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Implicit learning and non-clinical paranoia: does content matter?

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Abstract

Persons high and low in non-clinical paranoia (based on scores from the Paranoia Scale) were administered two implicit learning tasks that comprised information regarding the covariation between a stimulus (e.g. a face) and a specific characteristic (e.g. "fairness"). To assess whether persons high in non-clinical paranoia were particularly sensitive to learning social information, both social (faces) and non-social stimuli (cars) were used. Results showed that the group high in non-clinical paranoia demonstrated implicit learning to all stimuli, irrespective of content. The group low in non-clinical paranoia showed greater implicit learning for non-social relative to social stimuli. The results partially support a content-specific bias since there were differences in social ratings relative to non-social ratings between the two groups. Finally, the group high in non-clinical paranoia was significantly more confident in their ratings relative to the group low in non-clinical paranoia for all stimuli. The implications of these findings for non-clinical paranoia are discussed. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Non-clinical paranoia; Implicit learning; Content-specific bias; Social and non-social stimuli

In research on psychotic disorders, there has been an increased interest in the investigation of specific symptoms (e.g. paranoia), rather than on broad diagnostic syndromes (e.g. schizophrenia; Bentall, Corcorcan, Howard, Blackwood, & Kinderman, 2001; Bentall, Jackson, Pilgrim, 1988; Bentall, Kinderman, & Kaney, 1994). Research on paranoia has typically focused on cognitive biases. For example, persons with paranoid delusions show biases (jumping to conclusions) on probabilistic reasoning tasks; they require less information before making decisions (Bentall et al., 2001; Garety, Hemsley, & Wessely, 1991; Huq, Garety, & Hemsley, 1988), and they are more

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confident in their decisions, based on limited data, relative to persons without paranoia (Dudley, John, Young, & Over, 1997; Huq et al., 1988; for an exception, see Garety et al., 1991). This pattern is not limited to neutral reasoning tasks, but extends to more realistic social reasoning tasks as well (Bentall, Kaney, Dewey, 1991; Dudley et al., 1997). Finally, there is evidence that persons with paranoia make external attributions for negative outcomes and internal attributions for positive outcomes (i.e. a self-serving bias; Bentall et al., 1991, 1994; 2001; Kinderman & Bentall, 1996, 1997; see Martin & Penn, in press, for somewhat less supportive findings).

The cognitive biases in paranoia appear to be content-specific. Persons with paranoia have been shown to form illusory correlations to only threat-related words (Brennan & Hemsley, 1984). On a modified version of the Stroop task, persons with paranoia show interference to only threat words; reading times are not affected for depressed or neutral words (Bentall & Kaney, 1989; Fear, Sharp, & Healy, 1996; Kinderman, 1994). This content bias is also evident for memory tasks. Specifically, persons with paranoia show preferential recall for threatening words (Bentall, Kaney, & Bowen-Jones, 1995) and for stories with threatening propositions (Kaney, Wolfenden, Dewey, & Bentall, 1992), a pattern which is also evident in college samples high in paranoia (Fenigstein, 1997).

Previous research on paranoia has focused mainly on explicit-judgment tasks (i.e. reading a vignette, drawing beads from a jar, making attributional judgments, etc.) with little attention to tasks that assess implicit learning. Unlike explicit judgment tasks, in which the objective of the task is clearly verbalized to the subject, the objectives, rules, and strategies in implicit learning are not available to consciousness (Lewicki, Hill, & Czyzewska, 1992; Reber, 1989). For example, instructing a bus-driver to learn a new bus route would be an explicit learning activity, while a regular passenger who realizes that they are going on the wrong route would represent more of an implicit learning activity. Thus, implicit learning can be defined as learning without awareness and can be demonstrated on various memory, attention, and attributional tasks (see Garety & Freeman, 1999, for a review). Implicit tasks can be viewed as either "data driven" or "conceptually driven" with conceptual tasks having some degree of assigned meaning (Roediger, 1990). Conceptual implicit tasks have been previously used to study the role of schemata in several clinical areas (Edwards & Pearce, 1994; Hermans, Pieters, & Eelen, 1998; Hill, Lewicki, & Neunaber, 1991; Watkins, Vache, Verney, Mathews, & Muller, 1996). Furthermore, some have even argued that previous work in implicit learning is consistent with models of schematic processing (Dowd & Courchaine, 1996). Even when implicit learning is initially acquired through bottom-up or data driven processes, once established, implicitly acquired schemata may exert top-down or conceptually driven effects. Therefore, in the present study, the effects of implicitly activated schemata (from exposure to social/non-social stimuli during training) on judgments of test stimuli will be viewed as more of a top-down or conceptually driven process than bottom-up process (see Mathews, Roussel, Cochran, Cook, & Dunaway, in press, for further evidence on the point).

