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Differences in latent inhibition as a function of the autogenous–reactive OCD subtype

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ABSTRACT

We examined differences in a visual search-based latent inhibition (LI) task in 48 non-treatment seeking individuals diagnosed with obsessive–compulsive disorder (OCD) and 26 non-OCD controls, using a visual search-based LI task as a function of participants' primary obsessional presentation based on the autogenous–reactive subtype model of obsessions (Lee & Kwon, 2003; Lee & Telch, 2007). We hypothesized that LI would be significantly attenuated among OCD participants whose primary obsessions were characterized by aversive impulses, images, or thoughts with sexual, aggressive, blasphemous, and repulsive themes (autogenous obsessions) due to their weakened attentional inhibitory mechanisms and elevated schizotypal personality features, as compared with those whose primary obsessions were characterized by somewhat realistic aversive mental intrusions about contamination, mistakes, accidents, or disarray (reactive obsession) and non-OCD controls. Results showed that those primarily displaying autogenous obsessions failed to display LI, whereas those primarily displaying reactive obsessions and non-OCD controls displayed significant LI effects. Our data suggest that the magnitude of LI varies as a function of primary obsessional presentations among individuals with OCD.

The autogenous–reactive model (Lee & Kwon, 2003; Lee & Telch, 2007) proposes two different subtypes of obsessions in obsessive–compulsive disorder (OCD). *Autogenous obsessions* are defined as highly aversive and unrealistic mental intrusions that tend to be perceived as threatening in their own right. They usually take the form of recurrent thoughts, images, urges, or impulses with repulsive themes concerning unacceptable sexual behavior, violence and aggression, sacrilege and blasphemy, horrific scenes, and the like. Autogenous obsessions are perceived as highly irrational and unacceptable (i.e., ego-dystonic), resulting in threat perception and rituals focused on the thoughts themselves. They tend to occur without clear antecedents, or to be triggered by stimuli that are symbolically, unrealistically, or remotely associated with the thoughts.

Reactive obsessions, in contrast, are somewhat realistic aversive mental intrusions, in which the perceived threat is not the obsession itself, but rather the *trigger* of the intrusion or some associated negative possible (but improbable) *consequence*. Reactive obsessions take the form of persistent thoughts, concerns, or doubts about contamination, mistakes, accidents, asymmetry, or disarray. They are perceived as relatively realistic and likely to come true, thereby eliciting some corrective (usually overt) actions that aim to revert the associated uncomfortable situation to a safe or desired state. Thus, compared to autogenous obsessions, reactive obsessions are more likely to occur in reaction to explicit cues that also correspond to specific core threats perceived by the individual (e.g., potential contaminants, disarrayed objects). Reactive obsessions also evidence a more realistic and functional link with their triggers. For example, believing that one has been exposed to germs may serve as an invariable trigger for obsessions concerning contamination, and lead the person to strive to correct the triggering situation through cleaning or washing.

Existing studies have shown that OCD patients and individuals with non-clinical obsessions display significant differences in several OCD-related domains as a function of their primary obsessional presentations based on the autogenous–reactive taxonomy: (a) cognitive appraisals and neutralizing strategies (Belloch, Morillo, & Garcia-Soriano, 2007; Lee, Lee, Kim, Kwon, & Telch, 2005), (b) OCD symptom profile (Lee & Telch, 2005; Moulding, Kyrios, Doron, & Nedeljkovic, 2007), (c) associated dysfunctional beliefs (Lee, Kwon, Kwon, & Telch, 2005), and (d) associated personality features (Lee, Kim, & Kwon, 2005; Lee & Telch, 2005).

Particularly, several lines of evidence suggest that individuals who primarily present with autogenous obsessions as opposed to reactive obsessions have greater difficulty in inhibitory cognitive control. Specifically, autogenous obsessionals, relative to reactive

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obsessionals are more likely to: (a) engage in covert rituals aimed at removing/suppressing their thoughts, and perceive these covert rituals as uncontrollable (Lee & Kwon, 2003; Lee, Kwon et al., 2005); b) display stronger urges and worries of losing control over impulsive actions (Lee, Kwon et al., 2005); (c) show fewer overt rituals (Lee & Telch, 2005; Moulding et al., 2007); (d) show exaggerated threat appraisals of their mental intrusions (Lee & Telch, 2005); (e) show greater perceptual distortions and illogical/magical thinking (Lee, Kim, & Kwon, 2005; Lee & Telch, 2005), and (f) show impaired response inhibition as indicated by poorer performance (i.e., longer response latencies in a response-set shifting block) on a visual go/no-go task (Lee, Yost, & Telch, 2009).

Considering these findings, the central deficit in dysfunctional cognitive control shown by autogenous obsessionals is suspected as the deficient ability to direct and maintain their attentional focus on the proper target while inhibiting attention from being allocated to inconsequential, irrelevant, or even unwanted distressing stimuli. This is a critical cognitive capacity required for efficient selective attentional processing, which is also believed to lie at the center of latent inhibition (LI) processes. LI is defined as the retardation of learning to a stimulus that was previously presented without a consequence (=learned as an irrelevant distracter) as compared with learning to a novel stimulus (Lubow & Gewirtz, 1995). Thus, LI is indicative of an adaptive normal attention-related learning process that enables individuals to selectively attend to the relevant task stimuli while disregarding or filtering out information tagged as irrelevant based on their previous learning (Lubow & De la Casa, 2002). Existing data obtained from studies using humans and rodents suggest that dopamine receptor sensitivity is a key factor involved in regulating normal adaptive LI: dopamine agonists (e.g., D-amphetamine) diminish the magnitude of LI whereas dopamine antagonist (e.g., neuroleptic) enhance the magnitude of LI (e.g., Thornton et al., 1996; Weiner & Feldon, 1997; Weiner, Feldon, & Katz, 1987; Weiner, Lubow, & Feldon, 1984; Williams et al., 1997). In line with these data, numerous studies have demonstrated reduced LI among acute, non-medicated schizophrenic patients (e.g. Baruch et al., 1988a; Gray, Hemsley, & Gray, 1992) and among normal individuals with elevated psychosis-proneness or schizotypy (e.g., Baruch et al., 1988b; Lubow et al., 1992).

