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Splitting Language
Irony and Metaphor Comprehension in Individuals with Borderline Personality Disorder

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Table of contents

Abbreviations

AMPD	Alternative Model of Personality Disorders
BPD	Borderline personality disorder
DBT	Dialectical behavior therapy
DSM	Diagnostic and Statistical Manual of Mental Disorders
HC	Healthy controls
MBT	Mentalization-based therapy
SCZ	Schizophrenia
TFT	Transference-focused therapy
ToM	Theory of mind

1. Introduction

The psychopathology of borderline personality disorder (BPD) is manifested in interactions with others (Gunderson et al., 2018; Herpertz et al., 2014; Jeung & Herpertz, 2014; Luyten et al., 2020). Intense mood fluctuations and a disturbed sense of self pose significant challenges for individuals with BPD in responding appropriately in social interactions (Gunderson et al., 2018; Herpertz et al., 2014; Lieb et al., 2004; Lis & Bohus, 2013). Individuals with BPD may struggle with intense fear of rejection (Foxhall et al., 2019) and may engage in ambivalent and sometimes irrational behaviors in their relationships, oscillating between extreme idealization and devaluation (Gunderson et al., 2018; Lieb et al., 2004). Many individuals with BPD have a history of early childhood abuse and neglect, which can disrupt the development of trust in others (Fonagy et al., 2017) – resulting in a vicious cycle, where a lack of trust promotes unstable relationships, which in turn reinforces the mistrust and perpetuates the cycle of instability.

From the outset, disturbances in interpersonal interaction have been considered a central feature of BPD (Stern, 1938). Over the years, these clinical observations have been supported by empirical data (Gunderson et al., 2018; Herpertz et al., 2014; Jeung & Herpertz, 2014; Lieb et al., 2004; Lis & Bohus, 2013; Schmahl et al., 2014), confirming problems in interacting with others as distinct characteristics of BPD (Luyten et al., 2020; Sanislow et al., 2002). Within the 30 years following Premack and Woodruff's (1978) seminal paper „Does the chimpanzee have a theory of mind?", empirical research on BPD also focused on the underlying processes of these symptoms, including social cognition (Frith & Frith, 2007), Theory of Mind (ToM, Premack & Woodruff, 1978) and mentalization (Fonagy, 2006). Except for slight variations, concepts like these in general describe the ability to understand, interpret, and predict thoughts, beliefs, intentions, and emotions of others (Frith & Frith, 2007; Frith & Frith, 2012; Higgins & Bargh, 1987; Premack & Woodruff, 1978). In BPD an altered social cognition (Bora, 2021; Herpertz et al., 2014; Jeung & Herpertz, 2014; Lis & Bohus, 2013; Németh et al., 2018; Roepke et al., 2013; Schmahl et al., 2014) and heightened sensitivity to negative social cues (Domes et al., 2009; Schmahl et al., 2014), engages in a

causal interplay with inadequate emotion regulation. This often results in intense emotions, feeling misunderstood or rejected (Herpertz et al., 2014).

However, the medium of communication of emotions or thoughts has not been investigated yet: language. This is surprising considering that, despite all the advancements in neuroscience, genetics, and computational approaches, the conversation with patients still remains the basis of our diagnoses in the 21st century. In patients with schizophrenia (SCZ), language even becomes diagnostic object. The literal interpretation of non-literal statements, i.e., statements whose intended meaning diverges from the spoken words (Glucksberg, 2001), was first described by Eugen Bleuler as “schizophrenic concretism” (1911) and has since been considered characteristic of SCZ. Today, it is considered a feature of formal thought disorder. Concretism has been investigated in numerous studies in various linguistic forms, including deficits in understanding proverbs (Bambini et al., 2020; Barth & Küfferle, 2001; Bömmer & Brüne, 2006; Brattemo, 1961, 1962; Gorham, 1956; Morsanyi & Stamenković, 2021; Mossaheb et al., 2014; Reed, 1968; Rosen et al., 2021; Thoma et al., 2009; Watson, 1973; Watson et al., 1979) metaphors (Champagne-Lavau & Stip, 2010; Mo et al., 2008; Mossaheb et al., 2014; Rapp, Felsenheimer, et al., 2018; Rapp, 2019; Rossetti et al., 2018; Winner & Gardner, 1977) or irony (Ceccarelli et al., 2019; Happé, 1993; Kalandadze et al., 2018; Langdon, Coltheart, et al., 2002; Langdon, Davies, et al., 2002; Mo et al., 2008; Monetta et al., 2009; Parola et al., 2021; Rapp et al., 2013). Early on, however, doubts were raised about the specificity of the symptoms (Andreasen, 1977). Over the years, difficulties have been observed in other psychiatric disorders as well, ranging from individuals with autism (Kalandadze et al., 2018), depression (Brattemo, 1961, 1962; Iakimova et al., 2006; Sprock et al., 1983), Alzheimer’s dementia (Maki et al., 2013; Rapp, 2019; Rapp & Wild, 2011; Shany-Ur et al., 2012) Parkinson’s disease (Monetta et al., 2009; Tremblay et al., 2014), substance abuse (Amenta et al., 2013), to systemic lupus erythematosus (Ceccarelli et al., 2019).

BPD, which was eponymously located on the borderline between neurosis and psychosis (Kernberg, 1975; Stern, 1938), today also impresses empirically with overlaps to the schizophrenia spectrum (Cavelti et al., 2021; Kwapil et al., 2021;

Kwapil et al., 2022). Not only similar cognitive distortions (Puri et al., 2018) , but also symptoms considered classically psychotic (D'Agostino et al., 2019; Thompson et al., 2019), such as hallucinations (Niemantsverdriet et al., 2017; Slotema et al., 2012) and hearing voices (Merrett et al., 2016; Pearse et al., 2014; Slotema et al., 2017) are sometimes indistinguishable between the diagnoses, although they tend to involve trauma-related content in BPD (Beatson et al., 2019). Similarly, schizotypal personality traits repeatedly overlap with borderline symptoms (Kwapil et al., 2021; Kwapil et al., 2022). One of the consequences of this blurred distinction is that, since the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V, 2013; Falkai & Wittchen, 2018), personality disorders are not completely operationalized as individual categories. Instead, they can be determined as dimensional expressions of a “general psychopathology” (criterion A) and specific behavioral patterns (criterion B) in the Alternative Model of Personality Disorders (AMPD). Framing BPD symptoms as a continuum is clearly consistent with the overlap between schizotypal and schizophrenic symptoms. It is also consistent with the clinical course of BPD. Since the introduction of disorder-specific therapies such as dialectical behavior therapy (DBT, Linehan, 1993) or psychodynamic mentalization-based therapy (MBT, Allen & Fonagy, 2006), it has become increasingly clear that the severity of BPD can be successfully reduced below the level of a diagnosed, categorical disorder (Bohus et al., 2021).

However, despite the blurred boundaries with schizophrenic symptomatology and the increasing recognition of the difficulties in dealing with non-literal language as a transdiagnostic issue, the understanding of non-literal language in BPD has so far received no empirical research attention. This may be due to the fact that BPD, as a relatively new disorder, was only included in the DSM-III in 1980. Empirical research on concretism peaked in the decades before (Felsenheimer & Rapp, 2022). Clinical recommendations, on the other hand, are replete with how and which nonliteral language to use or not to use with BPD patients. As the field naturally spans linguistics and psychiatry, an interdisciplinary approach is

needed. This dissertation therefore aims to fill this gap by systematically investigating non-literal comprehension in BPD from both psycholinguistic and psychopathological perspectives.

Psycholinguistics of nonliteral language

Theories about the processes that underlie the understanding of non-literal language come primarily from the field of pragmatics. As a sub-discipline of linguistics, pragmatics studies how people use language in social situations and how they construct meaning with each other (Mey, 2006). One of the fundamental questions in pragmatics concerns the understanding of non-literal statements such as metaphors, irony, or sarcasm. Whereas literal statements refer directly to their object, in non-literal statements the semantic reference and the speaker's reference diverge.

This ultimately leads back to the idea introduced by Paul Grice (1975). According to him even behind every literal statement there are mental representations that do not necessarily coincide with what is said (e.g., "It's cold." as an implied request to close the window). In doing so, he was the first to introduce the essential distinction between intended and literal meaning, explaining how it is possible to even convey more in so-called "literal" language than is contained in its words (Grice, 1957). The development of linguistics in the wake of Grice's work has meant that language is now considered not only in terms of its signs and references to (real) objects, but also in terms of the intentions of its speakers.

To explain how communication works, Grice proposed that our language is also based on a general principle of cooperation (Grice, 1989, p. 26): we expect that every contribution to a conversation is useful to the conversation. Such an expectation is also illustrated clinically in psychopathological reports, in which *Vorbeireden* ("talking past the point") is attributed to formal thought disorders (Scharfetter, 2002). Communication is a truly cooperative process - and this cooperation is violated when a question is answered without any reference to the content of the question. But it is also violated when words are said that are not meant. Drawing on Kant's categories of reason, Grice (1975) identifies four conversational maxims that enable a smooth, two-way transfer of information. As listeners, we trust

that our interlocutor will tell us everything that is necessary (the maxim of quantity) and nothing that is irrelevant (the maxim of relation) in an understandable way (the maxim of manner). In particular, we assume that there will be no deliberate telling of untruths (maxim of quality, Grice, 1975, S. 47). While it is precisely this last maxim that non-literal language violates, it also allows a space of meaning beyond what is literally spoken (Grice, 1975, S. 52). However, the violation of the maxim provokes a search for meaning to restore the principle of cooperation: What is said is not true, but in conversation we expect only true statements, so something else must be meant. In the end, what is said is replaced by what is meant. This substitution mechanism is intended to apply to all forms of non-literal language (Grice, 1975, p. 53).

Irony and metaphor

Grice's idea of a general substitution mechanism joins classical theories of rhetoric in which rhetorical stylistic devices such as metaphor, hyperbole and irony are treated as a common class of tropes (Quintilianus, 1995, pp. 217-249). Post-Gricean approaches criticize both the mere substitution mechanism and its generalizability (Wilson, 2013). Specifically, although metaphors, irony and proverbs are all considered 'non-literal', they differ significantly in their function and the context of use (Colston & Gibbs Jr, 2002; Wilson, 2013; Winner, 1988; Winner & Gardner, 2012). Those theories following Grice increasingly, thus, also take into account the recipient, their understanding or non-understanding of the message, and the necessary knowledge of the world, insight into the context of the situation, and familiarity with linguistic conventions. Recent linguistic work thus moves away from a purely functionalist approach. It includes meta-linguistic, aesthetic, and social aspects in its investigations.

As a linguistic device that is distinct in its literal and symbolic meaning and thus must be understood in context, classical pragmatics includes irony among other tropes. Linguistic or verbal irony refers to the expression of a thing by words that denotes its opposite (Lausberg, 1960, § 582). In verbal irony, intention and words are thus opposed: in the simplest case, what is said is the opposite of what is meant. Metaphors, on the other hand, use what is said to express what is meant.

Here, meaning is not based on opposition but on the similarity of two concepts (Lausberg, 1960, § 558). Semantic properties of the literal are transferred to properties of what is meant. Usually, concrete, physical terms are used ("You break my heart."), which we know from direct perception, in order to make something more abstract tangible (lovesick).

Grice's theory of the maxim of communication merely provides the sine qua non for understanding both tropes. While it is necessary for a statement to be recognized as non-literal, it is not sufficient for the distinction between irony and metaphor. Accordingly, Winner and Gardner (2012) point to the differences between the two rhetorical figures and suggest that their reception is also based on distinct mechanisms.

The communicative function of a metaphor is to present a particular thematic object in a new way by means of an implicit comparison (Winner, 1988; Winner & Gardner, 2012). Two parts are juxtaposed: the target (what one speaks of: Holyoak & Stamenković, 2018; Kövecses, 2010; also termed vehicle: Richards, 1936) and the source (the concept characterizing the target: Holyoak & Stamenković, 2018; Kövecses, 2010; also termed tenor: Richards, 1936). In the process, properties are transferred from one semantic field to another (Glucksberg, 1998, 2003, 2008; Glucksberg et al., 1997). For a metaphor to make sense, a connection must be made between what we want to say (target) and what we use to say it (source). This connection can be based on mapping respective properties of target and source (analogy, Gentner, 1983) or on finding common features (categorization, Glucksberg & Keysar, 1990). Such a process also makes it possible to understand concepts that may not be directly observable. The interpretation of metaphorical statements therefore requires knowledge of the terms and concepts used. "Breaking someone's heart" illustrates the drastic failure of emotional affection, and for this purpose refers to a physical injury inflicted on the person who has been failed. The function of the metaphor is to heighten the meaning through analogy and the fusion of two images - the personal attitude towards "breaking a heart" is irrelevant.

Ironists, on the other hand, almost inevitably convey an attitude towards their statement in addition to the statement itself. In doing so, they also draw a picture

of themselves (Winner & Gardner, 2012). Stating “What a beautiful day” on a rainy morning is an implicit expression of a negative attitude towards the weather. By expressing the opposite of what one really means, a distance is created between what is said and the intended meaning, which can mitigate the actual criticism (Dews & Winner, 1995). Therefore, irony is not only a means of humor, but can also be used to save face in personal relationships (Dews et al., 1995). As irony is primarily a statement about the speaker rather than the subject, Winner und Gardner (2012) argue that understanding it requires the ability to adopt the other person’s perspective. This includes not only knowledge of the thoughts of the speaking subject, but also knowledge of their thoughts about us. It is only by recognizing this reciprocity that we can perceive statement as ironic a that would otherwise have to be seen as a lie or a faux pas (Dews & Winner, 1997; Winner & Leekam, 1991). The ability to take perspective, i.e., social cognition, ToM or mentalizing, thus becomes the central feature of irony comprehension.

Sperber and Wilson (2002) even propose that pragmatics in general is a special case of ToM in which we infer the mental states of others from their linguistic utterances. ToM and pragmatic understanding are defined as the same mechanism: Mental states are not directly present to us; we have to infer from the sensual or concrete - the drooping corners of the mouth, the vacant gaze and the tears in the eyes - to the abstract emotion. Similarly, in indirect speech we have to abstract from the directly given words to arrive at the intended meaning (Searle, 1975; Sperber & Wilson, 1986, 2002). In their approach, Sperber and Wilson (2002) suggest that a hallmark of our communication are *ostensive cues.* These are linguistic and non-linguistic signals that indicate that speakers are making relevant utterances (Sperber et al., 2010). These include, for example, intonation, facial expressions, gestures, or the direction of the interlocutor’s gaze (Sperber et al., 2010; Sperber & Wilson, 2002). These ostensive cues help listeners to take the utterance seriously, to interpret it and to recognize the mental states associated with it. Applied to non-literal language, an ironic tone of voice or a mischievous smile can be a sign that something other than what is said is the meaning. Following Sperber and Wilson (2002) premise that abstraction from the requires the same ability as abstraction of mental states, it is often postulated

that metaphor comprehension also requires at least a basic understanding of ToM, with some studies showing empirical evidence (Happé, 1995; Happé, 1993). However, this finding is not always replicated (Norbury, 2005). Further, children typically begin to understand irony around the age of six (Pexman & Glenwright, 2007) and the continue to improve it until about the age of 12 (Lee et al., 2021; Pexman et al., 2019), but metaphors already between the ages of three and four (Cacciari & Padovani, 2012). In line with this, some studies even demonstrated metaphors to be a driving force for ToM (Bowes & Katz, 2015; Del Sette et al., 2020). This is in line with the fact that, the requirements for perspective taking seem to much higher in the case of irony (Happé, 1993; Langdon, Coltheart, et al., 2002; Langdon, Davies, et al., 2002), since not only the literal statement but also the perspective of the speaker has to be abstracted.

Mentalization in BPD

As described above, it is not only patients with SCZ but also those with BPD who tend to interpret social cognition differently than healthy individuals (Barnow et al., 2009; Lis & Bohus, 2013; McLaren et al., 2022; Moritz et al., 2011). This often leads to dysfunctional expectations and interpretations of social situations (Schmahl et al., 2014). According to Peter Fonagy's psychodynamic theory of mentalization (2005) this is not just a symptom of the disorder, but the cause: a threatening, unempathetic or abusive childhood environment made it difficult for individuals with BPD to acquire the ability to understand the thoughts and feelings of others. This ability, called mentalization, is one of the many definitions of social cognition, but includes explicit and implicit processes, as well as thoughts about others and oneself. It is the empathic feedback we receive from others in childhood that helps us in childhood to understand how we feel and, later, how others feel (Fonagy, 2006).

When a caregiver mirrors the emotions of a crying child (e.g., pouting, tilting the head) and responds empathically (e.g., by comforting), the child experiences two things. Firstly, having their internal experience acknowledged by others as a mental condition (Fonagy, 2006; Fonagy & Bateman, 2008; Fonagy & Bateman,

2005). Secondly, how to deal with this mental state in a functional way. Eye contact or a change in the caregiver's voice act as ostensive cues (Sperber & Wilson, 2002), indicating to the child: "Look at me, this is how you feel" (Fonagy et al., 2017). In a world and language full of uncertainties and ambiguities, ostensive cues are seen as an indicator that we can believe the information we are given (Csibra, 2010; Csibra & Gergely, 2011). They trigger epistemic trust in what is being said (Csibra, 2010; Sperber & Wilson, 2002). Although the idea of mentalization has been described as too broad and imprecise (Choi-Kain & Gunderson, 2008), it offers an explanation of how we acquire the capacity for social cognition through communication – and how individuals with BPD may not. If children grow up in an environment where their thoughts, feelings and experiences are taken seriously and validated, they can develop stable trust and their ability to mentalize. However, if they are rejected, this experience is missing. A childhood history of trauma, abuse or neglect (de Aquino Ferreira et al., 2018; Gunderson et al., 2018; Lieb et al., 2004; Luyten et al., 2020; Porter et al., 2020) may impede a stable development of mentalization for individuals with BPD. And more: the mental state of others becomes something dangerous. Instead of epistemic trust, distrust arises (Fonagy et al., 2015; Fonagy et al., 2017; Luyten et al., 2020; Orme et al., 2019). This may lead to low confidence in the reliability of information conveyed by others, including their own thoughts and feelings. In fact, patients with BPD perceive social cues as less trustworthy than healthy controls (Fertuck et al., 2013; Miano et al., 2013; Nicol et al., 2013), with a clear correlation to childhood trauma (Nicol et al., 2013).

In Fonagy's view, this is the root cause of the problems with social cognition in patients with BPD that have been repeatedly demonstrated over the past decade (Bora, 2021; Hanegraaf et al., 2021; Herpertz et al., 2014; Jeung & Herpertz, 2014; Németh et al., 2018; Roepke et al., 2013). As an extension of this idea, Luyten et al. (2020) described BPD as a primary disorder of social communication. But even in an empathetic and caring environment, it can be difficult in everyday life to decide which statements to trust and which not. Especially if they are not meant literally. This is because non-literal statements are diametrically op-

posed to conventional conversation: in order to understand the transposed meaning, the literal meaning must not be trusted. However, while non-literal language has been extensively investigated in other disorders, studies on BPD have been limited to social inference without linking this to pragmatic skills.

Clinical recommendations

Despite the lack of empirical data, therapies for BPD make some recommendations about the use of non-literal language, albeit all in different ways. Specific recommendations on the use of irony are rare. In DBT, the communicative strategy of “irreverence” describes the therapist’s use of humor or playful language to highlight inconsistencies or contradictions in the client’s thoughts, behaviors or beliefs. In theory, this function could be achieved using ironic remarks. In fact, examples of irreverent communication often have ironic qualities. For example, Linehan suggests that for clients who have a tendency to avoid anxiety-provoking topics by bringing up other problems, an example of irreverent communication might be “Oh, no! Another soap opera” (Linehan, 1993, p. 396). The aim of irreverent communication is to raise awareness by its surprising nature. It encourages people to look at their situation from a different perspective. However, Linehan (1993) stresses, too, that patients should always be approached with a matter-of-factness combined with a warm, affirming attitude – and this explicitly excludes sarcastic remarks (Heard & Linehan, 1994). Unlike sarcasm, metaphors one of the most common dialectical strategies in DBT. They are explicitly recommended (Linehan, 2015b, p. 84) and manualized in a plethora of expressions within skills training (Linehan, 2015a). DBT therefore features a wealth of metaphors and imagery in the therapeutic process, which can be used to illustrate complex symptoms and behaviors (“emotion regulation”) with the help of concrete images (“emotion surfing”) (Esmail, 2020).

Psychodynamic MBT, on the other hand, considers that metaphors and irony are expressions of competent mentalizing - and has emphasized that metaphors should be clearly avoided in therapeutic conversations (Bateman & Fonagy, 2016; Bateman & Fonagy, 2003; Fonagy & Bateman, 2005; Fonagy et al., 2010).

According to Bateman and Fonagy, patients with BPD have “a poorly developed ability to use secondary representation and limited symbolic binding of internally experienced affects, so that the use of metaphor is relatively meaningless” (Bateman & Fonagy, 2003, p. 204). Instead of contributing to their own understanding of the disease, they are likely to be confusing to patients (Bateman & Fonagy, 2016, p. 208; Fonagy & Bateman, 2005, pp. 199 - 201; Fonagy et al., 2010, p. 58). Therefore, they should only be used at a stage in therapy when patients have established stable inner representations, if at all. Transference-focused therapy, in contrast, sees no obvious problems with the use of metaphors (Clarkin et al., 1999, p. 64; Normandin et al., 2015). In particular, it sees patient-created and personal metaphors as a particularly emotionally rich way of describing and understanding inner experience (Clarkin et al., 1999, p. 64)

In summary, therapeutic recommendations have so far been inconsistent and their empirical verification non-existent. This leaves the question open: can non-literal language be used in the therapeutic setting for BPD, and if so, what influences its understanding?

Aims of the thesis

The following thesis aims to move the knowledge about non-literal language in people with BPD from clinical theory to empirical evidence. Although post-Gricean psycholinguistics clearly argues for their detailed differentiation (Winner & Gardner, 2012), clinical recommendations and studies tend to underestimate the importance of the differences between types non-literal language (Bambini et al., 2020; Cacciari & Papagno, 2012). Bringing together psychopathology and psycholinguistics, the current work will be the first empirical investigation of pragmatic language comprehension in individuals with BPD. Three empirical studies systematically examine the interplay between the psychopathology of BPD and the psycholinguistics of each linguistic device, controlling for potential sources of (mis)understanding. Using irony and metaphor, the thesis focuses on two central and yet fundamentally divergent tropes.

All three studies examine borderline symptoms on a dimensional scale, and the role of mentalization in the form of affective and cognitive empathy questionnaires. For both irony and metaphor, mentalization is expected to be positively related to the recognition and understanding of non-literal language.

The **first study** investigates metaphor comprehension in patients with BPD in comparison to healthy controls (HC). Psycholinguistic research highlights the need to distinguish between conventional and novel metaphors (Bowdle & Gentner, 2005). Whereas novel metaphors require meanings to be constructed on-line, conventional metaphors are so frequent, that we almost understand them literally. Therefore, novel metaphors are harder to interpret than conventional metaphors. Using a paradigm previously applied in SCZ patients (Rapp, Felsenheimer, et al., 2018) the study adopts this distinction. Additionally, it controls for participants' individual knowledge with the expressions to distinguish between a deficit in pragmatic understanding and a lack of familiarity. Based on Fonagy's mentalization model, it is hypothesized that individuals with BPD will have difficulty understanding metaphors compared to controls. Due to conflicting evidence regarding other disorders (Mashal & Kasirer, 2011; Rapp, Purr, et al., 2018; Varga et al., 2014; Zeev-Wolf et al., 2014), the hypothesis regarding the influence of familiarity and novelty on metaphor comprehension remains exploratory.

