Behaviour Research and Therapy 48 (2010) 516–523

Contents lists available at ScienceDirect

Behaviour Research and Therapy

journal homepage: www.elsevier.com/locate/brat

Are obsessive–compulsive tendencies related to reliance on external proxies for internal states? Evidence from biofeedback–aided relaxation studies

Amit Lazarov, Reuven Dar*, Yuval Oded, Nira Liberman

Department of Psychology, Tel Aviv University, Tel Aviv 69978, Israel

ARTICLE INFO

Article history:
Received 20 December 2009
Received in revised form
21 February 2010
Accepted 23 February 2010

Keywords:
Obsessive–compulsive disorder
Doubt
Checking
Rituals
Feeling of knowing

ABSTRACT

This article presents two studies that examine the hypothesis that obsessive–compulsive (OC) tendencies are associated with a general deficiency in subjective conviction, which leads to seeking and reliance on external proxies to compensate for that deficiency. We examined this hypothesis using a biofeedback-aided relaxation procedure. In Study 1 low OC participants performed better on a relaxation task than high OC participants. More importantly, viewing the biofeedback monitor (an external proxy for the internal state of relaxation) had a different effect on the two groups: Whereas high OC participants performed better, low OC participants did not. In addition, when given the opportunity, high OC participants requested the biofeedback monitor more than did the low OC participants. In Study 2 high OC participants were more affected by false biofeedback when judging their level of relaxation compared to low OC participants. Real relaxation level differences between the two false biofeedback phases among the two groups were not found. These results provide preliminary support for the hypothesis that obsessive–compulsive disorder is associated with deficient subjective conviction in internal states and increased reliance on external proxies. Implications for the understanding of OCD-related rules and rituals as well as for cognitive therapy for OCD are discussed.

One of the principal symptoms of OCD is persistent and malignant doubt, which is often followed by compulsive checking (American Psychiatric Association, 2000). While these doubts typically revolve around issues of contamination, aggression, or safety, several studies demonstrated that they are not limited to such concerns. It is well established that people with OCD doubt their memory (e.g., Brown, Kosslyn, Breitler, Baer, & Jenike, 1994; Dar, 2004; Dar, Rish, Hermesh, Fux, & Taub, 2000; MacDonald, Antony, MacLeod, & Richter, 1997; Tolin et al., 2001), and recent studies have broadened this lack of confidence beyond general memory abilities to include related processes such as decision-making and concentration abilities (Nedeljkovic & Kyrios, 2007; Nedeljkovic, Moulding, Kyrios, & Doron, 2009). Other studies have shown that obsessive–compulsive (OC) individuals also distrust their attention, perception and senses (e.g., Hermans et al., 2008; Hermans, Martens, De Cort, Pieters, & Eelen, 2003; van den Hout, Engelhard, de Boer, du Bois, & Dek, 2008; van den Hout et al., 2009). Classic descriptions of OCD have also observed that OCD patients doubt their own feelings, preferences, comprehension and other internal states (Janet, 1903; Rapoport, 1989; Reed, 1985; Shapiro, 1965). These pervasive doubts are believed to account for the variety of pathological behaviors typical of OCD, including excessive self-monitoring, repeated checking, mental reconstruction, incessant questions and requests for external validation or reassurance (Dar et al., 2000).

Several models of OCD hypothesize that the pervasive doubts and related symptoms in this disorder stem from deficient "feeling of knowing" or "subjective conviction" (Boyer & Lienard, 2006; Joel & Avisar, 2001; Rapoport, 1989; Reed, 1985; Shapiro, 1965; Summerfeldt, 2004; Szechtman & Woody, 2004). According to the classic description by David Shapiro (1965), people with obsessive–compulsive (OC) tendencies have "lost the experience of conviction." These individuals have a diminished ability to access their own feelings, wishes and preferences directly and must therefore rely on external indicators to infer these internal states. To use a metaphor by Shapiro, OC individuals can be likened to pilots flying at night, who must rely on flight instruments instead of on their own vision. When asked whether they like someone, believe in something or prefer one thing to another, most people usually feel that they simply "know" the answer. In contrast, OC individuals, according to Shapiro, must deduce their answers from external indicators or base them on general rules or norms. A similar model was advanced by Reed (1985), who proposed that the clinical symptoms of OCD should be seen as

* Corresponding author. Tel.: +972 3 6408624; fax: +972 3 6409547.
E-mail address: ruvidar@freud.tau.ac.il (R. Dar).

0005-7967/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.brat.2010.02.007

manifestations of a functional impairment in the spontaneous organization and integration of experience. According to Reed, the symptoms of OCD patients can be seen as attempts to compensate for their impaired ability to define and put closure on experiences. Both Shapiro and Reed suggested that individuals with OCD are able to function well despite this deficit by using various compensation strategies, such as adopting rules and norms to guide their behavior. For example, an obsessive–compulsive man may conclude that he must be in love with his partner because she possesses all the "right" attributes (Shapiro, 1965).

The idea that OCD is related to a disturbance in the subjective experience of conviction has been adopted in several recent models of OCD. Szechtman and Woody (2004) suggest that OCD is related to a disturbance in the "feeling of knowing," defined as "a subjective conviction functionally separate from knowledge of objective reality (p. 115)." According to their model, this feeling of knowing serves as a termination signal to a "security motivation system." As OC individuals are unable to generate the feeling state that normally shuts down the system, they are left in a continuous state of anxiety and doubt. As a result, they repeat the security-related behavior over and over again in an attempt to overcome the dysfunctional feedback mechanism and to eventually dampen the driving motivation. Summerfeldt (2004) has also used the term "feeling of knowing" in her account of the OCD-related feeling of incompleteness. According to Summerfeldt, the core of incompleteness in OCD is a malfunction in an internal signal that usually terminates behavior by producing a "feeling of knowing"– an emotional indicator that signals to the individual that a satisfactory state has been achieved. Thus, the OCD individual remains with a tormenting feeling of incompleteness, continuously trying to get rid of this feeling, usually by performing different futile acts such as keeping symmetry, counting and checking. Finally, Boyer and Lienard (2006) postulated that OCD symptoms are related to the failure of "evolutionary precaution actions," which are taken in response to the detection of potential dangers, to trigger "satiety feedback feelings" that would put an end to the operation of the system.

