SOCIAL ANXIETY AND MENTAL IMAGERY PROCESSES

Maria Guarnera, Stefania Lucia Buccheri, Sabrina Castellano, Donatella Di Corrado, Santo Di Nuovo

Abstract

Objective: Mental imagery has featured prominently in several disorders. The recurrent and distressing imagery reported by individuals with social phobia is often that of a previously experienced event and such imagery is proposed to contribute to the maintenance of the disorder in contemporary cognitive models. The aims of the present study were to investigate which imagery processes (generation, maintenance, inspection and transformation) are most relevant to differentiate the performances of socially anxious individuals from those who are non-socially anxious, and that play a pivotal role in social phobia.

Method: Sixty-two undergraduate volunteer students were recruited from an Italian university, age range 18-23 (M 19.34, SD 1.27), 23 males and 39 females. We used a standardized battery, the *Mental Imagery Test* (MIT), measuring mental imagery skills involving generation and manipulation of different categories of images to examine imagery processes in individuals with social anxiety and non-anxious controls.

Results: Results shown that socially anxious students were impaired in MIT total score, and particularly in the imagined paths tasks and clock test, significantly more than non-anxious individuals. In overall group, total score was negatively associated with social anxiety, and the imagine paths test was the best predictor of social anxiety.

Conclusions: The current findings suggest that social anxiety is differently influenced by specific tasks of imagery based on the type of component involved in imaginative processes.

Key words: social phobia, mental imagery, image generation, image inspection, image maintenance, image transformation

Declaration of interest: none

Maria Guarnera[1], Stefania Lucia Buccheri[1], Sabrina Castellano[2], Donatella Di Corrado[1], Santo Di Nuovo[2]
[1] Kore University of Enna, Faculty of Human and Social Sciences, Cittadella Universitaria, 94100 Enna EN, Italy.
[2] University of Catania, Department of Educational Sciences, 24 Dante Alighieri, 95124 Catania CT, Italy

Corresponding author
Donatella Di Corrado
Faculty of Human and Social Sciences, UKE - Kore University of Enna
Cittadella Universitaria 94100, R6, Italy.
Cell: 0039-3472468598
E-mail: donatella.dicorrado@unikore.it

1. Introduction

Mental imagery is the simulation or re-creation of perceptual experience (Kosslyn et al., 2001; Pearson, 2007) across sensory modalities. Such imagery has been shown to play a key role in various psychological disorders (D'Argembeau et al., 2008; Hackmann et al., 2000; Hirsch et al., 2003; Holmes et al., 2005; Patel et al., 2007).

Mental imagery has featured prominently in current theoretical accounts of disorders such as post-traumatic stress disorder (PTSD; Brewin et al., 1996; Ehlers & Clark, 2000), social phobia (Clark & Wells, 1995; Rapee & Heimberg, 1997), and bipolar disorder (Holmes et al., 2008; Marazziti et al., 2014). Mental imagery processes may also underlie the effectiveness of clinical treatments such as "imagery re-scripting" in Cognitive Behavior Therapy (Holmes et al., 2007), schema focused therapy (Giesen-Bloo et al., 2006), and cognitive bias modification training (Britton & Bailey 2018; Holmes et al., 2006).

Particularly in social anxiety (often defined also as social phobia; Davidson et al., 1993) individuals fear situations such as public speaking, interviews and meeting people they do not already know (American Psychiatric Association, 2000). The recurrent and distressing imagery reported by individuals with social phobia is often that of a previously experienced event (Hackmann et al., 2000) and such imagery is proposed to contribute to the maintenance of the disorder in contemporary cognitive models (Clark & Wells, 1995; Rapee & Heimberg, 1997). The observer perspective adopted within imagery is a feature of this disorder (Hackmann et al., 2000). Such imagery has been demonstrated to have a causal impact on anxiety (Hirsch et al., 2005).

Hackmann et al. (2000) used a semi-structured interview to explore the phenomenological characteristics of mental imagery (that is how mental imagery is consciously experienced) in terms of frequency and nature of mental images in social phobia. All participants reported recurrent negative images,

Submitted May 2019, Accepted August 2019

most of which were related to an adverse social event occurring near to the time of onset of the disorder suggesting a relationship with onset and maintenance of the disorder. Lockett et al. (2012) employed the same interview method in socially anxious individuals with a comorbid diagnosis of psychosis. They found that some participants reported typical social anxiety imagery, whereas others experienced more threatening imagery that may be related to residual psychotic paranoia. Furthermore, whereas social anxiety images were experienced typically from an observer perspective, imagery related to psychosis tended to be experienced more from a field perspective.

According to Morrison et al. (2011), socially anxious individuals could also differ in their ability to use basic imagery (image generation ability for neutral stimuli), compared to non-anxious individuals. On the one hand, a predisposition to having vivid or lifelike imagery may exacerbate social anxiety during exposure to fear-provoking situations where anxious individuals tend to selectively process negative social information (Clark & Wells, 1995; Hofmann, 2007; Rapee & Heimberg, 1997). In contrast, difficulty experienced by socially anxious individuals in generating non-negative images to compete with their usual negative self-image, may also contribute to the maintenance of excessive anxiety.

The authors used a validated behavioral measure to examine image generation ability for neutral stimuli (letters of the alphabet) in both socially and non-socially anxious participants. Image generation was revealed by longer response latencies for probes located on ‘‘late’’ relative to ‘‘early’’ segments of the letters. Socially anxious individuals showed slower response to late versus early probe locations compared to the non-socially anxious individuals, suggesting that socially anxious participants were impaired in their ability to generate mental imagery as compared to non-socially anxious participants.