Irony comprehension is investigated in two studies. Irony has never been considered as an independent pragmatic phenomenon in BPD, although it is used in many tests as an indicator of social cognition (Dziobek et al., 2006; McDonald et al., 2003). These tasks merely use sarcastic remarks, equating irony with critique (Groeben & Scheele, 1984, p. 56). Although related, irony and sarcasm are not linguistically identical (Kałowski et al., 2023). In addition, according to Linehan's(1993) biosocial model, the emotional vulnerability of BPD patients leads to a tendency to pick up on emotional cues (e.g., negative cues), to react quickly, and to have a low threshold for emotional reactions ("hypersensitivity"). Empirically, they have a tendency to make negative interpretations (Barnow et al., 2009; Bertsch et al., 2022; Hepp et al., 2021; Kleindienst et al., 2019; Winter et al., 2015), can quickly feel set back (Foxhall et al., 2019; Lis & Bohus, 2013)

and show negative biases (Bertsch et al., 2022; Domes et al., 2009; Kleindienst et al., 2019), making the valence of the stimulus a crucial confounding factor in sarcasm. The **second study** will therefore first develop and validate an irony paradigm. It embeds stimuli in an ecologically valid way in the form of a text messenger interface and allows for the systematic investigation of irony in both a critical and praising form. As such, the studies will be the first to examine ironic compliments in BPD patients, following the linguistic idea of considering both emotional valence and intention of irony (Bruntsch & Ruch, 2017; Pfeifer & Pexman, 2023). Since irony comprehension has been shown in multiple disorders, relations between irony recognition and borderline, autistic schizotypal traits will be investigated in a healthy sample to preliminary evaluate the newly developed irony test. Following other studies on autism (Kalandadze et al., 2018) and schizoypy (Langdon & Coltheart, 2004; Rapp et al., 2010), and the alleged impaired mentalization in BPD, it is hypothesized that irony recognition will be negatively related to borderline symptoms, autistic and schizotypal traits in healthy adults.

The **third study** will then compare a clinical sample with BPD to HC in the detection of critical and praising irony within the new test. Due to the high overlap between schizotypy and BPD (Kwapil et al., 2021; Kwapil et al., 2022), and the continuous approach to personality disorders, the influence of schizotypal traits and borderline symptoms will also be investigated dimensionally. Applying signal detection theory, the sensitivity for detecting irony will be distinguished from general interpretation biases. The assumption on schizotypal traits on irony comprehension in BPD remains exploratory. Patients with BPD are hypothesized to detect irony less often than controls but tend to have more negative interpretive biases.

2. Results

Familiarity, empathy and comprehension of metaphors in patients with borderline personality disorder

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Familiarity, empathy and comprehension of metaphors in patients with borderline personality disorder

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ABSTRACT

Research on figurative language has a long tradition in psychiatry, as it is employed in psychotherapy and its (mis)comprehension plays a substantial role in differential diagnostics of schizophrenic spectrum disorders. Although often associated with empathy and mentalization, it has never been addressed in borderline personality disorder (BPD). Therefore, this study investigated metaphor comprehension and its relationship to cognitive and affective empathy in 20 patients with BPD and 20 matched healthy controls who completed a metaphor task comprising conventional metaphors (CM), novel metaphors (NM), meaningless stimuli (MS), and a rating scale of familiarity, a factor known to influence performance. For cognitive and affective empathy, the interpersonal reactivity index was applied. At first patients with BPD seemed to have significantly more problems in comprehending CM, but not NM or MS, and were less familiar with CM. When familiarity with the stimulus was controlled, this difference disappeared. As for empathy, only fantasy was positively related to familiar CM beyond borderline symptoms. Results indicate that the comprehension of novel metaphorical meaning is preserved in patients with BPD.

1. Introduction

Language constitutes the core of psychopathological diagnostics (Crow, 2010; DeLisi, 2001; Kasanin, 1949). While in everyday communication it is usually shaped by maxims to convey a message as clearly as possible (Grice, 1975), there is a specific phenomenon where ambiguity is constitutive: figurative language. The miscomprehension of figurative language in particular has been used in differential diagnosis since the very beginning of psychiatry (Bleuler, 1911; Kanner, 1946; Kircher et al., 2007; Mitchell and Crow, 2005; Wegrocki, 1940; Wernicke, 1890). In line with this, a deficit in understanding nonliteral, figurative language has traditionally been ascribed to schizophrenia and autism (Blaufarb, 1962; Bleuler, 1911; Gorham, 1956; Kanner, 1946). A prime example of figurative language is metaphor. As a figure of speech, metaphors originate in the transfer of the semantic field of one object to another (Glucksberg, 2003). While evidence for impairments in metaphor comprehension is good for both autism spectrum disorders (Kalandadze et al., 2018; Melogno et al., 2019) and schizophrenia (Rossetti et al., 2018; Schmierer and Rapp, 2009), a suggested specificity requires knowledge about impairments in other psychiatric conditions as well (Andreasen, 1977). This holds further interest, as diagnoses like borderline personality disorder (BPD) also experience psychotic symptoms (D'Agostino et al., 2019; Thompson et al., 2019) and report similar cognitive biases as psychotic patients (Puri et al., 2018). Unfortunately, research beyond autism and schizophrenia is limited, in turn limiting knowledge about miscomprehension as a transdiagnostic feature that can be applied to BPD as well. To date, BPD has been characterized by an unstable sense of self, emotional instability, and interpersonal hypersensitivity, as well as patterns of unstable relationships (Gunderson et al., 2018). Although the diagnostic and therapeutic process of BPD depends heavily on language (Killick et al., 2016; Linehan, 1993; Stott et al., 2015), there remains a lack of studies on figurative language in BPD. Preliminary results suggest, however, that nonliteral language may constitute an obstacle for adults with subclinical borderline symptoms. Kieckhaefer et al. (2019) applied a video-based irony paradigm in healthy adults and investigated the relationship between irony detection and subclinical autistic, schizotypal, and borderline traits. In their study, borderline symptoms were significantly negatively associated with irony detection.

A glance at the clinical context reveals a wide spectrum of different opinions and attitudes toward the comprehension of and work with

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metaphor in BPD. On the one hand, metaphor is considered a therapeutic tool often encouraged in dialectical behavioral therapy (DBT; Linehan, 1993, pp. 209–212), where it is used as a strategy to help patients to understand concepts of their psychopathology. Metaphors empower individuals to apply their knowledge of a concrete and familiar issue to enhance their understanding of a less-known subject (Gibbs, 1994; Lakoff and Johnson, 2013). They help to mitigate the extremes of a statement by expressing it indirectly (Giora, 2002) and lessen reactance and feelings of control toward the therapist (Linehan, 1993, p. 209). On the other hand, in mentalization-based treatment (MBT; Allen and Fonagy, 2006), it has been argued that metaphors should be applied cautiously, especially in the beginning of therapy. This assumption is based on the idea that perspective taking might be more challenging for patients with BPD (Fonagy and Bateman, 2005). Figurative expressions require the listener to go beyond the literal as well: it is the hidden meaning that needs to be decoded (Searle, 1975). That is why the (mis)comprehension of pragmatic language has often been associated with constructs like theory of mind (ToM; Premack and Woodruff, 1978) and mentalization (Frith and Frith, 2003) as an ability to infer a speaker's intention that is not directly expressed in words (Champagne-Lavau and Charest, 2015; Champagne-Lavau and Stip, 2010; Happe, 1995; Mo et al., 2008; Sperber and Wilson, 2002, 1986), even though it is still unclear if deficits in ToM explain pragmatic competence alone (Bosco et al., 2018) or only pertain to specific types, such as irony (Happe, 1995; Langdon et al., 2002). In MBT the use of figurative language is claimed to be restricted to a context in which the patient has already built up stable inner representations (Bateman and Fonagy, 2016, p. 208; Fonagy and Bateman, 2005, pp. 199–201). Without mentalizing skills, figurative language might confuse rather than clarify. Conversely, once stable self-representations have been established in the first step, metaphors can serve to further improve mentalization skills when applied within the patient's area of competence in the next step (Allen and Fonagy, 2006). However, although research on social cognition in BPD and impairments in mentalizing tasks has grown within the last decades (Németh et al., 2018; Roepke et al., 2012), research on figurative language has not.

The original definition of metaphor has received more fine-grained specifications (Holyoak and Stamenkovíc, 2018; Slack, 1980). For example, in their career of metaphor hypothesis, Bowdle and Gentner (2005) differentiate conventional and novel metaphors. Due to repeated exposure, conventional metaphors are understood almost literally, while novel metaphors still require a matching of implied and stated semantic fields (Slack, 1980). Novel metaphors are considered more complex in comprehension (Bowdle and Gentner, 2005; Gibbs, 1994; Giora, 2002), are processed more slowly (Damerall and Kellogg, 2016; Glucksberg, 2003), are supposed to require distinct cognitive processes (Bowdle and Gentner, 2005) and are associated with different hemispheric foci in the brain (Jung-Beeman, 2005; Rapp et al., 2012). The distinction is reflected in psychopathologies as well. Children with autism exhibit problems specifically with conventional metaphors (Mashal and Kasirer, 2011). For schizophrenia, studies are inconsistent. While Zeev-Wolf et al. (2014) demonstrated that patients outperformed healthy controls in judging novel metaphors, Rapp et al. (2018) reported that they underperformed. But even though the specific impact of conventionality in psychiatric disorders is unclear, these results highlight the need to distinguish both types in empirical studies.

So far, neither metaphor comprehension nor its relation to mentalizing has been empirically investigated in patients with BPD. For this reason, the aim of the study was to compare metaphor comprehension in patients with BPD and healthy controls. Based on preliminary evidence in nonliteral language (Kieckhaefer et al., 2019) and language-based social cognition paradigms in BPD (Baez et al., 2015), we hypothesized that patients with BPD would experience problems in metaphor comprehension compared to healthy adults. We applied a metaphor task that includes conventional and novel metaphors, as well as meaningless stimuli (Rapp et al., 2018). In addition, the task offers the option to differentially investigate unfamiliar stimuli, as conventional metaphors of a specific language need not be familiar to every individual (Rapp, 2019; Rapp and Wild, 2011). In doing so, we tried to distinguish a deficit in pragmatic competence from a lack of familiarity. Due to conflicting evidence regarding other disorders (Mashal and Kasirer, 2011; Rapp et al., 2018; Zeev-Wolf et al., 2014), our hypothesis on the influence of familiarity and novelty remained exploratory. However, we expected metaphor comprehension to be associated with mentalizing abilities as assessed via self-ratings of cognitive and affective empathy scales.

2. Methods

2.1. Participants

Twenty patients with BPD were recruited at the Department of Psychiatry and Psychotherapy, University of Tuebingen, Germany. Patients met DSM-IV criteria for BPD according to the Structured Clinical Interview for DSM-IV II (SCID II; Fydrich et al., 1997). Possible comorbidities were assessed via SCID I (Wittchen et al., 1997). General exclusion criteria were acute or anamnestic substance abuse or dependence, bipolar disorder, psychotic disorders, severe episodes of major depression and neurological diseases. Inclusion criteria were a normal or corrected to normal vision, age between 18 and 55 years, native German speakers and diagnosed BPD in patients. All patients were under inpatient treatment with DBT. A group of twenty healthy controls (HC) was matched for age, verbal intelligence according to the multiple-choice vocabulary test (MWT; Lehrl et al., 1995), gender, educational level and handedness according to the Edinburgh inventory (Oldfield, 1971). The study protocol was approved by the ethics committee of the Medical Faculty of the University of Tuebingen and carried out according to the Declaration of Helsinki. All participants provided written informed consent and received a monetary compensation.

2.2. Measures

We used a German metaphor comprehension test previously applied on patients with schizophrenia (Rapp et al., 2018). In brief, the test contains novel metaphors (NM, e.g. “a tender sting”), conventional metaphors (CM, e.g. “break a heart”) and meaningless statements (MS, e.g. “sport of citrons”). First, participants indicate whether they are familiar or unfamiliar with the stated phrasing. In the next step, one given interpretation must be matched to the stimulus, containing either a correct metaphoric meaning, a literal meaning, an unrelated meaning as a distractor or the statement “this phrase does not make sense”, which represents the correct choice for MS. Each stimulus type comprises 13 items and every correct identified interpretation counts as one point. A full version of the test is provided within the supplementary material.

Additionally, participants completed the short version of the Borderline Symptom List (BSL-23; Bohus et al., 2009) and the Interpersonal Reactivity Index (IRI; Davis, 1983) as German short version (Paulus, 2009). The IRI is a self-report instrument with two cognitive (perspective taking, fantasy) and two affective subscales (empathic concern, personal distress). Being part of a more extensive research project, both groups further completed measures not all of which reported here. Table 1 depicts demographics and self-report measures.

2.3. Statistical analysis

Since some variables failed to meet criteria for normality of distribution on a Shapiro-Wilk test ($p < .05$), we performed nonparametric tests in these cases. First, we compared the performance on each stimulus type between HC and BPD applying a Mann-Whitney-U test,

Table 1
Mean values, standard deviations, frequencies and *p*-values for healthy controls (HC) and patients with BPD in demographics and self-rating questionnaires.

	BPD (n = 20) *Value*	HC (n = 20) *Value*	*p*
age	28.25 (9.16)	28.45 (7.83)	.60[b]
male/female	5/15	12/8	.31[c]
handedness (right/left)	17/3	19/1	.29[c]
educational level (median/IQR)	4 (1)	5 (1)	.15[b]
verbal intelligence	29.40 (4.58)	31.00 (3.40)	.24[b]
BSL-23[a]	2.27 (1.08)	0.33 (0.50)	< .001[b]
IRI			
personal distress	16.00 (3.13)	10.90 (2.77)	< .001[d]
empathetic concern	15.90 (2.97)	14.60 (2.12)	.13[d]
perspective taking	13.95 (3.05)	15.60 (2.78)	.08[d]
fantasy	14.40 (3.65)	12.25 (3.32)	.06[d]

[a] BSL-23 = borderline symptom list 23, IRI = interpersonal reactivity index
[b] Mann-Whitney-U test
[c] Pearson's chi-squared test
[d] t-test

with the number of correct identified stimuli as dependent variable. In the next step, we tested if both groups differed on their familiarity with the stimulus types. Finally, we compared performance on only those items that had previously been rated as familiar. Considering the small sample size the exact method for calculating p-values was chosen. As for the within-group analyses of performance and familiarity, Wilcoxon signed-rank tests, Friedman test and Dunn-Bonferroni post hoc tests were carried out. Due to the exploratory character of the study alpha was set at .05 (two tailed) and Holm-Bonferroni corrections for multiple comparisons were applied. Data were analyzed using SPSS 24 (IBM Corp., Armonk, NY, USA).

3. Results

Groups did not differ significantly in age (Z = -.53, p = .60), gender (Z = 1.03, p = .31), verbal intelligence (Z = -1.19, p = .24), educational level (Z = -1.68, p = .15) and handedness (Z = 1.11, p = .29). BPD patients experienced significantly more borderline symptoms (Z = -4.59, p < .001) and personal distress (t (38) = -5.46, p < .001).

First, we tested group differences between patients and HC in the accuracy of detecting different stimuli types, irrespective of the individual familiarity with the stimulus (see Fig. 1). According to the Mann-Whitney-U test, accuracy did not differ between groups on NM and MS (NM: Z = -.63, p = .55, corrected p = .90; MS: Z = -.79, p = .45, corrected p = .90). However, patients with BPD showed a significant lower amount of correct identified CM (Z = -2.69, p = .013, corrected p = .039).

Next, we tested if familiarity with the stimulus type differed between patients and HC (see Fig. 2). According to the Mann-Whitney-U test, patients with BPD indicated to be less familiar with most of the CM than HC (Z = -3.44, p = .001, corrected p = .003). However, both groups did not differ in their familiarity with other stimulus types (NM: Z = -.48, p = .64, corrected p = 1; MS: Z = -1.10, p = .58, corrected p = 1).

Finally, we compared only those metaphors between patients and HC, that were familiar to them (see Fig. 3). As dependent variable we chose the proportion of familiar stimuli that were correctly answered. In each condition, we divided the number of correctly identified stimuli that had been specified as familiar by the number of familiar stimuli. In MS and for three NM in the group of BPD this would have led to a division by zero. Therefore, we only considered NM and CM and excluded data of those three patients for NM. According to Mann-Whitney-U test, no differences between groups on the proportion of correct identified metaphors on any stimulus type could be found (NM: Z = -.39, p = .76, corrected p = 1; CM: Z = -1.43, p = .60, corrected p = .1).

As regards the within-group analysis in the group of patients, Friedman test showed a statistically significant difference in accuracy rates depending on the type of stimulus irrespective of their familiarity ($\chi 2$(2) = 14.69, p = .001). Dunn-Bonferroni post hoc test were carried out with significant differences between CM and NM (z = -3.64, p = .001), but not between MS and CM (z = 1.82, p = .21) or NM (z = 1.82, p = .21; CM *median* = 12, *IQR* = 2; NM *median* = 9.5, *IQR* = 6; MS *median* = 11, *IQR* = 1). These results highlight that NM were harder to interpret than CM in patients with BPD. Next, for the number of familiar stimuli, Friedman test showed statistically significant differences depending on stimulus type ($\chi 2$(2) = 38.68, p < .001), with post hoc Dunn-Bonferroni test indicating that all comparisons were statistically significant (MS vs. NM: z = 2.69, p = .02; MS vs. CM: z = 6.09, p < .001; CM vs. NM: z = -3.40, p = .002; CM *median* = 10, *IQR* = 1; NM *median* = 3, *IQR* = 2.75; MS *median* = 0, *IQR* = 0). Thus, patients were most familiar with CM, followed by NM, but showed no familiarity with MS. In the last step, we analyzed the proportion of familiar stimuli that were correctly answered. In contrast to initially lower performance on NM compared to CM, taking the familiarity into account resulted in equal performance on both stimulus types indicated by an exact Wilcoxon signed-rank (z = -1.58, p = .156; CM *median* = 1, *IQR* = 0; NM *median* = 1, *IQR* = .20). In HC, the pattern of significance was the same: accuracy rates significantly depended on the type of stimulus irrespective of their familiarity ($\chi 2$(2) = 19.61, p < .001). Dunn-Bonferroni post hoc test showed significant differences between CM and NM (z = -4.02, p < .001), but not between MS and CM (z = -1.66, p = .29) or NM (z = 2.37, p = .05; CM *median* = 12, *IQR* = 2; NM *median* = 9.5, *IQR* = 6; MS *median* = 11, *IQR* = 2; see Fig. 1). The number of familiar stimuli significantly depended on stimulus type ($\chi 2$(2) = 40.00, p < .001), with post hoc Dunn-Bonferroni test showing that all comparisons were differing statistically significant (MS vs. NM: z = 3.16, p = .005; MS vs. CM: z = 6.33, p < .001; CM vs. NM: z = -3.16, p = .005; CM *median* = 12, *IQR* = 2; NM *median* = 2, *IQR* = 2.75; MS *median* = 0, *IQR* = 0). Finally, Wilcoxon signed-rank test showed no difference in CM and NM when the proportion of familiar stimuli that had been answered correctly was analyzed (z = -2.03, p = .06; CM *median* = 1, *IQR* = 0; NM *median* = 1, *IQR* = .09).

To test for the association between borderline symptoms, empathy and metaphor comprehension, Pearson correlation coefficients were estimated for IRI scales and performance on as well as familiarity with NM, CM and MS. Due to ceiling effects and low variability within each group, only correlation coefficients across all participants are reported. High borderline symptoms were significantly associated with empathetic concern (r = .43, p = .006), personal distress (r = .66, p < .001) and fantasy (r = .40, p = .01), as well as low performance on the number of correct CM (r = -.59, p < .001), the number of familiar CM (r= -.59, p < .001) and the proportion of correct identified CM that had been rated as familiar (r = -.34, p = .03). There was no link between any scores of NM and reported BPD psychopathology (all p > .05). Next, the association between empathy, performance and familiarity was examined. Across all participants, the number of correct identified NM, CM and MS was not associated with any of the IRI scales (all p > .05). However, familiarity with CM was lower in individuals reporting high empathetic concern (r = -.47, p = .002) and personal distress (r = -.47, p = .002). Further, the proportion of correct identified CM that had been rated as familiar correlated significantly positive with fantasy (r = .34, p = .032). These results gave rise to the question whether empathy scales generated a surplus variance over borderline symptoms. Thus, correlations were reanalyzed, controlling for BSL-scores. In partial correlation analysis, the relationship between personal distress, empathetic concern and number of selected familiar CM was no longer evident, suggesting that the relationship between affective empathy and familiarity was mainly driven by borderline symptoms. In contrast, performance on CM was significantly higher in

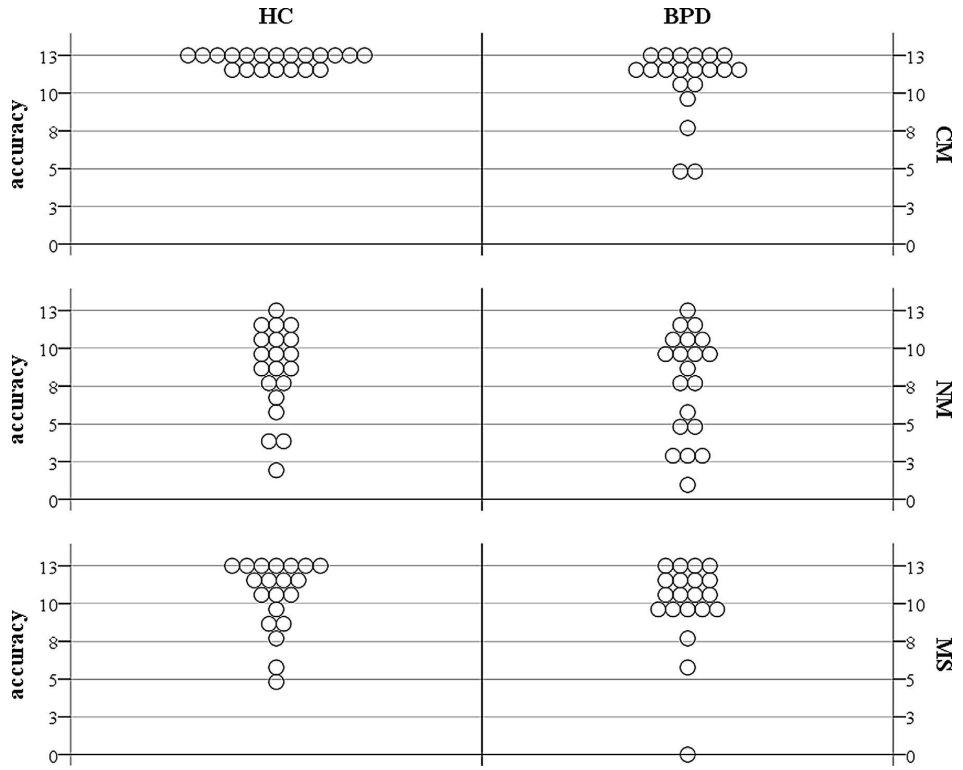

Fig. 1. Number of correct stimuli in the multiple choice metaphor test in healthy controls (HC) and patients (BPD) depending on stimulus type. A value of 13 would indicate perfect performance in any subject. Mann-Whitney-U test resulted in significant differences between HC and BPD in the accuracy of the detection of conventional metaphors. In both groups, Friedman tests showed significant lower performance in novel compared to conventional metaphors.

individuals scoring high on fantasy both in accuracy of all ($r = .54, p < .001$) and only familiar stimuli ($r = .55$, $p = .001$) when the effect of borderline symptoms was controlled for.

4. Discussion

To best of our knowledge, this was the first study to empirically investigate the comprehension of metaphors in patients with BPD. We applied a metaphor comprehension test (Rapp et al., 2018) that differentiates between NM, CM, and MS and takes the familiarity of each stimulus into account. The results indicated no impairment in the comprehension of novel metaphorical meanings in patients with BPD. Despite high performance on comprehending CM, patients with BPD initially appeared to perform worse than healthy individuals. However, this putative impairment could be explained by lower familiarity: Upon analyzing only those stimuli that had been indicated as known, this difference disappeared.

