was significantly correlated with higher TAS-20 total score, indicating a negative association between self-reported empathy and alexithymia in the sample. Radoš et al. (2021) investigated T-AE using the Emotional Empathy Scale (EES; Ashraf, 2004), which is a 26-item self-report scale designed to assess affective empathy disposition. They found a negative correlation between T-AE and TAS-20 total score, TAS-DDF, and TAS-EOT, but no significant association with TAS-DIF.

Konrath et al. (2018; study 6) examined T-OE using a single item trait empathy scale (SITES) and reported a significant correlation between reduced T-OE and TAS-20 total score as well as all TAS-20 factors. The study by Grynberg et al. (2012) used the Vicarious Distress Questionnaire (VDQ) to measure different vicarious responses to others' distress. The results showed that avoidance of others' distress (VDQ-AV) was positively related to all factors on the TAS-20. In addition, increased distress at the suffering of others (VDQ-DI) was found to be significantly correlated with increased TAS-DIF, but not with TAS-DDF and TAS-EOT. Contrarily, providing support for the suffering of others (VDQ-SU), which is considered a measure of T-EC, had a negative relationship with all factors on the TAS-20 in healthy adults (Grynberg et al., 2012).

Speyer et al. (2022) used two self-report questionnaires, the Empathy Questionnaire for Children and Adolescents (EmQue-CA; Overgaauw et al., 2017) and the Alexithymia Questionnaire for Children (AlexQ-C; Rieffe et al., 2006), as well as two parent-report questionnaires, the Empathy Quotient Child-Parent Questionnaire (EQ-Child; Auyeung et al., 2009) and the Alexithymia Questionnaire for Children - Parent Version (AlexQ-CP; Costa et al., 2017), to measure T-OE and alexithymia in typically developing children and those with ASD. The results showed that parent-report measures of T-OE and alexithymia significantly correlated with each other in typically developing children, but did not correlate with self-report measures of these variables. The self-reported measures of alexithymia and T-OE were significantly related to each other, while the self-report measure of alexithymia (AlexQ-C) correlated negatively with the self-report measure of T-OE (EmQue-CA), but not with the parent-report measure of T-OE (EQ-Child) in the combined sample of typical and ASD children. The parent-report measure of alexithymia (AlexQ-CP) was significantly related to both parent and self-report measure of T-OE, but mainly with the parent-report, as the AlexQ-CP total score showed a strong negative correlation ($r = -0.71$, $p < 0.05$) with EQ-Child total score.

The Multi-Dimensional Empathy Scale for Adolescents (MDESA; Tobari, 2003) is a 30-item self-report scale designed to measure multidimensional empathy in adolescents in Japan. The scale measures Empathic Concern, Personal Distress, Fantasy, and Cognitive Empathy, and is based on the IRI scale. In their study of healthy adolescents, Nishimura et al. (2009) used the MDESA and the Questionnaire to Assess Alexithymia for Adolescents (QAAA; Nishimura et al., 2009) to investigate the relationship between trait empathy and alexithymia. After

controlling for diagnostic literacy test scores, the MDESA factors showed positive associations with QAAA-DIF and QAAA-DDF scores but had negative relationships with QAAA-EOT.

Summary: Multidimensional trait empathy

After conducting a review of the available literature, it was found that the majority of the studies (35 out of 44 comparisons, or 79.5%) revealed a significant negative relationship between T-OE and overall alexithymia. Most of this evidence was provided by studies using the EQ, suggesting that higher levels of alexithymic traits were associated with less overall tendency to empathize with others. However, half of the studies conducted with non-adult samples did not find significant results. To explore this relationship further in children with ASD and typically developing children, Speyer et al. (2022) conducted a series of analyses using different measures of self-report and parent-report. Combining the entire sample, no significant correlation was found between self-reported overall alexithymia (AlexQ-C) and parent-reported T-OE (EQ-Child). Among typically developing children, AlexQ-C total score was also unrelated to EQ-Child total score, whereas parent-reported overall alexithymia (AlexQ-CP) was not significantly correlated with self-reported T-OE (EmQue-Ca). These findings suggest that measures of alexithymia and trait empathy commonly used in adults may not be sensitive enough to find relationships between these variables in children and adolescents. Additionally, discrepancies between parent-report measures and their child's self-report may lead to nonsignificant correlations between alexithymia and trait empathy. Additionally, studies by Sen Demirdogen et al. (2022) and Paricio et al. (2020) reported non-significant correlations between TAS-20 total score and BES

total score in adolescents. One possible explanation for these non-significant results is that measures of alexithymia and trait empathy commonly used in adults may not be sensitive enough to detect relationships between these variables in children and adolescents. Another possibility is that parent-report measures may not be equivalent to their child's self-report, leading to discrepancies and nonsignificant correlations between alexithymia and trait empathy.

Studies examining the individual influence of alexithymic symptoms on T-OE have consistently found significant relationships between all facets of alexithymia and overall empathy. For example, in 8 out of 12 analyses, DIF was associated with decreased T-OE, while increased DDF was significantly correlated with decreased T-OE in 10 out of 11 explorations. In all 9 comparisons, increased EOT was significantly related to decreased T-OE. It remains to be seen whether this trend of higher influence of EOT on T-OE will be magnified compared to other symptoms of alexithymia in future studies.

Of the 68 comparisons examined, 50 (73.5%) found a negative relationship between T-CE and overall alexithymia, with most studies using the IRI. This negative relationship may be even stronger if the IRI-FA is excluded, as only 5 out of 18 comparisons found a significant negative relationship between alexithymia and the tendency to fantasize about fictional characters. This suggests that alexithymia may have little effect on the tendency to engage in fantasy. On the other hand, 19 out of 22 comparisons showed a relationship between decreased IRI-PT and overall alexithymia, indicating that increased alexithymic traits are consistently related to decreased perspective-taking disposition. Of the 35 findings reviewed, 23 and 20 of them showed that increased DIF and DDF, respectively, were related to decreased T-CE. Additionally, almost all comparisons reviewed (33 out of 36)

showed that increased EOT was correlated with decreased T-CE. These results are in line with evidence that EOT is the main alexithymic symptom associated with impaired ability to recognize facial expressions of emotion (Prkachin et al., 2009). Out of the 24 reviewed findings, 14 (58.3%) showed a negative relationship between T-AE and overall alexithymia.

More than half of the reviewed results (14 of 24) showed a negative relationship between T-AE and overall alexithymia. These inconsistent results may be due to the diverse effects of alexithymia symptoms on affective empathy disposition. Among the 13 analyzed correlations between T-AE and alexithymia factors, DIF and DDF showed significant results in 5 and 9 of them, respectively. On the other hand, increased EOT was significantly correlated with decreased T-AE in 10 out of 13 comparisons. Once again, these findings suggest that EOT is the most influential alexithymic symptom in empathetic dispositions, particularly in the tendency to experience vicarious emotions by feeling others.

The reviewed literature consistently demonstrates a negative impact of alexithymic traits on the tendency to experience empathic concern for others, as evidenced by 21 (77.8%) out of 27 studies finding a significant association between increased overall alexithymia and decreased T-EC. However, these effects vary for different alexithymia symptoms, with only 5 of 14 comparisons showing significant correlations between DIF and T-EC, and 7 of 14 comparisons showing significant correlations between DDF and T-EC. Conversely, almost all of the reviewed results (11 of 12) showed a significant negative correlation between EOT and T-EC, highlighting the crucial role of externally oriented thinking in reducing the disposition to experience empathic concern for others.

In contrast to other components of empathy, there is a positive rather than negative association between T-PD and overall alexithymia, as evidenced by 27 (93.1%) of 29 comparisons. This suggests that individuals with high alexithymia tend to experience more personal distress in response to the suffering of others. The majority of outcomes showed a significant positive association between DIF and DDF with T-PD, as 16 of 17 and 13 of 17 findings, respectively, were significant. However, externally oriented thinking had less influence on the tendency to experience personal distress, as only 6 out of 14 reviewed results showed a significant positive relationship between EOT and T-PD.

Findings by measures of state empathy

Findings of the Multifaceted Empathy Test (MET)

The MET is a measure of empathy that uses photographs to assess both affective (MET-AE) and cognitive empathy (MET-CE) (Dziobek et al., 2008). Three publications, all of which consisted of clinical samples, employed the MET as a measure of overall empathy. Banzhaf et al. (2018) found no difference between high and low alexithymia groups on MET-AE tasks in a sample of individuals with MDD and healthy controls, but alexithymics performed worse on MET-CE tasks than non-alexithymics. Kerr-Gaffney et al. (2020) observed a negative association between overall alexithymia and MET-CE and MET-AE in a combined sample of patients with AN and healthy controls. Mul et al. (2018) reported that alexithymics with ASD performed significantly worse on MET-AE than non-alexithymic controls and non-alexithymics with ASD.

Findings of state empathy measures used in few studies

To investigate state empathy in aggressive men and healthy controls, Winter et al. (2017) used the EmpaToM, a performance-based task designed to assess ToM, but also affective empathy and empathic concern (Kanske et al., 2016). They reported that increased overall alexithymia was significantly related to decreased performance on S-AE and S-EC tasks of the EmpaToM (Winter et al., 2017). In their study on state empathy in children, Speyer et al. (2022) used the Kids Empathic Development Scale (KEDS; Reid et al., 2013), a performance-based empathy task for children that measures understanding of complex mental, emotional states and behavioral empathy. They found that self-reported and parent-reported overall alexithymia were not significantly correlated with performance on S-OE tasks, in either children with ASD or those with typical development (Speyer et al., 2022).

Zammuner et al. (2014) examined a relatively large sample of adults (N = 431) and found that increased EOT was the only alexithymia symptom significantly associated with reduced performance on the factor empathy of the Problematic Interpersonal Events at Work (PIEW; Zammuner & Galli, 2005; Zammuner et al., 2014). The PIEW presents scenarios involving relevant emotional intelligence themes for dealing with problematic interpersonal events at work, and participants rate a list of behavioral responses in terms of their suitability for the interpersonal context.

Santiesteban et al. (2021) used the Continuous Affective Rating and Empathic Response (CARER) task to measure state affective empathy in a sample composed of individuals with ASD and healthy controls. The CARER is a performance-based task that presents short videos of targets describing emotional or neutral real-life events, and participants must provide continuous (online) assessments of their own

feelings while watching the video (CARER-ON) or, in other blocks, offline assessments of their own feelings after the video ends (CARER-OFF). The authors observed that an increased TAS-20 total score and TAS-DDF were significantly associated with reduced performance in both CARER-ON and CARER-OFF. Increased TAS-DIF was significantly correlated with decreased performance in CARER-OFF but not CARER-ON, while increased TAS-EOT was related to decreased CARER-ON but not CARER-OFF.

Summary: Multidimensional State Empathy

Only one study has investigated the relationship between S-OE and overall alexithymia in four different comparisons, all of which were non-significant (Speyer et al., 2022). However, this study was conducted only with children, both typical and with ASD, which limits the generalization of these findings to healthy adults. Additionally, the alexithymia measures used in this study differed from the commonly used TAS-20, which may have influenced the results. Therefore, limited conclusions can be drawn about the relationship between S-OE and overall alexithymia, particularly in adults. In healthy adults, Zammuner et al. (2014) found a significant association between reduced S-OE and increased TAS-EOT, suggesting that externally oriented thinking may be more influential in reducing S-OE in adults. However, further research is needed to better understand the relationship between S-OE and alexithymia and its typical symptoms.

The effects of alexithymic traits on S-AE are more evident, with 7 analyzed studies on this relationship. In 6 of the reviewed outcomes, increased overall alexithymia was significantly associated with decreased S-AE, indicating a constant influence of alexithymic traits on affective empathy task performance. Additionally, increased alexithymic traits were found to significantly impair

performance on cognitive empathy tasks in all studies that investigated the relationship between S-CE and overall alexithymia, although only two studies compared degrees of alexithymia with S-CE performance, highlighting the need for further research. Similarly, research on the effects of alexithymia on performance in empathic concern tasks is limited, with only one study showing a negative correlation between S-EC and overall alexithymia (Winter et al., 2017). Therefore, more research is required to investigate the impact of alexithymia on S-EC.

Discussion

The aim of this systematic review was to investigate the potential association between alexithymia and multidimensional empathy. The measures used in the studies were categorized into trait empathy, which assesses the tendency to empathize with others, and state empathy, which evaluates the ability to empathize with specific stimuli or situations. The measures were further subdivided into four components: cognitive empathy, affective empathy, empathic concern, and personal distress. The findings of the review suggest that alexithymia is associated with multidimensional empathy, particularly with reduced overall trait empathy, as indicated by the majority of studies (79.5%). However, there is still limited evidence regarding state empathy due to the small number of studies investigating it.

Studies utilizing the Empathy Quotient have contributed the greatest amount of evidence to the relationship between overall trait empathy and alexithymia. The majority of these studies have found that an increased tendency towards alexithymia is associated with a decreased overall propensity to empathize with others (e.g., Schimmenti et al., 2019; Vellante et al., 2013; Redondo & Herrero-Fernández, 2018; Swart et al., 2009; Preti et al., 2011; Shalev & Uzefovsky, 2020; Zhao et al.,

2018; Goerlich et al., 2017). This pattern of results aligns with evidence that increased alexithymia is linked to impaired perception of emotional expressions (Delphine Grynberg, Chang, et al., 2012) and emotion regulation (D. A. Preece et al., 2022b), both of which are presumably important to experiencing empathy (Besel & Yuille, 2010; Thompson et al., 2019). Additionally, certain brain structures (such as insula, MPFC, amygdala, ACC, and human mirror neurons) involved in cognitive empathy (i.e., understanding another's inner state) and affective empathy (i.e., experiencing emotions vicariously) are less activated in individuals with high levels of alexithymia compared to those with low levels of alexithymia (Casebeer, 2003; Delphine Grynberg, Chang, et al., 2012; Moll & Schulkin, 2009). Therefore, this body of literature supports the current review's findings that alexithymia is linked to a lower tendency to empathize with others. However, in non-adult samples, the association between overall trait empathy and alexithymia was less consistent, as half of the studies conducted with children and adolescents did not yield significant results. As mentioned earlier, it is possible that differences in the specific measures of alexithymia and empathy used for adults and children could have contributed to the lack of significant results in non-adult samples.

Studies using the Interpersonal Reactivity Index (Davis, 1980) have provided most of the evidence for the association between alexithymia and trait empathy components. The majority of the studies reviewed found a significant negative relationship between decreased T-CE and increased overall alexithymia, although results varied mostly between IRI-PT and IRI-FA. Specifically, except for two studies, all others found that decreased IRI-PT was significantly associated with increased alexithymia, indicating a consistent effect of alexithymic traits in

reducing the tendency to take the perspective of others. In contrast, less than one-third of the studies found a significant relationship between IRI-FA and overall alexithymia, suggesting that the disposition to fantasize about fictional characters may be less affected by alexithymic traits. These mixed findings suggest that the commonly held view that perspective-taking and the ability to fantasize are part of the same component of cognitive empathy may be inaccurate. In fact, in early studies examining the validity of the Interpersonal Reactivity Index, Davis (1980; 1983) reported a rather weak correlation between IRI-FA and IRI-PT, which supports the hypothesis that these dimensions may not be part of a higher-order factor of cognitive empathy.

In the current review, a negative correlation between trait empathy's affective component (T-AE) and overall alexithymia was observed. However, the relationship is not very strong as just over half of the results were significant. These conflicting results regarding the relationship between T-AE and alexithymic traits may have occurred because measures of affective empathy often do not discriminate vicarious compassionate EC experiences from PD self-directed aversive feelings. This may be because measures of affective empathy do not differentiate between self-directed aversive feelings and vicarious compassionate experiences. The results from the review are consistent with this explanation, as overall alexithymia was found to be negatively related to T-EC but positively associated with T-PD. This pattern of results is expected, given that alexithymia is a strong predictor of reduced self-compassion (Lyvers, Randhawa, et al., 2020), a construct associated with increased other-focused concern and lower propensity for psychological distress (Fulton, 2018; Z. Gerber et al., 2015; Neff & Pommier, 2012).

Additionally, opposite relationships were observed in the ability to recognize emotions, with EC improving and PD worsening (Israelashvili et al., 2020). Since alexithymics have impaired emotional perception (Delphine Grynberg, Chang, et al., 2012), it is presumable that alexithymia exerts some influence on these opposing relationships. Perhaps impaired emotional perception of alexithymia leads to unpleasant experiences of PD rather than EC for another's distress. Future research could explore how alexithymia affects the relationships between PD and EC with emotion recognition. Furthermore, alexithymia may be associated with increased PD due to impaired emotional regulation (Preece et al., 2022). There is evidence that reduced emotional awareness further increases regulatory problems, which may explain why elevated alexithymia leads to higher PD (Boden & Thompson, 2015).

The current systematic review investigated the impact of alexithymia symptoms, such as language-related deficits (e.g., difficulties identifying and describing feelings) and an externally oriented cognitive style, on disturbed multidimensional empathy.The findings suggest that increased alexithymic symptoms related to language were associated with reduced T-OE. This may be due to poor communicative skills in alexithymics, which can impede their ability to connect and empathize with others (Shamay-Tsoory et al., 2019; Gvirts & Dery, 2021). In addition, the current systematic review found that a decrease in T-OE was associated with an increase in externally oriented thinking, rather than focusing on one's own inner states. This finding may indicate that individuals who distance themselves from their own emotional experiences may also struggle to connect with and empathize with others (Grynberg et al., 2010).

The current systematic review found that whilst alexithymic factors appear to homogeneously affect T-OE, impaired empathic components are symptom-specific. Specifically, T-CE was particularly affected by EOT, which suggests that alexithymia may be related to a diminished connection with others and impaired ability to infer their internal states (Vanheule et al., 2007). Increased EOT was also related to a reduced interest in emotional topics, specifically those involving the distress of others (Luminet et al., 2004). These findings suggest that higher EOT scores contribute to a deficit of attention to emotions (Wiebe et al., 2017), which may lead to a reduced propensity for perspective-taking. Moreover, decreased T-AE, specifically reduced T-EC, is significantly associated with increased EOT in the vast majority of reviewed outcomes. Previous studies have linked EOT to slower appraisal and poorer recognition of facial expressions of emotion (Grynberg et al., 2014; Prkachin et al., 2009), which may lead to reduced empathic arousal response to others' emotions (Davydov et al., 2013). Overall, it appears that the concrete cognitive style of individuals with alexithymia restricts their attention and appraisal of emotional stimuli, which may contribute to a disinterest and lack of concern for emotional topics. This deficit in emotional awareness may lead to a reduced disposition for both cognitive and affective empathy and is reflected in the reduced tendency to experience empathic concern for the suffering of others.

The current systematic review has found that language-related alexithymic symptoms have relevant associations with cognitive and affective empathy. While not as prevalent as OET, most studies have shown that increased DIF and DDF are linked to decreased T-CE and T-AE, indicating that language impairments may also impact empathy both cognitively and affectively. Alexithymia is associated with language deficits, such as reduced complexity of emotion vocabulary, a less open

style, and poor emotional content (Olivier Luminet et al., 2021a; Welding & Samur, 2018), which in turn are linked to deficits in both affective and cognitive processes of empathy (Gergely et al., 2002; Grynberg et al., 2018; Luminet et al., 2021b). Interventions involving emotional psychoeducation, such as dialectical behavior therapy (DBT; Linehan, 2014), have been shown to improve alexithymic symptoms (Salles et al., 2022). The results of the current review raise the question of whether emotional vocabulary training could attenuate alexithymia deficits in mature forms of empathy, particularly in terms of perspective-taking and empathic concern. Further research may provide insight into this issue.

Contrary to the other components of empathy, an increased tendency to experience personal distress was found to be significantly related to enhanced DIF and DDF, suggesting that the inability to label and verbalize emotions may facilitate more uncomfortable vicarious experiences of others' distress than externally oriented thinking. This pattern of result is consistent with evidence that DIF is linked with an exaggerated response to emotion or threat in people with high alexithymia (see Luminet et al., 2021a,b). Furthermore, the inability of alexithymics to describe their feelings is related to altered stimulus appraisal, cognitive control, and salience appraisal, including prolonged attention to negative and excitatory stimuli (see Luminet et al., 2021a,b; Preece et al., 2017).

Indeed, increased DDF was related to elevated cortisol at baseline (before participants were exposed to stressful situations), indicating that the inability to describe feelings modulates anticipation of stress rather than the stress response itself (de Timary et al., 2008). Furthermore, evidence has indicated that individuals with alexithymia experience heightened discomfort during social interaction, which can lead to social avoidance (Nemiah & Sifneos, 1970). Therefore, atypical

attention to and overreaction to others' negative emotions can disrupt regulatory abilities such as affect labeling, which in turn may induce heightened experiences of PD in alexithymics and, presumably, increased social avoidance (Torre & Lieberman, 2018).

One-third of the studies reviewed involved clinical samples, and most of them found a negative relationship between T-OE and overall alexithymia. This association was significant in samples of individuals with asthma (Khosravani et al. 2020), multiple sclerosis (Gleichgerrcht et al., 2015; Chalah et al., 2020), antisocial personality traits (Velotti et al., 2019), generalized anxiety disorder (Bayraktutan et al., 2020), and autism spectrum disorder (Speyer et al., 2022). These findings are consistent with previous research indicating that the degree of alexithymia may be a predictor of socio-emotional impairments in conditions commonly associated with empathy deficits, such as ASD and psychopathy (Bird et al., 2011, 2010; Cook et al., 2013; Cuve et al., 2021; Bird & Cook, 2013; Burghart & Mier, 2022). On the other hand, individuals with BPD (Kiliç et al., 2020), AUD (Maurage et al., 2011), and Parkinson's disease (Ricciardi et al., 2015) did not demonstrate a significant association between T-OE and overall alexithymia. However, due to the limited number of studies, it is difficult to draw any firm conclusions about the impact of these disorders on the relationship between T-OE and alexithymic traits. Therefore, it remains unclear whether these pathologies affect the relationship between these constructs, and future studies with clinical populations may provide further insights. Most studies with clinical populations showed a negative relationship between T-CE and overall alexithymia. Specifically, increased overall alexithymia was correlated with decreased T-CE in MDD (Banzhaf et al., 2018; Hoffmann et al., 2016), BPD (Guttman & Laporte, 2002; Grzegorzewski et al., 2016). al., 2019),

ASD (Silani et al., 2008; Santiesteban et al., 2021; Mul et al., 2018), EDs (Kerr-Gaffney et al., 2020; Guttman & Laporte, 2002; Brewer et al., 2019). These results are consistent with the negative relationship between T-CE and overall alexithymia found in healthy populations. However, some studies found no significant differences when using IRI-FA to measure T-CE. For example, Banzhaf et al. (2018) reported that individuals with MDD who were alexithymic had lower IRI-PT scores than non-alexithymics, but no differences in IRI-FA scores. Similar results were reported by Guttman and Laporte (2002) with a combined sample of individuals with BDP, AN and healthy controls. T in a combined sample of individuals with BDP, AN, and healthy controls. This suggests that the disposition to fantasize may not be a good measure of T-CE when examining the relationship with alexithymic traits.

