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Self-appraisals of emotion expressions in autistic and neurotypical individuals in consideration of the alexithymia hypothesis

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Anja Beate Rosenauer BSc

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Note on the use of AI-Supported Tools

AI-supported tools were used as follows: ChatGPT (OpenAI; versions 4o and 5) was utilized between 01/2025 and 04/2026 to review formal criteria and help with bugs regarding R coding.

All AI-generated suggestions were carefully reviewed and revised and, where substantively relevant, supported with appropriate academic sources. The final written content and all substantive arguments of this thesis were developed independently.

Abstract

Emotion expressions are a fundamental and everyday part of human life. Humans implicitly rely on each other to convey essential social information. However, autistic individuals face challenges when interpretating expressions of neurotypical individuals and vice versa. This leads to bidirectional misunderstandings also known as the double empathy problem.

Additionally, it is estimated that 5% to 9% of the world's population possess high levels of alexithymia, a profound difficulty of understanding and interpreting one's own emotions. In the autistic population this is even more pronounced with estimates ranging around 50%. It has been proposed that high levels of alexithymia in autistic individuals influence and contribute to differences in socio-emotional domains. Although studies show that the emotional life of autistic individuals differs from neurotypicals, ASD research has mainly relied on outside evaluations and neurotypical judgements offering limited insight into autistic experiences.

This study provides insight into the differences in emotion expression appraisals of autistic and neurotypical individuals. A total of 60 participants completed three emotion expression tasks, expressing four emotions each. The tasks were each followed by self-rating questions on emotional experience.

Results indicate no effect of group membership and no moderation effect of alexithymia on self-ratings. Overall, findings suggest that differences in emotional experience arise due to different modalities of expression and emotions being expressed. However, due to the limited sample size, the study showed problems being underpowered. Thus, future research should focus on larger samples in order to reliably assess effects of alexithymia and group membership.

Self-appraisals of emotion expressions in autistic and neurotypical individuals in consideration of the alexithymia hypothesis

A substantial part of everyday life is shaped by social interactions and relationships. Humans routinely navigate complex social environments to build and maintain relationships, may this be in personal or professional settings (van Kleef et al., 2016). Next to speech, non-verbal emotional expressions have become a system of communication that humans rely on (Frith, 2009) to infer each other's internal states. Reciprocal awareness of each other's emotions contributes significantly to the success of social interactions. Meanwhile, failing to notice expressions, such as of fear, anger, joy or embarrassment, can negatively impact social standings and relationships (Frith, 2009; Jack & Schyns, 2015). However, social interactions are not merely a contextual feature of human life but a central condition for well-being, with social deprivation resulting in adverse mental and physical health outcomes (Ilham et al., 2025; Jack & Schyns, 2015; Klingner & Guntinas-Lichius, 2023; Strong et al., 2020).

For many individuals with autism spectrum disorder (ASD; World Health Organization [WHO], 2025), navigating this socio-emotional landscape presents challenges. ASD is a life-long neurodevelopmental disorder which generally presents with persistent differences and/or difficulties in social communication, emotional difficulties, and persistent repetitive behaviour. It is estimated that around 1% of the world's population is autistic (World Health Organization, 2025; Zeidan et al., 2022). Importantly, ASD is also highly heritable with estimates ranging around 70 - 80% of cases having a prior history of ASD in the family (Genovese & Butler, 2023).

Historically ASD research has been embedded in a disability-focused medical model (Pearson & Rose, 2021), which has framed ASD as a form of "other" or "deficit" in need of correction (Milton, 2012; Waltz, 2013). Neurotypical individuals often lack awareness for these challenges that autistic individuals experience. As a result, autistic people, and their caregivers, often face stigmatization (Aubé et al., 2021; Clarke et al., 2024; Hungerford et al., 2025), which can reach such an extent that some autistic individuals suppress their natural behaviours (Cage & Troxell-Whitman, 2019; Hull et al., 2017; Miller et al., 2021; Pearson & Rose, 2021).

In recent years researchers have adopted a more inclusive standpoint. One theory of importance for this thesis is the double empathy problem by Milton (2012). In disability-focused models autistic individuals are seen as deficient in their socio-emotional communication skills. Milton (2012) however re-frames these alleged deficiencies as a problem in reciprocity and understanding evoked by differing worldviews or in this case implicit assumptions of "correct" emotion communication. The double empathy problem is supported by studies showing that neurotypical individuals also have difficulties recognizing facial expressions of autistic individuals not only vice versa (Brewer et al., 2016; Keating & Cook, 2020).

It is reasonable to assume that stigmatizations of autistic individuals further contribute to the double empathy problem and difficulties in socio-emotional communication, as has been argued before by Cage and Troxell-Whitman (2019). Research suggests that better knowledge of ASD and personal connections with autistic individuals correlate with lower stigma (Gillespie-Lynch et al., 2015; Nevill & White, 2011; White et al., 2019). Overall, there is a growing emphasis on the need for participatory approaches as autistic viewpoints are starkly underrepresented in ASD research (Jenks et al., 2025; Keating, 2021; Pellicano et al., 2022). Participatory methodologies has been shown to enhance the quality of research methods, strengthen trust between researchers and autistic individuals, ensure that findings are relevant to the priorities of the autistic community, and promote meaningful involvement (Keating, 2021). A survey by Benevides et al. (2020) investigated what topics were considered important by the autistic community to be studied. Among the highest-ranking themes were societal approaches for inclusion and acceptance of autistic individuals and social well-being.

An additional obstacle in ASD research is co-occurring alexithymia. This personality trait presents with profound difficulties in identifying and describing emotions as well as impoverished fantasy and an externally oriented thinking style (Sifneos, 1973; Taylor et al., 1991). It is estimated that about 50% of the ASD population show high trait alexithymia (Milosavljevic et al., 2016). This comorbidity further puts constraints on the socio-emotional experiences of autistic people. Thus, in 2013 Bird and Cook proposed the so-called *alexithymia hypothesis*, stating that emotional difficulties present in ASD may be in part due to high trait alexithymia, rather than representing a core symptom of ASD itself.

In this context, investigating differences in self-perception between autistic and neurotypical individuals may offer important insights into their respective experiences and perceptual processes. This may provide a more nuanced understanding, ultimately promoting mutual awareness between the two groups and lessening stigmatizations. Research in this area has mainly focused on facial expressions as the primary mode of emotion communication. However, face-to-face interactions have been established to be a challenge for some autistic individuals (Senju & Johnson, 2009). To address this limitation, this study additionally employed an abstract drawing task and a writing task as alternative emotion expression modalities. Furthermore, the study included self-rating measures for each modality to examine differences in participants' self-perception of emotion communication.

Moreover, as alexithymia has been proposed to influence the emotional functioning of autistic individuals, this study also examines a potential moderating effect of alexithymia traits on the relationship of autistic traits and self-perception.

The study described in this thesis is part of a PhD project conducted by Young Ah Kim and the Department of Psychology at the University of Vienna. As a result, the study procedure was adopted as proposed by the PhD candidate. Only the parts of the study procedure relevant to this thesis are included. The following literature review provides an overview of basic emotion research, ASD and alexithymia.

In this thesis the prefix *autistic* is used as a deliberate linguistic choice to adopt inclusive language and to minimize stigmatizing implications associated with other terminology (Bury et al., 2023; Keating et al., 2023; Monk et al., 2022). To provide a comprehensive overview of research on ASD, and in recognition of the fact that current diagnostic criteria remain framed within a medical model, this thesis examines both deficit-oriented and neurodiversity-informed perspectives.

Theoretical Background

Emotion, Expression and Perception

Emotions are an essential part of human life (van Kleef et al., 2016; Ward, 2025), guiding behaviour and decision making. Historically, emotions had been conceptualized as an intrapersonal phenomenon, with research focussing on emotion regulation and expression in humans as solitary units.

One of the most widely known classical models of emotion is the facial expression programme, which is based on the concept of basic emotions (Russell, 1997). It postulates a small set of genetically determined, discrete, and universal *basic* emotions. The most commonly known basic emotions are those of Ekman (Coppini et al., 2023; Ekman, 1992), namely anger, disgust, enjoyment, fear, sadness and surprise (but see also: Gendron et al., 2014; Niedenthal et al., 2017). Although all emotions arise typically due to social events, and can modulate social interactions, there is a distinct category of *social* emotions (Hareli & Parkinson, 2008). These emotions necessitate the presence or mental representation of another individual or social norms, to be evoked. Generally, pride, shame or embarrassment are thought of as social emotions (Hareli & Parkinson, 2008).

Emotion Communication

All emotions contain a social element (Lane & Schwartz, 1987), providing fundamental information and guiding social behaviour (van Kleef, 2009; Ward, 2025). In this sense, emotions are central to how individuals interpret and organize their affective experiences and social interactions (Ward, 2025).

From a functional perspective, emotion expression and communication can be understood as an adaptive tool for successful social interactions (Ward, 2025). Humans communicate emotion through a variety of modalities, such as speech, facial expressions and body-movements (Aviezer et al., 2012; Dael et al., 2012; Gross et al., 2010) but also writing (Chan & Horneffer, 2006; Sharp & Hargrove, 2004) and art (Drake & Winner, 2013; Sie Santosa et al., 2026). A study by App et al. (2011) investigating non-verbal emotion communication found that neurotypical participants' preferences for emotion expression channels varied by emotion. For example, while body language was preferred to express pride, shame, and embarrassment, participants opted to express anger, fear, happiness and sadness via facial movements. This suggests that a multimodal approach to emotion communication research may be beneficial.

Emotion communication is inherently ambiguous. Although some expressions are commonly recognized as signalling a specific emotion, this does not necessarily imply that they directly reflect the assumed internal state (Scholl, 2013). Fridlund (1994) argued that emotion expressions are better understood as communicative signals shaped by social motives rather than

a manifestation of an emotion itself. Similarly, Russell (1997) argues that facial expressions are not reliable indicators of emotional experience but likely reflect learned cultural conventions. Multiple studies have found supporting evidence, suggesting that facial expressions can be interpreted differently depending on context (Barrett et al., 2019; Downes & Trigg, 2017; Fridlund & Russell, 2024). For example, Aviezer et al. (2008) found that context provided by posture, body movement, and scenes influences what emotion is attributed to a facial expression.

The Self and the Other in social interaction

Substantial variability exists not only in the precision with which people express and recognize emotions, but also in how they identify, differentiate, and conceptualize their own and others emotional states (Back & Jordan, 2014). This raises an important question: to what extent does an individual's beliefs about another's internal experiences reflect the other's actual self-perception?

The concept of self. A self-concept refers to a person's cognitive schema about themselves. It is a multifaceted, dynamical structure which contains knowledge about traits, values, memories and personal goals allowing a person to organize, process and recall self-relevant information. Individuals can have varying clarity on their self-concepts referring to how internally and temporally stable a person's concept of self is. Yet, possessing a clear concept of self makes no claim of accuracy. A person could hold an internally consistent self-concept that an outside viewer might argue is inaccurate based on behaviour (Campbell et al., 1996).

Self-concept clarity may promote accuracy in terms of self-other perception agreement since clear and consistent self-beliefs should create more consistent behaviour. Thus, outside observers should be able to judge a person with high self-concept clarity more easily than they can judge a person with low self-concept clarity (Lewandowski Jr. & Nardone, 2012). Investigating this claim Lewandowski Jr. and Nardone (2012) found data suggesting self-concept clarity is linked to higher accuracy in terms of self-other perception agreement. These results were consistent even after controlling for acquaintance of participants, and self-esteem.

Self-other perception. In 2010, Vazire published a paper on the differences in accuracy of self-other perceptions. He proposed that self-other perception asymmetries arise due to different information being available to each party when forming judgements. Additionally, different weight is attributed to the available information. Individuals have privileged access to their internal thoughts and feelings and tend to assign greater importance to these than external observers do (Vazire, 2010).

Self-other perception accuracy is especially important during social interaction. People rely on others to accurately infer their emotional states by their emotion expressions (Barr & Kleck, 1995; Frith, 2009; Jack & Schyns, 2015). Barr and Kleck (1995) found that participants generally

rated their own facial expressiveness as more intense that outside perceivers did. In addition, a study differentiating between multiple non-verbal emotion expressions found variability in self-other agreement. For example, while self-other perception accuracy was high for expressions of shame (r = .71), it was low for expressions of fear (r = .02) (Hess et al., 2004). Similarly, Hall et al. (2007) reported that self-other agreement varied across behaviours, with the highest accuracy observed for smiling and the lowest for self-touching.

High self-other perception accuracy positively influences social relationships. Human and Biesanz (2012) found that accurate first impressions were positively associated with greater liking, both initially and over time. Similarly, Selfhout et al. (2009) found that for recently acquainted individuals, both perceived similarity and peer-rated similarity were associated with greater friendship intensity. Mosch and Borkenau (2016) investigated self-other perceptions specifically of acquainted individuals. They found that psychologically more well-adjusted perceivers were less aware of inaccuracies in self-other perceptions. Additionally, well acquainted perceivers expected higher accuracy of self-other perception.

Neurotype as influential factor. Difficulties in social interaction may, in part, be attributable to reduced self-other agreement between individuals. Moseley et al. (2025) propose that processing social information about individuals with a differing neurotype may be more effortful, potentially due to diminished perceived affiliation. This in turn may contribute to lower levels of self-other agreement. One population that has historically been characterized as exhibiting “deficits” in socio-emotional functioning is that of autistic individuals (World Health Organization, 2019). However, more recent theoretical accounts challenge this deficit-oriented perspective. Notably, Milton (2012) introduced the double empathy problem, suggesting that such difficulties may instead arise from reciprocal misunderstandings between individuals with differing neurotypes- that is, from reduced mutual self-other agreement.

Autism Spectrum Disorder

> “Autism is a way of being. It is pervasive; it colors every experience, every sensation, perception, thought, emotion, and encounter, every aspect of existence” (Sinclair, 1993).

ASD is a life-long, neurodevelopmental disorder characterized by difficulties in social interaction and communication, and behavioural differences. Although onset is generally in early childhood, diagnostic characteristics may not fully manifest until when social demands exceed the individual’s capacities (WHO, 2019).

Epidemiology

Recent estimates state that about 1% of the world’s population has ASD (World Health Organization, 2025; Zeidan et al., 2022), with prevalence estimations rising over the last couple

decades (De López & Møller, 2024; Jiang et al., 2024; Pérez-Crespo et al., 2019; Shaw et al., 2025). Although the exact aetiology remains unclear, most researchers agree that genetic factors play a significant role in the development of ASD (Amlang & Freund, 2011; Genovese & Butler, 2023). This claim is supported by high heritability estimates with only approximately 10% of cases occurring in families with no prior history of ASD. Researchers suggest that rising numbers of diagnoses can be attributed to evolving diagnostic criteria, improvements in early identification due to better diagnostic instruments, as well as cultural factors such as awareness (Matson & Kozlowski, 2011).

Measurement

Assessments of autistic individuals have historically relied mainly on outsider informant reports, partly due to ASD assessment often being conducted during early childhood, and concerns regarding self-report accuracy (Moss et al., 2015; Sandercock et al., 2020). However, recent research suggests that autistic adults are more capable of reliably reporting their internal states than previously assumed (Kim & Lecavalier, 2022; Sandercock et al., 2020).

Among self-report instruments assessing autistic traits, the Autism-Spectrum Quotient (AQ; Baron-Cohen, 2000) is widely used, although some studies on its' psychometric properties have reported inconsistencies (Lugnegård et al., 2015; Nishiyama et al., 2014; Wigham et al., 2019). In the present study, the German version of the Revised Comprehensive Autistic Trait Inventory (CATI-R; Hechler et al., 2025) was employed, which demonstrated a stable six-subscale structure, positive intercorrelations, and measurement invariance across gender (Hechler et al., 2025).