It is a well-known effect that unfamiliar and novel metaphors are harder to interpret and more complex (Bowdle and Gentner, 2005; Damerall and Kellogg, 2016; Giora, 1997). Accordingly, in both samples performance on NM was lower than on CM. However, familiarity is not equivalent to the conventionality of a metaphor (Blasko and Connine, 1993). Although a conventional stimulus should be familiar to most people, this need not be true of any particular individual – making its interpretation more difficult. This effect might explain the lower performance on CM when familiarity had not been taken into account: Being less familiar, the stimulus might have shown greater difficulty for BPD than for HC without reflecting an inability to understand CM per se. This is of importance, as equal performance on NM indicates that patients with BPD were not limited in their ability to interpret new metaphorical meanings in the first place.

Nonetheless, although both groups were matched in terms of verbal intelligence and educational level, patients reported to be less familiar with CM. In general, familiarity should reflect perceived experience with the stimulus. But when people are asked to evaluate a phrase for abstract qualities, they sometimes apply other sources than the one in question. In the case of figurative language, participants often use processing fluency to evaluate familiarity (Thibodeau et al., 2018; Thibodeau and Durgin, 2011). One can thus ask whether the low familiarity ratings in BPD might reflect a problem with validity rather than lack of knowledge. One potential confounder may be patients' level of confidence. Several studies have shown that patients with BPD are less confident in their decisions in emotional tasks (Kaletsch et al., 2014; Niedtfeld, 2017; Thome et al., 2016). Notably, stimuli with low confidence were mostly ambiguous (Kaletsch et al., 2014; Niedtfeld, 2017), which constitutes nonliteral language by definition. Thus, the categorical assessment of familiarity applied here might have inclined patients to indicate a phrasing they were uncertain of as nonfamiliar. In general, categorical classifications of familiarity seem oversimple and insufficiently representative of such a complex concept. Research specifically addressing this aspect indicates that metaphor familiarity may represent a dimensional phenomenon (Blasko and Connine, 1993; Lai et al., 2015). But while a continuous operationalization might decrease the potential confounding between familiarity and comprehension, it would not solve the problem of validity. This is of particular relevance in BPD, as Fonagy and

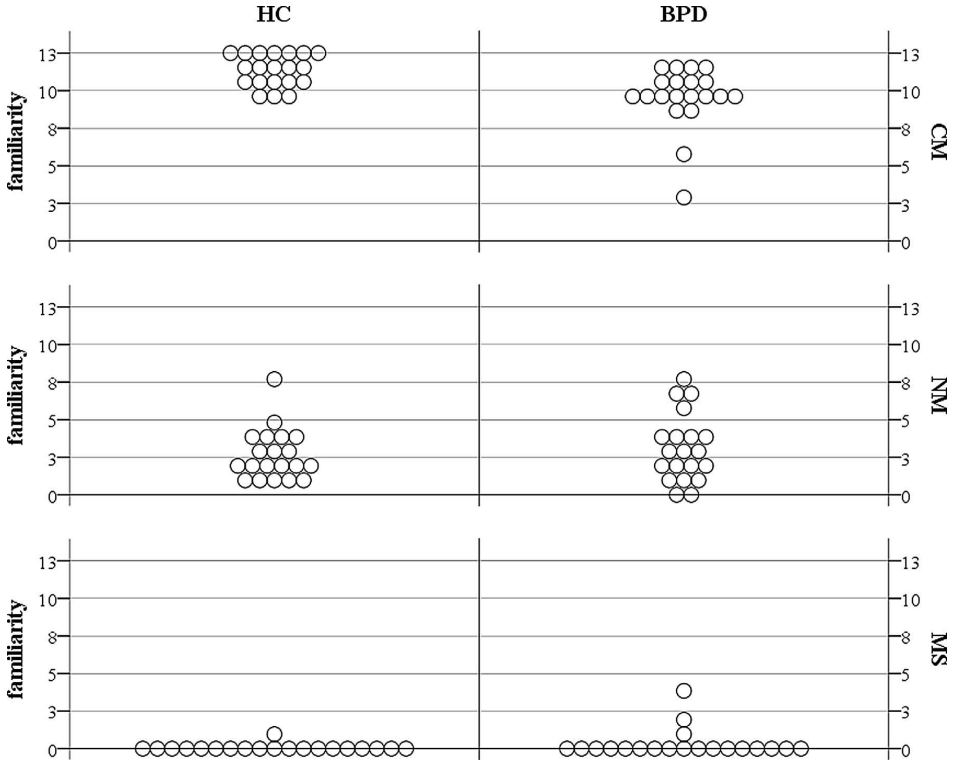

Fig. 2. Familiarity with stimulus types in healthy controls (HC) and patients (BPD). Mann-Whitney-U test resulted in significant differences between HC and BPD in the familiarity with conventional metaphors. Within-group analyses indicated that conventional metaphors were most familiar to both groups, followed by novel metaphors and meaningless stimuli.

Bateman (2016) suggest that beside low mentalizing (thinking about others' thoughts), low metacognition (thinking about own thoughts) shapes the pathology as well. Likewise, estimating familiarity constitutes a metacognitive process, as it requires thinking about own exposure to a stimulus. Future studies should include continuous confidence ratings as well as adequate quantifications such as signal-detection models (Fleming and Lau, 2014) to gain further insight into the relationship between metacognition and figurative language in BPD.

This study aimed to address the relationship between metaphor comprehension, borderline symptoms, and empathy. As for NM, performance and familiarity was associated neither with borderline symptoms nor empathy scales. This is consistent with the view that understanding new metaphorical expressions requires such processes as categorization and analogy (Holyoak and Stamenkovíc, 2018) rather than explicit mentalizing strategies (Langdon et al., 2002; Norbury, 2005). In CM, higher BPD psychopathology was related to lower performance and lesser familiarity. This association was even evident in CM that had been corrected for familiarity. However, due to almost ceiling performance, variability was substantially limited, and this result should be considered with caution. Regarding empathy, personal distress and empathetic concern, both subsumed as affective empathy, were closely linked with borderline symptoms. This has been shown multiple times (Guttman and Laporte, 2000; Jeung and Herpertz, 2014; New et al., 2012) and is in line with a rather affect-oriented way of understanding mental states in BPD (Gunderson et al., 2018), but it raised the question of whether empathy explains a substantial proportion of the performance on CM beyond borderline symptoms. Reanalysis of the results suggests the latter to be the case. While empathetic concern and personal distress were associated at first with the familiarity with CM, this relationship disappeared when the effect of borderline symptoms was controlled. However, it has been suggested that the role of affective empathy is greater in emotional metaphors (Holyoak and Stamenkovíc, 2018). Emotional metaphors differ in their cognitive demands and brain language lateralization (Mirous and Beeman, 2012) and have been repeatedly demonstrated to activate the amygdala (Bohrn et al., 2012; Citron and Goldberg, 2014; Rapp, 2019). Patients with BPD experience heightened sensitivity to emotional stimuli (Herpertz et al., 2014; Németh et al., 2018), which is accompanied with heightened fMRI activity in the amygdala (Domes et al., 2009; Donegan et al., 2003; Hazlett et al., 2012; Mier et al., 2013; Minzenberg et al., 2006; Schulze et al., 2016). Both findings imply that an affect-oriented approach to mentalization might interfere more with emotional metaphors. The current test was not explicitly developed for emotional metaphors, although some stimuli expressed emotional content (see supplementary material). Future studies should examine the role of emotions in metaphors and their relationship with affective empathy in BPD, including material controlling for valence and arousal (Citron et al., 2020, Citron et al., 2019).

Although our pilot study was in no way designed to provide authoritative data on the discriminative power of metaphor comprehension, two conclusions with clinical relevance may nonetheless be justified. First, our finding is compatible with the widespread clinical impression that metaphor and proverb comprehension is more impaired in schizophrenia and autism than in other frequent disorders (Rapp and Wild, 2011). Second, as with healthy subjects (Damerall and

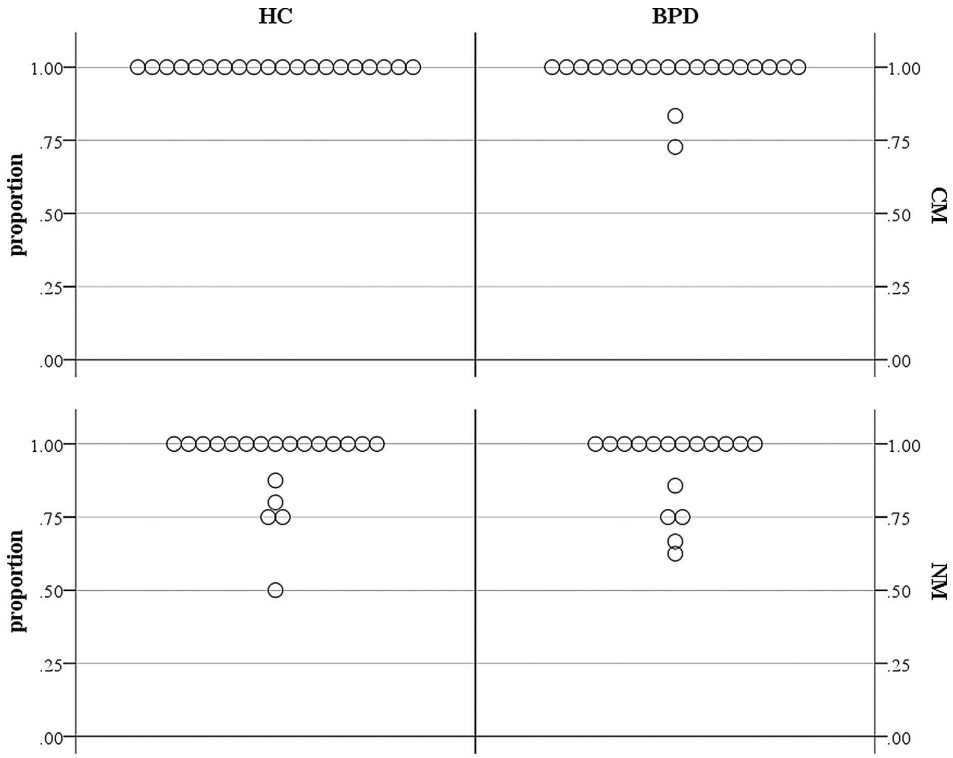

Fig. 3. Proportion of familiar metaphors that were correctly answered in healthy controls (HC) and patients (BPD) depending on metaphor type. In contrast to results on the accuracy irrespective of famililiarity, Mann-Whitney-U and Wilcoxon signed-rank test resulted no significant differences between HC and BPD, as well as NM and CM.

Kellogg, 2016), it makes a difference for the comprehension process (and its success) whether an individual is familiar with a figurative expression. To use unfamiliar and not decomposable proverbs or metaphors for clinical evaluation is often not recommended in bedside clinical practice. Our finding that familiarity is a relevant factor in performance further strengthens this clinical advice and points to the importance of familiarity with the stimuli used for testing (Blasko and Connine, 1993; Damerall and Kellogg, 2016).

We are aware of several limitations. First, as shown in a review by Jeung and Herpertz (2014), several studies highlight the relevance of complex paradigm when trying to detect slight nuances in which BPD patients differ to controls while attributing intentions. Impairments were mostly dominant in tests with ecologically valid material such as the Movie for the Assessment of Social Cognition (MASC; Sharp et al., 2011; Somma et al., 2019; Vaskinn et al., 2015). The current study, however, comprised only written metaphors without context. In future studies, for both mentalization and metaphors, more enriched paradigms than self-report questionnaires might be more appropriate for BPD. Second, in the applied paradigm, CM consisted of idiomatic expressions, which are in many respects different from metaphors. As a subset of fixed expressions, the meaning of an idiom is not derived purely via semantic composition (Glucksberg, 2008). Instead, by virtue of an arbitrary combination of signifier and signified, idioms are subject to a learning process similar to that of regular vocabulary and rely more on semantic memory (Cacciari, 2014; Glucksberg, 2008). In this context, it seems noteworthy that fantasy appeared to be the only scale linked to performance on CM but not NM once the effect of borderline symptoms and even familiarity was controlled. Closer examination of the scale clarifies its connection to conventional figurative language: Fantasy measures a specific form of cognitive empathy, the tendency to identify with characters in books and movies (Davis, 1983), whereby it is at least partly confounded with fondness for (Nomura and Akai, 2012) and exposure to (Mar et al., 2006) fiction, probably pertaining to those individuals confronted with a wide range of figurative expressions. Thus, it might be a more appropriate matching variable than the mere level of education when it comes to conventionalized, idiomatic expressions.

In this study we applied a metaphor comprehension task. However, our findings cannot be generalized to all forms of figurative language. Other types, such as irony, might differ in cognitive demands (Beck and Weber, 2016; Gibbs, 1994; Happe, 1995; Rapp, 2019) and required brain structures (Rapp et al., 2012). In line with this, our results differ from those of studies on social cognition in BPD (Roepke et al., 2012) as well as preliminary findings in irony, showing that subclinical borderline symptoms in nonclinical adults are associated with lower performance on an irony detection task (Kieckhaefer et al., 2019). Metaphors, in contrast to irony, might not cause confusion in BPD, as they might rely less on mentalizing capacities (Happe, 1995) - leading directly back to the scientific debate as to whether mentalizing abilities are even directly linked to or at the base of all pragmatic competence (Bosco et al., 2018). Future studies should include different forms of figurative language within one experimental setting. Irony in particular appears a strong candidate for investigating the role of mentalizing in clinical groups of BPD.

Apart from other forms of figurative language, we do not believe that our results necessarily generalize to all forms of metaphors.

Especially in therapy, metaphorical content is often embedded in pathology-related narratives, not just attributive metaphors used in the current paradigm (e.g., “a tender sting”). Meaning is made metaphorically in various sensory domains: through language, but also bodily in dance therapy (Koch et al., 2012) and visually in art therapy (Koch, 2017; Schwind et al., 2019). To examine metaphorical thinking, future research in BPD may apply experimental setups beyond language to directly compare different domains. Shedding a light on the question of a domain-general vs. domain-specific ability for metaphorical thinking could help identify potential markers for therapeutic outcome and individually determine the most beneficial therapeutic strategy.

As the high scores on verbal intelligence indicate, our sample has an overall high educational standard, having been recruited in a German university city. Epidemiologically, this may seem less often the case for borderline patients (Torgersen et al., 2001; Ullrich and Coid, 2009). At the same time, all patients stayed in a DBT ward, a therapy explicitly encouraging metaphors and analogies (Linehan, 1993). It can be assumed that the current sample exhibited a higher exposure to a sophisticated lexicon and was embedded in a clinical context where figurative language could already be implicitly practiced, leading to higher performance and familiarity. Being more exposed to figurative speech and perhaps even fiction, the therapeutic setting may also explain the relationship between borderline symptoms and the fantasy scale in the current sample, which has not been shown in other studies (Dziobek et al., 2011; Jeung and Herpertz, 2014; New et al., 2012), although some evidence on this issue has been presented (Guttman and Laporte, 2000). It would be reasonable if future studies include BPD patients with a broader variety of IQ levels and no previous experience in DBT, while controlling for exposure to fiction.

To summarize, this study provides an experimental assessment of a task that therapies like DBT for patients with BPD have made use of for many years: the comprehension of metaphorical meaning. Our results demonstrated a solid understanding of metaphors in patients, especially for new metaphorical content. An apparent reduced understanding of CM could be explained by lower familiarity with these phrasings. Once only known metaphors were compared, the difference between the groups disappeared. While clinical impressions and instructions provide heterogeneous hypotheses on the comprehension of metaphors in BPD, with DBT explicitly encouraging and MBT suggesting caution, our findings constitute evidence for the applicability of metaphors in patients with BPD, so long as the linguistic knowledge of the patient is taken into account. As the patients and HC performed equally well on NM, pragmatic competence itself seems to be preserved. Although the lack of familiarity might lead to confusion in the patient when applying figurative language in differential diagnostics and therapeutic interventions, this confusion should be easily resolved by guiding explanations.

CRediT authorship contribution statement

Anne Felsenheimer: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Visualization. **Carolin Kieckhaefer:** Conceptualization, Investigation, Writing - review & editing, Software. **Alexander Michael Rapp:** Conceptualization, Resources, Writing - original draft, Supervision, Project administration.

Declaration of Competing Interest

None.

Supplementary materials

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A new test for irony detection: the influence of schizotypal, borderline, and autistic personality traits

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A New Test for Irony Detection: The Influence of Schizotypal, Borderline, and Autistic Personality Traits

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Irony has repeatedly been suggested as a language based social cognition task. It has been argued to show specific variances in psychiatric disorders and healthy adults with certain personality traits. Above that, irony comprehension is based on a complex interplay of the informational context, the relationship of the conversational partners, and the personality of the recipient. The present study developed a video-based German language test for a systematic examination of irony detection accuracy (Tuerony). The test includes (i) a stereotypical conversation partner (doctor, actor) in (ii) different perspectives (direct interaction, neutral observer) and (iii) a bilateral chat history on a conventional messenger service interface with ironic criticism, ironic praise, literal criticism, and literal praise. Based on the continuous approach of psychiatric symptoms, schizotypal, borderline, and autistic personality traits were associated with irony detection accuracy in a healthy sample. Given the often reported role of mentalization in irony detection, these associations were also investigated. First, a broad variance of irony comprehension in our healthy sample could be shown. Second, schizotypal and borderline, but not autistic traits were significantly negatively associated with irony detection accuracy. Finally, in the current healthy sample, neither variation of the conversational context nor mentalization characteristics were significantly associated with performance beyond personality traits. The current results therefore highlight two aspects for future research in irony comprehension: the importance of ecological valid tests and the role of the individual personality of the recipient.

Keywords: irony comprehension, sarcasm, social cognition, figurative language, schizophrenia, praise

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INTRODUCTION

Irony comprehension has recently gained a remarkable increase in importance as a subtle pragmatic task for social functioning. Impairments of verbal irony comprehension have been known for a long time in clinical populations, such as persons with autism (1) and schizophrenia (2), and for a short time in non-clinical populations with high characteristics of certain personality traits. There has been a growing body of research highlighting the dimensional instead of categorical character of psychiatric personality traits and corresponding cognitive impairments in healthy adults (3). For example, there is reason to assume that autistic personality traits represent a continuum with manifest Asperger syndrome (4). Same suggestions have been made for personality disorders (4, 5),

showing associations between a dimensional approach and psychosocial symptoms in borderline traits (6), and schizotypy (7, 8). Assuming this continuity of personality traits, the reduced performance of irony comprehension in clinical populations raises the question on whether these deficits are related to irony comprehension accuracy in healthy adults as well. Nonetheless, in the field of irony research the dimensional approach has rarely been investigated (9). Langdon and Coltheart (10) showed that healthy adults with high schizotypal trait characteristics performed significantly worse in verbal irony comprehension. This relation between psychometric schizotypy and irony comprehension in a non-clinical population as observed in neuropsychological tests could not be shown by Jahshan and Sergi (11). On the neurobiological level, Rapp et al. (12) found a significant decrease of activation in the middle temporal gyrus during irony comprehension in subjects with high schizotypal personality characteristics.

As a possible reason for the heterogeneous results, this research draws further attention to a natural variance in irony comprehension. Apart from the symptom-related impairment of irony comprehension in clinical populations, differences in accuracy in detecting ironic remarks have also been found in healthy individuals, although to a much lesser degree (13). A possible suggestion implies a time-stable cognitive accuracy in detecting irony. Whereas, one individual may robustly show an almost perfect performance in detecting ironic intentions, another individual, despite having no manifest impairment in language comprehension, and use in general, may more often fail. Such an ability of verbal irony comprehension would interact with known factors that influence verbal irony comprehension, for example, the availability of contextual information. Assuming that an individual has a given "irony detection accuracy" would imply several things: the interindividual differences in accuracy may represent valuable information, not just noise. The individual irony detection accuracy may modulate comprehension performance by affecting established factors of the comprehension process. For instance, the difficulty of the stimulus or the quality of context information may be processed diversely according to the individual performance. Taking a closer look at the concrete process of irony comprehension, encoding the meaning of ironic utterances generally demands a set of different linguistic features and social skills for irony comprehension: world knowledge/common sense (14, 15), meta-representation (16), social context information (17, 18), cultural information (19, 20), familiarity (21), and prosody (22, 23).

In clinical contexts, irony is usually defined as an opposition between the literal and non-literal meaning of a given statement (24). Thus, the social cognition basis for irony comprehension is building representations of one's own and others' mental states, which is a prerequisite for irony use and comprehension, necessary to encode (speaker) and decode (listener) the opposite meaning. The abstract concept for the representations remains manifold and varies from the terms theory of mind [ToM; (25)], meta-representation (26), mind reading (27), and perspective-taking to mentalization (28). All of these terms comprise aspects of social cognition (29) and are generally used to describe the human ability to have thoughts about thoughts and to make inferences on the thoughts of others (14, 30).

In line with this, ToM as an underlying mechanism is a shared deficit in autism and schizophrenia (31–33) and has been shown to account for their specific impairments in irony (10, 34). However, ToM deficits do not seem to be restricted to autism and schizophrenia. Quite the contrary, there are numerous other psychiatric [unipolar depression: (35); bipolar affective disorder: (36); antisocial personality disorder: (37)] and somatic disorders [Parkinson's disease: (38); frontotemporal dementia: (39, 40)] with broadly varying types of representational deficits leading to distinct symptoms. Along with this, there is growing research on ToM differences associated with borderline personality disorder (41, 42).

Indeed, borderline personality traits may represent a candidate trait that could theoretically be related to irony detection accuracy. There is extensive rumor and anecdotes among clinicians that borderline personality patients exhibit a misinterpretation of ironic intentions. Moreover, there is some evidence of impaired irony comprehension in borderline personality disorder (43). This highlights not only the necessity to elucidate whether other personality traits may also be associated with irony detection accuracy in a similar or even more robust way (44), but also which role ToM plays beyond or within those personality traits. Investigating these associations in a healthy sample might help to elucidate possible explanations for the natural variance in irony comprehension in our everyday life. In fact, and in line with the assumption of a continuous model, healthy adolescents with borderline traits seem to differ in their ToM abilities (45), too. Moreover, autistic personality traits interrelate with other measures of social cognition in a comparable size schizotypal traits do (46, 47). Nevertheless, to the best of our knowledge, no previous work has investigated the relationship to irony comprehension in non-clinical individuals with only subthreshold autistic and borderline traits and research on schizotypal personality traits in healthy adults remain limited.

The importance of irony comprehension in everyday life and the complex cognitive requirements underline the importance of high ecological validity in tests of irony detection (48–51). This high ecological validity empowers irony comprehension tests to differentiate better than other social cognition and empathy measures between schizophrenia and other diagnoses (52). Beyond that, training in irony comprehension has been repeatedly suggested to be a target for social cognition training in these patients (48, 49).

In the English language, the Awareness of Social Inference Test [TASIT; (53)] is by far the most applied irony comprehension paradigm with high ecological validity (2). However, although the TASIT has already been translated into other languages (54, 55), it is not yet available in German. The video-based TASIT includes information on facial expression and prosody from the speaker such that adding prosody-free tests without facial expressions seems reasonable to show that an assumed deficit in a clinical population is not explained solely by these factors. Furthermore, an eligible, more profound knowledge of the distinct mechanisms in irony comprehension is of special interest because the frequencies with which ironic

remarks are misunderstood are dramatic even in healthy subjects (20, 56). It is therefore consequent to evaluate factors associated with irony comprehension performance in healthy subjects.

One of those often suggested factors is the social and cultural information about the ironic speaker (18, 57, 58). Pexman and Olineck (18) showed that healthy participants regard some occupations, such as actors and comedians, as more sarcastic than others, such as clergymen and physicians. However, the results on the influence of stereotypical occupations in clinical populations are inconsistent. A study by Champagne-Lavau and Charest (59) used the suggested occupations in a study with schizophrenia patients and matched healthy participants. In both groups, the irony detection depended significantly on the stereotype of the speaker, with greater performances observed for "sarcastic occupations" (e.g., actresses) than for "non-sarcastic occupations" (e.g., scientists and veterinarians). Castelli et al. (60) provided support for this view when they showed that general knowledge about stereotypes seemed to be preserved in patients with schizophrenia, enabling the same perception of stereotypical occupations in schizophrenic patients as that in healthy adults. Zalla et al. (61) applied an analogous study design in patients with autism spectrum disorders and in healthy controls. In contrast to previous studies, significantly improved irony detection for speakers with a sarcastic occupation was found only in healthy controls. Based on these findings, Zalla et al. (61) argued that although occupational stereotypes are perceived in patients with autistic spectrum disorders, they are not as much integrated in the pragmatic process as in healthy controls.