Visual search-based LI tasks typically present two separate learning phases (pre-exposure trials and subsequent test trials) using a within-subjects design with reaction time (RT) as the primary dependent variable. In pre-exposure trials, subjects are asked to attend to the target for detecting its presence/absence or its location while disregarding non-target stimuli. These irrelevant distracters from the pre-exposure phase later become the target in the test phase. According to the Conditioned Attention Theory (Lubow & Gewirtz, 1995), normal adaptive LI will evidence when intact attentional inhibitory mechanisms generate *learned inattention* to the distracter in the pre-exposure phase, which in turn results in greater difficulty for the individual to attend to this formerly disregarded stimulus relative to a novel target stimulus during the test phase. In contrast, deficient inhibitory attentional control may result in indiscriminate attention to both relevant and irrelevant stimuli in the pre-exposure phase, which will attenuate or remove the retardation of learning to the formerly irrelevant stimulus as compared with a novel stimulus. Thus, LI seems to be a relevant attention-related process that can shed light on the inhibitory processing deficits among autogenous obsessionals as compared with reactive obsessionals.

Deficient cognitive inhibition has received much attention in the context of OCD as its relevant cognitive factor. Several experimental paradigms have been used to illuminate cognitive inhibition deficits in OCD such as go/no-go tasks (e.g., Watkins et al., 2005), directed forgetting tasks (e.g., Bohne, Keuthen, Tuschen-Caffier, & Wilhelm, 2005), and negative priming tasks (e.g., Enright & Beech, 1993). However, primary obsessional presentations that directly contribute to the clinical heterogeneity of OCD have not received much attention in this line of experimental psychopathology work. The current study aimed to examine how primary obsessional presentations determined based on the autogenous–reactive subtype would affect LI effects among individuals with OCD. To this end, we compared performance on a computerized visual search LI task (Kaplan et al., 2006) among individuals diagnosed with OCD with a primary presentation of the autogenous vs. reactive subtype, and controls displaying low OCD symptoms. Based on our prior work, we predicted that obsessionals presenting with a primary autogenous subtype would show significantly poorer inhibitory control on the LI task (i.e., attenuated LI effects), relative to obsessionals presenting with a primary reactive subtype or non-OCD controls.

Methods

Participants

Undergraduates ($N = 2970$) enrolled in introductory psychology courses at a large Southwestern University underwent an initial web screening using the obsessive–compulsive inventory-revised (OCI-R; Foa et al., 2002). They received partial course credit in return for their participation. Those who scored in the top 3% ($N = 91$) and a random sample ($N = 45$) from those who scored in the bottom 3% were invited to participate.[1] From these two groups, 64 high OCI-R scorers and 26 low OCI-R scorers responded to the study invitation. These 90 study responders were then administered the OCD module of the Composite International Diagnostic Interview (CIDI; WHO, 1997) by master-level graduate students in clinical psychology who had received extensive training in conducting the CIDI. This diagnostic interview identified 48 individuals who met current DSM-IV criteria for OCD among the 64 high OCI-R scorers. None of the low OCI-R scorers met criteria for OCD based on the CIDI interview. Thus, the final sample included 74 participants (28 males, 46 females, mean age = 18.54, SD = 1.02) who either met current DSM-IV criteria for OCD ($N = 48$) or displayed low levels of OCD symptoms ($N = 26$; CONs).[2] Our sample presented the following ethnicity/race distribution: Hispanic (12.2%), African American/Black (6.8%), American Indian/Alaska Native (4.1%), Asian/Pacific Islander (17.6%), White (67.6%) and other (4.1%).

Measures

OCD symptoms

The severity of OCD symptoms was measured using the Obsessive–Compulsive Inventory-Revised (OCI-R; Foa et al., 2002).

[1] The initial screening cut-off on the OCI-R (i.e., top 3% in total scores) was designed to maximize the likelihood of recruiting individuals who would meet current DSM-IV criteria for OCD. In the current study, this cut-off provided a more stringent criterion compared to established cut-off scores (e.g., Foa et al., 2002), thus enhancing the sensitivity of the screening procedure. Most epidemiological studies have demonstrated the lifetime prevalence rates of OCD to range around 3%, for example, 2.5% – the Epidemiologic Catchment Area study (ECA; Regier et al., 1988; Robins et al., 1984), 2.9% – Bland and colleagues (Bland, Orn, & Newman, 1988; Kolada, Bland, & Newman, 1994), and 2.8% – Henderson and Pollard (1988). Nevertheless, our non-treatment seeking OCD sample may not be fully comparable to a clinical patient sample. Thus, we constructed the reference condition as individuals displaying low levels of OCD symptoms by confining their overall symptom level within the bottom 3% on the OCI-R, in order to increase the chance to demonstrate the impact of OCD diagnostic status upon the LI performance.

[2] We have analyzed different aspects of neuropsychological functioning in part of the current study sample in a different report (Lee, Yost, & Telch, 2009).