There are empirical, theoretical, and clinical reasons for investigating implicit learning in paranoia. Empirically, there is evidence that the attributional style of persons with paranoid delusions varies as a function of test format; on explicit attributional tasks, paranoid-deluded persons show the aforementioned self-serving bias, while on tasks disguised as a test of memory (i.e. a "non-obvious" attribution task), this bias disappears (Lyon, Kaney, & Bentall, 1994; for an exception, see Martin & Penn, in press). Theoretically, an investigation of implicit learning may shed further light on the role of schemata in the information processing of persons with paranoia and may broaden our understanding of the construct (Magaro, 1980, 1984). Implicit tasks may also circumvent the defensiveness associated with paranoia evident on explicit tasks (Bentall et al., 2001; Garety & Freeman, 1999). Therefore, schematic biases associated with paranoia should occur in an automatic fashion irrespective of whether explicit or implicit instruction is provided. This formulation is also consistent with the tendency for paranoid persons to over-interpret environmental stimuli and events as being personally relevant (i.e. ideas of reference; discussed in Fenigstein & Vanable, 1992), to form external attributions for negative personal events (i.e. schematic processing of threatening information; Bentall et al., 1994), to selectively attend to personally relevant information (which may explain the hastiness bias and overconfidence in judgments; Garety et al., 1991; Huq et al., 1988), and to interpret ambiguous stimuli in a negative manner (Lee, 1999). Clinically, Vinogradov, King, and Huberman (1992) stated that persons with paranoia often report a heightened sense of "connectedness" among unrelated environmental events, which may represent a form of schema-induced implicit learning since the reasons for this connection cannot be verbally reported (see illusory correlation research for another example). Therefore, the study of implicit learning in paranoia may provide evidence that threatening information is automatically processed and that associations are formed without conscious awareness. This could provide valuable insight into the social information processing biases present in this population.

Recent conceptualizations of psychosis argue for more of a dimensional or continuum-based view rather than a purely categorical approach (Clark, Watson, & Reynolds, 1995; Fenigstein & Vanable, 1992; discussed in Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). In fact, there is compelling evidence that symptoms such as delusions and hallucinations lay on a continuum (Johns & van Os, 2001). The lifetime prevalence of hallucinations in the general population in the USA has been estimated at 10–15% (Tien, 1991), while paranoid delusions have a lifetime prevalence of 4–8% (Eaton, Romanoski, Anthony, & Nestadt, 1991). Furthermore, Peters, Jospseh, and Garety (1999) compared psychotic inpatients with non-clinical controls on ratings on the Peters Delusions Inventory (PDI), and found that 10% of the non-clinical controls scored above the mean for the psychotic group. These findings strongly suggest that psychotic symptoms, such as paranoia, lay on a continuum, and that the study of non-clinical paranoia may provide insights into understanding clinical paranoid states.

The purpose of this study is to conduct a preliminary investigation of implicit learning and non-clinical paranoia. Because paranoia lies on a continuum, and persons with non-clinical levels of paranoia show biases in social information processing similar to those with clinical paranoia (Fenigstein, 1997; Turkat, Keane, & Thompson-Pope, 1990), we would expect a non-clinical sample of persons high in paranoia to represent a reasonable proxy for persons with paranoid delusions. Therefore, the implicit learning of an analogue sample of persons high in non-clinical paranoia will be compared to a control group low in non-clinical paranoia. Furthermore, content bias issues will be examined by investigating implicit learning differences for social versus non-social stimuli, a stimulus distinction of particular importance in schizophrenia research (Penn et al., 1997). This is a likely first step in the application of implicit learning paradigms to the study of paranoia, as once differences in implicit learning for social versus non-social stimuli are established, more *specific* content biases (e.g. for threatening versus non-threatening information) may be examined. Because of the greater potential to interpret social stimuli as having negative personal connotations, it is hypothesized that persons high in paranoia will show superior implicit learning for social, but not non-social stimuli (e.g. content-specific bias), relative to persons low in paranoia. Differences between social versus non-social ratings will be examined for an absolute content-specific bias (with post-hoc tests for differences in social versus non-social ratings), but relative differences in ratings may be informative as well. Furthermore, an examination of confidence levels (for the ratings of social and non-social stimuli) will also be investigated. Consistent with previous research, we expect that persons high in paranoia will be more confident in their judgments, irrespective of content.