The second, more direct influence of context on the irony comprehension process might be the relationship the individual has to the speaker of ironic utterances. Although in everyday life, irony rather occurs when someone is directly talking to you, most paradigms investigate stimuli where two others are talking to each other. More precisely, the recipient of irony in these tests is always someone else and never the participant. However, these situations differ immensely in the degree of self-involvement of the participant. This is because irony, and conversational turns in general, toward a protagonist may be interpreted differently from irony among other protagonists, and this effect may be even much larger in clinical populations. Parallel to our investigation, the importance of self-involvement and perspective-shifting in irony processing has been recently foregrounded by several authors (62–65). Unfortunately, only a limited number of studies have investigated this topic. Those that did, usually interchanged direct involvement with the amount of perspective-taking. For example, Deliens et al. (65) used a design for sarcasm detection, which involved the participant indirectly by giving more information to the participant than to the addressee in given scenarios. Under this asymmetry of information, the participants had significant deficits in sarcasm detection compared with scenarios with shared perspectives. Deliens et al. (65) argued that these differences were based on the additional cost for the necessary shift of perspectives. However, the setup seemed to be more of an adult version of the Sally-Ann scenario (66), in which the participant was not personally addressed. Instead, self-involvement was implemented only in the amount of information given. In a functional magnetic resonance imaging (fMRI) study by Akimoto et al. (63), Japanese participants were instructed to read stories with a first-person view and then to decide on whether utterances directed to the character were ironic or literal. However, the authors focused on neural mapping of relevant brain regions for irony comprehension and did not control for self-involvement with third-person view stories; thus, such influence was not thoroughly investigated.

In the present work, to attain particular personality trait–weighted differences and to avoid overly simple requirements for irony understanding in clinical and non-clinical populations, a new test for irony comprehension under various conditions is carried out, which takes previous findings into consideration. In the first step, the Tuebingen Test of Irony Detection Accuracy (tuerony) is introduced and evaluated, which combines a set of the most relevant conditions: speakers' occupational stereotypes, a variation of self-involvement of the addressee and the content of the remark, being either critical or praising and comparing ironic with literal statements. In the second step, the tuerony is used to systematically investigate the natural variance of irony detection accuracy in a healthy population. Finally, the underlying mechanisms of the comprehension process, in relation to schizotypal, borderline and autistic traits are examined according a dimensional model in a healthy sample and related to mentalization and the relevant context conditions of the test.

MATERIALS AND METHODS

Participants

Ninety-six (59 females, 61.5%) healthy and unmedicated adults with no history of psychiatric disorders took part in the current study. All participants were native German speakers. Mental and noteworthy physical disorders served as exclusion criteria. Recruitment was done through social platforms and advertisement at the University of Tuebingen, Germany. **Table 1** shows the personality and demographic characteristics of the study sample. Within this preliminary evaluation we mainly focused on possible influences on the detection process. Thus, the sample size was chosen in order to test these influences instead of fulfilling the full criteria for test construction. Because the main analysis comprised 4 subscales and 3 possible predictors, we oriented on the commonly suggested ratio of observed variables and cases 1:10, resulting in a minimum of 70 participants.

Materials

Tuebingen Test of Irony Detection Accuracy (Tuerony)

The Tuebingen Test of Irony Detection Accuracy (tuerony) is a social cognition and social language comprehension paradigm for use in clinical and non-clinical populations. The tuerony is computerbased and intended to be performed under laboratory conditions. In this study, it was implemented via the SoSciSurvey online platform (67). The test consists of videotaped context stories and written ironic, literal, critical, and praising remarks. The stimuli are embedded in a smartphone messenger service interface currently operated by many individuals (see **Figure 1**). The intended time for tuerony ranges from 10 to 20 min. However, no time limit is given.

TABLE 1 | Means (M), standard deviations (SD) and range (Min, Max) of personality and demographic characteristics of the study sample ($N = 96$).

	M	SD	Min	Max
Age	26.43	7.52	18	55
General Intelligence	30.39	3.60	20	36
Gender	59 females/37 males			
Share of students	76			
SPQ				
Total	14.67	9.97	0	40
Cogntive perceptual	9.97	7.04	0	30
Interpersonal	6.06	5.33	0	25
Referential thinking	2.21	2.00	0	8
Social anxiety	1.83	1.90	0	6
Magical ideation	0.81	1.25	0	6
Unusual perceptual experiences	1.30	1.52	0	8
Odd or eccentric behavior	1.45	1.60	0	7
No close friends	1.24	1.65	0	8
Odd speech	2.83	2.33	0	9
Constricted affect	1.63	1.76	0	7
Suspiciousness	1.36	1.38	0	5
AQ				
Total	15.97	5.57	4	33
Social	2.14	1.99	0	8
Attention switching	4.35	1.82	1	9
Attention to detail	4.57	2.06	1	10
Communication	2.08	1.79	0	8
Imagination	2.82	2.12	0	10
BSL-23				
Total	11.02	12.02	0	67
Dysfunctional behavior	1.20	1.66	0	7
SEE				
Congruence	22.65	4.37	9	30
Overwhelming emotions	17.99	5.77	7	31
Lack of emotions	11.33	3.85	5	22
Symbolization by bodily experience	23.77	6.34	10	38
Symbolization by imagination	14.71	5.45	6	27
Emotion Regulation	12.36	2.83	6	20
Self-Control	20.61	3.81	11	28
IRI				
Total	44.20	5.46	32	58
Fantasy	13.80	3.02	7	20
Empathic concern	14.84	2.30	10	20
Perspective taking	15.55	2.65	9	20
Personal distress	11.01	2.98	5	20
STHI				
Cheerfulness	33.21	5.43	15	40
Seriousness	26.98	4.70	15	37
Bad mood	19.25	6.15	10	35
TOSCA				
Shame	31.94	7.59	14	46
Guilt	45.25	4.15	35	53
Externlization	23.91	6.09	11	37
Detached	32.90	5.79	18	47
Edinburgh Handedness Inventory	91 right/5 left			

SPQ, Schizotypal Personality Questionnaire; AQ, Autism Spectrum Quotient; BSL-23, Borderline Symptom List 23; SEE, Subjective Experience of Emotions Scale; IRI, Interpersonal Reactivity Index; STHI, State-Trait-Heiterkeits-Inventory; TOSCA, Test of Self-Conscious Affect.

Every test run begins with a written instruction, followed by a short video sequence to establish a coherent context for subsequent item presentation (**Figure 1**). There are four possible videos for the test, all sharing one narrative, in which a fictitious character moved into town and meets another protagonist in a café. These video sequences vary in two ways (context condition). First, the character is either a physician or an actor (variation of stereotype). Both characters were either performed by a woman or a man, who turned out to be both actors as well as physicians in their every-day life, facilitating an authentic depiction of each role. For all figures and videos written informed consent was obtained for testing and publication from both actors and their names were changed for the videos, instructions and depicted conversations. Second, the video depicts this character talking to a neutral other person or directly toward the participant (variation of self-involvement). In the latter, participants are instructed to picture themselves that they are meeting the new character in the café. This variation of self-involvement was established through camera angle techniques with a neutral shot for the observing condition and a point-of-view shot for direct interaction with the participant. To guarantee differing degrees of self-involvement, actors were instructed to keep eye contact only with each other in videos for neutral observation and look directly and frontal into the camera in videos for the direct interaction. An example of an original video instruction is given in **Supplementary Video 1**.

After the video, participants get to read 20 conversational turns in the format of short text messages. While they are presented as conversations *among* a character and a neutral other in the observation condition, participants directly exchange predefined messages *with* the introduced character in the interaction condition. All dialogues were structured in two parts, providing information on an everyday situation of one speaker at first (context sentence) and a direct verbal reaction on that by another (target sentence). The items themselves are to be read, so that no prosodic or face expression information is given. Above that, no further paraverbal hints, such as emoticons, are given as indicators for irony. Thus, correct answers could only be hints for correct pragmatic and intentional comprehension simply based on content of the messages. Consequently, each answer of the introduced character must be evaluated by the study participant on a dichotomous scale on literality (ironic vs. literal). Afterwards, it is evaluated on a five-point smiley-based Likert scale on perceived intention (critical vs. praising) (see **Figure 2**).

In the final version, a participant completed two test versions, with crossed conditions of context and self-variation each. Thus, summation of correct identified items led to a total score of irony detection with a maximum of 40. Subscales were constructed by summation of correct identified items within every item condition ironic praise (IP), ironic criticism (IC), literal criticism (LC), literal praise (LP) with a total maximum of 20 above, and 10 within each context condition. In the main study, all four sets of items were pseudo-randomly combined with all videos, which led to 16 combinations. With a crossover design for stereotype and self-involvement, every participant was pseudo-randomly assigned to two combinations. Thus,

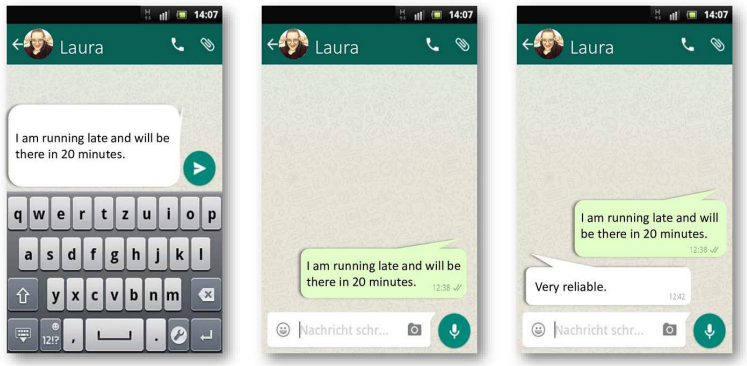

FIGURE 1 | Items were presented in a common messenger service interface.

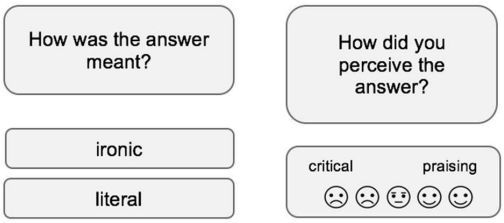

FIGURE 2 | Items were evaluated first on a dichotomous scale (ironic vs. literal) and second on a five-point smiley-based Likert scale (critical to praising).

every participant participated in two runs. The sequence was counterbalanced among the study participants.

Test Construction

The Tuebingen Test of Irony Comprehension was constructed *de novo* for the study. In a pre-study, 110 conversations containing ironic praise (IP), ironic criticism (IC), literal praise (LP), and literal criticism (LC) were presented. Stimuli consist of short statements. They were matched for syntactic structure (one sentence each, ending with a full stop), as well as length. Irony is defined as linguistic irony in this study: a figure of speech, that conveys a different meaning than what has literally been said. Due to often reported "asymmetry of affect" in irony, with ironic praise being less common (68–70) and probably more complex to interpret (70, 71), more items on ironical praise were constructed. Forty-two additional healthy subjects, which did not participate in the main study (mean age = 28.71, $SD = 7.22$, Range = 16–63), assigned all items regarding literality (ironic/literal) as well as intention (praising/critical) on a dichotomous scale and stated their certainty on the decisions on a four-point scale. Only those items that proved to be clearly ironic, literal, critical and praising and obtained highest certainty scores were then selected for further use. This selection was chosen for two reasons. First, it served as validation of our pragmatic definition for item construction. Second, since irony is characterized by a highly subjective nature, only those items were selected, that based on common ground. The final stimulus pool consisted of 80 scenarios and was randomly stratified into four test versions à 20 stimuli, containing five stimuli per condition (ironic praise, ironic criticism, literal criticism, literal praise) each. These versions did not differ in length and grammatic complexity.

With the healthy sample of the main study ($N = 96$, for a detailed description see **Table 1**), properties of the newly developed tureony were then examined (item statistics for each individual item are presented in **Supplementary Table 1**). First, Kuder-Richardson Formula 20 (72) was used for estimating internal consistency of the dichotomously rated items. Reliability of all scales was high (KR-20 IC = 0.95; IP = 0.96; LC = 0.98; LP = 0.96) and no inter-item-correlations were <0.30 or negative correlated. In the next step, theoretically postulated discriminant subscales (IC, IP, LC, LP) were tested empirically. For that reason, a confirmatory factor analysis was conducted via Mplus 6. In Mplus, Muthén and Muthén (73) propose the mean and variance adjusted weighted least squares (WLSMV) approach for categorical observed variables. As fit index, WLSMV estimates Weighted Root Mean Square Residual (WRMR) with <0.9, indicating a good model fit (74). In our analysis, the fit for two different models were tested: a general model with one factor defined by all items and a four-factor model with the subscales ironic criticism, ironic praise, literal criticism, literal praise items loading on one factor each. In a preliminary analysis, significant correlation within ironic (IP, IC), and literal (LP, LC) scales, but not within critical (IC, LC) and praising scales (IP, LP) had been shown and were therefore defined in the four-factor model as well. Both models had acceptable fit. The four-factor model ($\chi^2 = 1701.28$, df = 1704; CFI = 1.0; TLI = 1.01; RMSEA = 0.00, Probability < 0.05 = 1.00; WRMR = 0.83) had slightly better fit indices as the one-factor model ($\chi^2 = 1709.06$, df = 1710; CFI = 1.0; TLI = 1.00; RMSEA = 0.00, Probability

$< 0.05 = 0.99$; WRMR $= 0.84$). Even though WLSMV has been reported to be robust for small samples (75), the current sample was explicitly small for a confirmatory factor analysis (below $N = 200$). Thus, results should be regarded cautiously and replicated in a larger sample.

After that, validity of constructed items was elucidated more thoroughly. To examine if ironic items were correctly identified and contained irony, results of the five-point Likert scale for perceived intention were compared between test subscales. Using the average means of the critical ($M = 1.97$, $SD = 0.38$) and praising ($M = 3.29$, $SD = 0.22$) items, a significant difference was found [$t_{(95)} = -47.05$, $p < 0.001$] in paired-sample t-test, with each mean being beyond the mid-point of the likert scale ranging from 1 = "critical" to 5 = "praising." This indicated that every correct identified ironic or literal items was also perceived in the according intention. Then, scoring of perceived intention was used to replicate previously reported property of ironic utterances to be "tinged" with the literal phrase with items in tuerony, showing that ironic utterances in tuerony clearly differed from literal ones and contained irony. For that reason, again, paired-samples t-test was conducted on perceived intention of all correct identified items between LC and IC, as well as between LP and IC. Results confirmed that ironic criticism was perceived significantly less critical than literal criticism [$t_{(95)} = 2.27$, $p < 0.001$] and ironic praise was perceived significantly less praising than literal praise [$t_{(95)} = -12.94$, $p < 0.001$].

General Data

General intelligence was measured with the German Mehrfachwahl-Wortschatztest (MWT-B), a multiple-choice vocabulary test (76). The MWT-B was applied as paper and pencil test along the collection of demographic data regarding age, gender and education. For a more detailed description of the sample, also the German Versions of the Test of Self-Conscious Affect [TOSCA; (77)] and the State-Trait-Heiterkeits-Inventory [STHI-T<30>; (78)] were applied. Means and standard deviations for all scales and subscales are shown in **Table 1**.

Personality Traits

Metric characteristics of schizotypal personality traits were assessed with the German version of the Schizotypal Personality Questionnaire [SPQ; (79)] by Klein et al. (80). The scale is based on DSM-III-R criteria and contains 74 symptom-related items, with dichotomous yes/no answers. The degree of borderline personality traits were measured with the short version of Borderline Symptom List (BSL-23), based on DSM-IV criteria for Borderline Personality Disorder (81). BSL-23 contains 23 items with self-related statements and is used in clinical and non-clinical samples. Answers were to be given on a five-point Likert scale (ranging from "not at all" = 0 to "a lot" = 4). Autistic personality traits were assessed with the German version (82) of Autism Spectrum Quotient (AQ) by Baron-Cohen et al. (83). The scale is constructed as a self-rating instrument with 50 items on different performance aspects, related to autistic traits. Each item is evaluated on "definitely agree"/"slightly agree" or "slightly disagree"/"definitely disagree."

Mentalization

Measuring affective aspects of mentalization, the Interpersonal Reactivity Index [IRI; (84)] was used as a German short version (85). The IRI consists of 16 items on four subscales: perspective taking (PT), fantasy (FS), empathic concern (EC), and personal distress (PD). For German samples, a general factor for empathy is compounded by a total score of FS, EC, and PD (86). On a five-point Likert scale (ranging from "never" to "always") participants rate personal statements on perception of empathy. In order to extend the affective components of mentalization on perception of emotions, the Subjective Experience of Emotions Scale (SEE) was deployed. The German scale from Behr and Becker (87) consists of 42 items on perception and evaluation of personal emotions and requires agreement or disagreement on a five-point Likert scale ("not at all" – "true"). Factor analysis in a German sample provided seven subscales: congruence, overwhelming emotions, lack of emotions, symbolization of emotion by bodily experience, symbolization by imagination, regulation of emotions, self-control.

Procedure

Permission for the study was obtained from the ethics Committee at the University Clinic of Tübingen. After receiving complete information about the study, subjects gave their written informed consent. Subjects received a 5 Euro compensation for participation.

Statistical Analysis

Compiled data from the online survey and offline tests were transferred into and processed with IBM SPSS Statistics 24®. Significance level for all statistical calculations was set to $p < 0.05$. First, general performance on tuerony and other demographics of the sample were described. In line with this, t-tests were conducted to evaluate the difference between ironic and literal remarks.

In the next step, the role of the context factors "stereotype" and "self-involvement" in irony comprehension were investigated. A two-way multivariate analysis of variance (MANOVA) was conducted, with speaker's stereotype (physician/actor) and participant's self-involvement (neutral observer/direct interaction) as one factor each, personality scores of schizotypy (SPQ-G total score), borderline (BSL-23) and autism (AQ) as covariates, and the general performance on tuerony (total score) as dependent variable.

After that, possible influences of the participants' personality on irony comprehension were analyzed. All personality traits were considered as dimensional predictors in analyses. Due to inter-correlations (BSL-23 with SPQ $r = 0.65$, BSL-23 with AQ $r = 0.35$, SPQ and AQ $r = 0.57$, all $p < 0.001$) separate analyses were run for every personality trait. As general intelligence (MWT-B), gender and age did not correlate with performance on tuerony they were not included as additional covariates.

First, single regressions were conducted to elucidate if there was a general impact of each personality trait (schizotypal, borderline, autistic) on irony detection (total score). All models were calculated using a bootstrap procedure with a sample size $N = 1{,}000$ (88). If personality traits predicted significant general performance on tuerony in regression analyses, they were subsequently investigated regarding their impact on specific subscales. Thus, a separate multivariate analysis of covariance (MANCOVA) was conducted including respective personality scales as predicting covariate and four subscales of tuerony (IC, IP, LC, LP) as dependent variable each.

Afterwards, the influence of mentalization abilities contributing to performance on irony detection within each relevant personality trait were analyzed. Via median split, the sample was therefore divided into high and low scoring groups for each personality trait separately. Relevant subscales of mentalization were then compared between these groups with *t*-tests. Next, differences between high- and low-scoring subjects within the mentalization scales of SEE and IRI were examined to detect possible scales that might be related to decreased irony comprehension in high scoring individuals. Then, identified mentalization subscales were correlated with the total score of tuerony within the high scoring groups. To elucidate an influence of the respective mentalization scales beyond personality traits, they were finally entered with forced entry in one step in multiple linear regressions predicting the total score of tuerony each.

RESULTS

General Performance

The average total score for irony detection in the sample was 36.29 (±2.96) with no significant difference for gender [$t_{(94)} = 0.37$, $p = 0.71$] and no significant correlation with intelligence ($r = 0.17$, $p = 0.10$) and age ($r = 0.07$, $p = 0.51$). Instead, there were significant correlations within ironic (IP, IC, $r = 0.36$, $p < 0.001$) and literal (LP, LC, $r = 0.40$, $p < 0.001$) scales, but not within critical (IC, LC, $r = 0.09$, $p = 0.372$) and praising scales (IP, LP, $r = -0.03$, $p = 0.777$). Thus, in the next step, paired *t*-tests to examine differences in performance between ironic and literal subscales were conducted, comparing IC and LC, as well as IP an LP. Results showed that performance on literal scales were significantly lower than on ironic scales [IC vs. LC $t_{(95)} = 9.7$, $p < 0.001$; IP vs. LP $t_{(95)} = 3.32$, $p < 0.001$], both highlighting the relevance to distinguish literal and ironic remarks in a paradigm of pragmatic cognition. In **Supplementary Table 2** results for alternative subscales are provided.

Self-Involvement, Stereotype, and Irony Detection Accuracy

In two-way MANOVA, using Pillai's trace, neither stereotype [$V = 0.00$, $F_{(3,186)} = 0.22$, $p = 0.88$] nor self-involvement [$V = 0.01$, $F_{(3,186)} = 0.66$, $p = 0.58$] nor the interaction of stereotype and perspective [$V = 0.01$, $F_{(3,186)} = 0.30$, $p = 0.82$] had a significant effect on the total score of tuerony, considering borderline, autistic and schizotypal traits as covariates. Mean values and standard deviations are shown in **Supplementary Table 3**.

Personality Traits and Irony Detection Accuracy

Results of the linear regression analyses with schizotypal, borderline and autistic traits are presented in **Table 2**. Schizotypal and borderline traits both predicted the total score of tuerony (SPQ $\beta = -0.34$, $p < 0.001$; BSL-23 $\beta = -0.36$, $p < 0.001$) significantly negative, indicating that high expression of schizotypal and borderline traits were associated with lower performance on the detection of ironic and critical remarks (**Figures 3**, **4**). Autistic traits did not contribute significantly to general performance on tuerony ($\beta = -0.09$, $p = 0.104$).

As regression analyses revealed no significant effect for AQ, only borderline and schizotypal personality traits were included in subsequent MANCOVAs. Results are displayed in **Table 3** and revealed a significant negative mutlivariate influence of SPQ on performance on tuerony subscales [$F_{(4,91)} = 5.45$, $p = 0.001$, Pilai's trace = 0.193, partial $\eta^2 = 0.19$], confirming the previous linear regression in a statistically more valid analysis. Of the separate subscales, only IP [$F_{(1,94)} = 12.02$, $p = 0.001$, partial $\eta^2 = 0.113$] and LP [$F_{(1,94)} = 7.27$, $p = 0.008$, partial $\eta^2 = 0.072$] were significantly negative associated with schizotypal personality traits, indicating that individuals with high schizotypy show particular impairments in the detection of praising stimuli, regardless if they are uttered ironically or literally. For borderline symptoms, the results showed a significant negative multivariate influence of the borderline traits on performance on all subscales [$F_{(4,91)} = 10.52$, $p < 0.001$, Piliai's trace = 0.203, partial $\eta^2 = 0.316$]. Just as in schizotypal traits, BSL-23 was significantly negative associated with IP [$F_{(1,94)} = 36.68$, $p < 0.001$, partial $\eta^2 = 0.281$]. However, borderline personality traits were neither significantly associated with LP [$F_{(1,94)} = 1.97$, $p = 0.164$, partial $\eta^2 = 0.02$], nor with LC [$F_{(1,94)} = 3.33$, $p = 0.071$, partial $\eta^2 = 0.034$]. Instead, borderline personality traits were significantly negative associated with IC [$F_{(1,94)} = 5.28$, $p < 0.05$, partial $\eta^2 = 0.053$], indicating that

TABLE 2 | Linear regression analysis of predicted general performance on tuerony by characteristics of schizotypal (SPQ), borderline (BSL-23), and autistic (AQ) personality traits.

