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Creative puppet therapy reduces hallucinations in patients diagnosed with schizophrenia: Preliminary findings

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ABSTRACT

Anomalous experiences and hallucinations characterize schizophrenia. This study aimed at determining the efficacy of creative puppet therapy (CPT; creation of a puppet with malleable DAS) to reduce severe anomalous experiences and hallucinations among patients diagnosed with schizophrenia. Double-blinded, controlled trials were performed on a convenience sample of 24 patients from a mental health center. The intervention group of 12 patients (who created puppets) and the pseudo-treatment group of 12 patients (who were involved in outdoor leisure trips) were compared to the control group of 12 control participants (who created puppets). *Cardiff Anomalous Perceptions Scale* (CAPS) assessed hallucinations; *Emotional Expression Inventory* (EEXI) assessed the emotional expression of one's own puppet. Puppet facial features were measured. Results showed that CPT effectively reduced ($d = -4.00$) hallucination frequency in patients. Hallucination reduction occurred across all sensory modalities, but touch and bodily interoception. Exteroceptive vs. interoceptive hallucinations was the most valuable classification in patients. Compared to controls, puppets created by patients expressed more negative emotions and had larger eye diameters, shorter noses, and larger whole face width. Eye diameter was correlated with fear, sadness, anger, and disgust, and whole face width with boredom. Fragmented-self integration of schizophrenia through CPT treatment might exploit aggregative dominance of the patient's own body.

1. Introduction

Schizophrenia spectrum disorders are characterized by "delusions, hallucinations, disorganized thinking (speech), grossly disorganized or abnormal motor behaviors (including catatonia), and negative symptoms" [Diagnostic and Statistical Manual of mental disorders, Fifth edition (DSM-5), APA, 2013, page 87]. Hallucinations may be one of the most invalidating pathologies of schizophrenia, with auditory hallucinations that are more common than visual and then tactile and olfactory (McCarthy-Jones et al., 2017). Moreover, patients diagnosed with schizophrenia have difficulty with the emotion regulation process, substantial emotion awareness deficits, a lower threshold of negative emotional intensity, and struggle with ruminations when confronting negative experiences (O'Driscoll et al., 2014; Visser et al., 2018).

Therapies for alleviating hallucinations in schizophrenia are vital. In past decades, art therapy interventions have emerged to treat patients diagnosed with psychosis. For example, role-play therapy used puppets (Irwin, 1985). Puppet art therapy typically uses standard pre-crafted puppets. In a narrative review on the use of puppets on patients diagnosed with psychosis, Rojas-Bermudez and Mojano (2020) wrote that "puppets received verbal responses from those same patients that I, in direct communication with them, was unable to achieve. […] This unusual situation gives the puppet a new dimension as a communicational bridge for these patients. The puppet has become an intermediary object (IO) and a therapeutic tool" (p. 136). Moreover, puppetry can resemble drama therapy through role-play interactions in treating patients diagnosed with psychosis (Yotis, 2006). However, previous studies with puppets investigated the improvement in patients' negative symptoms and enhancement of general well-being, whereas the decrease of frequency of hallucinations and delusions often remains an unsolved issue.

Creativity can be applied to enhance the engagement of participants during art therapy (Chiang et al., 2019). Creative art therapy generally promotes the integration of sensory, somatic, visual, affective, cognitive, and symbolic processing levels (Hinz, 2020). Unlike traditional psychotherapeutic techniques, creative art therapy utilizes mainly non-verbal mediums of expression (Chiang et al., 2019). Creative art therapy strengthens the patient's sense of self through engagement in

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the artistic process and via aesthetic reflections on the artistic artifact (Teglbjaerg, 2011). Two theoretical models have been proposed to explain the healing effects of creative art therapy (Chiang et al., 2019): the body-mind Expressive Therapies Continuum and the holistic health Recovery Model. According to the Expressive Therapies Continuum, creative art therapy influences a three-tiered hierarchical system (kinesthetic/sensory, perceptual/emotional, and cognitive/symbolic) – i.e., sensory and physical experiences of artistic expression trigger emotional and perceptual responses that, in turn, support modifications of cognitive and symbolic evaluations (Czamanski-Cohen and Weihs, 2016; Lusebrink, 2004, 2014). Conversely, the Recovery Model focuses on seriously considering feedback received from patients in assisting them to develop self-confidence, restoring patients to independent living, and empowering patients by building upon their strengths and interests (Hanevik et al., 2013; Lynch et al., 2018).

The present study aimed at developing and evaluating a new therapeutic intervention (Creative Puppet Therapy, CPT) for a vulnerable patient group diagnosed with schizophrenia for which new treatment options are warranted. The primary aim of this research was the treatment of hallucinations and anomalous perceptions involved in psychosis. Moreover, the features of the artistic artifacts created (puppets) could discriminate patients from control participants. Analysis of puppets' formal features and emotional expressions could serve to develop hypotheses concerning the underpinning mental processes of patients diagnosed with schizophrenia. In turn, these hypotheses could aid in discovering potential mechanisms of change produced by CPT that future studies may investigate. This research is to be considered a pilot study that was explorative in nature, and the therapeutic theory has yet to be defined.

Creative art therapy can employ clay manipulation to craft objects. Clay work can engage with a patient's active tactile modality (i.e., *haptic*, or able to touch, manipulation) and elicit a more visceral (i.e., *interoceptive*) experience (Nan and Ho, 2017). Creative clay therapy was used for patients diagnosed with major depression (Nan and Ho, 2017), showing an increase in wellbeing and an attenuation of dysfunctional behaviors. Another study (Bae and Kim, 2018) employed patients with Parkinson's disease and found that hand dexterity, self-expression, mood depression, and quality of life improved after clay therapy. Creative clay therapy for puppet making was used with four patients diagnosed with severe mental illness (depression with psychotic symptoms, bipolar disorder, and post-traumatic stress disorder), and the results showed improvements in mental wellbeing, self-esteem, and body connection (Greaves et al., 2012).

Creative Puppet Therapy (CPT) for crafting puppets may, in principle, benefit patients diagnosed with schizophrenia since CPT takes advantage of both creative art therapy and puppet therapy. Indeed, CPT may produce improvements of haptic sensorimotor affordance, bodily interoceptive enhancement, cognitive symbolic integration, and interpersonal role-play interaction altogether. To our knowledge, no previous studies used CPT with patients diagnosed with schizophrenia, but only pre-crafted puppets for role-play therapy without the creation of their puppets by patients through the manipulation of clay or another malleable material.

Schizophrenia is a severe and complex mental illness that has a multifactorial cause stemming from early-life environmental and genetic risk factors (McCutcheon et al., 2020). From a phenomenological viewpoint, Sass and Parnas (2003, 2017) refer to schizophrenia as a self-disorder due to pre-reflexive '*basic*' self-disturbances characterized by complementary distortions of the act of awareness: hyper-reflexivity (i.e., an "exaggerated self-consciousness in which aspects of oneself are experienced as akin to external objects" p. 427; Sass and Parnas, 2003), diminished self-affection (i.e., a "diminished intensity or vitality of one's own subjective self-presence" p. 429), and disturbed salience of the objects of consciousness (i.e., "the sharpness or stability with which figures or meanings emerge from and against some kind of background context" p. 428).