With the exception of one study with individuals with BDP (Grzegorzewski et al. 2019), all other studies examining the relationship between T-AE and overall alexithymia found a significantly negative correlation in clinical samples, including individuals with AN (Kerr-Gaffney et al., 2020), ASD (Mul et al., 2018), AUD (Maurage et al., 2011), and TBI (Williams & Wood, 2010). These consistent findings suggest that a variety of disorders may have similar impacts of alexithymia on T-AE. Regarding the findings by Grzegorzewski et al. (2019), impaired emotional regulation in BDP may have somehow influenced the relationship between alexithymic traits and disposition to affective empathy. There is indeed evidence that BPD tendencies and emotional dysregulation partially mediate the relationship between alexithymia and secondary psychopathy (Ridings & Lutz-Zois, 2014), a trait characterized by a marked lack of affective empathy (van Dongen, 2020).

More than half of the reviewed studies (5 out of 9) found a significant negative association between T-EC and overall alexithymia in clinical samples such as individuals with BPD (Guttman & Laporte, 2002), ASD (Zıvralı Yarar et al., 2021; Silani et al., 2008), and EDs (Brewer et al., 2019; Guttman & Laporte, 2002). However, this pattern of results was not consistent across all studies, as two studies with ASD samples (Butera et al., 2022; McKenzie et al., 2022) and one study with a MDD sample (Banzhaf et al., 2018). These mixed results may be attributed to the varying influence of different alexithymia symptoms on T-EC, as observed in the healthy population. To avoid such conflicting outcomes, future research should focus not only on alexithymia in general but also on the specific effects of different alexithymic symptoms.

In all but one study with clinical samples (Zıvralı Yarar et al., 2021), increased T-PD was found to be associated with increased overall alexithymia. This pattern of results was observed in individuals with MDD (Banzhaf et al., 2018), BPD (Guttman & Laporte, 2002), ASD (Santiesteban et al., 2021; Butera et al., 2022), EDs (Brewer et al., 2019; Guttman & Laporte, 2002), and AN (Beadle et al., 2013). These findings are consistent with those observed in studies with healthy controls. However, it is important to note that most of these studies combined clinical samples with healthy controls, which could potentially obscure diagnostic-specific effects. Therefore, more research is needed to clarify the relationship between alexithymia and trait empathy in various clinical populations.

There is only one study available to draw conclusions about the relationship between alexithymic traits and S-OE. This study, which included a sample combined with typical and ASD children, did not report any significant findings (Speyer et al., 2022). Thus, it is essential to conduct more research in this area,

specifically investigating the relationship between alexithymic traits and state empathy. More studies have explored the relationship between alexithymia and S-AE, and with the exception of one study (Banzhaf et al., 2018), all others reported a significant negative correlation between decreased S-AE and increased overall alexithymia. This pattern of results is consistent with studies measuring T-AE, which also reported a negative correlation with alexithymic traits. Moreover, it has been shown that increased alexithymic traits impair performance on cognitive empathy tasks, although this relationship has been examined in only two studies. These findings are in line with evidence that increased alexithymia is often associated with poorer performance on ToM tasks, a construct closely related to cognitive empathy (Pisani et al., 2021). More research is needed to explore the effects of alexithymia on performance in empathic concern tasks, as only one study has examined the link between S-EC and overall alexithymia, reporting a negative correlation between them (Winter et al., 2017).

This systematic review emphasizes the importance of considering the specific components measured by empathy assessments when investigating the relationship between alexithymia and empathy. The findings suggest that the association between alexithymia and empathy varies depending on the alexithymia symptoms and the type of empathy measure used, such as cognitive empathy, affective empathy, empathic concern, or personal distress. This component dependency is consistent with previous reports of weak or almost non-existent correlations between scores on different empathy measures (e.g., Davis, 1983; Layton & Wykle, 1990).

In the case of alexithymia, it appears that language-related symptoms contribute to proto-empathic experiences (i.e., personal distress and emotional

contagion), while the concrete cognitive style leads to impairments of properly mature empathic abilities, such as perspective-taking and empathic concern.

In the case of alexithymia, it seems that language-related symptoms contribute proto-empathic experiences (personal distress and emotional contagion), while the concrete cognitive style leads to impairments of properly mature empathic abilities, such as perspective-taking and empathic concern. As noted by Luminet et al. (2021a), the influence of different alexithymia symptoms appears distinct and incorporating all factors into overall alexithymia score may mask more complex relationships of alexithymic traits with specific components of empathy, which can lead to false negative and false positive results. Therefore, it is crucial that researchers consider the specific components of empathy when investigating the relationship between alexithymia and empathy.

The diverse relationships between the facets of alexithymia and multidimensional empathy have both theoretical and clinical relevance, given that alexithymia often co-occurs with psychopathological conditions such as ASD (Berthoz & Hill, 2005; Hill et al., 2004; Lombardo et al., 2007), MDD (Hemming et al., 2019), EDs (Berkovskaya et al., 2020), panic disorder (Šago et al., 2020), AUD (Linn et al., 2021), dependence on other substances (Honkalampi et al., 2022). Therefore, future research should investigate whether alexithymic traits contribute to impaired empathy in clinical populations

Limitations

While this systematic review provides an extensive overview of the literature regarding the relationship between alexithymia and empathy, there are some limitations to consider. Firstly, it is important to note that this review focused mainly on studies that used self-report measures of both alexithymia and empathy.

Other methods, such as behavioral or physiological measures, may provide additional insights into the relationship between these constructs. Furthermore, while self-report measures are commonly used in research, they are not always accurate or reliable, and participants may be prone to social desirability biases. Another limitation is the heterogeneity of the included studies, particularly with regards to the measures used to assess both alexithymia and empathy. While this review attempted to group studies by the type of empathy measured, there were still substantial differences in empathy measures. This heterogeneity makes it difficult to draw definitive conclusions and may limit the generalizability of the findings.

Moreover, the majority of the studies included in this review were conducted with non-clinical samples, limiting the generalizability of the findings to clinical populations. As alexithymia is commonly associated with various psychiatric conditions, future research should aim to replicate and extend these findings in clinical samples. Lastly, it is important to note that this review only considers studies that have been published up until the knowledge cutoff date (September 2022). As research in this field continues to evolve, it is possible that new studies may emerge that challenge or expand upon the findings of this review. While this systematic review provides important insights into the complex relationship between alexithymia and empathy, the limitations highlighted above suggest that caution should be exercised when interpreting the findings. Future research should aim to overcome these limitations to provide a more comprehensive understanding of the relationship between these constructs.

Conclusion

In summary, the relationship between alexithymia and empathy appears to be nuanced and multifaceted. While some symptoms of alexithymia are linked to

reduced mature empathy, others are associated with increased personal distress. Specifically, externally oriented thinking was found to be related to reduced cognitive empathy, affective empathy, and empathic concern, while language-related deficits were associated with an increased tendency for personal distress. Future research should aim to determine the unique contribution of alexithymia to empathy, while controlling for affective (e.g., mood state and emotion regulation) and cognitive factors, such as mood state, emotion regulation, verbal ability, intelligence, and executive function. Additionally, investigations should explore whether alexithymia is responsible for impaired empathy in psychiatric conditions that are commonly associated with elevated levels of alexithymia.

References

Al Aïn, S., Carré, A., Fantini-Hauwel, C., Baudouin, J. Y., & Besche-Richard, C. (2013). What is the emotional core of the multidimensional machiavellian personality trait? *Frontiers in Psychology*, *4*(JUL), 1–8. https://doi.org/10.3389/fpsyg.2013.00454

Alkan Härtwig, E., Aust, S., Heekeren, H. R., & Heuser, I. (2020). No Words for Feelings? Not Only for My Own: Diminished Emotional Empathic Ability in Alexithymia. *Frontiers in Behavioral Neuroscience*, *14*(September), 1–13. https://doi.org/10.3389/fnbeh.2020.00112

Ashraf, S. (2004). Development and validation of the Emotional Empathy Scale (EES) and the dispositional predictor and potential outcomes of emotional empathy. Unpublished PhD Thesis Dissertation. *National Institute of Psychology*. http://173.208.131.244:9060/xmlui/handle/123456789/6915

Aslan, G., Bakan, A. B., & Yildiz, M. (2021). An investigation of the relationship between alexithymia and empathy tendency in university students receiving health education. *Perspectives in Psychiatric Care*, *57*(2), 709–716. https://doi.org/10.1111/ppc.12602

Auyeung, B., Wheelwright, S., Allison, C., Atkinson, M., Samarawickrema, N., & Baron-Cohen, S. (2009). The children's empathy quotient and systemizing quotient: Sex differences in typical development and in autism spectrum conditions. *Journal of Autism and Developmental Disorders*, *39*(11), 1509–1521. https://doi.org/10.1007/S10803-009-0772-X/FIGURES/3

Bagby, R. M., Parker, J. D. A., & 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*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bagby, R. M., Taylor, G. J., & Parker, J. D. A. (1994). The twenty-item Toronto Alexithymia scale—II. Convergent, discriminant, and concurrent validity. *Journal of Psychosomatic Research*, *38*(1), 33–40. https://doi.org/10.1016/0022-3999(94)90006-X

Bagby, R. M., Taylor, G. J., Parker, J. D. A., & Dickens, S. E. (2006). The Development of the Toronto Structured Interview for Alexithymia: Item Selection, Factor Structure, Reliability and Concurrent Validity. *Psychotherapy and Psychosomatics*, *75*(1), 25–39. https://doi.org/10.1159/000089224

Banzhaf, C., Hoffmann, F., Kanske, P., Fan, Y., Walter, H., Spengler, S., Schreiter, S., Singer, T., & Bermpohl, F. (2018). Interacting and dissociable effects of alexithymia and depression on empathy. *Psychiatry Research*, *270*, 631–638. https://doi.org/10.1016/j.psychres.2018.10.045

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the Mind in the Eyes" Test Revised Version: A Study with Normal Adults, and Adults with Asperger Syndrome or High-functioning Autism. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*(2), 241–251. https://doi.org/10.1017/S0021963001006643

Baron-Cohen, Simon, & Wheelwright, S. (2004). The Empathy Quotient: An Investigation of Adults with Asperger Syndrome or High Functioning Autism, and Normal Sex Differences. *Journal of Autism and Developmental Disorders 2004 34:2*, *34*(2), 163–175. https://doi.org/10.1023/B:JADD.0000022607.19833.00

Bayraktutan, M., Kalkan Oğuzhanoğlu, N., & Toker Uğurlu, T. (2020).

Sympathetic skin response in social anxiety disorder and its relationship with empathy skills, alexithymia. *Noropsikiyatri Arsivi*, *57*(1), 18–22. https://doi.org/10.29399/npa.24719

Beadle, J. N., Paradiso, S., Salerno, A., & McCormick, L. M. (2013). Alexithymia, emotional empathy, and self-regulation in anorexia nervosa. *Annals of Clinical Psychiatry*, *25*(2), 107–120.

Berkovskaya, M. A., Tarasenko, A. A., Fadeev, V. V., & Gurova, O. Y. (2020). [Alexithymia and its relation with eating disorders and obesity]. *Problemy Endokrinologii*, *66*(2), 42–48. https://doi.org/10.14341/PROBL12416

Berthoz, S., & Hill, E. L. (2005). The validity of using self-reports to assess emotion regulation abilities in adults with autism spectrum disorder. *European Psychiatry*, *20*(3), 291–298. https://doi.org/10.1016/J.EURPSY.2004.06.013

Besel, L. D. S., & Yuille, J. C. (2010). Individual differences in empathy: The role of facial expression recognition. *Personality and Individual Differences*, *49*(2), 107–112. https://doi.org/10.1016/J.PAID.2010.03.013

Bird, G, & Cook, R. (2013). Mixed emotions: The contribution of alexithymia to the emotional symptoms of autism. In *Translational Psychiatry* (Vol. 3, Issue 7, pp. e285–e285). Nature Publishing Group. https://doi.org/10.1038/tp.2013.61

Bird, Geoffrey, Press, C., & Richardson, D. C. (2011). The role of alexithymia in reduced eye-fixation in autism spectrum conditions. *Journal of Autism and Developmental Disorders*, *41*(11), 1556–1564. https://doi.org/10.1007/S10803-011-1183-3/FIGURES/2

Bird, Geoffrey, Silani, G., Brindley, R., White, S., Frith, U., & Singer, T. (2010). Empathic brain responses in insula are modulated by levels of alexithymia but not autism. *Brain*, *133*(5), 1515–1525. https://doi.org/10.1093/BRAIN/AWQ060

Boden, M. T., & Thompson, R. J. (2015). *Facets of Emotional Awareness and Associations With Emotion Regulation and Depression*. https://doi.org/10.1037/emo0000057

Brett, J. D., & Maybery, M. T. (2022). Understanding Oneself to Understand Others: The Role of Alexithymia and Anxiety in the Relationships Between Autistic Trait Dimensions and Empathy. *Journal of Autism and Developmental Disorders*, *52*(5), 1971–1983. https://doi.org/10.1007/s10803-021-05086-6

Brewer, R., Cook, R., Cardi, V., Treasure, J., Catmur, C., & Bird, G. (2019). Alexithymia explains increased empathic personal distress in individuals with and without eating disorders. *Quarterly Journal of Experimental Psychology*, *72*(7), 1827–1836. https://doi.org/10.1177/1747021818816051

Butera, C. D., Harrison, L., Kilroy, E., Jayashankar, A., Shipkova, M., Pruyser, A., & Aziz-Zadeh, L. (2022). Relationships between alexithymia, interoception, and emotional empathy in autism spectrum disorder. *Autism*. https://doi.org/10.1177/13623613221111310

Carré, A., Stefaniak, N., D'Ambrosio, F., Bensalah, L., & Besche-Richard, C. (2013). The basic empathy scale in adults (BES-A): Factor structure of a revised form. *Psychological Assessment*, *25*(3), 679–691. https://doi.org/10.1037/a0032297

Casebeer, W. D. (2003). Moral cognition and its neural constituents. *Nature Reviews Neuroscience 2003 4:10*, *4*(10), 840–846.

https://doi.org/10.1038/nrn1223
Chalah, M. A., Kauv, P., Palm, U., Lefaucheur, J. P., Hodel, J., Créange, A., & Ayache, S. S. (2020). Deciphering the neural underpinnings of alexithymia in multiple sclerosis. *Neuroscience Letters*, *725*(January), 134894. https://doi.org/10.1016/j.neulet.2020.134894
Chlopan, B. E., McCain, M. L., Carbonell, J. L., & Hagen, R. L. (1985). Empathy. Review of Available Measures. *Journal of Personality and Social Psychology*, *48*(3), 635–653. https://doi.org/10.1037/0022-3514.48.3.635
Colombarolli, M. S., Zuanazzi, A. C., Miguel, F. K., & Giromini, L. (2019). Psychometric properties of the Toronto Alexithymia Scale (TAS-20) in Brazil. *Transcultural Psychiatry*, *56*(5), 992–1010. https://doi.org/10.1177/1363461519847312
Cook, R., Brewer, R., Shah, P., & Bird, G. (2013). Alexithymia, Not Autism, Predicts Poor Recognition of Emotional Facial Expressions. *Psychological Science*, *24*(5), 723–732. https://doi.org/10.1177/0956797612463582
Costa, A. P., Steffgen, G., & Samson, A. C. (2017). Expressive incoherence and alexithymia in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *47*(6), 1659–1672. https://doi.org/10.1007/S10803-017-3073-9/FIGURES/1
Cuve, H. C., Castiello, S., Shiferaw, B., Ichijo, E., Catmur, C., & Bird, G. (2021). Alexithymia explains atypical spatiotemporal dynamics of eye gaze in autism. *Cognition*, *212*(April). https://doi.org/10.1016/j.cognition.2021.104710
Davis, M H. (1980). Interpersonal reactivity index. *JSAS Catalog of Selected Documents in Psychology*.
Davis, Mark H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/0022-3514.44.1.113
Davydov, D. M., Luminet, O., & Zech, E. (2013). An externally oriented style of thinking as a moderator of responses to affective films in women. *International Journal of Psychophysiology*, *87*(2), 152–164. https://doi.org/10.1016/j.ijpsycho.2012.12.003
de Timary, P., Luts, A., Hers, D., & Luminet, O. (2008). Absolute and relative stability of alexithymia in alcoholic inpatients undergoing alcohol withdrawal: Relationship to depression and anxiety. *Psychiatry Research*, *157*(1–3), 105–113. https://doi.org/10.1016/J.PSYCHRES.2006.12.008
Demers, L. A., & Koven, N. S. (2015). The relation of alexithymic traits to affective theory of mind. *American Journal of Psychology*, *128*(1), 31–42. https://doi.org/10.5406/amerjpsyc.128.1.0031
Di Girolamo, M., Giromini, L., Winters, C. L., Serie, C. M. B., & de Ruiter, C. (2019). The Questionnaire of Cognitive and Affective Empathy: A Comparison Between Paper-and-Pencil Versus Online Formats in Italian Samples. *Journal of Personality Assessment*, *101*(2), 159–170. https://doi.org/10.1080/00223891.2017.1389745
Diotaiuti, P., Valente, G., Mancone, S., Grambone, A., & Chirico, A. (2021). Metric Goodness and Measurement Invariance of the Italian Brief Version of Interpersonal Reactivity Index: A Study With Young Adults. *Frontiers in Psychology*, *12*(December). https://doi.org/10.3389/fpsyg.2021.773363
Dökmen, Ü. (1988). Empatinin yeni bir modele dayanılarak ölçülmesi ve psikodrama ile geliştirilmesi. *Ankara Universitesi Egitim Bilimleri Fakultesi*

Dergisi, *21*(1), 001–034. https://doi.org/10.1501/egifak_0000000999

Donaldson, P. H., Bekkali, S., Youssef, G. J., Kirkovski, M., Ford, T. C., & Enticott, P. G. (2022). Does empathy predict autistic traits? A multi-modal investigation. *Personality and Individual Differences*, *196*(May), 111722. https://doi.org/10.1016/j.paid.2022.111722

Dvash, J., & Shamay-Tsoory, S. G. (2014). Theory of mind and empathy as multidimensional constructs: Neurological foundations. *Topics in Language Disorders*, *34*(4), 282–295. https://doi.org/10.1097/TLD.0000000000000040

Dziobek, I., Rogers, K., Fleck, S., Bahnemann, M., Heekeren, H. R., Wolf, O. T., & Convit, A. (2008). Dissociation of cognitive and emotional empathy in adults with Asperger syndrome using the Multifaceted Empathy Test (MET). *Journal of Autism and Developmental Disorders*, *38*(3), 464–473. https://doi.org/10.1007/S10803-007-0486-X/TABLES/4

Eddy, C. M., & Hansen, P. C. (2021). Alexithymia Is a Key Mediator of the Relationship Between Magical Thinking and Empathy. *Frontiers in Psychiatry*, *12*. https://doi.org/10.3389/fpsyt.2021.719961

Flasbeck, V., Enzi, B., & Brüne, M. (2017). Altered empathy for psychological and physical pain in borderline personality disorder. *Journal of Personality Disorders*, *31*(5), 689–708. https://doi.org/10.1521/pedi_2017_31_276

Fulton, C. L. (2018). Self-Compassion as a Mediator of Mindfulness and Compassion for Others. *Counseling and Values*, *63*(1), 45–56. https://doi.org/10.1002/CVJ.12072

Gerber, Z., Tolmacz, R., & Doron, Y. (2015). Self-compassion and forms of concern for others. *Personality and Individual Differences*, *86*, 394–400. https://doi.org/10.1016/J.PAID.2015.06.052

Gergely, G., Fonagy, P., Jurist, E., & Target, M. (2002). *Affect regulation, mentalization, and the development of the self*. International Journal of Psychoanalysis.

Gleichgerrcht, E., & Decety, J. (2013). Empathy in Clinical Practice: How Individual Dispositions, Gender, and Experience Moderate Empathic Concern, Burnout, and Emotional Distress in Physicians. *PLoS ONE*, *8*(4), 1–12. https://doi.org/10.1371/journal.pone.0061526

Gleichgerrcht, E., Tomashitis, B., & Sinay, V. (2015). The relationship between alexithymia, empathy and moral judgment in patients with multiple sclerosis. *European Journal of Neurology*, *22*(9), 1295–1303. https://doi.org/10.1111/ene.12745

Goerlich, K. S., Votinov, M., Lammertz, S. E., Winkler, L., Spreckelmeyer, K. N., Habel, U., Gründer, G., & Gossen, A. (2017). Effects of alexithymia and empathy on the neural processing of social and monetary rewards. *Brain Structure and Function*, *222*(5), 2235–2250. https://doi.org/10.1007/s00429-016-1339-1

Grynberg, D., Berthoz, S., & Bird, G. (2018). Social and interpersonal implications. In O. Luminet, R. M. Bagby, & G. J. Taylor (Eds.), *Alexithymia: Advances in research, theory, and clinical practice* (pp. 174–189). Cambridge University Press.

