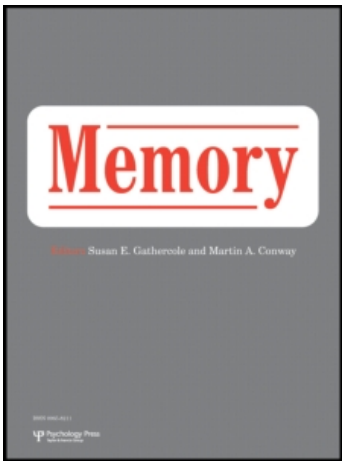

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Prepartum autobiographical memory specificity predicts post-traumatic stress symptoms following complicated pregnancy

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Prepartum autobiographical memory specificity predicts post-traumatic stress symptoms following complicated pregnancy

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Prior research has shown that reduced autobiographical memory specificity predicts an increase in post-traumatic stress severity in traumatised individuals. Studies have also demonstrated that reduced memory specificity predicts later symptoms of depression after pregnancy-related life stress. So far, no reported studies have tested the predictive value of memory specificity at the onset of a potentially traumatic situation. Therefore the aim of the present study was to investigate whether prenatal memory specificity would predict post-traumatic stress after complicated pregnancy. The results demonstrate that women who retrieved fewer specific memories with a pregnancy-related content to positive cues during pregnancy (i.e., directly after hospitalisation) reported more post-traumatic stress 6 weeks after giving birth. This relationship remained significant after controlling for variables that were related to both baseline autobiographical memory specificity and later post-traumatic stress. A similar pattern was found for depression symptomatology, even when somatic symptoms were excluded from the analyses. Taken together, these data suggest that the relationship of memory specificity with later depression can be generalised to post-traumatic stress symptoms.

Keywords: Autobiographical memory specificity; Post-traumatic stress; Depression.

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There is a wealth of evidence that individuals suffering from post-traumatic stress find it relatively difficult to recall specific autobiographical memories in response to cue words (e.g., death, party) on the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986), compared with less-distressed trauma survivors and with those with no history of trauma exposure (e.g., Hauer, Wessel, Geraerts, Merckelbach, & Dalgleish, 2008; McNally, Lasko, Macklin, & Pitman, 1995; Schönfeld & Ehlers, 2006; see Moore & Zoellner, 2007, for a review). Similar results have consistently been found for patients suffering from mood disorders (see Williams et al., 2007).

An important reason why such reduced specificity in autobiographical memory has attracted significant research attention is that it independently predicts poorer symptom outcomes in longitudinal studies in a range of clinical and sub-clinical groups (see Williams et al., 2007). For example, individuals with unipolar depression or with seasonal affective disorder who show relatively reduced memory specificity when depressed go on to show more depressive symptoms when followed up several months later (e.g., Brittlebank, Scott, Williams, & Ferrier, 1993; Dalgleish, Spinks, Yiend, & Kuyken, 2001; Mackinger, Pachinger, Leibetseder, & Fartacek, 2000; although see Brewin, Reynolds, & Tata, 1999).

To our knowledge, two studies have shown that reduced memory specificity after experiencing a traumatic event predicts the course of post-traumatic stress symptomatology. Kleim and Ehlers (2008) assessed autobiographical memory specificity 2 weeks after their participants had been assaulted and found that reduced specificity predicted PTSD as well as depression diagnoses 6 months later. Harvey, Bryant, and Dang (1998) showed that reduced specificity on the AMT in the immediate aftermath of a motor vehicle accident (MVA) predicted later post-traumatic stress disorder (PTSD) at follow-up, even when initial acute stress disorder (ASD) diagnosis and depressive symptoms were covaried. Interestingly, however, it was only reduced specificity of memories with MVA-related content that was significantly predictive. Specificity of memories *un*related to the accident was not associated with later PTSD symptoms. However, this latter finding was not replicated in a later study using a similar design in a sample of cancer patients (Kangas, Henry, & Bryant, 2005). Here, although both initial ASD diagnosis and depressive symptoms predicted PTSD 6 months later, memory specificity (whether cancer-related or not cancer-related) was not a significant predictor.