In line with the models reviewed above, we suggest that OC symptoms, and in particular doubting and checking, are related to a reduced sense of subjective conviction. We suggest that this deficit is not limited to security and safety concerns or to feelings of incompleteness, but can be relevant to any internal state (Liberman & Dar, 2009). In addition, the models reviewed above (Boyer & Lienard, 2006; Summerfeldt, 2004; Szechtman & Woody, 2004) do not include a mechanism through which OC individuals can compensate for the missing inner feeling, which they are unable to generate endogenously. According to our model, in contrast, OC individuals develop and rely on external "*proxies*," defined as objectively verifiable indicators of internal states, to compensate for their deficient inner subjective experience (Liberman & Dar, 2009). We further suggest that the reliance on these external proxies and the tendency of OC individuals to monitor and question their own subjective experiences further reduces their confidence in these experiences. It is well established that checking behavior has the ironic effect of reducing confidence and increasing doubt regarding memory (e.g., Ashbaugh & Radomsky, 2007; Radomsky, Gilchrist, & Dussault, 2006; Tolin et al., 2001; van den Hout & Kindt, 2003a,b), perception (van den Hout et al., 2008, 2009) and even general knowledge (Dar, 2004).

We can illustrate the divergence between previous models and the one proposed here by using compulsive and ritualistic hand washing as an example. From one point of view, the washing ritual can be considered a repetitive and futile action emanating from the inability of the normative washing act to generate an inner feeling of cleanness, a feeling that would normally shut down the operation of the security/precaution system. From another point of view, the washing ritual can be considered an objectively verifiable indicator (i.e., the external proxy) signaling to the individual that his hands are clean, thus compensating for his missing internal feeling of cleanness. To give another example of the current model, a young OCD patient that was tortured by worries that he did not fully understand the material he was studying in school. The more he questioned and attempted to monitor his level of understanding, the more his uncertainty grew. To compensate, he developed the rule that he should know the material by heart. Knowing by heart, unlike understanding, has an objectively verifiable criterion, and thus can serve as a proxy for understanding when one does not have access to his or her internal states.

In the research presented here, we examined this general hypothesis using a biofeedback-aided relaxation procedure. Applied biofeedback is a group of therapeutic procedures that uses electronic or electromechanical instruments to accurately measure, process, and feedback to users information about their neuromuscular and autonomic activity in the form of auditory and/or visual feedback signals. With the aid of these procedures, users develop greater awareness of, confidence in, and an increase in voluntary control over their physiological processes that are otherwise outside awareness and/or under less voluntary control. This is achieved by first controlling the external signal, and then by using cognitions, sensations, or other cues to prevent, stop, or reduce symptoms (Schwartz & Schwartz, 2003). Thus, the biofeedback apparatus utilizes external representations of internal physiological activity as cues for the learning of voluntary control or modification of the internal activity (Ince, Leon, & Christidis, 1987), especially when internal cues are not discriminable (Segreto, 1995). This function of the biofeedback apparatus makes it suitable for examining our model's predictions, as it can be used as an "objective" verifiable criterion for the participant (i.e., an external proxy) for the subjective and vague state of relaxation.

In the studies presented in this paper we employed a sample of extreme high and low scorers on a measure of OCD. There is abundant evidence as to the similarity in content and type of OC phenomena across clinical and non-clinical populations (e.g., Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). Furthermore, the use of non-clinical or sub-clinical populations in OCD research is a common practice that has produced useful and valuable insights regarding many aspects of this disorder (e.g., Amir, Freshman, Ramsey, Neary, & Brigidi, 2001; Gibbs, 1996: Hajack, Huppert, Simons, & Foa, 2004; Nedeljkovic & Kyrios, 2007; Nedeljkovic et al., 2009; Rachman & de Silva, 1978; Salkovskis & Harrison, 1984; Soref, Dar, Argov, & Meiran, 2008).

The two studies presented below examined the hypothesis that OC tendencies are associated with deficiency in feeling of knowing or subjective conviction and increased seeking of and reliance on objectively verifiable cues and proxies. In Study 1 we examined the hypothesis that participants with high OC tendencies, compared to those with low OC tendencies, would rely on and benefit more from external objective feedback in attaining a state of relaxation. In Study 2 we examined the hypothesis that OC tendencies would be related to reliance on self-perception processes in inferring internal states. Specifically, we predicted that participants with high OC tendencies, compared to those with low OC tendencies, would be more strongly influenced by false feedback regarding their state of relaxation.

Study 1 – Reliance on the biofeedback screen in achieving relaxation

As detailed above, we hypothesize that OC tendencies are related to a reduced sense of subjective conviction and that this leads OC individuals to develop and rely on external "*proxies*" to compensate for their deficient inner subjective experience

(Liberman & Dar, 2009). This implies that high OC individuals, as compared with low OC individuals, should perform more poorly on tasks in which they are asked to attain an inner subjective feeling or state. Moreover, external proxies should improve the performance of high OC individuals more than that of low OC individuals on such tasks, as for the latter group the proxies are unnecessary and might even distract them from attending to their internal states. Finally, our model implies that when given the opportunity, high OC individuals, as compared with low OC individuals, would be more likely to request external proxies for their internal states.

In this first study, we predicted that the high OC group, as compared with the low OC group, will perform more poorly on a relaxation task, which relies on subjective internal cues. We also predicted that viewing a biofeedback monitor during the relaxation task would improve the performance of the high OC group more than the performance of the low OC group. Finally, we predicted that when given the opportunity, the high OC participants, as compared to the low OC participants, will be more inclined to request feedback for their performance from the biofeedback monitor.

Method

Participants

Four hundred and two psychology students (284 women, 118 men) at Tel-Aviv University were screened with the Obsessive–Compulsive Inventory-Revised (OCI-R; Foa et al., 2002; see Measures below). We invited students who scored at the top and bottom of the distribution for participation in this study, with a cut off score of 23 for high OC participants and a cut off score of 4 for low OC participants. We chose the total OCI-R score of participants over the checking subscale score in creating our two groups in line with previous studies examining differences among diagnostic groups, which have found the total score of the OCI-R to be better than the checking subscale score at differentiating OCD patients from non-anxious or anxious controls (Foa et al., 2002). The correlation between the total OCI-R score and the checking subscale score in our sample was .73 ($p < .05$). The final sample included 44 students (M age = 22.7 years, SD = 1.71, range = 20–28 years): Twenty two (17 women and 5 men) with high OC tendencies ($M = 36.5$, $SD = 7.53$) and 22 (17 women and 5 men) with low OC tendencies ($M = 2.18$, $SD = 1.13$), $t(42) = 21.12$, $p < .001$. The scores in the high OC group ranged between 23 and 48, and in the low OC group between 0 and 4. For comparison, the mean OCI-R for OCD patients in Foa et al. (2002) was 28.01 ($SD = 13.53$) with a cutoff score of 21 for differentiating OCD patients from non-anxious controls, and 18 for differentiation from anxious controls. In a previous study in our laboratory (Reuven-Magril, Dar, & Liberman, 2008) the mean OCI-R for OCD patients was 29.22 ($SD = 15.22$). The two groups differed significantly ($p < .001$) on all the subscales of the OCI-R. None of the participants had prior experience with biofeedback. Participants signed an informed consent and received course credit for participation.