Grynberg, Delphine, Chang, B., Corneille, O., Maurage, P., Vermeulen, N., Berthoz, S., & Luminet, O. (2012). Alexithymia and the processing of emotional facial expressions (EFEs): Systematic review, unanswered questions and further perspectives. *PLoS ONE*, *7*(8), 42429. https://doi.org/10.1371/journal.pone.0042429

Grynberg, Delphine, Heeren, A., & Luminet, O. (2012). Development and validation of the vicarious distress questionnaire. *Canadian Journal of Behavioural Science*, *44*(2), 138–145. https://doi.org/10.1037/a0027509

Grynberg, Delphine, Luminet, O., Corneille, O., Grèzes, J., & Berthoz, S. (2010). Alexithymia in the interpersonal domain: A general deficit of empathy? *Personality and Individual Differences*, *49*(8), 845–850. https://doi.org/10.1016/j.paid.2010.07.013

Grynberg, Delphine, Vermeulen, N., & Luminet, O. (2014). Amplification of attentional blink by distress-related facial expressions: Relationships with alexithymia and affectivity. *International Journal of Psychology*, *49*(5), 371–380. https://doi.org/10.1002/IJOP.12006

Grzegorzewski, P., Kulesza, M., Pluta, A., Iqbal, Z., & Kucharska, K. (2019). Assessing self-reported empathy and altruism in patients suffering from enduring borderline personality disorder. *Psychiatry Research*, *273*, 798–807. https://doi.org/10.1016/j.psychres.2018.12.109

Guttman, H., & Laporte, L. (2002). Alexithymia, empathy, and psychological symptoms in a family context. *Comprehensive Psychiatry*, *43*(6), 448–455. https://doi.org/10.1053/comp.2002.35905

Gvirts, H. Z., & Dery, L. (2021). Alexithymia and reaching group consensus. *Cognition & Emotion*, *35*(3), 510–523. https://doi.org/10.1080/02699931.2019.1675600

Hall, J. A., & Schwartz, R. (2019). Empathy present and future. *Journal of Social Psychology*, *159*(3), 225–243. https://doi.org/10.1080/00224545.2018.1477442

Hao, Z., Jin, L., Lyu, R., & Rabia Akram, H. (2020). Problematic mobile phone use and altruism in Chinese undergraduate students: The mediation effects of alexithymia and empathy. *Children and Youth Services Review*, *118*(March), 105402. https://doi.org/10.1016/j.childyouth.2020.105402

Hemming, L., Haddock, G., Shaw, J., & Pratt, D. (2019). Alexithymia and its associations with depression, suicidality, and aggression: An overview of the literature. *Frontiers in Psychiatry*, *10*(APR), 203. https://doi.org/10.3389/FPSYT.2019.00203/BIBTEX

Herrero-Fernández, D., Parada-Fernández, P., Rodríguez-Arcos, I., Amaya-Carrillo, L., González-Sáez, M. E., & Rubio-González, M. (2022). The mediation effect of mentalization in the relationship between attachment and aggression on the road. *Transportation Research Part F: Traffic Psychology and Behaviour*, *86*, 345–355.

Hill, E., Berthoz, S., & Frith, U. (2004). Brief Report: Cognitive Processing of Own Emotions in Individuals with Autistic Spectrum Disorder and in Their Relatives. *Journal of Autism and Developmental Disorders*, *34*(2).

Himichi, T., Osanai, H., Goto, T., Fujita, H., Kawamura, Y., Smith, A., & Nomura, M. (2021). Exploring the Multidimensional Links Between Trait Mindfulness and Trait Empathy. *Frontiers in Psychiatry*, *12*(August). https://doi.org/10.3389/fpsyt.2021.498614

Hoffmann, F., Banzhaf, C., Kanske, P., Gärtner, M., Bermpohl, F., & Singer, T. (2016). Empathy in depression: Egocentric and altercentric biases and the role of alexithymia. *Journal of Affective Disorders*, *199*, 23–29. https://doi.org/10.1016/j.jad.2016.03.007

Hojat, M., Mangione, S., Nasca, T. J., Cohen, M. J. M., Gonnella, J. S., Erdmann, J. B., Veloski, J., & Magee, M. (2001). The Jefferson Scale of Physician

Empathy: Development and preliminary psychometric data. *Educational and Psychological Measurement*, *61*(2), 349–365. https://doi.org/10.1177/00131640121971158

Honkalampi, K., Jokela, M., Lehto, S. M., Kivim, M., Aki, €, & Virtanen, M. (2022). Association between alexithymia and substance use: A systematic review and meta-analysis. *Scandinavian Journal of Psychology*. https://doi.org/10.1111/SJOP.12821

Israelashvili, J., Sauter, D., & Fischer, A. (2020). *Two facets of affective empathy: concern and distress have opposite relationships to emotion recognition*. https://doi.org/10.1080/02699931.2020.1724893

Jolliffe, D., & Farrington, D. P. (2006). Development and validation of the Basic Empathy Scale. *Journal of Adolescence*, *29*(4), 589–611. https://doi.org/10.1016/J.ADOLESCENCE.2005.08.010

Jonason, P. K., & Krause, L. (2013). The emotional deficits associated with the Dark Triad traits: Cognitive empathy, affective empathy, and alexithymia. *Personality and Individual Differences*, *55*(5), 532–537. https://doi.org/10.1016/j.paid.2013.04.027

Kanske, P., Böckler, A., & Singer, T. (2016). Models, mechanisms and moderators dissociating empathy and theory of mind. In *Current Topics in Behavioral Neurosciences* (Vol. 30, pp. 193–206). Springer Verlag. https://doi.org/10.1007/7854_2015_412/COVER

Kanske, P., Böckler, A., Trautwein, F. M., & Singer, T. (2015). Dissecting the social brain: Introducing the EmpaToM to reveal distinct neural networks and brain–behavior relations for empathy and Theory of Mind. *NeuroImage*, *122*, 6–19. https://doi.org/10.1016/J.NEUROIMAGE.2015.07.082

Karras, M., Csillik, A., Delhomme, P., Fenouillet, F., & Fenouillet, F. L. (2020). L'empathie est-elle une ressource protectrice sur la route ? *Sciences & Bonheur*, 62–81. https://hal.archives-ouvertes.fr/hal-03165173/

Karras, M., Delhomme, P., & Csillik, A. (2022). French drivers' behavior: Do psychological resources and vulnerabilities matter? *Journal of Safety Research*, *80*, 235–242. https://doi.org/10.1016/j.jsr.2021.12.005

Kennedy, M., & Franklin, J. (2002). Skills-based Treatment for Alexithymia: An Exploratory Case Series. *Behaviour Change*, *19*(3), 158–171. https://doi.org/10.1375/BECH.19.3.158

Kerr-Gaffney, J., Harrison, A., & Tchanturia, K. (2020). Autism spectrum disorder traits are associated with empathic abilities in adults with anorexia nervosa. *Journal of Affective Disorders*, *266*(August 2019), 273–281. https://doi.org/10.1016/j.jad.2020.01.169

Khosravani, V., Samimi Ardestani, S. M., Alvani, A., & Amirinezhad, A. (2020). Alexithymia, empathy, negative affect and physical symptoms in patients with asthma. *Clinical Psychology and Psychotherapy*, *27*(5), 736–748. https://doi.org/10.1002/cpp.2458

Kılıç, F., Demirdaş, A., Işık, Ü., Akkuş, M., Atay, İ. M., & Kuzugüdenlioğlu, D. (2020). Empathy, Alexithymia, and Theory of Mind in Borderline Personality Disorder. *The Journal of Nervous and Mental Disease*, *208*(9), 736–741. https://doi.org/10.1097/NMD.0000000000001196

Konrath, S., Meier, B. P., & Bushman, B. J. (2018). Development and validation of the single item trait empathy scale (SITES). *Journal of Research in Personality*, *73*, 111–122. https://doi.org/10.1016/j.jrp.2017.11.009

Kupfer, J., Brosig, B., & Brähler, E. (2001). TAS-26: Toronto-Alexithymie-Skala-

26. *Göttingen: Hogrefe*. https://www.testzentrale.de/shop/toronto-alexithymie-skala-26.html#1+1

Lawrence, E. J., Shaw, P., Baker, D., Baron-Cohen, S., & David, A. S. (2004). Measuring empathy: reliability and validity of the Empathy Quotient. *Psychological Medicine*, *34*(5), 911–920. https://doi.org/10.1017/S0033291703001624

Layton, J. M., & Wykle, M. H. (1990). A validity study of four empathy instruments. *Research in Nursing & Health*, *13*(5), 319–325. https://doi.org/10.1002/NUR.4770130508

Lee, H. R., Nam, G., & Hur, J. W. (2020). Development and validation of the Korean version of the Reading the Mind in the Eyes Test. *PLoS ONE*, *15*(8 August 2020), 1–13. https://doi.org/10.1371/journal.pone.0238309

Li, W., Lou, W., Zhang, W., Tong, R. K.-Y., Jin, R., & Peng, W. (2022). Gyrus rectus asymmetry predicts trait alexithymia, cognitive empathy, and social function in neurotypical adults. *Cerebral Cortex*, 1–14. https://doi.org/10.1093/cercor/bhac184

Linehan, M. M. (2014). *DBT skills training manual*. Guilford Publications.

Linn, B. K., Zhao, J., Bradizza, C. M., Lucke, J. F., Ruszczyk, M. U., & Stasiewicz, P. R. (2021). Alexithymia disrupts emotion regulation processes and is associated with greater negative affect and alcohol problems. *Journal of Clinical Psychology*, *77*(12), 2915–2928. https://doi.org/10.1002/JCLP.23279

Lombardo, M. V., Barnes, J. L., Wheelwright, S. J., & Baron-Cohen, S. (2007). Self-Referential Cognition and Empathy in Autism. *PLOS ONE*, *2*(9), e883. https://doi.org/10.1371/JOURNAL.PONE.0000883

Luminet, Olivier, Nielson, K. A., & Ridout, N. (2021a). Cognitive-emotional processing in alexithymia: an integrative review. *Cognition and Emotion*, *35*(3), 449–487. https://doi.org/10.1080/02699931.2021.1908231

Luminet, Olivier, Nielson, K. A., & Ridout, N. (2021b). Having no words for feelings: alexithymia as a fundamental personality dimension at the interface of cognition and emotion. *Cognition and Emotion*, *35*(3), 435–448. https://doi.org/10.1080/02699931.2021.1916442

Luminet, Olivier, Rimé, B., Bagby, R. M., & Taylor, G. J. (2004). A multimodal investigation of emotional responding in alexithymia. *Cognition and Emotion*, *18*(6), 741–766. https://doi.org/10.1080/02699930341000275

Lyvers, M., Cotterell, S., & Thorberg, F. A. (2020). "Music is my drug": Alexithymia, empathy, and emotional responding to music. *Psychology of Music*, *48*(5), 626–641. https://doi.org/10.1177/0305735618816166

Lyvers, M., Lsdorf, S. M. K., Edwards, M. S., & Thorberg, F. A. (2017). Alexithymia and mood: Recognition of emotion in self and others. *American Journal of Psychology*, *130*(1), 83–92. https://doi.org/10.5406/amerjpsyc.130.1.0083

Lyvers, M., Mccann, K., Coundouris, S., Edwards, M. S., & Thorberg, F. A. (2018). Alexithymia in relation to alcohol use, emotion recognition, and empathy: The role of externally oriented thinking. *American Journal of Psychology*, *131*(1), 41–51. https://doi.org/10.5406/amerjpsyc.131.1.0041

Lyvers, M., Randhawa, A., & Thorberg, F. A. (2020). Self-compassion in Relation to Alexithymia, Empathy, and Negative Mood in Young Adults. *Mindfulness*, *11*(7), 1655–1665. https://doi.org/10.1007/s12671-020-01379-6

MacDonald, H. Z., & Price, J. L. (2017). Emotional Understanding: Examining

Alexithymia as a Mediator of the Relationship Between Mindfulness and Empathy. *Mindfulness*, *8*(6), 1644–1652. https://doi.org/10.1007/s12671-017-0739-5

Martínez-Velázquez, E. S., Ahuatzin González, A. L., Chamorro, Y., & Sequeira, H. (2020). The Influence of Empathy Trait and Gender on Empathic Responses. A Study With Dynamic Emotional Stimulus and Eye Movement Recordings. *Frontiers in Psychology*, *11*(January). https://doi.org/10.3389/fpsyg.2020.00023

Martínez-Velázquez, E. S., Honoré, J., Zorzi, L. de, Ramos-Loyo, J., & Sequeira, H. (2017). Autonomic reactivity to arousing stimuli with social and non-social relevance in alexithymia. *Frontiers in Psychology*, *8*(MAR), 1–10. https://doi.org/10.3389/fpsyg.2017.00361

Martingano, A. J., Konrath, S., Zarins, S., Okaomee, A. A., Martingano, A. J., Konrath, S., Zarins, S., & Okaomee, A. A. (2022). Psychology of Popular Media Empathy , Narcissism , Alexithymia , and Social Media Use. *Psychology of Popular Media*.

Maurage, P., Grynberg, D., Noël, X., Joassin, F., Philippot, P., Hanak, C., Verbanck, P., Luminet, O., de Timary, P., & Campanella, S. (2011). Dissociation between affective and cognitive empathy in alcoholism: A specific deficit for the emotional dimension. *Alcoholism: Clinical and Experimental Research*, *35*(9), 1662–1668. https://doi.org/10.1111/j.1530-0277.2011.01512.x

Mayer, J. D., DiPaolo, M., & Salovey, P. (1990). Perceiving Affective Content in Ambiguous Visual Stimuli: A Component of Emotional Intelligence. *Journal of Personality Assessment*, *54*(3–4), 772–781. https://doi.org/10.1080/00223891.1990.9674037

McKenzie, K., Russell, A., Golm, D., & Fairchild, G. (2022). Empathic Accuracy and Cognitive and Affective Empathy in Young Adults With and Without Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, *52*(5), 2004–2018. https://doi.org/10.1007/s10803-021-05093-7

Mehrabian, A. (1996). *Manual for the balanced emotional empathy scale (BEES)*.

Mehrabian, Albert, & Epstein, N. (1972). A measure of emotional empathy. *Journal of Personality*, *40*(4), 525–543. https://doi.org/10.1111/j.1467-6494.1972.tb00078.x

Moher, D., Altman, D. G., Liberati, A., & Tetzlaff, J. (2011). PRISMA statement. *Epidemiology*.

Moll, J., & Schulkin, J. (2009). Social attachment and aversion in human moral cognition. In *Neuroscience and Biobehavioral Reviews* (Vol. 33, Issue 3, pp. 456–465). https://doi.org/10.1016/j.neubiorev.2008.12.001

Morice-Ramat, A., Goronflot, L., & Guihard, G. (2018). Are alexithymia and empathy predicting factors of the resilience of medical residents in France? *International Journal of Medical Education*, *9*, 122–128. https://doi.org/10.5116/ijme.5ac6.44ba

Moriguchi, Y., Decety, J., Ohnishi, T., Maeda, M., Mori, T., Nemoto, K., Matsuda, H., & Komaki, G. (2007). Empathy and judging other's pain: An fMRI study of alexithymia. *Cerebral Cortex*, *17*(9), 2223–2234. https://doi.org/10.1093/cercor/bhl130

Mul, C. lène, Stagg, S. D., Herbelin, B., & Aspell, J. E. (2018). The Feeling of Me Feeling for You: Interoception, Alexithymia and Empathy in Autism. *Journal of Autism and Developmental Disorders 2018 48:9*, *48*(9), 2953–

2967. https://doi.org/10.1007/S10803-018-3564-3

Nam, G., Lee, H., Lee, J. H., & Hur, J. W. (2020). Disguised Emotion in Alexithymia: Subjective Difficulties in Emotion Processing and Increased Empathic Distress. *Frontiers in Psychiatry*, *11*(July), 1–11. https://doi.org/10.3389/fpsyt.2020.00698

Neff, K. D., & Pommier, E. (2012). The Relationship between Self-compassion and Other-focused Concern among College Undergraduates, Community Adults, and Practicing Meditators. *Https://Doi.Org/10.1080/15298868.2011.649546*, *12*(2), 160–176. https://doi.org/10.1080/15298868.2011.649546

Nemiah, J. C., & Sifneos, P. E. (1970). Psychosomatic Illness: A Problem in Communication. *Psychotherapy and Psychosomatics*, *18*(1–6), 154–160. https://doi.org/10.1159/000286074

Neumann, D., Zupan, B., Malec, J. F., & Hammond, F. (2014). Relationships between alexithymia, affect recognition, and empathy after traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *29*(1), 18–27. https://doi.org/10.1097/HTR.0b013e31827fb0b5

Nishimura, H., Komaki, G., Igarashi, T., Moriguchi, Y., Kajiwara, S., & Akasaka, T. (2009). Validity issues in the assessment of alexithymia related to the developmental stages of emotional cognition and language. *BioPsychoSocial Medicine*, *3*, 1–9. https://doi.org/10.1186/1751-0759-3-12

Önal, A., Rapp, M. A., Sebold, M., Garbusow, M., Chen, H., Kuitunen-Paul, S., Montag, C., Kluge, U., Smolka, M. N., & Heinz, A. (2021). Empathy and the ability to experience one's own emotions modify the expression of blatant and subtle prejudice among young male adults. *Journal of Psychiatric Research*, *137*(March), 471–479. https://doi.org/10.1016/j.jpsychires.2021.03.011

Overgaauw, S., Rieffe, C., Broekhof, E., Crone, E. A., & Güroglu, B. (2017). Assessing empathy across childhood and adolescence: Validation of the empathy questionnaire for children and adolescents (EmQue-CA). *Frontiers in Psychology*, *8*(MAY), 870. https://doi.org/10.3389/FPSYG.2017.00870/BIBTEX

Paricio, D., Herrera, M., Rodrigo, M. F., & Viguer, P. (2020). Association Between Group Identification at School and Positive Youth Development: Moderating Role of Rural and Urban Contexts. *Frontiers in Psychology*, *11*(August), 1–14. https://doi.org/10.3389/fpsyg.2020.01971

Patil, I., & Silani, G. (2014). Reduced empathic concern leads to utilitarian moral judgments in trait alexithymia. *Frontiers in Psychology*, *5*(MAY), 1–12. https://doi.org/10.3389/fpsyg.2014.00501

Pisani, S., Murphy, J., Conway, J., Millgate, E., Catmur, C., & Bird, G. (2021). The relationship between alexithymia and theory of mind: A systematic review. *Neuroscience and Biobehavioral Reviews*, *131*, 497–524. https://doi.org/10.1016/j.neubiorev.2021.09.036

Preece, D. A., Mehta, A., Becerra, R., Chen, W., Allan, A., Robinson, K., Boyes, M., Hasking, P., & Gross, J. J. (2022). Why is alexithymia a risk factor for affective disorder symptoms? The role of emotion regulation. *Journal of Affective Disorders*, *296*, 337–341. https://doi.org/10.1016/J.JAD.2021.09.085

Preece, D., Becerra, R., Allan, A., Robinson, K., & Dandy, J. (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. https://doi.org/10.1016/J.PAID.2017.08.003

Preti, A., Vellante, M., Baron-Cohen, S., Zucca, G., Petretto, D. R., & Masala, C. (2011). The Empathy Quotient: A cross-cultural comparison of the Italian version. *Cognitive Neuropsychiatry*, *16*(1), 50–70. https://doi.org/10.1080/13546801003790982

Prkachin, G. C., Casey, C., & Prkachin, K. M. (2009). Alexithymia and perception of facial expressions of emotion. *Personality and Individual Differences*, *46*(4), 412–417. https://doi.org/10.1016/J.PAID.2008.11.010

Radoš, S. N., Matijaš, M., Brekalo, M., Webb, R., & Ayers, S. (2021). Validation of the city infant faces database in student and parent samples. *Psihologijske Teme*, *30*(3), 591–614. https://doi.org/10.31820/pt.30.3.10

Redondo, I., & Herrero-Fernández, D. (2018). Validation of the Reading the Mind in the Eyes Test in a healthy Spanish sample and women with anorexia nervosa. *Cognitive Neuropsychiatry*, *23*(4), 201–217. https://doi.org/10.1080/13546805.2018.1461618

Reid, C., Davis, H., Horlin, C., Anderson, M., Baughman, N., & Campbell, C. (2013). The Kids' Empathic Development Scale (KEDS): A multi-dimensional measure of empathy in primary school-aged children. *British Journal of Developmental Psychology*, *31*(2), 231–256. https://doi.org/10.1111/BJDP.12002

Reniers, R. L. E. P., Corcoran, R., Drake, R., Shryane, N. M., & Völlm, B. A. (2010). The QCAE: A Questionnaire of Cognitive and Affective Empathy. *Http://Dx.Doi.Org/10.1080/00223891.2010.528484*, *93*(1), 84–95. https://doi.org/10.1080/00223891.2010.528484

Ricciardi, L., Pomponi, M., Demartini, B., Ricciardi, D., Morabito, B., Bernabei, R., & Bentivoglio, A. R. (2015). Emotional Awareness, Relationship Quality, and Satisfaction in Patients with Parkinson's Disease and Their Spousal Caregivers. *Journal of Nervous and Mental Disease*, *203*(8), 646–649. https://doi.org/10.1097/NMD.0000000000000342

Ridings, L. E., & Lutz-Zois, C. J. (2014). Emotional dysregulation and Borderline Personality Disorder: Explaining the link between secondary psychopathy and alexithymia. In *Personality and Individual Differences* (Vol. 57, pp. 14–19). University of Dayton. https://doi.org/10.1016/j.paid.2013.09.008

Rieffe, C., Oosterveld, P., & Terwogt, M. M. (2006). An alexithymia questionnaire for children: Factorial and concurrent validation results. *Personality and Individual Differences*, *40*(1), 123–133. https://doi.org/10.1016/J.PAID.2005.05.013

Romero-Martínez, Lila, M., & Moya-Albiol, L. (2021). Alexithymic traits are closely related to impulsivity and cognitive and empathic dysfunctions in intimate partner violence perpetrators: New targets for intervention. *Applied Neuropsychology:Adult*, *28*(1), 71–79. https://doi.org/10.1080/23279095.2019.1594233

Šago, D., Babić, G., Bajić, Ž., & Filipčić, I. (2020). Panic Disorder as Unthinkable Emotions: Alexithymia in Panic Disorder, a Croatian Cross-Sectional Study. *Frontiers in Psychiatry*, *11*, 466. https://doi.org/10.3389/FPSYT.2020.00466/BIBTEX

Salles, B. M., Maturana de Souza, W., Dos Santos, V. A., & Mograbi, D. C. (2022). Effects of DBT-based interventions on alexithymia: a systematic

review. *Cognitive Behaviour Therapy*, *00*(00), 1–22. https://doi.org/10.1080/16506073.2022.2117734