	SPQ			BSL-23			AQ		
	B	SE B	β	B	SE B	β	B	SE B	β
Total Score	−0.10	0.03	−0.34**	−0.09	0.02	−0.36***	−0.09	0.05	−0.17

****p < 0.001, **p < 0.01; all Durbin-Watson coefficients between d = 1.85 and d = 2.47.*

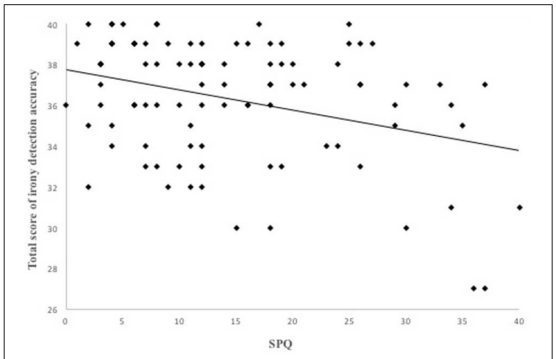

FIGURE 3 | Schizotypal personality traits negatively predicted the total score of irony detection accuracy in *tuerony* in a linear regression.

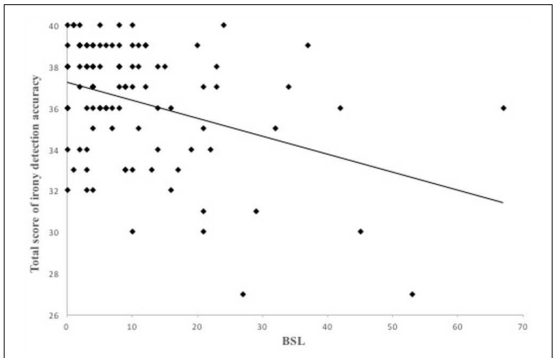

FIGURE 4 | Borderline personality traits negatively predicted the total score of irony detection accuracy in *tuerony* in a linear regression.

healthy adults with high borderline traits might have specific problems in detecting ironic remarks, regardless of their critical or praising intention.

Mentalization and Irony Detection Accuracy

The median split conducted for schizotypal traits (median SPQ = 12), resulted in groups of 52 low-schizotypal and 44 high-schizotypal individuals. Both groups differed significantly in the total SPQ value [$t_{(60)} = -13.46$, $p = 0.00$]. No significant difference for males and females in the SPQ value was found [$t_{(94)} = 0.13$, $p = 0.90$] and no significant correlation for age ($r = -0.11$, $p = 0.29$) and general intelligence ($r = -0.20$, $p = 0.05$). As depicted in **Table 4**, *t*-tests revealed five subscales of mentalization with significant differences for high and low schizotypal individuals: personal distress (IRI), congruence (SEE), overwhelming emotions (SEE), lack of emotions (SEE) and symbolization by imagination (SEE). Only personal distress was significantly negative related to general performance on *tuereony* ($r = -0.33$, 95% BCa CI [−0.523, −0.126], $p = 0.03$). The multiple regression analysis had a significant effect [$F_{(2,93)} = 6.55$, $p = 0.00$] for the proportion of explained variance ($R^2 = 0.12$). The details are displayed in **Table 5**. However, only SPQ was significantly predicting the dependent variable ($\beta = -0.28$, $t = -2.55$, $p = 0.01$), indicating that specific aspects of mentalization did not explain more than schizotypal personality.

TABLE 3 | Results of the two MANCOVAs to predict the influence of borderline (BSL-23) and schizotypal (SPQ) personality traits on tuerony subscales.

	BSL-23			SPQ		
Scale	***F***	***df***	**Partial η^2**	***F***	**df**	**Partial η^2**
IC	5.28*	94	0.05	2.9	94	0.03
IP	13.19***	94	0.281	12.02**	94	0.113
LC	1.97	94	0.02	2.94	94	0.03
LP	3.34	94	0.03	7.27**	94	0.072

*Personality traits were included as covariates in each in order to measure them dimensionally. IC, ironic criticism; IP, ironic praise; LC, literal criticism; LP, literal praise. ***p < 0.001, **p < 0.01, *p < 0.05.*

Median split of the sample based on the total score of BSL-23 (median = 8) resulted in 53 low-borderline, and 43 high-borderline individuals. There was a significant difference in the BSL total score between both groups [$t_{(51)} = -8.46$, $p < 0.001$]. The characteristics of borderline symptoms were not related with gender [$t_{(94)} = 0.42$, $p = 0.68$], general intelligence ($r = -0.14$, $p = 0.19$), and age ($r = -0.13$, $p = 0.21$). High and low trait borderline individuals showed significant differences in four mentalization subscales: personal distress (IRI), congruence (SEE), overwhelming emotions (SEE), lack of emotions (SEE), all displayed in **Table 4**. In high borderline individuals, there was no significant correlation between any of those scales and total score on tuerony (all $p > 0.05$). Thus, no additional regression analysis was performed.

DISCUSSION

The new irony detection test tuerony is intended for use in healthy and clinical populations. The test consists of ironic and literal conversational turns, which can be either critical or praising. Stimuli were developed and matched according to several linguistic criteria and with utmost distinction in terms of both literality (ironic vs. literal) and intention (praise vs. criticism) to ensure that they truly contain verbal irony and praising or critical utterances. A paper and pencil version of the test is provided in **Supplementary Test 1** and **Supplementary Answer Sheet 1**. In the present study, the test was evaluated in a sample of 96 healthy, non-clinical individuals. Moreover, a comprehensive assessment of personality traits and mentalization abilities was applied. The results indicate that in addition to known factors, such as contextual information, personality traits may influence irony detection performance. For the first time, a significant impairment of irony detection was shown in non-clinical adults with high characteristics of

TABLE 4 | Differences in mentalization scales (IRI, SEE) between individuals with high and low schizotypal (SPQ) and borderline (BSL-23) traits.

		Schizotypy			Borderline		
		Low M(SD)	High M(SD)	*t*	Low M(SD)	High M(SD)	*t*
IRI	Total score	44.19 (5.60)	44.20 (5.36)	−0.01	43.85 (5.60)	44.63 (5.32)	−1.40
	Fantasy	13.46 (3.04)	14.20 (2.98)	−1.21	13.42 (3.09)	14.28 (2.89)	−1.06
	Empathic concern	14.88 (2.33)	14.80 (2.33)	0.19	14.74 (2.35)	14.98 (2.25)	−0.51
	Perspective taking	15.85 (2.39)	15.20 (2.92)	1.18	15.70 (2.66)	15.37 (2.66)	0.6
	Personal distress	9.96 (2.28)	12.25 (3.24)	−3.94***	10.11 (2.41)	12.12 (3.25)	−3.47**
SEE	Congruence	23.73 (3.35)	21.36 (5.07)	2.65**	23.81 (3.40)	21.21 (4.99)	2.91**
	Overwhelming emotions	15.42 (4.39)	21.02 (4.39)	−5.28***	15.98 (4.83)	20.47 (5.91)	−4.01***
	Lack of emotions	10.42 (3.17)	12.41 (4.32)	−2.53*	10.51 (3.12)	12.35 (4.40)	−2.3**
	Symbolization by bodily experience	22.71 (6.58)	25.02 (5.88)	−1.80	23.36 (7.01)	24.28 (5.44)	−0.72
	Symbolization by imagination	13.65 (5.21)	15.95 (5.53)	−2.10*	13.83 (5.59)	15.79 (5.14)	−1.77
	Emotion regulation	12.63 (2.27)	12.05 (3.38)	0.98	12.64 (2.77)	12.02 (2.91)	1.06
	Self-Control	21.17 (3.42)	19.95 (4.17)	1.57	21.09 (3.80)	20.02 (3.78)	1.38

*M, Mean; SD, Standard deviation; IRI, Interpersonal Reactivity Index; SEE, Scales for experiencing emotions; SPQ, Schizotypal Personality Questionnaire; BSL-23, Borderline Symptom List 23. ***p < 0.001, **p < 0.01, *p < 0.05; in case of significant Levene-Tests: the corrected T-value is reported.*

TABLE 5 | Relation between schizotypal traits and mentalization.

	Unstandardized coefficients		Standardized coefficients			
Predictors	**B**	**SE_B**	**β**	**R**	**R^2**	**VIF**
Step 1						
Constant	38.75	1.11				
	[36.56, 40.94]					
Total score SPQ	−0.08	0.03	−0.28*			1.31
	[−0.149, −0.019]					
Personal distress	−0.11	0.11	−0.11	0.35	0.12	1.31
	[−0.330, 0.108]					

*Multiple regression model within high-schizotypal healthy individuals with SPQ and Personal Distress (IRI) as predictors and total score of tuerony as dependent variable, with 95% bias corrected and accelerated confidence intervals based on N = 1,000 bootstrap-sample. *p < 0.05; corrected R^2 = 0.105; Durbin-Watson coefficients d = 2.38.*

borderline personality traits, expanding the known deficits in clinical populations.

A New Test of Irony Detection Accuracy

The tuerony test comprises four types of items, which vary in literality (ironic vs. literal) and intention (praise vs. criticism). The idea behind this variation is that adding praise and criticism seems to be particularly relevant in the clinical context because problems associated with criticism are part of the clinical picture of numerous mental disorders (89, 90). In our paradigm, the influence of specific syntactic and prosodic hints in ironic utterances was limited by the construction of all items according to the same linguistic criteria. Hence, the performance in irony detection would rely on the systematic variation of intention and literality. Previous irony paradigms that more often rely on ironic criticism or sarcasm are supplemented. By integrating praising and literal remarks, a crossover control condition for the incorrect classification of literal statements as ironic is facilitated. In this regard, sufficient reliability can be shown for all subscales (IC, IP, LC, and LP). These subscales are found to be based on distinct factors, with IC and IP, as well as LC and LP, being intercorrelated. This confirmed the importance of distinguishing between literality (ironic vs. literal) and intention (criticism vs. praise) in the examination of pragmatic and social cognition abilities. Likewise, brain lesion studies have indicated that positive emotional connotation in irony could possibly be more demanding for the medial prefrontal cortex (91). Although the present study is insufficient to assess the role of brain regions, the results provide support for the argument against a positive connotation being generally more difficult.

As expected, the healthy sample showed a high performance because the item construction was based on the common ground of irony perception in healthy adults to enable the detection of possible deficits in clinical populations. However, the scores still showed sufficient variability to indicate interindividual differences in irony detection accuracy. In general, contrary to the expectation, the participants performed better in the detection of irony than in the detection of literal utterances. This finding

is in contrast to most previous experimental research on irony comprehension. Nevertheless, it should be noted that lack of significant (92, 93) or even marginally better performance for ironic stimuli (94, 95) has been reported in the literature before. The exact reasons for these different results between studies have yet to be explored. A possible, but from our perspective not very likely, explanation is that the combination with either a critical or a praising intention could make the decision more difficult for literal sentences. Further, theoretically, the explicit instruction to decide on the literality of every item and the dichotomous scaling of this answer could also relate to this. On the one hand, there might be a greater amount of ambiguity, particularly in literal utterances, when the individual is instructed to decide if an item is ironic or not. This is because irony is implemented by the incongruence of the given context sentence (e.g., something good happened to the speaker) and the target sentence (e.g., the conversational partner ironically criticizes the speaker for that). Because it usually violates expectancies, this incongruence may be a "hint" of an ironic utterance when there is an explicit instruction to look for hints. However, such incongruence cannot be found in literal statements, leaving more room for the interpretation of intentions where there might be none. On the other hand, the decision has to be assessed on a dichotomous scale. This scale is a simplification because it ignores the fact that conversational turns can have a "soft" ironic "tongue-in-cheek" and can therefore be both ironic and literal at the same time (14, 17). Thus, it would be interesting to evaluate if continuous scales would influence the irony detection in future studies. Nevertheless, this forced dichotomous response type is chosen for two reasons. First, it simplifies the result score. Second, based on previous experience (51, 96), clinical populations, such as persons with schizophrenia, find it challenging to rate certain degrees of ironic intent, which dramatically increases the test duration.

The second decision for any item was to judge the intention. The test participants rated each item on a five-point scale based on how much they perceived the answer of the speaker as praising or criticizing. In the current study, the results of this rating were used to confirm whether the items, correctly identified on their literality were also classified under the correct intention. This evaluation further considered one of the most common intentions for the use of irony: to politely criticize or praise (97–99). Accordingly, ironic utterances were evaluated as significantly less critical or praising than literal ones. This phenomenon can be seen as an additional validation of the stimuli, as it has been long known in irony research as the "tinge hypothesis" (18, 98, 100, 101) and recently also shown in electrophysiologic reactions (102) claiming that irony mutes the positive or negative information given by the speaker.

Personality Traits and Irony Detection Accuracy

Apart from evaluating the test in a larger group of healthy subjects, the second main goal of this study was to investigate more thoroughly the factors that may influence irony detection.

In the current study, results confirmed previous studies with schizotypal traits (10, 12) and, for the first time, revealed difficulties in the understanding of irony in healthy adults with borderline traits, showing that the personality of the recipient plays a substantial role in the pragmatic communication process. However, in contrast to our expectations based on studies applying the continuity approach (47) in this sample of healthy adults, autistic traits did not impact the detection of ironic remarks. One explanation might be the complexity of the stimuli and task in the current test. In clinical samples, irony comprehension often been investigated in autism by written stories (34, 103, 104). However, in some studies using a more elaborated design patients with autism did not exhibit more difficulties in irony understanding than healthy controls did (105–107). Above that, choosing a forced choice answering format instead of verbal explanations often facilitates the correct interpretation even in clinically diagnosed samples with autism (106). However, Mathersul et al. (108), applying the video-based as well as forced-choice TASIT on a sample of individuals with high-functioning autism, demonstrated specific deficits in those parts including sarcastic remarks. Nevertheless, all studies did not investigate a subclinical population, resulting in the question whether in the pragmatic domain only a higher degree of autistic traits may lead to impairments in healthy adults. Thus, the often reported reduced performance of irony comprehension in clinical populations raises the question on whether these deficits in irony detection accuracy are categorical or dimensional.

The present study adds to the growing body of literature that assumes a relationship between mentalization abilities and irony detection accuracy. Previous research has repeatedly linked mentalization or ToM abilities to impairments in irony comprehension, particularly in investigating reasons for decreased irony comprehension in clinical populations, with the most research available for autism (1, 30, 106, 109), schizophrenia (59, 110–112), and related personality traits in healthy populations (10–12, 113). Bruntsch et al. (13) emphasized a high interindividual variance in irony comprehension even in healthy populations and suggested several personality traits (schizotypy, histrionic self-presentation, sense of humor, self-esteem, and gelotophobia) as potential explanations for this variance. These findings raise the question as to what degree personality traits or psychopathologic characteristics are distinct from or overlap with mentalizing abilities in irony processing. In the current study, only one subscale of the mentalization assessments of SEE and IRI was associated with irony comprehension in individuals with high schizotypal and borderline personality traits. However, such influence was non-significant compared with the impact of personality traits. This result is in line with the study of Mo et al. (114), who also found that ToM abilities had only a limited influence on irony comprehension in schizophrenic patients. However, these findings are in contrast with several studies that showed a high relevance of mentalization abilities in irony detection in psychiatric patients, such as those with autism (1) and schizophrenia (115). One explanation could be that most of

those studies did not directly investigate personality traits and mentalization abilities together, thus impeding a comparison between the two.

Variation of the Speaker

Communication is always embedded in a context. Hence, this study aimed to investigate how this aspect of context, implemented in the occupation of the speaker, influences irony detection. In the current study in healthy individuals no differences in irony detection was found between individuals with an "ironic occupation" (actors) and those with a "non-ironic occupation" (doctors). This was contrary to most previous studies reporting that the type of occupation essentially influences the interpretation of the possible ironic remark (18, 57–59, 61). One explanation for the difference in results may be the use of only one occupation each and the lack of a non-occupational control condition. Subtended to the other studies, the initial presentation of the occupational stereotype had to be maintained and thus was not changed for a large number of items. Theoretically, this could have led to the fading out of the generated impression from the previous shown video. In contrast, it can be argued that the presentation of the stereotypical character in this study was more elaborate. In other studies, the profession and context story were usually changed for every item, and the test was based only on short written texts (18, 59, 61). In the tuerony, all items are embedded in the same narrative context with one stereotype each, presented in a video. Thus, perhaps not despite but rather because of the more elaborate, ecologically valid narrative of the video sequence and the resulting text messages of different forms of irony, the stereotypical occupation might just not have been so central than in short written text vignettes without much more other information. This would be in line with the results of Bruntsch et al. (13), who, taking an extreme position, considered most contextual information simply as "noise" that distracts rather than serves as an additional resource for interpretation. The present research could not control for this hypothesis because all the stimuli were embedded in one stereotypical context. Thus, future studies could also include video vignettes of other occupations, as well as non-occupational control conditions, to investigate whether stereotypes presented in a more elaborate way, such as through video vignettes, enhance, impair, or do not at all impact the comprehension of ironic remarks. Additionally, the application of even more ecologically valid paradigms in clinical populations might add further insights on the recent limited and rather inconsistent findings on this topic. More respectively, the influence of the occupation of the speaker could theoretically be significant in a patient sample as they have more distinguished experiences in their every day life with one of the stereotypes included in our test, namely physicians. This is currently evaluated in another clinical sample.

Variation of Self-Involvement

Variation of self-involvement of the addressee of the ironic remark was the second possible influence of context on irony comprehension this study tried to investigate, as it has been suggested by several authors before (62–65). To our knowledge, the present study is the first to compare direct self-involvement with a neutral control condition. However, in this healthy population, no significant differences in detection of irony were found between direct interaction and neutral observation. This may not be the case in clinical populations. For example, in patients with schizophrenia (116) and borderline personality disorder (117), self-involved judgments are attributed aberrantly, e.g., as either hyperbolic self-enhancing or insulting (118, 119). Thus, the obtained result may probably be due to the inclusion of non-clinical individuals. Further research should investigate these differences in patients with schizophrenia, autism, and borderline personality disorder.

Limitations and Future Directions

We are aware of several limitations within our study. Especially as our test is intended for use in healthy and clinical populations, a larger sample is needed to meet criteria for a full-fledged test construction. Instead, the rationale for sample size in the current study followed the examination of influences on irony detection. Among this group of healthy individuals, performance was not associated with general intelligence, serving as a preliminary result for discriminant validity. The result suggests that it may not be a particular executive form of ability, but the individual's proneness or character constellation affecting the recognition of irony (13). However, in future studies it would be eligible to integrate a more detailed validity analysis, e.g., comparing the current test with other paradigms addressing executive functions and more elaborated intelligence tests than the one addressed in this study, even though it has been shown to be correlate well with premorbid intelligence within clinical samples (76). Further, convergent validity needs to be evaluated, comparing the current with other irony detection paradigms. Not only for the investigation of its clinical relevance, but also for a sufficient variance of performance, the test should be applied and analyzed in clinical populations. Especially in patients with disorder specific experiences ans character constellations, there might be different influences of the test conditions. Applying the paradigm on more extreme groups in irony detection could resolve the problem of the restriction of range found in this healthy sample. As item construction and selection was based on common ground in order to avoid the highly subjective nature of irony detection in the first place, all items in the current sample obtained near-ceiling scores. A sample with higher range could therefore ensure characterizing retest-reliability in future studies. Also, predictive validity would be supported if performance on the test could discriminate between patients and healthy controls. Finally, in this paper we focused only on one side of the communicative channel: the receiver of an ironic statement. However, the active use of irony as a rhetorical figure, might also be influenced by personality traits as recently shown by Bruntsch and Ruch (120).

CONCLUSION

Previous research has predominantly focused on two aspects of this issue: the established finding that context influences the ease and accuracy of irony detection, and the relationship between

irony detection accuracy and the "mentalization" capabilities of the individual. Whereas, the first aspect influenced the field of linguistics, the latter has dominated the research on the relationship between irony detection accuracy and mental disorders. However, as the current results suggest, bringing into focus only the conversational context or mentalization skills might be too limited. The present work proposes a third aspect that could be of major relevance to irony detection accuracy: the individual personality of the recipient.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2019.00028/full#supplementary-material

Supplementary Table 1 | Item statistics for healthy individuals ($N = 96$) in the irony detection accuracy test tuerony. Percentage of correct answers and item statistics for single items within the categories ironic criticism, ironic praise, literal criticism, and literal praise are presented. Items with 100% of correct answers were excluded from item statistics (ironic criticism: item 2, 4, 5, 7, 9, 11, 17, and 20; ironic praise: item 2, 3, 4, 5, 6, 12, 13, and 18; literal praise: tem 2, 6, and 18).

Supplementary Table 2 | Additional analyses for alternative subscales, considering literality and irony as separate values. Mean values and standard deviations for self-involvement (neutral observer/direct interaction) and stereotypes (doctor/actor) on irony detection accuracy for the total population ($N = 96$).

Supplementary Table 3 | Performance of healthy individuals in the irony detection accuracy test tuerony. Survey of total scores, subscores, and perceived criticism and praise in the total sample ($N = 96$) and specified for females ($n = 59$) and males ($n = 37$).

Supplementary Answer Sheet 1 | A simplified version of the original answer sheet, containing a dichotomous scale (ironic vs. literal) and a five-point smiley-based Likert scale (critical to praising).

Supplementary Test 1 | One version of the Tuebingen Test of Irony Detection Accuracy with the conditions actress and neutral observer. The test follows the presentation of **Supplementary Video 1**.

Supplementary Video 1 | Video instruction for the Tuebingen Test of Irony Detection Accuracy presenting the social situation in a variation of perspective (direct/neutral observation) and speaker's occupation (doctor/actor). The video shows a combination of the conditions actress (speaker's occupation) and neutral observer (perspective).

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Irony detection in patients with borderline personality disorder: an experimental study examining schizotypal traits, response biases and empathy

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Borderline Personality Disorder and Emotion Dysregulation

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Irony detection in patients with borderline personality disorder: an experimental study examining schizotypal traits, response biases and empathy

Anne Katrin Felsenheimer[1,2*], Carolin Kieckhäfer[3] and Alexander Michael Rapp[1]

Abstract

Background: In verbal irony we often convey meanings that oppose the literal words. To look behind these words, we need to integrate perspectives of ourselves, others, and their beliefs about us. Although patients with borderline personality disorder (BPD) experience problems in social cognition and schizotypal symptoms, research on irony comprehension mainly focused on the schizophrenic spectrum. Accounting for possible negative biases in BPD, the current study examined the detection of praising and critical irony in a text messaging interface.

Methods: The cross-sectional study included 30 patients and 30 matched controls, who completed measures of cognitive and affective empathy (Interpersonal Reactivity Index, IRI), schizotypal (Schizotypal Personality Questionnaire; SPQ), and borderline symptoms (Borderline Symptom List; BSL-23) and the irony detection task. The irony task contained critical and praising remarks embedded in text messages. Asking for literality (ironic vs. literal) and intention ratings (critical to praising) of the stimuli, it allowed to analyze the sensitivity of literality detection as well as implicit and explicit response biases in a signal detection framework.

Results: Borderline symptoms explained lower sensitivity for the detection of literal and ironic statements across groups. Whereas HC showed a negativity bias when implicitly asked about the literalness of the statement, patients with BPD perceived praising utterances as less praising when explicitly asked about their perceived intention. Neither empathy nor schizotypy explained outcomes beyond borderline symptoms.

Conclusions: This was the first study to show lower detection of verbal irony in patients with BPD. While patients were less biased when asked about the literality of a statement, they perceived praising remarks as less positive on explicit measurements. The results highlight the importance of congruent, transparent communication in promoting epistemic trust in individuals with BPD.