In another study, Amir et al. (2012) used a visual image generation task with social-threat and neutral stimuli to test the hypothesis that individuals with Generalized Social Phobia are more efficient at generating images related to social-threat words than non-anxious-controls. They found that, contrary to their hypothesis, the two groups did not differ in speed of generating images related to social-threat words. However, the socially anxious group was significantly slower than the non-anxious group at generating images related to neutral words. To further examine the generation of neutral images, they conducted a second study using the same task used by Morrison et al. (2011) also including an anxious control (AC) group to determine whether any obtained effects were specific to Generalized Social Phobia (GSP) or characteristic of overall anxious individuals.

They showed that socially anxious participants and non-anxious-controls did not differ in response latencies for early probe locations. However, the socially anxious group responded to early probes significantly slower than the anxious-control group. Individuals with social anxiety responded to late probe locations significantly slower than non-anxious and anxious controls. The non-anxious and anxious controls groups did not differ in response latencies for early and late probe locations.

The above mentioned studies suggest that social phobia is characterized by less efficiency in generating neutral images. Despite some studies suggest that processes such as inspection, maintenance, and transformation could play a role in clinical treatments, to our knowledge no studies have examined performance in social anxiety using objective measures of such imagery processes. Some researchers have attributed the success of clinical treatments of PTSD such as Eye Movement Desensitization and Reprocessing (EMDR) to modality-specific disruption of visual working memory processes (Holmes et al., 2010; Lilley et al., 2009; van den Hout et al., 2012). This can be linked to literature data on image maintenance and inspection processes, which have been argued to overlap with the processes involved during rehearsal in visuo-spatial working memory (Borst et al., 2011; Logie, 1995; Pearson & Sawyer, 2011). In addition, during mental synthesis, discrete parts of an image are transformed and manipulated in order to produce novel patterns or allow new insights (Pearson & Sawyer, 2001). This process clearly relates to the clinical psychology technique used in Cognitive Behavior Therapy. This highlights the need to explore inspection, maintenance and transformation processes in addition to the generation of the imagery associated with social phobia.

The aims of the present study were to investigate which of these processes are most relevant to differentiate the performances of socially anxious individuals from those who are non-socially anxious, and that play a pivotal role in social phobia.

To address this issue, we recruited an analogue sample of individuals scoring high on a measure of social anxiety and a comparison group of individuals scoring low in social anxiety. We used a battery of tasks differentiated for categories of target stimuli, type of processing, and type of components involved.

Furthermore, to evaluate the subjective aspects of the imagery along with the performance tasks, we used self-report questionnaires on the perceived image vividness.

2. Method

2.1. Participants

Sixty-two undergraduate volunteer students were recruited from an Italian university, age range 18-23 (M 19.34, SD 1.27), 23 males and 39 females. Informed consent was obtained from all individual participants. All procedures performed in the study were in accordance with the ethical standards of 1964 Helsinki declaration and its later amendments and were approved by the IERB - Internal Ethic Review Board (University of Catania – Department of Education Sciences, Psychology Section. With the aim to add to the analysis overall sample an analysis of extreme groups of more or less anxious participants, we selected the participants who showed very little vs a great lot of social anxiety, as this could be useful in the absence of clinical comparison groups. For this reason, individuals who scored 29 or above on the I-SPIN were assigned to the Socially Anxious (SA) group and individuals who scored 9 or below on the I-SPIN were assigned to the Non-Anxious Control (NAC) group. After this procedure, 15 SA and 16 NAC participants were selected. The two groups did not differ significantly by age [M(SD): SA =19.13 (1.25), NAC =19.69 (1.66); $t_{(29)} = 1.04$, p=.30], or percentage of females [SA = 80.0%, NAC = 62.5%; $\text{chi-square}_{df=1}$, p=.28]. Compared with the NAC group, individuals in the SA group were more state anxious, $t_{(29)} = 5.11$, p<.001, [M(SD):SA = 45.80 (10.62), NAC = 29.56 (6.78)], and trait anxious, $t_{(29)} = 4.83$, p<.001, [M(SD): SA = 51.60 (10.15), NAC = 33.88 (10.27)], and also more depressed, $t_{(29)}$ =6.98, p<.001, [M(SD): SA = 24.00 (6.71), NAC = 8,69 (5.47)]. These statistically significant preliminary comparisons confirmed the adequacy of the discrimination between the groups based on the emotional variables focused on in our study.

2.2. Measures

For the assessment of the personality variables regarding Anxiety, Depression and Social Phobia, some questionnaires suitable for collective testing were used: the *State-Trait Anxiety Inventory* (STAI; Spielberger et al., 1970, Italian translation by Lazzari & Pancheri, 1980, State reliability: alpha = .91, Trait reliability: alpha =.93); the *Beck Depression Inventory-II* (BDI-II; Beck et al., 1996, Italian translation by Ghisi et al., 2006; reliability: alpha = .83); the Italian version of the *Social Phobia Inventory* (I-SPIN; Connor et al., 2000; Gori et al. 2013; reliability: alpha = .87).

For assessing imagery by means of performance tasks, we used the *Mental Imagery Test* (MIT), a standardized battery (Di Nuovo et al., 2014) measuring mental imagery skills involving generation, maintenance, inspection, and manipulation of different categories of images. As the imagery battery used in the present study was previously validated in samples with an age range different from that of the present study, we calculated the reliability of our sample that was satisfactory (alpha=.75). The tasks included in the test were derived from different sources in the mental imagery literature.

Visualizing letters: Participants are requested, without seeing the stimuli and using only imagination, to say which upper-case letters have curved parts (e.g., B, P, G, or R, not L, M, V or N).

The Brooks "F" test: Using their imagination, the participants are asked to walk along the contour of a large upper-case letter F that is printed on a card that they have viewed for 30 seconds. The participant is asked to say whether the edges encountered when moving from the lower left corner in a counterclockwise direction are external or internal.