Apparatus

Autonomic arousal level was measured by a biofeedback apparatus (Prorelax interactive program, version 4.0, Mindlife, Jerusalem, Israel), earlier versions of which were shown in previous studies to provide reliable measures of autonomic arousal levels in various clinical contexts (Leahy, Clayman, Mason, Lloyd, & Epstein, 1998; Nagai, Goldstein, Fenwick, & Trimble, 2004; Shapiro, Melmed, Sgan-Cohen, Eli, & Parush, 2007; Yahav & Cohen, 2008). Monitoring was done by two Velcro strapped electrodes applied to the fingertips of the second and forth digits of the right hand. Electrodes were connected to a sensor and the data was transmitted through infrared telemetry to a receiver, which was connected to a laptop computer. An isolated skin conductance coupler applied a constant 0.5 V potential across the electrode pair. The finger sensors measured the galvanic skin response (GSR) – electrical changes in the skin that are affected by sweat gland activity in response to physical, emotional and mental states (Leahy et al., 1998; Nagai et al., 2004; Shapiro et al., 2007; Yahav & Cohen, 2008). The GSR changes were reflected on the computer screen as a moving red dot, which creates a continuous line graph in numerical data. An upward movement of the dot signaled an autonomic arousal trend, whereas a downward movement of the dot signaled an autonomic de-arousal trend.

Measures

Obsessive–compulsive tendencies

Obsessive–compulsive tendencies were measured by the Obsessive–Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). The OCI-R lists 18 characteristic symptoms of OCD. Each symptom is followed by a 4- point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*), on which participants indicate the symptom's prevalence during the last month. The OCI-R has been shown to have good validity, test-retest reliability and internal consistency in both clinical (Foa et al., 2002) and non-clinical samples (Hajack et al., 2004). Cronbach's alpha of the OCI-R in our sample was .87, which is identical to the figure reported in previous studies with college samples (Hajack et al., 2004; Soref et al., 2008).

Level of relaxation

One of the physiological processes commonly associated with overarousal is the galvanic skin response (GSR), which results from sympathetic modulation of skin sweat glands secretions, a function particularly relevant to arousal states (Andreassi, 2000). Thus, GSR is an accessible and sensitive index of peripheral sympathetic nervous activity, reflecting peripheral autonomic change (Nagai et al., 2004), and can serve as a sensitive way of monitoring autonomic responses to external and/or internal stimuli (Shapiro et al., 2007). One measure of GSR autonomic response which has been widely employed in previous studies as a physiological correlate of arousal or anxiety and relaxation levels is GSR nonspecific activity or spontaneous GSR (e.g., Ashcroft, Guimaraes, Wang, & Deakin, 1991; Hensman, Guimaraes, Wang, & Deakin, 1991; Katkin, 1965, 1966; Katkin & McCubbin, 1969; Orme-Johnson, 1973). This measure is defined as measurable fluctuations in skin resistance that occurs in the absence of specific stimulation (Katkin, 1965, 1966; Orme-Johnson, 1973). Consistent with previous studies, level of relaxation in this study was measured by calculating the total number of spontaneous or nonspecific GSR fluctuations each participant exhibited during the relaxation task, so that lower scores indicate a more relaxed state. As in previous studies, a spontaneous GSR was defined as a sudden decrease in skin resistance of at least 10 GSR units followed by a recovery of resistance. Only spontaneous GSR fluctuations which occurred independently of outside noise or participant's physical movement were scored. We also chose this measure because it enables more control over irrelevant interferences such as outside noise or physical movements, which greatly affect other biofeedback relaxation measures.

Procedure

Participants were tested individually in a small and quiet room. The study included four phases, 5-min each. Before each phase participants were instructed to “try to relax deeply” while being

monitored by the biofeedback apparatus. They were also asked to refrain from talking or moving as much as possible during the different phases. Before the first phase participants were told to try to relax deeply. Nothing was explained about the biofeedback apparatus and participants were not able to view its monitor, which was turned away from them. After the first phase, participants received a brief explanation as to the general nature and function of the biofeedback apparatus. They were told that a downward movement of the line signals an increase in relaxation, whereas an upward movement of the line signals a decrease in relaxation. This explanation was followed by a 2-min "self-discovery" during which participants were able to familiarize themselves with the apparatus, with no specific instructions. Subsequently, participants were again instructed to relax deeply for 5-min at a time, first while viewing the biofeedback monitor (second phase) and then without viewing the monitor (third phase).

Before the fourth and final phase participants were told that at several points during the 5-min period the experimenter would offer them a chance to view the biofeedback monitor for a few seconds each time, so that they could see their progress and current state, but that it might affect their level of arousal. Participants were offered the choice of whether or not to view the monitor at five points during this phase (at 30, 90, 150, 210 and 270 seconds from the beginning of the phase). At those points the experimenter asked "interested?" and participants were to nod if they chose to view the monitor and to withhold response if they chose not to. When choosing to view the monitor the experimenter rotated the biofeedback monitor for a few seconds toward the participant and then turned it back again. Each of the four phases was followed by a 3-min interval of watching a screen saver on the monitor, in order to permit the participant's arousal level to return to its baseline level before proceeding to the next phase.

During each of the first three phases we measured the spontaneous GSR fluctuations of each participant, as defined above. During the fourth and final phase we counted the number of times each participant requested to view the biofeedback monitor.

Results and discussion

Fig. 1 displays the spontaneous GSR fluctuations of the two groups in the three phases of the experiment. We tested the first two hypotheses within a 2 (OC tendencies: high vs. low) X 3 (phase: P1-P3) mixed-model analysis of variance (ANOVA) with number of spontaneous GSR fluctuations as the dependant measure.

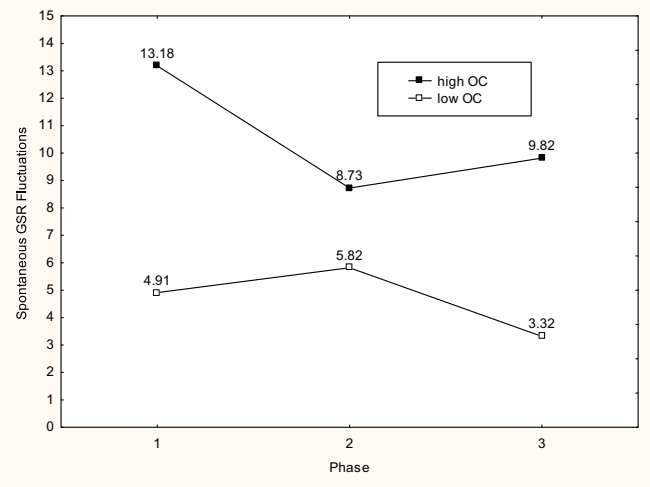

Fig. 1. Spontaneous GSR fluctuations by phase and OC tendencies.