Keywords: Schizotypal personality, Sarcasm, Negativity bias, Social cognition, Pragmatic language, Mentalization, Nonliteral

Introduction

The psychopathology of borderline personality disorder (BPD) manifests in social interaction. In line with this, research on BPD has focused increasingly on the inferences people draw from these interactions, so-called social cognition [1–3]. One of the numerous concepts

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within the domain of social cognition is mentalization [4, 5]. It comprises the implicit and explicit understanding of oneself and others [6] and is developed in early social interactions throughout childhood [6]. Mentalization-based theory proposes an errant development of mentalization contributes to etiology of BPD [6, 7]. In a supportive environment, the caregiver shows the child that they are seen as an intentional being by empathetically mirroring the child's expressed state of mind (e.g., crying). This helps the child internalize a coherent representation of self and others [6]. Additionally, caregivers provide ostensive cues (e.g., turn-taking or appropriate eye contact) to show that they are communicating socially relevant information [8]. It fosters epistemic trust, which is the general assumption that the information we receive from others is accurate, reliable and personally relevant. Epistemic trust assures us that we are not being intentionally misinformed and allows us to integrate information in our knowledge about the world [8–11]. A history of maltreatment and neglect may facilitate mistrust around communication in patients with BPD, which can make it harder to believe others [10, 11, 12]. That is, individuals with BPD experience childhood adversity 13 times more than non-clinical individuals, especially emotional abuse and neglect [13]. With an abusive parent, integrating given information can be dangerous [12] and those with BPD may overinterpret hostile motives when there are none. This form of "hypermentalization" [14–22] preserves and prolongs interpersonal conflicts [11].

To master the complexity of communication, we not only have to trust the information given to us, but also distrust it from time to time. A prime example is verbal irony, in which the vocal pitch or incongruent context suggest that the speaker intends the opposite of the literal words [23]. Impairments in the comprehension of irony has been mostly demonstrated for autism [24] and in the context of concretism in schizophrenia [25–30]. Being equipped with higher mistrust in the first place, it is likely that patients with BPD, too, may have difficulties to decide which information to trust in irony. In line with this and BPD's eponymous description of the 'border' between psychosis and neurosis [31], individuals with BPD share cognitive biases with schizophrenia [32], show schizotypal traits [33], and/or psychotic symptoms [34–38]. Such a transdiagnostic symptomatology challenges the differential diagnostic specificity of nonliteral language deficits. Notably, in personality disorders (PD), BPD and schizotypal personality disorder (SPD) are known to co-occur [33, 39]. Hence, with regard to the dimensional alternative model for personality disorders (AMPD), which has been increasingly applied since the DSM V, the question arises as to which PD pathology is responsible for the ironic misinterpretation in previous studies of schizotypy [28, 40].

In irony, there are two causes of misinterpretation: not being able to detect the intention of the speaker, and being able to, but opting for the literal meaning regardless. The first cause is closely related to mentalization. Irony requires recognizing an intention hidden behind literal words. For this reason, it has been studied mainly in research on social cognition [41–43] and is used as its direct measure in video-based tasks [14, 44]. One of these tasks, the Movie for the Assessment of Social Cognition (MASC; [44]) has been widely applied in BPD [18, 45–47]. The MASC does not specifically examine irony, but uses ironic remarks among other scenarios as a measure of social cognition. Németh et al. [1] showed that in these multimodal tasks, individuals with BPD's social cognition impairments are most pronounced [1, 48, 49]. Their response formats offer different interpretations of social situations [44], so selecting the right one requires the subject to explicitly compare different mental states [1]. In these tasks, participants with BPD demonstrate reasoning about mental states, but tend to overinterpret social cues [14–22]. By contrast, they show no impairments in nonverbal paradigms such as the Reading the Mind in the Eyes Task [50] which only requires to identify an emotion based on pictures of the eye region [1]. The authors concluded that the mere detection of emotions seems to be preserved in BPD. Instead, difficulties arise when multiple perspectives need to be explicitly compared. Multiple perspectives, however, are an inevitable part of irony [41, 51, 52]. And understanding irony requires a flexible shift between them - shifts that seems to be harder for individuals with BPD [53–55].

Yet, even the full capacity to compare mental states does not necessarily guarantee that a statement will be perceived as ironic. Irony explicitly leaves the intention of the speaker ambiguous and along that room for interpretation. Individuals who tend to perceive others as dishonest may decide to ignore irony, irrespective of their ability to infer mental states. Addressing this distinction in schizophrenia, Parola et al. [27] analyzed both sensitivity (the detection of a communicative intention) and response bias (the tendency to favor a specific response) during indirect speech comprehension. Individuals with schizophrenia had equal difficulty detecting ironic, deceitful, and sincere phrasings, but tended to perceive ironic utterances more deceitful than healthy controls. Negative attribution styles are common in BPD as well [2]; many individuals with BPD tend to interpret others' behavior as aggressive and hostile [56] and neutral faces as less trustworthy [57]. This places patients in a vicious cycle of reliving traumatic relationships [12, 58]. Therapists are often

encouraged to use clear, unambiguous communication to avoid unintentionally reinforcing the threat perceived by their patients [59]. This is especially true as negative biases in BPD tend to develop specifically in the face of ambiguous stimuli [3, 49, 60–62].

Using irony as a prime example of ambiguous language allows both pragmatic inference and attributional bias to be examined within one linguistic phenomenon. Most studies on irony comprehension, however, focus solely on ironic criticism or sarcasm [44], thereby confounding irony with an a priori negative bias. Analyzing both praising and critical irony bypasses positive testing and allows interpretation errors to be analyzed without overtly asking for them. For example, Kieckhäfer et al. [63] examined how the detection of ironic and literal praising and critical relate to borderline and schizotypal traits in healthy adults. In their study, both traits were associated with lower detection accuracy, though each set of traits had differing error patterns. In line with Parola et al.'s findings in schizophrenia [27], individuals with higher schizotypy interpreted the stimuli more mocking: They indicated literal praise as ironic critique and ironic praise as literal critique. In contrast, individuals with high borderline traits only made errors identifying ironic remarks and this was regardless of the intention.

We applied Kieckhaefer et al.'s [63] paradigm, for the first time, on participants diagnosed with BPD. We compared the detection of literality (ironic vs. literal) and implicit response biases within a signal detection theory (SDT) framework, as well as explicit ratings of the perceived intention (critical to praising) with healthy controls (HC). In accordance with findings on healthy adults with borderline symptoms [63], we hypothesized that participants with BPD would have more difficulty differentiating ironic and literal utterances. We further assumed that negativity biases would emerge in a more pronounced BPD symptomatology. Thus, in contrast to Kieckhäfer et al.'s results [63], we expected participants with BPD to interpret ironic praise and literal criticism literally, and ironic criticism and literal praise ironically. In line with this, we predicted BPD participants would rate critical remarks as more critical and praising remarks as less praising. To clarify the specific contributions of borderline and schizotypal symptoms on irony and to consider a more dimensional assessment of PD, we examined the relationship between these characteristics and irony comprehension across groups. Last, we included possible mentalizing capacities related to irony comprehension in BPD via affective and cognitive empathy.

Methods

30 participants with BPD were recruited from the University Hospital of Tuebingen, Department of Psychiatry and Psychotherapy, Germany. The ward was specialized on dialectical behavioral therapy (DBT, [64]). General exclusion criteria were acute or anamnestic substance abuse or dependence, bipolar disorder, psychotic disorders, severe episodes of major depression, and neurological diseases. Inclusion criteria involved normal or corrected-to-normal vision, age between 18–55, native German speakers, and a clinical diagnosis of BPD for the patient group. A trained clinician assessed the DSM-IV criteria according to Structured Clinical Interview for DSM IV II (SCID II) [65] and comorbidities according to SCID I [66]. Except for 7 individuals, patients exhibited comorbid diagnoses, which included depressive disorders ($n=13$), post traumatic stress disorder ($n=11$), substance use but abstinent for at least 2 months ($n=1$) and attention deficit hyperactivity disorder ($n=1$). However, none of them fulfilled the diagnostic criteria for other personality disorders according to the traditional DSM-IV model. The study protocol was approved by the ethics committee of the Medical Faculty of the University of Tuebingen and carried out according to the Declaration of Helsinki. All participants provided written informed consent and received monetary compensation.

A group of 30 healthy controls (HC), was matched for age, verbal intelligence according to the multiple-choice vocabulary test (MWT, [67]), gender, and educational level. Both groups filled out the short version of the Borderline Symptom List (BSL-23, [68]) and the German version of the Schizotypal Personality Questionnaire (SPQ, [69, 70]). For the evaluation of cognitive and affective empathy, the Interpersonal Reactivity Index (IRI, [71]) was used as a German short version [72]. The IRI is a self-report instrument comprising two cognitive subscales (perspective taking, fantasy) and two affective subscales (empathic concern, personal distress).

After consenting to participate, demographics were assessed in paper-pencil format. Then, participants completed the irony paradigm and self-report instruments on a computer in a quiet, distraction-free room. The stimuli were the same as in Kieckhäfer et al. [63]; test construction and development are explained in detail there. Each trial consisted of a videotaped context story introducing a character in a café and subsequent message exchanges. According to the narrative, participants saw text messages containing a context sentence and a reaction to that message by the protagonist of the video (see Additional file 1). The message was either ironic praise (IP), ironic criticism (IC), literal praise (LP), or literal criticism (LC). In ironic stimuli, the intended meaning opposed the literal meaning. For example, IP had a praising intention

by way of critique ("I went running today" "You are so lazy."). Videos varied in the degree of proximal perspective, and were either addressed directly by the protagonist (2nd person) or observed by the protagonist talking to a neutral other (3rd person). The protagonist's answers were to be scored on their literality (ironic vs. literal) in a binary response format, and their perceived intention (criticism vs. praise) on a five-point Likert scale (see Additional file 2). Each trial comprised five items per condition (20 items total). Participants completed two test versions, with one perspective each. Summation of correct identified items lead to a total maximum score of 10 correct responses per condition (IP, IC, LP, LC) for both test versions.

We applied SDT to quantify sensitivity (d') and response biases (β). As in SDT designs, the irony task required a binary label of literality (literal vs. ironic), which could be compared to the presence or absence of a signal (irony present vs. irony absent), resulting in four logical outcomes (Table 1): hit (choosing ironic in an ironic stimulus), false alarm (choosing ironic in a literal stimulus), miss (choosing literal in an ironic stimulus), and correct rejection (choosing literal in a literal stimulus). Each category was assigned a likelihood ratio. For instance, the hit rate represents the proportion of ironic stimuli to which the participant responded "ironic", and false alarm rate denotes the proportion of literal trials to which the participant responded "ironic". Unlike the mere number of correct responses, SDT's measure of sensitivity reflects the probability of identifying the intention of the stimulus while avoiding false alarms, and corresponds to the Z-value of the hit rate minus the false-alarm rate.

SDT further accounts for the response bias β: a systematic criterion when a signal is considered as present. It can capture the tendency of an individual to interpret statements either as ironic or literal. An individual who tends to interpret statements as "ironic" shows high hits for ironic (IC and IP), but high false alarms in literal stimuli (LC and LP). An unbiased observer's β is close to 1. With a tendency to respond "ironic" (liberal criterion), β approaches 0. With the tendency to choose "literal" (conservative criterion), β exceeds 1. d' and β were computed with the R package psycho. The binary answer format (ironic vs. literal) and definition of irony as the opposite of the literal meaning resulted in two corresponding conditions (IP vs. LC; IC vs. LP). Specifically, in an IC stimulus ("I am too late." "You are so reliable."), the detection of the correct literality (i.e., "ironic") requires detecting the critical intention, despite the literal praise. The same holds true for IP and LC for a praising intention. For each participant, we calculated the hits, false alarms, misses, and correct rejections for both matching pairs.

Then, we applied linear mixed effect models in R with the lme4 package using d', β, and ratings of perceived intention as respective outcome; group (HC vs. BPD) and intention (praise vs. criticism) as sum-coded fixed effects; age and verbal intelligence as continuous covariates; gender as a categorical covariate; and random effects by participant. Post-hoc tests with adjusted p-values were carried out with Tukey's test. Based on the stimulus design, misclassifying literality causes perception of the opposite intention (e.g., ironic praise as literal criticism). Thus, perceived intention was estimated by the mean rating of items correctly identified as ironic or literal.

For each model, the impact of borderline symptoms, schizotypal symptoms, and empathy scales was analyzed. Model fits were estimated hierarchically, starting out with the null model, then adding borderline and schizotypal symptoms, and finally IRI subscales, as fixed effects. Models were compared via Likelihood-ratio tests using the anova function.

Similar to previous results [63], the perspective of the speaker had no effect on detection performance in a preceding repeated measure Analysis of Variance (rmANOVA, see supplementary Table 1). Thus, the conditions were not included in analysis.

Table 1 Signal detection theory matrix with possible outcomes for each contrastive pair of stimuli

Stimulus pair	response	
	ironic	literal
IC vs. LP		
IC (irony present)	hit	miss
LP (irony absent)	false alarm	correct rejection
IP vs. LC		
IP (irony present)	hit	miss
LC (irony absent)	false alarm	correct rejection

IC ironic criticism, *IP* ironic praise, *LC* literal criticism, *LP* literal praise

Results

Groups did not differ significantly in age (t (58) = − .812, p = .420), gender (Z = .417, p = .519), educational level (Z = −1.736, p = .083), or verbal intelligence (t (58) = −1.062, p = .293). Patients with BPD had significantly more borderline symptoms (t (38.46) = −8.971, p < .001) and personal distress (t (58) = −6.215, p < .001), as well as lower perspective taking (t (58) = 2.871, p = .006) and more schizotypal symptoms (t (58) = −8.662, p < .001). A detailed sample description can be found in Table 2.

Final models are depicted in Table 3. There was no effect of gender, age, or verbal IQ. Despite possible ceiling effects, patients with BPD (M = 1.00, SD = 0.32)

Table 2 Means (M) and standard deviations (SD) of demographic and psychometric data

	BPD ($n=30$)		HC ($n=30$)		*p*
	M	*SD*	*M*	*SD*	
Demographics					
age (years)	29.27	9.03	27.20	10.03	.420[a]
gender (female/male)	25/5		23/7		.519[b]
education (median/IQR)	4.00	1.25	4.00	0.00	.083[c]
verbal intelligence	28.51	4.07	28.89	3.71	.293[a]
Questionnaires[a]					
BSL-23	2.28	1.02	0.39	0.40	< .001
IRI					
personal distress	15.87	3.01	10.60	3.53	< .001
empathetic concern	15.63	2.47	14.73	2.60	.174
perspective taking	13.30	2.74	15.27	2.56	.006
fantasy	13.80	3.94	14.47	3.14	.472
SPQ	34.7	13.5	15.5	10.6	< .001
Perceived intention					
IC	2.25	0.62	2.17	0.46	
IP	3.56	0.69	4.01	0.47	
LC	1.94	0.49	1.81	0.42	
LP	4.52	0.37	4.70	0.25	
Sensitivity (d')					
IC vs. LP	1.11	0.31	1.17	0.21	
IP vs. LC	0.89	0.31	1.07	0.22	
Response bias (β)					
IC vs. LP	1.01	0.09	0.95	0.09	
IP vs. LC	1.07	0.11	1.13	0.09	

HC healthy controls, *BPD* borderline personality disorder, *BSL-23* Borderline Symptom List, *IRI* interpersonal reactivity index, *SPQ* schizotypal personality questionnaire, *IC* ironic criticism, *IP* ironic praise, *LC* literal criticism, *LP* literal praise

[a] independent sample t-test

[b] Pearson-Chi-Quadrat

[c] Mann-Whitney-U-Test

[d] Welch-Test

showed significantly less sensitivity d' than HC ($M=1.12$, $SD=0.22$) in differentiating ironic and literal statements (t (58) = 2.184, $p=.033$), regardless of the intention (see Fig. 1). Above groups, sensitivity was higher for IC vs. LP ($M=1.14$, $SD=.27$) than IP vs. LC ($M=.98$, $SD=.28$; t (58) = 4.22, $p<.001$).

For response bias, there was a significant interaction of group on intention. However, post-hoc pairwise comparisons of group by level of intention indicated group differences in β for both IC vs. LP (t (116) $=-2.313$, $p=.023$) and IP vs. LC (t (116) = 2.321, $p=.022$). On a descriptive level, β tended to be closer to 1 in BPD (see Table 1 and Fig. 2), indicating that BPD participants were almost unbiased. In contrast, HC showed a lower β in ironic criticism, corresponding with a tendency to interpret an answer as ironic in IC and LP and thus as mocking. The same negativity bias was evident in the other pair, with HC having a higher β in IP vs. LC and a tendency to choose literal. There was a significant effect of gender, with males having higher β than females (t (55) $=-2.027$, $p=.048$).

Borderline symptoms significantly improved model fit for d' ($\chi2$ (1) = 5.497, $p=.019$), with a significant effect on d' diminishing the effect of group. Neither SPQ ($\chi2$ (1) = .187, $p=.633$), nor IRI subscales ($\chi2$ (4) = 2.302, $p=.680$) improved model fit. For β, neither BSL ($\chi2$ (1) = 0.011, $p=.917$), nor SPQ ($\chi2$ (1) = 0.517, $p=.472$) or IRI scales ($\chi2$ (1) = 0.064, $p=.999$) improved model fit.

In the last step we analyzed the ratings of perceived intention (Table 4). There was a significant interaction of group*intention, with clinical participants perceiving praising remarks as less praising (t (172) = 3.480, $p<.001$), but no difference in the perception of critical remarks (t (172) $=-1.133$, $p=.259$). Post-hoc comparisons for the interaction of intention*literal indicated all pairwise comparisons to be significant (all $p<.0001$), confirming previous findings that ironic remarks were perceived as less praising (IP: $M=2.21$, $SD=.63$ vs. LP: $M=4.61$,

Table 3 Analysis of deviance table (Type II Wald chi-square tests) for the linear mixed effect models with sum-coded contrasts and random intercepts by subject of sensitivity d' (left) and response bias β (right) including borderline symptoms

Fixed effects	sensitivity d' ~ group*intention + bsl + age + gender + iq + (1|ID)				response bias β ~ group*intention + age + gender + iq + (1|ID)			
	b	*χ2*	*df*	*p*	*b*	*χ2*	*df*	*p*
group	0.00	0.01	1	.752	0.00	0.01	1	.923
intention	0.08	17.81	1	<.001***	−0.06	51.86	1	<.001***
group*intention	−0.03	2.31	1	.129	−0.03	10.90	1	<.001***
age	0.00	0.24	1	.623	0.11	0.73	1	.736
gender	0.05	0.62	1	.432	0.04	4.11	1	.042*
IQ	0.01	1.53	1	.216	−0.00	0.58	1	.446
BSL	−0.08	4.12	1	.042*				

BSL score on borderline symptom list 23

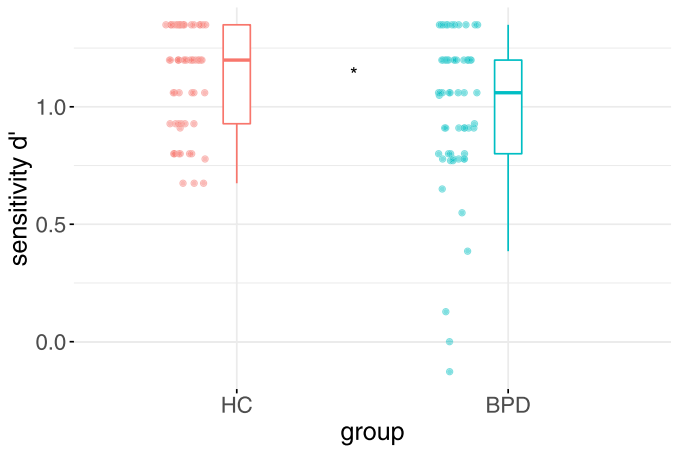

Fig. 1 Sensitivity (dprime d') values for BPD and HC groups

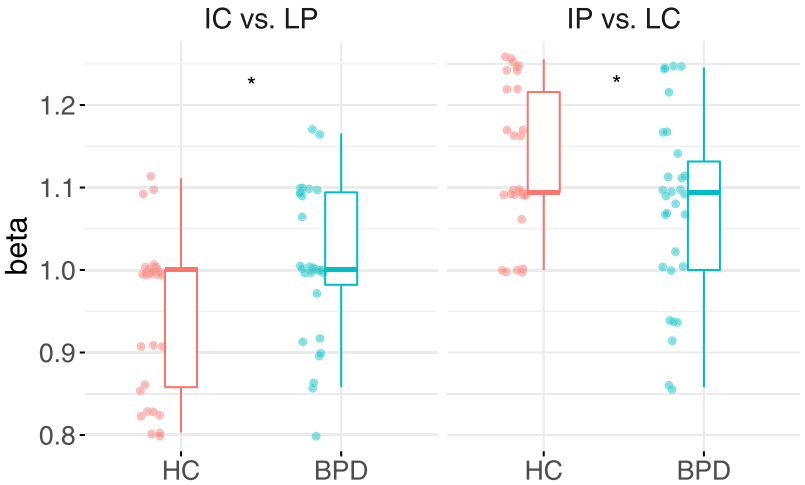

Fig. 2 Response bias β for the comparisons of ironic criticism (IC) with literal praise (LP) and ironic praise (IP) with literal criticism (LC). An unbiased β corresponds to 1, a β approaching zero a tendency to choose ironic, a β increasing over one a tendency to choose literal as response

SD = .33) and less critical (IC: *M* = 2.21, *SD* = .54 vs LC: *M* = 1.87, *SD* = 46) in both groups. Again, neither BSL ($\chi 2$ (1) = 0.472, *p* = .491), SPQ ($\chi 2$ (1) = .740, *p* = .187), nor IRI scales ($\chi 2$ (1) = 5.017, *p* = .414) improved model fit.

Discussion

This was the first study to examine irony comprehension among individuals with BPD. Participants were presented with both ironic and literal text messages varying in praising and critical intention. Within a signal detection framework, we assessed response biases and the ability to discriminate literal from ironic remarks. Biases were distinguished on two levels: implicit tendencies measured in the choice of the literalness of the statement (ironic vs. literal) and explicit ratings of perceived intention (critical to praising).

Participants with BPD exhibited more difficulty differentiating literal from ironic remarks than HC. Yet, group differences did not vary with critical or praising content, showing that it was the literality of the stimulus, not the intention, affecting performance. For both groups, ironic praise was harder to detect than ironic criticism, replicating that ironic criticism is easier to process [73, 74],

Table 4 Analysis of deviance table (Type II Wald chi-square tests) for the linear mixed model of perceived intention with sum-coded contrasts and random intercepts by subject

fixed effects	**perceived intention rating ~ group*intention*literality + (1|ID)**			
	estimate	***X²***	***df***	***p***
between-subject				
group	0.053	2.72	1	.098
group*literality	0.042	1.74	1	0.187
group*intention	−0.103	10.77	1	< .001***
group*literality*intention	−0.027	0.75	1	.386
within-subject				
literality	−0.123	15.15	1	< .001***
intention	−1.076	1158.61	1	< .001***
intention*literality	0.290	84.45	1	< .001***

mostly because it is much more common [74–76]. The current results are commensurate with those in social cognition paradigms using sarcasm as a stimulus [15, 22, 46]. For the first time, these impairments have been confirmed with respect to verbal irony. Importantly, borderline symptoms explained reduced sensibility beyond categorical groups, confirming findings among healthy adults with borderline traits in a clinical sample [63] and corroborating dimensional approaches to personality disorders [77].

Other forms of nonliteral language, such as metaphors, have recently been shown to be preserved in BPD [78]. This is of particular importance, as metaphor comprehension is commonly impaired in schizophrenia [79] with whom BPD patients share symptoms [32, 33]. Contrary to other studies [28, 29, 40, 63, 80], schizotypal symptoms did not explain irony detection beyond borderline symptoms, although patients scored high on both. Our results support the idea that different forms of nonliteral language are subject to different cognitive processes [27, 81, 82]. And it implies that different expressions of psychopathologies may have their own causes of miscomprehension. For example, the cause of schizophrenic concretism has traditionally been understood as a difficulty with abstraction [83, 84]. In that sense, both metaphor and irony require an abstraction from the literal words, but irony further demands to integrate multiple mental states [8, 85, 86]. It is yet to explore whether specific sets of personality traits have their own processes hindering the comprehension of nonliteral language. To analyze this, there is a strong need to include assessments of abstraction (e.g., Wisconsin Card Sorting Test, [87]) and ecologically valid social cognition paradigms (e.g., The Awareness of Social Inference Test, [88]) as well as different forms of nonliteral language in future research.