What are the reasons for these discrepant results? One possibility is that the relationship between memory specificity and the course of post-traumatic stress is unreliable. Another is that the studies used trauma populations that differed on critical dimensions. For example, in the MVA survivors the traumatic event itself was over, whereas for many of the cancer victims the problems were presumably chronic and ongoing. Finally, a number of other variables that we know to be related to reduced memory specificity were not always controlled or assessed. For example, Harvey et al. (1998) did not investigate the contributions of trauma severity, history of depression, or executive capacity in their study, all of which can impact on reduced specificity (see Williams et al., 2007). This leaves open the possibility that these other variables may be responsible for the reported effects in their study. The first aim of the present study was therefore to examine the replicability of the longitudinal relationship between memory specificity (both trauma-related and unrelated) and later post-traumatic stress, while taking into account the putative contributions of depression severity, trauma severity, and executive functioning.

A key aspect of the majority of the studies to date examining the relationship between memory specificity and post-traumatic stress (Moore & Zoellner, 2007) is that both memory style and symptoms have been assessed *after* the trauma. A potential problem of assessing memory specificity and symptoms post-trauma is that one cannot rule out the possibility that some aspect of the event itself is accounting for both variations in memory specificity and variations in symptoms, as well as the longitudinal relationship between them. Indeed, influential theories of reduced autobiographical memory specificity have argued that it arises *as a result* of the experience of trauma; for example, as a way of avoiding those specific aspects of the personal past that may be upsetting (Dalgleish, Rolfe, Golden, Dunn, & Barnard, 2008; Williams et al., 2007; Williams, Stiles, & Shapiro, 1999).

However, there are good reasons to believe that pre-trauma memory style may itself influence the course of post-traumatic stress reactions (e.g., Bryant, Sutherland, & Guthrie, 2007; Williams et al., 2007). For example, Bryant et al. (2007) found within a sample of male firefighters that pre-trauma reduced autobiographical memory

specificity to positive cue words significantly predicted post-traumatic stress severity after trauma exposure. Furthermore, cognitive theories of post-traumatic stress (see Dalgleish, 2004) suggest that recovery from trauma requires the successful integration of the trauma memory into one's autobiographical memory database. An inability to retrieve specific memories could potentially disrupt this process of assimilation. Furthermore, reduced memory specificity is related to reduced social problem solving ability (see Williams et al., 2007), which may be particularly relevant for successfully coping with stressful life events (Van Minnen, Wessel, Verhaak, & Smeenk, 2005).

Of course, assessing autobiographical memory style (or indeed any variable) pre-trauma in a sample where the participants had no knowledge that a traumatic event was likely, is very difficult and would require extremely large samples of unselected participants. However, this research design can be approximated by recruiting a sample for whom a traumatic or distressing event is likely in the future. The second aim of the present study was therefore to examine the relationship between memory specificity assessed *prior* to a predicted, yet nevertheless potentially traumatic, event and post-traumatic stress assessed after that event. To pursue this aim we recruited a sample of women with pregnancy complications who were hospitalised in anticipation of a difficult and potentially traumatic childbirth experience.

Our rationale for selecting this sample of patients was that previous prospective studies have demonstrated that reduced memory specificity assessed prior to pregnancy-related life-stress predicts later general symptoms of depressed and anxious mood (Mackinger, Loschin, & Leibetseder, 2000; Van Minnen et al., 2005). For example, Mackinger et al. (2000) found that reduced memory specificity to negative word cues during pregnancy was associated with more severe postnatal depressive symptoms 3 months after normal childbirth.