1. Method

1.1. Participants and measures

Participants comprised 50 undergraduate students from Louisiana State University who received extra credit toward their coursework in exchange for participating in the study. Persons were divided into two groups based on their scores on the Paranoia Scale (PS; Fenigstein & Vanable, 1992). The PS is a 20-item measure developed to assess paranoia in non-clinical samples. Each item is rated on five-point Likert scale anchored by "not at all applicable" to "extremely applicable". Higher scores indicate greater levels of non-clinical paranoia. The PS has sound reliability and validity data (Fenigstein & Vanable, 1992), and is related to independent ratings of paranoia in a sample with schizophrenia (Smari, Stefansson, & Thorgilisson, 1994). For the current study, the PS showed excellent internal consistency (Cronbach's alpha = 0.89).

Twenty-two persons (14 females, 8 males) who scored at or above the 70th percentile ($\geqslant 48$) on the PS comprised the high paranoia group. Twenty-eight persons (21 females, 7 males) who scored at or below the 30th percentile ($37 \leqslant$) on the PS comprised the low paranoia control group. Percentile cutoff scores for the PS were taken from normative data found in Fenigstein and Vanable (1992). This type of extreme groups design has been utilized in previous research with analogue samples both with the Paranoia Scale and with other measures of delusional ideation (Fenigstein, 1997; Fenigstein & Vanable, 1992; Linney, Peters, & Ayton, 1998). Furthermore, because the implicit learning task involves the detection of subtle differences in cognitive processing, it may be best studied by extreme group designs rather than median split methods (see Hill et al., 1991). A summary of the demographic characteristics of the two groups is reported in Table 1.

Analyses of variances and chi square tests were conducted on the demographic variables to assess group differences. There were no group differences in age or gender, although there was a significant group difference in ethnicity, $\chi^2 = 34.3$, $P = 0.0001$; there was a higher proportion of white participants in the low paranoia group than in the group high in paranoia. However, follow-up analyses revealed no significant differences on any of the dependent measures as a function of ethnicity.

1.2. Measures

Participants completed the Expanded Attributional Style Questionnaire (EASQ; Peterson & Villanova, 1988), and the Emotional Stroop Task for paranoia (Bentall & Kaney, 1989) in addition

Table 1
Participants' demographic characteristics

Variable	Group	
	High paranoia	Low paranoia
Sample size	22	28
Age		
Mean (S.D.)	22.41 (6.59)	23.32 (8.26)
Education (years)		
Mean (S.D.)	15.27 (1.08)	15.14 (1.18)
Gender		
Male	8	7
Female	14	21
Ethnicity		
White	11*	26*
African-American	8	2
Other	3	0

*$P < 0.05$.

to the implicit learning tasks. These measures were administered as a validity check for the group assignment; participants in the high paranoia group, relative to the low paranoia group, should show a selective interference for color-naming only paranoid words, and take less responsibility for negative outcomes on the attributional task (i.e. consistent with the self-serving bias in paranoia).

The EASQ (Peterson & Villanova, 1988) was developed to improve upon the original ASQ as a measure with better reliability and validity. The EASQ comprises 24 items involving various negative outcomes (e.g. one cannot find a job). The EASQ contains 12 social and 12 non-social scenarios. The person's task is to write down one major cause for the event and then rate the cause on a scale of 1 (totally due to others) to 7 (totally due to me). The ratings are summed to obtain a total score (range 24–168) or social and non-social subscale scores. Higher scores represent attributions that are more internally focused. For this sample, the internal consistency was adequate (Cronbach's alpha = 0.64).

The Emotional Stroop Task was developed by Bentall and Kaney (1989) to measure selective attention in paranoia. This modified test is based on the Stroop task developed by Williams and Broadbent (1986). The Stroop task consists of different colored words in which the person has to name the color the word is printed in. There are three different cards each containing 50 words written in five colors. The lists differ in the content of the words comprising the list. The first list consists of five emotionally neutral words (i.e. bud, recipe); the second list consists of depression-related words (i.e. sad, hopelessly); and the third list consists of threat-related words (i.e. spy, threat, follow). Each list is administered separately and the time to read each list is recorded using a stopwatch. A short practice list of words is given to each participant to demonstrate the task. Presentation of each list was administered in random order to avoid practice and order effects. Performance on the Stroop is based on an interference index (Bentall & Kaney, 1989), which is computed by subtracting the time to color name the neutral words from each of the times to color name the paranoia and depression words separately.