Clock test: The task requires imagining a clock with hands indicating 10 minutes past 10:00, then imagining the clock reflected in a mirror and saying what time the reflected clock will show after 10 minutes.

Cube test: The picture of a large cube is shown for 30 seconds; it is composed of nine small cubes per face (3 × 3), and the external faces are colored. After the stimulus is removed, the participants are asked to state how many small cubes have three external (colored) faces, how many have two, how many one or none.

Subtraction of parts: A digital display with the number 88 composed of small segments is shown for 10 seconds. Then, another digital display with selected segments of an illuminated two-digit number is shown for 10 seconds. This figure is removed, and the participant is asked to imagine what two-digit number will remain after subtracting the parts of the new figure from the figure with all digits illuminated, as seen previously.

Mental exploration of a map: The participant is presented with a map of an island, with a house, a church, a lake, and woods located on it. The instructions ask the participant to look with attention, remembering the distances between the elements. After the map is removed, the participant is asked to answer four questions about the comparative distance between couples of the previously seen elements.

Imagined paths: The participant is asked to visualize a small ball moving in different directions, following a suggested path in the imagined space, and stating if at the end of the route the ball will end up above or below the starting point, or at the same level.

Mental representation of shapes of objects: The participant hears the names of twenty concrete objects (e.g. bottle, pizza, candle, tower, bed), and is asked to visualize them and decide if the object has a taller or larger shape.

The tasks, derived from previous literature on mental imagery, were aimed at representing all the functions involved in imagery according to the taxonomy suggested by Pearson, Deeprose, Wallace-Hadrill, Burnett Hayes, and Holmes (2013). Therefore, the tasks present different levels of complexity depending on the components of imagery involved, varying from those in which the generation process prevails (as in the *Visualizing letters* task) to the more complex ones in which transformation and reinterpretation processes are activated (as in the *Subtraction of parts* task).

A total score of mental imagery can be obtained by summing up the scores in the single subtests. Cronbach's alpha for this score of imagery is .83. In the study of standardization of the Mental Imagery Test (Di Nuovo et al., 2014), a confirmatory factor analysis demonstrated the mono-dimensionality of the measure including the eight tasks, in a sample of 308 participants aged 65 to 93 years (chi-square = 51.69, $p < .01$; RMSEA = .08, $p < .01$; CFI = .94;SRM = .05; GFI = .96).

With the aim of assessing the subjective imagery, both in static and movement features, the participants completed the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973; Italian translation by Antonietti & Crespi, 1995), and the Vividness of Movement Imagery Questionnaire Revisioned Version (VMIQ-2; Roberts et al., 2008).

Vividness of Visual Imagery Questionnaire (reliability: alpha =.73*)*: The VVIQ is a 16-item self-report instrument developed to assess how vividly individuals experience visual mental images (e.g., characteristics of a friend or relative, the weather, a local shop, and the country). Once the participants have imagined a scene, they are asked to rate the images on clearness and vividness on a five-point scale: 1: "No image at all (only "knowing" that you are thinking of the object)"; 2: "Vague and dim"; 3: "Moderately clear and vivid"; 4: "Clear and reasonably vivid"; and 5: "Perfectly clear and vivid as normal." Higher scores indicate greater vividness (Antonietti & Crespi, 1995).

Vividness of Movement Imagery Questionnaire 2 (reliability: alpha =.76): The VMIQ-2 is a revised version of the VMIQ that was designed to measure visual and kinesthetic imagery of a variety of motor tasks (e.g., running downhill, jumping off a high wall). This questionnaire is composed of 12 items. It requires individuals to imagine themselves performing the 12 items, from three imagery perspectives: internal visual imagery (a first-person perspective), external visual imagery (a third-person perspective), and kinesthetic imagery (feeling the movement). When using internal visual imagery, one sees him/herself performing a movement in his or her own mind; when using external visual imagery, one imagines performing a movement by looking at his or her body from the outside; when using kinesthetic imagery, one imagines how the movement feels. Lower scores indicate greater vividness.

2.3. Procedure

Self-report questionnaires were administered to participants collectively in university classrooms used for regular lessons. The time required to complete the questionnaires was approximately 20-30 minutes. With regard to the MIT, participants were evaluated during individual sessions. The time required to perform all the MIT tasks was about 30-40 minutes. All participants completed all the tests, and no missing data were detected.

2.4. Statistical Analyses

The following statistical analyses were performed: Pearson correlations to explore the relationship between objective and subjective measures of the imagery; t-test to compare groups with and without social anxiety in imagery measures (objective and subjective); Pearson correlations to explore the relationship between personality variables (state and trait anxiety, social anxiety, depression) and imagery measures (total score of MIT and subjective); regression analysis to explore the relationship between: a) single objective measures of the imagery, as independent variable, and social anxiety, state and trait anxiety, and depression as dependent variables; and b) social anxiety, as dependent variable, and total score of MIT, state and trait anxiety, and depression as independent variables.

3. Results

We firstly tested in the whole group of participants (N = 62) the correlations between the objective measures of the imagery (MIT tasks) and the subjective measures of the imaginary (questionnaire on vividness). We did not observe significant correlations, confirming that these dimensions regard distinct domains of imagery, which have to be assessed and analyzed separately.

Table 1 shows the results of the comparison between the group of socially anxious participants and the controls in the subjective and performance measures of mental imagery. Significant differences were observed for static vividness (test VVIQ) and for MIT total score; among the tasks included in MIT, the clock test and imagined paths are the tasks that differentiated the two groups the most.

To test the relationships between personality variables and mental imagery, we calculated the Pearson correlations in the whole sample between both performance and subjective measures of imagery and the scores in state and trait anxiety, social anxiety and depression.