In order to apply this research design to the study of post-traumatic stress, we recruited women who had just been hospitalised because of an elevated risk of encountering a life-threatening situation during later pregnancy and childbirth and for whom a complicated delivery was anticipated; for example, women with pre-eclampsia. Prior research has shown that preterm birth and term delivery after pre-eclampsia are associated with substantial PTSD symptoms compared to an uneventful term birth (Engelhard et al., 2002). In fact, studies suggest that up to 30% of women may present with significant symptoms of PTSD and depression after such pregnancy complications or pregnancy loss, and such symptoms usually develop within 1 month after the delivery or loss (Engelhard, van den Hout, & Arntz, 2001; Engelhard et al., 2002; see Olde, van der Hart, Kleber & van Son, 2006, for a review). Furthermore, contrary to Mackinger et al. (2000) and Van Minnen et al. (2005), who were more interested in general post-natal depressed and anxious mood, the present study assessed the influence of trauma history, prepartum mental health problems, emotions and mood (see Williams et al., 2007).

We had three specific hypotheses. First, in order to ground this study within the extant memory-specificity literature, we hypothesised that the prepartum data would replicate key established findings. Consequently, we predicted that specific memories at baseline would be negatively related to concurrent depressive symptoms (Van Vreeswijk & De Wilde, 2004) and to any post-traumatic stress arising from prior distressing events (e.g., Schönfeld, Ehlers, Böllinghaus, & Rief, 2007). We also expected specific memories to be positively related to a measure of executive functioning (Dalgleish et al., 2007; Neshat-Doost, Dalgleish & Golden, 2008). Confirmation of this first hypothesis would serve to validate the AMT for our sample in the prepartum phase.

Our second and central hypothesis was that lower levels of prepartum specific memories would predict higher levels of *later* postnatal post-traumatic stress symptoms. Although the pre-delivery period during hospitalisation may itself be stressful, ''baseline'' symptoms were assessed during this period because we were interested in *increases* in these symptoms after delivery. Critically, we predicted that this relationship would remain after statistical covariation of baseline symptoms and other relevant variables (e.g., executive functioning). As already noted, previous results have indicated that the relationship of retrieved memories to the traumatic or distressing event is particularly important in the prediction of later symptoms (Harvey et al., 1998; Van Minnen et al., 2005). Although we were deliberately examining memory specificity prepartum, and asked participants to only retrieve memories prior to their hospitalisation, we still predicted that a number of the memories generated would be about aspects of the pregnancy

prior to hospitalisation or about earlier pregnancies, as this is what previous work had indicated (Van Minnen et al., 2005). Consequently, for these longitudinal analyses we examined the role of specific memories for pregnancy-related and non-pregnancy-related events separately in our analyses. Furthermore, specific memories to positive and negative cue words were entered separately into the longitudinal analyses because the literature indicates that cue word valence may be important in predicting later symptoms (e.g., Bryant et al., 2007; Williams et al., 2007). We therefore anticipated differences in the predictive value of cue valence and/or the pregnancy-relatedness of the prepartum retrieved memories.

Finally, the third hypothesis was that the longitudinal pattern predicted for post-traumatic stress (Hypothesis 2) would be mirrored for depressive symptoms, thus replicating earlier longitudinal findings examining more general mood variables.

METHOD

Participants

Patients hospitalised in the University Hospital Maastricht for pregnancy complications, who were fluent in Dutch and were physically able to be interviewed (according to hospital staff), received information about this study. A total of 88 women were eligible to participate in the study, and 34 of them declined, either because they were only willing to participate at Baseline ($n = 5$), because they were already taking part in other research ($n = 5$), or for an undisclosed reason ($n = 24$). Thus, 54 women completed the Baseline measurement (response rate = 61%).