1.3. Implicit learning

The method for the implicit presentation of stimuli was based on the work of Lewicki and colleagues (Hill, Lewicki, Czyzewska, & Schuller, 1990; Lewicki et al., 1992). In order to test implicit learning, participants have to be presented, in a training phase, with a paired association between two stimuli (e.g. face length and a particular personality characteristic). Following a training phase, the test phase involves presentation of a number of new stimuli (e.g. new faces) and the participant is asked to make judgments concerning the target's personality characteristics. Implicit learning is believed to occur when the participant uses the paired association from the training phase to rate the new stimuli. Since both social and non-social stimuli were presented to each person, the order was randomized to eliminate any order effects. The specific procedures and methods used in this study are described below.

1.4. Stimulus pictures: faces

Six male faces were selected from the graphics program Kai's Power Goo 1.0 (1997) for use in the study. Each face was rated as average in attractiveness by four independent raters. Faces were chosen to be relatively similar in age (over 30) and appearance (all had glasses). For each face, three versions were constructed: long, short, and average. The three versions differed in the proportionate length of the chin to the total face[1]. The specific proportions for each face type can be found in Hill et al. (1990). Since three face types were created for the six faces, a total of 18 possible faces were available for presentation (six long, six short, six average). The six faces presented to any one subject were determined randomly.

1.5. Stimulus pictures: cars

From area newspapers, six pictures of automobiles were selected for inclusion in the study. The cars were judged to be similar in estimated cost by four independent raters. All cars were four-door models with side profile views. For each car, long, short, and average versions were created based on the proportion of trunk length to total length of the car. The trunk measurements were similar in proportion to those used in the creation of the faces[2]. Because the cars could not be imported into the graphics program, they were created by hand. A final version of each car type was inspected by two persons to ensure that the cars appeared normal (i.e. without obvious

[1] Faces were constructed according to criteria specified in Hill et al. (1990). Average faces had a proportion of approximately 10:10 (distance between chin and eyes compared to the distance between eyes and top of head. Short faces had proportions of 11:9 (chin approximately 20% shorter). Long faces had a proportion of 9:11 (chin approximately 20% longer).

[2] The cars were constructed to approximate and match the measurements used for the faces. Before manipulation all cars were approximately similar in total length and trunk length. For the average car there was no manipulation of trunk length. The long car was created by lengthening the trunk by 20%. The short car was created by reducing each trunk in length by 20%. Trunk length was defined as the distance between the wheel and end of the trunk.

flaws). Finally, in order to check that the three versions were perceived as different in trunk length, two raters sorted the cars into long, short, and average categories with 100% accuracy. Since three versions were created for each of the six cars, a total of 18 possible cars were available for presentation (six long, six short, six average). The six cars presented to any one participant were determined randomly.

1.6. Training phase: faces

In this phase, participants were presented with six pictures of male college professors (two long, two short, and two average faces) contained in a stimulus book. The order of stimulus presentation was randomly determined. Before arriving, each person was randomly assigned to one of two training conditions. In condition one, long faces were always described as being unfair, short faces were always described as fair, and average faces were always described as average in fairness. In condition two, face length and fairness descriptions were reversed, with the exception of average-length faces, which were still described as average in fairness. Participants were told that "they would see pictures of college professors who were rated on fairness by their students." Participants were instructed "to look at each picture and form an impression". The instructions closely followed the wording used in Hill et al. (1990) and was an attempt to minimize an analytic task orientation (i.e. that this is problem to be solved), which could influence results (Lewicki, Hill, & Gzyzewska, 1997). The experimenter then showed the first picture and read the appropriate description allowing 12 s to view each face.

1.7. Testing phase: faces

After viewing each of the six faces (each paired with a description of fairness), the participant was then asked "to rate three new target faces for fairness"; a short, long, and average face was presented individually to the participant with instructions to rate each face on a 10-point Likert scale anchored by 1 (very fair) to 10 (very unfair). After rating each face for fairness, the participant rated her/his confidence in their fairness ratings on a scale of 1 (very unsure) to 5 (very sure).