Consistent with our first prediction, the high OC group had a significantly higher number of spontaneous GSR fluctuations ($M = 10.58$, $SD = 8.35$) than the low OC group ($M = 4.68$, $SD = 6.83$), $F(1, 42) = 6.57$, $p = .014$. To test our second prediction, we examined the interaction contrast of high vs. low OC tendencies and viewing vs. not viewing the monitor (P2 vs. P1 and P3). Consistent with our prediction, this interaction contrast was significant, $F(1, 42) = 4.93$, $p = .03$, reflecting a different effect of viewing the monitor on the two groups. As Fig. 1 illustrates, high OC participants improved their performance when they viewed the monitor in the second phase as compared to the first, $F(1, 42) = 8.06$, $p = .006$, whereas low OC participants did not, $F(1, 42) = .33$, $p = .56$.

Finally, we conducted a two-tail independent sample t-test to examine the hypothesis that high OC would be more inclined than low OC participants to request the biofeedback monitor during the fourth phase. Consistent with this prediction, high OC participants asked to see the monitor more times ($M = 2.90$, $SD = 1.63$) than the low OC participants ($M = 1.04$, $SD = 1.46$), $t(42) = 3.99$, $p < .001$.

As predicted, high OC participants, compared to low OC participants, performed more poorly on the relaxation task. More importantly, when an external proxy for relaxation was provided in the form of the biofeedback monitor, high OC participants performed better whereas low OC individuals did not. Finally, when given the opportunity, high OC individuals were more likely to request this external proxy.

We believe that the performance improvement of high OC participants with the inclusion of the biofeedback apparatus is accounted for by their diminished ability to access their own feelings of relaxation. Conversely, low OC participants, whose subjective experience of internal states and feelings is intact, did not show a significant performance change. The inclination of high OC participants, as compared with low OC participants, to rely on the biofeedback apparatus when given the opportunity also suggests a diminished ability to access their own feelings of relaxation. To compensate for this lack of access to their internal sense of relaxation, high OC participants chose to rely on a previously learned and useful external proxy, whereas low OC participants did not feel the need to rely on this proxy.

Study 1 had several limitations. The choice presented in this study between relying on external objective proxies and relying on subjective inner feelings was given in the context of achieving a distinct goal (of relaxation). Trying to succeed in this task may have invoked perfectionist tendencies, which are associated with OCD (e.g., Antony, Purdon, Huta, & Swinson, 1998; Frost, Marten, Lahart, & Rosenblate, 1990; Frost & Steketee, 1997), in the high OC participants. It might be that high OC participants relied on the monitor in order to do their very best in this task rather than because they were doubtful regarding their internal experience of relaxation. In addition, the task used in Study 1 did not include a direct measurement of participants' subjective assessment as to their inner experience and we could not contrast this assessment against objective physiological measures. These limitations were addressed in our next study.

Study 2 – self-perception of relaxation: the effects of false feedback

Self-perception theory (Bem, 1972) asserts that people can learn about their attitudes, preferences and other internal states from their knowledge about their overt behavior and the circumstances in which that behavior occurred, in much the same way as do external observers. Self-perception processes and effects have been long demonstrated in a wide variety of domains (for reviews, see Fazio, 1987; Olson & Hafer, 1990), such as formation of attitudes (e.g., Fazio, Zanna, & Cooper, 1977; Nisbett & Valins, 1971), personal

characteristics and dispositions (e.g., Darley & Fazio, 1980; Fazio, Effrein, & Falender, 1981; Winkielman, Schwarz, & Belli, 1998), motivation (e.g., Deci, 1971; Lepper, Greene, & Nisbett, 1973), self-esteem (e.g., Jones, Rhodewalt, Berglas, & Skelton, 1981), and emotions (e.g., Bem, 1965; Damrad-Frye & laird, 1989; Olson, 1992; Valins, 1966).

When first formulating the self-perception theory, Bem (1972) speculated that individuals would infer their internal dispositions (e.g., attitudes, emotions) from their overt behavior only when "internal cues are weak, ambiguous, or uninterpretable" (p. 2). It was assumed that to the extent that individuals lack access to their internal dispositions, they will have to infer their internal states from external cues (Wood, 1982). Several studies have supported this prediction regarding strong vs. weak attitudes (e.g., Chaiken & Baldwin, 1981; Holland, Verplanken, & Van Knippenberg, 2002; Wood, 1982). More directly relevant to the proposed studies, Detwiler and Zanna (1976) found that self-perception effects due to false physiological feedback had its clearest and strongest effect when prior knowledge about the stimulus object was minimal.

Our model predicts that high OC individuals, as compared with low OC individuals, would be more susceptible to self-perception effects in relation to internal states. We predict this to be the case because we hypothesize that Bem's (1972) assertion regarding self-perception effects in situations of weak and ambiguous internal cues is more of a constant condition regarding OC individuals as to their inner feelings and subjective conviction. When asking themselves "how do I feel?" high OC individuals would find it more difficult to assess their internal state and would resort, instead, to external signals that may inform them about their own feelings.

In Study 2 we examined this hypothesis with a false physiological feedback procedure. Using false physiological feedback in self-perception research of emotions and internal states was first introduced in a classic study by Valins (1966). Valins' male participants looked through photographs of women and rated their attractiveness while listening to a recorded sound of a heartbeat, which they mistakenly believed to be their own. Participants rated as more attractive the pictures that they viewed while listening to an increased heartbeat. Presumably, this was the case because participants interpreted their own heartbeat as indicative of attraction. Valins concluded that participants' self-perceptions or attribution of physiological arousal were a major determinant regarding their emotional experience (Woll & McFall, 1979). The primary finding on the effect of false physiology feedback was replicated with a variety of emotional experiences (e.g., Hirschman, 1975; Woll & McFall, 1979), including anxiety and relaxation (e.g., Borkovec, Wall, & Stone, 1974; Holmes & Frost, 1976; Leboeuf, 1980; Shahidi & Powell, 1988).

In this study, we examined the effect of false feedback on reported relaxation levels. Based on the reasoning explained above, we predicted that the high OC group, as compared with the low OC group, would be more susceptible to the influences of self-perception. Specifically, we predicted that high OC participants would rely more on the false biofeedback in judging their own level of relaxation in comparison to the low OC group, which would rely more on their internal feeling of relaxation. We predicted no effect of the false feedback on the actual relaxation measure in either group.

Method

Participants

Two hundred and thirteen psychology students (150 women, 63 men) at Tel-Aviv University were screened using the OCI-R (see above; Foa et al., 2002). As in Study 1, we invited students who scored at the top and bottom of the distribution for participation in this study. The final sample included 36 students (M age = 22.6 years, SD = 1.73, range = 19–28 years): Eighteen (13 women and 5 men) with high OC tendencies ($M = 34.94$, $SD = 6.43$) and 18 (13 women and 5 men) with low OC tendencies ($M = 3.38$, $SD = 1.24$), $t(34) = 20.44$, $p < .001$. The scores in the high OC group ranged between 28 and 48, and in the low OC group between 1 and 5. The two groups differed significantly on all subscales of the OCI-R. None of the participants had previous experience with biofeedback. Participants signed an informed consent and received course credit for participation.