The OCI-R is a well-established 18-item questionnaire with good psychometric properties: good internal consistency, test–retest reliability, convergent validity and good discriminant validity (Foa et al., 2002). The OCI-R was found to be more strongly correlated with other OCD symptom measures than with the measures of pathological worry or depression in a study using student samples (Hajcak, Huppert, Simons, & Foa, 2004).

Schizotypal personality features

The Schizotypal Personality Scale (STA; Claridge & Broks, 1984) is a 37-item self-report measure of schizotypal personality traits based on a Yes/No response format. With the total scores ranging from 0 to 37, higher scores indicate greater proneness to psychosis. The STA assesses a general psychosis-proneness in accordance with the current multidimensional conceptualization of schizotypy (Lenzenweger, 1999), presenting with three robust factors (Hewitt & Claridge, 1989; Rawlings et al., 2001): (a) Magical Thinking (e.g., Have you ever felt that you were communicating with another person telepathically?); (b) Unusual Perceptual Experiences (e.g., Have you ever had the sensation of your body or part of it changing shape?); and (c) Paranoid Suspiciousness (e.g., Do you often feel that other people have it in for you?). The STA has also demonstrated good construct and discriminant validity (Rawlings et al., 2001). High scorers on the STA resemble schizophrenics in their performance on various experimental tasks, e.g., negative priming paradigm (e.g., Beech, Baylis, Smithson, & Claridge, 1989). High schizotypal individuals identified by the STA also display reduced LI effects (see Lubow & Kaplan, 2005).

General emotional distress

We also administered the State-Trait Anxiety Inventory – trait version (STAI; Spielberger et al., 1983) and the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) to index general emotional distress by assessing levels of trait anxiety and depressive symptoms.

Autogenous vs. reactive obsessions

The Revised Obsessional Intrusion Inventory (ROII; Purdon & Clark, 1993) – Part I is 52-item self-report measure assessing experienced frequencies of 52 obsessional thoughts on a 7-point scale (0 = *never* ~ 6 = *frequently during the day*). A two-factor structure, which corresponds to the autogenous–reactive distinction, has been demonstrated in previous studies using confirmatory factor analysis (Lee & Kwon, 2003; Moulding et al., 2007). The autogenous–obsession factor includes 41 thoughts, images, and impulses concerning sex, violence, aggression, and blasphemies, while the reactive-obsession factor includes 11 thoughts, concerns, and doubts about mistakes, accidents, dirt, or contamination. Previous research has demonstrated the utility of the ROII in classifying individuals into the autogenous vs. reactive subgroup based on the subtype of their primary obsessions (Lee & Kwon, 2003; Lee, Kwon et al., 2005).

Composite International Diagnostic Interview (World Health Organization, 1997; CIDI)

The OCD module of the CIDI was administered to determine participants' OCD diagnostic status. The CIDI is a fully structured diagnostic interview that can be administered by trained non-clinician or clinician interviewers. Overall, the CIDI has demonstrated excellent reliability and validity (overall Kappa = .90; Andrews & Peters, 1998; Wittchen, 1994), and the OCD module has also shown adequate inter-rater reliability and diagnostic sensitivity (Andrews & Peters, 1998; Peters & Andrews, 1995). All our CIDI interviewers underwent six 2-h training sessions for reliable OCD assessment under the supervision of the senior author (MJT), which covered general interview techniques, the psychopathology of OCD, case examples of OCD, interview observations, and practice interview trials.

Computerized visual latent inhibition Task

We generated a computerized visual LI task based on the task descriptions in Kaplan et al. (2006). Each trial presented a display consisting of 19 identical (distracter) figures and 1 unique (target) figure. All figures were produced in the form of five randomly connected straight-lines from a 3 × 3 matrix (1.5 cm in both width and height; see Fig. 1).

Participants were seated at normal viewing distance from a 15-inch computer monitor. Their task was to press the left or right response key as quickly as possible on each trial according to the location of the unique target figure relative to the gray vertical midline of the display. For example, participants were instructed to promptly press the left response key if the unique figure appeared on the left side of the gray midline, or the right response key if the unique figure appeared on the right side of the gray midline. The stimulus display has an imaginary 12 × 8 matrix, which yields 96 possible stimulus positions. Each trial presented 19 distracters and 1 unique in 20 random spots of the 96 possible stimulus positions. Throughout the task, the probability of the target figure to appear on the left vs. right side of the visual display was equal.

On each trial, the stimulus display (consisting of 19 distracters and 1 unique figure) lasted on the screen until the participant responded to the trial by pressing the left or right response key. The interval between the offset of the previous trial (determined by the participant's key input) and the onset of the next trial was 1.5 s.

The LI task consisted of three phases: (1) 12 practice trials, (2) 96 pre-exposure trials, and (3) 96 test trials. The practice trials were designed to teach participants how to respond to the LI task. Each practice trial presented a feedback message indicating whether or not their response was correct. The target and distracter figures remained the same with varying stimulus positions throughout the 12 practice trials.

After ensuring that participants understood how to respond to the LI task through the practice trials, the pre-exposure block followed immediately. Participants were instructed to continue to respond to the same type of visual discrimination task consisting of 96 trials. They were told that the target and distracter figures would be different from those used in the preceding practice trials. The target and distracters remained the same throughout the 96 pre-exposure trials with randomly varying stimulus positions. The target figure did not appear on the same position twice, and its location was counterbalanced across the imaginary 12 × 8 matrix. The pre-exposure block proceeded in the same fashion with the

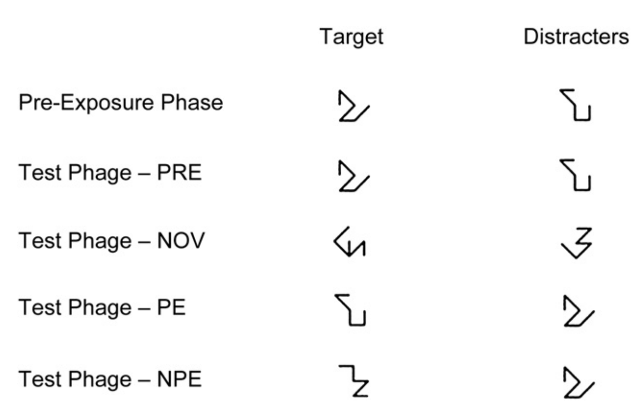

Fig. 1. Stimuli of the current latent inhibition task.

practice block with the exception that participants did not receive feedback on their response.