1.8. Training and test phase: cars

In a stimulus book, each person was randomly shown six cars (two long, two short, and two average) in a manner similar to the face training condition. Participants were again randomly assigned to one of two training conditions (i.e. long cars as having a high number of breakdowns or short cars as having a high number of breakdowns). Therefore, for each condition, a specific car length (i.e. short or long) was paired with the tendency to have a large number of breakdowns. Ratings of three new cars during the test phase were then conducted in a manner identical to the face condition.

1.9. Post-experimental assessment

After the study, each participant was asked to write down their perceptions about the purpose of the study and what features they attended to in the stimuli. This manipulation check allowed the experimenter to determine if a participant was aware of the experimental pairings. Follow-up questioning was conducted for persons who were unsure or gave vague responses. Participant responses can be summarized as follows: 58% of the participants paid attention to a cognitive process (memory, perception, or judgments, etc.); 32% used general appearance in their judgments (i.e. "He looked mean"); 8% identified specific aspects of the stimuli, such as eyes or mouth, as important, and 2% could not generate any answers after follow-up questioning. No participant identified the specific feature (i.e. length of face/chin or trunk) that was manipulated in the study. The results of this assessment support the conclusion that participants were not aware of the manipulations used in the study.

2. Results

2.1. Group validity check

To check the validity of the group assignment, we examined participants' scores on the EASQ and Stroop task (see Table 2). A between-groups *t*-test revealed that there were no group differences on the Expanded Attributional Style Questionnaire total score, $t\ (48) = 0.795$, ns. There were also no differences found on the EASQ social, $t\ (48) = 0.87$, ns and non-social, $t\ (48) = 0.016$, ns, subscales. However, a 2 (Group: High vs. Low in non-clinical paranoia) × 2 (Stroop task: Paranoid words vs. Depressed words) MANOVA, with repeated measures on the Stroop task, revealed a significant Group × Stroop task interaction, $F(1,48) = 24.6$, $P = 0.0001$. Significant group differences were observed on the Stroop paranoia interference index, $F(1,48) = 28.18$, $P < 0.0001$, but

Table 2
Measures of paranoia by group membership

Measure	Group			
	High paranoia		Low paranoia	
	Mean	S.D.	Mean	S.D.
Paranoia scale	52.95	(6.42)	28.25	(3.18)*
Expanded ASQ	110.55	(17.39)	112.68	(10.00)
Social	49.54	(10.13)	51.62	(6.84)
Non-social	61.00	(10.07)	60.90	(5.99)
Stroop Paranoia[a]	39.09	(3.77)*	32.93	(3.75)*
Stroop Neutral[a]	33.05	(2.40)	31.71	(3.60)
Stroop Depression[a]	34.09	(2.37)	32.79	(4.09)
Interference index				
Paranoid List[b]	6.04	(3.61)*	1.21	(2.80)*
Depressed List[b]	1.04	(1.91)	1.07	(2.59)

* $P < 0.0001$.
[a] Color naming time (in seconds).
[b] Interference index.

not on the depression interference index, $F(1,48) = 0.002$, ns (see Table 2); subjects high in non-clinical paranoia showed greater interference to the paranoia words relative to the group low in non-clinical paranoia. The significant differences on the Stroop paranoia index lends further support to the group classification approach (i.e. high vs. low in non-clinical paranoia) used in this study.

2.2. Data analysis overview

The data were analyzed with a 2 (Group: High vs. Low in non-clinical Paranoia) × 2 (Task type: Social vs. Non-social) mixed model Analysis of Variance (ANOVAs). Group was analyzed as a between-subjects variable and Task Type (i.e. Social vs. Non-social) was analyzed as a repeated measures variable. It should be noted that the analyses were collapsed across Training Condition (i.e. long vs. short), as this variable did not have any main nor interactive effects on participants' ratings or confidence levels. Two dependent variables were used: (1) a difference index was computed for both the face and car ratings (described below), and (2) mean confidence levels for the face and car ratings.

The difference index was computed by subtracting the short stimuli rating from the long stimuli ratings for both the faces and cars when the long stimuli were presented in the training phase as either "unfair" or having a "high number of breakdowns." When the short stimuli were presented as "unfair" or having a "high number of breakdowns," then the long stimuli ratings were subtracted from the short stimuli ratings. Thus, a higher difference index reflects greater implicit learning. Because there were no significant group differences in ratings for the average stimuli, they were not included in the primary analyses. The second dependent variable, mean confidence level, was computed based on the average confidence level for the long and short stimuli. To control for type I error, Bonferroni correction was employed, which reduced the overall alpha to 0.025 [i.e. 0.05/2 (the number of analyses)] for each set of analyses.