Salminen, J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of alexithymia and its association with sociodemographic variables in the general population of finland. *Journal of Psychosomatic Research*, *46*(1), 75–82. https://doi.org/10.1016/S0022-3999(98)00053-1

Santiesteban, I., Gibbard, C., Drucks, H., Clayton, N., Banissy, M. J., & Bird, G. (2021). Individuals with Autism Share Others' Emotions: Evidence from the Continuous Affective Rating and Empathic Responses (CARER) Task. *Journal of Autism and Developmental Disorders*, *51*(2), 391–404. https://doi.org/10.1007/s10803-020-04535-y

Schimmenti, A., Jonason, P. K., Passanisi, A., La Marca, L., Di Dio, N., & Gervasi, A. M. (2019). Exploring the Dark Side of Personality: Emotional Awareness, Empathy, and the Dark Triad Traits in an Italian Sample. *Current Psychology*, *38*(1), 100–109. https://doi.org/10.1007/s12144-017-9588-6

Sen Demirdogen, E., Aluc, N., Akdeniz, B., Basar, D., Warikoo, N., & Yavuz, M. (2022). The associations between reading mind in the eyes abilities, alexithymia, empathy, and bullying behavior in Turkish adolescents. *Journal of Child and Adolescent Psychiatric Nursing*, *35*(3), 230–239. https://doi.org/10.1111/jcap.12366

Shah, P., Livingston, L. A., Callan, M. J., & Player, L. (2019). Trait Autism is a Better Predictor of Empathy than Alexithymia. *Journal of Autism and Developmental Disorders*, *49*(10), 3956–3964. https://doi.org/10.1007/s10803-019-04080-3

Shalev, I., & Uzefovsky, F. (2020). Empathic disequilibrium in two different measures of empathy predicts autism traits in neurotypical population. *Molecular Autism*, *11*(1), 1–13. https://doi.org/10.1186/s13229-020-00362-1

Shamay-Tsoory, S. G., Saporta, N., Marton-Alper, I. Z., & Gvirts, H. Z. (2019). Herding Brains: A Core Neural Mechanism for Social Alignment. *Trends in Cognitive Sciences*, *23*(3), 174–186. https://doi.org/10.1016/J.TICS.2019.01.002

Shariat, S. V., Eshtad, E., & Ansari, S. (2010). Empathy and its correlates in Iranian physicians: A preliminary psychometric study of the Jefferson Scale of Physician Empathy. *Https://Doi.Org/10.3109/0142159X.2010.498488*, *32*(10). https://doi.org/10.3109/0142159X.2010.498488

Silani, G., Bird, G., Brindley, R., Singer, T., Frith, C., & Frith, U. (2008). Levels of emotional awareness and autism: An fMRI study. *Http://Dx.Doi.Org/10.1080/17470910701577020*, *3*(2), 97–112. https://doi.org/10.1080/17470910701577020

Song, Y., Nie, T., Shi, W., Zhao, X., & Yang, Y. (2019). Empathy Impairment in Individuals With Autism Spectrum Conditions From a Multidimensional Perspective: A Meta-Analysis. *Frontiers in Psychology*, *10*(October). https://doi.org/10.3389/fpsyg.2019.01902

Sonnby-Borgström, M. (2009). Alexithymia as Related to Facial Imitation, Mentalization, Empathy, and Internal Working Models-of-Self and -Others. *Neuropsychoanalysis*, *11*(1), 111–128. https://doi.org/10.1080/15294145.2009.10773602

Speyer, L. G., Brown, R. H., Camus, L., Murray, A. L., & Auyeung, B. (2022). Alexithymia and Autistic Traits as Contributing Factors to Empathy

Difficulties in Preadolescent Children. *Journal of Autism and Developmental Disorders*, *52*(2), 823–834. https://doi.org/10.1007/s10803-021-04986-x

Spreng, R. N., McKinnon, M. C., Mar, R. A., & Levine, B. (2010). The Toronto Empathy Questionnaire: Scale Development and Initial Validation of a Factor-Analytic Solution to Multiple Empathy Measures. *Http://Dx.Doi.Org/10.1080/00223890802484381*, *91*(1), 62–71. https://doi.org/10.1080/00223890802484381

Stinson, J., Wolfe, R., & Spaulding, W. (2022). Social Connectedness in Schizotypy: The Role of Cognitive and Affective Empathy. *Behavioral Sciences*, *12*(8). https://doi.org/10.3390/bs12080253

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with Feelings: Characterization of Trait Alexithymia on Emotion Regulation Strategies and Cognitive-Emotional Processing. *PLOS ONE*, *4*(6), e5751. https://doi.org/10.1371/JOURNAL.PONE.0005751

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (2003). The 20-Item Toronto Alexithymia Scale: IV. Reliability and factorial validity in different languages and cultures. *Journal of Psychosomatic Research*, *55*(3), 277–283. https://doi.org/10.1016/S0022-3999(02)00601-3

Teten, A. L., Miller, L. A., Bailey, S. D., Dunn, N. J., & Kent, T. A. (2008). Empathic deficits and alexithymia in trauma-related impulsive aggression. *Behavioral Sciences & the Law*, *26*(6), 823–832. https://doi.org/10.1002/BSL.843

Tholen, M. G., Trautwein, F. M., Böckler, A., Singer, T., & Kanske, P. (2020). Functional magnetic resonance imaging (fMRI) item analysis of empathy and theory of mind. *Human Brain Mapping*, *41*(10), 2611–2628. https://doi.org/10.1002/HBM.24966

Thompson, N. M., Uusberg, A., Gross, J. J., & Chakrabarti, B. (2019). Empathy and emotion regulation: An integrative account. *Progress in Brain Research*, *247*, 273–304. https://doi.org/10.1016/BS.PBR.2019.03.024

Tobari, M. (2003). The Development of Empathy in Adolescence : A Multidimensional View. *The Japanese Journal of Developmental Psychology*, *14*(2), 136–148.

Torre, J. B., & Lieberman, M. D. (2018). Putting Feelings Into Words: Affect Labeling as Implicit Emotion Regulation. *Https://Doi.Org/10.1177/1754073917742706*, *10*(2), 116–124. https://doi.org/10.1177/1754073917742706

Tremblay, M. P. B., Marcoux, A., Turcotte, V., Woods, J., Rouleau, C., Grondin, F., & Jackson, P. L. (2021). I Can But I Shall Not Always Be Empathic. *Psychological Reports*, *124*(4), 1634–1672. https://doi.org/10.1177/0033294120945180

Trentini, C., Tambelli, R., Maiorani, S., & Lauriola, M. (2022). Gender Differences in Empathy During Adolescence: Does Emotional Self-Awareness Matter? *Psychological Reports*, *125*(2), 913–936. https://doi.org/10.1177/0033294120976631

van Dongen, J. D. M. (2020). The Empathic Brain of Psychopaths: From Social Science to Neuroscience in Empathy. *Frontiers in Psychology*, *11*, 695. https://doi.org/10.3389/FPSYG.2020.00695/BIBTEX

Vanheule, S., Desmet, M., Meganck, R., & Bogaerts, S. (2007). Alexithymia and interpersonal problems. *Journal of Clinical Psychology*, *63*(1), 109–117. https://doi.org/10.1002/JCLP.20324

Vellante, M., Baron-Cohen, S., Melis, M., Marrone, M., Petretto, D. R., Masala, C., & Preti, A. (2013). The “reading the Mind in the Eyes” test: Systematic review of psychometric properties and a validation study in Italy. *Cognitive Neuropsychiatry*, *18*(4), 326–354. https://doi.org/10.1080/13546805.2012.721728

Velotti, P., Garofalo, C., Dimaggio, G., & Fonagy, P. (2019). Mindfulness, alexithymia, and empathy moderate relations between trait aggression and antisocial personality disorder traits RUNNING HEAD: Mentalizing and Antisocial Personality Disorders Patrizia Velotti. *Mindfulness*, 1082–1090.

Vorst, H. C. M., & Bermond, B. (2001). Validity and reliability of the Bermond–Vorst Alexithymia Questionnaire. *Personality and Individual Differences*, *30*(3), 413–434. https://doi.org/10.1016/S0191-8869(00)00033-7

Welding, C., & Samur, D. (2018). Language processing in alexithymia. In *Alexithymia: Advances in research, theory, and clinical practice*.

Williams, C., & Wood, R. L. (2010). Alexithymia and emotional empathy following traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology*, *32*(3), 259–267. https://doi.org/10.1080/13803390902976940

Winter, K., Spengler, S., Bermpohl, F., Singer, T., & Kanske, P. (2017). Social cognition in aggressive offenders: Impaired empathy, but intact theory of mind. *Scientific Reports*, *7*(1), 1–11. https://doi.org/10.1038/s41598-017-00745-0

Zammuner, V. L., & Galli, C. (2005). Wellbeing: Causes and consequences of emotion regulation in work settings. *International Review of Psychiatry*, *17*(5), 355–364. https://doi.org/10.1080/09540260500238348

Zammuner, Vanda L., Verzeletti, C., & Sbrascini, F. (2014). Awareness of Emotionally Competent Responding in Work Contexts and its Relationship with Personal Traits and Well-being. *Procedia - Social and Behavioral Sciences*, *159*, 784–788. https://doi.org/10.1016/j.sbspro.2014.12.448

Zhang, X., Wu, Z., Li, S., Lai, J., Han, M., Chen, X., Liu, C., & Ding, D. (2020). Why people with high alexithymia make more utilitarian judgments the role of empathic concern and deontological inclinations. *Experimental Psychology*, *67*(1), 23–30. https://doi.org/10.1027/1618-3169/a000474

Zhang, Y., Liang, T., Gan, X., Zheng, X., Li, H., & Zhang, J. (2022). Social Self-Efficacy and Internet Gaming Disorder Among Chinese Undergraduates: The Mediating Role of Alexithymia and the Moderating Role of Empathy. *Frontiers in Psychology*, *13*(July), 1–9. https://doi.org/10.3389/fpsyg.2022.898554

Zhao, Q., Neumann, D. L., Cao, X., Baron-Cohen, S., Sun, X., Cao, Y., Yan, C., Wang, Y., Shao, L., & Shum, D. H. K. (2018). Validation of the Empathy Quotient in Mainland China. *Journal of Personality Assessment*, *100*(3), 333–342. https://doi.org/10.1080/00223891.2017.1324458

Zıvralı Yarar, E., Howlin, P., Charlton, R., & Happé, F. (2021). Age-Related Effects on Social Cognition in Adults with Autism Spectrum Disorder: A Possible Protective Effect on Theory of Mind. *Autism Research*, *14*(5), 911–920.

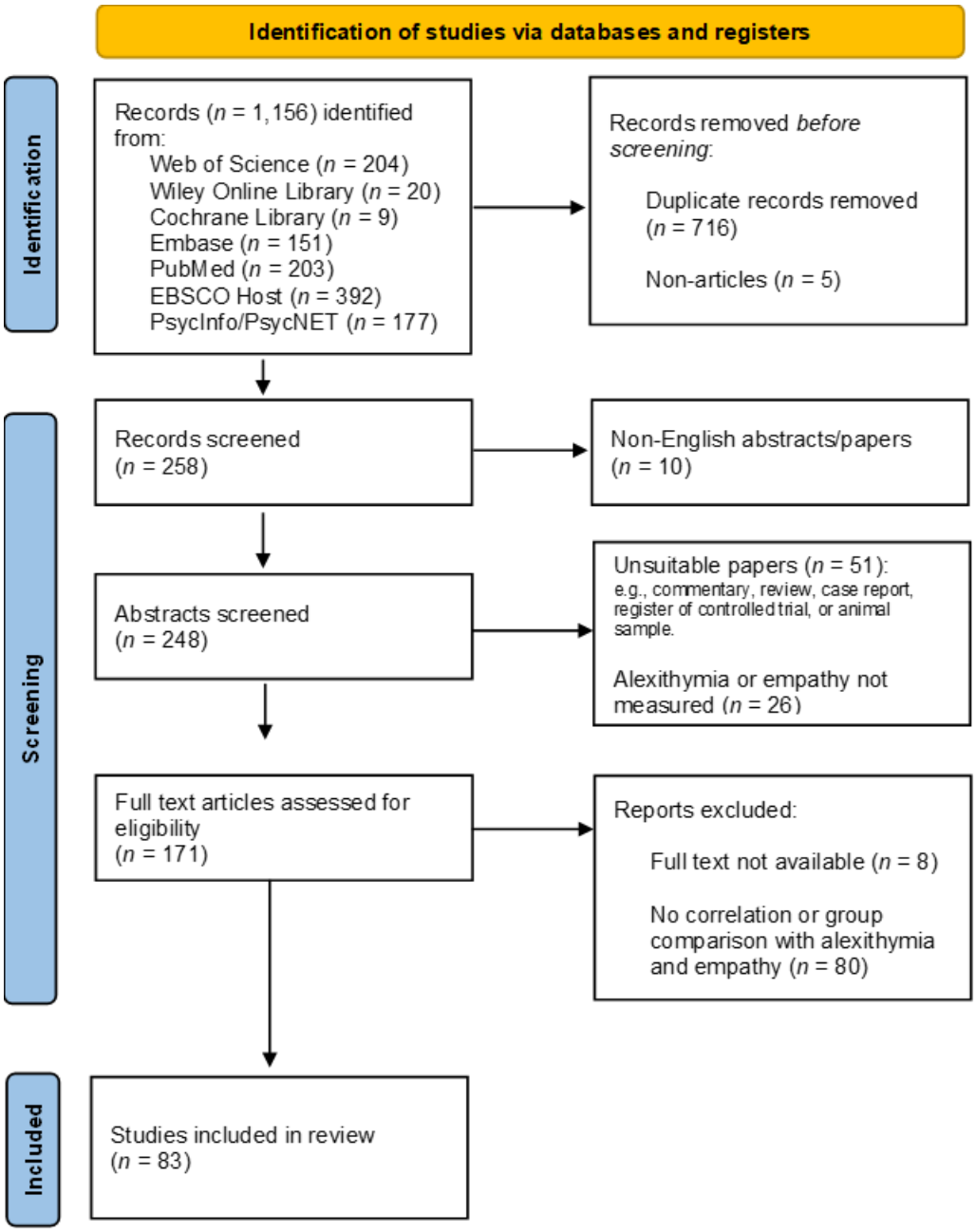

Figure 1. Flow diagram of study selection process.

Table 1. Trait empathy components measures

Measures	Trait Empathy (TE)				
	Overall	***Cognitive Empathy***	***Affective Empathy***	***Personal Distress***	***Empathic concern***
IRI	IRI-Total	IRI-PT IRI-FA	[IRI-EC; IRI-PD]	IRI-PD	IRI-EC
EmQue-CA	EmQue-CA Total	—	—	—	EmQue-CA (COMP)
EQ-Child	EQ-Child Total	—	—	—	—
QCAE	QCAE Total	QCAE-CE = [QCAE-PT; QCAE-OS]	QCAE-AE = [QCAE-PRO; QCAE-PER; QCAE-CO]	QCAE-CO	—
BES	BES Total	BES-CE	BES-AE	—	—
BES-A	BES-A Total	BES-A (CE)	BES-A (AE) BES-A (ED inverse)	—	—
TEQ	TEQ Total	—	—	—	—
short-FTEQ	short-FTEQ Total	—	—	—	—
EC	EQ Total	EQ-CE	EQ-ER	—	—
ET	ETS Total	—	—	—	—
f-JSI	f-JSPE Total	—	—	—	—
SITI	SITES Total	—	—	—	—
MDE	MDESA Total	MDESA-CE MDESA-FA	—	MDESA-PD	MDESA-EC
QMI	—	—	QMEE Total	—	—
EE	—	—	EES Total	—	—
VD	—	—	—	VDQ-DI VDQ-AV	VDQ-SU
BEES	—	—	BESS Total	—	—

BES = The Basic Empathy Scale; BES-A = The Basic Empathy Scale in Adults; BES-AE = BES Affective Empathy; BES-CE = BES Cognitive Empathy; BES-A (AE) = BES-A Affective Empathy; BES-A (CE) = BES-A Cognitive Empathy; BES-A (EmCon) = BES-A Emotional Contagion; BEES = The Balanced Emotional Empathy Scale; EQ = Empathy Quotient; EQ-CE = EQ Cognitive Empathy; EQ-ER = EQ Emotional Reactivity; EQ-Child = Empathy Quotient Child-Parent Questionnaire; EES = Emotional Empathy Scale; EmQue-CA = Empathy Questionnaire for Children and Adolescents; IRI = Interpersonal Reactivity Index; IRI-EC = IRI Empathic Concern; IRI-FA = IRI Fantasy; IRI-PD = IRI Personal Distress; IRI-PT = IRI Perspective-Taking; MDESA = Multi-Dimensional Empathy Scale for Adolescents; MDESA-PT = MDESA Perspective-Taking; MDESA-FA = MDESA Fantasy; MDESA-EC = MDESA Personal Distress; QCAE = The Cognitive and Affective Empathy scale; QCAE-AE = QCAE Affective Empathy; QCAE-CE = QCAE Cognitive Empathy; QCAE-EmCon = QCAE Emotional Contagion; QCAE-OnSim = QCAE Online Simulation; QCAE-PerRes = QCAE Peripherical Responsivity; QCAE-ProRes = QCAE Proximal Responsivity; QCAE-PT = QCAE Perspective-Taking; QMEE = Questionnaire Measure of Emotional Empathy; short-FTEQ = Short-French Toronto Empathy Questionnaire; SITES = Single Item Trait Empathy Scale; TEQ = Toronto Empathy Questionnaire; VDQ = Vicarious Distress Questionnaire; VDQ-AV = VDQ Avoidance of others' distress; VDQ-DI = VDQ Distress at the suffering of others; VDQ-SU = VDQ Support for the suffering of others.

Table 2. State empathy components measures

Measures	**State Empathy**			
	Overall	***Cognitive Empathy***	***Affective Empathy***	***Empathic concern***
MET	—	MET-CE	MET-AE	—
KEDS	KEDS	—	—	—
PIEW	PIEW-EMP	—	—	
CARER			CARER-ON	
			CARER-OFF	
EmpaToM task	—	—	EmpaToM-AE	EmpaToM-EC

AE = Affective Empathy; CARER = The Continuous Affective Rating and Empathic Response Task; CE = Cognitive Empathy; EmpaToM-AE = Affective Empathy; EmpaToM-EC = Empathic Concern; KEDS = Kids Empathic Development Scale; MET = The Multifaceted Empathy Test; OFF = Offline assessment; ON = Online assessment; PIEW-EMP = Problematic Interpersonal Events at Work – Empathy.

Appendix A. Characteristics of studies examining the relationship between measures of alexithymia and trait empathy components

Study		Sample	Measure of Alexithymia	Measure of Empathy	Effect	T-OE	T-CE	T-AE	T-EC	T-PD
Banzhaf e	**, 2018**	*N* = 70 61% female Adult sample *M* age: Healthy LA = 42.8 (± 12.7) Healthy HA = 60.5 (± 19.0) MDD LA = 47.6 (± 12.7) MDD HA = 39.4 (± 11.7) Healthy controls and MDD-patients	TAS-20 Cut-off: >53 (men); >52 (women)	IRI	IRI-PT: LA > HA ($p = 0.001$, $\eta2 = 0.16$) IRI-PD: HA > LA ($p = 0.029$, $\eta2 = 0.07$) IRI-FA: LA ~ HA ($p = 0.311$/n.s., $\eta2$ = n.r.) IRI-EC: LA ~ HA ($p = 0.073$/n.s., $\eta2$ = n.r.)	n/a	PT: HA < LA FA: HA ~ LA	n/a	HA ~ LA	HA > LA
Speyer et	**2022**	*N* = 59 69.7% female Children sample *M* age = 9.46 (8-12y) Typically and atypically developing children	AlexQ-C AlexQ-CP	EmQue-CA EQ-Child	**Typically Developing and Autistic Children** AlexQ-C: EmQue-CA ($r = -0.34$, $p < 0.05$) EQ-Child ($r = -0.18$, n.s.) AlexQ-CP: EmQue-CA ($r = -0.30$, $p < 0.05$) EQ-Child ($r = -0.71$, $p < 0.05$) **Typically developing children only** AlexQ-C: EmQue-CA ($r = -0.33$, $p < 0.05$) EQ-Child ($r = -0.14$, n.s.) AlexQ-CP: EmQue-CA ($r = -0.26$, n.s.) EQ-Child ($r = -0.66$, $p < 0.05$)	**Typically Developing and Autistic Children** ALEX: < ~ < < **Typically developing children only** ALEX: < ~ ~ <	n/a	n/a	n/a	n/a

Li et al., 2022 **China**	N = 142 52.11% female Adult sample M age = 21.68 (± 2.28) General population	TAS-20	QCAE	TAS-20: QCAE-CE (r = − 0.44, p < 0.001) QCAE-AE (*r* = 0.18, n.s.)	n/a	ALEX: <	ALEX: ~	n/a	n/a
Guttman & Laporte, 2002 **USA**	N = 204 100.00% female Adult sample *M* age: MDP = 32 (± 6.00), AN = 22 (± 6.00), HC = 21 (± 5.00) HA (n = 100) LA (n = 104)	TAS-20 >/54 (HA) <44 (LA)	IRI	IRI-PT: LA > HA (p < 0.001) IRI-PD: HA > LA (p < 0.001) IRI-EC: LA > HA (p < 0.01) IRI-FA: LA ~ HA (*n.s.*)	n/a	PT: HA < LA FA: HA ~ LA	n/a	HA < LA	HA > LA
Khosravani et al., 2020 **Iran**	N = 300 57.33% female Adult sample *M* age: 13.8 (± 9.8) Patients with asthma	TAS-20 > 61 (HA) < 51 (LA)	BES	BES: LA > HA (p = 0.001) BES-AE: TAS-DIF (r = − 0.32, p < 0.001) TAS-DDF (r = − 0.30, p < 0.001) TAS-EOT (r = − 0.10, n.s.) BES-CE: TAS-DIF (r = − 0.08, n.s.) TAS-DDF (r = − 0.01, n.s.) TAS-EOT (r = − 0.07, n.s.)	HA < LA	DIF: ~ DDF: ~ EOT: ~	DIF: < DDF: < EOT: ~	n/a	n/a
Lyvers et al., 2020 **Australia**	N = 253 82.21% female Adult sample *M* age: 21.57 (18-30y, ± 3.4) General population	TAS-20	TEQ	*r* = − 0.40, p < 0.01	ALEX: <	n/a	n/a	n/a	n/a