Table 2 shows that I-SPIN Social anxiety correlated negatively with MIT total score. In addition, STAI State and Trait Anxiety negatively correlated with MIT. As specifically regards the subjective aspects of visual imagery, social anxiety and trait-anxiety negatively correlated only with static vividness measured by the VVIQ.

To examine more in detail the influence of Mental Imagery performance (as measured by the MIT test), we further performed separate multiple regression analyses with the single tasks of the MIT tests as independent variables (predictors) and social anxiety, state and trait anxiety, and depression as dependent variables (**table 3**).

Results show that social anxiety, trait anxiety and depression scores, are mainly predicted by the task of imagining paths, while the mental representation of shapes of objects significantly predicts trait anxiety.

Notably, we observed that it was not possible to show specificity for social anxiety in the absence of other anxiety-disorder control groups. We tested the specificity to some extent, including the general anxiety measures and depression measure, in the regression predicting social anxiety score (**table 4**).

Results show that social anxiety score is predicted inversely by mental imagery, positively by depression.

Table 1. *Comparison between groups with and without social anxiety in Imagery Tasks*

	Socially anxious group SA (N = 15)		*Non-Anxious Control group NAC (N = 16)*		*Significance of Differences T*	*p*	*d (effect size)*
Imagery Tasks	*M*	*SD*	*M*	*SD*			
VVIQ	49.47	8.84	62.56	11.67	3.50	0.01*	1.26
VMIQ	79.13	20.98	90.56	26.00	1.34	0.19	0.48
MIT -Total score	58.80	5.37	67.00	8.50	3.18	0.01*	1.14
MIT – Subscores:							
Visualizing letters	11.47	0.64	11.63	1.02	0.51	0.61	0.18
Brooks "F" test	8.27	1.98	9.50	1.75	1.84	0.08	0.66
Clock Test	0.27	0.70	1.25	1.24	2.69	0.01°	0.97
Cube Test	0.00	0.00	1.13	1.45	(a)	-	-
Subtraction of parts	8.13	2.45	9.31	3.26	1.13	0.27	0.41
Mental exploration of a map	5.00	1.56	5.31	1.30	0.61	0.55	0.22
Imagined paths	6.40	2.47	9.25	2.14	3.43	0.01*	1.23
Mental representation of shapes of objects	19.27	0.70	19.63	0.62	1.51	0.14	0.54

*** p<.001; ** p<.01; * p<.05; ° p<.10 (after Bonferroni correction for multiple comparisons)
[(a)] In the Cube test the group with social anxiety committed 100% errors.

Table 2. *Correlations (Pearson coefficients) between personality variables (Social Phobia Inventory I-SPIN, State-Trait Anxiety Inventory STAI, Beck Depression Inventory-II BDI-II), and Mental Imagery measured by MIT, Vividness of Visual Imagery Questionnaire (VVIQ) and Vividness of Movement Imagery Questionnaire (VMIQ)*

	MENTAL IMAGERY TESTS (N=62)		
PERSONALITY VARIABLES (N=62)	MIT	VVIQ	VMIQ
I-SPIN Social anxiety	-0.45**	-0.44*	-0.15
STAI State-Anxiety	-0.42*	-0.31	-0.15
STAI Trait-Anxiety	-0.43*	-0.47**	-0.04
BDI-II Depression	-0.24	-0.28	-0.07

*** $p<.001$; ** $p<.01$; * $p<.05$

Table 3. *Regression Analyses of the single MIT Tasks (predictors) on social anxiety (I-SPIN), State and Trait anxiety (STAI), and depression (BDI-II)*

	Social Anxiety (N=62) R^2.37		State anxiety (N=62) R^2.28		Trait anxiety (N=62) R^2.27		Depression (N=62) R^2.26	
MIT task (N=62)	ß coefficients	p-value	ß coefficients	p-value	ß coefficients	p-value	ß coefficients	p-value
Visualizing letters	0.00	0.97	0.06	0.62	-0.21	0.08	-0.02	0.88
Brooks “F” test	-0.16	0.18	0.01	0.93	0.06	0.60	0.08	0.53
Clock test	-0.17	0.26	-0.27	0.09	-0.26	0.08	-0.24	0.13
Cube test	-0.23	0.11	-0.13	0.42	-0.15	0.31	-0.17	0.27
Mental exploration of a map	0.12	0.33	-0.08	0.54	0.07	0.55	0.12	0.36
Subtraction of parts	-0.18	0.17	-0.04	0.79	0.06	0.63	0.26	0.08
Imagined paths	-0.46	<0.001	-0.27	0.10	-0.46	0.00	-0.45	0.01
Mental representation of shapes of objects	0.12	0.35	0.15	0.28	0.32	0.02	0.20	0.17

Table 4. *Regression Analyses of the MIT total scores, anxiety and depression on social anxiety (I-SPIN)*

	I-SPIN (social anxiety) (N=62) R^2.62	
	ß coefficients	p-value
MIT (total scores) (N=62)	-0.26	0.01
STAI (trait anxiety) (N=62)	0.05	0.72
STAI (state anxiety) (N=62)	0.10	0.45
BDI II (depression) (N=62)	0.58	0.001

4. Discussion

The general aim of this study was to further investigate visual mental imagery in social anxiety, by comparing the performance of socially anxious and not anxious individuals in several tasks of imagery, involving inspection, maintenance and transformation processes, that were not previously considered. For this purpose, we used the Mental Imagery Test (MIT), representing several different components involved in imagery, according to the taxonomy suggested by Pearson et al. (2013).