Upon completion of the pre-exposure phase, 96 test trials followed immediately. This test phase included four different types of trials: (a) 24 trials that presented the same target and distracters as those used in the pre-exposure block (RRE), (b) 24 trials that presented a new target and new distracters (NOV), (c) 24 trials that presented the pre-exposure phase target as distracters, and the pre-exposure phase distracters as the target (PE), and (d) 24 trials that presented the pre-exposure phase target as distracters, but used a novel figure as the target (NPE). With respect to assessing the magnitude of LI effects, PE and NPE constituted the most critical conditions. Both PE and NPE presented the same distracters which had been presented as the target stimulus in the pre-exposure phase, but their target stimuli are different such that the PE condition presented the previous distracter that participants were led to learn not to pay attention to in the pre-exposure phase whereas the NPE condition presented a novel stimulus as the target. Thus, the difference in RTs from the two conditions indicated the magnitude of LI in the current paradigm. Throughout the test phase, the four different types of trials were presented in a random order with no more than two consecutive trials formed from the same trial type.

Classification of autogenous vs. reactive OCD subgroups

Forty-eight individuals diagnosed with OCD were divided into the autogenous or reactive subgroup based on their primary obsession identified by the ROII. Classification of the autogenous vs. reactive subgroups followed procedures outlined in our previous studies (Lee, Kim, & Kwon, 2005; Lee, Kwon et al., 2005). Participants were instructed to indicate their primary obsession out of the 52 items listed on the ROII. Participants were also instructed to write their unique primary obsession down on the form in the event that they could not identify it from the ROII. However, all participants were able to identify their primary obsessions from the items listed on the ROII. In the next step, participants meeting for OCD were classified into either the Autogenous or Reactive group based on whether their primary obsession loaded on the autogenous vs. reactive subscale of the ROII.

Of the 48 participants diagnosed with OCD, 23 were classified as presenting with the autogenous subtype (AOs) while 25 were classified as presenting with the reactive subtype (ROs). Because this classification of AOs vs. ROs was based on participants' primary obsession rather than their factor scores on the ROII, we examined the possibility that participants classified as AOs might display an overall pattern of mental intrusions that was more consistent with the reactive subtype or vice versa. Consequently, we compared AOs and ROs on their *overall* pattern of mental intrusions as measured by the ROII factor scores (see Table 1). Consistent with their primary obsession classification, AOs scored significantly higher than ROs on the autogenous factor of the ROII ($p < .01$) and significantly lower than ROs on the reactive factor ($p < .05$). Thus, the primary obsessional presentation determined based on the autogenous–reactive taxonomy closely represented the subtype of overall mental intrusions.

Analyses

The three groups (AOs, ROs, and CONs) were compared on several indices generated from the LI task. First, to ensure that any group differences observed on the LI task did not merely reflect the influence of differential reaction speed or response accuracy, we conducted ANOVAs to compare the three groups on the average RT and number of errors computed from the pre-exposure phase. This simple learning block presented the same geometric figures repeatedly throughout 96 trials, and thus was expected to yield stable estimates of overall reaction speed and response accuracy across the three groups.

Table 1
Demographic and clinical characteristics across the three groups.

% Female	AOs ($N = 23$)		ROs ($N = 25$)		CON ($N = 26$)	
	60.9		56.0		68.0	
	M	SD	M	SD	M	SD
Age	18.17	0.72	18.68	1.03	18.73	1.19
BDI	13.68	10.41	11.80	6.45	2.23	2.45
STAI-T	52.27	9.40	48.80	8.96	31.42	6.47
OCI-R total	33.04	10.71	36.48	8.35	3.73	2.59
OCI-R checking	4.17	2.21	6.52	2.87	0.62	0.90
OCI-R hoarding	6.43	3.15	6.04	2.46	1.19	1.17
OCI-R neutralizing	4.35	3.52	4.52	3.44	0.12	0.33
OCI-R obsessing	6.87	2.85	5.48	2.84	0.54	1.33
OCI-R ordering	6.57	2.54	7.52	2.57	1.08	1.16
OCI-R washing	4.65	2.84	6.40	3.74	0.19	0.57
ROII-autogenous obsessions	48.35	34.32	22.32	17.53	5.58	5.26
ROII-reactive obsessions	15.29	8.04	20.76	9.45	1.31	1.49
Schizotypal Personality Scale	19.91	5.44	15.76	6.60	4.56	3.45
Magical thinking	3.68	1.49	2.48	1.71	1.00	0.91
Unusual perceptual	4.45	2.13	3.36	2.08	0.76	1.16
Paranoid suspiciousness	5.09	2.35	4.36	2.56	0.88	1.39

Second, the magnitude of LI was computed by subtracting the average RT of the NPE condition from the average RT of the PE condition. The PE and NPE conditions used the identical figure as distracters and thus differences in RTs from the two conditions can be attributed to differential attentional processing of their target stimuli: the pre-exposed stimulus that individuals learned not to attend to (PE condition) vs. a novel stimulus (NPE condition). The resulting LI effects computed from the above formula reflect the degree of individuals' response delay arising from their difficulty in learning previously exposed irrelevant stimulus relative to a novel stimulus. We conducted (a) paired t-tests to examine the significance of LI effects and (b) ANOVAs to compare the relative size of LI effects across the three groups.