From another viewpoint, aberrant *haptic* manipulation was found in patients diagnosed with schizophrenia (Foerster et al., 2021). Moreover, aberrant early *interoception* characterizes schizophrenia (Ardizzi et al., 2016) and influences emotional and cognitive functioning. Indeed, interoception has a crucial role in the development of the self and emotion; interoceptive abnormality could lead to self-disturbances and emotional disturbances, and interoceptive aberration is specifically correlated to hallucinations in schizophrenia (Koreki et al., 2020).

Furthermore, *touch* sensory modality is closely connected with interoception (McGlone et al., 2014). Touch sensitivity is atypical in psychiatric patients (Keizer et al., 2022), and this may be the consequence of disorganized attachment patterns (Spitoni et al., 2020) that are over-represented in schizophrenia (Harder, 2014). Awareness in touch modality can be either exteroceptive (e.g., tactile discrimination of the surface of an external stimulus) or interoceptive (e.g., affective touch, pain sensation) or proprioceptive (e.g., kinesthetic muscle contraction) (Casals-Gutierrez and Abbey, 2020; Crucianelli and Ehrsson, 2023; McGlone et al., 2014). These bodily-sensory domains partly overlap (Schleip and Jäger, 2012).

Interoception is at the core of emotional and bodily self-awareness (Craig, 2009; Feldman et al., 2024). Bodily self-awareness is a multidimensional construct that involves several facets, such as the experience of body ownership, the perception of interoceptive signals from own body, the feeling of body in space, and the agency over actions (Berlucchi and Aglioti, 2010). Interoceptive awareness enhances body ownership through affective touch (Crucianelli et al., 2018), or, from another viewpoint, an increase in a coarse touch should decrease body ownership. Furthermore, awareness of negative emotions is associated with interoceptive awareness (Füstös et al., 2013), and patients with psychotic disorders show marked impairment of emotion regulation (Ludwig et al., 2019).

In this framework, clay art therapy engages somatosensory processes of the hands for haptic perception and embodied action (as suggested by Elbrecht and Antcliff, 2014). Thus, haptic manipulation of a malleable material like clay or DAS might help patients diagnosed with schizophrenia enhance their interoceptive awareness and, consequently, promote the integration of the fragmented sense of self (Ebisch and Aleman, 2016). Furthermore, creating puppets with human features can implicate a representation of the human body in which bodily parts are integrated into a whole and coherent human form.

In the present study, we encouraged patients diagnosed with schizophrenia to create their own puppets. They used modeling clay (DAS) as a malleable material, which is lighter and easier to manipulate and paint than clay. Hallucinations and anomalous perceptions were evaluated by administering the self-report Cardiff Anomalous Perceptions Scale (CAPS) (Bell et al., 2006) before and after CPT treatment. Results of patients engaged in CPT were compared to two other groups: (i) a control group of patients diagnosed with schizophrenia engaged in a pseudo-treatment (not CPT), and (ii) a control group of control participants who did CPT. Some hypotheses can now be presented.

Research question: Since patients diagnosed with schizophrenia show marked impairment of interoception (Yao and Thakkar, 2022; Yao et al., 2023) and altered insula structure (Kittleson et al., 2024), it can be hypothesized that interoceptive and touch hallucinations may be the most difficult to decrease through CPT treatment in patients diagnosed with schizophrenia, because, indeed, interoceptive and touch hallucinations are the most 'basic' pre-reflexive self-disturbances in schizophrenia (cf. Sass and Parnas, 2003, 2017). Conversely, exteroceptive hallucinations might stem from 'basic' interoceptive and touch hallucinations. Therefore, exteroceptive hallucinations should show a significant decrease after CPT treatment since they may not be 'basic' self-disturbances (cf. Sass and Parnas, 2003, 2017). In this rationale, statistically *non*-significant changes in interoceptive modalities – compared to statistically significant changes in exteroceptive modalities – can also become informative and meaningful. A statistical interaction should be present when a minor decrease of 'basic' interoceptive

hallucinations can produce a significant decrease of exteroceptive hallucinations in patients after CPT treatment.

The *first (main) hypothesis* is that creative art therapy with puppets should decrease hallucinations and anomalous experiences in patients who did CPT compared to patients who did not engage in CPT (while being involved in outdoor daily activities and leisure trips). Therefore, CAPS scores of the two groups of patients should show a statistical non-significant difference at baseline (before CPT treatment). In contrast, CAPS scores of the two groups of patients should show a statistically significant difference after CPT treatment, with a substantial reduction of hallucinations for patients who received CPT.

Furthermore, anomalous perceptions are also found in the general population (Bell et al., 2006). Schizophrenia can exacerbate anomalous perceptions as a pathway towards pathological hallucinations (Bell et al., 2006). Hence, the *second hypothesis* is that anomalous experiences by control participants should decrease after CPT treatment.

Schizophrenia shows emotional dysfunctions. A longitudinal study revealed deficits in recognition of sadness and disgust in prodromal individuals compared to control participants, and deficits in recognition of negative emotions in both first-episode and multi-episode patients diagnosed with schizophrenia (Comparelli et al., 2013), while no differences on positive emotions were found between the two groups. Instead, emotion expression revealed blunted joy expression in individuals at high clinical risk of psychosis (Gupta et al., 2022). Hence, compared to control participants, we hypothesize that negative emotions should be over-represented in puppets created by patients. At the same time, no differences in positive emotions should be recorded between the two groups. Ten items of the emotional expression inventory (EEXI) evaluated one's own puppet. Six basic emotions (Ekman and Friesen, 1975) were tested together with one positive emotion (calm) and one negative emotion (boredom). Boredom was found to affect patients diagnosed with chronic psychosis and can be an indicator of mild and severe psychopathology, affecting the outcome of psychiatric patients (Seiler et al., 2023). Thus, the *third hypothesis* is that the expression of negative emotions of puppets should be different between patients and control participants. This difference might explain the unsettling feeling that someone can often experience in front of puppets created by patients diagnosed with psychosis.

It can be hypothesized that the puppet's face acts as a mirror during its creation. Previous studies showed that patients diagnosed with schizophrenia perceive pronounced deformations of their own faces in front of the mirror (Caputo et al., 2012; Poletti and Raballo, 2023). Thus, the *fourth hypothesis* is that 'objective' figurative aspects of the puppets (specifically, the puppet's facial feature dimensions) created by patients should show more facial features deformations than puppets created by control participants.

Finally, the *fifth hypothesis* is that an association between deformations displayed on puppet's facial features and EEXI scores may exist. We hypothesize that a correlation can exist between objective puppet's facial feature dimensions and subjective self-rated emotional expressions of the same puppet. In this way, this finding may indicate which face-feature parameters are associated with specific emotions in both patients and control participants.

2. Materials and methods

2.1. Sample size

Statistical power analysis was used to determine the sample size needed. A sample of 12 participants allows 80% power to detect a 'large' effect size (0.8) using one-tail paired-sample *t*-test, for $\alpha = 0.05$ significance level on a single, hence uncorrected, scale (i.e., CAPS total score).

2.2. Participants

The experiment was run in accordance with the Helsinki declaration of human rights. Ethical approval for this study was obtained from a University based research ethics committee (verbal n. 75, 26 October 2023, CESU, University of Urbino). Participants signed written informed consent, and were anonymized with an alphanumeric code.