Clinical presentation

The ICD-11 lists two domains in which individuals have to exhibit significant, persistent deficiencies to fulfil the requirements for an ASD diagnosis (WHO, 2019). One domain encompasses persistent repetitive, restricted and inflexible patterns of behaviour, activities and interests. These are often considered excessive or atypical given the individual's chronological age or sociocultural background (Amlang & Freund, 2011; Morris et al., 2025; Prizant, 1983; Zhou et al., 2023).

Of relevance for this thesis, however, is the second domain which focuses on persistent deficiencies in social communication and interactions, outside of the expected functional range given the individual's chronological age and intellectual development (WHO, 2019). Manifestations thereof may include, but are not limited to, inappropriate responses to verbal or non-verbal social communication, profound difficulty making and sustaining peer relationships (Amlang & Freund, 2011; Bauminger & Kasari, 2000; Girardi et al., 2021), limited or lack of development of spoken language, limited non-verbal cues such as eye-contact or facial expressions (Sauer et al., 2021;

Bernard-Opitz et al., 2004; Falck-Ytter, 2015; Frazier et al., 2017; Miller et al., 2017; Senju & Johnson, 2009), and an inability to respond to or imagine emotional states of others (Carlsson et al., 2018; Dağdelen, 2021; Jones et al., 2018; Rosenthal et al., 2019).

From Deficits to Differences

The attribution of "deficient" socio-emotional communication in autistic individuals has been propelled by a plethora of studies. The following paragraphs outline the most influential theoretical approaches in ASD research of interest for this thesis, as well as their shortcomings.

Theory of Mind. The Theory of Mind (ToM) account is one of the most influential and best-known subjects in ASD research. First introduced by Premack and Woodruff (1978). Possessing a ToM refers to the ability *to impute mental states to oneself and others*. A ToM is not an innate trait in humans but rather forms with age and the acquisition of knowledge. Neurotypical children present with a foundational ToM around the ages four to five (Hofmann et al., 2016; Wimmer & Perner, 1983), while in autistic children a ToM generally develops later in life (Amlang & Freund, 2011). Research on ToM in autistic children repeatedly emphasizes a reduced or impaired ToM (Long et al., 2025). For example, a landmark study by Baron-Cohen et al. (1985) inspired the belief that autistic children cannot represent mental states of others. One of the best-known experiments is that of the Sally-Anne Test, in which autistic and neurotypical children were tested on their ability to impute and infer mental states of an actor. The autistic children consistently failed to represent the mental states of the actor and rather answered questions based on their own knowledge, not on what they were shown the actor to know (Baron-Cohen et al., 1985). Since then, multiple papers have reported a general impairment in ToM in autistic individuals (Baron-Cohen, 2000; Dağdelen, 2021; Rosenthal et al., 2019). Some researchers argue that a reduced ToM in autistic people may be one of the core factors influencing their social interactions and communication quality (Jones et al., 2018). However, as Senju (2012) points out, autistic children may fail due to weaker cognitive control or difficulties in pragmatic understanding.

The ToM account is not without fault. In their paper, Long et al. (2025) point out two main problems with ToM research in ASD. Firstly, the varying definitions of mental states between papers and secondly the often-overlooked difference between *representation* and *inference* of mental states. Following the definition of Premack and Woodruff (1987), a theory of mind constitutes the ability to *represent* different mental states in individuals. Thus, an individual either has the capacity to represent mental states or does not. However, as pointed out by Long et al. (2025), a second aspect of the ToM account is the ability to accurately infer mental states. An individual with the ability to represent mental states may well always incorrectly infer their content. Thus, when testing ToM, it is important to define what constitutes a mental state and define whether representation or inference accuracy is being tested. Long et al (2025) report that both

neurotypical and autistic people overall perform above chance level at inference accuracy tests. Thus, autistic individuals may present with a functional ToM and rather differences in accuracy thereof, when tasked to infer the mental states of neurotypical individuals. Yet, the question still stands how these accuracy differences emerge (see also: Milton, 2012).

Social Motivation Hypothesis. A theory focusing on the development of differences in social behaviour is the social motivation theory of ASD (Chevallier et al., 2012). Social motivation refers to a set of biological and psychological mechanisms which predispose an individual to actively seek out and orient towards social signals. In neurotypical individuals it is hypothesized that social interactions provide a form of pleasure (social reward), which then drives them to keep seeking social interactions (social orienting) and maintain social relationships (social maintaining) (Chevallier et al., 2012).

The social motivation theory centres around the belief that autistic people possess less intrinsic social motivation which in turn leads to less learning possibilities of neurotypical social behaviour. Thus, differences in social behaviour in autistic people are hypothesized due to missed learning opportunities (Chevallier et al., 2012; Jaswal & Akhtar, 2018) rather than due to an innate inability as proposed by the ToM account.

Studies report that autistic children respond less frequently to their names, show diminished eye contact (Chevallier et al., 2012) and respond to social signals no better than chance level (Burnside et al., 2017; Dubey et al., 2015; Hedger et al., 2020). Additionally, they show fewer social maintaining strategies like social laughter, gestures of greetings, and typical representations of social emotions such as embarrassment (Hobson et al., 2006; Hobson & Lee, 1998; Hudenko et al., 2009).

These reports are often interpreted as a lack of social motivation. However, this interpretation has been criticised. In their review, Jaswal and Akhtar (2018) argue that behavioural differences in autistic people do not reflect a reduced social motivation. The perspectives of autistic individuals are rarely included in research which denotes them as less socially motivated. Yet autistic individuals deny that their social motivation is reduced, or that their behavioural differences stem from a reduced motivation to engage with others. As behaviour is only a subpar indicator for mental states (Jaswal & Akhtar, 2018), this contradiction also falls in line with the criticism of the ToM account explained above. It is well possible that the ToM of neurotypical people is inaccurate when inferring mental states of autistic individuals. A second argument of their critique is that social interactions are a dynamic process. What a neurotypical person may view as socially motivated behaviour does not necessarily translate to an autistic individual as such (Jaswal & Akhtar, 2018).

The double empathy problem. This criticism of bidirectional inaccuracies in imputing mental states falls into the domain of a theory described by Milton (2012) as the double empathy problem (DEP). Milton (2012) re-frames social communication difficulties in ASD as an issue in reciprocity rather than a one-sided deficiency. This becomes evident when two individuals, in this context an autistic person and a neurotypical person, interact according to different worldviews, resulting in a failure of reciprocal understanding (Milton et al., 2022 Milton, 2012).

A growing body of research suggests that differences in social interactions of autistic individuals may be more accurately explained by the DEP than by deficit-based models of ASD. Moseley et al. (2025) suggest that processing information about people with a different neurotype might be more difficult due to reduced affiliation with them, which could partially explain communication difficulties between autistic and neurotypical individuals. Jones et al. (2024) found that neurotypical observers were able to perceive aspects of the DEP when viewing interactions between autistic and neurotypical individuals. Similarly, Sheppard et al. (2024) reported that neurotypical individuals have difficulties interpreting the mental states of autistic people. In a study by Edey et al. (2016) autistic and neurotypical people had to express emotions by animating shapes. The findings indicated that neurotypical individuals showed less accuracy in matching mental states conveyed by the animations of autistic individuals compared to the animations of neurotypical individuals. Meanwhile the autistic participants showed comparable accuracy when matching animations produced by both groups. This supports the view that emotion communication difficulties arise due to different neurotypes rather than due to deficiencies in ASD.

Further evidence for this perspective comes from studies examining interaction preferences among autistic individuals. For example, a study by DeBrabander et al. (2019) on autistic social affiliation found that autistic participants tended to prefer interacting with other autistic individuals and reported greater self-disclosure when communicating with autistic partners compared to neurotypical partners. Consistent with these findings, Chen et al. (2021) observed a similar pattern of within-neurotype interaction preferences and reported that same-group peer interactions were more likely to reflect genuine social interest rather than purely functional communication. Same-neurotype interactions also tend to be evaluated more positively. For instance, Crompton et al. (2020b) found that both autistic and neurotypical participants rated interactions with members of their own neurotype more favourably than mixed-neurotype interactions.

Qualitative research also suggests that autistic individuals experience fewer difficulties when interacting with other autistic friends and family members, and that such interactions are perceived as fundamentally different from those with neurotypical individuals (Crompton, 2020a, Hallett, et al., 2020). Overall, autistic participants describe their communication as more direct,

monologue-like, and predominantly about their special interests. They also report more ease and comfort in interactions with other autistic individuals due to a shared understanding (Cummins et al., 2020; Marocchini & Baldin, 2024).

In contrast, research reports that communication between autistic and neurotypical people is described as stressful and challenging by autistic individuals and is associated with heightened anxiety (Walsh et al., 2025). Neurotypical communication is seen as indirect and ambiguous, particularly when conversations involve irony or sarcasm (Black et al., 2023; Marocchini & Baldin, 2024). Additionally, autistic participants reported being mocked or experiencing hostility from neurotypical conversation partners, as well as feeling like conversations followed an unseen script (Marocchini & Baldin, 2024; Walsh et al., 2025).

These findings suggest that inferencing mental states of others is a bidirectional problem generally support the DEP highlighting real-life consequences. Milton (2012) argues that the DEP emerges in part due to neurotypical people labelling autistic people as “other” and in turn forgoing their responsibility to a functional social interaction. Rather, if an individual is labelled as “deficient”, problems in social interactions are fully transferred to this “other’s” responsibility (Milton, 2012).

Emotion processing in ASD

Emotional awareness refers to the ability of clearly differentiating emotional quality and intensity as well as identifying and describing complex, differentiated emotional states in oneself and others (Lane & Schwartz, 1987; Müller et al., 2024). Arguably, one skill encompassed in this domain is accurate emotion recognition.

Emotion Recognition in ASD. Findings on emotion recognition in ASD remain inconsistent. As Cassidy et al. (2014) note, studies investigating how well autistic individuals recognize basic emotions often report ceiling effects or no differences between their clinical and non-clinical samples. For example, a study by Williams and Happé (2010) found no difference in emotion recognition ability in autistic and neurotypical children across both social and non-social emotions. However, the authors note that these results were contrary to their predictions.

In contrast, other studies have reported reduced emotion recognition performance in autistic individuals. Yang et al. (2022) for instance, found that autistic participants performed worse than neurotypical participants when processing social emotions. Additionally, a meta-analysis by Masoomi et al. (2025) found an overall negative correlation of emotion recognition accuracy and autistic traits. However, when assessing emotion-specific differences in recognition accuracies the authors found no significant effects. Research by Yeung (2022) suggests that autistic individuals are impaired in their recognition of basic emotions in facial expressions. However, from their article it is to be assumed that the autistic individuals had to rate emotion expressions by

neurotypical actors. Arguably, autistic individuals may be able to recognize basic emotions expressed by autistic actors.

Emotional self-awareness in ASD. An interesting idea in this domain has been proposed by Silani et al. (2008). They propose the requirement of awareness of oneself as an entity that can experience and monitor emotions, which they propose is particularly relevant in ASD.

In a two-part systematic literature review, Huggins et al. (2020; 2021) assessed how emotional self-awareness is conceptualized by researchers and measured in autistic individuals. Their analysis identified overarching themes in the definition of emotional self-awareness including interoceptive abilities, the identification, interpretation, and communication of one's emotions, as well as empathising and recognizing emotions of others. Additionally, the authors note that differentiation between emotions has received little attention in research on emotional self-awareness of autistic individuals.

In the second part of their literature review, Huggins et al. (2021) reported that 32 out of 41 studies found lower levels of emotional self-awareness in autistic participants. The authors also reported age-related effects, with particularly large differences in emotional self-awareness abilities between autistic and neurotypical individuals aged 17 and above, whereas no group effect was found for children aged 12 and lower. This suggests that differences in emotional self-awareness in autism may not be innate and rather develop with age or certain life experiences.

Reduced emotional awareness in individuals may manifest in what is commonly referred to as *alexithymia*, which refers to an inability or difficulties in experiencing and expressing one's own emotions (Hogeveen & Grafman, 2021; Huggins et al., 2021; Taylor et al., 1991). Indeed, alexithymia is one of the most common co-occurring conditions of ASD (Berthoz & Hill, 2005; Milosavljevic et al., 2016).

Emotion Expression in ASD

The following chapter examines how emotional expressions in ASD may differ in contrast neurotypical patterns, with a focus on facial, written and artistic expressions as these reflect the modalities investigated in the present study.

ASD and Facial Expressions. Studies on emotion expressions of autistic individuals frequently report differences when compared to neurotypical individuals. However, findings remain inconclusive regarding the nature and direction of these differences (Zane et al., 2018).

Reduced emotional expression has been described as an early sign of ASD and has been reported in numerous studies (Bieberich & Morgan, 2004; Capps et al., 1992; Kanner, 1943; Kasari et al., 1990; Loveland et al., 1994; Rozga et al., 2011; Snow et al., 1987; Stagg et al., 2014; Stel et al., 2008; Yirmiya et al., 1989). Findings of a meta-analysis by Trevisan et al. (2018) suggest that autistic individuals show facial expressions for a shorter duration than neurotypical

individuals and that their expressions are seen as less congruent to the social context, while intensity of expression was comparable to the non-autistic groups.

Yet contrasting results have also been numerously reported (Capps et al., 1992; Grossman et al., 2013; Quinde-Zlibut et al., 2022; Zane et al., 2018). Zane et al. (2018) presented autistic and neurotypical adolescents with videos of salient dynamic faces and instructed them to mirror the expressions. The findings indicate that autistic participants overall produced less differentiated facial expressions with the extent of facial movement not systematically varying between positive and negative expressions. Importantly, however, autistic participants did not display a flatter or more neutral affect. Rather the authors note a non-significant trend towards more, and more varied facial movement in autistic individuals. The study however did not assess how similar the replicated facial expressions were to the presented stimuli. Thus, findings cannot make claims on how well either group completed the task. Differences in facial movements may represent how accurate groups were in mimicking expressions rather than their natural behaviour of emotional facial expression.

When investigating how neurotypical individuals rated staged and evoked facial expressions of autistic and neurotypical individuals Faso et al. (2015) found that posed expressions of autistic individuals were more accurately recognized than those of neurotypical participants.

Similarly, a study by Quinde-Zlibut et al. (2022) assessed naturally evoked facial expressions in autistic and neurotypical individuals while they looked at emotionally salient pictures. Their results showed no group differences in emotional congruency suggesting that groups were comparable in how often their facial expression matched the valence of the stimulus. However, autistic participants demonstrated higher expressiveness than neurotypical participants. Interestingly, in autistic participants higher levels of expressiveness were negatively associated with emotion recognition.

As Trevisan et al. (2018) note it seems that autistic individuals naturally produce different facial expressions than neurotypical individuals, yet they show little impairments when prompted to express like neurotypical individuals.

Autistic Masking. Autistic individuals consistently report engaging in active monitoring of themselves and others during conversations to gage social engagement and interest (Black et al., 2022; Walsh et al., 2025). They also describe engaging in masking behaviours, mimicking strategies and imitation of others' speech and gesture patterns (further referred to as *masking*) to facilitate social integration (Walsh et al., 2025).