Due to the linkages observed between schizotypal traits and LI task performance (e.g., Shrira & Tsakanikos, 2009) and between schizotypal traits and the autogenous obsessionals subtype (Cohen et al., 2004; Lee & Telch, 2005), we controlled for level of shizotypal personality features in testing the hypothesized relationship between the autogenous obsessionals subtype and inhibitory deficits as indexed by performance on the LI task. We also considered general emotional distress and gender as potential covariates in our analysis because some authors have reported significant effects of trait anxiety and gender in LI effects (Braunstein-Bercovitz, 2000; Lubow & De la Casa, 2002; Shrira & Kaplan, 2009).

Statistical power to detect the group difference in go/no-go performance

We used the program G* Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) to compute power for the main analysis examining group difference in LI effects based on the one-way ANOVA. Our power to detect a medium to large effect size (Cohen's $f = .35$) in the hypothesized direction with the current sample size was .76.

Results

Demographic and clinical characteristics of the groups

Table 1 presents basic demographic and clinical characteristics across the three groups. No group differences were observed

Table 2
Performance on the latent inhibition task across the three groups.

	AOs ($N = 21$)		ROs ($N = 24$)		CON ($N = 25$)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Pre-exposure reaction time	603.52	141.93	651.79	89.13	645.20	133.50
Block 1 (PRE) reaction time	762.58	171.89	800.77	112.95	818.79	216.99
Block 2 (NEW) reaction time	789.35	173.05	824.85	123.60	816.15	146.34
Block 3 (PE) reaction time	979.95	188.95	1102.53	157.63	1084.39	173.41
Block 4 (NPE) reaction time	978.09	197.61	973.86	120.30	961.87	142.70
Latent inhibition effects	1.86	105.29	128.67	142.12	122.53	149.98
Pre-exposure average # error	1.52	1.66	1.50	1.47	.76	1.09
Block 1 (PRE) average # error	0.48	0.75	0.50	0.93	0.28	0.54
Block 2 (NEW) average # error	0.38	0.59	0.54	1.18	0.32	0.63
Block 3 (PE) average # error	1.14	1.71	0.50	0.66	0.72	0.89
Block 4 (NPE) average # error	1.00	1.38	0.88	0.80	0.64	0.86

for any of the demographic variables including age, gender, ethnicity, race, and marital status. As expected, significant group differences were observed for OCD symptom severity as indexed by total scores of the OCI-R [$F(2,71) = 133.80$, $p < .001$, η_p^2 (partial eta square) = .79], overall schizotypal personality features as indexed by total scores of the SPA [$F(2,71) = 53.36$, $p < .001$, $\eta_p^2 = .61$], and levels of general emotional distress as indexed by total scores of the BDI [$F(2,71) = 19.11$, $p < .001$, $\eta_p^2 = .35$] and the STAI-T [$F(2,71) = 44.84$, $p < .001$, $\eta_p^2 = .56$]. Follow-up LSD post-hoc tests showed that the two OCD groups scored significantly higher than the CONs group on all of these measures (all *ps* < .001). In contrast, the AOs and ROs groups did not differ on any of these measures (all *ps* > .10) with the exception that the AOs group showed significantly greater schizotypal personality features compared to the ROs group ($p < .05$).

Group differences on schizotypal personality features

To further examine the pattern of group differences on multidimensional schizotypal personality features, a MANOVA was conducted including the three subscales of the STA as the dependent measures in the model. Results revealed a significant multivariate effect, Wilks' Lambda = .41, $F(6,134) = 12.43$, $p < .001$, $\eta_p^2 = .36$. Follow-up univariate and LSD post-hoc tests showed that the AOs group scored significantly higher on the Magical Thinking [$F(2,69) = 21.40$, $p < .001$, η_p^2.38, post-hoc $p < .01$] and Unusual Perceptual Experience subscales [$F(2,71) = 25.62$, $p < .001$, $\eta_p^2 = .43$, post-hoc $p < .05$], relative to the ROs group. Both the AO and RO groups scored higher than the CON group on all of the three subscales of the STA (all post-hoc *ps* < .001).

Performance on the latent inhibition task across the three groups

Data from the LI task are summarized in Table 2. LI task data were unusable for three participants due to unexpected computer operation errors (one from each of the three groups – two files were overwritten and one file was not properly saved). Additionally, data from one AO participant were excluded from analyses because of inconsistent responding and reported difficulty in concentrating on the task. Thus, the final sample for analyses of LI effects included 70 participants: AOs ($n = 21$), ROs ($n = 24$), and CONs ($n = 25$).

Overall reaction speed and accuracy (pre-exposure phase performance)

An ANOVA comparing the average RT derived from the pre-exposure phase revealed no significant group difference, $F(2,68) = .98$, $p = .38$, $\eta_p^2 = .03$. The three groups did not differ with respect to their overall reaction speed in the LI task. Moreover, a Kruskal–Wallis test showed no significant group difference in the average number of errors made during the pre-exposure phase. Additionally, we examined Pearson correlation coefficients between RTs and errors for each participant group. Only the ROs group displayed a significant correlation coefficient ($r = -.55$, $p < .01$). Thus, overall reaction speed and response accuracy did not differ across the groups, but a significant speed-accuracy trade-off was observed for the ROs group in the pre-exposure phase.