Ironists do not intend to deceive but seek duplicitous understanding. As such, irony proves particularly challenging for mentalizing: It requires the listener to identify the other's and own perspective, their relation and context. In our study, errors indicated that in some instances patients decided to stick to the literal meaning, even when an incongruence between context and target sentence suggested otherwise. Reduced mentalization may make it more difficult for individuals with BPD to decide which of these two meanings the speaker wants them to believe [10]. As a solution, they may adhere to one of them [16, 89] and choose a context-inappropriate interpretation. Indeed, shifts in the representation of the self and of others have long been deemed problematic in BPD [31]. They constitute the main personality psychopathology captured in Criterion A of the DSM-5 [90] and are largely represented by borderline symptoms [91]. Empirically, patients with BPD experience difficulties alternating between egocentric and altercentric perspectives with face-morphing tasks [54] and show overlapping self-other boundaries on a bodily and cognitive level [53, 54]. Accordingly, in our study, patient's personal distress in response to others' emotions was higher and cognitive perspective-taking lower than those of HC, replicating previous findings on self-reported empathy scales in BPD [92–94]. However, both were unrelated to outcomes in our study of irony. Future studies should include more complex social cognition paradigms that may be more commensurate with metacognitive processes than with self-ratings [48], and speech varying in self-other representation (e.g., deceit and faux pas). Instead of categorical groups, it will be essential to dimensionally assess impairments in self and interpersonal functioning (criterion A, [90]); e.g., via the Levels of Personality Functioning Scale (LPFS, [95]), as well as maladaptive personality variants (criterion B, [96, 97]).

Contrary to our expectations, HC (and not BPD) tended to interpret stimuli critically when deciding whether a remark was meant literally or ironically. Interpreting literal praise ironically HC ascribed negative intent to literal praise ("I have an A in my test" "You are clearly not smart"), while ironic criticism was seen as literal criticism. The same negativity bias was evident in ironic praise and literal criticism: HC tended to interpret these statements literally, considering ironic praise as literal critique and literal critique as such. What could be the reason for this? In our everyday conversations, ironic remarks usually express a critical attitude [74, 98, 99]. So, when asked to look for irony, a negative bias is a strategy that promises the most success. In terms of our cultural knowledge and experience, HCs decisions about whether

or not to trust the literal remarks were therefore appropriate. Patients with BPD who grew up in an unreliable [6, 10, 11] communicative environment may not have developed such stable expectations about when interlocutors use what communicative intent [11]. And in a state of epistemic mistrust, a repeated experience such as "irony is typically negative" may not be internalized and generalized to other social contexts [11]. Instead, the trustworthiness of each new statement is assessed de novo. This can create uncertainty about what to expect and prevent efficient calibration of epistemic confidence, especially in ambiguous situations. Without stable priors, choosing whether to trust the negative (positive) context or the positive (negative) comment may thus be more random.

When it comes to explicit ratings of a critical or praising intent, the results are consistent with previous research on negativity biases. Both groups tended to rate ironic utterances as less praising and critical than literal ones, confirming the well-known perception of irony as "tinged" with the literal meaning [100, 101]. In contrast to implicit biases, patients with BPD perceived praising remarks as less praising than HC. So far, only a limited number of studies have investigated the effect of positive social stimuli in BPD [49]. Our findings are in line with BPD participants' fear of positive appraisal [102], negative ratings of appreciating video-clips [103] or self-referential information [104] and approach-avoidance behavior [105, 106]. Muting the positive experience of praise has major implications, since positive feedback is a crucial part of the therapeutic process [107] and of positive interactions with others. Yet, contrary to other studies [103] and patients with BPD's heightened rejection sensitivity [108] clinical participants did not differ to HC in perception of critical remarks.

The current study differs on multiple dimensions to tasks that often report a negativity bias [49, 109, 110]. First, it only included verbal stimuli. Negativity biases in BPD have mostly been found in non-verbal tasks such as facial emotion recognition [3, 49, 111, 112], especially in combination with other modalities [113, 114]. Second, we only assessed criticism and praise. Most biases in BPD regard anger and disgust [3, 111] or neutral stimuli [3, 61, 115]. Criticism only expresses dissatisfaction and less intense than anger. Further, irony is impossible to be neutral, as its principal function is to tacitly convey an opinion of the ironized content [52]. Third, implicit biases were assessed by asking participants to indicate the literalness of the stimulus (ironic vs. literal). In addition to explicit ratings of perceived intention, this allowed for a covert assessment of affective biases. In most emotion recognition paradigms, participants are asked directly about the emotion being displayed, which makes emotion as such the focus of attention and activates associated expectations about other people's affective states. It may be that negativity biases are more pronounced when explicitly asked about the valence rather than the literalness of a statement.

We are aware of several limitations. First, they concern the generalizability of our sample. The patient sample had a high verbal IQ and educational background, which may be less prevalent in BPD among the general population [116, 117]. Patients were recruited in a specialized ward for DBT [118], which trains the differentiation between self and other and emotion regulation. On the one hand, this may have even minimized the group differences in irony detection. On the other hand, active practice of emotion regulation skills may have contributed to the unbiased response pattern in BPD compared to HC. This is further supported by the fact that borderline symptoms showed no association with response bias across groups. Despite inclusion and exclusion criteria, there was a high comorbidity of traditional Axis I disorders, resulting in heterogeneous psychopathology in the sample. Second, other limitations concern the applied paradigm. The difficulty of the stimuli seemed to be limited, which is why ceiling effect may have attenuated effects. Further, our stimuli did not contain nonverbal language such as prosody, facial expression or body posture. In line with this, the concept of irony transcends verbal irony, such as situational irony, hyperbole or understatement [119]. However, the study focused on the messenger interface which is a major part of current communication. Third, we did not account for experienced abuse or neglect, which is associated with epistemic distrust [10]. Lastly, this study did not include clinical controls, leaving the question of clinical specificity to be explored.

Conclusions

This was the first study to provide evidence for an impaired irony detection in patients with BPD. Borderline symptoms explained this effect, but neither schizotypal traits nor empathy scales were related to outcomes of irony. While the use of ambiguous language is claimed to be restricted in therapeutic contexts with BPD patients [7, 107], the current study shows that this claim cannot be generalized to all forms of nonliteral language. With a preserved metaphor [78], but impaired irony comprehension in BPD, it seems that it is not the ambiguity of being nonliteral, but the ambiguity of the intention that imposes an obstacle for BPD. Just as irony forms a sense of collusion for those who understand [120], a patient's misunderstanding may leave them with feelings of exclusion. In BPD this may even lead to a rupture in the therapeutic relation. Patients with BPD only showed a negative bias when explicitly asked to rate perceived intention. To

them, praising remarks were considered less praising. Therapists and research alike naturally focus on negative social perceptions in BPD, but our results highlight the importance of targeting the diminished beneficial effect of positive feedback as well. Both findings emphasize the relevance of a shared and open discussion of the possible inferences BPD patients may draw from social interactions. But they also have significance for therapists. Together, they emphasize the need for practitioners to make their implicit mental states explicit, as encouraged in MBT [11, 107] and in DBT by specifying the dialectic [64, 118]. Our findings place a strong emphasis on MBT's claim to encourage practitioners to be especially transparent, self-revealing, and explicit about their thoughts to promote epistemic trust, open the epistemic channel to integrate culturally and personally relevant information, and model the capacity for intentional communication in the patient. But they also stress the vital role of the therapist's communication between the lines. Explicit mentalization is not a fully abstract process, but inherently interwoven with implicit, bodily intersubjectivity [121, 122]. Aligning words with intention and both with posture, prosody, and facial expression can serve to provide a clear basis for exploration of self and others in language.

Abbreviations

AMPD: Alternative Model of Personality Disorders; rmANOVA: Repeated measurements analysis of variance; BPD: Borderline personality disorder; BSL-23: Borderline Symptom List – short version; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders; HC: Healthy control participants; IC: Ironic criticism; IP: Ironic praise; IRI: Interpersonal reactivity index; LC: Literal praise; LP: Literal criticism; MASC: Movie for the Assessment of Social Cognition; MWT: German multiple-choice vocabulary test; PD: Personality disorder; SCID-II: Structured Clinical Interview for axis II personality disorders; SCID-I: Structured Clinical Interview for axis I; SDT: Signal detection theory; SPD: Schizotypal personality disorder; SPQ: Schizotypal personality questionnaire.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40479-022-00194-w.

Additional file 1. Example stimulus presentation of ironic criticism.

Additional file 2. Dichotomous (literality) and rating scale (perceived intention) for each stimulus.

Additional file 3: Supplementary Table 1. Results of the rmANOVA of the dependent variables irony detection accuracy and perceived intention based on literality, intention, and perspective of presented stimuli. There were no group differences and interactions regarding the perspective the participant adopted with regard to the written dialogues.

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Authors' contributions

AF, CK and AR designed the study. AF and CF acquired the data. CF and AF prepared the data for analyzing. AF analyzed the data. AF wrote the article, which all authors reviewed and approved for publication. The author(s) read and approved the final manuscript.

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Availability of data and materials

The datasets and material in the current study are available from the corresponding author upon request.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Commission of the Medical Faculty of the University Clinic of Tuebingen and complied with the Declaration of Helsinki. All participants provided written informed consent to participate in the study.

Consent for publication

Both actors provided written informed consent for publication of video and picture material of the irony paradigm.

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

3. Discussion

Human language has the unique ability to abstract not only from the world, but also from its own literalness. But just as finding the right words can be a challenge, so too can understanding them. Although the abstraction of language allows us to use tropes like irony and metaphor, the risk of being misunderstood is even greater when we try to convey meaning beyond words. Given that first-line treatment for BPD is psychotherapy based on language and communication, with medication only relevant for comorbid disorders (Lieb et al., 2020; Simonsen et al., 2019), therapists' careful choice of words can be crucial in avoiding feelings of rejection (Allen & Fonagy, 2006; Clarkin et al., 1999; Linehan, 1993). However, when it comes to non-literal language, there is a considerable amount of disagreement between different types of therapy, combined with a lack of empirical data. The current dissertation fills this gap. Its studies aimed to understand both the comprehension of irony and metaphor in BPD, as well as possible influencing factors such as mentalizing and schizotypal symptoms. In doing so, it provides the first findings for different rhetorical figures and, in turn, use their characteristics to contribute to a better understanding of the psychopathology of BPD.

Summary of results

The **first study** (pp. 16 - 25) examined the relationship between BPD symptomatology and metaphor comprehension. It differentiated between conventional and novel metaphors and compared performance with healthy individuals. While metaphor conventionality is likely to have an impact on interpretation difficulty (Bowdle & Gentner, 2005), it is not necessarily consistent with an individual's knowledge of phrasings (Rapp, Felsenheimer, et al., 2018). Therefore, the study further controlled for participants' individual familiarity with the stimuli. Contrary to the anticipated hypotheses, there was a robust comprehension of novel metaphors in both patients and HC, suggesting a preserved ability to construct and understand metaphorical meaning. While patients initially seemed to have more problems with conventional metaphors, the differences to HC disappeared when only familiar expressions were compared. Using the same metaphor paradigm in patients with SCZ, we previously found a similar effect of individual familiarity on

conventional metaphors (Rapp, Felsenheimer, et al., 2018) However, unlike our findings in BPD patients, SCZ patients' ability to comprehend novel metaphorical meaning remained impaired.

The second and third studies shifted the focus to irony detection in individuals with BPD symptoms and/or diagnoses. Difficulties with irony comprehension are known to relate to schizotypal traits (Langdon & Coltheart, 2004; Rapp et al., 2010), but evidence for BPD has only come from ToM paradigms using sarcasm (Dziobek et al., 2006; McDonald et al., 2003). This confounds not only irony with criticism, but neglects other intentions, such as ironic compliments (Bruntsch & Ruch, 2017). Therefore, in the **second study** (pp. 17 - 41), a new irony detection test was developed and evaluated. It was implemented in a messenger interface, video narratives and resolved the confound of a mocking tone by including both criticism and praise in ironic or literal statements. The first administration to a sample of 96 healthy adults supported the categorization in praising and critical variability and showed appropriate reliability. As in previous studies, schizotypal symptoms were associated with lower detection of ironic statements (Langdon & Coltheart, 2004; Rapp et al., 2010). For the first time, the study demonstrated a relation of borderline symptoms and irony detection difficulties.

The **third study** (pp. 42 - 54) replicated these preliminary findings in a clinical sample of individuals with BPD compared with HC. Given the frequent co-occurrence of borderline and schizotypal symptoms (Kwapil et al., 2021; Kwapil et al., 2022) and the association between schizotypy and irony detection in the second study, the experiment also took into account the possible influence of schizotypal symptoms in explaining an irony deficit in patients with BPD and HC. In addition, it extended the previous study by analyzing the sensitivity of irony detection and possible response biases within a signal detection framework. Although performance was high in both groups, our results confirmed lower sensitivity in a clinical sample of BPD patients compared with controls. Schizotypal symptoms did not account for this effect.

Mentalization in nonliteral language

Contrary to our predictions derived from the mentalization-based model of BPD (Fonagy et al., 2017) cognitive and affective empathy did not explain nonliteral language comprehension beyond borderline symptoms in all three studies. This effect is likely due to the way the constructs were assessed. There is little evidence that self-reported measures of empathy are a proxy for behavioral social-cognitive skills (Sunahara et al., 2022). Despite the regular use of self-report questionnaires in patients with BPD, the objective results of ToM tests may better explain mentalization than subjective data for dispositional empathy (Montag et al., 2012). However, this does not mean that pragmatic language comprehension and social cognition are two sides of the same coin. Although ToM may indeed be necessary in some cases of nonliteral language (Sperber & Wilson, 2002), it is not sufficient in all cases (Bosco et al., 2018). Even studies using objective mentalizing tasks in SCZ have yielded mixed results: Some find a relationship only with irony (Langdon, Davies, et al., 2002), some only with metaphors (Mo et al., 2008) and some only with non-conventional metaphors (Champagne-Lavau & Stip, 2010; Mazza et al., 2008).

Similarly, brain research has yet to determine which tropes require mentalizing and which do not (Spotorno et al., 2012). So far, meta-analytic fMRI data reveal that comprehending nonliteral language involves both social cognition and language comprehension networks (Hauptman et al., 2023; Rapp, 2019; Rapp et al., 2012). This in turn suggests at least two, if not more, sources of misunderstanding: linguistic processes and social cognition (Landau et al., 2010; Pfeifer & Pexman, 2023). And just as the schizophrenia spectrum and BPD are only overlapping, not identical (Beatson et al., 2019; Cavelti et al., 2021; Niemantsverdriet et al., 2017; Pearse et al., 2014; Slotema et al., 2019; Slotema et al., 2017; Slotema et al., 2012), each of these clinical conditions may have their own processes that interfere with the comprehension of nonliteral language. The typical assessment of concretism, the verbal responses of SCZ patients to proverbs, is an excellent illustration of the various mechanisms leading to misinterpretation. For example, not only a lack of abstraction, i.e., from sticking to the literal meaning (concretism, “The sun shines on everybody” as response

to: "The sun shines on us all alike"; Brattemo, 1961) but also bizarre thinking (“It’s love, I think of it as love” as response to: "Rome wasn’t built in a day"; Marengo et al., 1986), may lead to incorrect responses to given proverbs.

SCZ and BPD

The current results of patients with BPD differed from those of individuals with SCZ and schizotypal traits in previous studies (Langdon & Coltheart, 2004; Rapp, Felsenheimer, et al., 2018; Rapp et al., 2010). Unlike BPD patients, SCZ patients performing the same metaphor task as in the current study showed impaired novel metaphor comprehension. In addition, although schizotypal traits have been reported to be associated with poorer irony comprehension, they did not explain the poorer performance of patients with BPD in our results. Although the lack of clinical controls in the studies precludes definitive differential diagnostic conclusions, disorder-specific processes may tentatively explain these findings.

In general, the necessary condition for understanding any type of nonliteral language is to identify it as nonliteral (Grice, 1975). Patients with SCZ, however, potentially show difficulties to inhibit the literal words in the first place (Rapp et al., 2013). Such concretistic thinking would imply problems with all types of nonliteral statements, regardless of their type. Indeed, patients with SCZ show impairments not only in metaphors (Bambini et al., 2020; Mossaheb et al., 2014; Rapp, Felsenheimer, et al., 2018; Rapp, 2019; Rossetti et al., 2018) or irony (Langdon, Davies, et al., 2002; Parola et al., 2021; Rapp et al., 2013; Rapp et al., 2014; Rapp et al., 2010), but also in proverbs (Rapp & Schmierer, 2010; Rapp et al., 2014; Rosen et al., 2021), idioms (Iakimova et al., 2006; Rapp, 2019; Sela et al., 2015) or indirect requests (Champagne-Lavau & Stip, 2010; Champagne-Lavau et al., 2006).

In this context, both metaphor and irony comprehension in SCZ appear to be related to language processing networks rather than ToM areas (Kircher et al., 2007; Mitchell & Crow, 2005). Specifically, metaphor miscomprehension in SCZ is linked to semantic networks (Kircher et al., 2007), language, and executive functions (Rossetti et al., 2018). Similarly, irony comprehension problems across

the schizophrenia spectrum appear to involve lateral temporal language network dysfunction (Rapp et al., 2013; Rapp et al., 2010).

In contrast to patients with SCZ, in the current thesis, individuals with BPD showed effortless interpretation of novel metaphorical meanings. On the one hand, if one form of nonliteral language is understood and the other not, it provides further evidence that, despite Grice's (1975) initial assumption, comprehending nonliteral language may not be sufficiently described by one mechanism for all types. For BPD, it implies not only an intact ability to detect non-literality, but also to map semantic concepts to gain a new metaphorical meaning. At least on a behavioral level this clearly speaks against a dysfunction in semantic or language-related areas as a reason for difficulties in irony. Clearly, this needs to be tested in further studies that replicate the results and potentially investigate their neurological basis. However, if future studies show that the semantic abilities that affect the lack of understanding of irony in schizotypy are indeed intact in BPD, it would explain why schizotypy does not account for the reduced understanding of irony in BPD patients.

If not for its non-literal nature, it would seem that there must be something specific about irony that makes it difficult for people with BPD to recognize it. Several factors could explain this observation. First, in social cognition research, patients with BPD have been reported to have the most difficulty with complex tasks that require considering multiple perspectives in context (Herpertz et al., 2014; Németh et al., 2018; Roepke et al., 2013) and self-other distinction (De Meulemeester, Lowyck, & Luyten, 2021; De Meulemeester, Lowyck, Panagiotopoulou, et al., 2021; Luyten et al., 2021). Likewise, to understand irony, we need to understand that speakers do not want us to trust their words, i.e., we need to be able to determine what one person thinks about another person's thoughts. This type of meta-representation, or second-order ToM (Happé, 1993; Monetta et al., 2009), makes irony a prime example of integrating multiple perspectives and self-other distinctions. In this way, our results confirm complex video paradigms that include sarcasm as stimulus material and present multiple characters in interaction (McLaren et al., 2022; Németh et al., 2018; Petersen et al., 2016).

Second, patients with BPD tend to hold the belief that they will be betrayed and abandoned (Fertuck et al., 2018). They can experience a general lack of trust in others (Fertuck et al., 2019; Orme et al., 2019) and evaluate social cues as untrustworthy (Fertuck et al., 2013; Miano et al., 2013; Nicol et al., 2013). It is possible that when faced with ambiguous social information, such as ironic praise and criticism, patients may have difficulty deciding whether or not to trust the words spoken - but not when spoken literally. Following this line of reasoning, it would be the ambiguity of the speaker's intention, not the non-literality, that is the obstacle for individuals with BPD.

Irony and metaphor

The present work not only examined two different forms of nonliteral language, but further differentiated their linguistic characteristics and how they affect comprehension in patients with BPD. In metaphors, we differentiated between novel expressions, as well as frequent and conventional expressions. Previous research suggests that novel metaphors are more difficult to comprehend due to the need for active mapping of meaning (Bowdle & Gentner, 2005; Desai et al., 2011; Holyoak & Stamenković, 2018). Our findings replicated this effect in both patients and healthy controls. When we hear a conventional expression many times, we tend to understand it almost literally, like any other word we know (Holyoak & Stamenković, 2018). But just because a linguistic community considers an expression conventional, it doesn't mean that every individual in the community has heard it before. This may be true for patients with BPD, who tended to have lower familiarity with conventional metaphors in the current experiment. This underscores the need in clinical settings, but also in research on nonliteral language, to be aware of the different linguistic habits between and within patients and health care providers. To date, in most experimental designs of nonliteral language in psychiatric disorders, researchers, independent raters, or dictionaries determine familiarity, not the participants themselves (Mossaheb et al., 2014). For example, in SCZ, only two studies have shown that patients are less familiar with figurative language than HC (Rapp, Felsenheimer, et al., 2018; Thoma et al.,

2009). While in Rapp, Felsenheimer, et al. (2018) an alleged deficit in understanding conventional metaphors disappeared when only familiar metaphors were considered, in Thoma et al. (2009) differences in proverbs remained. This suggests that familiarity clearly has an impact on alleged group differences, but in contrast to BPD, it does not explain the full picture in SCZ. Importantly, it supports the notion that differential cultural knowledge and repeated exposure may contribute to miscommunication with patients from different ethnocultural backgrounds. For example, African Americans recognize more proverbs than Whites when they are drawn from African American culture (Brown & Wright-Harp, 2011). Despite the emphasis of psycholinguistic theory (Kreuz & Link, 2002; Pfeifer & Pexman, 2023) and empirical research (Bruntsch & Ruch, 2017; Filik et al., 2015; Thompson et al., 2016) on the significance of distinguishing between the valence of ironic statements, clinical investigations on irony comprehension often conflate irony with sarcasm (Dziobek et al., 2006; McDonald et al., 2003; Rapp, Purr, et al., 2018). In an effort to disentangle these constructs and employ a signal detection approach, the current study investigated both implicit and explicit response biases by incorporating both praise and criticism. Given that individuals with BPD frequently display heightened sensitivity to emotional stimuli (Gunderson et al., 2018; Herpertz et al., 2014) and attenuated perception of positive feedback (Jeung et al., 2018; Reichenberger et al., 2017; Weinbrecht et al., 2020; Winter et al., 2015), we predicted that judgments of literalness would be contingent on the critical or praising intention of the statement. However, our findings indicated that this was not the case for either healthy adults with borderline symptoms (study one) or the clinical sample of BPD patients (study two). Contrary to our initial hypotheses, healthy individuals tended to interpret the stimulus literally in a mocking manner, which challenges the notion of a negativity bias in BPD. Notably, this indirect negativity bias was only evident in healthy controls when asked to classify the statement as ironic or literal, but not when asked to judge the critical or praising intention. In contrast, individuals with BPD exhibited a tendency to perceive compliments as less praiseworthy, regardless of whether they were expressed ironically or not, when explicitly asked to judge the critical or praising intent of the statement.

The inclination of HC to select the negative interpretation as ironic could potentially be explained by the "asymmetry of affect" in the usage of irony, where criticism prevails as the dominant form of ironic expression (Kreuz & Link, 2002; Sperber et al., 1981). In that sense, the search for negative intent may simply reflect a strategy based on our daily experiences with irony. With a lack of epistemic trust, individuals with BPD may be less likely to integrate their experiential knowledge about communication (Fonagy & Bateman, 2008; Fonagy et al., 2015; Fonagy et al., 2017). In the absence of stable priors of how irony is usually expressed, BPD individuals would need to make new decisions about the credibility of statements each time. As this study is the first to explore irony comprehension using this particular approach in both BPD and healthy adults, it is crucial that the results are replicated to ensure their robustness and reliability. Notably, the social function of irony appears to be preserved in BPD, despite their tendency to perceive compliments as less praiseworthy. Irony is a well-established mechanism for diminishing the severity of criticism while also reducing the impact of praise (Dews & Winner, 1995; Pexman & Olineck, 2002). This effect was observed in both healthy controls and BPD patients. Consequently, this suggests that once individuals with BPD comprehend the irony, its semantic and pragmatic functions are comparable to those of HC.