Masking is defined as the conscious or unconscious suppression of natural responses and use of alternative responses in a range of domains such as social interactions, behaviour, and

movement (Pearson & Rose, 2021). Studies on masking identified a need or want to fit in with mainstream society, or an avoidance of discrimination as main motivators for this behaviour (Cage & Troxell-Whitmann, 2019; Hull et al., 2017; Miller, 2021; Pearson & Rose, 2021). Masking may also serve goal-directed purposes, such as forming friendships (Hull et al., 2017) or romantic relationships (Cage & Troxell-Whitmann, 2019).

Pearson and Rose (2021) argue that masking stands at odds with the social motivation hypothesis (see: Chevallier et al., 2012) as masking requires an awareness of social difference and a desire to conform to societal norms. Autistic Individuals describe masking as effortful and highly stressful, making an absence of social motivation unlikely (Pearson & Rose, 2021). Masking may emerge following repeated unsuccessful social interactions, reflecting social orientation that is achieved at greater cost and difficulty than in neurotypical individuals, possibly caused in part by the double empathy problem. Masking is yet an underexplored topic in ASD research (Alaghband-Rad et al., 2023) and adds another obstacle if experimenters are not aware of this behaviour, or clear in their instructions for expression tasks. It may represent a factor contributing to the inconsistent findings on emotion processing in ASD.

ASD and written expressions. Research on written expression in autistic people is underexplored (Shevchuk-Hill et al., 2023) and has mostly focused on mechanical characteristics such as writing speed and legibility (Zajic & Wilson, 2020). In their meta-analysis, Zajic and Wilson (2020) found that overall, autistic individuals showed average spelling abilities, while handwriting legibility and speed findings were mixed. Brown et al. (2014) reported lower performance on syntactic and lexical complexity, which is in line with findings by Baixauli et al. (2021) and Hilvert et al. (2020) yet contrasts that of Shevchuk-Hill et al. (2023). In a recent study by Gillespie-Lynch et al. (2020) autistic college students exhibited more advanced writing skills than their neurotypical peers, as well as more perfectionistic attitudes towards their own writing.

Research on emotional language has identified differences in processing of emotional words among autistic individuals. For example, Yeh et al. (2026) reported slightly lower accuracy in autistic children and adolescents when rating the valence of emotional words. Von Hausen et al. (2025) found consistent differences in the emotional interpretation of words, with autistic participants assigning higher ratings to emotionally intense and bodily sensation-related terms, whereas neurotypical participants showed a preference for words embedded in social contexts. When assessing written expression of autistic individuals, Caldwell-Harris and Posner (2024) found that their texts contain less positive emotional words, while Newton et al. (2009) report that blog posts of autistic and neurotypical individuals were comparable in all their assessed variables but the use of social words, in which autistic individuals showed more variability.

A review of the current literature for this thesis revealed little to no research examining differences between autistic and neurotypical individuals in self-appraisal of their own written communication. This apparent lack of empirical evidence indicates a notable research gap, which the present study seeks to address.

ASD and artistic expression. Research on artistic expression in autistic individuals has mainly focused on children's development of artistic talents. Studies on autistic children found no overall differences in drawing ability and emotional expressiveness (Charman & Baron-Cohen, 1993; Eames & Cox, 1994; Jolley et al., 2013) When distinguishing between social and basic emotions, Kotroni et al. (2019) observed reduced expressivity of basic emotions in drawings of autistic children, while drawings of social emotions did not differ to the neurotypical group. Studies also found a trend towards depicting non-social scenes rather than social content (Darewych et al., 2018; Jolley et al., 2013). Additionally, autistic individuals have been found to demonstrate lower imaginative fluency and reduced creativity in tasks requiring spontaneous production (Allen & Craig, 2016; Craig & Baron-Cohen, 1999).

Visual arts have also been employed as therapeutic interventions for autistic individuals (Richardson, 2015). Li et al. (2025) conducted a randomised control trial employing an art therapy programme over a nine-week period for autistic children and adolescents. During the art intervention, autistic children worked in small groups with neurotypical children who where matched in overall cognitive function and psychiatric symptoms. This was done to enhance social engagement and mutual understanding of each other. Overall, the intervention group demonstrated significantly reduced levels of self-criticism and physical discomfort, and heightened levels of positive affect and interpersonal skills, and more coherent self-representation compared to the non-intervention group which followed routine training.

As art therapy for autistic children is frequently evaluated though single-case studies, thus Schweizer et al. (2014) conducted a systematic review of existing qualitative research. The authors report that art therapy supported the children in self-expression and lead to overall improved self-image. Additionally, the participants demonstrated enhanced social skills during and outside of art therapy, higher awareness and tolerance of others and more engagement during social interactions.

Although research on art therapy in this context has predominantly employed qualitative methods (Schweizer et al., 2014), a review of the literature conducted for this thesis identified little to no research assessing autistic perspectives on their own art-making process. Nevertheless, the process of artistic creation seems to provide meaningful support for autistic individuals (Li et al., 2025; Richardson, 2015; Schweizer et al., 2014) indicating a valuable future research domain.

The present thesis seeks to contribute to this domain by investigating how autistic individuals evaluate artmaking as a channel of emotion communication.

Alexithymia

Alexithymia is a common comorbidity of ASD regarded as a multidimensional, sub-clinical personality trait (Larionow et al., 2025; Silani et al., 2008). It refers to a cognitive-affective disturbance of an individual's ability to experience and express their own emotions (Taylor, 1984) and can be argued as a manifestation of overall diminished emotional (self-)awareness in individuals (Hogeveen & Grafman, 2021; Huggins et al., 2020). For a detailed account on the history and emergence of alexithymia research see López-Muñoz and Pérez-Fernández (2020).

Alexithymia, as proposed by Taylor et al. (1991) encompasses four main characteristics: difficulty identifying and describing feelings, difficulty distinguishing between feelings and bodily sensations, reduced fantasy, and externally oriented thinking style. However, many researchers today orient themselves on the three facets used in the Toronto Alexithymia Scale (TAS-20, Taylor et al., 1991), one of the most commonly used self-report measurements in alexithymia research. This questionnaire differentiates between only three subscales: difficulty identifying feelings, difficulty describing feelings and an externally focussed thinking style. Since the present study employs the TAS-20 this thesis also accepts its' subscales as its theoretical foundation for alexithymia.

Comorbidities and Epidemiology

Alexithymic individuals are more likely to be diagnosed with schizotypal conditions (Cai et al., 2023; Huo et al., 2023; Seghers et al., 2011; C. Wang et al., 2025), depression (Honkalampi et al., 2000; Liu et al., 2025; Preece et al., 2024; Son et al., 2012; Touche et al., 2021) suicidal ideation and suicidal self-injury (Iskric et al., 2020; Norman et al., 2020). Alexithymia has also been linked to poorer education, lower income and male sex (Kokkonen et al., 2001; Mattila et al., 2006; Salminen et al., 1999).

The prevalence rate of alexithymia in adults is estimated to be around 9% to 17% in men and 5% to 10% women (Kokkonen et al., 2001; Mattila et al., 2006; Salminen et al., 1999). Prevalence of alexithymia is particularly elevated in the ASD population, with estimates of nearly 50% of the population showing high trait alexithymia (Berthoz & Hill, 2005; Milosavljevic et al., 2016).

Alexithymia and Emotion Processing

Alexithymic individuals experience disruptions in emotion processing across multiple domains, including interoception, emotion recognition and emotional expression. The following paragraphs review several cognitive and perceptual processes associated with alexithymia across emotional and social functioning.

A meta-analysis by Trevisan et al. (2019) found that alexithymia traits had a small negative correlation with interoceptive awareness. However, strength and direction of this correlation depended on which facet of interoception was measured and the method of measurement employed. Additionally, the correlation was only significant in clinical samples, while no correlation was observed in neurotypical samples. In contrast, Quinton and Wagner (2005) found that interoceptive awareness was positively correlated with the facet difficulty identifying emotions. A more recent metal-analysis by van Bael et al. (2024) examined different operationalizations of interoception. The authors found a positive relationship between alexithymia and both interoceptive confusion and heightened interoceptive attention, while it was negatively associated with interoceptive accuracy.

Beyond the perception of internal bodily signals, research has also examined how alexithymia influences attentional processes toward external emotional information. Study findings suggest that alexithymia presents with valence-dependent differences in emotion processing. Van der Velde et al. (2013) found that alexithymic individuals showed reduced emotional awareness towards positive emotional stimuli as well as decreased attention to negative emotional stimuli. Similarly, Wang et al. (2021) report that alexithymia was correlated negatively with processing accuracy of emotional stimuli of negative valence. In an integrative review (Luminet et al., 2021) also found that the majority of findings suggest a link of alexithymia and deficits in early, automatic attention to affect. Studies have reported an attentional bias in alexithymic individuals towards threat (Pandey & Mandal, 1997) and illness-related words (Lundh & Simonsson-Sarnecki, 2002). When studies controlled for negative affect alexithymia was associated with reduced emotion interference, indicative of a deficit in automatic processing of affect (Coffey, 2003; Mueller et al., 2006). Similarly, a systematic review by Suslow and Donges (2017) found that alexithymia was negatively correlated with automatic processing of emotional stimuli.

In addition to attentional processing differences, alexithymic individuals also present with emotion recognition difficulties (Di Tella et al., 2020). Studies found that alexithymia is associated with difficulties in emotion recognition of both auditory expressions and facial expressions (Gehdu et al., 2023; Jongen et al., 2014; Wang et al., 2021). In a metal-analysis Van der Velde et al. (2013) found higher activation in the dorsal anterior cingulate of alexithymic individuals, possibly indicating increased cognitive demand when processing emotional stimuli.

Finally, alexithymia has also been linked to socio-cognitive processes, particularly facets related to empathy. Studies report high alexithymia scores are associated with less perspective taking (Di Tella et al., 2020; Guttman & Laporte, 2002), lower empathic concern for others, yet higher personal distress when seeing someone else in distress (Grynberg et al., 2010). As Decety und Lamm (2006) report that maintaining distance from other people’s emotions and recognizing

who is experiencing them is associated with greater empathic concern, yet less personal distress, this may indicate that alexithymic individuals exhibit less self-other distinction, which was supported by Saito et al. (2016) whose data show that highly alexithymic individuals did not automatically resort to self-other distinction when viewing pain stimuli, although they were able to do so when instructed.

Alexithymia and Emotion Expression

While many studies focus on how alexithymia influences internal processes, a different line of research investigates how alexithymia is associated with external representations, namely emotion expression. Fantini-Hauwel et al. (2015) report that alexithymia is a predictor for positive affect intensity, and negative affect frequency. Their data suggests that highly alexithymic individuals experience negative affect more often, yet not more intensely than their control group. Additionally, their findings suggest that individuals who exhibited higher difficulties describing emotions showed less intense positive affect. Different studies have found negative relationships between alexithymia and emotion expression, such as McDonald and Prkachin (1990) and Wagner and Lee (2008) who found that alexithymia was negatively associated with non-verbal emotion expression. In line with this Rasting et al. (2005) observed higher alexithymia scores to correlate with less negative affect display and higher affect blends.

A second important domain of emotion expression that Luminet et al. (2021) reviewed is that of language. Out of sixteen studies the authors reviewed all but one found language deficits in alexithymic individuals. Findings suggest reduced emotional expression, frequency of emotion words and descriptions used in both spoken and written language (Páez et al., 1999; Roedema & Simons, 1999; Tull et al., 2005; Wotschack & Klann-Delius, 2013). Notably, the findings were still consistent when studies controlled for comorbidities such as affect or depression (Luminet et al., 2021).

When reviewing literature on alexithymia and emotion expression via art results are sparse. A study by Botella et al. (2015) examined alexithymia in artists. Their results found lower levels of alexithymia in artists compared to both art students and non-artists. Similarly, Lennartsson et al. (2017) found that achievements in creative arts were associated with lower alexithymia scores. A different study by Giannini et al. (2013) found that alexithymia is also associated with differences in aesthetic preferences. However, to the best of current knowledge, no studies have examined how alexithymia modulates emotional expression through art, reflecting an apparent research gap.

The interplay of ASD and Alexithymia

Alexithymia has been hypothesized to account for some of the heterogeneous symptom presentation in ASD and thus has gained increasing interest of ASD researchers in recent

decades (Poquérusse et al., 2018). Research has suggested that social-emotional differences in ASD may reflect co-occurring alexithymia rather than a core symptom of ASD itself (Bird & Cook, 2013; Kinnaird et al., 2019; Pisani et al., 2021).

Bird and Cook (2013) popularized this line of thinking as the *alexithymia hypothesis*. The authors base their theory on the heterogeneous results of studies investigating emotional competence in autistic individuals. Alexithymia has been linked to similar emotional difficulties as ASD, for example poorer emotion recognition and reduced empathy (Grynberg et al., 2010; Parker et al., 2005; Swart et al., 2009). As alexithymia is neither necessary nor sufficient for an ASD diagnosis, autistic individuals with high trait alexithymia may be conceptualised as a distinct subgroup (Kinnaird et al., 2019; Pearson & Rose, 2021). Bird and Cook (2013) state that, up until their publication, studies on ASD and emotional symptoms rarely considered alexithymia as a variable and suggest that matching samples for alexithymia should become common routine (Bird & Cook, 2013). Since then, studies investigating the interaction of ASD and alexithymia have focussed mainly on socio-emotional domains, such as interoception (Hassen et al., 2023; Shah et al., 2016) and emotion recognition (Bird et al., 2011; Cook et al., 2013).

Overall, study findings suggest that concurrent alexithymia in autistic individuals contributes to worse emotion regulation, social communication difficulties, and greater symptoms of anxiety and depression (Milosavljevic et al., 2016; Morie et al., 2019; Oakley et al., 2022). Raman et al., 2023 found within an ASD sample that higher levels of alexithymia were associated with lower empathic concern. However, the authors did not find any group differences in interoception or emotional empathy. Complementary, Ziermans et al. (2019) reported that autistic individuals scored significantly lower on cognitive empathy and higher on cognitive alexithymia compared to controls. However, the group difference in cognitive empathy remained significant even after controlling for levels of cognitive alexithymia, suggesting that reduced cognitive empathy in ASD cannot be fully explained by co-occurring alexithymia traits.

Effects on Emotion Expression

As emotion experience and expression in ASD is already an underexplored topic, it is to no surprise that there are little studies that have additionally assessed the effect of concurrent alexithymia. The only study pertinent to this thesis that was found is by Trevisan et al. (2016). They investigated how alexithymia modulates facial expressions in autistic children. The authors found that higher alexithymia scores were associated with less facial expressions overall. Their findings showed that alexithymia scores were negatively correlated with time spent producing negative facial expressions yet positively correlated with neutral expressions. They also found no association of alexithymia with time spent on positive facial expressions. Most importantly, after the effects of alexithymia were partialed out, the authors found no association of ASD on facial

expressions. When employing a forced entry hierarchical regression, Trevisan et al. (2016) found that only alexithymia predicted variance in facial expression production, while covariates and autistic traits did not. Their results thus support the alexithymia hypothesis by Bird and Cook (2013).

Synthesis and study rationale

Taken together, socio-emotional communication may be best understood as a relational process influenced by how an individual conceptualizes themselves and others. Central to this idea is the concept of self, which organizes, processes and recalls self-relevant information. This includes experiences, traits, values and goals (Campbell et al., 1996). It stands to reason, that since self-other perception accuracy influences interaction quality, and emotion expressions are interpreted differently due to social and cultural conventions and contextual cues (Barrett et al., 2020; Downes & Trigg, 2017; Fridlund, 1994; Fridlund & Russell, 2021; Russell, 1997), then successful emotion communication depends in part on the extent to which interaction partners share similar interpretative frameworks. Additional support for this idea comes from the relative ease reported in same-neurotype interactions whereas cross-neurotype interactions require greater effort due to differing expectations of emotional signalling (Black et al., 2022; Chen et al., 2021; Crompton et al., 2020a; DeBrabander et al., 2019; Marocchini & Baldin, 2024; Moseley et al., 2025; Walsh et al., 2025). This aligns with the double empathy problem (Milton, 2012), which frames communication difficulties between autistic and neurotypical individuals as reciprocal misunderstanding. Within this theoretical framework, reduced emotion recognition accuracy in ASD may reflect mismatched interpretative systems rather than reduced socio-emotional capacity alone.