Three groups of participants, matched for age and sex, were enrolled. All participants were unaware of the aims of the study. A convenience sample of 24 patients diagnosed with schizophrenia – who were clients of the psychiatric hospital "ASL Asti, Casa Albergo Maria e Federico Venturello" – volunteered in the present study. They were randomly divided into two groups, which were stratified by sex and age (see Procedure). One group (female/male = 6/6; mean age = 45.33; SD = 9.34) received CPT treatment and the other (female/male = 6/6; mean age = 45.75; SD = 8.01) received the pseudo-treatment (outdoor daily activity and leisure trips). For the third control group, a convenience sample of 12 control participants (female/male = 6/6; mean age = 45.08; SD = 9.00) was recruited from the general population. Control participants were matched to patients for female/male ratio and same (or similar) age.

For the patients, the inclusion criteria were as follows: age > 20 years and diagnosis of schizophrenia according to the DSM-5. The exclusion criteria were based on the diagnosis of other mental illnesses (e.g., psychotic disorders due to organic condition or substance abuse), violent or socially non-compliant behaviors, and inability to complete self-report assessments. Control participants of the control group had no history of neurological or psychiatric diseases.

All patients and control participants were naïve to experimental procedures. They had no previous experience in psychological or behavioral experiments.

2.3. Art therapy

The first author (JC) conducted CPT sessions. Sessions consisted in creating a puppet with DAS (air-hardening, acid-free, non-toxic paper-based modeling clay made of water, inorganic fillers and vegetable bindings). Instructions given to the group of patients who did CPT and to the group of control participants were the following: "*You can realize a puppet with the available materials. Your puppet should not have features of your own face, nor facial features of your parents and relatives, nor facial features of friends, nor facial features of the other members of the group*." In other words, patients and control participants were invited to *not* make self-portraits, *nor* convey references to their personal life and other participants.

These instructions aimed at disentangling patients and control participants from mere reality, thus appeal to their fantasy and enhance their creativity. In other words, free from reality: patients and control participants use interoceptive awareness and cognitive imagination to create their puppets. This endeavor might promote the cognitive and emotional expression of the participant's self into their puppet without the constraints of realism. Moreover, from a more pragmatic viewpoint, this procedure can foster and encourage those participants who have had difficulties in haptic DAS manipulation when portraying the human body.

The available materials were DAS, wooden spoons, colors and paintbrushes, colored wool for hair, tissues for clothes, and glue. The safety utensils facilitated DAS malleable manipulation. The wooden spoon supported the puppet's creation with DAS. Spoon sizes implicitly bound the relative homogeneity of the puppet's head and body dimensions among participants.

The two groups (patients who did CPT vs. control participants) worked separately, in the same laboratory, which was independent from the psychiatric hospital. Twelve sessions, 2 h each, were planned across 12 weeks. Sessions were organized for creating and painting the puppets.

2.4. Measures

2.4.1. Self-report scales

2.4.1.1. Cardiff anomalous perception scale (CAPS; Bell et al., 2006). The self-report CAPS scale consisted of 32 items. Items of CAPS describe anomalous perceptions across different 'domains' (i.e., different sensory modalities). Responders endorsed scales evaluating the 'frequency of occurrence' of the experiences described by items. Instructions were: "*Please evaluate how often you may have had the following experiences*." The answers were given on a 6-level verbal descriptor scale (VDS) from 'never' (=0) to 'always' (=5).

The CAPS 'total score' was the algebraic sum of endorsements to 32 items. Moreover, nine 'scales' were defined by the algebraic sum of subsets of items (see Table 2 in Bell et al., 2006): (1) *Changes in Levels of Sensory Intensity* (Relevant Domains: Sight, Sound, Taste, Touch, Smell), e.g. "Do you ever find that your skin is more sensitive to touch, heat, or cold than usual?" (item#20); (2) *Having a Nonshared Sensory Experience* (Relevant Domains: Sight, Sound, Smell), e.g. "Do you ever hear sounds or music that people near you don't hear?" (item#32); (3) *Inherently Unusual or Distorted Sensory Experience* (Relevant Domains: Sight, Sound, Taste, Touch, Smell), e.g. "Do you ever experience unusual burning sensations or other strange feelings in or on your body?" (item#5); (4) *Sensory Experience From an Unexplained Source* (Relevant Domains: Sight, Sound, Taste, Touch, Smell), e.g. "Do you ever feel that someone is touching you, but when you look nobody is there?" (item#12); (5) *Distortion of Form (Size, Shape) of Own Body and of External World*, e.g. "Do you ever look in the mirror and think that your face seems different from usual?" (item#22); (6) *Verbal Hallucinations*, e.g. "Have you ever heard 2 or more unexplained voices talking with each other?" (item#28); (7) *Sensory Flooding*, e.g. "Do you ever find that sensations happen all at once and flood you with information?" (item#15); (8) *Thought Echo and Hearing Thoughts Out Loud*, e.g. "Do you ever hear your own thoughts repeated or echoed?" (item#3); (9) *Temporal Lobe*, e.g. "Do you ever sense the presence of another being, despite being unable to see any evidence?" (item#2).

Items of CAPS parse and integrate different scales already published (Andreasen, 1994; Bebbington and Nayani, 1995; Bunney et al., 1999; Eckblad and Chapman, 1983; Makarec and Persinger, 1985; Mason et al., 1995; Morrison et al., 2002; Peters et al., 1999; Wing et al., 1974). For example, the 'Temporal Lobe' scale is based on experiences that have been induced by the stimulation of the temporal lobes by magnetic fields, including anomalous proprioceptive and interoceptive experiences (Persinger and Healey, 2002).

CAPS item endorsements were also analyzed for *sensory modalities* (called sensory 'domain' in CAPS). The five sensory modalities were: sight (items #4, #23, #26, #31), sound (items #1, #6, #13, #16, #28, #32), taste (items #14, #21, #30), smell (items #8, #18, #25, #29), and touch (items #5, #12, #20). In addition, a sixth modality was introduced – *bodily interoception* (items #9, #10) that dealt with internal bodily sensations, bodily-part connections or body ownership. Indeed, bodily interoception resumes the only two CAPS items that ask responders about their internal awareness of own body: "Do you ever have the sensation that your body, or a part of it, is changing or has changed shape?" (item#9), and "Do you ever have the sensation that your limbs might not be your own or might not be properly connected to your body?" (item#10). The term 'bodily' is used to indicate interoception for bodily feelings, which include a larger class than 'classical' interoception of internal organs (e.g., heartbeat interoception, urinary interoception), and is in line with contemporary theories about interoceptive awareness (Craig, 2009; McGlore et al. 2014; Schleip and Jäger, 2012). Furthermore, CAPS items related to touch are facets of interoception. Indeed, subjective burning sensation (item#5), phantom touch (item#12), and unusual skin sensitivity (item#20) can also be considered facets of interoception (Schleip and Jäger, 2012), which could be named 'interoceptive touch' for completeness. Therefore, both touch and bodily interoception are measures of different aspects of the same general modality of interoception. Hallucination score for each modality is the sum of endorsements of its respective items.

Finally, the total score of exteroceptive hallucinations was the sum of scores of sight, sound, taste, and smell hallucination scores. The total score of interoceptive hallucinations was the sum of touch and bodily-interoception hallucination scores.