Apparatus and measures

Autonomic arousal levels were measured by the same biofeedback apparatus used in Study 1. Obsessive–compulsive tendencies were measured by the OCI-R, as in Study 1.

Anxiety levels

Subjective levels of current anxiety were measured by the short form of the State subscale of the State-Trait Anxiety Inventory (STAI-6; Marteau & Bekker, 1992). The STAI-6 is a 6 item measure that assesses subjective feelings of anxiety and tension at the particular moment during which the test is completed. Rating is done on a 4-point Likert-type scale ranging from 1 (*not at all*) to 4 (*very much*). The STAI-6 produces scores similar to those obtained using the full 20 item State subscale of the STAI (Spielberger, Gorsuch, & Lushene, 1970). It has been shown to have good validity, test-retest reliability and internal consistency across subject groups manifesting normal and raised levels of anxiety. The STAI-6 remains sensitive to different degrees of anxiety while offering a briefer and more acceptable scale for participants (Marteau & Bekker, 1992).

Procedure

Participants were tested individually in a small and quiet room and received the same introduction to the biofeedback apparatus as in Study 1. In addition, participants in this study were told that "usually the biofeedback apparatus functions quite well, although its reliability is not a hundred percent, so that sometimes the feedback given as to levels of relaxation is not accurate." This explanation was followed by a 3-min interval of watching a screen saver on the monitor, in order to permit the participant's arousal level to return to its baseline level before the start of the experiment and to minimize prior sources of attribution regarding participant's relaxation levels.

The study included two false 5-min pre-programmed biofeedback phases, one of a descending line graph signaling to participants increase in relaxation, and one of an ascending line graph signaling a decrease in relaxation. The order of the two false pre-programmed biofeedback phases was counter-balanced across participants. Before each relaxation phase participants were instructed to "try and relax deeply" while being monitored by the biofeedback apparatus. They were told that they will be able to view the biofeedback monitor and were asked to refrain from talking or moving as much as possible during the different phases. After each relaxation phase participants were instructed to complete the STAI-6. Before the second relaxation phase participants again watched a 3-min screen saver on the monitor, in order to permit the participant's arousal level to return to its baseline level before proceeding to the next phase. While participants viewed the false biofeedback monitor, we measured their actual spontaneous GSR fluctuations, as defined above, in order to rule out

a possible alternative explanation of real relaxation level differences between the two biofeedback phases.

Results and discussion

We tested our hypotheses with a 2 (OC tendencies: high vs. low) × 2 (trend: upward vs. downward) mixed-model ANOVA with STAI-6 score as the dependant measure. Consistent with our prediction, the interaction was significant, $F(1, 34) = 9.77$, $p < .001$, reflecting a differential effect of the false biofeedback on the two groups. As Fig. 2 shows, high OC participants were more affected by the false biofeedback when judging their level of relaxation compared to low OC participants.

In order to rule out real relaxation level differences between the two false biofeedback phases among the two groups, which might serve as an alternative explanation to the interaction we found, we conducted a 2 (OC tendencies: high vs. low) × 2 (trend: upward vs. downward) mixed-model ANOVA with number of spontaneous GSR fluctuations as the dependant measure. Consistent with our prediction, there was no interaction between trend and OC tendencies, $F(1, 34) = .44$, $p = .51$, indicating that real relaxation level differences between the two false biofeedback phases among the two groups did not exist (see Fig. 3). There were no other significant effects.

As predicted, high OC participants, compared to low OC participants, relied more on the false biofeedback in judging their own internal state of relaxation, indicating that they were more susceptible to self-perception effects. This effect could not be accounted for by the actual state of relaxation, which did not interact with OC tendencies.

We believe that the inclination of the high OC participants to rely on the false biofeedback reflects their tendency to rely on external proxies in order to compensate for their diminished ability to access their own internal states. This proposition is consistent with Bem's (1972) suggestion that self-perception effects would be especially strong in situations of weak and ambiguous internal states, a condition we believe characterizes the experience of high OC individuals.

General discussion

The present studies were driven by the hypothesis that OC tendencies are related to a reduced sense of subjective conviction, which leads people with high OC tendencies to rely on external proxies as a means to compensate for this deficiency. We examined this hypothesis using a biofeedback-aided relaxation procedure, in which relaxation was used as a vague internal state and the biofeedback monitor was used as an external proxy.

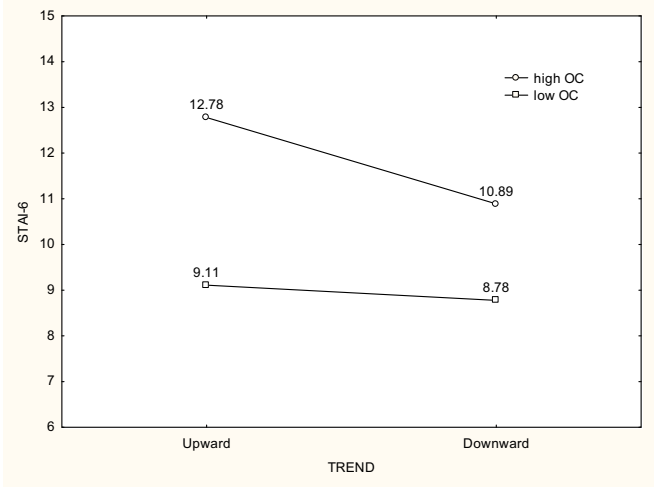

Fig. 2. STAI-6 scores by trend and OC tendencies.

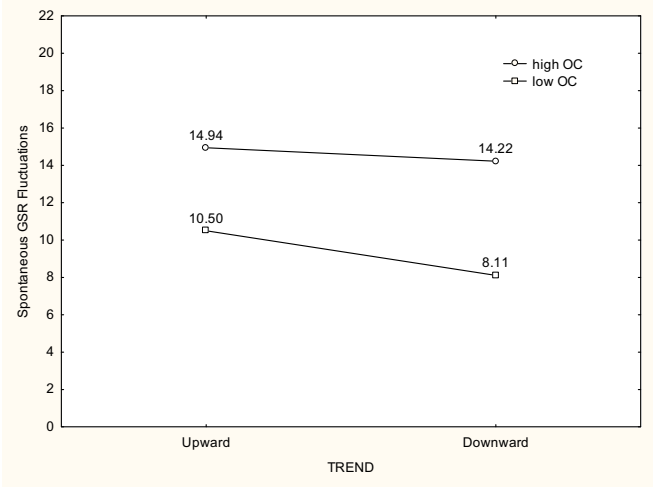

Fig. 3. Spontaneous GSR fluctuations by trend and OC tendencies.