Latent inhibition effects

The average LI effect for each participant group is presented in Fig. 2. Paired *t*-tests showed significant LI effects among the ROs ($t = 4.44$, $p < .001$) and CONs groups ($t = 4.09$, $p < .001$). In contrast, the AOs group failed to reveal a significant LI effect ($t = .08$, $p = .94$). An ANOVA was conducted to compare the relative magnitude of LI effects across the three groups. Results showed a significant group difference, $F(2, 67) = 6.16$, $p < .005$, $\eta_p^2 = .16$]. LSD post-hoc tests showed that the both the ROs group and the CONs group showed significantly larger LI effects than the AOs group (post-hoc *ps* < .005). The RO group did not differ from the CON group in the magnitude of LI effects (see Fig. 2).

Average reaction times and response errors for the PE and NPE conditions

As follow-up analyses, we compared the three groups for the PE and NPE conditions. RTs differed only in the PE condition, $F(2,68) = 3.34$, $p < .05$, $\eta_p^2 = .09$, and the post-hoc test (LSD) showed significantly shorter RTs in the AOs group relative to the ROs or CONs

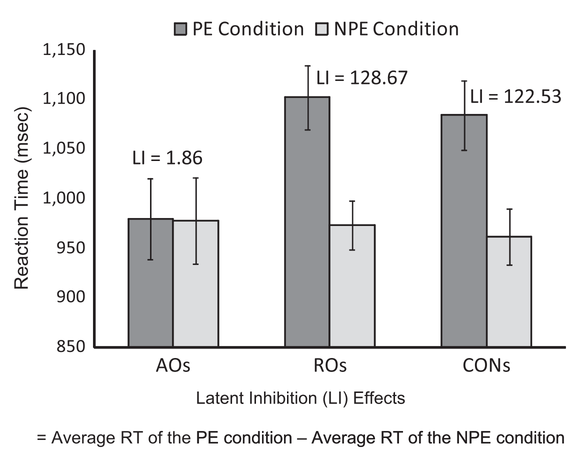

Fig. 2. Reaction times from the PE and NPE conditions and the magnitude of latent inhibition effects across the three groups.

group (*ps* < .05). Kruskal–Wallis *t* tests revealed no group difference in the average number of errors in both the PE and NPE conditions. Additionally, the CONs group did not show any significant RT-error correlations, whereas both OCD groups showed significant negative RT-error correlations for the NPE condition (for AOs $r = -.59$, $p < .01$; for ROs $r = -.41$, $p < .05$). However, no speed-accuracy trade-off was observed for the PE condition (for AOs $r = -.17$; for ROs $r = -.10$).

Hierarchical linear regression using continuous autogenous and reactive obsession scores

In the current study, our participants diagnosed with OCD were able to identify their *primary* obsessions that were of either the autogenous or the reactive subtype, and the primary obsession was also found to reflect their overall mental intrusions fairly well. Although individuals' primary obsessional presentation can be classified based on the autogenous–reactive distinction as shown in the current study and several of our previous studies (e.g., Lee, Kwon, et al., 2005; Lee, Lee et al., 2005), most individuals with OCD may experience autogenous and reactive obsessions together to a certain degree. Thus, we conducted hierarchical linear regression analyses, in which the autogenous-reaction subtype was treated as a continuous variable (as measured by subscale scores of the ROII) after collapsing the three participant groups.

We also sought to examine the impact of autogenous obsessions on LI effects while controlling for other relevant variables. To this end, schizotypal personality features, general emotional distress and gender were included in earlier steps of the regression model. Thus, in predicting LI effects, general emotional distress factors (total scores of the BDI and the STAI-Trait) and gender were entered in Step 1, the three subscales of the STA were entered in Step 2, and autogenous and reactive subscale scores were entered in Step 3. The hierarchical regression model aimed to test whether the elevation in autogenous obsession scores relative to reactive obsession scores would significantly predict the magnitude of LI effects beyond the potential contribution of relevant individual factors such as general emotional distress, gender, and schizotypal personality features. In this analysis, continuous variables that were shown to be not normally distributed via Kolmogorov–Smirnov tests were entered into the regression model after being square-root transformed (BDI total score, autogenous and reactive scores, the three subscale scores of the STA).

Results showed that general emotional distress and gender in Step 1 explained 17.3% of the variance in LI effects, $F(3,63) = 4.38$, $p < .01$, and gender was the only significant predictor ($\beta = .32$, $t = 2.83$, $p < .01$). In Step 2, the three schizotypal subscales explained an additional 1.2% of the variance in LI effects, $F(3,60) = .28$, $p = .84$ (for R^2 change), and among all variables entered in Steps 1 and 2, gender still remained the only significant predictor of LI effects ($\beta = .34$, $t = 2.84$, $p < .01$). Thus, none of the schizotypal subscales significantly contributed to explaining LI effects when gender was taken into consideration. Finally, in Step 3, the inclusion of autogenous and reactive subscale scores of the ROII explained an additional 19.2% of the variance in LI effects, $F(2,58) = 8.90$, $p < .001$ (for R^2 change). In this final regression model, autogenous obsession scores emerged as the only significant predictor of LI effects ($\beta = -.68$, $t = -3.94$, $p < .001$). This full regression model explained 37.6% of the variance in LI effects, $F(8,58) = 4.36$, $p < .001$. Additionally, due to the speed-accuracy trade-off observed in the NPE condition in the two OCD groups, we repeated these analyses including the average number of errors from the PE and NPE conditions in the model, but the overall pattern of findings remained unchanged.