Limitations and future work

The current thesis has several limitations that should be addressed to ensure accurate interpretation and generalization of the findings and to guide future research.

Firstly, the paradigms differed in their social embeddedness and ecological validity. It is unclear whether the results for metaphors would be different if they were presented as part of a conversation (Mashal & Faust, 2010). However, the use of minimal stimuli allowed us to assess metaphorical thinking without potentially confounding social interactions. Verbal irony, defined as saying the opposite of what is intended (Garmendia, 2018, p. 18; Lausberg, 1960, § 582), is necessarily embedded in a conversational setting, and the stimulus presentation used in the study was designed to resemble everyday conversations. To control for these


Figure 1. Example of visual irony.

confounds, future studies could integrate metaphoric and ironic expressions into the same paradigm, such as using the messenger-interface from our irony paradigm. Conversely, studies of irony comprehension could be complemented by paradigms that examine whether ironic thinking is impaired or preserved in BPD outside of social settings. Defined as a structural incongruity between what is expected and what is presented, irony exists in several forms other than verbal irony, such as in situations (Lucariello, 2007). For instance, ironic thinking could be evaluated through visual juxtapositions or contradictions without the need for a conversational setting.

Second, upon examining Figure 1, it becomes apparent that not only metaphors are heavily reliant on pre-existing cultural knowledge (Dews et al., 1995; Pexman, 2005), which can pose a challenge for individuals who are not familiar with the cultural references. This also includes the knowledge of certain ironic markers such as mimic (wink), prosodic hints (Attardo et al., 2003) or emoticons in written language (Thompson et al., 2016). It becomes even more important as BPD patients in the current study were less familiar with conventional metaphors, suggesting that cultural knowledge may affect their ability to understand irony as well. Furthermore, it was beyond the scope of this study to examine every form of non-literal language. Even metaphors occur in many more variations than those used in the current dissertation (Holyoak & Stamenković, 2018). For example, art therapy often works with visual metaphors (Koch, 2017) or dance therapy with the physical body (Böger, 2012). All of this clearly limits the generalizability of our results. Further research could explore other rhetorical figures, including proverbs, metonymies, or indirect speech, to better understand the scope and boundaries of BPD patients' cognitive abilities in this domain.

Third, the inclusion of praise and criticism in the irony paradigm introduced a valence, which may have added complexity to the process that was not present in the metaphor task. In contrast to neutral metaphors, emotional content modulates

the neural response in metaphor comprehension (Samur et al., 2015), and activates the amygdala (Bohrn et al., 2012). Given that individuals with BPD often exhibit higher sensitivity to emotional stimuli (Herpertz et al., 2014; Miano et al., 2013; Schmahl et al., 2014), with a tendency to a heightened physiological reaction (Bortolla et al., 2019), our results cannot be extrapolated to all metaphoric content. Therefore, although the current study demonstrated a robust capacity for metaphorical thinking in BPD, future research needs to rule out that emotional metaphors, which is true of most metaphors in therapeutic settings (Linehan, 2015a), are as easily understood.

Fourth, the questions posed to participants in the tasks differed between tasks. Specifically, the irony test explicitly asked about the literalness of the stimulus, whereas our metaphor paradigm provided predefined response alternatives for the meaning of the expression. Previous research with other clinical diagnoses has shown that performance can vary depending on the response format used (Bambini et al., 2020; Kalandadze et al., 2018). In this context, an open-response format is likely to be favorable. It allows for the identification of the types of errors that lead to a miscomprehension of an utterance, providing a rich basis for further hypotheses. As seen in the open-ended responses of individuals with SCZ to proverbs (Brattemo, 1961, 1962; Marengo et al., 1986), the examiner can directly analyze the origin of the misunderstanding. For example, individuals with BPD have been shown to overinterpret or “hypermentalize” rather than lack the ability to take perspective (McLaren et al., 2022). Both would lead to reduced irony recognition, but with different clinical implications.

In line with this, the present thesis exclusively examined language comprehension; however, there is at least some empirical data that individuals with BPD employ sarcasm towards their therapist as a means of expressing anger (Chalker et al., 2015; Snyder et al., 1985). This naturally raises the question of whether the production and reception of nonliteral language may differ in their underlying mechanisms (Kałowski et al., 2023), opening up a novel future research domain, that is so far almost unexplored (Barnden & Gargett, 2020).

Finally, the current thesis did investigate irony and metaphor comprehension in two separate experiments. While this approach allowed for tailored control variables specific to each form of language, caution must be taken when comparing the two forms of comprehension in BPD patients. Similar care must be taken when comparing the performance of BPD patients to those with SCZ in understanding nonliteral language. Borderline (studies 1-3) and schizotypal (studies 2-3) symptoms were assessed dimensionally across groups. Consistent with the AMPD's conceptualization of personality disorders as continuous manifestations, borderline symptoms outperformed group comparisons in both metaphor and irony studies. Nonetheless, it is imperative that future studies include clinical control groups to elucidate the distinct mechanisms underlying each disorder. Combining various nonliteral expressions and clinical controls in one experimental setting would allow for more precise hypotheses and operationalization of the underlying social and linguistic processes, which may vary depending on the specific trope and clinical condition being studied.

Clinical implications

When therapy is based primarily on verbal communication, finding the right words is essential to avoid misunderstandings. However, therapeutic approaches differ significantly in whether or not non-literal language is considered appropriate when communicating with patients with BPD. While DBT considers metaphors a central component of its approach, MBT explicitly discourages their use, and TFT sees the benefits of self-generated imagery. Until now, there was no empirical data to support either of these recommendations. The results of this in this dissertation may provide preliminary evidence and answers.

The current data do not completely rule out the possibility that irony can be used in the context of irreverent communication, as irony detection was high in both clinical and non-clinical individuals. However, borderline symptoms increased the likelihood of misinterpreting ironic remarks. Creating misunderstandings through the therapist's use of irony would clearly impede the establishment of a factual, authentic, and transparent foundation in therapy, which is essential for the construction of a validating environment (Bedics & McKinley, 2020). Irony can be

used as a way to define social belonging (Dews & Winner, 1995), but failure to understand it can lead to exclusion. The potential damage of the therapeutic relationship reinforces that the effectiveness of the irreverent communication style is highly dependent on the simultaneous validation and support of the therapist (Linehan, 1993, p. 396). Likewise, irony creates a distance between what is said and what is meant (Dews & Winner, 1995). This enables irony to soften criticism, but also obscure praise, making it a prominent tool for saving one's face in conversations (Clark & Gerrig, 1984; Jorgensen, 1996; Sperber et al., 1981). In a clinical setting, however, there appear to be more validating and matter-of-fact strategies for providing praise and criticism that carry less risk of leaving a patient feeling rejected.

When it comes to metaphors, the study finds that patients with BPD demonstrate a solid understanding of metaphorical content. This finding confirms the clinical experience of DBT programs. Metaphors can facilitate understanding of complex concepts and assist patients in generating their own solutions and insights (Linehan & Heard, 1992, p. 391). As noted above, this implication should be considered with the caveat that the current work did not account for emotional content and, more importantly, showed that BPD patients were less familiar with conventional metaphors. Therefore, it is crucial to take into account the knowledge of the patient and, in case of doubt, to provide sufficient explanations. Following TFT (Clarkin et al., 1999), one method to avoid misunderstandings due to lack of familiarity might be to embed metaphors in the individual's history and let the patient choose familiar images or, if necessary, provide guiding explanations. As suggested in DBT, these could be developed alternately with the patient and the therapist to ensure common ground (Linehan & Heard, 1992, p. 391). In this way, the metaphors can create distance from the issue at hand, potentially making it less intimidating and daunting to approach (Linehan & Heard, 1992, pp. 390 - 391). Used within the patient's knowledge, metaphors can thus reduce resistance and promote a positive therapeutic relationship by establishing a common basis for communication - without creating a hierarchy based on scientific and complex explanations.

Whereas irony hides the intention of the speaker, metaphors make the mental state directly available to the other person, potentially bringing interlocutors closer together (Colston & Katz, 2004). In fact, some studies have shown that metaphors increase perceived intimacy (Bowes & Katz, 2015; Horton, 2007, 2013). For example, in fictional narratives, readers tend to perceive characters as having a deeper understanding of each other when their interactions involve the use of metaphors, even when there is no explicit evidence that the characters actually understand each other (Horton, 2007). Furthermore, Bowes and Katz (2015) showed that reading metaphors induces a general orientation toward interpersonal information. Most strikingly, it also improved participants' subsequent performance on ToM tasks (Bowes & Katz, 2015). In line with this, metaphorical thinking has been shown to be a driving factor in the development of ToM (Del Sette et al., 2020). While irony obscures direct access to another person's mind, metaphors may actually help us reach it.

The unique role of metaphor in making sense of one's own and others' mental worlds seems to contribute to the formation of social thought (Landau et al., 2010). Rather than being omitted from therapeutic settings due to a presumed lack of mentalizing (Bateman & Fonagy, 2003, p. 204), metaphors appear to promote it. By promoting sensitivity to social cues (Bowes & Katz, 2015) and establishing intimacy, metaphors could potentially help patients learn that the social information being conveyed is trustworthy, thereby restoring the capacity for social learning - and with it, epistemic trust (Folmo et al., 2021). In other words, they can serve as ostensive cues themselves.

Conclusion

The careful choice of words by therapists is crucial, especially in a disorder characterized by rejection sensitivity, emotional dysregulation, and difficulties in mentalization. Even more so in nonliteral language, when the intention differs from what is literally said leaves room for (mis)interpretation. Integrating linguistic and psychopathological knowledge, this thesis presents the first empirical studies on irony and metaphor comprehension in individuals with BPD, bridging conflicting clinical suggestions with empirical data.

In short, borderline symptoms were associated with lower detection of irony, but preserved metaphor comprehension. These findings have implications for both psycholinguistics and clinical practice. From a psycholinguistic perspective, the results support post-Gricean theories that suggest that comprehension of nonliteral language requires more than the ability to detect nonliterality (Winner & Gardner, 2012). Clinically, the findings contradict the MBT recommendation against using metaphor, while supporting its frequent use in DBT. While the current work warrants caution in the use of irony with BPD patients, it promotes metaphor as a powerful and distinctive tool for shaping our understanding of the world. A tool that simplifies complex ideas and emotions, makes them more relatable, and creates shared understanding.

Summary

Human language has the unique ability to transcend not only the physical world, but also its own literal words. This allows for non-literal “figurative” language such as irony and metaphor, but also carries the risk of misunderstanding. As psychotherapy constitutes the first-line treatment for borderline personality disorder (BPD), the careful choice of words is vital - especially in a disorder characterized by rejection sensitivity, emotional dysregulation, and difficulties in mentalization. However, when it comes to the use of non-literal language, there is a significant disagreement among therapies, and a paucity of empirical data to guide clinical practice. While Dialectical Behavior Therapy (DBT) is rich in metaphor and, in some cases, allows for irony, Mentalization-based therapy strictly discourages their use. And despite the shared symptoms between BPD and schizophrenia, nonliteral language has only been studied in the latter, never in BPD.

Integrating knowledge from both linguistics and psychopathology, the studies in this thesis are the first to test clinical considerations about nonliteral language comprehension in BPD with empirical data. By assessing irony and metaphor, two types of nonliteral language are considered, each controlled for its specific linguistic characteristics. All three studies examine mentalization through cognitive and affective empathy as potential influences on comprehension. Borderline symptoms are assessed dimensionally to address the shortcomings of traditional categorical approaches to personality disorders.

The **first study** examined metaphor comprehension in patients with BPD compared to healthy controls (HC). The paradigm distinguished between two types of metaphors: novel metaphors, which require active construction of meaning, and conventional metaphors, which are interpreted almost literally. Because conventional expressions may be unfamiliar to the individual, the study also assessed participants' familiarity with them. Patients with BPD had robust comprehension of novel metaphors, suggesting a preserved ability to construct metaphorical meaning. Reported problems with conventional metaphors disappeared when familiarity was taken into account.

Next, the thesis examined irony comprehension in both clinical and non-clinical populations. Social cognition research frequently conflates irony with sarcasm, linking it to a critical attitude and neglecting ironic compliments. With a heightened sensitivity for to rejection, this is particularly problematic for BPD. Thus, the **second study** devised an irony paradigm that embedded ironic, literal, critical, and praising conversations into a messenger interface. The new paradigm was tested in healthy adults and related to borderline and schizotypal traits. The paradigm showed high reliability and the data confirmed distinct factors for each item category, underscoring the importance of distinguishing ironic praise and criticism. Beyond the known relation between irony and schizotypal symptoms, for the first time, borderline symptoms were associated with reduced irony detection.

The **third study** aimed to replicate the previous findings on irony detection in BPD patients while controlling for schizotypal symptoms. To achieve this, a signal detection framework was applied to assess sensitivity and response bias. Results confirmed that, independent of schizotypal symptoms, BPD patients were less sensitive than controls in discriminating between ironic and literal remarks. While HC tended to interpret the literalness of a stimulus more critically, BPD patients showed an explicit tendency to perceive praising remarks as less praising.

Across studies, mentalization did not explain performance beyond borderline symptoms, possibly due to its assessment as a self-report questionnaire. Consistent with the continuous conceptualization of personality disorders, borderline symptoms outperformed all group comparisons.

This thesis offers the first empirical evidence on nonliteral language comprehension in BPD. Patients demonstrated comprehension of metaphoric language, but had difficulty with irony , suggesting that it may be the ambiguity of the speaker‘s intention, rather than the nonliteral language itself, that impedes their comprehension. The findings urge caution with irony, but clearly support the use of metaphor in therapy, potentially helping to understand complex contexts, symptoms or feelings, and to establish a common ground for communication.

German summary

Die menschliche Sprache hat die einzigartige Eigenschaft, nicht nur die physische Welt, sondern auch ihre eigene wörtliche Bedeutung zu transzendieren. Dies ermöglicht nicht-wörtliche „figurative“ Sprache wie Ironie und Metapher, birgt aber auch die Gefahr von Missverständnissen. Da die primäre Behandlung der Borderline-Persönlichkeitsstörung (BPS) in der Psychotherapie besteht, ist eine sorgfältige Wortwahl von entscheidender Bedeutung - insbesondere bei einer Störung, die durch Ablehnungssensibilität, emotionale Dysregulation und Schwierigkeiten bei der Mentalisierung gekennzeichnet ist. Allerdings geben unterschiedliche therapeutische Schulen diskrepante Empfehlungen zur Verwendung nicht-wörtlicher Sprache, und es fehlen empirische Daten, die als Leitfaden für die klinische Praxis dienen könnten. Während die Dialektisch-Behaviorale Therapie (DBT) reich an Metaphern ist und in einigen Fällen auch Ironie zulässt, rät die Mentalisierungsbasierte Therapie strikt von deren Verwendung ab. Während nicht-wörtliche Sprache bei Schizophrenie jedoch ausreichend erforscht ist, gibt es bisher keine Studien bei der BPS, obwohl beide Störungsbilder sich symptomatisch überschneiden.

Durch die Verbindung von Linguistik und Psychopathologie sind die vorliegenden Studien die ersten, die die klinischen Überlegungen über das Verständnis nichtwörtlicher Sprache bei Patient*innen mit BPS durch empirische Daten überprüfen. Mit Ironie und Metapher werden zwei unterschiedliche Formen nicht-wörtlicher Sprache gewählt, die jeweils auf ihre spezifischen sprachlichen Merkmale hin überprüft werden. In allen Studien wird Mentalisierung anhand von Fragebögen zu kognitiver und affektiver Empathie als möglicher Einfluss auf das Verstehen untersucht. Um den Unzulänglichkeiten traditioneller kategorialer Ansätze für Persönlichkeitsstörungen Rechnung zu tragen, werden Borderline-Symptome zusätzlich dimensional erfasst.

Die **erste Studie** untersuchte das Metaphernverständnis von Patient*innen mit BPS im Vergleich zu gesunden Kontrollpersonen (GK). Das Paradigma unterschied zwei Arten von Metaphern: neue Metaphern, die eine aktive Bedeutungs-

konstruktion erfordern, und konventionelle Metaphern, die fast wörtlich interpretiert werden. Da konventionelle Metaphern den einzelnen Personen nicht unbedingt geläufig sind, wurde auch die individuelle Vertrautheit der Teilnehmer*innen erfasst. Patient*innen mit BPD zeigten ein solides Verstehen neuer Metaphern, was auf eine erhaltene Fähigkeit zur Konstruktion metaphorischer Bedeutungen hindeutet. Scheinbare Probleme mit konventionellen Metaphern konnte durch eine fehlende Vertrautheit erklärt werden.

Anschließend wurde das Verständnis von Ironie in klinischen und nicht-klinischen Populationen untersucht. In der Forschung zur sozialen Kognition wird Ironie häufig mit Sarkasmus gleichgesetzt, wodurch sie mit Kritik assoziiert wird und ironische Komplimente unbeachtet bleiben. Aufgrund der erhöhten Sensibilität für Zurückweisung ist dies bei Patient*innen mit BPS besonders problematisch. Daher wurde in der **zweiten Studie** ein Ironie-Paradigma entwickelt, das ironische, wörtliche, kritische und lobende Konversationen in eine Messenger-Benutzeroberfläche einbettet. Das neue Paradigma wurde an gesunden Erwachsenen getestet und mit borderline und schizotypen Eigenschaften in Beziehung gesetzt. Der Test zeigte eine hohe Reliabilität und distinkte Faktoren für jede Itemkategorie, was die Notwendigkeit der Unterscheidung von ironischem Lob und Kritik untermauert. Neben den bekannten Zusammenhängen von Ironie und schizotypen Symptomen wurden erstmals auch Borderline-Symptome mit einer reduzierten Ironieerkennung in Verbindung gebracht.

Ziel der **dritten Studie** war es, die Ergebnisse der vorherigen zu replizieren und dabei für schizotype Symptome zu kontrollieren. Durch die Anwendung von Methoden der Signalentdeckungsthorie wurden zusätzlich Sensitivität und Antwortverzerrung untersucht. Die Ergebnisse bestätigten, dass Patient*innen unabhängig von schizotypen Symptomen schlechter zwischen ironischen und wörtlichen Äußerungen unterscheiden konnten als GK. Während GK dazu neigten, die Wörtlichkeit eines Stimulus kritische zu interpretieren, zeigten Patient*innen mit BPS die Tendenz, lobende Äußerungen als weniger lobend wahrzunehmen.

In allen Studien erklärte die Mentalisierung nicht mehr als Borderline-Symptome, was möglicherweise auf Erhebung als Fragebogen zurückzuführen ist. In Über-

einstimmung mit der kontinuierlichen Konzeptualisierung von Persönlichkeitsstörungen erklärten Borderline-Symptome die Ergebnisse besser als Gruppenvergleiche.

Diese Arbeit liefert die ersten empirischen Befunde zum Verständnis nicht-wörtlicher Sprache bei Patient*innen mit BPS. Patient*innen zeigten ein robustes Metaphernverstehen, jedoch Schwierigkeiten mit Ironie. Die Ergebnisse deuten daher gegebenenfalls darauf hin, dass es die Ambiguität der Intention und nicht die Wörtlichkeit der Sprache ist, die das Verständnis erschwert. Während Ironie in der Therapie vorsichtig eingesetzt werden sollte, scheint der Einsatz von Metaphern unterstützenswert - insbesondere, da sie helfen können komplexe Zusammenhänge, Symptome oder Gefühle zu verstehen und eine gemeinsame Basis für die Kommunikation zu schaffen.

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Declaration of contribution

Die Arbeit wurde in der Klinik für Psychiatrie und Psychotherapie Tübingen unter der Betreuung von PD Dr. Alexander Rapp durchgeführt.

Die Konzeption der ersten Studie erfolgte in Zusammenarbeit mit Dr. med. Carolin Kieckhäfer und Alexander Rapp.

Genauere Angaben zu den jeweiligen Anteilen der Co-Autor*innen finden sich in der angefügten Declaration of Contributions.

Ich versichere, das Manuskript selbständig verfasst zu haben und keine weiteren als die von mir angegebenen Quellen verwendet zu haben.

Berlin, den 9. Mai 2023

Herewith I, Anne Katrin Felsenheimer, declare, that I have contributed to the major part of the following publications:

1. **Kieckhäfer, C.*, Felsenheimer, A. K.*, & Rapp, A. M. (2019). A New Test for Irony Detection: The Influence of Schizotypal, Borderline, and Autistic Personality Traits. *Frontiers in psychiatry*, *10*, 28. https://doi.org/10.3389/fpsyt.2019.00028**

   *equal contribution

Contribution	Anne Katrin Felsenheimer	Carolin Kieckhäfer	Alexander Michael Rapp
Research concept	40%	40%	20%
Selection of methods	45%	45%	10%
Recruitment of patients	50%	50%	0%
Data acquisition	10%	90%	0%
Data analysis	60%	40%	0%
Interpretation of results	50%	50%	0%
Preparation of manuscript	50%	50%	0%
Editing	0%	0%	100%
Supervising	0%	0%	100%

2. **Felsenheimer, A., Kieckhaefer, C., & Rapp, A. M. (2020). Familiarity, empathy and comprehension of metaphors in patients with borderline personality disorder. *Psychiatry research*, *291*, 113152. https://doi.org/10.1016/j.psychres.2020.113152**

Contribution	Anne Katrin Felsenheimer	Carolin Kieckhäfer	Alexander Michael Rapp
Research concept	40%	40%	20%
Selection of methods	45%	45%	10%
Recruitment of patients	50%	50%	0%
Data acquisition	50%	50%	0%
Data analysis	100%	0%	0%
Interpretation of results	90%	10%	0%
Preparation of manuscript	100%	0%	0%
Editing	0%	50%	50%
Supervising	0%	0%	100%

3. **Felsenheimer, A., Kieckhäfer, C., & Rapp, A. (accepted). Irony detection, implicit and explicit response biases in patients with borderline personality disorder. *Borderline personality disorder and emotion dysregulation.***

Contribution	Anne Katrin Felsenheimer	Carolin Kieckhäfer	Alexander Michael Rapp
Research concept	40%	40%	20%
Selection of methods	45%	45%	10%
Recruitment of patients	50%	50%	0%
Data acquisition	50%	50%	0%
Data analysis	100%	0%	0%
Interpretation of results	100%	0%	0%
Preparation of manuscript	100%	0%	0%
Editing	0%	50%	50%

Academic contributions

Publications

Heekerens, J. B., **Felsenheimer, A.,** Lebovitz, J., & Černis, E. (2025). The Černis Felt Sense of Anomaly (ČEFSA) Scale: Psychometric Properties and Validity of a German Version. Psychological Test Adaptation and Development, 6, 54–68. https://doi.org/10.1027/2698-1866/a000097

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Felsenheimer, A., Garfinkel, S., Villringer, A. & Haggard, P. Is self-touch anxiolytic? International Max Planck Research School on Cognitive NeuroImaging (IMPRS CoNI) & University College London Summer School, September 2024, London, UK.

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Spalek, K., **Felsenheimer, A.**, Sun, C. & Koch, X. Individual differences in recall of focused words and contextual alternatives. Workshop on Individual Differences in Pragmatics and Discourse (IndiPRAG), September 2023, Saarbrücken, Germany.

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Felsenheimer, A. & Rapp, A. A meta-analysis on proverb comprehension in schizophrenia considering 60 years of research. Schizophrenia International Research Society (SIRS) Conference, April 2022, Florence, Italy.

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Arbuzova, P., **Felsenheimer, A.,** Espinosa, P. & Filevich, E. Relationship between metacognition of motor, visual and memory processes. Mind, Brain, Body Symposium, MindBrainBody Institute, March 2021, Berlin, Germany.

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