2.4.1.2. Emotion expression inventory (EEXI). Emotional responses were evaluated through puppet expression. Participants were asked to evaluate the emotions that their own puppets expressed. An ad hoc 10-item self-report emotional-expression inventory (EEXI; Table 2) was designed. Instructions were: "*Please evaluate what emotion your puppet expresses*." Participants endorsed their responses to items on 5-level verbal descriptor scale (VDS) from 'none' (=0) to 'very much' (=4).

2.4.2. Face features of puppets

Puppets were objectively evaluated for their geometrical facial features. The height and width of the whole face of the puppets were measured in millimeters. Mouth width and nose length were also measured. The average eye dimension was measured for the puppet's left and right eyes.

2.5. Procedure

Randomization of patients was as follows. First, hospital care providers (who did not know the hypotheses of the study) selected patients who were socially compliant and interested in being engaged in an "outdoor recreational activity." Then, patients were absent when paired by sex and same (or similar) age. Finally, paired members were randomly divided and allocated either to CPT treatment or pseudo-treatment (not CPT) via a two-alternative forced-choice (2AFC) algorithm. In this way, randomization of patients was stratified by sex and age. No group knew in advance which one underwent the therapeutic treatment since both groups were enrolled in an "outdoor recreational activity" and engaged in similar test measurements.

Patients (who did CPT treatment) and control participants used moldable material (DAS) to create puppets. Twelve sessions, 2 h each, were organized over 12 weeks. Patients of the pseudo-treatment group (who did not engage in CPT) were involved, during the same period and for a similar duration, in outdoor daily activities and leisure trips without being treated with creative art therapy.

Two endorsements of CAPS were done individually on printed paper. Firstly, CAPS administration was done at the first session before CPT, or pseudo-treatment, began (Baseline assessment). Secondly, after 12 weeks, a final CAPS was administered at the end of the last session (Post-treatment-cessation assessment). In the following and the Tables, the two CAPS assessments are labeled '*Baseline*' and '*Post-treatment*' for briefness.

After puppet completion and Post-treatment assessment, patients who did CPT and control participants responded to the EEXI to assess their own puppet's emotions. They were allowed to observe their puppets during EEXI endorsement.

Measurements were carried out in double-blind conditions. Patients and control participants did not know the hypotheses of the study. Both groups of patients were involved in an "outdoor recreational activity" without knowing which one was a therapeutic treatment. The experimenter who administered CAPS and EEXI scales was unaware of the research hypotheses. Objective measurements of puppet face features were carried out in similar double-blind conditions.

2.6. Statistical analyses

2.6.1. Within-group analyses

Shapiro-Wilk test showed that some measured variables were not normally distributed. Therefore, within each group the comparison between Baseline assessment and Post-treatment-cessation assessment was carried out with non-parametric Wilcoxon *W*-test.

Statistically significant levels were Bonferroni-corrected in order to exclude type I errors for multiple comparisons. The Bonferroni correction was used because it offers a conservative approach to control for false positive in both parametric and non-parametric tests (Lee and Lee, 2018).

For the one-dimension CAPS total score the statistically significant level was (uncorrected) $p < 0.05$. For the nine CAPS scales, the statistically significant level was Bonferroni-corrected by a 9-level factor ($p < 0.0055$). For the six CAPS sensory modalities, the statistically significant level was Bonferroni-corrected by a 6-level factor ($p < 0.008$). Effect-sizes were assessed via Cohen's *d*, and classified according to the rule of thumb from 'very small' to 'huge' (Sawilowsky, 2009).

Exteroception and interoception scores of hallucinations and anomalous perceptions were tested for normal distribution (Shapiro-Wilk test). Statistical analysis used repeated-measure ANOVA (RM-ANOVA). RM-ANOVA was carried out with two within-subject factors in a 2 × 2 design (Baseline vs Post-treatment × Exteroception vs. Interoception).

2.6.1. Between-group analyses

Comparisons between the three groups were carried out with non-parametric Kruskal-Wallis *K*-test. Comparisons between patients who did CPT vs. patients who did not engage in CPT were carried out with *K*-test at the Baseline and Post-treatment cessation assessments. Statistically significant levels were Bonferroni-corrected for multiple comparison, as previously described.

EEXI responses were compared between patients who did CPT vs. control participants though *K*-test. The statistically significant level was 10-level Bonferroni-corrected ($p < 0.005$). Effect-size was assessed via Cohen's *d*.

Objective (geometrical) face features of puppets were analyzed through *K*-test between patients who did CPT vs. control participants. The statistically significant level was 6-level Bonferroni-corrected ($p < 0.008$). Effect-sizes of face-feature differences were assessed via Cohen's *d*.

Associations between puppets' objective face features and puppets' subjective self-rated EEXI scores were analyzed through non-parametric correlations (Spearman *rho*). These correlations were calculated by pooling together scores from both patients who did CPT and control participants ($N = 24$). The statistically significant level was 10-level Bonferroni-corrected ($p < 0.005$).

3. Results

All patients and control participants completed the study. The number of non-respondent participants was zero ($N_{\text{nonresponders}} = 0$) in the three groups. Based on non-parametric tests, the variables 'sex' and 'age' had statistically non-significant effects on any of the dependent variables investigated. Therefore, both 'sex' and 'age' were not included in statistical analyses.

3.1. CAPS total score

Comparisons between Baseline and Post-treatment assessments found that: (1) in patients who did CPT, CAPS total scores showed a statistically significant decrease [mean (SD): 90.83 (13.57) vs. 55.75 (6.15); $W = 3.06$; $p < 0.005$; 'huge' effect size: $d = 3.32$]; (2) in patients who did not engage in CPT, CAPS total scores showed a statistically non-significant difference [89.75 (10.45) vs. 90.66 (10.67); $W = 1.8$; $p > 0.05$]; (3) in control participants, CAPS total scores showed a statistically significant decrease [10.50 (5.38) vs. 6.50 (3.96); $W = 3.08$; $p < 0.005$; 'large' effect size: $d = 0.84$].

The two groups of patients (patients who did CPT vs. patients who did not engage in CPT) did not differ on CAPS total score at Baseline assessments [90.83 (13.57) vs. 89.75 (10.45); $K = 0.10$; $p = 0.75$]. Instead, the comparison of Post-treatment assessments showed a significant *decrease* of CAPS total score [55.75 (6.15) vs. 90.66 (10.67); $K = 17.31$; $p < 0.0005$; 'huge' effect size: $d = –4.00$] in patients who did CPT compared to patients who did not engage in CPT.

3.2. CAPS scales

Table 1 shows results of (Baseline – Post-treatment) assessments of the nine CAPS scales for the three groups. *W*-tests showed that: (1) in patients, CPT treatment significantly decreased ($d = 3.26$ to 1.97) hallucinations for all CAPS scales; (2) in patients, pseudo-treatment did not change hallucinations for any CAPS scale; (3) in control participants, CPT decreased anomalous perceptions of 'Sensory Flooding' and 'Inherently Unusual or Distorted Sensory Experience' scales.

3.3. CAPS sensory modalities

Table 2 shows the results of (Baseline – Post-treatment) measurements of the six CAPS sensory modalities for the three groups. *W*-tests showed that: (1) in patients, CPT treatment significantly decreased ('huge' effect sizes: $d = 2.82$ to 2.06) hallucinations of sight, sound, taste, and smell sensory modalities; (2) in patients, CPT treatment did not significantly decrease hallucinations of touch and bodily interoception sensory modalities; (3) in patients, pseudo-treatment (not CPT) did not produce any change for hallucinations of all sensory modalities; (4) in control participants, CPT treatment decreased ('medium' effect size: $d = 0.79$) anomalous perceptions only in sight modality.