2.3. Primary analyses

A 2 (Group: High vs. Low in non-clinical paranoia) ×2 (Task Type: Social vs. Non-social) mixed model repeated measures ANOVA was conducted to examine the mean difference indexes for the face and car ratings[3]. The means for the face and car difference ratings along with the respective confidence levels for each task are presented in Table 3.

The ANOVA revealed a significant main effect for group, $F\,(1,48) = 21.5$, $P = 0.0001$; individuals high in non-clinical paranoia showed greater implicit learning on the social task, $t\,(48) = 5.8$, $P = 0.0001$), and a trend (at conventional levels of significance) for differences on the non-social task, $t\,(48) = 2.0$, $P = 0.044$, compared to persons low in paranoia. However, this main effect for group was qualified by a significant Group × Task Type interaction, $F\,(1,48) = 5.3$, $P = 0.02$; within group comparisons showed that only persons low in non-clinical paranoia showed a significant difference in implicit learning among ratings for the social ($M = 0.5$) and non-social stimuli ($M = 2.6$), $t(27) = 2.4$, $P < 0.023$ (Fig. 1). There was no difference within the group high in non-clinical paranoia among social and non-social ratings, which suggests that the

[3] Power to detect between group differences at the present sample size for face/car ratings was estimated at 0.995 for this analysis.

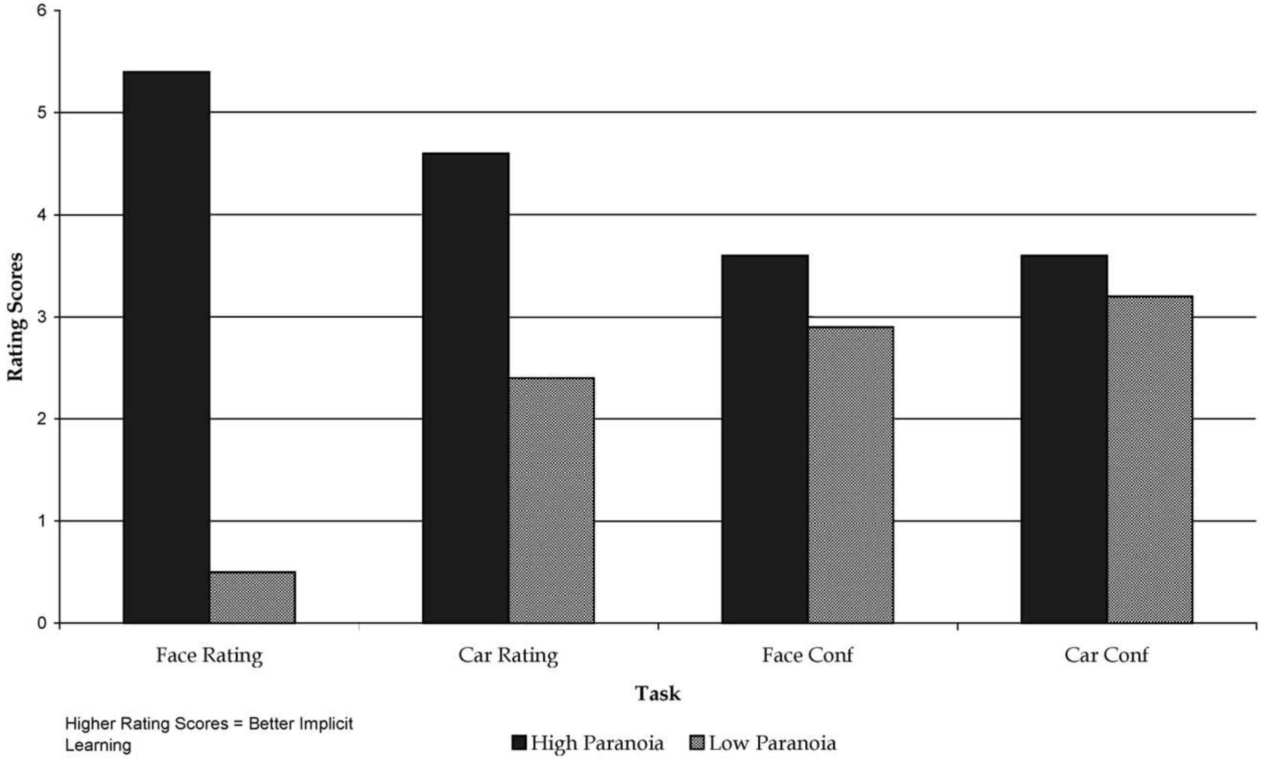

Fig. 1. Rating scores for face and car stimuli. Face and car ratings are reported as difference index scores (range of 0–9); confidence levels are reported as mean values (range 1–5). Higher scores reflect better implicit learning.