Importantly, this may be a circular process reinforcing itself over time. Autistic individuals report heightened anxiety, discrimination and hostility during interactions with neurotypical individuals (Marocchini & Baldin, 2024; Walsh et al., 2025), which may contribute to alienation and reduced opportunities to engage with or learn alternative communicative conventions. This asymmetry is likely bidirectional, as neurotypical individuals also appear to have limited familiarity with autistic communicative styles, as evidenced by research on neurotypical individuals inferring autistic mental states (Edey et al., 2016; Sheppard et al., 2015).

Since autistic individuals represent a minority (World Health Organization, 2025; Zeidan et al., 2022), they are often expected to adapt to neurotypical norms (Milton, 2012) instead of being accepted in their differences. Autistic individuals frequently report engaging in masking behaviours reflecting neurotypical normative behaviour (Black et al., 2022; Pearson & Rose, 2021; Walsh et al., 2025) to facilitate successful social interactions. While potentially facilitating short-term social functioning, sustained masking may carry socio-emotional costs. Indeed, evidence suggests lower

emotional self-awareness in autistic individuals, particularly from adolescence onwards (Huggins et al., 2021), indicating that these differences may be shaped by lived experience rather than being purely innate. Theoretically, repeated suppression of spontaneous, natural emotional responses may contribute to difficulties in identifying and representing one's own emotions, potentially affecting the coherence of the emotional self-concept.

However, this interpretation is complicated by the high prevalence of alexithymia in ASD (Berthoz & Hill, 2005; Milosavljevic et al., 2016). Thus, Bird and Cook (2013) proposed the alexithymia hypothesis, which denotes that socio-emotional differences attributed to ASD may instead reflect co-occurring alexithymia. Although supported in domains such as interoceptive abilities (Hassen et al., 2023; Shah et al., 2016) emotion recognition (Bird et al., 2011; Cook et al., 2013), its role in emotion expression itself remains underexplored.

Crucially, as has been recounted in the chapters above, emotion expression is not only externally observable behaviour, but also an internally monitored and continuously regulated process that feeds back into how individuals understand and represent their own emotional states. Building on this, it becomes important to move beyond observer-based accounts of emotion expression and to examine how individuals themselves evaluate and interpret their own emotional communication, as this may provide insight into underlying emotional self-concepts. Examining self-appraisals may therefore help understand how autistic and neurotypical individuals perceive the expressiveness and success of their own emotional communication, and whether these perceptions differ systematically across neurotypes.

Aim of the study

The present study aims to investigate how autistic and neurotypical individuals differ in their self-appraisals of emotion expression across different communicative modalities while explicitly acknowledging and further examining the alexithymia hypothesis (Bird & Cook, 2013). Specifically, it examines how participants evaluate their own emotional communication in terms of perceived successful communication (i.e., how effectively they believe their expression would evoke the intended emotion in a hypothetical viewer), subjective task difficulty, experienced expressiveness, extent of thinking about others during expression, and emotional valence. These self-appraisals are assessed across three modalities of expression, allowing for a comparison of how internal evaluation processes vary not only between neurotypes but also as a function of expressive channel.

Ultimately, the thesis contributes to a more differentiated understanding of socio-emotional processing in ASD, with the goal of refining theoretical models and encouraging research approaches that move beyond deficit-based interpretations. Building on the reviewed literature, the following research questions and hypotheses are derived.

Research questions

For each modality (face, drawing and writing) the same research questions Q1 to Q6 apply.

Q1: How do autistic and neurotypical participants differ in their mean successful communication score?

Q2: How do autistic and neurotypical participants differ in their mean difficulty score?

Q3: How do autistic and neurotypical participants differ in their mean emotion felt score?

Q4: How do autistic and neurotypical participants differ in their mean expressiveness score?

Q5: How do autistic and neurotypical participants differ in their mean thought of others score?

Q6: How do autistic and neurotypical participants differ in their mean valence score?

Hypotheses

H1: Participants with an ASD diagnosis have higher mean TAS-20 scores than participants without an ASD diagnosis.

H2: Participants with an ASD diagnosis have higher mean CATI-R scores than participants without an ASD diagnosis.

H3: TAS-20 scores moderate the association of CATI-R scores and mean self-rating scores.

H3 is deliberately formulated in general terms to minimize redundancy. However, H3 is investigated across all six self-rating dimensions for each modality.

Materials and Methods

Recruitment and Participants

Recruitment ensued via a convenience sampling using online advertisements on social media, the Study Participant Platform of the Vienna Cognitive Science Hub, as well as flyers in public places. Possible participants were also contacted through an emailing-list of ASD participants that had already taken part in different studies of the Department of Psychology and had given consent to be contacted for further studies. Potential participants filled out an online pre-screening questionnaire on Qualtrics.

The inclusion criteria comprised an age of 18 to 65 years, fluency in German and normal or corrected to normal vision. Additionally, a valid ASD diagnosis was required to be part of the ASD group. Participants had to bring a document proving validity of diagnosis on the day of the study. Exclusion criteria included recreational illegal drug use, intellectual disabilities, and sensitivity on the scalp (for example skin irritations or eczema, since the whole PhD project included FNIRS). To ensure no undiagnosed autistic people in the control group, a score below 17 on the Autism Quotient short version (AQ-k; Freitag et al., 2007) in the pre-screening was

required. Additionally, participants with further psychiatric or neurological diagnoses were excluded for the non-ASD group.

The sample size was based on an a priori power analysis using G*Power (Faul et al., 2007), assuming a power of beta = 0.8, and a medium effect size of f = 0.25 and an alpha level of 0.05. This resulted in an estimated needed sample of 34 participants overall and 17 participants for each group. To account for possible dropouts and ensure enough test power the sample size goal was upped to at least 60 participants overall. This G*Power analysis was based on the Ph. D. candidate's overall project and was calculated for the overall study design.

The total recruited sample consisted of 62 participants. Two participants had to be excluded due to missing ASD diagnosis documents resulting in a sample size of N = 60 (33 women, 17 men, 10 non-binary / non-conforming) aged 18 to 65 years (M = 29.7, SD = 10.43). Participants were assigned in age and gender matched pairs resulting in 30 participants per group (Group 1: ASD diagnosis, Group 2: No diagnosis). Demographic analysis showed that most participants were Austrians (N = 40), eight participants were from Germany, and 12 participants indicated different nationalities. Participants came from a variety of educational backgrounds. Most graduated high school (N = 21) or had a bachelor's degree (N = 20). Other educational levels included master's degrees (N = 6), compulsory school certificates (N = 4), vocational training (N = 3), Ph.D. (N = 2), an MBA (N = 1) and one participant preferred not to answer.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics committee of the University of Vienna.

Measurements

The Revised Comprehensive Autistic Trait Inventory

The Revised Comprehensive Autistic Trait Inventory (CATI-R) is a self-report questionnaire designed to assess autistic traits across the general population (Hechler et al., 2025). It consists of 42 items, rated on a 5-point Likert scale ranging from definitely disagree to definitely agree. An example item for the CATI-R would be *I like to stick to certain routines/rituals for everyday tasks,* representing the adherence to rules which is often displayed by autistic individuals. The CATI-R comprises six subscales of seven items each, namely social Interactions, communication, social camouflage, repetitive behaviours, cognitive rigidity, and sensory sensitivity. Psychometric evaluation demonstrated excellent internal consistency for the total scale (stratified Cronbach's $\alpha \approx .95$) and good to excellent reliability for all subscales (α ranging from .80 to .94). The questionnaire shows strong convergent validity with established measures of autistic traits (e.g., AQ), robust factorial validity supported by confirmatory factor analyses, and measurement invariance across sex. Overall, the CATI-R provides a reliable and comprehensive assessment of multiple autistic trait dimensions.

Toronto Alexithymia Scale

The Toronto Alexithymia Scale (TAS-20) measures emotion processing in adults and is composed of 20 self-rate items employing a 5-Point-Likert scale (1 = strongly disagree, 5 = strongly agree). For example, one item of the TAS-20 is *I am often confused about what emotion I am feeling*, representing the difficulty identifying feelings subscale. The tool is made up of three subscales: Difficulty Identifying Feelings (DIF), Difficulty Describing Feelings (DDF) and Externally Oriented Thinking (EOT), as well as a total score. The recommended cut-off score for alexithymia is 61, with scores between 51 to 60 implying possible alexithymia traits. Taken together reliability estimates derived from adequately sized samples, suggest that the TAS-20 demonstrates adequate to excellent internal consistency, with a Cronbach's alpha ranging from 0.80 to 0.86. Retest reliability assessments showed an average intraclass correlation of 0.79. (Bach et al., 1996; Bagby et al., 1994, Bagby et al., 2020).

Self-rating dimensions

After each emotion expression task, the participants provided self-evaluations on multiple dimensions, using a 7-point-Likert scale. Depending on which emotion expression task (Face, Drawing or Writing) they were currently doing, they were asked between six to nine self-rating questions. However, only those dimensions which were rated after each task were further investigated. The full transcript of self-rating questions is available in appendix A.

The dimensions relevant to this thesis were as follows.

'Successful communication' how strongly the participants thought their drawing / text / facial expression would evoke the intended emotion in a hypothetical viewer. The difficulty dimension assessed subjective task difficulty, while the dimension of emotion felt assessed how much the participant felt the expressed emotion during the task. Thought of others investigated how much the participants thought of a different person during the task and valence assessed how positive or negative the expressed emotion felt to the participant.

Emotion selection

Overall, this study investigated four emotions namely happiness, sadness, fear, and anger which are commonly classified as basic emotions (Coppini et al., 2023; Ekman, 1992). Although the inclusion of more socially complex emotions such as pride or embarrassment was considered, these were ultimately excluded in order to maintain conceptual comparability and focus on a set of widely studied, prototypical affective states.

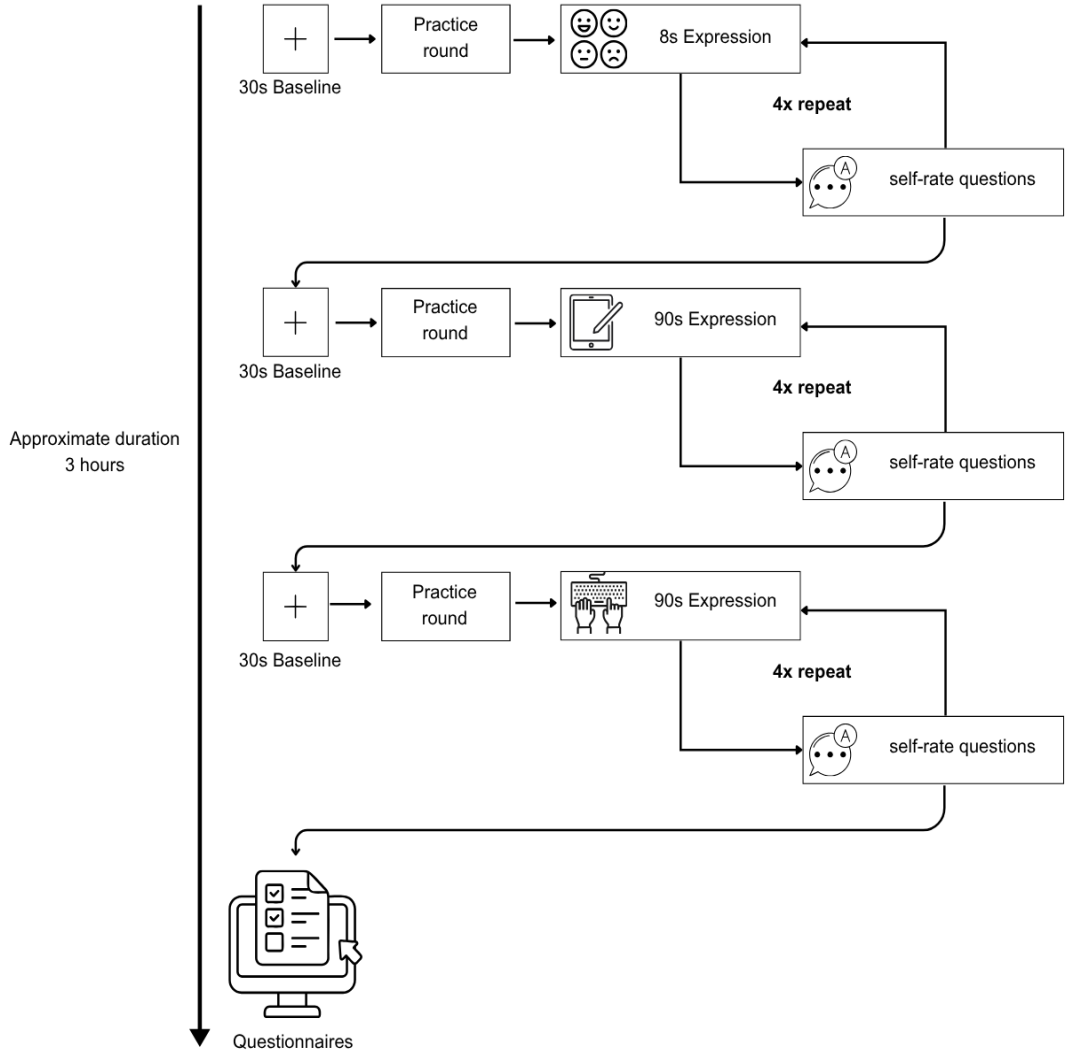
Procedure

Data acquisition took place between September 2024 and February 2025. The overall study duration was approximately 3 hours for one participant, with a maximum of two participants

completing the study on one day. The study took place at the department of Psychology at the University of Vienna at Liebiggasse 5.

All participants gave written informed consent before participation; they were informed about the procedure of the study and their right to withdraw their data from the sample post-study any time. Participants received 30€ to compensate them for their time. Early drop out of the study did not affect the amount of compensation. They were asked to put their phones on silent in order to avoid disturbances. Since the study is part of a Ph.D. project the full procedure included more tasks than listed below. However, only relevant tasks for the thesis at hand are explained in further detail. For a general overview of the procedure see Figure 1.

Figure 1
Study Procedure



Every emotion expression task consisted of a practice emotion (surprise) and the examined emotions anger, fear, sadness and happiness. Each task was completed five times, once for each of these emotions. After the practice was completed the order in which they had to express the investigated emotions was randomised. Every participant started with the facial expression task due to Facial EMG and FNIRS being part of the broader PhD study, yet the drawing task and the writing task were randomised as well.

After participants completed all expression tasks, they were allowed to take a break for as long as they wanted during which they could use the restroom or eat and drink. After the break participants filled out questions on demographic variables such as age, nationality and educational background as well as a series of tests and questionnaires including the German versions of the CATI-R and the TAS-20.