Grynberg et al., 2010 **France an elgium**	N = 645 52% female Adult sample *M* age: 21.19 (± 3.00) General population	TAS-20	IRI	IRI-PD: TAS-20 Total (r = 0.25, p < 0.001) TAS-DIF (r = 0.32, p < 0.001) TAS-DDF (r = 0.22, p < 0.001) TAS-EOT (r = 0.02, n.s.) IRI-EC: TAS-20 Total (r = − 0.18, p < 0.001) TAS-DIF (r = − 0.07, n.s.) TAS-DDF (r = − 0.12, p < 0.01) TAS-EOT (r = − 0.24, p < 0.001) IRI-FA: TAS-20 Total (r = − 0.01, n.s.) TAS-DIF (r = 0.12, p < 0.01) TAS-DDF (r = − 0.01, n.s.) TAS-EOT (r = − 0.21, p < 0.001) IRI-PT: TAS-20 Total (r = − 0.28, p < 0.001) TAS-DIF (r = − 0.14, p < 0.001) TAS-DDF (r = − 0.18, p < 0.001) TAS-EOT (r = − 0.37, p < 0.001)	n/a	ALEX: (FA ~) (PT <) DIF: (FA <) (PT <) DDF: (FA <) (PT <) EOT: (FA <) (PT <)	n/a	ALEX: < DIF: ~ DDF: < EOT: <	ALEX: > DIF: > DDF: > EOT: ~
Jonason & Krause, 2013 **France and Belgium**	N = 320 75.63% female Adult sample *M* age: 24.24 (± 7.33) General population	TAS-20	BES	BES-CE: TAS-DDF (r = − 0.32, p < 0.01) TAS-DIF (r = − 0.21, p < 0.01) TAS-EOT (r = − 0.46, p < 0.01) BES-AE: TAS-DDF (r = − 0.06, n.s.) TAS-DIF (r = 0.08, n.s.) TAS-EOT (r = − 0.46, p < 0.01)	n/a	DIF: < DDF: < EOT: <	DIF: ~ DDF: ~ EOT: <	n/a	n/a
Lyvers, Cotterell, et al., 2020	N = 205 66.3% female Adult sample	TAS-20	IRI	r = − 0.03, n.s.	ALEX: <	n/a	n/a	n/a	n/a

	M age: n.r. (18-45y) General population								
Australia									
Hoffmann et al., 2016 **Germany**	N = 71 62.0% female Adult sample *M* age: MDD-LA = 47.5 (± 12.7), MDD-HA = 39.4 (± 11.7), HC-LA = 41.4 (± 13.0), HC-HA = 62.2 (± 17.9) HC and MDD patients	TAS-20 >/53 (men) and >/52 (women)	IRI-PT	HA < LA (p = 0.003, ηp2 = 0.139)	n/a	HA < LA	n/a	n/a	n/a
Martinga et al., 2022 **USA**	N = 1253 69.7% female Adult sample *M* age: 27.6 General population	TAS-20	IRI	IRI-PT: TAS-20 Total (r = − 0.248, p < 0.01) TAS-DIF (r = − 0.141, p < 0.01) TAS-DDF (r = − 0.225, p < 0.01) TAS-EOT (r = − 0.226, p < 0.01) IRI-EC: TAS-20 Total (r = − 0.293, p < 0.01) TAS-DIF (r = − 0.135, p < 0.01) TAS-DDF (r = − 0.228, n.s.) TAS-EOT (r = − 0.391, p < 0.01) IRI-FA: TAS-20 Total (r = − 0.011, n.s.) TAS-DIF (r = 0.135, p < 0.01) TAS-DDF (r = − 0.033, n.s.) TAS-EOT (r = − 0.238, p < 0.01) IRI-PD: TAS-20 Total (r = 0.347, p < 0.01) TAS-DIF (r = 0.365, p < 0.01) TAS-DDF (r = 0.347, p < 0.01)	n/a	ALEX: (PT <) (FA ~) DIF: (PT <) (FA <) DDF: (PT <) (FA ~) EOT: (PT <) (FA <)	n/a	ALEX: < DIF: < DDF: ~ EOT: <	ALEX: > DIF: > DDF: > EOT: >

				TAS-EOT (r = 0.058, p < 0.05)					
Zhang et al., 2022 **China**	N = 888 55.1% female Adult sample *M* age: 21.08 (± 1.57) Undergraduate students	TAS-20	IRI	r = − 0.43, p < 0.01	ALEX: <	n/a	n/a	n/a	n/a
Hao et al., 20 **China**	N = 674 49% female Adult sample *M* age: 20 (18-24y, ± 1.181) Undergraduate students	TAS-20	IRI	TAS-20: IRI-C (r = 0.091, p < 0.05) IRI-A (r = 0.09, p < 0.05)	n/a	ALEX: >	ALEX: >	n/a	n/a
Zıvralı Yı et al., 2021 **UK**	N = 97 49% female Adult sample *M* age: ASD-Younger = 29.48 (19-48y, ± 8.51) ASD-Older = 61.32 (50-71y, ± 6.18) TD-Younger = 29.40 (20-44y, ± 7.54) TD-Older = 57.83 (52-71y, ± 6.33) ASD and TD individuals	TAS-20 ≥ 61 (HA)	IRI	IRI-EC: LA > HA (p < 0.05; d = 0.57) IRI-PT: LA ~ HA (p = 0.28; d = 0.28) IRI-FA: LA ~ HA (n.s., d = 0.32) IRI-PD: LA ~ HA (p = 0.40; d = 0.23)	n/a	PT: HA ~ LA FA: HA ~ LA	n/a	HA < LA	HA ~ LA
Gleichgerrcht et al., 2015 **Argentina**	N = 76 87% female Adult sample *M* age: MS = 42.3 (± 11.3)	TAS-20	IRI	IRI and TAS-20 (r = − 0.68, p < 0.001).	ALEX: <	n/a	n/a	n/a	n/a

	HC = 39.3 (± 8.1) HCs and MS-patients								
Silani et a[illegible]08 **UK**	N = 30 13.3% female Adult sample *M* age: ASD = 36.6 (± 11.7) HC = 33.7 (± 10.3) ASD and HC	TAS-20 BVAQ-B	IRI	**HC group** TAS-20 and IRI-EC (r = − 0.853, p < 0.01) **ASD group** TAS-20: IRI-EC (r = − 0.682, p < 0.01) IRI-PT (r = − 0.661, p < 0.01)	n/a	**ASD group** ALEX: <	**ASD group** ALEX: <	**HC group** ALEX: < HFA/AS group ALEX: <	n/a
MacDona[illegible]k Price, 2017 **USA**	N = 616 81.5% female Adult sample *M* age: 19.24 (± 1.37) Undergraduate students	TAS-20	QCAE	TAS-20 total: QCAE-CE (r = − 0.31, *p* < 0.001) QCAE-AE (r = − 0.01, n.s.)	n/a	ALEX: <	ALEX: ~	n/a	n/a
Lyvers et al., 2018 **USA**	N = 161 55.3% female Adult sample *M* age: 22.64 (18-63y, ± 7.15) Undergraduate students	TAS-20	IRI	IRI-PT: TAS-DIF (r = − 0.12, n.s.) TAS-DDF (r = − 0.08, n.s.) TAS-EOT (r = − 0.30, *p* < 0.001) IRI-FA: TAS-DIF (r = 0.05, n.s.) TAS-DDF (r = 0.00, n.s.) TAS-EOT (r = − 0.29, p < 0.001) IRI-EC: TAS-DIF (r = − 0.06, n.s.) TAS-DDF (r = − 0.09, n.s.) TAS-EOT (r = − 0.36, p < 0.001) IRI-PD: TAS-DIF (r = 0.31, p < 0.001)	n/a	DIF: (PT ~) (FA ~) DDF: (PT ~) (FA ~) EOT: (PT <) (FA <)	n/a	DIF: ~ DDF: ~ EOT: <	DIF: > DDF: > EOT: >

				TAS-DDF (r = 0.20, p < 0.05) TAS-EOT (r = 0.22, p < 0.01)					
Velotti et al., 2019 **Italy**	N = 403 100.0% male Adult sample *M* age: 39.91 (19-77y, ± 11.79) Inmates for violent offending	TAS-20	EQ	$r = -0.45$, $p < 0.001$	ALEX: <	n/a	n/a	n/a	n/a
Martínez-Vázquez et al., 2017 **France**	N = 49 68.1% female Adult sample *M* age: LA = 22.4 (± 2.7) AA = 22.1 (± 1.8) CA = 21.0 (± 1.6)	TAS-20 BVAQ LA: TAS ≤ 44, A-BVAQ ≤ 44, and C-BVAQ ≤ 64 AA: A-BVAQ > 44 and C-BVAQ ≤ 64 CA: A-BVAQ ≤ 44 and C-BVAQ > 64	IRI	IRI-PT: CA < LA ($p = 0.001$; $\eta 2 = 0.27$) Affective empathy (FA+PD+EC): AA < (LA ~ CA) ($p < 0.011$; $\eta 2 = 0.18$) IRI-FA: AA < LA ($p = 0.007$; $\eta 2$ = N.R.) IRI-PD: CA > AA ($p = 0.003$; $\eta 2$ = N.R.) IRI-EC: (CA ~ AA ~ LA) (n.s.)	n/a	PT: CA < LA FA: AA < LA	AA < (LA ~ CA)	(CA ~ AA ~ NA)	CA > AA
Al Aïn et al., 2013 **France**	N = 107 58.9% female Adult sample *M* age: 23.9 (18-30y, ± 3.4) Undergraduate students	TAS-20	BES	BES-total: TAS-20 total (r = − 0.28, p < 0.05) TAS-DIF (r = − 0.02, ns.) TAS-DDF (r = − 0.33, p < 0.05) TAS-EOT (r = − 0.33, p < 0.05) BES-CE: TAS-20 total (r = − 0.43, p < 0.05) TAS-DIF (r = − 0.17, ns.) TAS-DDF (r = − 0.39, p < 0.05) TAS-EOT (r = − 0.38, p < 0.05)	ALEX: < DIF: ~ DDF: < EOT: <	ALEX: < DIF: ~ DDF: < EOT: <	ALEX: ~ DIF: ~ DDF: < EOT: <	n/a	n/a

				BES-AE: TAS-20 total (r = − 0.12, ns.) TAS-DIF (r = − 0.13, ns.) TAS-DDF (r = − 0.20, p < 0.05) TAS-EOT (r = − 0.21, p < 0.05)					
Herrero-F ández et al., 202 Spain	N = 469 65.0% female Adult sample *M* age: 36.34 (18-76y, ± 12.48) General population	TAS-20	IRI	IRI-PT: TAS-DIF (r = − 0.20, p < 0.001) TAS-DDF (r = − 0.13, p < 0.01) TAS-EOT (r = − 0.51, *p* < 0.001) IRI-FA TAS-DIF (r = 0.04, n.s.) TAS-DDF (r = 0.12, p < 0.05) TAS-EOT (r = − 0.30, p < 0.001) IRI-EC TAS-DIF (r = − 0.08, n.s.) TAS-DDF (r = − 0.15, p < 0.01) TAS-EOT (r = − 0.28, p < 0.001) IRI-PD: TAS-DIF (r = 0.31, p < 0.001) TAS-DDF (r = 0.45, p < 0.001) TAS-EOT (r = 0.18, p < 0.001)	n/a	DIF: (PT <) (FA ~) DDF: (PT <) (FA <) EOT: (PT <) (FA <)	n/a	DIF: ~ DDF: < EOT: <	DIF: > DDF: > EOT: >
Schimmenti et al., 2019 **Italy**	N = 799 55.0% female Adult sample *M* age: 35.78 (18-64y, ± 10.96) General population	TAS-20	EQ	EQ-total: TAS-20 total (r = − 0.36, p < 0.01) TAS-DIF (r = − 0.29, p < 0.01) TAS-DDF (r = − 0.24, p < 0.01) TAS-EOT (r = − 0.24, p < 0.01) EQ-CE: TAS-20 total (r = − 0.15, p < 0.01) TAS-DIF (r = − 0.12, p < 0.01) TAS-DDF (r = − 0.08, p < 0.05)	ALEX: < DIF: < DDF: < EOT: <	ALEX: < DIF: < DDF: < EOT: <	ALEX: < DIF: < DDF: < EOT: <	n/a	n/a

				TAS-EOT (r = − 0.11, p < 0.01) EQ-ER: TAS-20 total (r = − 0.37, p < 0.01) TAS-DIF (r = − 0.26, p < 0.01) TAS-DDF (r = − 0.24, p < 0.01) TAS-EOT (r = − 0.27, p < 0.01)					
Aslan et a 021 **Turkey**	N = 376 57.7% female Adult sample *M* age: 20.92 (18-32y, ± 1.88) General population	TAS-20	ETS	*r* = − 0.344, *p* < 0.001	ALEX: <	n/a	n/a	n/a	n/a
Carré et a 013 **France an elgium**	N = 370 70.3% female Adult sample *M* age: 26.05 (± 12.41) General population	TAS-20	BES-A	BES-A (emotional contagion): TAS-20 total (r = 0.13, n.s.) TAS-DIF (r = 0.09, p < 0.05) TAS-DDF (r = 0.19, n.s.) TAS-EOT (r = − 0.03, n.s.) BES-A (cognitive empathy): TAS-20 total (r = − 0.17, p < 0.05) TAS-DIF (r = − 0.18, p < 0.05) TAS-DDF (r = − 0.21, p < 0.05) TAS-EOT (r = − 0.06, n.s.)	n/a	ALEX: < DIF: < DDF: < EOT: ~	n/a	n/a	ALEX: ~ DIF: > DDF: ~ EOT: ~
Tremblay et al., 2021 **Canada**	N = 59 50.8% female Adult sample *M* age: 25.71 (± 9.05) University students and employees	TAS-20	IRI	**Study 1:** *r* = − 0.15, *n.s.* **Study 2:** *r* = − 0.37, *p* < 0.01	ALEX: ~ <	n/a	n/a	n/a	n/a

Himichi et al., 2021 **Japan**	N = 416 50.0% female Adult sample *M* age: 39.41 (20-59y, ± 11.19) General population	TAS-20	IRI	TAS-20: IRI-PD (r = 0.44, p < 0.001) IRI-EC (r = − 0.28, p < 0.001) IRI-PT (r = − 0.09, p < 0.05) IRI-FA (r = − 0.09, n.s.)	n/a	ALEX: (PT <) (FA ~)	n/a	ALEX: <	ALEX: >
Grzegorz[illegible]ki et al., 2019 **Poland**	N = 68 100.0% female Adult sample *M* age: BPD = 27.30 (18-50y, ± 6.12) HC = 25.60 (18-45y, ± 5.87) BPD and HC individuals	TAS-20	QCAE	**HC group** TAS-20: QCAE-CE (r = − 0.29, n.s.) QCAE-AE (r = − 0.01, n.s.) **BDP group** TAS-20: QCAE-CE (r = − 0.43, p < 0.05) QCAE-AE (r = − 0.04, n.s.)	n/a	**HC group** ALEX: ~ **BDP group** ALEX: <	**HC group** ALEX: ~ **BDP group** ALEX: ~	n/a	n/a
Gleichger[illegible]t & Decety, 2013 **Argentina and 22 other Latin American countries**	N = 7,584 46.5% female Adult sample *M* age: Female = 41.6 (± 11.3) Male = 47.2 (± 12.1) Physicians	TAS-20 LA: ≤ 51 MA: 52-60 HA: ≥ 61	IRI	IRI-PD: (HA ~ MA) > LA (p < 0.001; d = 0.39) IRI-PT: (HA ~ MA) < LA (p < 0.001; d = 0.46) IRI-EC: (HA ~ MA) < LA (p = 0.01; d = 0.15) TAS-20: IRI-PD (r = 0.300, p < 0.01) IRI-PT (r = − 0.225, p < 0.01) IRI-EC (r = − 0.208, p < 0.01)	n/a	(HA ~ MA) < LA ALEX: <	n/a	(HA ~ MA) < LA ALEX: <	(HA ~ MA) > LA ALEX: >
Grynberg et al., 2012 **France**	N = 160 70.0% female Adult sample *M* age: 33.27 (± 13.06)	TAS-20	VDQ	VDQ-DI: TAS-DIF (r = 0.43, p < 0.001) TAS-DDF (r = 0.11, n.s.) TAS-EOT (r = − 0.03, n.s.) VDQ-SU:	n/a	n/a	n/a	DIF: < DDF: < EOT: <	DIF: > > DDF: ~ > EOT: ~ >

	General population			TAS-DIF (r = − 0.28, p < 0.01) TAS-DDF (r = − 0.35, p < 0.001) TAS-EOT (r = − 0.25, p < 0.01) VDQ-AV: TAS-DIF (r = 0.27, p < 0.001) TAS-DDF (r = 0.24, p < 0.001) TAS-EOT (r = 0.42, p < 0.001)				
Vellante e , 2013 **Italy**	N = 200 54.0% female Adult sample *M* age: 24.1 (19-32y, ± 2.8) Undergraduate students	TAS-20	EQ	*r* = − 0.358, *p* < 0.001	ALEX: <	n/a	n/a	n/a	n/a
Moriguch al., 2007 **Japan**	N = 30 83.3% female Adult sample *M* age: NA = 20.8 (± 0.89) HA = 20.2 (± 1.00) Undergraduate students	TAS-20 > 60 (high alexithymia) < 39 (low-alexithymia)	IRI	IRI-PT: NA > HA (p < 0.05) IRI-EC: NA > HA (p < 0.05) IRI-PD: HA > NA (p < 0.05) IRI-FA: NA ~ HA (n.s.)	n/a	PT: HA < LA FA: HA ~ LA	n/a	HA < LA	HA > LA
Sen Demirdogen et al., 2022 **Turkey**	N = 351 57.8% female Adolescent sample *M* age: (13-16y) Girls = 14.32 (± 0.73) Boys = 14.38 (± 0.86) School students	TAS-20	BES	BES-total: TAS-20 total (r = 0.015, n.s.) TAS-DIF (r = 0.053, n.s.) TAS-DDF (r = 0.063, n.s.) TAS-EOT (r = − 0.186, p < 0.01) BES-CE: TAS-20 total (r = − 0.130, p < 0.05) TAS-DIF (r = − 0.21, p < 0.05) TAS-DDF (r = − 0.115, p < 0.05) TAS-EOT (r = − 0.173, p < 0.01) BES-AE:	ALEX: ~ DIF: ~ DDF: ~ EOT: <	ALEX: < DIF: < DDF: < EOT: <	ALEX: > DIF: ~ DDF: > EOT: <	n/a	n/a

				TAS-20 total (r = 0.083, p < 0.05) TAS-DIF (r = 0.096, n.s.) TAS-DDF (r = 0.187, p < 0.05) TAS-EOT (r = − 0.134, p < 0.05)					
Santiesteban et al., 2021 **UK**	N = 66 63.6% female Adult sample *M* age: ASD = 29 (18-55y, ± 2.06) HC = 25 (18-53y, ± 1.22) ASD and HC individuals	TAS-20	IRI	TAS-20 total: IRI-FA (r = − 0.48, p < 0.01) IRI-EC (r = − 0.62, p < 0.01) IRI-PT (r = − 0.48, p < 0.01) IRI-PD (r = 0.27, p < 0.05) TAS-DIF: IRI-FA (r = − 0.27, p < 0.05) IRI-EC (r = − 0.48, p < 0.01) IRI-PT (r = − 0.45, p < 0.01) IRI-PD (r = 0.34, p < 0.01) TAS-DDF: IRI-FA (r = − 0.48, p < 0.01) IRI-EC (r = − 0.58, p < 0.01) IRI-PT (r = − 0.36, p < 0.01) IRI-PD (r = 0.19, n.s.) TAS-EOT: IRI-FA (r = − 0.48, p < 0.01) IRI-EC (r = − 0.48, p < 0.01) IRI-PT (r = − 0.37, p < 0.01) IRI-PD (r = 0.07, n.s.)	n/a	ALEX: (FA <) (PT <) DIF: (FA <) (PT <) DDF: (FA <) (PT <) EOT: (FA <) (PT <)	n/a	ALEX: < DIF: < DDF: < EOT: <	ALEX: > DIF: > DDF: ~ EOT: ~
Alkan Härtwig et al., 2020 **Germany**	N = 50 44.0% female Adult sample *M* age: HA = 34.96 (± 10.52) LA = 34.69 (± 10.05) General population	TAS-20 HA: > 56 LA: < 40	IRI	IRI-FA: NA > HA (p = 0.011) IRI-EC: NA > HA (p < 0.001) IRI-PT: NA > HA (p = 0.047) IRI-PD: HA > NA (p = 0.045)	n/a	PT: HA < LA FA: HA < LA	n/a	HA < LA	HA > LA

Bayraktutan et al., 2020 **Turkey**	N = 66 43.9% female Adult sample *M* age: SAD = 22.02 (19-34y, ± 0.33) HC = 21.2 (18-37, ± 0.37) SAD and HC individuals	TAS-20	EQ	NA > HA ($p = 0.029$)	HA < LA	HA < LA	n/a	n/a	n/a
Zhang et al., 2020 **China**	N = 92 81.5% female Adult sample *M* age: HA = 18.58 (± 1.69) LA = 19.15 (± 1.32) General population	TAS-20	IRI-EC	$r = -0.42$, $p < 0.001$	n/a	n/a	n/a	ALEX: <	n/a
Brewer et al., 2019 **UK**	N = 43 100.0% female Adult sample *M* age: ED = 25.9 (± 6.0) HC = 23.0 (± 6.3) EDs and HC individuals	TAS-20	IRI	IRI-PD: HA > LA (p < 0.01) IRI-FA: LA > HA (p < 0.01) IRI-EC: LA > HA (p < 0.05) IRI-PT: LA ~ HA (n.s.)	n/a	FA: HA < LA PT: HA ~ LA	n/a	HA < LA	HA > LA
Mul et al., 2018 **UK**	N = 52 26.9% female Adult sample *M* age: ASD = 25.9 (± 7.3) HC = 25.4 (± 7.6) ASD and HC individuals	TAS-20	QCAE	QCAE-AE: HA-ASD < LA-CO (p = 0.009, d = 0.94) HA-ASD < LA-ASD (p = 0.02, d = 0.97) QCAE-CE: HA-ASD < LA-CO (p < 0.001, d = 2.00) HA-ASD < LA-ASD (p = 0.002, d = 1.32)	n/a	HA-ASD < LA-CO HA-ASD < LA-ASD	HA-ASD < LA-CO HA-ASD < LA-ASD	n/a	n/a