3.4. CAPS exteroceptive vs. interoceptive hallucinations

In patients who did CPT treatment, both exteroception and interoception scores had a normal distribution (Shapiro-Wilk test; $p > 0.18$). RM-ANOVA showed the main effects of Exteroceptive vs. Interoceptive scores ($F = 643.91$; $p < 0.0005$; $\eta^2 = 0.98$) and Baseline vs. Post-treatment scores ($F = 61.55$; $p < 0.0005$; $\eta^2 = 0.85$). More importantly, their interaction was statistically significant ($F = 54.23$; $p < 0.0005$; $\eta^2 = 0.83$). Thus, in patients who did CPT treatment, a relatively limited albeit statistically significant decrease of interoceptive hallucination score [Baseline vs. Post-treatment of Interoceptive hallucination score: 9.83 (2.40) vs. 7.17 (1.80); $d = 1.25$] produced a 'huge' drop in exteroceptive hallucination score [Baseline vs. Post-treatment of Exteroceptive hallucination score: 50.67 (8.40) vs. 31.17 (3.24); $d = 3.06$].

3.5. EEXI scores

Table 3 displays EEXI scores for the two groups engaged in CPT treatment (patients who created puppets vs. control participants). *K*-tests of the differences between the two groups showed that: (1) one's own puppet expressed more negative emotions for the patients than for control participants; (2) patients expressed through their puppets increased levels of fear, anger, sadness, boredom, and disgust ($d = 3.82$ to 1.50); (3) positive emotions, happiness, calm, and surprise showed statistically non-significant differences between patients and control participants.

3.6. Face features of puppets

Table 4 indicates the sizes of face features of puppets. All control participants and seven patients created the nose in their puppets, while five patients created puppets without a nose, leaving their space void (i.

Table 1
Scores on CAPS scales for frequency of occurrence of anomalous perceptions. *Baseline*: initial assessment of the three groups. *Post-treatment*: assessment after cessation of creative art therapy (CRT) for two groups (Patients who created puppets, and Control participants), and assessment after cessation of pseudo-treatment for the group of Patients who did not create puppets. Wilcoxon *W*-tests, *p*-values, and Cohen's *d* effect sizes for the Baseline vs. Post-treatment-cessation assessments in the two groups of Patients, and in the group of Control participants.

Hallucinations and anomalous perceptions per CAPS category	Baseline	Post-treatment	Baseline vs. Post-treatment		
	M (*SD*)	*M* (*SD*)	*W*	*p*	*d*
Patients who created puppets (*N* = 12)					
1. Changes in Levels of Sensory Intensity	14.58 (1.97)	9.25 (1.21)	3.08	0.002*	3.26
2. Having a Nonshared Sensory Experience	11.83 (2.75)	7.41 (0.99)	2.94	0.003*	2.13
3. Inherently Unusual or Distorted Sensory Experience	14.91 (3.02)	8.91 (1.92)	3.07	0.002*	2.37
4. Sensory Experience From an Unexplained Source	15.25 (2.41)	10.08 (1.24)	3.07	0.002*	2.69
5. Distortion of Form of Own Body and of External World	9.50 (1.93)	5.83 (1.40)	3.09	0.002*	2.17
6. Verbal Hallucinations	10.25 (2.80)	5.66 (0.88)	3.07	0.002*	2.21
7. Sensory Flooding	7.33 (2.05)	3.91 (0.90)	3.07	0.002*	2.16
8. Thought Echo and Hearing Thoughts Out Loud	6.83 (1.46)	4.16 (0.38)	3.08	0.002*	2.50
9. Temporal Lobe	8.83 (1.89)	5.83 (1.02)	2.95	0.003*	1.97
Patients who did not create puppets (*N* = 12)					
1. Changes in Levels of Sensory Intensity	14.16 (1.80)	14.33 (1.66)	0.42	0.67	
2. Having a Nonshared Sensory Experience	11.00 (2.41)	10.66 (1.61)	0.60	0.54	
3. Inherently Unusual or Distorted Sensory Experience	15.08 (2.87)	14.91 (3.17)	0.18	0.85	
4. Sensory Experience From an Unexplained Source	15.91 (2.74)	16.75 (1.91)	1.54	0.12	
5. Distortion of Form of Own Body and of External World	10.08 (1.78)	10.16 (2.16)	0.06	0.95	
6. Verbal Hallucinations	8.50 (1.56)	8.50 (1.56)	0	1	
7. Sensory Flooding	6.25 (1.21)	5.83 (1.52)	1.51	0.13	
8. Thought Echo and Hearing Thoughts Out Loud	6.25 (1.21)	6.33 (098)	0.37	0.70	
9. Temporal Lobe	10.75 (1.76)	11.50 (2.06)	1.26	0.21	
Control participants who created puppets (*N* = 12)					
1. Changes in Levels of Sensory Intensity	3.16 (1.99)	2.25 (1.54)	2.63	0.008	
2. Having a Nonshared Sensory Experience	0.16 (0.57)	0.08 (0.28)	1.00	0.31	
3. Inherently Unusual or Distorted Sensory Experience	2.41 (1.67)	1.25 (1.28)	2.89	0.004*	0.77
4. Sensory Experience From an Unexplained Source	1.75 (1.86)	1.50 (1.73)	1.73	0.08	
5. Distortion of Form of Own Body and of External World	0.33 (0.88)	0.25 (0.62)	1.00	0.31	
6. Verbal Hallucinations	0	0	0	1	
7. Sensory Flooding	2.33 (1.30)	0.66 (0.88)	3.12	0.002*	1.50
8. Thought Echo and Hearing Thoughts Out Loud	0.16 (0.38)	0.16 (0.38)	0	1	
9. Temporal Lobe	0.25 (0.62)	0.41 (0.66)	1.41	0.15	

Bonferroni-corrected (9 scales) significance *p*-value: $*p < 0.0055$.

Table 2
Scores on CAPS scales for frequency of occurrence of anomalous perceptions across sensory modalities. *Baseline*: initial assessment of the three groups. *Post-treatment*: assessment after cessation of creative art therapy (CRT) for two groups (Patients who created puppets, and Control participants), and assessment after cessation of pseudo-treatment for the group of Patients who did not create puppets. Wilcoxon *W*-tests, *p*-values, and Cohen's *d* effect sizes for the Baseline vs. Post-treatment-cessation assessments in the two groups of Patients, and in the group of Control participants.