Facial Expression Task

Every participant started the study with the facial expression task. For this, they were sat in a chair backed to the wall, with a camera and two diffuse lights pointed at them. For better lighting, the overhead lights were turned off. Participants were instructed to look in the general direction of the camera and to not hide or turn their face away from the camera, since other participants would watch the footage in the future. To ensure that participants did not feel watched or uncomfortable a curtain was drawn between them and the researchers during the task. The task started with a baseline of 30 seconds where participants were asked to look towards the direction of the camera and not think about “anything in particular”. Then followed a practice round with a practice emotion (surprise), which they were allowed to repeat as many times as they needed to feel secure with the task. Participants were instructed to read the emotion on the monitor next to them and try to feel the emotion or think of a situation which may evoke this emotion in them. Pressing the space bar started a 5 second countdown with a tone at the end indicating to then start expressing the emotion using facial expressions. After 8 seconds they heard a second tone indicating they could stop. Then participants had to answer the self-rate questions using the keyboard. This procedure was then repeated four times.

Abstract drawing Task

For the abstract drawing task participants were instructed on how to use a drawing tablet. Their works were screen recorded via the tablet as well as filmed using an external camera. Participants were instructed to express the emotion via an abstract drawing. They were asked not to draw anything representational (e.g. no landscapes or faces). Additionally, they were not allowed to erase anything, were only able to use the colour black and one kind of pen with a set thickness. The monitor of the PC in front of them showed further instructions on which emotion they had to express.

Participants went through a 30 second baseline again for which they had to assume a position as if they were about to draw, without following through. Then followed the practice round. This was also an opportunity to ask if what they drew was considered abstract or not. Participants had 90 seconds to finish each of their drawings. If they felt as though their drawing was complete earlier, they could skip the remaining time. However, participants were asked to draw for at least one minute. After one minute had passed a prerecorded woman's voice from the computer told the participants they had 30 seconds left to finish their task. After each drawing they had to answer the same self-rate questions using the keyboard. This procedure was repeated four times, once for each emotion.

Writing Task

For the writing task participants had to express emotions in text using the keyboard of a computer. Their works were screen recorded using VLC Media Player. The participants were instructed that the written text had to be in German and should not include the name or synonyms of the emotion itself. Participants were allowed to be creative in their expression and were instructed not to worry about style or grammar of the text.

The writing task followed the general procedure of the abstract drawing task. Starting with a 30 second baseline during which participants had to hold their hands in a writing position on the keyboard, followed by a practice round. Then they went through the same steps with each emotion and self-rate questions as before. Again, participants had 90 seconds to finish each of their texts, and after one minute had passed, they heard a voice cue from the computer that 30 seconds were left. Participants were again allowed to skip the remaining time if they felt that they had completed the task earlier.

Analysis

Statistical analysis was carried out using R and RStudio version 4.2.2 (Posit Team, 2026; R Core Team, 2026). Scores for the TAS-20 and the CATI-R as well as self-rate dimensions were z-standardized to allow for comparability in the LMMs, otherwise raw test scores were used when indicated. Before testing group differences, assumptions for parametric analyses were evaluated for normality (Shapiro-Wilk test), homogeneity of variances (Levene’s Test) as well as outlier detection (Cook’s distance with a threshold of .08).

To assess H1 and H2 group differences in mean CATI-R scores and mean TAS-20 scores were investigated using two Welchs t-tests. To further examine the association of TAS-20 and CATI-R a Pearson correlation was run.

Model Specifications for LMMs

Across all outcome variables, linear mixed-effects models were fitted to examine predictors of self-ratings. All models included random intercepts for participants (ID) and fixed effects of

group, modality, emotion, TAS-20 score, CATI-R score, as well as the interaction between TAS-20 score and CATI-R score. Models were estimated using restricted maximum likelihood (REML), with t-tests based on Satterthwaite's approximation for degrees of freedom.

For analyses involving linear mixed-effects models (LMMs), the assumption of linearity between continuous predictors (standardized CATI-R and TAS-20 scores) and outcome variables was evaluated after model fitting.

To investigate H3 and H4, LMMs were fitted for each self-rate dimension. First, a base model was fitted following the structure of "lmm_base_dimension = (lmm_ dimension_z ~ (1|ID), data=data.cleaned)". Then the base model was updated to include random intercepts (indicated by "ri") and then followed the structure "lmm_ri_dimension = lmm_base_dimension,. ~ . + group + modality + emotion + TAS-20_z * CATI-R_z)". Afterwards, the random intercept model was updated to include random slopes (indicated by "rs") and followed the structure of "lmm_ri_rs_dimension = (lmm_ri_dimension,. ~ . + (0 + modality || ID) + (0 + emotion || ID)". Models were compared using an ANOVA, best model fit was assessed by AIC and BIC values as well as p-values. The best fitting models, which did not show convergence issues, as well as post hoc contrasts are reported in the results below. The access to the full R script is available in appendix B.

Assumption Testing

For H1 and H2, normality and homogeneity of variance were assessed using Shapiro-Wilk and Levene Tests. The Shapiro-Wilk tests were significant showing deviations from normality for both CATI-R and TAS-20 scores. However, since t-tests are relatively robust especially when group sample sizes are similar, a Welch t-test was run. Levene-tests for CATI-R ($F(1, 718) = 0.85$, $p = .357$) and TAS-20 ($F(1, 718) = 1.90$, $p = .168$) were non-significant indicating homogeneity of variances.

For H3, model assumptions were evaluated separately for each model fitted to the six assessed self-rating dimensions. Residual normality was assessed using Shapiro–Wilk tests. Significant deviations from normality were observed for communication ($W = 0.99$, $p < .001$), difficulty ($W = 0.99$, $p < .001$), emotion felt ($W = 0.99$, $p < .001$), expressiveness ($W = 0.99$, $p < .001$), thought of others ($W = 0.96$, $p < .001$), and valence ($W = 0.94$, $p < .001$). The Shapiro-Wilk W statistics were close to 1, indicating approximate normality of the residuals. Additionally, residual skewness was assessed and ranged from -0.32 to 0.82. Quantile-quantile plots of model residuals for all outcome variables are provided in appendix B.

Homoscedasticity of residuals was supported for all models (p-values ranging from .15 to .97). No influential outliers were detected based on Cook's distance (threshold = 0.8). Multicollinearity was low across all models, with variance inflation factors ranging from 1.00 to 4.48

across predictors. Linearity of the continuous predictors TAS-20 score and CATI-R score were assessed visually for all outcome models using model-based predicted values; no substantial deviations from linearity were observed. Q-Q plots and VIFs for all outcome variables are available in appendix B.

Results

Descriptive Statistics

Sample descriptives

The final sample comprised 60 participants, with N = 30 for each group. Participants provided self-ratings on a 7-point Likert scale across all rating dimensions. Descriptive statistics for all self-ratings sorted by group are reported in table 1.

Table 1

Z-Standardized self-ratings per group across all dimensions

Self-rating Dimension	ASD		Neurotypical	
	M (SD)	Min-Max	M (SD)	Min-Max
Communication	-0.12 (0.59)	-1.10–1.15	0.12 (0.37)	-0.69–0.69
Difficulty	0.13 (0.55)	-1.36–1.00	-0.13 (0.55)	-1.36–0.91
Emotion felt	-0.24 (0.76)	-1.69–1.17	0.24 (0.52)	-1.64–1.12
Expressiveness	-0.14 (0.58)	-1.24–1.16	0.14 (0.48)	-1.29–1.32
Thought of others	0.06 (0.80)	-1.04–1.83	-0.06 (0.73)	-1.04–2.44
Valence	0.03 (0.33)	-0.37–0.84	-0.03 (0.28)	-0.37–0.73

Note. Values are based on participant-level mean ratings aggregated across all trials. Self-ratings were z-standardized across the full dataset.

Table 2

Z-standardized and raw scores for CATI-R and TAS-20 by group

	ASD		Neurotypical	
Measurement	**M (SD)**	**Min-Max**	**M (SD)**	**Min-Max**
CATI-R (z)	0.86 (0.52)	-0.33–1.72	-0.86 (0.51)	-1.75–0.35
TAS-20 (z)	0.76 (0.63)	-0.70–1.81	-0.76 (0.68)	-1.80–1.81
CATI-R (raw)	170.73 (20.70)	123.00–205.00	101.50 (20.47)	66.00–150.00
TAS-20 (raw)	59.83 (8.51)	40.00–74.00	39.07 (9.25)	25.00–74.00

Note. Descriptives are based on participant-level aggregation across repeated measures. Scores were z-standardized across the full dataset.

Main Analysis

H1 and H2: Differences in mean scores for CATI-R and TAS-20 by group

A Welch t-test was run for both CATI-R and TAS-20 raw scores to assess differences in means between the autistic and the neurotypical group. Further, two logistic regressions were run to investigate predictability of group membership by CATI-R and TAS-20 scores. Results are presented in table 3 and table 15 below.

Table 3

t-test results for CATI-R and TAS-20

Measurement	ASD Mean (SD)	Neurotypical Mean (SD)	t (df)	95% CI	*p*	*d*
CATI-R	170.73 (20.7)	101.5 (20.47)	45.83 (717.90)	[66.27, 72.20]	$p < .001$***	2.37
TAS-20	59.83 (8.51)	39.07 (9.25)	31.83 (713.11)	[19.49, 22.05]	$p < .011$***	3.42

Note. Group values are presented as mean (standard deviation). Welch's independent-samples t-tests were used due to unequal variances between groups. Degrees of freedom are adjusted accordingly. d = Cohen's effect size.

Additionally, a Pearson product–moment correlation found a positive association between CATI-R and TAS-20 scores, $r(58) = .75$, $p < .001$, 95% CI [.61, .84].

H3: TAS-20 scores moderate the association of CATI-R scores and mean self-rating scores.

Overall, no significant effect of group membership and no interaction effect of alexithymia across all self-appraisal ratings was found. Results for all self-rating dimensions are reported in the following paragraphs below.

Communication Ratings

A linear mixed model with random intercepts for participants was fitted to estimate the variance attributable to between-subject differences. The model showed a residual variance of $\sigma^2 = 0.820$ and $\tau_{00} = 0.183$ for the random intercept of participants with an intraclass correlation coefficient (ICC) of .182.

Further, fixed effects of group, modality, emotion, alexithymia and autistic traits as well as the interaction of alexithymia and ASD were added. The model provided a significant improvement in model fit ($\chi^2(9) = 116.96$, $p < .001$). However, the model found no significant main effect of group membership ($b = 0.18$, SE = 0.27, $t(55) = 0.67$, $p = 0.507$).

Modality showed significant effects, with higher communication ratings for the writing task ($b = 0.76$, SE = 0.08, $t(655) = 9.95$, $p < .001$) and the facial expression task ($b = 0.36$, SE = 0.08, $t(655) = 4.70$, $p < .001$) compared to the drawing task.

For emotion, communication ratings were significantly higher for happiness ($b = 0.35$, SE = 0.09, $t(655) = 3.96$, $p < .001$) and anger ($b = 0.30$, SE = 0.09, $t(655) = 3.41$, $p < .001$), whereas sadness did not differ significantly from fear ($b = 0.05$, SE = 0.09, $t(655) = 0.62$, $p = .535$).

Neither alexithymia ($b = -0.03$, SE = 0.11, $t(55) = -0.29$, $p = .774$) nor autistic traits ($b = -0.002$, SE = 0.13, $t(55) = -0.01$, $p = .990$) showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = 0.03$, SE = 0.10, $t(55) = 0.35$, $p = .730$). A model including random slopes was fitted next which significantly improved model fit. However, the model showed a singular fit. Thus, the model explained above was used for further analysis.

Post Hoc Analysis of Communication ratings. The linear mixed model showed main effects of emotion and modality. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed for both and are reported in tables 4 and 5 below.

Table 4

Pairwise and deviation contrasts for emotion on Communication.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p < .001*** t = -3.96 [-0.57, -0.12] SE = 0.09	p = 0.925 t = -0.62 [-0.28, 0.17] SE = 0.09	p = 0.004** t = -3.41 [-0.53, -0.07] SE = 0.09	p = 0.003** t = -3.26 [-0.31, -0.04] SE = 0.05
Happiness		-	p = 0.005** t = 3.34 [0.07, 0.52] SE = 0.09	p = 0.948 t = 0.54 [-0.18, 0.27] SE = 0.09	p = 0.003** t = 3.20 [0.04, 0.31] SE = 0.05
Sadness			-	p = 0.027* t = -2.79 [-0.47, -0.02] SE = 0.09	p = 0.025* t = -2.25 [-0.26, 0.01] SE = 0.05
Anger				-	p = 0.025* t = 2.31 [-0.01, 0.26] SE = 0.05

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Table 5

Pairwise and deviation contrasts for modality on Communication.

Modality	Drawing	Writing	Facial Expression	Grand Mean
Drawing	—	p < .001*** t = -9.95 [-0.94, -0.58] SE = 0.08	p < .001*** t = -4.70 [-0.54, -0.18] SE = 0.08	p < .001*** t = -8.46 [-0.48, -0.27] SE = 0.04
Writing		—	p < .001*** t = 5.24 [0.22, 0.58] SE = 0.08	p < .001*** t = 8.77 [0.28, 0.49] SE = 0.04
Facial Expression			—	p = 0.756 t = -0.31 [-0.12, 0.09] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Difficulty Ratings

A linear mixed model with random intercepts for participants was fitted. The model showed a residual variance of $\sigma^2 = 0.749$ and a random intercept variance of $\tau_{00} = 0.255$, resulting in an ICC of .254.

Next a model with fixed effects for group, modality, emotion, alexithymia, autistic traits and their interaction significantly improved model fit compared to the intercept-only model ($\chi^2(9) = 52.72$, $p < .001$. The model found no main effect of group membership ($b = -0.26$, SE = 0.31, $t(55) = -0.85$, $p = .400$).

Modality showed significant effects, with lower difficulty ratings for the writing task ($b = -0.43$, SE = 0.08, $t(655) = -5.65$, $p < .001$) and the facial expression task ($b = -0.19$, SE = 0.08, $t(655) = -2.44$, $p = .015$) compared to the drawing task.

For emotion, difficulty ratings were significantly lower for happiness ($b = -0.32$, SE = 0.09, $t(655) = -3.60$, $p < .001$) and anger ($b = -0.28$, SE = 0.09, $t(655) = -3.19$, $p = .001$), whereas sadness did not differ significantly from fear ($b = -0.10$, SE = 0.09, $t(655) = -1.10$, $p = .273$).

Neither alexithymia ($b = 0.09$, SE = 0.12, $t(55) = 0.75$, $p = .456$) nor autistic traits ($b = -0.08$, SE = 0.15, $t(55) = -0.52$, $p = .608$) showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = -0.04$, SE = 0.11, $t(55) = -0.37$, $p = .712$).

A model including random slopes for modality and emotion provided a substantially better fit than the random-intercept model ($\chi^2(16) = 107.41$, $p < .001$). However, the model showed a singular fit and thus was not retained for further analysis.

Post Hoc Analysis of Difficulty ratings. The linear mixed model showed main effects of emotion and modality. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed for both reported in tables 6 and 7 below.

Table 6
Pairwise and deviation contrasts for emotion on Difficulty.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p = 0.002** t = 3.60 [0.09, 0.55] SE = 0.09	p = 0.691 t = 1.10 [-0.13, 0.32] SE = 0.09	p = 0.008** t = 3.19 [0.05, 0.51] SE = 0.09	p = 0.005** t = 3.22 [0.04, 0.31] SE = 0.05
Happiness		—	p = 0.060 t = -2.50 [-0.45, 0.01] SE = 0.09	p = 0.976 t = -0.41 [-0.26, 0.19] SE = 0.09	p = 0.016* t = -2.66 [-0.28, -0.01] SE = 0.05
Sadness			—	p = 0.156 t = 2.09 [-0.04, 0.41] SE = 0.09	p = 0.154 t = 1.43 [-0.06, 0.21] SE = 0.05
Anger				—	p = 0.063 t = -1.99 [-0.24, 0.03] SE = 0.05

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Table 7
Pairwise and deviation contrasts for modality on Difficulty.