Neumann et al., 2014 **USA and ıada**	N = 120 37.5% female Adult sample *M* age: TBI = 40.98 (22-63y, ± 12.45) HC = 40.64 (18-63y, ± 13.05) HC and patients with TBI	TAS-EOT	IRI	**TBI patients** TAS-EOT: IRI-EC (r = − 0.182, n.s.) IRI-PT (*r* = − 0.387, *p* < 0.05)	n/a	TBI patients EOT: <	n/a	EOT: ~	n/a
Teten et a 008 **USA**	N = 38 17.9% female Adult sample *M* age: 59.47 (± 4.6) War veterans	TAS-20	IRI-EC	*r* = − 0.39, *p* < 0.05	n/a	n/a	n/a	ALEX: <	n/a
Kılıç et al. 20 **Turkey**	N = 35 100.0% female Adult sample *M* age: 27.3 (± 5.2) BPD individuals	TAS-20 LA: ≤51 HA: ≥61	EQ	EQ: NA ~ HA (*p* = 0.601) TAS-20 and EQ (*r* = *n.r.*, *p* > 0.05)	HA ~ LA ALEX: ~	n/a	n/a	n/a	n/a
Eddy & Hansen, 2021 **UK**	N = 297 85.2% female Adult sample *M* age: 19.19 (18-29y, ± 1.21) Undergraduate students	TAS-20	IRI	TAS-20: IRI-PT (r = − 0.334, p < 0.0001) IRI-EC (r = − 0.295, p < 0.0001) IRI-FA (r = − 0.110, n.s.) IRI-PD (r = 0.211, p < 0.001)	n/a	ALEX: (PT <) (FA ~)	n/a	ALEX: <	ALEX: >
Morice-Ramat et al., 2018 **France**	N = 137 68.6% female Adult sample *M* age: 26.5 (± 1.3)	TAS-20	f-JSPE	*r* = − 0.38, *p* < 0.001	ALEX: <	n/a	n/a	n/a	n/a

		General practice residents								
Beadle et al., 2013 **USA**		N = 42 100.0% female Adult sample *M* age: AN = 24.4 (± 5.5) HC = 24.8 (± 5.4) AN and HC individuals	TAS-20	IRI-PD	**Starvation phase:** $r = 0.46$, $p < 0.05$ **Weight restoration phase:** $r = 0.64$, $p < 0.05$	n/a	n/a	n/a	n/a	**Starvation phase** > **Weight restoration phase** >
Butera et al., 2022 **USA**		N = 75 25.3% female Children and Adolescent sample *M* age: 11.90 (8-17y; ± 2.16) ASD and TD individuals	AQC	IRI	**Full sample** IRI-EC: AQC-I (r = N.R., p = N.R.) AQC-C (r = − 0.36, p = 0.002) AQC-Total (r = N.R., p = N.R.) IRI-PD: AQC-I (r = 0.39, p = 0.001) AQC-C (r = 0.359, p = 0.002) AQC-Total (r = 0.444, p < 0.001) **TD sample** IRI-EC: AQC-I (*r* = − 0.04, *n.s.*) AQC-C (r = − 0.25, n.s.) AQC-Total (r = − 0.16, n.s.) IRI-PD: AQC-I (r = 0.23, n.s.) AQC-C (r = 0.32, p = 0.05) AQC-Total (r = 0.36, p = 0.02) **ASD sample** IRI-EC: AQC-I (r = − 0.10, p = n.s.)	n/a	n/a	n/a	**Full sample** ALEX: ~ DIF: ~ DDF: < **TD sample** ALEX: ~ DIF: ~ DDF: ~ **ASD sample** ALEX: ~ DIF: ~ DDF: <	**Full sample** ALEX: > DIF: > DDF: > **TD sample** ALEX: > DIF: ~ DDF: > **ASD sampl** ALEX: > DIF: > DDF: >

				AQC-C (r = − 0.47, p < 0.01) AQC-Total (r = − 0.20, n.s.) IRI-PD: AQC-I (r = 0.41, p = 0.02) AQC-C (r = 0.40, p = 0.02) AQC-Total (r = 0.52, p < 0.01)				
Brett & M[illegible]bery, 2022 **Australia**	N = 301 67.1% female Adult sample *M* age: 20.72 (16-56y, ± 5.42) General population	TAS-20	IRI-PD QCAE	TAS-20: IRI-PD (r = 0.27, p < 0.01) QCAE-CE (r = − 0.32, *p* < 0.01) QCAE-AE (r = − 0.06, n.s.)	n/a	ALEX: <	ALEX: ~	n/a	ALEX: >
Shah et al. [illegible]19 **UK**	N = 306 45.0% female Adult sample *M* age: 34.0 (18-85y, ± 11.9) General population	TAS-20	QCAE	TAS-20: QCAE-total (r = − 0.39, p < 0.001) QCAE-CE (r = − 0.44, *p* < 0.001) QCAE-AE (r = − 0.19, p < 0.001)	ALEX: <	ALEX: <	ALEX: <	n/a	n/a
Martínez-Velázquez et al., 2020 **Mexico**	N = 60 51.7% female Adult sample *M* age: 18-30y Male = 21.1 (± 2.4) Female = 10.9 (± 1.8) Undergraduate students	TAS-20	IRI	*r* = − 0.58, *p* < 0.001	ALEX: <	n/a	n/a	n/a	n/a
Konrath et al., 2018 (Study 6) **USA**	N = 270 53.8% female Adult sample *M* age: 33.5 (± 11.6) General population	TAS-20	SITES	SITES: TAS-20 total (r = − 0.25, p < 0.001) TAS-DIF (r = − 0.19, p < 0.01) TAS-DDF (r = − 0.22, p < 0.001) TAS-EOT (r = − 0.25, p < 0.001)	ALEX: < DIF: < DDF: < EOT: <	n/a	n/a	n/a	n/a

Flasbeck et al., 2017 **Germany**	Total sample (*N* = 98) 100.0% female Adult sample BPD (*n* = 50) *M* age: 28.7 (± 7.28) HC (*n* = 48) *M* age: 26.33 (± 6.42)	TAS-20	IRI	IRI-PD: TAS-DIF (r = 0.74, p < 0.001) TAS-DDF (r = 0.62, p < 0.001) TAS-EOT (r = 0.25, p = 0.012) IRI-EC: TAS-DIF (r = N.R.) TAS-DDF (r = N.R.) TAS-EOT (r = − 0.30, p = 0.003) IRI-FA: TAS-DIF (r = N.R.) TAS-DDF (r = N.R.) TAS-EOT (r = − 0.37, p < 0.001) IRI-PT: TAS-DIF (r = − 0.46, p < 0.001) TAS-DDF (r = − 0.39, p < 0.001) TAS-EOT (r = − 0.49, p < 0.001)	n/a	DIF: (FA ~) (PT <) DDF: (FA ~) (PT <) EOT: (FA <) (PT <)	n/a	DIF: ~ DDF: ~ EOT: <	DIF: > DDF: > EOT: >
Demers & Koven, 2015 **USA**	*N* = 86 66.3% female Adult sample M age: 18.0 (± 1.1) Undergraduate students	TAS-20	QMEE	QMEE: TAS-Total (r = − 0.10, n.s.) TAS-DIF (r = − 0.27, p < 0.05) TAS-DDF (r = 0.02, n.s.) TAS-EOT (r = − 0.41, p < 0.005)	n/a	n/a	ALEX: ~ DIF: < DDF: ~ EOT: <	n/a	n/a
Colombarolli et al., 2019 **Brazil**	*N* = 850 83.2% female Adult sample M age: 30.97 (18-71y, ± 1.1) General population	TAS-20	QCAE	TAS-20 total: QCAE-PT (r = − 0.27 p < 0.001) QCAE-OnSim (r = − 0.35, p < 0.001) QCAE-EmCon (r = 0.22, p < 0.001) QCAE-ProRes (r = − 0.09, p < 0.01) QCAE-PerRes (r = − 0.16, p < 0.001) QCAE-CE (r = − 0.38, p < 0.001) QCAE-AE (r = − 0.01, n.s.) QCAE-Total (r = − 0.30, p < 0.001)	ALEX: < DIF: < DDF: < EOT: <	ALEX: < < < DIF: < < < DDF: < < < EOT: < < <	ALEX: ~ DIF: > DDF: < EOT: <	n/a	ALEX: > DIF: > DDF: > EOT: >

				TAS-DIF: QCAE-PT (r = − 0.19, p < 0.001) QCAE-OnSim (r = − 0.27, p < 0.001) QCAE-EmCon (r = 0.26, p < 0.001) QCAE-ProRes (r = 0.01, n.s.) QCAE-PerRes (r = − 0.05, n.s.) QCAE-CE (r = − 0.28, p < 0.001) QCAE-AE (r = 0.12, p < 0.001) QCAE-Total (r = − 0.17, p < 0.001) TAS-DDF: QCAE-PT (r = − 0.20 p < 0.001) QCAE-OnSim (r = − 0.20, p < 0.001) QCAE-EmCon (r = 0.14, p < 0.001) QCAE-ProRes (r = − 0.08, p < 0.05) QCAE-PerRes (r = − 0.08, p < 0.05) QCAE-CE (r = − 0.24, p < 0.001) QCAE-AE (r = 0.00, n.s.) QCAE-Total (r = − 0.19, p < 0.001) TAS-EOT: QCAE-PT (r = − 0.26 p < 0.001) QCAE-OnSim (r = − 0.34, p < 0.001) QCAE-EmCon (r = 0.08, p < 0.05) QCAE-ProRes (r = − 0.17, p < 0.001) QCAE-PerRes (r = − 0.27, p < 0.001) QCAE-CE (r = − 0.37, p < 0.001) QCAE-AE (r = − 0.15, p < 0.001) QCAE-Total (r = − 0.37, p < 0.001)					
McKenzie et al., 2022 **UK**	Total sample (*N* = 61) Adult sample ASD (n = 29) 58.6% female *M* age: 18.31 (± 1.65)	TAS-20	IRI	TAS-20: IRI-PT (r = − 0.075, n.s.) IRI-FA (r = − 0.074, n.s.) IRI-EC (r = − 0.327, n.s.)	n/a	ALEX: (PT ~) (FA ~)	n/a	ALEX: ~	n/a

		HC (n = 31) 41.4% female *M* age: 17.81 (± 1.85)								
Karras et al., 2022 **France**		*N* = 550 52.7% female Adult sample M age: 40.27 (18-88y, ± 15.51) Licensed drivers	TAS-20	IRI short-FTEQ	TAS-20: Short-FTEQ (r = − 0.13, p < 0.01) IRI-PT (r = − 0.30, p < 0.001) IRI-PD (r = 0.32, p < 0.001)	ALEX: <	ALEX: <	n/a	n/a	ALEX: >
Romero-Martínez et al., 2021 **Spain**		Total sample (*N* = 88) 100.0% male Adult sample IPVAW (n = 47) *M* age: 38.61 (± 11.40) Noncriminals (n = 41) *M* age: 41.72 (± 11.01)	TAS-20	IRI-PD	*r* = 0.474, *p* < 0.001	n/a	n/a	n/a	n/a	ALEX: >
Trentini et al., 2022 **Italy**		*N* = 211 51.2% female Adolescent sample M age: 16.10 (14-19y, ± 1.40) School students	TAS-20	IRI	IRI-EC: TAS-DIF (r = 0.03, n.s.) TAS-DDF (r = − 0.07, n.s.) TAS-EOT (r = − 0.37, p < 0.001) IRI-PD: TAS-DIF (r = 0.50, p < 0.001) TAS-DDF (r = 0.28, p < 0.001) TAS-EOT (r = − 0.13, n.s.) IRI-FA: TAS-DIF (r = − 0.29, p < 0.001) TAS-DDF (r = − 0.08, n.s.) TAS-EOT (r = − 0.38, p < 0.001) IRI-PT:	n/a	DIF: (FA <) (PT <) DDF: (FA ~) (PT <) EOT: (FA <) (PT <)	n/a	DIF: ~ DDF: ~ EOT: <	DIF: > DDF: > EOT: ~

					TAS-DIF (r = − 0.20, p < 0.001) TAS-DDF (r = − 0.17, p < 0.05) TAS-EOT (r = − 0.35, p < 0.001)					
Redondo Fernánde **Spain**	**Herrero- 018**	*N* = 433 80.8% female Adult sample M age: 20.0 (± 2.05) Undergraduate students	TAS-20	IRI EQ	IRI-total TAS-DIF (r = − 0.24, p < 0.001) TAS-DDF (r = − 0.25, p < 0.001) TAS-EOT (r = − 0.31, p < 0.001) TAS-20 total (r = − 0.34, p < 0.001) EQ-total: TAS-DIF (r = − 0.23, p < 0.001) TAS-DDF (r = − 0.37, p < 0.001) TAS-EOT (r = − 0.41, p < 0.001) TAS-20 total (r = − 0.42, p < 0.001) EQ-CE: TAS-DIF (r = − 0.10, p < 0.05) TAS-DDF (r = − 0.22, p < 0.001) TAS-EOT (r = − 0.30, p < 0.001) TAS-20 total (r = − 0.26, p < 0.001) EQ-ER: TAS-DIF (r = − 0.08, n.s.) TAS-DDF (r = − 0.25, p < 0.001) TAS-EOT (r = − 0.32, p < 0.001) TAS-20 total (r = − 0.27, p < 0.001)	ALEX: < < DIF: < < DDF: < < EOT: < <	ALEX: < DIF: < DDF: < EOT: <	ALEX: < DIF: ~ DDF: < EOT: <	n/a	n/a
(Lyvers et al., 2017) **UK**		*N* = 102 87.3% female Adult sample *M* age: 22.18 (18-50y) Undergraduate students	TAS-20	IRI	IRI-PT: TAS-20 total (r = − 0.40, p < 0.001) TAS-DIF (r = − 0.23, p < 0.05) TAS-DDF (r = − 0.36, p < 0.001) TAS-EOT (r = − 0.40, p < 0.001) IRI-FA:	n/a	ALEX: (PT <) (FA <) DIF: (PT <) (FA ~) DDF: (PT <) (FA ~) EOT: (PT <) (FA <)	n/a	ALEX: < DIF: < DDF: < EOT: <	n/a

				TAS-20 total (r = − 0.11, n.s.) TAS-DIF (r = − 0.13, n.s.) TAS-DDF (r = − 0.13, n.s.) TAS-EOT (r = − 0.32, p < 0.01) IRI-EC: TAS-20 total (r = − 0.38, p < 0.001) TAS-DIF (r = − 0.23, p < 0.05) TAS-DDF (r = − 0.34, p < 0.001) TAS-EOT (r = − 0.37, p < 0.001)				
Maurage l., 2011 **Belgium**	*N* = 60 40.0% female Adult sample AUD (n = 30) M age: 46.67 (± 9.37) HC (n = 30) M age: 43.13 (± 13.06) AUD and HC	TAS-20	EQ	TAS-20: EQ-total (r = − 0.25, n.s.) EQ-CE (r = − 0.20, n.s.) EQ-ER (r = − 0.51, p < 0.01)	ALEX: ~	ALEX: ~	ALEX: <	n/a	n/a
Williams & Wood, 2010 **UK**	*N* = 128 17.2% female Adult sample M age: TBI = 35.84 (20-62y, ± 13.33) HC = 36.09 (20-62y, ± 14.24)	TAS-20	BEES	**TBI Patients** BEES: TAS-20 total (r = − 0.323, p < 0.005) TAS-DIF (r = − 0.122, n.s.) TAS-DDF (r = − 0.233, p < 0.001) TAS-EOT (r = − 0.401, p < 0.001) **HC Group** BEES: TAS-20 total (r = − 0.473, p < 0.0001) TAS-DIF (r = − 0.313, *p* < 0.01)	n/a	n/a	**TBI Patients** ALEX: < DIF: ~ DDF: < EOT: < **HC Group** ALEX: < DIF: < DDF: < EOT: <	n/a	n/a

				TAS-DDF (r = − 0.378, p < 0.001) TAS-EOT (r = − 0.520, p < 0.0001)					
Swart et a **The Neth**	**009** **nds**	Total sample (*N* = 43) Adult sample NA (n = 18) 61.1% female M age: 19.3 (± 1.0) HA (n = 16) 56.3% female M age: 20.1 (± 1.7)	BVAQ-Verbalizing HA: ≥ 29.73 LA: ≤ 20.97	EQ	HA< LA (*p* = 0.01)	HA< LA	n/a	n/a	n/a	n/a
Preti et al. **Italy**	**11**	*N* = 256 53.9% female Adult sample M age: 24.0 (18-38y, ± 4.5) Undergraduate students	TAS-20	EQ	**Total sample** TAS-20: EQ-CE (r = − 0.199, p < 0.01) EQ-ER (r = − 0.507, p < 0.001) **Female sample:** EQ and TAS-20 (r = − 0.38, p < 0.01)	**Female sample** ALEX: <	ALEX: <	ALEX: <	n/a	n/a
Nishimura et al., 2009 **Japan**		*N* = 202 49.5% female Adolescent sample M age: 13.86 (12-15y, ± 0.95) School students	QAAA	MDESA	MDESA-EC: QAAA-DIF (r = 0.24, p < 0.001) QAAA-EOT (r = − 0.45, p < 0.001) QAAA-CIC (r = − 0.38, p < 0.001) QAAA-DDF (r = 0.16, p < 0.05) MDESA-PD: QAAA-DIF (r = 0.40, p < 0.001) QAAA-EOT (r = − 0.26, p < 0.01) QAAA-CIC (r = − 0.17, p < 0.05) QAAA-DDF (r = 0.40, p < 0.001) MDESA-FA: QAAA-DIF (r = 0.40, p < 0.001) QAAA-EOT (r = − 0.40, p < 0.001) QAAA-CIC (r = − 0.69, p < 0.001)	n/a	DIF: (FA >) (PT >) DDF: (FA >) (PT >) EOT: (FA <) (PT <)	n/a	After controlling for diagnostic literacy test scores DIF: > DDF: > EOT: <	After controlling for diagnost literacy test scores DIF: > DDF: > EOT: <

					QAAA-DDF (r = 0.21, p < 0.01) MDESA-PT: QAAA-DIF (r = 0.44, p < 0.001) QAAA-EOT (r = − 0.55, p < 0.001) QAAA-DDF (r = 0.29, p < 0.001)					
Önal et al **Germany**	**21**	*N* = 136 100.0% male Adult sample M age: 21.5 (± 0.3) General population	TAS-DIF	IRI	*r* = 0.29, *p* = 0.001	DIF: >	n/a	n/a	n/a	n/a
Chalah et **France**	**2020**	Total sample (*N* = 45) Adult sample LA with MS (n = 28) 60.7% female *M* age: 52.79 (± 13.71) HA with MS (n = 17) 35.3% female *M* age: 54.18 (± 11.52)	TAS-20 HA: ≥ 56 LA: < 56	EQ	HA< LA (*p* = 0.002)	HA< LA	n/a	n/a	n/a	n/a
Diotaiuti et al., 2021 **Italy**		*N* = 300 52.7% female Adult sample M age: 22.0 (± 2.63) Undergraduate students	TAS-20	IRI	IRI-PT: TAS-20 total (r = − 0.217, p < 0.01) TAS-DIF (r = − 0.067, n.s.) TAS-DDF (r = − 0.040, n.s.) TAS-EOT (r = − 0.461, p < 0.01) IRI-PD: TAS-20 total (r = 0.349, p < 0.01) TAS-DIF (r = 0.428, p < 0.01) TAS-DDF (r = 0.283, p < 0.01) TAS-EOT (r = 0.093, n.s.) IRI-EC:	n/a	ALEX: (PT <) (FA ~) DIF: (PT ~) (FA <) DDF: (PT ~) (FA ~) EOT: (PT <) (FA <)	n/a	ALEX: < DIF: < DDF: ~ EOT: <	ALEX: > DIF: > DDF: > EOT: ~

				TAS-20 total (r = − 0.277, p < 0.01) TAS-DIF (r = − 0.109, p < 0.05) TAS-DDF (r = − 0.041, n.s.) TAS-EOT (r = − 0.369, p < 0.001) IRI-FA: TAS-20 total (r = − 0.025, n.s.) TAS-DIF (r = − 0.225, p < 0.01) TAS-DDF (r = 0.021, n.s.) TAS-EOT (r = − 0.315, p < 0.01)				
Di Girola et al., 2019 **Italy**	*N* = 407 74.0% female Adult sample M age: 22.6 (18-57y, ± 4.6) General population	TAS-20	QCAE	TAS-DIF: QCAE-PT (r = − 0.16, n.s.) QCAE-OnSim (r = − 0.16, n.s.) QCAE-EmCon (r = 0.29, p < 0.01) QCAE-ProRes (r = 0.03, n.s.) QCAE-PerRes (r = 0.00, n.s.) QCAE-CE (r = − 0.18, n.s.) QCAE-AE (r = 0.14, n.s.) QCAE-Total (r = − 0.04, n.s.) TAS-DDF: QCAE-PT (r = − 0.27, p < 0.01) QCAE-OnSim (r = − 0.13, n.s.) QCAE-EmCon (r = 0.06, n.s.) QCAE-ProRes (r = − 0.17, n.s.) QCAE-PerRes (r = − 0.14, n.s.) QCAE-CE (r = − 0.25, p < 0.01) QCAE-AE (r = 0.10, n.s.) QCAE-Total (r = − 0.22, p < 0.01) TAS-EOT: QCAE-PT (r = − 0.31, p < 0.01) QCAE-OnSim (r = − 0.27, p < 0.01) QCAE-EmCon (r = 0.15, n.s.) QCAE-ProRes (r = − 0.17, n.s.) QCAE-PerRes (r = − 0.16, n.s.)	DIF: ~ DDF: < EOT: <	DIF: ~ ~ ~ DDF: < ~ < EOT: < < <	DIF: ~ DDF: ~ EOT: ~	n/a	DIF: > DDF: ~ EOT: ~