It is noteworthy to remember that no significant correlations were observed between subjective and objective measures of imagery. The results supported previous findings suggesting that mental imagery is not a unitary construct (Campos, 1998; Campos & Pérez-Fabello, 1990; Dean & Morris, 1991; Di Corrado, Guarnera, & Quartiroli, 2014; Di Corrado, Guarnera, Vitali, Quartiroli, & Coco, 2019; Moran et al., 2012; Moreau et al., 2011). Moreover, Hishitani and Nishihara (2007) also concluded that imagery vividness and image rotation are mutually independent. These results underline the independence of the two aspects of the imagery, one relative to the phenomenological characteristics, the other to the imagery skills that can be measured in performance.

As regards subjective measures of imagery, socially anxious students were significantly impaired in static vividness more than non-anxious individuals and the static vividness of mental images was negatively associated with social anxiety. This result is not consistent with those of previous studies that have shown that anxious individuals had more vivid imagery for neutral or negative situations (Moore, 2002; Morina et al., 2011; Stöber, 2000), whereas Moriya (2018) found that vividness of mental images was not associated with social anxiety. He hypothesized that, in "natural" scenes, socially anxious individuals do not necessarily generate vivid mental imagery, whereas in "social" situations, they might exhibit vivid imagery. The results of the present study further suggest that mental imagery for "neutral" situations or stimuli are impaired in socially anxious individuals.

With respect to objective measures of imagery, socially anxious students were impaired in MIT total score, and particularly in the imagined paths tasks and clock test, significantly more than non-anxious individuals; in the cube task the social anxiety group committed 100% errors.

In overall group MIT total score was negatively associated with social anxiety; more in detail, the imagined paths task (involving active elaboration of mental representations) is the best predictor of social anxiety.

The current findings suggest that social anxiety is differently influenced by specific tasks of imagery based on the component involved in imaginative processes. The most relevant tasks for social anxiety and those that better differentiate the two groups (imagined paths tasks, clock test, and cube), require both inspection and transformation processes.

We can suppose that individuals with social anxiety are indeed impaired in their ability to inspect and actively transform visual mental images of neutral (non-threatening) stimuli.

The results of the present study could also be explained by the tendency, common in socially anxious persons, to generate, more than other people, negative images of themselves when they feel exposed to social judgment; this could interfere with the imagery processes required by the task when it is perceived to be more difficult. Coherently with both hypotheses, no differences in performing imagery tasks requiring more simple processes were detected between the two groups.

In overall sample, the results also show that the MIT total scores are negatively correlated with STAI. In particular, the imagined paths task is the best predictor of both trait anxiety and depression. This could mean that the imagery is compromised in these disorders, particularly when the task requires an active transformation of the generated images.

Several other studies have shown impaired imagery even in other disorders. Cocude et al. (1997) found that depressed participants were slower than non depressed control participants to generate images in response to cue words (emotionally neutral nouns) and were sometimes unable to generate an image at all. The mental rotation of letters has also been shown to be impaired in unipolar major depression (Rogers et al., 2002), which may be indicative of a more general deficit in image transformation processes. Chen et al. (2013a) found that people with MDD showed slower mental rotation (of images of hands and letters) relative to healthy controls, and Chen et al. (2013b) further found that slower mental rotation was positively related to the number of depressive episodes. However, as noted by Holmes et al. (2016), since in these studies imagery control tasks were absent, results may not apply specifically to mental imagery and manipulation but may instead reflect generalized cognitive slowing in depression (see, e.g., Zarrinpan et al., 2006).

Aleman et al. (2005) reported that people with schizophrenia are impaired on a measure of image inspection, but not of image generation. This may reflect deficiency in the voluntary control of imagery, or over-taxing of imagery processes caused by persistent hallucinatory or delusional states. There is also evidence that schizophrenia is related to problems in maintaining and controlling visual information in working memory (Kang et al., 2011), as well as deficits in spatial working memory maintenance (Lee et al., 2008).

It should be noted that, unlike the above studies, Di Simplicio et al. (2016) showed that there are no deficits in the ability to generate, manipulate, and recall images in the context of bipolar disorder. They claimed that biases in imagery generation and manipulation in unipolar depressed individuals reported from previous studies, were only present in measures that index the sensory/response component of imagery tasks rather than specific imagery (e.g. spatial ability) processing biases. According to the authors, discrepancies between studies may be explained by differences in sensory-motor retardation symptoms between the samples. This hypothesis cannot be extended to our results because the battery used in this study evaluates the specific imagery processes rather than the sensory / response component of imagery.

Furthermore, previous studies on elderly adults with and without cognitive impairment, showed similar performance in the tasks of image generation, requiring less inspection of the details. However, at the same time, performance degrades in tasks requiring the inspection, maintenance, and transformation of an image that in turn require an efficient functioning of the visual-spatial memory (Castellano et al., 2015; Hussey et al., 2011).

Other studies have linked imagery skills in anxiety and social anxiety with the processes of voluntary attention control.

Kaltner and Jansen (2014) conducted the mental rotation test, which is associated with voluntary spatial imagery, and showed poor mental-rotation performance in highly anxious individuals. They insisted that impoverished prefrontal attentional control in anxiety delayed performance in highly anxious individuals, because mental rotation involves the active manipulation of visual representation, which is more a controlled process of voluntary attention. Moriya (2018), using self-report questionnaires showed that although high object imagery and low spatial imagery were associated with high social anxiety, these associations were not significant for individuals with high effortful control. Moriya (2018) argued that effortful control mitigated the impact of maladaptive mental processing in social anxiety.

If replicated in a sample of individuals meeting diagnostic criteria for social anxiety, the current findings may have relevant clinical implications.