Hallucinations and anomalous perceptions per sensory modality	Baseline	Post-treatment	Baseline vs. Post-treatment		
	M (*SD*)	*M* (*SD*)	*W*	*p*	*d*
Patients who created puppets (*N* = 12)					
1. Sight	12.42 (2.23)	7.33 (1.23)	3.07	0.002*	2.82
2. Sound	18.92 (3.82)	11.75 (1.21)	3.06	0.002*	2.53
3. Taste	8.33 (1.67)	4.92 (0.90)	3.09	0.002*	2.54
4. Smell	11.00 (2.37)	7.17 (1.11)	3.08	0.002*	2.06
5. Touch	5.92 (1.56)	4.50 (1.98)	2.56	0.01	
6. Bodily interoception	3.92 (1.88)	2.67 (1.15)	2.58	0.01	
Patients who did not create puppets (*N* = 12)					
1. Sight	11.92 (1.78)	11.83 (2.03)	0.14	0.88	
2. Sound	17.92 (3.26)	17.92 (2.90)	0	1	
3. Taste	8.08 (1.44)	8.17 (1.52)	0.28	0.77	
4. Smell	11.33 (2.53)	11.25 (2.34)	0.24	0.81	
5. Touch	6.92 (1.31)	7.50 (1.44)	1.14	0.25	
6. Bodily interoception	4.50 (1.50)	4.92 (1.56)	1.38	0.16	
Control participants who created puppets (*N* = 12)					
1. Sight	3.25 (1.65)	2.00 (1.47)	3.21	0.001**	0.79
2. Sound	1.58 (1.31)	0.82 (0.99)	2.53	0.01	
3. Taste	0.92 (0.90)	0.75 (075)	1.41	0.15	
4. Smell	0.42 (0.51)	0.33 (0.49)	1.00	0.31	
5. Touch	1.33 (1.07)	1.08 (0.90)	1.34	0.18	
6. Bodily interoception	0.25 (0.86)	0.17 (0.57)	1.00	0.31	

Bonferroni-corrected (6 sensory modalities) significance *p*-values: $*p < 0.008$; $**p < 0.0016$.

e., nose length = 0). In nine patients, puppets showed intrusions of facial features not belonging to the human form (e.g., the mouth transformed in a bird beak). K-test statistical analyses found that, compared to

Table 3
Scores on *Emotional Expression Inventory* (EEXI). Emotional expressions were self-evaluated on their own puppet by patients and control participants. Mean (*M*) and standard deviation (*SD*). Differences between the two groups (Patients who created puppets vs. Control participants): Kruskal-Wallis *K*-tests, *p*-values, and Cohen's *d* effect sizes.

Items of EEXI		Patients who created puppets (*N* = 12)	Control participants (*N* = 12)	Patients who created puppets vs. Control participants		
		M (*SD*)	*M* (*SD*)	*K*	*p*	*d*
01	Positive emotion (e.g. pleasure, joy, happiness, love, etc.)	2.92 (0.79)	2.50 (0.52)	1.76	0.183	
02	Negative emotion (e.g. pain, sadness, fear, anger, etc.)	2.75 (0.75)	1.08 (0.28)	18.29	0.0005***	2.95
03	Happiness	2.83 (0.71)	2.25 (0.45)	4.60	0.032	
04	Sadness	2.83 (0.71)	1.08 (0.51)	16.80	0.0005***	2.83
05	Fear	2.76 (0.62)	0.92 (0.28)	19.73	0.0005***	3.82
06	Anger	2.92 (0.90)	1.00 (0.00)	20.07	0.0005***	3.01
07	Surprise or interest	3.08 (0.79)	2.50 (1.08)	1.88	0.170	
08	Disgust	1.42 (0.51)	0.67 (0.49)	8.68	0.003*	1.50
09	Calm	2.08 (1.16)	1.75 (0–75)	0.30	0.581	
10	Boredom	1.17 (0.71)	0.25 (0.45)	9.05	0.003*	1.55

Bonferroni-corrected (10 emotions) significance levels: *$p < 0.005$; **$p < 0.001$; ***$p < 0.0005$.

Table 4
Face features of puppets in the two groups that created puppets. Mean (*M*) and standard deviation (*SD*). Comparison between the two groups (Patients who created puppets vs. Control participants): Kruskal-Wallis *K*-tests, *p*-values, and Cohen's *d* effect sizes. Measures are in millimeters [mm].

Face features of puppets	Patients who created puppets (*N* = 12)	Control participants (*N* = 12)	Patients who created puppets vs. Control participants		
	M (*SD*)	*M* (*SD*)	*K*	*p*	*d*
Face width	71.83 (10.73)	60.72 (3.17)	12.65	0.0005***	1.40
Face height	90.33 (11.25)	85.58 (3.57)	4.71	0.030	
Mouth width	30.83 (11.73)	19.92 (8.61)	5.62	0.018	
Nose length	10.42 (11.13)	25.08 (18.00)	6.98	0.008*	–0.98
Left eye	25.25 (6.18)	14.25 (1.76)	15.74	0.0005***	2.42
Right eye	24.25 (5.39)	14.75 (1.42)	16.01	0.0005***	2.41

Bonferroni-corrected (6-features) significance levels: *$p < 0.008$; **$p < 0.0016$; ***$p < 0.0008$.

puppets created by control participants, the patients crafted puppets having larger eyes, shorter noses, and larger whole face width. In patients, the difference between left and right eye diameter was non-significant ($W = 0.15$; $p > 0.8$).

3.7. Correlations

When pooling together data ($N = 24$) from patients and control participants, Table 5 displays *rho* correlations between puppet objective geometrical face features and puppet subjective EEXI scores. Eye diameters showed significant correlations with negative emotions (fear, anger, sadness, and disgust), hence indicating that eyes were larger as negative emotions increased. Finally, boredom showed a specific correlation with the puppet's whole face width.

4. Discussion

The findings of the present study can be summarized as follows: (1) CPT treatment using DAS decreased frequencies of hallucinations and anomalous experiences in patients diagnosed with schizophrenia with (1.1) 'huge' decrease of hallucinations in sight, sound, taste, and smell sensory modalities, (1.2) but *non*-significant decrease in touch and bodily interoception modalities; (2) in control participants, CPT decreased anomalous experiences in sight modality; (3) emotional expressions of puppets' faces displayed more negative emotions (fear, anger, sadness, boredom, and disgust) in patients compared to control participants; (4) puppets' faces displayed strong deformations of facial features, showing (4.1) larger eye diameters and (4.2) larger whole face width in puppets created by patients compared to puppets created by control participants; (5) there was a correlation between (5.1) puppet's eye diameters and negative emotions (fear, anger, sadness, and disgust), and between (5.2) puppet's whole face width and boredom.

Hypothesis 1 is confirmed: CPT decreased anomalous experiences and hallucinations in patients who did CPT compared to patients who did not undergo CPT. We focused our study on the relief of hallucinations and anomalous perceptions in schizophrenia since hallucinations are frequent and can be the cause of suffering in schizophrenia (McCarthy-Jones et al., 2017).

The findings show that some typical interoceptive hallucinations of schizophrenia – impairments of whole-body integrity (e.g., impaired body ownership) and bodily hallucinations (e.g., touch hallucinations) – seem to be particularly unchangeable regardless of CPT treatment. The results indicate that the classification of the 32 CAPS items into 9 scales is not perfectly adequate in some aspects. Indeed, the 9 scales are not capable of detecting *non*-significant changes before and after CPT treatment in patients. Those non-significant changes can, instead, be detected through the classification across six sensory modalities. On one side, *touch* modality was detected to change non-significantly after CPT treatment in patients. On the other side, the introduction of *bodily interoception* modality is a means of uncovering a dysfunctional bodily representation that is completely undetected in the CAPS 9-scale classification because it is overwhelmed within the overall scores of 'Temporal lobe' and 'Distortion of form of own body and of external world' scales. Both interoceptive hallucinations are difficult to decrease through CPT treatment (see Table 2).