Modality	Drawing	Writing	Facial Expression	Grand Mean
Drawing	—	p < .001*** t = 5.65 [0.25, 0.61] SE = 0.08	p = 0.040* t = 2.44 [0.01, 0.37] SE = 0.08	p < .001*** t = 4.67 [0.10, 0.31] SE = 0.04
Writing		—	p = 0.004** t = -3.21 [-0.42, -0.07] SE = 0.08	p < .001*** t = -5.11 [-0.33, -0.12] SE = 0.04
Facial Expression			—	p = 0.656 t = 0.45 [-0.09, 0.13] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on

estimated marginal means. Confidence intervals are reported at the 95% level. $p < .05$*, $p < .01$**, $p < .001$***.

Emotion felt Ratings

A linear mixed-effects model with random intercepts for participants was first fitted to estimate the proportion of variance attributable to between-subject differences. The model revealed a residual variance of $\sigma^2 = 0.551$ and a random intercept variance of $\tau_{00} = 0.387$.

Adding fixed effects of group, modality, emotion, alexithymia, autistic traits, and their interaction significantly improved model fit compared to the intercept-only model ($\chi^2(9) = 45.78$, $p < .001$).

In this model, there was no significant main effect of group ($b = 0.29$, SE = 0.36, $t(55) = 0.81$, $p = .423$). Modality showed a significant effect for the facial expression task ($b = 0.18$, SE = 0.07, $t(655) = 2.59$, $p = .010$), whereas the writing task did not differ significantly from the drawing task ($b = 0.09$, SE = 0.07, $t(655) = 1.37$, $p = .171$).

For emotion, ratings were significantly higher for happiness ($b = 0.42$, SE = 0.08, $t(655) = 5.35$, $p < .001$) and sadness ($b = 0.17$, SE = 0.08, $t(655) = 2.18$, $p = .029$), whereas the effect for anger did not reach statistical significance ($b = 0.15$, SE = 0.08, $t(655) = 1.88$, $p = .060$).

Neither alexithymia ($b = −0.20$, SE = 0.14, $t(55) = −1.44$, $p = .154$) nor autistic traits ($b = 0.06$, SE = 0.18, $t(55) = 0.34$, $p = .732$) showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = −0.08$, SE = 0.13, $t(55) = −0.61$, $p = .544$).

A model including random slopes for modality and emotion significantly improved model fit compared to the random-intercept model($\chi^2(16) = 72.34$, $p < .001$). However, the model showed a singular fit, thus the model above was used for further analysis.

Post Hoc Emotion felt Ratings. The linear mixed model showed main effects of emotion and modality. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed for both reported in tables 8 and 9 below.

Table 8

Pairwise and deviation contrasts for emotion on Emotion felt.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p < .001*** t = -5.35 [-0.62, -0.22] SE = 0.08	p = 0.129 t = -2.18 [-0.37, 0.03] SE = 0.08	p = 0.237 t = -1.88 [-0.35, 0.05] SE = 0.08	p < .001*** t = -3.84 [-0.30, -0.06] SE = 0.05
Happiness		—	p = 0.009** t = 3.17 [0.05, 0.45] SE = 0.08	p = 0.003** t = 3.47 [0.07, 0.47] SE = 0.08	p < .001*** t = 4.89 [0.11, 0.35] SE = 0.05
Sadness			—	p = 0.991 t = 0.30 [-0.18, 0.22] SE = 0.08	p = 0.780 t = -0.28 [-0.13, 0.11] SE = 0.05
Anger				—	p = 0.590 t = -0.77 [-0.16, 0.08] SE = 0.05

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Table 9

Pairwise and deviation contrasts for modality on Emotion felt.

Modality	Drawing	Writing	Facial Expression	Grand Mean
Drawing	—	p = 0.357 t = -1.37 [-0.25, 0.07] SE = 0.07	p = 0.026* t = -2.59 [-0.33, -0.02] SE = 0.07	p = 0.042* t = -2.29 [-0.18, 0.00] SE = 0.04
Writing		—	p = 0.440 t = -1.22 [-0.24, 0.08] SE = 0.07	p = 0.932 t = 0.09 [-0.09, 0.10] SE = 0.04
Facial Expression			—	p = 0.042* t = 2.20 [-0.01, 0.18] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Expressiveness Ratings

A linear mixed-effects model with random intercepts for participants was first fitted to estimate the proportion of variance attributable to between-subject differences. The model revealed a residual variance of $\sigma^2 = 0.771$ and a random intercept variance of $\tau_{00} = 0.232$, resulting in an intraclass correlation coefficient (ICC) of .232.

Adding fixed effects of group, modality, emotion, alexithymia, autistic traits, and their interaction significantly improved model fit compared to the intercept-only model ($\chi^2(9) = 47.43$, $p < .001$).

In this model, there was no significant main effect of group membership ($b = 0.47$, SE = 0.30, $t(55) = 1.60$, $p = .116$). For modality, ratings were significantly higher for the writing task compared to the reference modality ($b = 0.33$, SE = 0.08, $t(655) = 4.27$, $p < .001$), whereas the facial expression task did not differ significantly from the drawing task ($b = 0.09$, SE = 0.08, $t(655) = 1.20$, $p = .232$).

For emotion, anger was associated with significantly higher expressiveness ratings than fear ($b = 0.35$, SE = 0.09, $t(655) = 3.87$, $p < .001$). The effect of happiness did not reach statistical significance ($b = 0.15$, SE = 0.09, $t(655) = 1.66$, $p = .098$), and sadness was not significantly different from fear ($b = -0.05$, SE = 0.09, $t(655) = -0.59$, $p = .554$).

Neither alexithymia ($b = 0.03$, SE = 0.11, $t(55) = 0.29$, $p = .774$), nor autistic traits ($b = 0.09$, SE = 0.14, $t(55) = 0.64$, $p = .524$), showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = 0.07$, SE = 0.10, $t(55) = 0.64$, $p = .525$).

Post Hoc Analysis of Expressiveness ratings. The linear mixed model showed main effects of emotion and modality. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed for both reported in tables 10 and 11 below.

Table 10

Pairwise and deviation contrasts for emotion on Expressiveness.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p = 0.347 t = -1.66 [-0.38, 0.08] SE = 0.09	p = 0.934 t = 0.59 [-0.18, 0.29] SE = 0.09	p < .001*** t = -3.87 [-0.58, -0.12] SE = 0.09	p = 0.059 t = -2.01 [-0.25, 0.03] SE = 0.06
Happiness		—	p = 0.111 t = 2.25 [-0.03, 0.43] SE = 0.09	p = 0.122 t = -2.21 [-0.43, 0.03] SE = 0.09	p = 0.489 t = 0.69 [-0.10, 0.18] SE = 0.06
Sadness			—	p < .001*** t = -4.46 [-0.63, -0.17] SE = 0.09	p = 0.006** t = -2.98 [-0.30, -0.03] SE = 0.06
Anger				—	p < .001*** t = 4.30 [0.10, 0.38] SE = 0.06

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Table 11

Pairwise and deviation contrasts for modality on Expressiveness.

Modality	Drawing	Writing	Facial Expression	Grand Mean
Drawing	—	p < .001*** t = -4.27 [-0.52, -0.15] SE = 0.08	p = 0.456 t = -1.20 [-0.28, 0.09] SE = 0.08	p = 0.002** t = -3.16 [-0.25, -0.03] SE = 0.04
Writing		—	p = 0.006** t = 3.08 [0.06, 0.42] SE = 0.08	p < .001*** t = 4.24 [0.08, 0.30] SE = 0.04
Facial Expression			—	p = 0.278 t = -1.09 [-0.16, 0.06] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Thought of others ratings

A linear mixed-effects model with random intercepts for participants was first fitted. The model revealed a residual variance of $\sigma^2 = 0.464$ and a random intercept variance of $\tau_{00} = 0.545$, resulting in an intraclass correlation coefficient (ICC) of .540.Adding fixed effects of group, modality, emotion, alexithymia, autistic traits, and their interaction significantly improved model fit compared to the intercept-only model ($\chi^2(9) = 36.91$, $p < .001$).

In this model, there was no significant main effect of group membership ($b = -0.42$, SE = 0.43, $t(55) = -0.99$, $p = .326$. Modality showed a significant effect for the facial expression task, with higher ratings compared to the reference modality ($b = 0.27$, SE = 0.06, $t(655) = 4.39$, $p < .001$), whereas the writing task did not differ significantly from the drawing task ($b = 0.05$, SE = 0.06, $t(655) = 0.79$, $p = .432$).

For emotion, ratings were significantly lower for sadness ($b = -0.15$, SE = 0.07, $t(655) = -2.15$, $p = .032$) and anger ($b = -0.22$, SE = 0.07, $t(655) = -3.11$, $p = .002$) compared to fear, whereas happiness did not differ significantly ($b = -0.01$, SE = 0.07, $t(655) = -0.14$, $p = .886$).

Neither alexithymia ($b = 0.03$, SE = 0.16, $t(55) = 0.21$, $p = .835$) nor autistic traits ($b = -0.19$, SE = 0.21, $t(55) = -0.94$, $p = .353$) showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = 0.07$, SE = 0.15, $t(55) = 0.47$, $p = .642$).

A model including random slopes for modality and emotion significantly improved model fit compared to the random-intercept model ($\chi^2(16) = 145.44$, $p < .00$). However, the model also showed a singular fit and was not retained for post hoc analysis.

Post Hoc Analysis of Thought of other ratings. The linear mixed model showed differences in emotion. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed reported in tables 12 and 13 below.

Table 12

Pairwise and deviation contrasts for emotion on Thought of others.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p = 0.999 t = 0.14 [-0.17, 0.19] SE = 0.07	p = 0.138 t = 2.15 [-0.03, 0.33] SE = 0.07	p = 0.011* t = 3.11 [0.04, 0.40] SE = 0.07	p = 0.055 t = 2.21 [-0.01, 0.20] SE = 0.04
Happiness		—	p = 0.186 t = 2.01 [-0.04, 0.32] SE = 0.07	p = 0.016* t = 2.97 [0.03, 0.39] SE = 0.07	p = 0.065 t = 1.97 [-0.02, 0.19] SE = 0.04
Sadness			—	p = 0.774 t = 0.96 [-0.11, 0.25] SE = 0.07	p = 0.191 t = -1.31 [-0.16, 0.05] SE = 0.04
Anger				—	p = 0.017* t = -2.87 [-0.23, -0.02] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Table 13

Pairwise and deviation contrasts for modality on Thoughts of others.

Modality	Drawing	Writing	Facial Expression	Grand Mean
Drawing	—	p = 0.711 t = -0.79 [-0.19, 0.09] SE = 0.06	p < .001*** t = -4.39 [-0.41, -0.12] SE = 0.06	p = 0.004** t = -2.99 [-0.19, -0.02] SE = 0.04
Writing		—	p < .001*** t = -3.60 [-0.36, -0.08] SE = 0.06	p = 0.104 t = -1.63 [-0.14, 0.03] SE = 0.04
Facial Expression			—	p < .001*** t = 4.62 [0.08, 0.25] SE = 0.04

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Valence Ratings

A linear mixed-effects model with random intercepts for participants was first fitted to estimate the proportion of variance attributable to between-subject differences. The model revealed a residual variance of $\sigma^2 = 0.464$ and a random intercept variance of $\tau_{00} = 0.545$, resulting in an intraclass correlation coefficient (ICC) of .540.

Adding fixed effects of group, modality, emotion, alexithymia, autistic traits, and their interaction significantly improved model fit compared to the intercept-only model ($\chi^2(9) = 36.91$, $p < .001$).

In this model, there was no significant main effect of group membership, ($b = -0.42$, SE = 0.43, t(55) = −0.99, $p = .326$). Modality showed a significant effect for the facial expression task, with higher ratings compared to the reference modality ($b = 0.27$, SE = 0.06, t(655) = 4.39, $p < .001$), whereas the writing task did not differ significantly from the drawing task ($b = 0.05$, SE = 0.06, t(655) = 0.79, $p = .432$).

For emotion, ratings were significantly lower for sadness ($b = -0.15$, SE = 0.07, t(655) = −2.15, $p = .032$) and anger ($b = -0.22$, SE = 0.07, t(655) = −3.11, $p = .002$) compared to fear, whereas happiness did not differ significantly ($b = -0.01$, SE = 0.07, t(655) = −0.14, $p = .886$).

Neither alexithymia ($b = 0.03$, SE = 0.16, t(55) = 0.21, $p = .835$) nor autistic traits ($b = -0.19$, SE = 0.21, t(55) = −0.94, $p = .353$) showed significant main effects. The interaction between alexithymia and autistic traits was also not significant ($b = 0.07$, SE = 0.15, t(55) = 0.47, $p = .642$).

A model including random slopes for modality and emotion significantly improved model fit compared to the random-intercept model ($\chi^2(16) = 145.44$, $p < .001$). Again, the random slopes model showed a singular fit and was not used for further analysis.

Post Hoc Analysis of Valence ratings. The linear mixed model showed main effects of emotion and modality. To further analyse these, pairwise comparisons and deviation contrast to the overall mean were computed for both reported in table 14 below.

Table 14

Pairwise and deviation contrasts for emotion on Valence.

Emotion	Fear	Happiness	Sadness	Anger	Grand Mean
Fear	-	p < .001*** t = -42.19 [-2.15, -1.90] SE = 0.05	p = 0.013* t = -3.04 [-0.27, -0.02] SE = 0.05	p = 0.367 t = -1.62 [-0.20, 0.05] SE = 0.05	p < .001*** t = -19.13 [-0.64, -0.49] SE = 0.03
Happiness		—	p < .001*** t = 39.14 [1.76, 2.00] SE = 0.05	p < .001*** t = 40.56 [1.82, 2.07] SE = 0.05	p < .001*** t = 49.76 [1.39, 1.54] SE = 0.03
Sadness			—	p = 0.487 t = 1.42 [-0.06, 0.19] SE = 0.05	p < .001*** t = -14.16 [-0.49, -0.34] SE = 0.03
Anger				—	p < .001*** t = -16.48 [-0.56, -0.41] SE = 0.03

Note. Upper triangle cells present Tukey-adjusted pairwise comparisons; the final column presents deviation contrasts against the grand mean (FDR-adjusted). Values are based on estimated marginal means. Confidence intervals are reported at the 95% level. p < .05*, p < .01**, p < .001***.

Exploratory Analysis

Two logistic regressions were run to assess whether CATI-R and TAS-20 scores could predict group membership. Results are presented in table 15 below.

Table 15

Logistic Regression for CATI-R and TAS-20 scores and group

Predictor	b	SE	z	p	OR	AIC
CATI-R						
Intercept	-10.05	0.68	-14.72	*p* <.001***		
CATI-R	0.21	0.01	14.82	*p* <.001***	1.15	207.46
TAS-20						
Intercept	-18.94	1.76	-10.77	*p* <.001***		
TAS-20	0.14	0.01	10.63	p <.001***	1.23	460.48

Note. b = log-odds coefficient; SE = standard error; OR = odds ratio. Positive coefficients indicate a higher likelihood of belonging to the ASD group.

Discussion

Summary of Main Analysis

This thesis aimed to investigate how ASD and alexithymia influence self-evaluations of emotion expressions in autistic and neurotypical individuals. Specifically, this study assessed how groups differed in their self-evaluation on six different dimensions, namely Successful communication, Difficulty, Emotion felt, Expressiveness, Thoughts of Others and Valence.