Our findings are consistent with previous descriptions of the pervasiveness of doubt in OCD (Janet, 1903; Rapoport, 1989; Reed, 1985; Shapiro, 1965). They extend previous findings regarding mistrust in general memory abilities, decision-making, concentration abilities, attention and perception in OCD to include feelings and internal states. These findings complement the models proposed by Szechtman and Woody (2004), by Boyer and Lienard (2006) and by Summerfeldt (2004). First, they expand the proposed deficiency to non-security-related areas and to internal states not related to incompleteness feelings. Second, they propose the use of proxies as a means to cope with this deficiency. Our results corroborate both of these additional propositions.

Our findings may also be related to studies examining explicit and implicit processing in OCD, which suggest that OC individuals rely on explicit processing as a compensation strategy to overcome a deficit in implicit processing. Studies by Rauch et al. (1997) and Deckersbach et al. (2002) showed that OCD patients employ explicit processing in tasks that usually involve implicit processing. Joel et al. (2005) supported these conclusions by showing impaired performance of OCD patients in the card betting task, which is considered to require implicit learning. They interpreted this finding as indicating that the OCD patients relied on explicit rather than implicit processing. Similar conclusions were reached by Marker, Calamari, Woodard, and Riemann (2006), who proposed that impaired implicit processing and learning in OCD results in a compensatory reliance on explicit learning strategies. From this perspective it is possible to interpret the reliance of OC individuals on the biofeedback as reflecting an inclination toward explicit learning of how to achieve and judge the internal state of relaxation.

The two studies presented here are a preliminary examination of the hypothesis that high OC individuals have deficient subjective conviction which leads them to rely on objective, verifiable proxies. Many questions remain to be resolved in regard to the nature of this deficiency in OCD, its relation to rituals and its effects on OC individuals' lives, and future research should try and clarify these questions. First, further research is needed to clarify why and how a general deficiency in feeling of knowing or subjective conviction expresses itself in specific realms or worlds of content. We believe this deficiency to be a primary feature of OCD, rather than just a symptom or a part of the disorder's phenomenology, leading to

vulnerability to feelings of doubt and uncertainty. But the question of why it is that one individual experiences doubt in regard to locking the door, another with regard to the cleanness of his hands, and still another with regards to his level of understanding remains open. A possible answer is that the lack of subjective conviction might serve as a necessary but not sufficient prerequisite for the development of OCD. It might be that a second prerequisite is needed, namely, some indication of importance regarding a specific area of content. Second, while there is typically a logical relation between one's realm of doubt and one's ritual or proxy, future research is still needed to clarify the development of the specific proxy used as a compensation strategy and its elaboration over time. Third, it would be important to examine whether relying on external cues and proxies, as a compensation strategy for weak subjective conviction, varies with the seriousness of making a mistake or the looming presence of threat.

There are some limitations of these studies that need to be addressed in future research. The present studies examined our hypothesis in a specific context, namely in trying to achieve a state of relaxation with biofeedback as an external proxy. Results from our first study suggested a real difference between high and low OC participants regarding relaxation abilities. Since OCD is currently considered an anxiety disorder (Bartz & Hollander, 2006) and classified as such in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2000) it seems imperative to test our model with a task not confounded with relaxation ability. Future studies should examine our hypothesis in the context of other domains that require access to subjective states besides relaxation ability, including other physical states as well as attitudes, feelings and preferences. In addition, our findings are based on a non-clinical, highly functioning, largely female student sample and their generalization to OCD requires replication with a clinical sample. Still, we believe that this line of research can facilitate the understanding of the mechanisms that create and maintain the incessant doubts and repeated checking that are hallmarks of OCD. If OC tendencies are indeed associated with seeking and reliance on external proxies, this relationship may also shed light on the development of rituals, which can be understood as rules and procedures aimed to compensate for the loss of internal conviction (Shapiro, 1965; Reed, 1985).

Finally, the proposed model can be integrated into existing cognitive and meta-cognitive therapy for OCD. For example, patients can be informed about mechanisms that undermine conviction and can lead to the development of rituals, such as repeatedly questioning and examining their own feelings and preferences. The reframing of the ritual as an external proxy designed to buttress one's weak subjective conviction can be explained to patients with emphasis on the high “price” the patient typically pays for using these proxies, which only further undermine the patients' internal conviction and experience. In addition, patients can be helped, with the aid of biofeedback procedures, to learn to identify and control internal states such as tension and anxiety, and perhaps to generalize this ability to other internal states in regard to which they may experience uncertainty. Future research should examine the viability of acquiring a general skill of identifying and relying on internal states, which may help to counter the self-doubt that is so pervasive in OC individuals.

Acknowledgement

This research was supported by the Israel Science Foundation (Grant number 972/07)