A first consideration is that the non-significant decreases in hallucinations of touch and bodily interoception modalities (compared to 'huge' reductions of hallucinations in the exteroceptive modalities) can be due to the relatively short duration of CPT treatment in patients. Longer CPT treatments might also decrease hallucination frequencies in touch and bodily interoception modalities.

A second consideration is that patients' responses to CAPS items may be grounded on the real situation in which they are engaged. The manipulation of DAS during CPT treatment involves haptic skills, in which both touch sensitivity and action aptitude are concerned. Consequently, one might have expected that training in haptic manipulation during CPT should decrease hallucination frequencies both of touch and bodily interoception modalities via sensual pleasantness of moldable DAS manipulation (McGlone et al., 2024; Moscatelli et al., 2021). Thus, the lack of significant decreases in both of these hallucinations after CPT treatment is quite unexpected.

Table 5
Correlations (Spearman's *rho; N* = 24) between objective puppet's face features and subjective puppet's emotional expression (EEXI) rated on own puppets.

Face features of puppets	Emotional Expression Inventory (EEXI)									
	Positive	Negative	Happiness	Sadness	Fear	Anger	Surprise	Disgust	Calm	Boredom
Face width	0.291	0.668***	0.467	0.625**	0.757***	0.711***	0.431	0.637**	0.036	0.639**
Face height	–0.022	0.306	0.259	0.383	0.374	0.501	0.288	0.170	0.268	0.269
Mouth width	0.197	0.430	0.205	0.484	0.481	0.508	–0.029	0.460	0.329	0.310
Nose length	0.324	–0.531	0.181	–0.457	–0.506	–0.389	0.077	–0.095	0.316	–0.234
Left eye	0.298	0.809***	0.419	0.731***	0.780***	0.746***	0.310	0.555**	–0.014	0.397
Right eye	0.253	0.782***	0.333	0.742***	0.795***	0.758***	0.297	0.660***	0.109	0.423

Bonferroni-corrected (10 emotions) significance levels: *$p < 0.005$; **$p < 0.001$; ***$p < 0.0005$.

A third consideration is that *non*-significant decrease in hallucinations of *interoceptive* modalities corroborate the idea that interoception is one of the most 'basic' and profound diseases in schizophrenia (Ardizzi et al., 2016; Koreki et al., 2020; Yao and Thakkar, 2022), hence being the most difficult to change by CPT treatment. Moreover, *touch* modality and interoception are associated through the interoceptive-touch pathway via the insula cortex (Craig, 2002, 2009). Indeed, CAPS items assess interoceptive hallucinations through perceptions such as: subjective burning sensation, phantom touch, unusual skin sensitivity, body ownership dysfunction, and anomalous body shape feeling. These interoceptive hallucinations suggest that patients' negative interoceptive feelings are prevailing over positive interoceptive feelings, similarly to the prevalence of negative emotions over positive emotions (see Table 3). This finding agrees with Spitoni et al. (2020) who found that "people with a history of traumatic parental bonds and a disorganized attachment pattern perceive a "caress-like" stimulus as being unpleasant, whereas participants with organized attachment consider the same tactile stimulation to be pleasant" (page 1).

A fourth consideration is that hallucinations in the exteroceptive sensory modalities (i.e., sight, sound, taste, and smell) cannot be considered 'basic' self-disturbances (Sass and Parnas, 2003, 2017) since they, indeed, decreased after CPT. Instead, only hallucinations of touch and bodily interoception modalities are pre-reflexive 'basic' self-disturbances since they showed *non*-significant decreases after CPT. In fact, they are the most difficult to treat through CPT.

When summarizing previous considerations on patients diagnosed with schizophrenia who did CPT treatment, it can be hypothesized that haptic manipulation of malleable DAS material might have been efficacious in CPT treatment because, indeed, it engages interoception through sensorimotor haptic activity during material modeling. In turn, interoceptive training could have diminished the exteroceptive hallucinations because the latter probably stemmed from bodily pre-reflexive 'basic' self-disturbances. We speculate that creating a puppet can lead to the integration of the fragmented self of schizophrenia through the exploitation of the aggregative dominance of one's own body (Metzinger, 2009). Our speculation could be explored in future studies.

Hypothesis 2 is confirmed: CPT treatment decreased anomalous experiences in control participants. In particular, CAPS scales of 'Inherently Unusual or Distorted Sensory Experience' and 'Sensory Flooding' show a significant decrease after CPT in control participants. However, anomalous perceptions by control participants are kept within the sight modality (see Table 2). This finding may indicate healing benefits through CPT from mild, benign dissociative states of absorption-imaginative (i.e., visual) involvement in the general population (Ross et al., 1991).

Hypothesis 3 is confirmed: Negative emotions portrayed by puppets are over-represented in patients compared to control participants. The noteworthy differences between these two groups were, in decreasing order of effect size: fear, anger, sadness, boredom, and disgust. Our results agree with previous studies that found the prevalence of negative emotions in patients diagnosed with schizophrenia compared to controls (Comparelli et al., 2013; Gupta et al., 2022).

The patient can perceive their own emotions in the puppet's face during CPT treatment. Since patients can achieve emotional awareness while creating their own puppets, it may be possible to use CPT in programs for psychoeducation of emotion regulation. Previous studies used mindfulness on patients diagnosed with schizophrenia to improve emotion regulation and reduce rumination (Lam et al., 2020). CPT might be a way to achieve emotional regulation through emotional recognition/expression in their own puppet by administering the EEXI at the end of each CPT session instead of only once at the end of CPT treatment. Giving a verbal label to emotions portrayed by the patient's puppet could achieve a psychoeducational element.

Boredom is present among patients also when they are engaged in CPT treatment. This emotion, which is elicited by low information and monotony (Seiler et al., 2023), finds expression in their puppets and correlates to the width of the whole puppet's face (at parity of face height). In our opinion, boredom may be the depressive counterpart of psychotic omnipotence, hence being higher in patients diagnosed with schizophrenia than in control participants. Indeed, boredom is associated with the negative symptomatology of schizophrenia (Todman, 2003). As previously suggested, psychoeducational elements aim at enhancing emotion awareness at the end of each CPT session, in addition to probably alleviating boredom in patients.

Hypothesis 4 is confirmed: Patients create puppets with large eyes and, sometimes, without the nose. These deformations of facial features show correlations with negative emotions of fear, sadness, and anger. Disturbances of face perception have repeatedly been described in schizophrenia during mirror-gazing behaviors (Poletti and Raballo, 2023). The results may support the hypothesis that interoceptive and proprioceptive feelings of facial skin sensors and facial muscular activities may enhance strange-face illusions under a low illumination level (Caputo, 2023). Interoceptive dysfunction can lead to a significant increase in face deformations in front of a mirror among patients diagnosed with schizophrenia compared to controls (Caputo et al., 2012).

Hypothesis 5 is confirmed: Objective facial features are correlated to subjective emotions. Puppets' eye diameter shows statistically significant correlations with negative emotions. Puppets are created with larger eyes as fear, sadness, and anger increase. The width of the puppet's face shows a correlation with boredom. Nose length shows a tendency to decrease as negative emotions (in particular, fear) increase. It can be hypothesized that puppets without a nose can plastically represent "freezing" of breath in threatening situations (Ogden and Fisher, 2015). Emotional expression/recognition may be compared to graphical techniques used in face caricatures (Brennan, 1985; Laishram et al., 2023) and to artistic portraits of strange-face illusions (Caputo and Lepore, 2021), which have some similarity while not so dramatic as in patients.