The study was able to replicate previous findings of strong associations of ASD and alexithymia. As proposed in H1 autistic participants showed higher alexithymia than neurotypical participants. Thus, the data further supports the notion that alexithymia is heightened overall in the autistic population as has been reported by several studies (Berthoz & Hill, 2005; Milosavljevic et al., 2016).

Regarding H3, no interaction effect of autistic traits and alexithymia was found which stands in contrast of the alexithymia hypothesis of Bird and Cook (2013). Overall, findings suggest that both emotion and modality play a critical role influencing emotion expression, while autistic traits and alexithymia seem to have no effect. This may suggest that while alexithymia seems to have a moderating effect on emotion recognition and interoceptive abilities in autistic individuals (), it may not interact with emotion expression.

The data also found no effects of group membership in any of the tested self-appraisals, which was also highly unpredicted. This suggests both autistic and neurotypical participants overall rated their emotion expressions similarly across all self-rating scales. For example, there

were no group effects in self-assessed task difficulty. Viewing this in a broader light, this may indicate that autistic individuals may not view emotion expression as more difficult than neurotypicals but rather resort to different expressions naturally, with difficulties arising during social interactions rather than solitary expression.

Summary of participant ratings

Across emotions, happiness and anger were generally perceived as the most successfully communicated, whereas sadness and fear were rated as less effectively conveyed. This pattern was mirrored in perceived task difficulty, with fear rated as the most difficult emotion to express and happiness as the least difficult. Consistent with this, participants reported feeling happiness most strongly during expression tasks, while fear was felt least intensely. Anger, in contrast, was rated as relatively well communicated and highly expressive despite not being strongly felt, suggesting a partial dissociation between internal experience and perceived communicative output.

Differences also emerged across modalities. Writing was consistently evaluated as the most effective and least difficult medium, with the highest perceived expressiveness, whereas drawing was rated as the most difficult, least successful, and least expressive modality. This pattern may be partly explained by the constraints of the drawing task, which required abstract, black-and-white representations and may therefore have increased ambiguity and reduced participants' perceived ability to convey emotional content. Facial expressions tended to occupy an intermediate position but were associated with the highest reported consideration of others, suggesting greater social attunement during this modality. In contrast, drawing involved the least other-oriented thinking. Writing showed relatively stable ratings across affective and social dimensions. These findings broadly align with prior work by App et al. (2011), who demonstrated that preferences for emotion expression channels vary depending on the emotion being communicated.

Finally, valence ratings followed a clear and robust pattern, with happiness rated as significantly more positive than all other emotions and no found modality effect.

Limitations

Sample size

One major limitation of the present study is the relatively small sample size. The power analysis and corresponding sample size estimation were inherited from the broader PhD project framework of which this thesis forms a part. As a result, a total sample of N = 60 was analysed. However, a simulation-based power analysis conducted in R indicated that a minimum sample size of N = 220 would be required to detect an effect size of 0.20 with a power of 0.85. Accordingly, the results and their interpretation should be treated with caution.

P values in LMMs

The interpretation of p-values in linear mixed models (LMMs) is not always straightforward. Although p-values can be approximated using methods such as Satterthwaite's or Kenward-Roger's approaches, the accuracy of these approximations is not guaranteed across all model specifications. Consequently, greater emphasis should also be placed on effect size estimates and their direction when interpreting results (Field, 2024).

Assessing results via p-values in LMMs is not always appropriate. P values can be approximated using Satterthwaite and Kenward-Roger's methods, however if these approximations are correct is not always assured. Thus, trends in effect estimators should also be considered when interpreting results (Field, 2024).

Grouping by Diagnosis

Another limitation concerns the use of diagnostic grouping. Since ASD is a spectrum disorder it is questionable whether a categorical grouping by diagnosis is advantageous in contrast to using autistic traits as a continuous predictor. This study employed the CATI-R as an approximator for autistic traits. In the statistical analysis participants were first grouped by diagnosis, then data was assessed by CATI-R score. However, results may have differed if participant data was only analysed using CATI-R. As results showed overlap in CATI-R scores between groups (see: Appendix B).

Masking

As outlined in the theoretical framework, masking is an effortful adaptive behaviour frequently reported by autistic individuals during social interaction (Black et al., 2022; Pearson & Rose, 2021; Walsh et al., 2025). This process can substantially shape observable emotional expression, yet there is a notable lack of empirical work examining emotion expression specifically in relation to active masking. This was also a limitation of the present study, as no measure captured whether participants were orienting their expression toward an imagined autistic or neurotypical interaction partner, which may have introduced heterogeneity within the autistic sample.

Although the Thoughts of Others dimension assessed the extent of other-oriented cognition during expression, it did not specify the perceived neurotype of the imagined other. Similarly, Successful Communication could reflect qualitatively different underlying processes, such as successfully communicating a masked expression to a presumed neurotypical observer or effectively conveying an unmasked expression to an autistic peer. While these scenarios may yield similar ratings, the underlying mechanisms are likely distinct and theoretically meaningful, particularly in the context of neurotype-dependent communication strategies and reciprocal communication differences described by the double empathy problem (Milton, 2012).

Future research should therefore explicitly account for masking by either experimentally manipulating interaction context (e.g., instructing participants to adopt autistic- or neurotypical-oriented communication strategies) or by directly assessing the degree and nature of masking during the task. This would allow a more precise interpretation of self-appraisals of emotion expression across neurotypes.

Conclusion

The present study contributes to a more nuanced understanding of emotion expression appraisals in autistic and neurotypical individuals. Despite elevated alexithymia in autistic participants, emotion expression may be experienced more similarly across neurotypes than previously assumed. Contrary to expectations, no significant differences emerged between autistic and neurotypical participants across any of the self-appraisal dimensions. While this finding should be interpreted cautiously due to methodological limitations and the scarcity of prior research, it nevertheless challenges assumptions that autistic individuals necessarily perceive emotional expression as more difficult than neurotypical individuals. Rather than neurotype, emotional expression appeared to be shaped more strongly by the emotion being communicated and the modality through which communication occurred.

The findings further suggest that theoretical accounts of emotional communication in ASD may benefit from shifting emphasis away from broad assumptions of expressive impairment toward more context-sensitive and interactional models. In line with the double empathy problem (Milton, 2012), differences in emotional communication may not necessarily reflect reduced expressive ability, but rather variation in communicative style and interpretation across contexts. At the same time, the absence of an interaction effect between autistic traits and alexithymia suggests that while alexithymia may contribute to emotional awareness difficulties, its role in shaping self-perceived emotional expression may be more limited.

In conclusion, the present study contributes to an underexplored area of autism research by foregrounding autistic self-appraisals of emotional expression. The findings support a more differentiated understanding of emotional communication across neurotypes, highlighting the importance of emotion-specific and modality-sensitive approaches in future research while challenging assumptions of universal expressive difficulties in ASD.

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Appendix A

Abstract English

Emotion expressions are a fundamental and everyday part of human life. Humans implicitly rely on each other to convey essential social information. However, autistic individuals face challenges when interpretating expressions of neurotypical individuals and vice versa. This leads to bidirectional misunderstandings also known as the double empathy problem.

Additionally, it is estimated that 5% to 9% of the world's population possess high levels of alexithymia, a profound difficulty of understanding and interpreting one's own emotions. In the autistic population this is even more pronounced with estimates ranging around 50%. It has been proposed that high levels of alexithymia in autistic individuals influence and contribute to differences in socio-emotional domains. Although studies show that the emotional life of autistic individuals differs from neurotypicals, ASD research has mainly relied on outside evaluations and neurotypical judgements offering limited insight into autistic experiences.

This study provides insight into the differences in emotion expression appraisals of autistic and neurotypical individuals. A total of 60 participants completed three emotion expression tasks, expressing four emotions each. The tasks were each followed by self-rating questions on emotional experience.

Results indicate no effect of group membership and no moderation effect of alexithymia on self-ratings. Overall, findings suggest that differences in emotional experience arise due to different modalities of expression and emotions being expressed. However, due to the limited sample size, the study showed problems being underpowered. Thus, future research should focus on larger samples in order to reliably assess effects of alexithymia and group membership.

Abstract German

Emotionsausdrücke sind ein grundlegender und alltäglicher Bestandteil des menschlichen Lebens. Menschen verlassen sich implizit darauf, dass ihr gegenüber durch nonverbale Ausdrucksweisen wesentliche soziale Informationen vermittelt. Autistische Personen haben jedoch Schwierigkeiten die Emotionsausdrücke neurotypischer Personen zu interpretieren und vice versa. Dies führt oft zu Missverständnissen beiderseits, was als double empathy problem bezeichnet wird.

Darüber hinaus weisen einige Personen hohe Ausprägungen von Alexithymie auf, einer ausgeprägten Schwierigkeit, eigene sowie fremde Emotionen zu erkennen und zu interpretieren. Es wird angenommen, dass hohe Alexithymiewerte bei autistischen Personen ihr sozio-emotionales Verhalten beeinflussen und diese Schwierigkeiten mitverursachen. Schätzungen zufolge zeigen etwa 50% der autistischen Population hohe Alexithymiewerte. Obwohl Studien zeigen, dass sich das emotionale Erleben autistischer Personen von dem neurotypischer Personen unterscheidet, basiert die Autismusforschung bislang überwiegend auf externen Bewertungen und neurotypischen Einschätzungen, wodurch die Perspektiven autistischer Personen nur begrenzt berücksichtigt werden.

Die vorliegende Studie untersucht Unterschiede im Erleben nonverbaler Emotionsausdrücke zwischen autistischen und neurotypischen Personen. Insgesamt nahmen 60 Personen teil, welche in drei verschiedenen Aufgaben jeweils vier Emotionen ausdrückten. Nach jeder Aufgabe erfolgten Selbsteinschätzungen zu ihrem emotionalen Erleben während des Emotionsausdrucks.

Die Ergebnisse zeigen keinen Effekt der Gruppenzugehörigkeit und keinen moderierenden Effekt von Alexithymie auf die Selbsteinschätzungen. Insgesamt deuten die Ergebnisse darauf hin, dass Unterschiede in Selbsteinschätzungen eher durch die Ausdrucksmodalität und die jeweilige Emotion als durch diagnostische Gruppenzugehörigkeit oder Alexithymie erklärt werden können. Aufgrund der begrenzten Stichprobengröße ist die Aussagekraft der Studie eingeschränkt. Zukünftige Forschung sollte größere Stichproben untersuchen, um Effekte von Alexithymie und Gruppenzugehörigkeit zuverlässiger zu erfassen.

Self-rating questions

Successful communication

How strongly do you agree that the drawing will evoke the intended emotion in the viewer?

How strongly do you agree that the writing will evoke the intended emotion in the viewer?

How strongly do you agree that the facial expression will evoke the intended emotion in the viewer?

Difficulty

How hard was this task for you?

Expressiveness

How expressive do you find the drawing?

How expressive do you find the writing?

How expressive do you think your facial expression was?

Emotion felt

Did you feel the emotion while drawing?

Did you feel the emotion while writing?

Did you feel the emotion while making the expression?

Thought of others

How much did you think about the viewer while drawing?

How much did you think about the viewer while writing?

How much did you think about the viewer while making the expression?

Valence

How positive or negative is the emotion you have been instructed to draw in your opinion?

How positive or negative is the emotion you have been instructed to express in your opinion?

How positive or negative is the emotion you have been instructed to express in your opinion?

Appendix B

Supplementary material on statistical results

Boxplots

Figure 2

CATI-R score by group

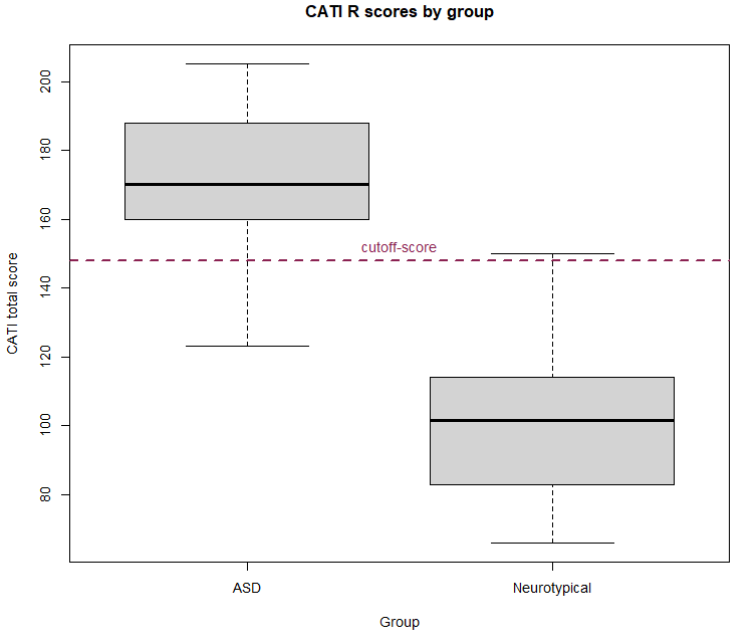
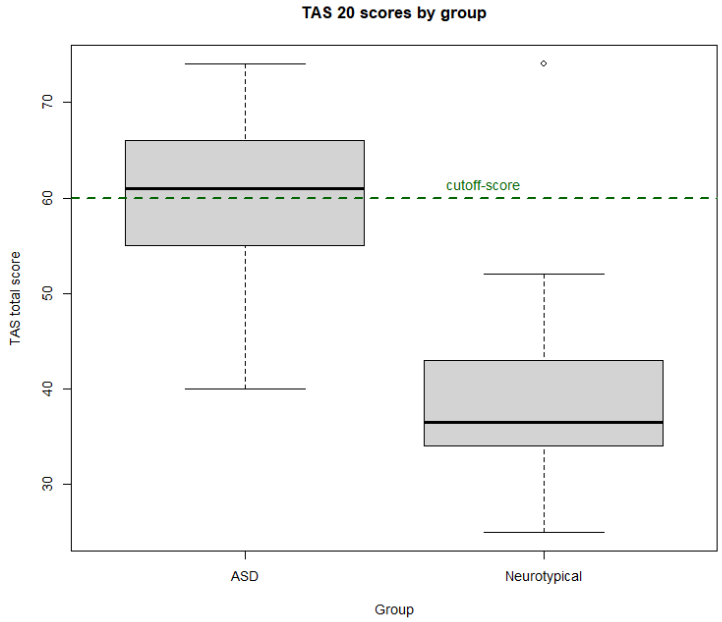