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (DSM-IV-R)*. Washington, DC: American Psychiatric Association.
Amir, N., Freshman, M., Ramsey, B., Neary, E., & Brigidi, B. (2001). Thought–action fusion in individuals with OCD symptoms. *Behaviour Research and Therapy, 39*, 765–776.
Andreassi, J. L. (2000). *Psychophysiology: human behavior and physiological response* (4th edn.). Mahwah, New Jersey: Lawrence Erlbaum Associates.
Antony, M. M., Purdon, C. L., Huta, V., & Swinson. (1998). Dimensions of perfectionism across anxiety disorders. *Behaviour Research and Therapy, 36*, 1143–1154.
Ashbaugh, A. R., & Radomsky, A. S. (2007). Attentional focus during repeated checking does influence memory but not metamemory. *Cognitive Therapy and Research, 31*, 291–306.
Ashcroft, K. R., Guimaraes, F. S., Wang, M., & Deakin, J. F. W. (1991). Evaluation of psychophysiological model of classical fear conditioning in anxious patients. *Psychopharmacology, 104*, 215–219.
Bartz, J. A., & Hollander, E. (2006). Is obsessive–compulsive disorder an anxiety disorder. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 30*, 338–352.
Bem, D. J. (1965). An experimental analysis of self-persuasion. *Journal of Experimental Social Psychology, 1*, 199–218.
Bem, D. J. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology*. San Diego, CA: Academic Press.
Borkovec, T. D., Wall, R. L., & Stone, N. M. (1974). False physiological feedback and the maintenance of speech anxiety. *Journal of Abnormal Psychology, 83*, 164–168.
Boyer, P., & Lienard, P. (2006). Why ritualized behaviour? Precaution systems and action parsing in developmental, pathological and cultural rituals. *Behavioural and Brain sciences, 29*, 595–650.
Brown, H. D., Kosslyn, S. M., Breitler, H. C., Baer, L., & Jenike, M. A. (1994). Can patients with obsessive compulsive disorder discriminate between percepts and mental images? A signal detection analysis. *Journal of Abnormal Psychology, 103*, 445–454.
Chaiken, S., & Baldwin, M. W. (1981). Affective–cognitive consistency and the effect of salient of behavioral information on the self-perception of attitudes. *Journal of Personality and Social Psychology, 41*, 1–12.
Damrad-Frye, R., & Laird, J. D. (1989). The experience of boredom: the role of the self perception of attention. *Journal of Personality and Social Psychology, 57*, 315–320.
Dar, R. (2004). Elucidating the mechanism of uncertainty and doubt in obsessive compulsive checkers. *Journal of Behavior Therapy and Experimental Psychiatry, 35*, 153–163.
Dar, R., Rish, S., Hermesh, H., Fux, M., & Taub, M. (2000). Realism of confidence in obsessive–compulsive checkers. *Journal of Abnormal Psychology, 109*, 673–678.
Darley, J. M., & Fazio, R. H. (1980). Expectancy confirmation processes arising in the social interaction sequence. *American Psychologist, 35*, 867–881.
Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*, 105–115.
Deckersbach, T., Savage, C. R., Curran, T., Bohne, A., Wilhelm, S., Baer,…Rauch, L., et al. (2002). A study of parallel implicit and explicit information processing in patients with obsessive–compulsive disorder. *American Journal of Psychiatry, 159*, 1780–1782.
Detwiler, R. A., & Zanna, M. P. (1976). Physiological mediation of attitudinal responses. *Journal of Personality and Social Psychology, 33*, 107–116.
Fazio, R. H. (1987). Self-perception theory: a current perspective. In M. P. Zanna, J. M. Olson, & C. P. Herman (Eds.), *Social influence: the Ontario symposium*. Hillsdale, NJ: Erlbaum.
Fazio, R. H., Effrein, E. A., & Falender, V. J. (1981). Self perception following social interaction. *Journal of Personality and Social Psychology, 41*, 232–242.
Fazio, R. H., Zanna, M. P., & Cooper, J. (1977). Dissonance and self perception: an integrative view of each theory's proper domain of application. *Journal of Experimental Social Psychology, 13*, 464–479.
Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., et al. (2002). The obsessive–compulsive inventory: development and validation of a short version. *Psychological Assessment, 14*, 485–496.
Frost, R. O., Marten, P., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive Therapy and Research, 14*, 449–468.
Frost, R. O., & Steketee, G. (1997). Perfectionism in obsessive–compulsive disorder patients. *Behaviour Research and Therapy, 35*, 291–296.
Gibbs, N. A. (1996). Non-clinical populations in research on obsessive–compulsive disorder: a critical review. *Clinical Psychology Review, 16*, 729–773.
Hajack, G., Huppert, J. D., Simons, R. F., & Foa, E. B. (2004). Psychometric properties of the OCI-R in a college sample. *Behaviour Research and Therapy, 42*, 115–123.
Hensman, R., Guimaraes, F. S., Wang, M., & Deakin, J. F. W. (1991). Effects of ritanserin on aversive classical conditioning in humans. *Psychopharmacology, 104*, 220–224.
Hermans, D., Engelen, U., Grouwels, L., Joos, E., Lemmens, J., & Pieters, G. (2008). Cognitive confidence in obsessive–compulsive disorder: distrusting perception, attention and memory. *Behaviour Research and Therapy, 46*, 98–113.
Hermans, D., Martens, K., De Cort, K., Pieters, G., & Eelen, P. (2003). Reality monitoring and metacognitive beliefs related to cognitive confidence in obsessive compulsive disorder. *Behaviour Research and Therapy, 41*, 383–401.
Hirschman, R. D. (1975). Cross-modal effects of anticipatory bogus heart rate feedback in a negative emotional context. *Journal of Personality and Social Psychology, 31*, 13–19.