Indeed, many programs for the cognitive treatment of social anxiety (for example imagery descripting techniques that consist in evoking partially or totally a negative memory and helping the patient to rewrite it in order to foresee a desirable outcome; Clark et al., 2006; Hackmann et al., 2014; Wild et al., 2008) presuppose that patients possess the capacity to transform mental images. However, compared to our study, it is necessary to highlight the potential nature of the relationship between performance in the imagery and treatment of social anxiety. In fact, the low performance in the imagery could be a consequence of social anxiety in the examination situations, which would not necessarily occur in the context of the treatment. Further studies should therefore clarify this aspect.

4.1. Limitations and future research

Participants were undergraduate students scoring high and low on a measure of social anxiety rather than individuals with a primary diagnosis of social anxiety. Future research should examine whether imagery ability differs also based on diagnostic status.

In addition, our sample size was underpowered to examine potentially interesting moderators, such as sex differences. This study showed that participants with high levels of social phobia have lower scores in tasks of manipulation of neutral mental images. However, because our groups differed on more than just the level of social anxiety (although being non-clinical participants), it is possible that the current findings may be explained, in part, due to differences in depression, state anxiety or trait anxiety. Although by including the general anxiety measures and depression measure in the regression, predicting social anxiety score, results showed that, in the absence of other clinical control groups, social anxiety score is only predicted by depression, it is not possible to show specificity for social anxiety.

A more complex model (i.e., a causal model with mediating variables) with a wider sample including appropriate clinical control groups (e.g., high anxious or depressed participants) could highlight the specific influence of mental imagery on social anxiety. Finally, as mentioned above, previous studies have reported difficulties in mental imagery in different disorders. In some studies, the low scores in mental imagery tests have been explained, in part, as due to deficits in general cognitive functioning. In this regard, it would be interesting to verify whether, in socially anxious individuals, difficulties in the mental manipulation of images are due to general cognitive deficit rather than factor specifically imagery-related.

The results of our preliminary study confirm that both subjective and performance-based imagery have relevant relations with social anxiety in non-clinical samples. Further studies are needed to clarify the specificity of the relationship between social anxiety and impaired mental imagery.

References

Aleman, A., de Haan, E. H. F., & Kahn, R. S. (2005). Object versus spatial visual mental imagery in patients with schizophrenia. *Journal of Psychiatry & Neuroscience*, *30*(1), 53-56.

Antonietti, A., & Crespi, M. (1995). Analisi di tre questionari per la valutazione della vividezza dell'immagine mentale [Analysis of three questionnaires for assessing the vividness of mental image]. Technical Report, Department of Psychology, Catholic University of the Sacred Heart, Milan, Italy. Unpublished document. Retrieved from http://www.neurovr.org/psylab/ricerca_pc_im.html.

Amir, N., Najmi, S., & Morrison, A. S. (2012). Image generation in individuals with generalized social phobia. *Cognitive Therapy and Research*, *36*, 537–547.

Arntz, A. (2012). Imagery rescripting as a therapeutic technique: Review of clinical trials, basic studies, and research agenda. *Journal of Experimental Psychopathology, 3*, 121-126.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory-Second Edition: Manual*. San Antonio, TX: The Psychological Corporation (Italian translation by Ghisi, M., Flebus, G. B., Montano, A., Sanavio, E., & Sica, C., 2006. Beck Depression Inventory-II. BDI-II. Firenze: Organizzazioni Speciali).

Borst, G., Ganis, G., Thompson, W. L., & Kosslyn, S. M. (2011). Representations in mental imagery and working memory: Evidence from different types of visual masks. *Memory & Cognition*, *40*(2), 204–217.

Brewin, C. R., Dalgleish, T., & Joseph, S. (1996). A dual representation theory of posttraumatic stress disorder. *Psychological Review, 103*, 670-686.

Britton, G. I., & Bailey, H. (2018). Attention bias modification effects on interpretive bias for fear of positive and negative evaluation in social anxiety. *Clinical Neuropsychiatry*, *15*(2), 94-104.

Campos, A., & Perez-Fabello, M. J. (1990). A factor analytic study of two measures of mental imagery. *Perceptual and Motor Skills, 71*, 995-1001.

Campos, A. (1998). A measure of visual imaging capacity: A preliminary study. *Perceptual and Motor Skills, 87*, 1012-1014.

Castellano, S., Guarnera, M., & Di Nuovo, S. (2015). Imagery in healthy and in cognitively impaired aging. *Clinical Gerontologist, 28*(2), 103–113.

Chen, J., Yang, L., Ma, W., Wu, X., Zhang, Y., et al. (2013a). Ego-rotation and object-rotation in major depressive disorder. *Psychiatry Research, 209*(1), 32–39.

Chen, J., Yang, L., Zhang, Z. J., Ma, W., Xing-qu, W., et al. (2013b). The association between the disruption of motor imagery and the number of depressive episodes of major depression. *Journal of Affective Disorder, 150*(2), 337-43.

Clark, D. M., Ehlers, A., Hackmann, A., McManus, F., Fennell, M., Grey, N., et al. (2006). Cognitive therapy versus exposure and applied relaxation in social phobia: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 74*(3), 568–578.

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R., Heimberg, M., Liebowitz, D. A., Hope, & F. R., Schneier (Eds.), *Social phobia: Diagnosis, assessment and treatment*. New York: Guilford Press.