When summarizing previous discussions, the patients diagnosed with schizophrenia are relatively preserved at the general level as they can craft puppets. The work-in-progress for crafting puppets continued steadily from one session to the next. Nevertheless, the patients crafted puppets with prominent facial feature deformations (see Table 4). Their puppets show both omissions of relevant facial features (e.g., the absent nose) and intrusions of facial features belonging to categories other than the human form (e.g., the mouth transformed in a bird beak). These dramatic facial feature deformations are *not* directly connected to exteroceptive (e.g., visual) hallucinations since the results indicate that

a 'huge' decrease of hallucinations in the sight modality is achieved through CPT (see Table 2) without any corresponding improvements in puppets' facial features across CPT sessions. Instead, the patients are severely impaired in pre-reflexive 'basic' interoception, hence showing a *non*-significant decrease after CPT (see Table 2). Moreover, puppets' facial feature deformations are intertwined with negative emotions (see Table 3 and Table 5), and this association can occur via interoception dysfunction (Feldman et al., 2024; Füstös et al., 2013; Koreki et al., 2020). Thus, the *disturbances of pre-reflexive 'basic' interoception may, for the most part, yield anomalous face perceptions and face hallucinations*. This statement can answer the *Research question* listed first in the Introduction section.

Puppets may give rise to overt expression (i.e., 'projection,' in psychodynamic terms) of interoceptive feelings. These covert pre-reflexive feelings can be 'codified' into puppets' facial features and overt emotional expressions. Our speculation is that subjective emotional expression and objective facial features, albeit processed independently, are correlated because they both stem from the 'basic' facial interoception. This speculation could be explored in future studies.

4.1. *Limitations*

A first limitation of the present study concerns the relatively small number of patients. A larger number of patients may provide evidence that some face feature deformations (e.g., the increase of mouth width, the reduction of nose length) may rise when negative emotions increase.

A second limitation is that we do not know the maintenance of hallucination decrease over time. We did not make further follow-up assessments. However, as an appreciation by patients and support for CPT, it can be noted that 8 out of 12 patients decided to continue the creation of puppets, which will take part in public events, after the conclusion of the 12 sessions of this study.

A third limitation is that our study focused on the relief of hallucinations and anomalous perceptions in schizophrenia. However, we did not investigate whether other dysfunctional behaviors of schizophrenia were also relieved.

A fourth limitation is that the study involved only patients diagnosed with schizophrenia, while also other pathologies characterized by anomalous perceptions and hallucinations can be investigated. We hypothesize that patients with Parkinson's and Lewy body diseases, which are characterized by often having hallucinations, would benefit from CPT treatment. Future studies could explore this hypothesis.

A fifth limitation is that the current study offers limited and indirect evidence of a more theoretical account of possible underlying processes of change – e.g., the haptic sensorimotor manipulation of the malleable material as the 'basic' healing process involved during CPT. The study's design does not allow to test the theoretical underpinning of these speculative arguments. Future CPT research should require a different study design. In particular, using more explicit and discriminative measures of interoceptive vs. exteroceptive awareness is recommended to investigate the role of haptic affordance through a comparison of different artistic techniques (e.g., DAS manipulation vs. canvas painting for creating human form portraits).

5. Conclusion

CPT has two merits. First, the haptic manipulation of malleable DAS material is beneficial in patients diagnosed with schizophrenia as well as in patients diagnosed with major depression (Nan and Ho, 2017) and Parkinson's disease (Bae and Kim, 2018). The advantage may be produced by enhanced embodiment and interoceptive awareness (as suggested in Elbrecht and Antcliff, 2014), hence improving haptic affordance, emotional feeling, and bodily self-consciousness.

Second, interpersonal role-playing interactions between the patient and their puppet may be relevant in CPT as in other therapies that use puppets (Rojas-Bermudez and Mojano, 2020). Patients may use puppets to portray their covert negative emotions and see them overtly when embodied in the puppet. Moreover, the puppets may objectify mental representations of "deep" imaginary companions (Lange et al., 2023) into an artifact (i.e., the puppet) that the patient is creating during CPT treatment. Furthermore, during their work-in-progress of puppet creation, the patient can engage in an interior dialogue (Fernyhough, 2016) with the puppet itself, which can help the integration of both hallucinated voices and internal characters towards recomposing fragmentation in schizophrenia at the metacognitive functional level (Lysaker et al., 2020). In our opinion, the (non)constraint conveyed in instructions for CPT treatment for asking patients and participants *not* to make a self-portrait and *not* to make a portrait of another person is vital since it opens possibilities in minds beyond mere realism and offers freedom to creativity and self-awareness. Moreover, disconnecting from mere realism in task instructions did elude potential frustrating experiences of abnormal portraits created by patients. Indeed, the patients crafted their puppets that were far from a realistic facial representation due to the pronounced facial trait deformations (e.g., larger eyes, the mouth distorted to a bird beak) and, sometimes, the disappearance of specific facial features (e.g., the nose shrank until annihilation).

Exteroception vs. Interoception may be the most valuable classification of hallucinations in patients diagnosed with schizophrenia. The present research has found differences between sensory modalities that can be conceptualized in the exteroceptive vs. interoceptive dichotomy. This classification is clearly superior to standard classifications of items in CAPS, which are based on psychodiagnostics. Exteroceptive hallucinations can significantly be decreased by CPT, while interoceptive hallucinations are the most difficult to be decreased, thus can be considered 'basic.'

The puppet may operate like a mirror focused on, in particular, the puppet's face. Face deformation, which is common in patients diagnosed with schizophrenia (Caputo et al., 2012; Poletti and Raballo, 2023), produces distortions of specific facial features: increase of the eye diameters and puppet's whole face width, and perhaps nose length reduction and mouth width expansion. A hypothesis is that these deformations should be dissimilar from other pathologies, such as, for example, substance abuse. Future studies could explore this hypothesis by applying CPT treatment to patients suffering from other pathologies.

The results may support both the Expressive Therapies Continuum (Czamanski-Cohen and Weihs, 2016; Hinz, 2020; Lusebrink, 2004, 2014) and the Recovery Model (Hanevik et al., 2013). These theories seem to address two intertwined processes of healing, with the former more focused on restoring mental processes (in the present study, this is supported by differential recovery from hallucinations measured by CAPS) and the latter more focused on outcomes in community functioning and independent living (in the present study, this is supported by the finding that 8 out of 12 patients decided to continue the creation of puppets for public events).

This study is the first to demonstrate the positive efficacy of CPT for decreasing the frequency of hallucinations and anomalous perceptions in patients diagnosed with schizophrenia. The results show the importance of CPT and encourage the possibility of implementing this type of therapy in- and out-patient settings. CPT intervention costs are relatively low, risks are low or nonexistent, and benefits can be high. CPT treatment may positively affect the lives of people who are suffering from psychosis. Since the present research is a pilot study, future investigations (which will be registered as clinical trials) could further discern haptic processes and role-play interactions involved in CPT treatment, which we have put forward as hypotheses. This pilot study has unearthed new issues that can help plan well-focused future CPT interventions.

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Josephine Ciufalo: Writing – review & editing, Investigation. **Simone Zaccone:** Writing – review & editing, Data curation. **Giuseppe Fatiga:** Writing – review & editing, Data curation. **Giovanni B. Caputo:** Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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