Figure 3

TAS-20 score by group



Q-Q-Plots

Figure 4

Q-Q Plot Communication

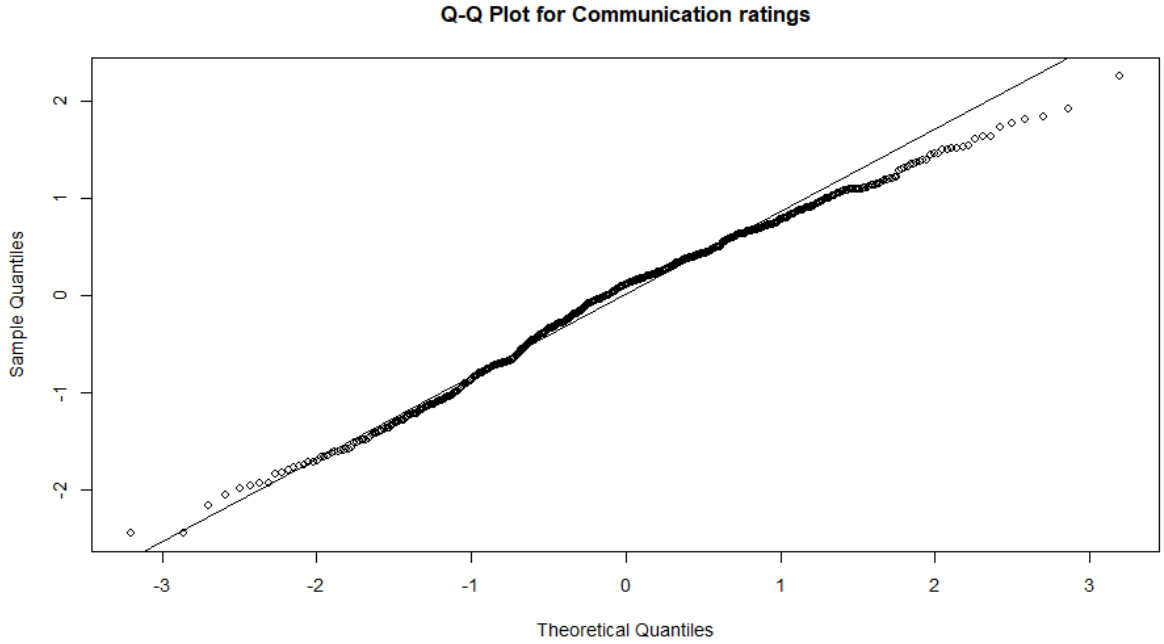


Figure 5
Q-Q Plot Difficulty

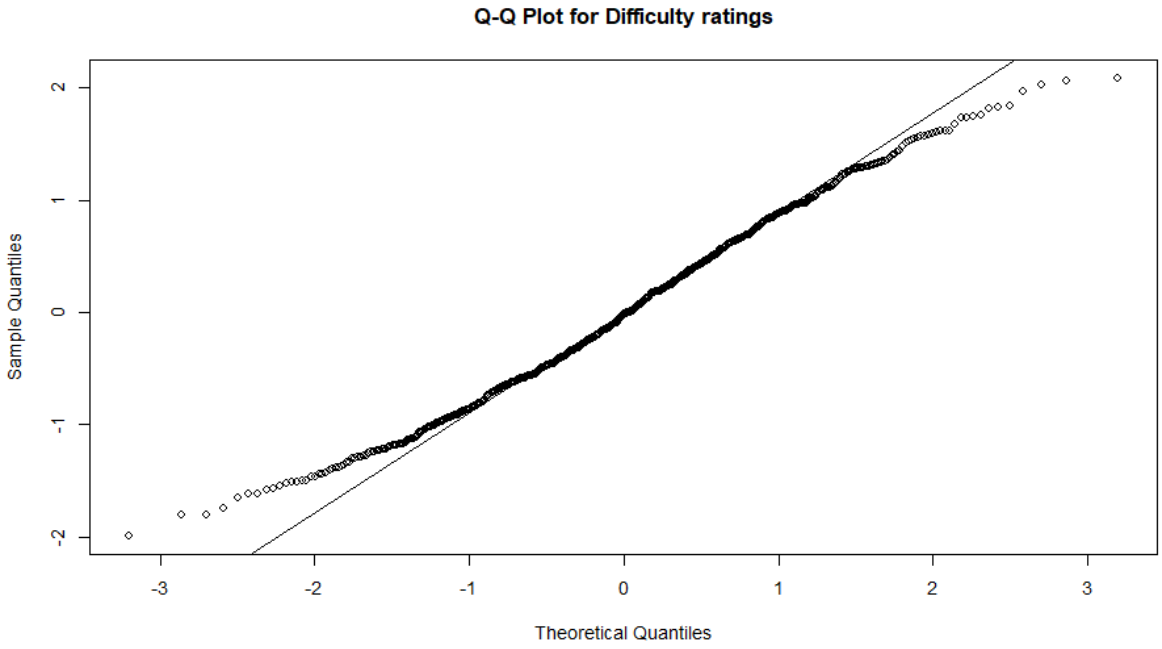


Figure 6
Q-Q Plot Emotion felt

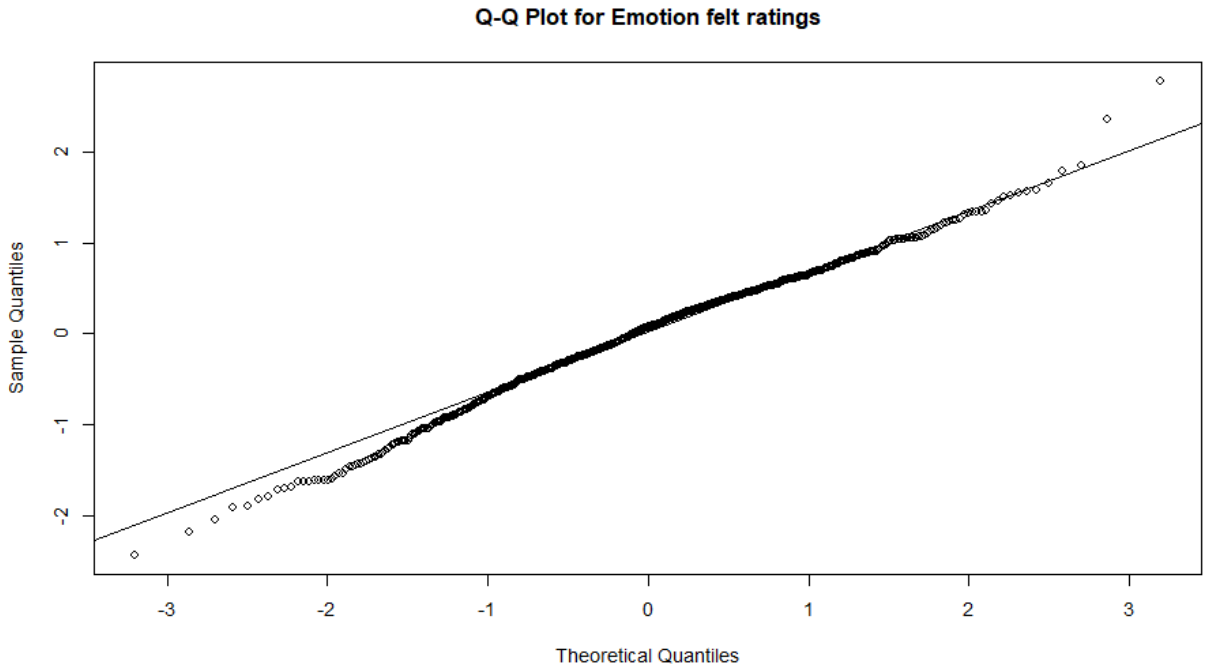


Figure 7
Q-Q Plot Expressiveness

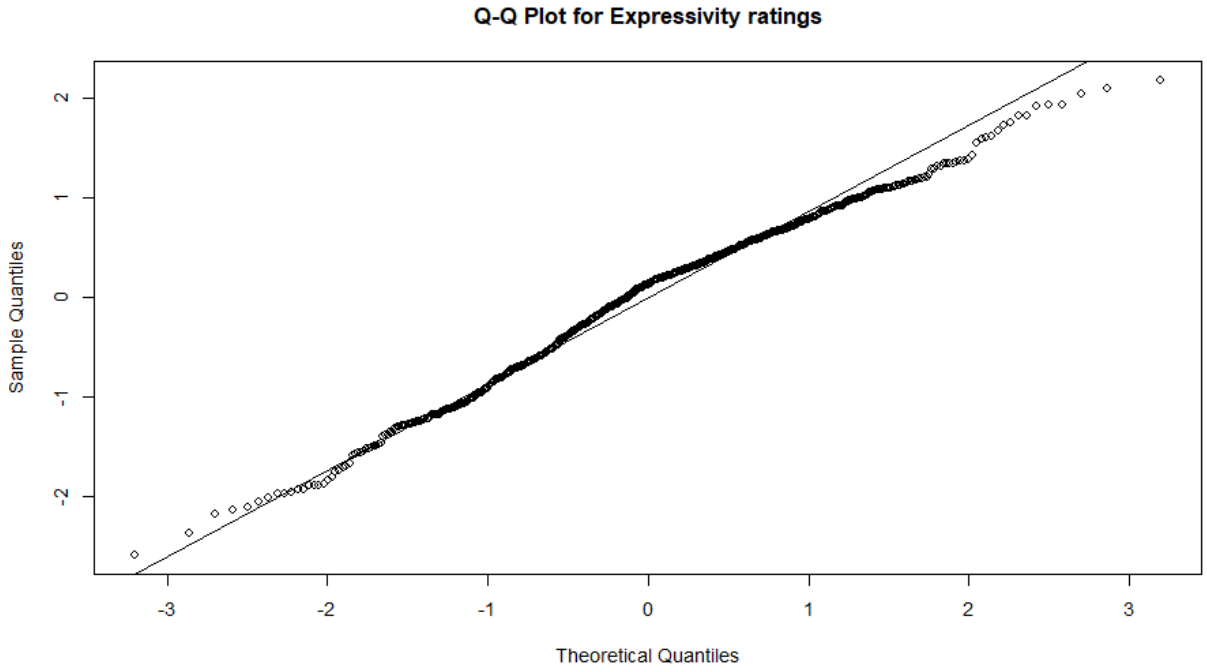


Figure 8
Q-Q Plot Thought of others

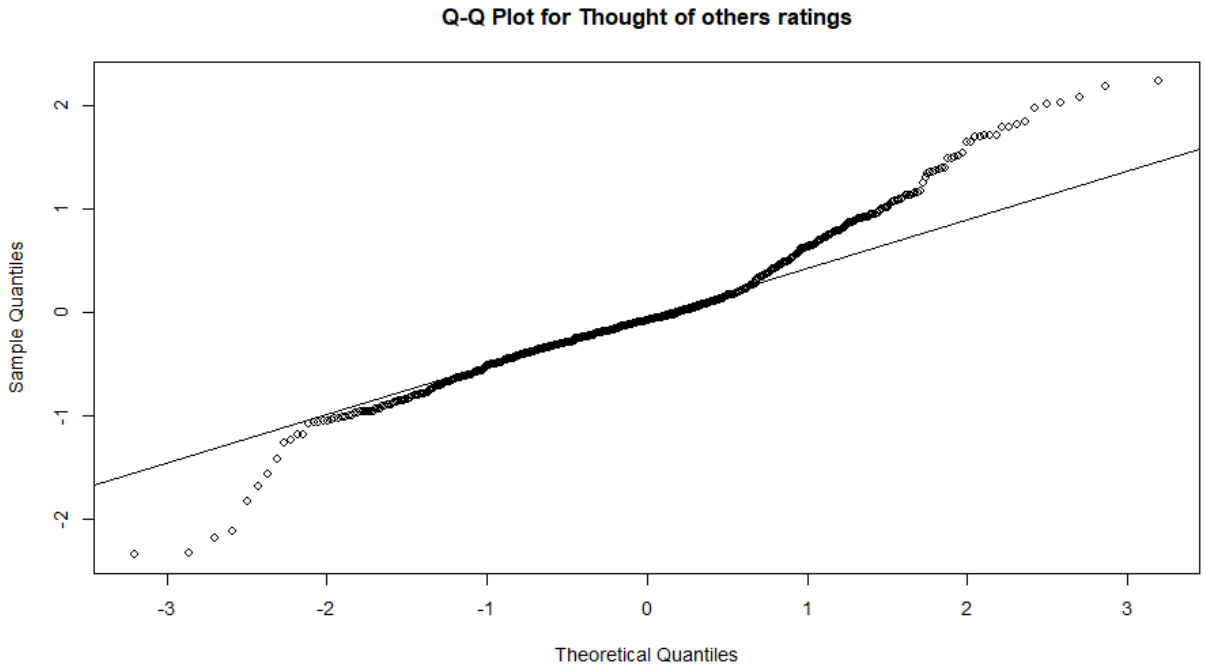
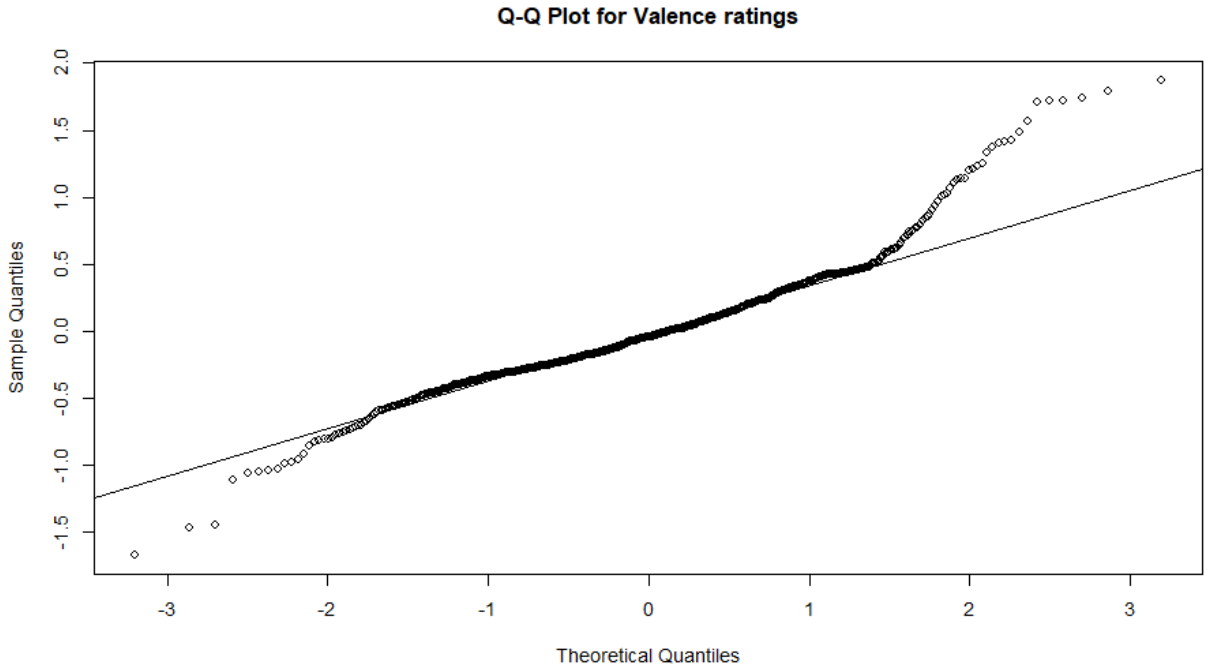


Figure 9
Q-Q Plot Valence



Variance inflation factors

Table 16

VIFs Communication

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	—
Emotion	1.00	—
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Communication ratings.

Table 17

VIFs Difficulty

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	—
Emotion	1.00	—
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Difficulty ratings.

Table 18

VIFs Emotion felt

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	—
Emotion	1.00	[1, Inf]
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Emotion felt ratings.

Table 19

VIFs Expressiveness

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	[1, NaN]
Emotion	1.00	—
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Expressiveness ratings.

Table 20

VIFs Thought of others

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	—
Emotion	1.00	—
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Thought of others ratings.

Table 21

VIFs Valence

Predictor	VIF	95% CI
Group	4.48	[3.95, 5.1]
Modality	1.00	—
Emotion	1.00	[1, NaN]
TAS (z)	2.62	[2.34, 2.95]
CATI (z)	4.26	[3.76, 4.84]
TAS × CATI	1.02	[1, 1.66]

Note. Variance inflation factors and 95% Confidence intervals for Valence ratings.

R script access

The full R script is accessible under: https://docs.google.com/document/d/1hC-Cy1gQtxXDX7x5s9SKtNPOApl-E6c11RXMRAWCybo/edit?usp=sharing