Holland, R. W., Verplanken, B., & Van Knippenberg, A. (2002). On the nature of attitude behavior relations: the strong guide, the weak follow. *European Journal of Social Psychology, 32*, 869–876.
Holmes, D. S., & Frost, R. O. (1976). Effects of false autonomic feedback on self reported anxiety, pain perception, and pulse rate. *Behavior therapy, 7*, 330–334.
van den Hout, M. A., Engelhard, I. M., de Boer, C., du Bois, A., & Dek, E. (2008). Perseverative and compulsive like staring causes uncertainty about perception. *Behaviour Research and Therapy, 46*, 1300–1304.
van den Hout, M. A., Engelhard, I. M., Smeets, M., Dek, E., Turksma, K., & Saric, R. (2009). Uncertainty about perception and dissociation after compulsive like staring: time course of effects. *Behaviour Research and Therapy, 47*, 535–539.
van den Hout, M. A., & Kindt, M. (2003a). Repeated checking causes memory distrust. *Behaviour Research and Therapy, 41*, 301–316.
van den Hout, M. A., & Kindt, M. (2003b). Phenomenological validity of an OCD memory model and the remember/know distinction. *Behaviuor Research and Therapy, 41*, 369–378.
Ince, L. P., Leon, M. S., & Christidis, D. (1987). EMG biofeedback with the upper extremity: a critical review of experimental foundations of clinical treatment with the disabled. *Rehabilitation Psychology, 32*, 77–91.
Janet, P. (1903). *Les Obessions et la Psychasthénie*. Paris: Alcan.
Joel, D., & Avisar, A. (2001). Excessive lever pressing following post-training signal attenuation in rats: a possible animal model of obsessive–compulsive disorder? *Behavioural Brain Research, 12*, 77–87.
Joel, D., Zohar, O., Afek, M., Hermesh, H., Lerner, L., Kuperman, R., et al. (2005). Impaired procedural learning in obsessive compulsive disorder and Parkinson's disease, but not in major depressive disorder. *Behavioural Brain Research, 157*, 253–263.
Jones, E. E., Rhodewalt, F., Berglas, S., & Skelton, J. A. (1981). Effects of strategic self presentation on subsequent self-esteem. *Journal of Personality and Social Psychology, 41*, 407–421.
Katkin, E. S. (1965). Relationship between manifest anxiety and two indices of autonomic response to stress. *Journal of Personality and Social Psychology, 2*, 324–333.
Katkin, E. S. (1966). The relationship between a measure of transitory anxiety and spontaneous autonomic activity. *Journal of Abnormal Psychology, 71*, 142–146.
Katkin, E. S., & McCubbin, R. J. (1969). Habituation of the orienting response as a function of individual differences in anxiety and autonomic lability. *Journal of Abnormal Psychology, 74*, 54–60.
Leahy, A., Clayman, C., Mason, I., Lloyd, G., & Epstein, O. (1998). Computerized biofeedback games: a new method for teaching stress management and its use in irritable bowel syndrome. *Journal of the Royal College of Physicians of London, 32*, 552–556.
Leboeuf, A. (1980). Effects of frontalis biofeedback on subjective ratings of relaxation. *Perceptual and Motor Skills, 50*, 99–103.
Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: a test of the over-justification hypothesis. *Journal of Personality and Social Psychology, 28*, 129–137.
Liberman, N., & Dar, R. (2009). Normal and pathological consequences of encountering difficulties in monitoring progress toward goals. In G. Moskowitz, & H. Grant (Eds.), *The psychology of goals* (pp. 277–303). New York: Guilford Press.
MacDonald, P. A., Antony, M. M., MacLeod, C. M., & Richter, M. A. (1997). Memory and confidence in memory judgments among individuals with obsessive compulsive disorder and non clinical controls. *Behaviour Research and Therapy, 35*, 497–505.
Marker, C. D., Calamari, J. E., Woodard, J. L., & Riemann, B. C. (2006). Cognitive self consciousness, implicit learning and obsessive–compulsive disorder. *Journal of Anxiety Disorders, 20*, 389–407.
Marteau, T. M., & Bekker, H. (1992). The development of a six item short form of the state scale of the Spielberger state trait anxiety inventory (STAI). *British Journal of clinical Psychology, 31*, 301–306.
Nagai, Y., Goldstein, L. H., Fenwick, P. B. C., & Trimble, M. R. (2004). Clinical efficacy of galvanic skin response biofeedback training in reducing seizures in adult epilepsy: a preliminary randomized controlled study. *Epilepsy & Behavior, 5*, 216–223.
Nedeljkovic, M., & Kyrios, M. (2007). Confidence in memory and other cognitive processes in obsessive compulsive disorder. *Behaviour Research and Therapy, 45*, 2899–2914.
Nedeljkovic, M., Moulding, R., Kyrios, M., & Doron, G. (2009). The relationship of cognitive confidence to OCD symptoms. *Journal of Anxiety Disorders, 23*, 463–468.
Nisbett, R. E., & Valins, S. (1971). Perceiving the causes of one's own behavior. In E. E. Jones, D. E. Kanouse, H. H. Kelley, R. E. Nisbett, S. Valins, & B. Weiner (Eds.), *Attribution: perceiving the causes of behavior*. Morristown. N.J.: General Learning Press.
Olson, J. M. (1992). Self perception of humor: Evidence for discounting an augmentation effects. *Journal of Personality and Social Psychology, 62*, 369–377.
Olson, J. M., & Hafer, C. L. (1990). Self-inference processes: looking back and ahead. In J. M. Olson, & M. P. Zanna (Eds.), *Self-inference processes: the Ontario symposium*. Hillsdale, NJ: Erlbaum.
Orme-Johnson, D. W. (1973). Autonomic stability and transcendental meditation. *Psychosomatic Medicine, 35*, 341–349.
Rachman, S., & de Silva, P. (1978). Abnormal and normal obsessions. *Behaviour Research and Therapy, 16*, 233–248.
Radomsky, A. S., Gilchrist, P. T., & Dussault, D. (2006). Repeated checking really does cause memory distrust. *Behaviour Research and Therapy, 44*, 305–316.
Rapoport, J. L. (1989). *The boy who couldn't stop washing: The experience and treatment of obsessive–compulsive disorder*. New York: Dutton.
Rauch, S. L., Savage, C. R., Alpert, N. M., Dougherty, D., Kendrick, A., Curran,… Jenike, T., et al. (1997). Probing striatal function in obsessive–compulsive disorder: a PET study of implicit sequence learning. *Journal of Neuropsychiatry and Clinical Neuroscience, 9*, 568–573.
Reed, G. F. (1985). *Obsessional experience and compulsive behaviour: a cognitive structural approach*. Orlando, Florida: Academic Press.
Reuven-Magril, O., Dar, R., & Liberman, N. (2008). Illusion of control and behavioral control attempts in obsessive–compulsive disorder. *Journal of Abnormal Psychology, 117*, 334–341.
Salkovskis, P. M., & Harrison, J. (1984). Abnormal and normal obsessions: a replication. *Behavior Research and therapy, 22*, 549–552.
Schwartz, N. M., & Schwartz, M. S. (2003). Definitions of biofeedback and applied psychophysiology. In M. S. Schwartz, & F. A. Andrasik (Eds.), *Biofeedback: A practitioner's guide* (3rd ed.). New York: Guilford Press.
Segreto, J. (1995). The role of EMG awareness in EMG biofeedback learning. *Biofeedback and Self Regulation, 20*, 155–167.
Shahidi, S., & Powell, G. E. (1988). Biofeedback training of relaxation: the effects of false feedback and the influence of suggestibility. *Personality and Individual Differences, 6*, 995–999.
Shapiro, D. (1965). *Neurotic styles*. New York: Basic Books.
Shapiro, M., Melmed, R. N., Sgan-Cohen, H. D., Eli, I., & Parush, S. (2007). Behavioural and physiological effect of dental environment sensory adaptation on children's dental anxiety. *European Journal of Oral Science, 115*, 479–483.
Soref, A., Dar, R., Argov, G., & Meiran, N. (2008). Obsessive–compulsive tendencies are related to focused information processing strategy in the flanker task. *Behaviour Research & Therapy, 46*, 1295–1299.
Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the state-trait anxiety inventory (self evaluated questionnaire)*. Palo Alto, CA: Consulting Psychologists Press.
Summerfeldt, L. J. (2004). Understanding and treating incompleteness in obsessive–compulsive disorder. *Journal of Clinical Psychology, 60*, 1155–1168.
Szechtman, H., & Woody, E. (2004). Obsessive–compulsive disorder as a disturbance of security motivation. *Psychological Review, 111*, 111–127.
Tolin, D. F., Abramowitz, J. S., Brigidi, B. D., Amir, N., Street, G. P., & Foa, E. B. (2001). Memory and memory confidence in obsessive–compulsive disorder. *Behaviour Research and Therapy, 39*, 913–927.
Valins, S. (1966). Cognitive effects of false heart-rate feedback. *Journal of Personality and Social Psychology, 4*, 400–408.
Winkielman, P., Schwarz, N., & Belli, R. F. (1998). The role of ease of retrieval and attribution in memory judgments: judging your memory as worse despite recalling more events. *Psychological Science, 9*, 124–126.
Woll, S. B., & McFall, M. E. (1979). The effects of false feedback on attributed arousal and rated attractiveness in female subjects. *Journal of Personality, 47*, 214–229.
Wood, W. (1982). Retrieval of attitude-relevant information from memory: effects on susceptibility to persuasion and on intrinsic motivation. *Journal of Personality and Social Psychology, 42*, 798–810.
Yahav, R., & Cohen, M. (2008). Evaluation of a cognitive–behavioral intervention for adolescents. *International Journal of Stress Management, 15*, 173–188.