Cocude, M., Charlot, V., & Denis, M. (1997). Latency and duration of visual mental images in normal and depressed

subjects. *Journal of Mental Imagery, 21*(1-2), 127–42.
Connor, K. M., Davidson, J. R., Churchill, L. E., Sherwood, A., Foa, E., & Weisler, R. H. (2000). Psychometric properties of the Social Phobia Inventory (SPIN). *British Journal of Psychiatry, 176*, 379-386.
D'Argembeau, A., Raffard, S., & Van der Linden, M. (2008). Remembering the past and imagining the future in schizophrenia. *Journal of Abnormal Psychology, 117*(1), 247-251.
Davidson, J., Huges, D., George, L., & Blazer, D. (1993). The epidemiology of social phobia: Findings from the Duke Epidemiological Catchment Area Study. *Psychological Medicine*, *23*, 709-718.
Dean, G., & Morris, P. E. (1991). Imagery and spatial ability: When introspective reports predict performance. In R. H., Logie, & M., Denis (Eds.), *Mental images in human condition*. Amsterdam: Elsevier. Pp. 331-34.
Di Corrado, D., Guarnera, M., & Quartiroli, A. (2014). Vividness and transformation of mental images in karate and ballet. *Perceptual and Motor Skills, 119*(3), 764–773.
Di Corrado, D., Guarnera, M., Vitali, F., Quartiroli, A., & Coco, M. (2019). Imagery ability of elite level athletes from individual vs. team and contact vs. no-contact sports. *PeerJ, 7*, e6940.
Di Nuovo, S., Castellano, S., & Guarnera, M. (2014). *MIT—Mental Imagery Test*. Firenze, Italy: Hogrefe.
Di Simplicio, M., Renner, F., Blackwell, S. E., Mitchell, H., Stratford, H. J., Watson, P., Myers, N., Nobre, A. C., Lau-Zhu, A., & Holmes, E. A. (2016). An investigation of mental imagery in bipolar disorder: Exploring "the mind's eye". *Bipolar Disorder*, *18*(8), 669–683.
Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy, 38*, 319–345.
Giesen-Bloo, J., van Dyck, R., Spinhoven, P., van Tilburg, W., Dirksen, C., van Asselt, T., et al. (2006). Outpatient psychotherapy for borderline personality disorder: A randomized clinical trial of schema focused therapy versus transference focused psychotherapy. *Archives of General Psychiatry, 63*(6), 649−658.
Gori, A., Giannini, M., Socci, S., Luca, M., Dewey, D., Schuldberg, D., & Craparo, G. (2013). Assessing social anxiety disorder: Psychometric properties of the Italian Social Phobia Inventory (I-SPIN). *Clinical Neuropsychiatry, 10*, 37–42.
Hackmann, A., Clark, D. M., & McManus, F. (2000). Recurrent images and early memories in social phobia. *Behaviour Research and Therapy*, *38*, 601–610.
Hagenaars, M. A., & Arntz, A. (2012). Reduced intrusion development after post-trauma imagery rescripting; an experimental study. *Journal of Behavior Therapy and Experimental Psychiatry, 43*, 808-814.
Hirsch, C. R., Clark, D. M., Mathews, A., & Williams, R. (2003). Self-images play a causal role in social phobia. *Behaviour Research and Therapy, 41*, 901–921.
Hirsch, C. R., Clark, D. M., Williams, R., Morrison, J., & Mathews, A. (2005). Interview anxiety: Taking the perspective of a confident other changes inferential processing. *Behavioural & Cognitive Psychotherapy, 33*(1), 1-12.
Hishitani, S., & Nishihara, S. (2007). A measurement of the ability to assess imagery vividness based on a model of working memory and signal detection theory. *The Japanese Journal of Cognitive Psychology, 4*, 103-115.
Hofmann, S. G. (2007). Cognitive factors that maintain social anxiety disorder: A comprehensive model and its treatment implications. *Cognitive Behaviour Therapy, 36*, 195–209.
Holmes, E. A., Arntz, A., & Smucker, M. R. (2007). Imagery rescripting in cognitive behaviour therapy: Images, treatment techniques and outcomes. *Journal of Behavior Therapy and Experimental Psychiatry, 38*(4), 297−305.
Holmes, E., Blackwell, S., Heyes, S., Renner, F., & Raes, F. (2016). Mental Imagery in Depression: Phenomenology, Potential Mechanisms, and Treatment Implications. *Annual Review of Clinical Psychology, 12*(1), 249-280.
Holmes, E. A., Geddes, J. R., Colom, F., & Goodwin, G. M. (2008). Mental imagery as an emotional amplifier: Application to bipolar disorder. *Behaviour Research and Therapy, 46*(12), 1251−1258.
Holmes, E. A., Grey, N., & Young, K. A. D. (2005). Intrusive images and "hotspot" of trauma memories in posttraumatic stress disorder: An explanatory investigation of emotions and cognitive themes. *Journal of Behaviour and Therapy and Experimental Psychiatry, 36*, 3-17.
Holmes, E. A., James, E. L., Kilford, E. J., & Deeprose, C. (2010). Key steps in developing a cognitive vaccine against traumatic flashbacks: Visuospatial Tetris versus verbal pub quiz. *Plos One, 5*, 11.
Holmes, E. A., Mathews, A., Dalgleish, T., & Mackintosh, B. (2006). Positive interpretation training: Effects of mental imagery versus verbal training on positive mood. *Behavior Therapy, 37*(3), 237−247.
Hussey, E. P., Smolinsky, J. G., Piryatinsky, I., Budson, A. E., & Brandon, A. A. (2011). Using mental imagery to improve memory in patients with Alzheimer disease. *Alzheimer Disease and Associated Disorders, 26*(2), 124–134.
Isaacs, A., Marks, D. F., & Russel, D. G. (1986). An instrument for assessing imagery of movement: the Vividness of Movement Imagery Questionnaire (VMIQ). *Journal of Mental Imagery, 10*, 23-30.
Kaltner, S., & Jansen, P. (2014). Specific effects of fear and anxiety on mental rotation performance. *Frontiers in Psychology: Emotion Science, 5*, 792.
Kang, S. S., Sponheim, S. R., Chafee, M. V., & MacDonald III, A. W. (2011). Disrupted functional connectivity for controlled visual processing as a basis for impaired spatial working memory in schizophrenia. *Neuropsychologia, 49*(1), 2836-2847.
Kosslyn, S. M., Ganis, G., & Thompson, W. L. (2001). Neural foundations of imagery. *Nature Reviews Neuroscience, 2*, 635–642.
Lee, J., Folley, B. S., Gore, J., & Park, S. (2008). Origins of spatial working memory deficits in schizophrenia: An event-related fMRI and near-infrared spectroscopy study. *PLoS ONE, 3*, 3.
Lilley, S. A., Andrade, J., Turpin, G., Sabin-Farrell, R., & Holmes, E. A. (2009). Visuospatial working memory interference with recollections of trauma. *British Journal of Clinical Psychology, 48*, 309-321.
Lockett, S. H., Hatton, J., Turner, R., Stubbins, C., Hodgekins, J., & Fowler, D. (2012). Using a semistructured interview to explore imagery experienced during social anxiety for clients with a diagnosis of psychosis: An exploratory study conducted within an early intervention for psychosis service. *Behavioural and Cognitive Psychotherapy, 40*(1), 55–68.
Logie, R. H. (1995). *Visuo-spatial Working Memory*. Sussex: Lawrence Erlbaum.
Marazziti, D., Abelli, M., Baroni, S., Carpita, B., Piccinni, A., & Dell'Osso, L. (2014). Recent findings on the pathophysiology of social anxiety disorder. *Clinical Neuropsychiatry*, *11*(2), 91-100.
Marks, D. F. (1973). Visual imagery differences in the recall of picture. *British Journal of Psychology*, *64*, 17-24.
Moore, K. (2002). Habitual visualizer/verbalizer cognitive style: the impact of anxiety and depression. *Imagination, Cognition and Personality, 21*(3), 183–199.
Moran, A. P., Campbell, M. J., Holmes, P. S., & MacIntyre, T. (2012). Mental imagery, action observation and skill learning. In M. A., Williams, N. J., Hodges, & A. M., Williams (Eds.), *Skill Acquisition in Sport*. New York: Routledge. P. 385.