					QCAE-CE (r = − 0.35, p < 0.01) QCAE-AE (r = − 0.06, n.s.) QCAE-Total (r = − 0.27, p < 0.01)					
Lee et al., 0 **Korea**		*N* = 200 55.5% female Adult sample M age: 23.07 (18-32y, ± 2.67) General population	TAS-20	IRI	IRI-CE (PT+FA): TAS-20 total (r = − 0.218, p < 0.01) TAS-DIF (r = − 0.121, n.s.) TAS-DDF (r = − 0.188, p < 0.001) TAS-EOT (r = − 0.241, p < 0.001)	n/a	ALEX: < DIF: ~ DDF: < EOT: <	n/a	n/a	n/a
Shalev & fovsky, 2020 **Israel**		*N* = 671 56.0% female Adult sample M age: 24.5 (± 2.5) General population	TAS-20	IRI EQ	TAS-20: EQ (r = − 0.49, p < 0.0005) IRI (r = − 0.17, p < 0.0005)	ALEX: < <	n/a	n/a	n/a	n/a
Zhao et al., J18		*N* = 588 63.8% female Adult sample M age: 24.12 (± 6.20) General population	TAS-20	EQ	EQ-40: TAS-DIF (r = − 0.29, p < 0.001) TAS-DDF (r = − 0.36, p < 0.001) EQ-15: TAS-DIF (r = − 0.16, p < 0.001) TAS-DDF (r = − 0.26, p < 0.001)	DIF: < < DDF: < <	n/a	n/a	n/a	n/a
Goerlich et al., 2017 **Germany**		*N* = 45 100.0% male Adult sample M age: 24.1 (± 3.2) General population	TAS-20	EQ	TAS-20 total: EQ-total (r = − 0.74, p < 0.001) EQ-CE (r = − 0.74, p < 0.001) EQ-ER (r = − 0.66, p < 0.001)) EQ-total: TAS-DIF (r = − 0.57, p < 0.001) TAS-DDF (r = − 0.69, p < 0.001) TAS-EOT (r = − 0.51, p < 0.001)	ALEX: < DIF: < DDF: < EOT: <	ALEX: <	ALEX: <	n/a	n/a

Stinson et al., 2022 **Switzerlar**	*N* = 824 80.6% female Adult sample M age: N.R. Undergraduate students	TAS-20	QCAE	TAS-20 total: QCAE-CE (r = − 0.381, p < 0.001) QCAE-EmCon (r = − 0.060, n.s.) QCAE-RtO (ProRes+PerRes) (r = − 0.154, p < 0.001)	n/a	ALEX: <	n/a	n/a	ALEX: ~
Nam et al 20 **Switzerlar**	Total sample (*N* = 200) 55.5% female Adult sample M age: 23.07 (19-32y, ± 2.68) NA (n = 129) M age: 23.28 (± 2.62) HA (n = 71) M age: 22.69 (± 2.74)	TAS-20	IRI	IRI-PT: HA< LA (p = 0.043, ηp2 = 0.02) IRI-FA: HA~ LA (n.s., ηp2 = 0.00) IRI-EC: HA~ LA (n.s., ηp2 = 0.00) IRI-PD: HA>LA (p < 0.001 ηp2 = 0.10)	n/a	PT: HA< LA FA: HA~ LA	n/a	HA~LA	ALEX: HA > LA
Patil & Silani, 2014 **Italy**	*N* = 330 65.2% female Adult sample M age: 24.06 (18-60y, ± 5.50) General population	TAS-20	IRI	TAS-20: IRI-FA (r = 0.083, n.s.) IRI-PT (r = − 0.115, p < 0.001) IRI-EC (r = − 0.125, p < 0.001) IRI-PD (r = 0.303, p < 0.001)	n/a	ALEX: (FA ~) (PT <)	n/a	ALEX: <	ALEX: >
Paricio et al., 2020 **Spain**	*N* = 246 48.8% female Adolescent sample M age: 13.90 (12-16y, ± 0.86) School students	TAS-20	BES	r = 0.024, n.s.	n/a	n/a	n/a	n/a	n/a
Study 1: Radoš et al., 2021	*N* = 426 77.1% female Adult sample	TAS-20	EES	EES: TAS-20 total (r = − 0.19, p < 0.01) TAS-DIF (r = − 0.00, n.s.)	n/a	n/a	ALEX: < DIF: ~	n/a	n/a

	M age: 22.5 (18-51y, ± 4.58) Undergraduate students			TAS-DDF (r = − 0.12, p < 0.05) TAS-EOT (r = − 0.36, p < 0.01)			DDF: < EOT: <		
Ricciardi et al., 2015 **Italy**	*N* = 30 52.0% female Adult sample M age: PD Patients = 67.8 (± 6.9) Partners = 65.8 (± 6.5)	TAS-20	EQ	**Full sample:** r = 0.328, n.s. **Patients:** r = 0.031, n.s. **Partners:** r = 0.436, n.s.	**Full sample** ALEX: < **Patients** ALEX: < **Partners** ALEX: <	n/a	n/a	n/a	n/a
Mayer et al 1990 **USA**	*N* = 139 N.R.% female Adult sample M age = N.R. (17-63y) Undergraduate students	TAS-20	QMEE	r = 0.01, n.s.	ALEX: ~	n/a	n/a	n/a	n/a
Sonnby-Borgström, 2009 **Sweden**	*N* = 102 50.0% female Adult sample M age: 24.0 Undergraduate students	TAS-20	IRI	TAS-20: IRI-Total (r = − 0.18, p = 0.06) IRI-FA (r = − 0.20, p < 0.05) IRI-PT (r = − 0.25, p < 0.05) IRI-EC (r = − 0.20, p < 0.01) IRI-PD (r = 0.12, n.s.)	ALEX: <	ALEX: (FA <) (PT <)	n/a	ALEX: <	ALEX: ~

A-BVAQ = BVAQ Affective Alexithymia; AA = Affective Alexithymic; AN = Anorexia Nervosa; AlexQ-C = Alexithymia Questionnaire for Children; AlexQ-CP = Alexithymia Questionnaire for Children - Parent Version; ALEX = alexithymia total score; ASD = Autism Spectrum Disorder; BES = Basic Empathy Scale; BES-A = Basic Empathy Scale in Adults; BES-AE = BES Affective Empathy; BES-CE = BES Cognitive Empathy; BEES = Balanced Emotional Empathy Scale; BPD = Borderline Personality Disorder; BVAQ = Bermond–Vorst Alexithymia Questionnaire; CA = Cognitive Alexithymic; C-BVAQ = BVAQ Cognitive Alexithymia; DDF = difficulty describing feelings; DIF = difficulty identifying feelings; EDs = Eating Disorders; EmQue-CA = Empathy Questionnaire for Children and Adolescents; EQ = Empathy Quotient; EQ-CE = EQ Cognitive Empathy; EQ-ER = EQ Emotional Reactivity; EQ-Child = Empathy Quotient Child-Parent Questionnaire; EOT = externally oriented thinking; ETS = Empathy Tendency Scale; HA = High Alexithymia; HC = Healthy Control; IRI = Interpersonal Reactivity Index; IRI-EC = IRI Empathic Concern; IRI-FA = IRI Fantasy; IRI-PD = IRI Personal Distress; IRI-PT = IRI Perspective-Taking; LA = Low Alexithymia; M = mean; MDD = Major Depressive Disorder; MDESA = Multi-Dimensional Empathy Scale for Adolescents; MDESA-PT = MDESA Perspective-Taking; MDESA-FA = MDESA Fantasy; MDESA-EC = MDESA-PD = MDESA Personal Distress; MS = Multiple Sclerosis; n/a = not applicable; n.r. = not reported; n.s. = not significant; N = Number of participants; QAAA = Questionnaire to Assess Alexithymia for Adolescents; QCAE = Cognitive and Affective

Empathy scale; QCAE-AE = QCAE Affective Empathy; QCAE-CE = QCAE Cognitive Empathy; QCAE-EmCon = QCAE Emotional Contagion; QCAE-OnSim = QCAE Online Simulation; QCAE-PerRes = QCAE Peripherical Responsivity; QCAE-ProRes = QCAE Proximal Responsivity; QCAE-PT = QCAE Perspective-Taking; SAD = Social Anxiety Disorder; SITES = Single Item Trait Empathy Scale; T-AE = Trait Affective Empathy; TAS-20 = The 20-item Toronto Alexithymia Scale; T-CE = Trait Cognitive Empathy; TEQ = Toronto Empathy Questionnaire; TEC = Trait Personal Distress; T-EC = Trait Empathic Concern; T-OE = Trait Overall Empathy; UK = United Kingdom; USA = United States of America; VDQ = Vicarious Distress Questionnaire; VDQ-AV = VDQ Avoidance of others' distress; VDQ-DI = VDQ Distress at the suffering of others; VDQ-SU = VDQ Support for the suffering of others; y = years old; ~ not significant correlation or difference between groups; < negative relationship or lower score; > positive relationship or higher score.

Appendix B. Characteristics of studies examining the relationship between measures of alexithymia and state empathy components

Study	Sample	Measure of Alexithymia	Measure of Empathy	Effect	S-OE	S-CE	S-AE	S-EC
Banzhaf et al., 2018 **Germany**	*N* = 70 61% female Adult sample *M* age: Healthy LA = 42.8 (± 12.7) Healthy HA = 60.5 (± 19.0) MDD LA = 47.6 (± 12.7) MDD HA = 39.4 (± 11.7) Healthy controls and MDD-patients	TAS-20 HA: >53 (men); >52 (women)	MET	MET-CE: HA< LA (p = 0.047, η^2 = 0.06) MET-AE: HA~LA (p = 0.197/n.s., η^2 = *n.r.*)	n/a	HA< LA	HA ~ LA	n/a
Speyer et al., 2022 **UK**	*N* = 59 69.7% female Children sample *M* age To PUC-Rio and CAPES for the aid granted, without which this work could not have been carried out This study was financed in part by the Coordenação de Aperfeiçoaento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001	AlexQ-C AlexQ-CP	KEDS	**Typically Developing and Autistic Children** KEDS: AlexQ-C (r = − 0.24, n.s.) AlexQ-CP (r = − 0.23, n.s.) **Typically developing children only** KEDS: AlexQ-C (r = − 0.15, n.s.) AlexQ-CP (r = − 0.13, n.s.)	**Typically Developing and Autistic Children** ALEX: ~ ~ **Typically developing children only** ALEX: ~ ~	n/a	n/a	n/a

	= 9.46 (8-12y) Typically and atypically developing children							
Zammur et al., 2014 **Italy**	N = 431 74.0% female Adult sample *M* age: 25.47 (18-34y, ± 3.36) General population	TAS-20	PIEW-EMP	PIEW-EMP: TAS-DIF (r = 0.060, n.s.) TAS-DDF (r = 0.065, n.s.) TAS-EOT (r = − 0.242, p < 0.01)	DIF: ~ DDF: ~ EOT: <	n/a	n/a	n/a
Santieste et al., 2021 **UK**	N = 66 63.6% female Adult sample *M* age: ASD = 29 (18-55y, ± 2.06) HC = 25 (18-53y, ± 1.22) ASD and HC individuals	TAS-20	CARER	TAS-20 total: ON (r = − 0.28, p < 0.05) OFF (r = − 0.34, p < 0.01) TAS-DIF: ON (r = − 0.20, n.s.) OFF (r = − 0.29, p < 0.05) TAS-DDF: ON (r = − 0.25, p < 0.05) OFF (r = − 0.37, p < 0.01) TAS-EOT: ON (r = − 0.24, p < 0.05) OFF (r = − 0.13, n.s.)	n/a	n/a	ALEX: < < DIF: ~ < DDF: < < EOT: < ~	n/a
Kerr-Gaffney et al., 2020 **UK**	N = 147 94.6% female Adult sample *M* age: (18-55y)	TAS-20	MET	TAS-20: MET-CE (r = − 0.20, p = 0.02) MET-AE (r = − 0.35, p < 0.001)	n/a	ALEX: <	ALEX: <	n/a

		AN = 27.57 (± 8.52) REC = 26.33 (± 8.04) HC = 24.37 (± 4.43)							
Mul et al., 2018 **UK**		N = 52 26.9% female Adult sample *M* age: ASD = 25.9 (± 7.3) HC = 25.4 (± 7.6) ASD and HC individuals	TAS-20	MET	MET-AE: HA-ASD < LA-CO ($p < 0.05$, d = *n.r.*) HA-ASD < LA-ASD ($p = 0.007$, $d = 1.16$)	n/a	n/a	HA-ASD < LA-CO HA-ASD < LA-ASD	n/a
Winter et al., 2017 **Germany**		Total sample ($N = 63$) 100.0% male Adult sample Aggressive group ($n = 29$) M age: 32.17 (± 7.70) Control group ($n = 34$) *M* age: 31.71 (± 5.71)	TAS-26	The EmpaToM task	TAS-26 total: EmpaToM-AE ($r = -0.35$, $p = 0.001$) EmpaToM-EC ($r = -0.36$, $p = 0.016$)	n/a	n/a	ALEX: <	ALEX: <

ALEX = alexithymia total score; AlexQ-C = Alexithymia Questionnaire for Children; AlexQ-CP = Alexithymia Questionnaire for Children - Parent Version; AN = Anorexia Nervosa; ASD = Autism Spectrum Disorder; CARER = The Continuous Affective Rating and Empathic Response Task; DDF = difficulty describing feelings; DIF = difficulty identifying feelings; EmpaToM-AE = Affective Empathy; EmpaToM-EC = Empathic Concern; HA = High Alexithymia; HC = Healthy Control; KEDS = Kids Empathic Development Scale; LA = Low Alexithymia; M = mean; MDD = Major Depressive Disorder; MET = The Multifaceted Empathy Test; MET-AE = MET Affective Empathy; MET-CE = MET Cognitive Empathy; n/a = not applicable; n.r. = not reported; n.s. = not significant; N = Number of participants; OFF = Offline assessment; ON = Online assessment; PIEW-EMP = Problematic Interpersonal Events at Work – Empathy; REC = Recovered anorexia nervosa; S-AE = State Affective Empathy; S-CE = State Cognitive Empathy; S-EC = State Empathic Concern; S-OE = State Overall Empathy; TAS-20 = The 20-item Toronto Alexithymia Scale; EOT = externally oriented thinking; y = years old; ~ not significant correlation or difference between groups; < negative relationship or lower score; > positive relationship or higher score.

IV. GENERAL DISCUSSION

1. Main Findings

The central objective of the thesis was to establish a robust theoretical and empirical framework that would facilitate the development of intervention programs for alexithymia, which is grounded in socio-emotional impairments. This goal was pursued through a series of studies, beginning with two validation studies of scales adapted to Brazilian Portuguese for measuring alexithymia and interoceptive accuracy (Articles 1 and 2, respectively). Subsequently, two systematic reviews were conducted, as presented in Article 3, which examines the impact of DBT-based interventions on alexithymia, while Article 4 delves into the multifaceted relationship between alexithymia and empathy.

Article 1 aimed to validate an adapted version of the BVAQ for Brazilian Portuguese (BVAQ-BR). The results indicated that the BVAQ-BR presented a factorial structure similar to the original scale and acceptable psychometric properties. Although the BVAQ-BR was almost identical to the TAS-20 regarding cognitive factors, the affective factors of the BVAQ-BR did not significantly correlate with the TAS-20 or showed a negative correlation.

These findings corroborate the claim that the TAS-20 only measures the cognitive aspects of alexithymia, while the BVAQ also includes affective aspects. However, this may also suggest that BVAQ affective factors do not effectively measure alexithymia. The emotionalizing factor had low internal consistency and was either unrelated or negatively correlated with other BVAQ-BR factors, which may weaken the reliability of the scale. Moreover, some items in this factor appear to measure constructs other than alexithymia, such as empathy (e.g., *"When I see*

someone else sobbing heavily, I feel sadness well up inside me") or emotional regulation (e.g., *"Unexpected events often overwhelm me with emotion"*), rather than of alexithymia. Therefore, it is debatable whether there are any benefits in using the BVAQ instead of the TAS-20 to assess alexithymia, given the low reliability of the affective components of the BVAQ.

As far as we know, Article 1 presented for the first-time data for the prevalence of alexithymia in Brazil. Prevalence rates varied from 29.3% to 37%. These findings revealed a markedly higher prevalence of alexithymics in Brazil compared to other countries, which present rates around 10% (Franz et al., 2008; Joukamaa et al., 2003; Salminen et al., 1999). The higher prevalence of alexithymia in Brazil compared to other countries may reflect broader cultural and social factors. Anecdotal evidence posits that Brazilian culture places a strong emphasis on emotional expressiveness and sociability, and there may be social stigma associated with difficulties in these areas. This may lead to individuals with alexithymia being less likely to seek help or disclose their symptoms, which could contribute to the higher prevalence rates found in the study. It is also important to note that the prevalence rates in the study were based on cut-off scores for the TAS-20 and BVAQ-BR and may not accurately represent the true prevalence of alexithymia in the Brazilian population. Further research is needed to confirm these findings and to explore the underlying factors contributing to the high prevalence of alexithymia in Brazil.

Article 2 aimed to investigate the psychometrical proprieties of an adaption the Interoceptive Accuracy Scale to Brazilian Portuguese (IAS-BR). The IAS-BR demonstrated slightly higher internal consistency compared to the original scale, and an exploratory analysis showed a three-factor solution. The factors were

interoceptive signals, bodily functions, and tactile signals, which differed from the original scale's two-factor structure. The validity analyses indicated that the IAS-BR was negatively correlated with alexithymia, symptoms of ASD, and dysphoric syndromes. These findings are consistent with prior research demonstrating the association between atypical interoception, alexithymia, and clinical conditions (Garfinkel et al., 2015).

Articles 1 and 2 provide robust evidence supporting the psychometric validity of the Brazilian Portuguese adaptations of the BVAQ and IAS, respectively, thereby furnishing effective tools for assessing alexithymia and interoceptive accuracy in Brazil. These studies also highlight the significance of interoception on healthy mental functioning, and emphasize the potential benefits of interoceptive interventions for individuals with alexithymia and related psychopathologies (Giner-Sorolla & Fischer, 2017; Werner et al., 2009). Both articles further demonstrate that increased alexithymia and decreased interoceptive accuracy are linked to higher levels of ASD symptoms, as well as psychological issues such as anxiety, depression, and stress. These results highlight the role of difficulties in recognizing emotions and accurately identifying bodily sensations as potential risk factors for the development of psychiatric disorders.

In Article 3, the effectiveness of DBT to improve emotional processing skills in alexithymia has been investigated. While DBT aims to help individuals understand their emotions, the current evidence on the effects of DBT-based interventions on alexithymia was inconclusive due to methodological problems such as low numbers of controlled trials, small sample sizes, and high variability between DBT programs, which increases the risk of bias across study outcomes (Salles et al., 2022). Nevertheless, our review indicated that DBT-based

interventions are generally associated with reductions in self-reported alexithymia and improvements in the ability to identify emotional states. Notably, interventions that incorporate principles from other treatments were shown to be more effective in improving alexithymia than those that were purely DBT. Therefore, while DBT appears promising, interventions for alexithymia need to incorporate elements from different therapeutic approaches and specifically focus on alexithymia-related impairments.

As posited in Article 3, further investigation is necessary to discern which specific components of DBT skills training are most critical in achieving substantial improvement in alexithymia. Articles 1 and 2 may offer insight into which DBT elements are instrumental in ameliorating alexithymia symptoms. Specifically, Article 1 reveals that individuals with alexithymia often hold maladaptive beliefs about emotions and display limited emotional expressivity. The DBT emotion regulation module could be integral in addressing these challenges, as it emphasizes the significance of comprehending emotions and expressing them through functional behaviors. Moreover, the DBT mindfulness module provides patients with tasks to connect with their emotions and understand the associated physical sensations, which can be particularly beneficial for individuals with alexithymia, given that Article 1 and 2 indicates that they struggle with accurately identifying bodily states.

Article 4 conducted a systematic review of the effects of alexithymia on specific components of empathy. After reviewing 83 publications, the study found that decreased mature empathy (i.e., cognitive empathy, affective empathy, and empathic concern) was associated with increased alexithymia symptoms, mainly related to externally-oriented thinking. On the other hand, an increased disposition

for personal distress was associated with increased overall alexithymia symptoms and language-related deficits (i.e., difficulties in identifying and describing feelings). These findings suggest that the relationship between alexithymia and empathy is complex, and different symptoms of alexithymia may affect specific components of empathy rather than a global impairment.

Based on the findings of Articles 1, 2, and 4, it is possible to speculate that a complex network involving alexithymia, reduced empathy, and interoception could be contributing to the development of psychiatric disorders. Indeed, recent research conducted a network analysis using these constructs and found that the alexithymia node demonstrated greater centrality and influence, serving as a bridge to interoceptive deficits and empathic impairments in autism spectrum disorder (Yang et al., 2022). These results may inspire future investigations to examine these interconnections in other mental disorders, in order to clarify the role of alexithymia as a transdiagnostic risk factor.

The results presented in Articles 1, 2, and 4 shed lights on the potential strengths and weaknesses of DBT-based interventions discussed in Article 3. Interventions that addressed common deficits in alexithymia, such as reduced empathy, difficulty identifying bodily sensations, and poor emotional recognition, were likely more successful in reducing alexithymia scores. Notably, the study conducted by Holmqvist Larsson et al. (2020), which focused on developing mindfulness, emotional labeling, and empathy skills (e.g., compassion towards others in suffering), had the largest effect size for reducing alexithymia among the reviewed studies in Article 3. These findings suggest that future interventions for alexithymia should not solely concentrate on the traditional symptoms of alexithymia, such as difficulty identifying and describing emotions, but also on the socio-emotional

impairments of related psychological constructs, including reduced empathy, poor interoceptive accuracy, and ineffective emotion regulation.