Table 3
Summary of face and car ratings and confidence levels

Variable	Group			
	High paranoia		Low paranoia	
	Mean	S.D.	Mean	S.D.
Face ratings	5.40	3.40	0.50	2.54
Car ratings	4.68	3.79	2.46	3.72
Face confidence	3.61	0.84	2.91	1.09
Car confidence	3.68	0.88	3.21	1.11

ratings were consistent between the social and non-social tasks for this group. Finally, there were no main effects for Task Type, $F\,(1{,}48)=1.3$, ns.

A 2 (Group: High vs. Low in non-clinical paranoia) × 2 (Task Type: Social vs. Non-social) mixed model ANOVA was conducted on the mean confidence levels for the face and car ratings[4]. There was a significant main effect for Group, $F\,(1{,}48)=5.4$, $P=0.023$; persons high in non-clinical paranoia were more confident in their ratings, irrespective of the content of the stimulus (see Table 3 and Fig. 1 for means). Both the Group×Task Type interaction, $F\,(1{,}48)=0.69$, and the Task Type effect were not significant, $F\,(1{,}48)=1.7$, respectively.

2.4. Supplementary analyses

In addition to the above analyses, implicit learning can also be demonstrated by showing that the face/car difference ratings are significantly greater than zero (chance level). In other words, someone who did not show implicit learning would likely rate the social and non-social stimuli in a similar manner and their ratings should be close to zero, which indicates an absence of learning. In the high non-clinical paranoia group, both social, $t\,(21)=7.4$, $P=0.0001$,and non-social ratings, $t\,(21)=5.7$, $P=0.001$ were significantly greater than zero. In the low paranoia group, only the non-social ratings were greater than zero, $t\,(27)=3.4$, $P=0.002$. These results suggest that in the group high in non-clinical paranoia, implicit learning occurred for both tasks, while in the group low in non-clinical paranoia, implicit learning was evident for only the non-social task.

3. Discussion

This study investigated implicit learning in non-clinical paranoia. The results revealed that persons high in non-clinical paranoia showed greater implicit learning, relative to those low in paranoia, to both social and non-social stimuli. Furthermore, the level of implicit learning for this high paranoia group was fairly consistent across stimulus content. Although absolute differences between the two groups in the direction of a true content-specific bias were not consistently found, there were relative differences between social and non-social ratings. An examination of Fig. 1 clearly shows that the

[4] Power to detect between group differences at the present sample size for confidence levels was estimated at 0.63 for this analysis.

group high in non-clinical paranoia was significantly superior to the group low in non-clinical paranoia on the social task, with a trend of significant differences on the non-social one. Thus, our hypothesis that a content-specific bias would be found was partially supported, which is in line with a schematic interpretation of paranoia as social stimuli were more effectively learned and processed than non-social stimuli. Finally, consistent with previous research on the confidence levels of persons with paranoia (e.g. Dudley et al., 1997), persons high in non-clinical paranoia had higher confidence in their ratings for both social and non-social stimuli than persons low in paranoia.

In general, the findings revealed that the group high in non-clinical paranoia showed relatively greater implicit learning and higher confidence ratings for *all* stimuli (although social ratings were significantly different between groups), while the group low in non-clinical paranoia showing a pattern of implicit learning to only the non-social stimuli. What could account for this pattern of findings? One possible mechanism may be the differential utilization of contextual information by persons high and low in paranoia. Specifically, previous work on social perception indicates that when forming impressions of others, a person may correct or adjust their impression based on external/other factors (e.g. situational factors; Fiske & Taylor, 1991; Gilbert, 1995). For example, the first impression that someone is rude may be corrected by knowledge that the person has just lost his or her job. For the face stimuli used in the present study, one such corrective factor may be the amount of information needed to make an informed judgment. For the theses stimuli, the minimal implicit learning in persons low in non-clinical paranoia may reflect knowledge that personality descriptors (e.g. "unfairness") are a function of *both* dispositions and situational factors. Therefore, they might assume that student ratings alone (i.e. regarding fairness level) are inadequate for them to make a judgment because only dispositional information is provided. In contrast, one could argue that cars require less inference than people regarding their characteristics (see Fiske & Taylor, 1991, for a discussion of the differences between social and non-social stimuli). The implicit learning for these stimuli by the group low in paranoia may reflect the assumption that additional information is *not* necessary for making judgments about the characteristics of non-social stimuli. Thus, correction for situational factors may not be necessary.