Moreau, D., Mansy-Dannay, A., Clerc, J., & Guerrien, A. (2011). Spatial ability and motor performance: assessing mental rotation processes in elite and novice athletes. *International Journal of Sport Psychology, 42*(6), 525-547.

Morina, N., Deeprose, C., Pusowski, C., Schmid, M., & Holmes, E. A. (2011). Prospective mental imagery in patients with major depressive disorder or anxiety disorders. *Journal of Anxiety Disorder, 25*(8), 1032–1037.

Moriya, J. (2018). Association between social anxiety and visual mental imagery of neutral scenes: The moderating role of effortful control. *Frontiers in Psychology*, *8*, 2323.

Morrison, A. S., Amir, N., & Taylor, C. T. (2011). A behavioral index of imagery ability in social anxiety. *Cognitive Therapy and Research, 35*, 326-332.

Patel, T., Brewin, C. R., Wheatley, J., Wells, A., Fisher, P., & Myers, S. (2007). Intrusive images and memories in major depression. *Behaviour Research and Therapy, 45*, 2573–2580.

Pearson, D. C. (2007). Mental imagery and creative thought. In I., Roth (Ed.), *Imaginative minds*. Oxford, UK: Oxford University Press. Pp. 187–212.

Pearson, D. G., Deeprose, C., Wallace-Hadrill, S. M. A., Heyes, S. B., & Holmes, E. A. (2012). Assessing mental imagery in clinical psychology: a review of imagery measures and a guiding framework. *Clinical. Psychology Review, 33*, 1–23.

Pearson, D. G., & Sawyer, T. (2011). Effects of dual task interference on memory intrusions for affective images. *International Journal of Cognitive Therapy, 4*, 122-133. DOI:https://doi.org/10.1521/ijct.2011.4.2.122.

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*, 741–756.

Roberts, R., Callow, N., Hardy, L., Markland, D., & Bringer, J. (2008). Movement imagery ability: Development and assessment of a revised version of the Vividness of Movement Imagery Questionnare. *Journal of Sport & Exercise Psychology*, *30*, 200–221.

Rogers, M. A., Bradshaw, J. L., Phillips, J. G., Chiu, E., Mileshkin, C., & Vaddadi, K. (2002). Mental rotation in unipolar major depression. *Journal of Clinical and Experimental Neuropsychology, 24*(1), 101-106.

Spielberger, C., Gorsuch, R., & Lushene, R. (1970). *Manual for the State–Trait Anxiety Inventory*. Palo Alto: Consulting Psychologist Press (tr. it. a cura di Lazzari, R., & Pancheri, P., S.T.A.I. Questionario di autovalutazione dell'ansia di stato e di tratto. Firenze: Organizzazioni Speciali, 1980).

Stöber, J. (2000). Prospective cognitions in anxiety and depression: replication and methodological extension. *Cognition & Emotion, 14*(5), 725-729.

Van den Hout, M. A., Engelhard, I. M., Smeets, M. A. M., Hornsveld, H., Hoogeveen, E., de Heer, E., & Rijkeboer, M. (2010). Counting during recall: Taxing of working memory and reduced vividness and emotionality of negative memories. *Applied Cognitive Psychology, 24*(3), 303–311.

Wild, J., Hackmann, A., & Clark, D. M. (2008). Rescripting early memories linked to negative images in social phobia: A pilot study. *Behavior Therapy, 39*, 47-56.

Zarrinpar, A., Deldin, P., & Kosslyn, S. M. (2006). Effects of depression on sensory/motor versus central processing in visual mental imagery. *Cognition and Emotion, 20*(6), 737–58.