Based on the results of the studies conducted, it is possible to develop intervention programs for alexithymia grounded in socio-emotional impairments. Such programs could utilize principles from DBT-based interventions to help individuals understand and regulate their emotions. While the evidence on the effects of DBT-based interventions on alexithymia is still inconclusive due to methodological problems and reduced number of studies, our review indicated that these interventions are generally associated with improvements in emotional processing skills. Incorporating principles from other treatments, such as mindfulness-based interventions, may also be helpful in improving emotional regulation skills and increasing accurate understanding of physical sensations. Additionally, principles from other therapeutic approaches, such as CBT and EFT, can be effective in emotional psychoeducation and in developing empathic skills, which are typically lacking in individuals with alexithymia.

However, it is worth noting that the four articles referenced in the thesis have certain limitations. Article 1 reported that the emotionalizing factor of the BVAQ-BR had low internal consistency and contained items that measured constructs other than alexithymia, potentially weakening the scale's reliability. Additionally, the affective factors of the BVAQ-BR did not significantly correlate with the TAS-20 or were negatively correlated, raising questions about the usefulness of the BVAQ compared to the TAS-20 for assessing alexithymia. Article 2 demonstrated that the IAS-BR had a three-factor structure, different from the two-factor structure of the original scale. Article 3 found that current evidence on the effects of DBT-based interventions on alexithymia was inconclusive due to methodological problems,

such as low numbers of controlled trials, small sample sizes, and high variability among DBT programs. Finally, the systematic review of Article 4 had some limitations, including possible publication bias and heterogeneity between studies in terms of assessment measures, study design, and sample characteristics.

The aforementioned limitations must be taken into account when creating intervention programs for alexithymia. It is important not to rely solely on the results of this thesis, but also consider evidence from the literature regarding impairments related to alexithymia and other intervention studies that may be effective for alexithymia. By adopting a comprehensive approach to intervention development, utilizing principles from various therapeutic approaches, and recognizing the limitations of current research, a more comprehensive and effective intervention program for individuals with alexithymia can be developed. It is essential to acknowledge the potential impact of these limitations and strive to address them in future research and interventions.

V. CONCLUSION

The studies presented in this thesis aimed to develop a theoretical and empirical framework for intervention programs targeting alexithymia, a socio-emotional impairment. The thesis began by adapting and validating two scales, the BVAQ-BR for alexithymia, and the IAS-BR for interoceptive accuracy, providing effective tools for assessing alexithymia and interoceptive accuracy in Brazil. These studies highlighted the significance of interoception for healthy mental functioning and emphasized the potential benefits of interoceptive interventions for individuals with alexithymia and related psychopathologies.

Furthermore, increased alexithymia and decreased interoceptive accuracy were found to be linked to higher levels of ASD symptoms, anxiety, depression, and stress, underlining the importance of recognizing emotions and identifying bodily sensations as potential risk factors for the development of psychiatric disorders. While the evidence on the effectiveness of DBT-based interventions on alexithymia was inconclusive, our review suggested that they could lead to reductions in self-reported alexithymia and improvements in the ability to identify emotional states.

The complex relationship between alexithymia and empathy was also explored. The review revealed that alexithymia is associated with impairments in both cognitive and affective empathy, suggesting that alexithymic individuals may have difficulties in recognizing, understanding, and responding to others' emotions. Moreover, the findings suggest that empathy deficits may contribute to the social difficulties experienced by alexithymic individuals, such as problems in forming and maintaining interpersonal relationships. The results of the study underscore the importance of considering both cognitive and affective components of empathy in intervention programs for alexithymia, and highlight the need for further research on this complex relationship.

Overall, the framework developed in this thesis provides a basis for the development of effective intervention programs for alexithymia, which could ultimately improve mental health outcomes for individuals experiencing socio-emotional impairments.

VI. REFERENCES

Ben-Zeev, D., Scherer, E. A., Wang, R., & Xie, H. (2015). Next-Generation Psychiatric Assessment: Using Smartphone Sensors to Monitor Behavior and Mental Health. *Psychiatric Rehabilitation Journal*, *38*(3), 218. https://doi.org/10.1037/PRJ0000130

Berardis, D., Campanella, D., Nicola, S., Gianna, S., Alessandro, C., Chiara, C., Valchera, A., Marilde, C., Salerno, R., & Ferro, F. (2008). The Impact of Alexithymia on Anxiety Disorders: a Review of the Literature. *Current Psychiatry Reviews*, *4*(2), 80–86. https://doi.org/10.2174/157340008784529287

Brewer, R., Cook, R., Cardi, V., Treasure, J., Catmur, C., & Bird, G. (2019). Alexithymia explains increased empathic personal distress in individuals with and without eating disorders. *Quarterly Journal of Experimental Psychology*, *72*(7), 1827–1836. https://doi.org/10.1177/1747021818816051

Bydlowski, S., Corcos, M., Jeammet, P., Paterniti, S., Berthoz, S., Laurier, C., Chambry, J., & Consoli, S. M. (2005). Emotion-processing deficits in eating disorders. *International Journal of Eating Disorders*, *37*(4), 321–329. https://doi.org/10.1002/EAT.20132

Cameron, K., Ogrodniczuk, J., & Hadjipavlou, G. (2014). Changes in alexithymia following psychological intervention: A review. *Harvard Review of Psychiatry*, *22*(3), 162–178. https://doi.org/10.1097/HRP.0000000000000036

Chen, J., Xu, T., Jing, J., & Chan, R. C. K. (2011). Alexithymia and emotional regulation: A cluster analytical approach. *BMC Psychiatry*, *11*(1), 1–6.

https://doi.org/10.1186/1471-244X-11-33/TABLES/2

de Timary, P., Luts, A., Hers, D., & Luminet, O. (2008). Absolute and relative stability of alexithymia in alcoholic inpatients undergoing alcohol withdrawal: Relationship to depression and anxiety. *Psychiatry Research*, *157*(1–3), 105–113. https://doi.org/10.1016/J.PSYCHRES.2006.12.008

Decety, J., & Lamm, C. (2013). Empathy versus Personal Distress: Recent Evidence from Social Neuroscience. *The Social Neuroscience of Empathy*, *March*, 199–214. https://doi.org/10.7551/mitpress/9780262012973.003.0016

Di Tella, M., Adenzato, M., Catmur, C., Miti, F., Castelli, L., & Ardito, R. B. (2020). The role of alexithymia in social cognition: Evidence from a non-clinical population. *Journal of Affective Disorders*, *273*(May), 482–492. https://doi.org/10.1016/j.jad.2020.05.012

Ebert, D. D., Harrer, M., Apolinário-Hagen, J., & Baumeister, H. (2019). Digital Interventions for Mental Disorders: Key Features, Efficacy, and Potential for Artificial Intelligence Applications. *Advances in Experimental Medicine and Biology*, *1192*, 583–627. https://doi.org/10.1007/978-981-32-9721-0_29/COVER

Franz, M., Popp, K., Schaefer, R., Sitte, W., Schneider, C., Hardt, J., Decker, O., & Braehler, E. (2008). Alexithymia in the German general population. *Social Psychiatry and Psychiatric Epidemiology*, *43*(1), 54–62. https://doi.org/10.1007/S00127-007-0265-1/TABLES/6

Frye-Cox, N. E., & Hesse, C. R. (2013). Alexithymia and marital quality: the mediating roles of loneliness and intimate communication. *Journal of Family Psychology : JFP : Journal of the Division of Family Psychology of the*

American Psychological Association (Division 43), *27*(2), 203–211. https://doi.org/10.1037/A0031961

Galderisi, S., Mancuso, F., Mucci, A., Garramone, S., Zamboli, R., & Maj, M. (2008). Alexithymia and Cognitive Dysfunctions in Patients with Panic Disorder. *Psychotherapy and Psychosomatics*, *77*(3), 182–188. https://doi.org/10.1159/000119738

Garfinkel, S. N., Seth, A. K., Barrett, A. B., Suzuki, K., & Critchley, H. D. (2015). Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. *Biological Psychology*, *104*, 65–74. https://doi.org/10.1016/J.BIOPSYCHO.2014.11.004

Giner-Sorolla, R., & Fischer, A. H. (2017). Contempt, like any other social affect, can be an emotion as well as a sentiment. In *Behavioral and Brain Sciences*. https://doi.org/10.1017/S0140525X16000765

Goerlich-Dobre, K. S., Lamm, C., Pripfl, J., Habel, U., & Votinov, M. (2015). The left amygdala: A shared substrate of alexithymia and empathy. *NeuroImage*, *122*, 20–32. https://doi.org/10.1016/J.NEUROIMAGE.2015.08.014

Grynberg, D., Chang, B., Corneille, O., Maurage, P., Vermeulen, N., Berthoz, S., & Luminet, O. (2012). Alexithymia and the processing of emotional facial expressions (EFEs): Systematic review, unanswered questions and further perspectives. *PLoS ONE*, *7*(8), 42429. https://doi.org/10.1371/journal.pone.0042429

Grynberg, D., & López-Pérez, B. (2018). Facing others' misfortune: Personal distress mediates the association between maladaptive emotion regulation

and social avoidance. *PLOS ONE*, *13*(3), e0194248. https://doi.org/10.1371/JOURNAL.PONE.0194248

Grynberg, D., Luminet, O., Corneille, O., Grèzes, J., & Berthoz, S. (2010). Alexithymia in the interpersonal domain: A general deficit of empathy? *Personality and Individual Differences*, *49*(8), 845–850. https://doi.org/10.1016/j.paid.2010.07.013

Grynberg, D., Vermeulen, N., & Luminet, O. (2014). Amplification of attentional blink by distress-related facial expressions: Relationships with alexithymia and affectivity. *International Journal of Psychology*, *49*(5), 371–380. https://doi.org/10.1002/IJOP.12006

Güleç, M. Y., Altintaş, M., Inanç, L., Bezgin, Ç. H., Koca, E. K., & Güleç, H. (2013). Effects of childhood trauma on somatization in major depressive disorder: The role of alexithymia. *Journal of Affective Disorders*, *146*(1), 137–141. https://doi.org/10.1016/j.jad.2012.06.033

Guttman, H., & Laporte, L. (2002). Alexithymia, empathy, and psychological symptoms in a family context. *Comprehensive Psychiatry*, *43*(6), 448–455. https://doi.org/10.1053/comp.2002.35905

Haviland, M. G., Hendryx, M. S., Shaw, D. G., & Henry, J. P. (1994). Alexithymia in women and men hospitalized for psychoactive substance dependence. *Comprehensive Psychiatry*, *35*(2), 124–128. https://doi.org/10.1016/0010-440X(94)90056-N

Hemming, L., Haddock, G., Shaw, J., & Pratt, D. (2019). Alexithymia and its associations with depression, suicidality, and aggression: An overview of the literature. *Frontiers in Psychiatry*, *10*(APR), 203.

https://doi.org/10.3389/FPSYT.2019.00203/BIBTEX

Holmqvist Larsson, K., Lowén, A., Hellerstedt, L., Bergcrona, L., Salerud, M., & Zetterqvist, M. (2020). Emotion regulation group skills training: A pilot study of an add-on treatment for eating disorders in a clinical setting. *Journal of Eating Disorders*, *8*(1), 141–155. https://doi.org/10.1186/s40337-020-00289-1

Honkalampi, K., Hintikka, J., Laukkanen, E., & Viinamäki, J. L. H. (2001). Alexithymia and Depression: A Prospective Study of Patients With Major Depressive Disorder. *Psychosomatics*, *42*(3), 229–234. https://doi.org/10.1176/APPI.PSY.42.3.229

Horsch, C. H. G., Lancee, J., Griffioen-Both, F., Spruit, S., Fitrianie, S., Neerincx, M. A., Beun, R. J., & Brinkman, W. P. (2017). Mobile phone-delivered cognitive behavioral therapy for insomnia: A randomized waitlist controlled trial. *Journal of Medical Internet Research*, *19*(4), 1–21. https://doi.org/10.2196/jmir.6524

Hur, J. W., Kim, B., Park, D., & Choi, S. W. (2018). A Scenario-Based Cognitive Behavioral Therapy Mobile App to Reduce Dysfunctional Beliefs in Individuals with Depression: A Randomized Controlled Trial. *Https://Home.Liebertpub.Com/Tmj*, *24*(9), 710–716. https://doi.org/10.1089/TMJ.2017.0214

Iskric, A., Ceniti, A. K., Bergmans, Y., McInerney, S., & Rizvi, S. J. (2020). Alexithymia and self-harm: A review of nonsuicidal self-injury, suicidal ideation, and suicide attempts. *Psychiatry Research*, *288*, 112920. https://doi.org/10.1016/J.PSYCHRES.2020.112920

Joukamaa, M., Kokkonen, P., Veijola, J., Läksy, K., Karvonen, J. T., Jokelainen, J., & Järvelin, M. riitta. (2003). Social situation of expectant mothers and alexithymia 31 years later in their offspring: A prospective study. *Psychosomatic Medicine*, *65*(2), 307–312. https://doi.org/10.1097/01.PSY.0000030389.53353.BC

Kano, M., Fukudo, S., Gyoba, J., Kamachi, M., Tagawa, M., Mochizuki, H., Itoh, M., Hongo, M., & Yanai, K. (2003). Specific brain processing of facial expressions in people with alexithymia: an H215O-PET study. *Brain*, *126*(6), 1474–1484. https://doi.org/10.1093/BRAIN/AWG131

Kennedy, M., & Franklin, J. (2002a). Skills-based Treatment for Alexithymia: An Exploratory Case Series. *Behaviour Change*, *19*(3), 158–171. https://doi.org/10.1375/BECH.19.3.158

Kennedy, M., & Franklin, J. (2002b). Skills-based Treatment for Alexithymia: An Exploratory Case Series. *Behaviour Change*, *19*(3), 158–171. https://doi.org/10.1375/BECH.19.3.158

Kugel, H., Eichmann, M., Dannlowski, U., Ohrmann, P., Bauer, J., Arolt, V., Heindel, W., & Suslow, T. (2008). Alexithymic features and automatic amygdala reactivity to facial emotion. *Neuroscience Letters*, *435*(1), 40–44. https://doi.org/10.1016/J.NEULET.2008.02.005

Laloyaux, J., Fantini, C., Lemaire, M., Luminet, O., & Larøi, F. (2015). Evidence of Contrasting Patterns for Suppression and Reappraisal Emotion Regulation Strategies in Alexithymia. *Journal of Nervous and Mental Disease*, *203*(9), 709–717. https://doi.org/10.1097/NMD.0000000000000353

Lane, R. D., Weihs, K. L., Herring, A., Hishaw, A., & Smith, R. (2015). Affective

agnosia: Expansion of the alexithymia construct and a new opportunity to integrate and extend Freud's legacy. *Neuroscience and Biobehavioral Reviews*, *55*, 594–611. https://doi.org/10.1016/j.neubiorev.2015.06.007

Lukas, C. A., Trevisi Fuentes, H., & Berking, M. (2019). Smartphone-based emotion recognition skills training for alexithymia - A randomized controlled pilot study. *Internet Interventions*, *17*, 100250. https://doi.org/10.1016/J.INVENT.2019.100250

Mahapatra, A., & Sharma, P. (2018). Association of Internet addiction and alexithymia – A scoping review. *Addictive Behaviors*, *81*, 175–182. https://doi.org/10.1016/J.ADDBEH.2018.02.004

Martínez-Velázquez, E. S., Honoré, J., Zorzi, L. de, Ramos-Loyo, J., & Sequeira, H. (2017). Autonomic reactivity to arousing stimuli with social and non-social relevance in alexithymia. *Frontiers in Psychology*, *8*(MAR), 1–10. https://doi.org/10.3389/fpsyg.2017.00361

McGillivray, L., Becerra, R., & Harms, C. (2017). Prevalence and Demographic Correlates of Alexithymia: A Comparison Between Australian Psychiatric and Community Samples. *Journal of Clinical Psychology*, *73*(1), 76–87. https://doi.org/10.1002/JCLP.22314

Moriguchi, Y., & Komaki, G. (2013). Neuroimaging studies of alexithymia: Physical, affective, and social perspectives. *BioPsychoSocial Medicine*, *7*(1), 1–12. https://doi.org/10.1186/1751-0759-7-8/FIGURES/5

Morr, M., Lieberz, J., Dobbelstein, M., Philipsen, A., Hurlemann, R., & Scheele, D. (2021). Insula reactivity mediates subjective isolation stress in alexithymia. *Scientific Reports 2021 11:1*, *11*(1), 1–9.

https://doi.org/10.1038/s41598-021-94799-w

Nemiah, J. C., & Sifneos, P. E. (1970). Psychosomatic Illness: A Problem in Communication. *Psychotherapy and Psychosomatics*, *18*(1–6), 154–160. https://doi.org/10.1159/000286074

Norman, H., Marzano, L., Coulson, M., & Oskis, A. (2019). Effects of mindfulness-based interventions on alexithymia: A systematic review. *Evidence-Based Mental Health*, *22*(1), 36–53. https://doi.org/10.1136/ebmental-2018-300029

Ogrodniczuk, J. S., Piper, W. E., & Joyce, A. S. (2011). Effect of alexithymia on the process and outcome of psychotherapy: A programmatic review. *Psychiatry Research*, *190*(1), 43–48. https://doi.org/10.1016/J.PSYCHRES.2010.04.026

Panahi, M. S., Hoseinzadeh, A., Razaghpour, M., & Hosieni, N. (2018). Formulating a model for the relationship between alexithymia, social support, loneliness, and marital satisfaction: Path analysis model. *Journal of Family Medicine and Primary Care*, *7*(5), 1068. https://doi.org/10.4103/JFMPC.JFMPC_3_18

Panayiotou, G., Leonidou, C., Constantinou, E., & Michaelides, M. P. (2020). Self-Awareness in alexithymia and associations with social anxiety. *Current Psychology*, *39*(5), 1600–1609. https://doi.org/10.1007/s12144-018-9855-1

Pinna, F., Manchia, M., Paribello, P., & Carpiniello, B. (2020). The impact of alexithymia on treatment response in psychiatric disorders: A systematic review. *Frontiers in Psychiatry*, *11*, 311. https://doi.org/10.3389/fpsyt.2020.00311

Preece, D. A., Mehta, A., Becerra, R., Chen, W., Allan, A., Robinson, K., Boyes, M., Hasking, P., & Gross, J. J. (2022). Why is alexithymia a risk factor for affective disorder symptoms? The role of emotion regulation. *Journal of Affective Disorders*, *296*, 337–341. https://doi.org/10.1016/J.JAD.2021.09.085

Prkachin, G. C., Casey, C., & Prkachin, K. M. (2009). Alexithymia and perception of facial expressions of emotion. *Personality and Individual Differences*, *46*(4), 412–417. https://doi.org/10.1016/J.PAID.2008.11.010

Rychtarik, R. G., McGillicuddy, N. B., & Barrick, C. (2015). Web-based coping skills training for women whose partner has a drinking problem. *Psychology of Addictive Behaviors*, *29*(1), 26–33. https://doi.org/10.1037/ADB0000032

Saito, N., Yokoyama, T., & Ohira, H. (2016). Self-Other Distinction Enhanced Empathic Responses in Individuals with Alexithymia. *Scientific Reports 2016 6:1*, *6*(1), 1–7. https://doi.org/10.1038/srep35059

Salles, B. M., Maturana de Souza, W., Dos Santos, V. A., & Mograbi, D. C. (2022). Effects of DBT-based interventions on alexithymia: a systematic review. *Cognitive Behaviour Therapy*, *00*(00), 1–22. https://doi.org/10.1080/16506073.2022.2117734

Salminen, J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of alexithymia and its association with sociodemographic variables in the general population of finland. *Journal of Psychosomatic Research*, *46*(1), 75–82. https://doi.org/10.1016/S0022-3999(98)00053-1

Samson, A. C., Hardan, A. Y., Podell, R. W., Phillips, J. M., & Gross, J. J. (2015). Emotion Regulation in Children and Adolescents With Autism Spectrum

Disorder. *Autism Research*, *8*(1), 9–18. https://doi.org/10.1002/AUR.1387

Samson, A. C., Huber, O., & Gross, J. J. (2012). Emotion regulation in Asperger's syndrome and high-functioning autism. *Emotion*, *12*(4), 659–665. https://doi.org/10.1037/A0027975

Sifneos, P. E. (1973). The Prevalence of 'Alexithymic' Characteristics in Psychosomatic Patients. *Psychotherapy and Psychosomatics*, *22*(2–6), 255–262. https://doi.org/10.1159/000286529

Swart, M., Kortekaas, R., & Aleman, A. (2009a). Dealing with feelings: Characterization of trait Alexithymia on emotion regulation strategies and cognitive-emotional processing. *PLoS ONE*, *4*(6). https://doi.org/10.1371/journal.pone.0005751

Swart, M., Kortekaas, R., & Aleman, A. (2009b). Dealing with Feelings: Characterization of Trait Alexithymia on Emotion Regulation Strategies and Cognitive-Emotional Processing. *PLOS ONE*, *4*(6), e5751. https://doi.org/10.1371/JOURNAL.PONE.0005751

Van der Velde, J., Servaas, M. N., Goerlich, K. S., Bruggeman, R., Horton, P., Costafreda, S. G., & Aleman, A. (2013). Neural correlates of alexithymia: A meta-analysis of emotion processing studies. *Neuroscience and Biobehavioral Reviews*, *37*(8), 1774–1785. https://doi.org/10.1016/J.NEUBIOREV.2013.07.008

Wagner, H., & Lee, V. (2008). Alexithymia and individual differences in emotional expression. *Journal of Research in Personality*, *42*(1), 83–95. https://doi.org/10.1016/J.JRP.2007.04.001

Werner, N. S., Jung, K., Duschek, S., & Schandry, R. (2009). Enhanced cardiac perception is associated with benefits in decision-making. *Psychophysiology*, *46*(6), 1123–1129. https://doi.org/10.1111/J.1469-8986.2009.00855.X

Yang, H. X., Hu, H. X., Zhang, Y. J., Wang, Y., Lui, S. S. Y., & Chan, R. C. K. (2022). A network analysis of interoception, self-awareness, empathy, alexithymia, and autistic traits. *European Archives of Psychiatry and Clinical Neuroscience*, *272*(2), 199–209. https://doi.org/10.1007/S00406-021-01274-8/FIGURES/2

Zamani, S., Hasani, J., Hatami, M., & Tadros, E. (2023). *Emotion Dysregulation and Alexithymia within Marital Burnout through an Emotion-Focused Therapy Lens*. https://doi.org/10.1080/15332691.2023.2165206