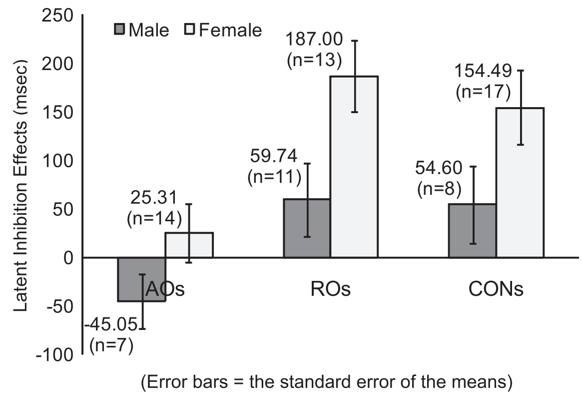

Fig. 3. Latent inhibition effects by gender across the three groups.

The effect of gender on latent inhibition

Because of the observed main effect of gender observed in the initial steps of the hierarchical regression analyses, we further inspected how LI effects varied by gender across the three groups. Fig. 3 shows the overall tendency for females to display greater LI effects relative to males across the three groups.[3] Additional regression analyses showed that gender did not significantly interact with autogenous/reactive obsessions or schizotypal personality features in predicting LI effects.

Discussion

This study sought to examine whether inhibitory attentional processing deficits, as indexed by a visual search LI task, would vary among non-treatment seeking individuals with OCD as a function of their primary obsessional presentations based on the autogenous–reactive taxonomy. Consistent with prediction, AOs showed significantly smaller LI effects relative to ROs and CONs. Indeed, AOs failed to display a significant LI effect, which suggests that their attentional filtering processes are significantly impaired such that irrelevant distracters cannot be effectively disregarded in a task that requires selective attentional processing to occur only toward the target stimulus. In the pre-exposure phase, AOs' deficient inhibitory attentional mechanism may have allowed their attention to be continuously drawn to the irrelevant distracters, which prevented their acquisition of adaptive inattentional response that is necessary for LI effects to emerge. Inspection of Fig. 3 even suggests the possibility that some individuals in the AOs group (particularly males) might have allocated more attention to the distracters than to the target during the pre-exposure phase, because they showed the tendency to detect the former distracter (PE condition) *faster* than a new figure (NPE condition). In contrast, significant LI effects were observed among ROs who primarily present with somewhat realistic aversive mental intrusions (e.g., contamination, mistakes, accidents, asymmetry, or disarray) and among non-OCD controls.

Consistent with previous research (Lee & Telch, 2005; Lee, Kim, et al., 2005), AOs also displayed significantly greater (positive) schizotypal personality features such as magical thinking and unusual perceptual experience than ROs in the current study. However, the contribution of schizotypal personality features to predicting LI effects was negligible as compared with that of autogenous obsessions. Similarly, the impact of trait anxiety on LI effects was also

[3] LI effects significantly differed across the three groups only among females, but not males. However, these gender-related findings should be interpreted with caution due to the small sample size.

shown to be negligible. Thus, the overall pattern of findings indicates that the level of autogenous obsessions is a stronger predictor of LI than other individual characteristic variables that have been linked to the magnitude of LI in the literature such as schizotypal personality features, trait anxiety, and gender (Braunstein-Bercovitz, 2000; Lubow & De la Casa, 2002; Shrira & Kaplan, 2009).

Our data present preliminary evidence that the magnitude of LI effects varies as a function of the primary autogenous–reactive obsessional presentation. AOs' primary clinical feature is the strenuous struggle with the mental intrusions themselves that the individuals strive to remove/suppress through mostly covert or cognitive rituals, whereas ROs' primary clinical feature is the exhaustive struggle with external thought-triggering cues that the individuals strive to change through mostly overt and behavioral rituals. AOs' weakened attentional inhibitory capacity, as demonstrated in the current study, likely contributes to their inability to keep irrelevant and senseless mental intrusions out of their attentional focus. In contrast, the persistence of ROs' mental intrusions is likely to be contingent on the perceived success in modifying the thought-triggering external cues such as suspected germs or disarrayed objects. These two subtypes' difference in perceived core threat may be related to different levels of underlying inhibitory attentional processing deficits. Relatedly, the primary focus of therapeutic intervention for AOs should be on preventing their efforts toward intentional thought suppression that are likely to be highly counterproductive given their deficient inhibitory control, whereas preventing overt rituals intended to modify external cues seems to be a more important treatment target for ROs.

To date, the few studies that have examined LI effects in OCD have produced mixed findings. Swerdlow et al. (1996) failed to find any differences in LI effects among OCD patients vs. normal controls, using a well-established auditory LI task. In contrast, two studies using visual LI tasks reported *enhanced* LI among OCD patients as compared with non-anxious or normal controls (Kaplan et al., 2006; Swerdlow et al., 1999). These authors interpreted enhanced LI among OCD patients as reflecting their cognitive rigidity (Swerdlow et al., 1999) or compensatory rigid attention to the relevant stimulus (Kaplan et al., 2006), which may result in the difficulty in switching between different stimulus sets. In the current study, ROs displayed the largest amount of LI effects among the three participant groups, although they did not differ significantly from non-OCD controls. However, the absence of LI effects in the AOs group is at odds with the two previous studies that have shown enhanced LI effects in OCD. Some methodological differences across studies might explain the observed discrepancies in LI effects. First, the two existing studies that reported enhanced LI in OCD *excluded* individuals displaying past or present psychotic symptoms, which might have reduced the overall level of schizotypal traits in their samples. The present study conceptualizes AOs as a subgroup of OCD with elevated schizotypy. Although the effect of schizotypy on LI was negligible relative to that of autogenous obsessions in the current study, several studies have demonstrated attenuated LI among individuals with schizophrenia or elevated schizotypy (e.g., Gray et al., 1995; Lubow et al., 1992).