For persons high in non-clinical paranoia, their consistently high confidence ratings may reflect a tendency to under-utilize contextual information when forming impressions about negative outcomes and/or stimuli (Bentall et al., 1994, 2001; Kinderman & Bentall, 1997). This under-utilization of contextual information may be a function of their tendency to over-apply a schematic interpretation to a variety of stimuli. Therefore, these individuals show a similar pattern of implicit learning to *all* stimuli because their decisions are more schema- rather than data-driven, and consideration of contextual factors are minimized and/or ignored. Another possibility is whether the cognitive biases present in non-clinical paranoia operate mainly on the content for explicit tasks whereas information for implicit tasks is processed more generally, regardless of content. Thus, stimulus content may be processed differently in paranoia depending on whether implicit or explicit approaches are used.

Unfortunately, we were unable to replicate previous research on attributional style with our analogue sample. There were no differences found on the EASQ between the two groups; however, previous research in our laboratory has failed to replicate the presence of an externalizing bias among a clinical sample with paranoid symptoms (Martin & Penn, in press) and among a sample of college students high and low in paranoid ideation (Combs & Penn, submitted for publication). Other studies using similar clinical samples with persecutory delusions have found differences in attributional style, although these studies used different measures (i.e. SAQ, IPSAQ) to assess this construct (Bentall et al., 1991; Kinderman & Bentall, 1996, 1997). However, our lack of replication is not surprising given the inconsistent support for clear attributional differences in persons with paranoid/persecutory delusions (Garety & Freeman, 1999). It is possible that attributional differences become pronounced and detectable only when paranoia reaches diagnostic or clinical levels or when a depressed control group is included for comparison.

The present study has several limitations, the first of which being the use of an analogue sample. However, within the current view that symptoms exist on a continuum (Clark, Watson, & Reynolds, 1995; Johns & van Os, 2001), the use of an analogue sample may provide findings ultimately relevant to clinical paranoia. A second limitation concerns whether implicit learning actually occurred. In an attempted replication of Hill et al. (1990), Hendrickx, De Houwer, Baeyens, Eelen, and Van Avermaet (1997) found that some persons were aware of the association between face length and fairness. A post-experiment recognition test was used instead of the free-recall test format used in our study. Persons who were aware of the implicit association performed as predicted (i.e. they showed implicit learning), and those who were not aware did not show a learning pattern. Thus, the findings of the present study should be replicated using a recognition type test to explore one's awareness of the manipulation. Thirdly, even though the social/non-social tasks were similar in task demands, the actual stimuli may have differed in several ways. It is possible that the stimuli differed in visual complexity (faces being more complex) so as to influence the ratings; second, only the faces were modified by computer software, which may have led to subtle differences in quality and presentation.

Fourth, it is likely that the two groups differed on unmeasured personality traits, which may have affected performance. For example, Ball and Zuckerman (1990) showed that level of sensation seeking was related to performance on implicit learning tasks. The effect of sensation seeking on the current study results is unfortunately unknown. Finally, one could argue that the social and non-social tasks both required the subject to make judgments regarding potentially negative attributes (i.e. "unfairness" and "number of breakdowns"). These tasks may have been perceived as threat-related by the group high in paranoia or at least negative in content. Therefore, it would be of interest to examine whether the greater implicit learning shown by the group high in non-clinical paranoia is also demonstrated on social tasks of neutral or positive valence (e.g. describing the faces as more or less "extraverted"). Such a task would have allowed us to assess whether the general implicit learning bias in persons high in paranoia is present for all social stimuli or to only those that could potentially be perceived in a negative manner. This, in fact, would be an important next step in better examining content-specific biases in non-clinical paranoia.

Future research should focus on comparisons between analogue and clinical samples of persons with paranoia to explore the similarities and differences in their performance on a wide variety of tasks (explicit and implicit). Also, it is time to incorporate some behavioral measures of paranoia into the traditional social-cognitive research paradigm. The link between cognition and behavior may reveal important clues for *when* and *where* paranoid behaviors are expressed.

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