Second, our study used a non-treatment seeking undergraduate sample rather than a treatment-seeking clinical OCD sample. Participants in the AOs and ROs groups met DSM-IV criteria for OCD and showed equivalent symptom severity scores on the OCI-R and STAI-trait as compared with Kaplan et al. (2006)'s OCD patient sample. Nevertheless, some important aspect of a treatment-seeking OCD sample may not be reflected by diagnostic status or symptom scale scores. Moreover, our comparison group (CONs) included individuals with markedly low levels of OCD symptoms (lower 3%). Their mean OCI-R total score (=3.73) is much lower than that of the normal controls reported by Kaplan et al. (=12.09). It is unclear how the current non-OCD controls would differ in LI effects from normal controls used in previous studies. Likewise, it is unclear whether ROs' significant LI effect observed in this study indicates an enhanced level of LI or a normal level of LI as compared with existing studies.

Current findings of AOs' failure to show LI effects, however, are in line with (a) the Conditioned Attention Theory of LI that predicts increased distractibility and impaired selective attention will result in the deficient acquisition of inattentional response to irrelevant distracters, which may result in attenuated LI, and (b) the line of research that has shown OCD patients' distractibility and related deficits in selective attention and negative priming procedures (e.g., Enright & Beech, 1993; Kuelz et al., 2004; Okasha et al., 2000). Compared to other set-shifting tasks (e.g., go/no-go), the current visual LI task presents a more distracting context (i.e., a single target surrounded by 19 distracters) that may render it quite difficult for individuals with impaired selective attention to learn to inhibit attention toward dominant but to-be-ignored distracters. Much work remains to be done to draw any firm conclusions about LI in OCD.

The current findings showed that females showed greater overall LI effects than males, but there was no significant interaction between gender and schizotypal personality features in predicting LI. Existing research has provided mixed results in this regard. For example, a few studies reported smaller LI effects among female schizophrenics (vs. normal females) and among high-schizotypal females (vs. low-schizotypal females), whereas no such group differences were found among males (Lubow, Kaplan, et al., 2000; Lubow et al., 2001). Similarly, one study showed reduced LI in high-schizotypal (but not low-schizotypal) females, but this pattern was reversed among males (Lubow & De la Casa, 2002). In contrast, a more recent study found the reverse pattern of gender interaction such that reduced LI effects were shown among high-schizotypal males, but not high-schizotypal females (Shrira & Kaplan, 2009). As reviewed by Lubow and Kaplan (2005), gender may have quite complex effects on LI through its interaction with other individual characteristics such as schizotypy. With respect to the overall gender effect, Lubow and Kaplan (2005) suggested that males may show greater LI effects for several reasons including higher experiment-induced anxiety levels, increased level of striatal dopamine, and higher positive schizotypal symptoms among females.

Interestingly, the current study found a reverse effect of gender, which was rendered non-significant once the level of autogenous obsessions was taken into account. Our additional analyses showed that males showed significantly higher autogenous obsession scores than females in both the AOs and ROs groups (AO males = 70.29, AO females = 40.79; RO males = 35.55, RO females = 11.93) despite no gender difference in overall severity of OCD symptoms as measured by the OCI-R. These findings indicate that the observed gender effect may simply reflect the impact of primary obsessional presentations on LI effects. Taken together, the effect of gender on LI should be further examined to clarify the nature of its interaction with other relevant individual characteristics. For the current study, the gender-related findings again indicate the significant role of autogenous obsessions in attenuating LI effects.

Our findings also suggest the importance of considering primary obsessional presentations in understanding the clinical heterogeneity and underlying cognitive processes in OCD. Unlike the subgrouping of OCD based on statistical data reduction techniques (e.g. Baer, 1994), the autogenous–reactive subtyping takes a more theoretical approach with the central focus on the characteristics of the individual's primary obsessional presentation. Nonetheless, a recent meta-analysis incorporating multiple factor-analytic studies found that sexual, religious, and aggressive thoughts grouped together as a forbidden thought factor, which closely resembles the autogenous obsession factor, aside from other obsessions concerning symmetry, contamination, and hoarding (Bloch et al., 2008). Combining individuals with heterogeneous clinical presentations of OCD into one group could lead one to overlook meaningful variations in cognitive processes such as latent inhibition that might underlie OCD. Thus, further research is warranted on how cognitive anomalies vary as a function of OCD individuals' primary obsessional presentation. Based on findings from the current study, the autogenous–reactive taxonomy seems to provide a promising subtyping approach.

Several limitations of the study should be noted. First, the use of non-treatment seeking undergraduates with OCD limits the generalizability of our findings. Second, data on the reliability of OCD diagnoses based on the CIDI-Auto were not collected. Third, the assessment of schizotypal personality features based solely on participants' responses on a self-report measure may have limited our ability to detect the influence of schizotypy on the magnitude of LI effects. Future research needs to include various modes of assessment such as a structured diagnostic interview (e.g., the SID-P Schizotypal Personality Disorder) as well as self-report schizotypy measures. Finally, this study was underpowered to detect the effects of gender on LI. Future research needs to address how gender interacts with schizotypy in the context of OCD.

Despite these limitations, the current study presents data suggesting that LI effects vary as a function of primary obsessional presentations among individuals with OCD. The inability to learn to inhibit attention toward irrelevant distracters may pose these individuals at greater risk of being caught in a strenuous struggle with unwanted mental intrusions. Our data also point to the potential value in considering primary obsessional presentations in future research to enhance our understanding on the clinical heterogeneity and underlying cognitive processes in OCD.

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