Between Baseline and Follow-up, 19 women dropped out of the study. Thus, 35 women (mean age = 31.71 years; $SD = 4.84$; mean level of finished education [ranging from 1 = primary school to 7 = university] = 4.51, $SD = 1.62$) completed both the Baseline measures before delivery and the Follow-up measures 6 weeks after delivery (65% retention rate). Reasons for dropping out were that some participants delivered a stillborn child ($n = 2$), were completely occupied by childcare ($n = 7$), could not be reached, or failed to return the measures ($n = 10$). Participants not retained at Follow-up were comparable in age, $F(1, 53) = 2.95$, $p < .10$, education, $\chi^2(6) = 4.99$, $p > .50$, and Baseline PSS-SR, IES, and BDI-II scores, Fs < 1, with those retained. However, participants who dropped out at Follow-up were less likely to be married than those retained, $\chi^2(4) = 8.61$, $p < .08$. The indications for hospital admission were: hypertensive disorder of pregnancy (i.e., pre-eclampsia; $n = 16$), pre-term labour ($n = 13$), bleeding in late pregnancy ($n = 4$), unstable diabetes ($n = 1$), and ovarian surgery during pregnancy ($n = 1$). A total of 12 participants had a history of psychotherapy; 22 women had been pregnant before, with 12 having one ($n = 8$) or more ($n = 4$) children; 10 women had a prior miscarriage, a stillborn child, or a child that had died after birth. The present study was part of a larger, ongoing project concerning post-traumatic stress after complicated pregnancy. It was approved by the institutional review board of the University Hospital Maastricht.

Materials

Autobiographical Memory Test (AMT). The AMT contained five positive and five negative cue words (Wessel, Meeren, Peeters, Arntz, & Merckelbach, 2001; Williams & Broadbent, 1986). The AMT cue words in English (Dutch) were: *sorry (spijt)*, *happy (gelukkig)*, *angry (boos)*, *safe (veilig)*, *clumsy (onhandig)*, *interested (geïnteresseerd)*, *hurt (gekwetst)*, *successful (succesvol)*, *lonely (eenzaam)*, and *surprised (verrast)*. Participants were instructed to recall to each cue word a different specific memory about a personally experienced event that happened at a particular time and place *before* being hospitalised, and that lasted for less than 1 day. The cue words were presented orally and visually with alternating positive and negative words. To familiarise participants with the procedure they first practised with neutral words (e.g., shop, car, trip, conversation) until they understood the task. Participants were required to report a specific memory within 60 seconds. If participants gave a non-specific answer within that time, they were prompted once with 'Could you be more specific?' After 60 seconds, the experimenter presented the next cue word. Responses were audiotaped.

The first memories recalled to each cue word were coded by an independent rater. Each response was coded as a specific memory (i.e., referring to an event at a particular time and place, lasting less than a day), a categoric memory (i.e., involving repeated occasions), an extended memory (i.e., lasting longer than a day), no

memory (e.g., an evaluative statement), or an omission (i.e., no response). Furthermore, specific memories were scored as either pregnancy-related or non-pregnancy-related. A pregnancy-related memory was defined as a memory that was associated with the current or a previous pregnancy. A second rater scored 250 AMT responses from a subsample of the participants ($n = 25$). Inter-rater reliability for coding a memory as specific or non-specific was acceptable, kappa = .70. It was clear from the transcripts when a memory was related to pregnancy. Examples are ''When we heard it was a girl'', ''Feeling the first kick in my stomach'', and ''Hearing there was something wrong with the baby''. All pregnancy-related memories were independently classified by two raters. There was complete agreement on the categorisation of content.

Beck Depression Inventory – Second edition (BDI-II). The BDI-II consists of 21 items that each contain four statements reflecting depressive symptoms, in increasing severity (scored 0–3; range 0–63; Beck, Steer, & Brown, 1996; Van der Does, 2002). The BDI-II consists of three subscales that measure somatic (e.g., sleeping problems), cognitive (e.g., feelings of guilt), and affective (e.g., feelings of sadness) symptoms of depression (Van der Does, 2002). Participants were asked to complete the Dutch version of the BDI-II (Van der Does, 2002) with respect to the previous 2 weeks. Internal reliability of the BDI-II in the present sample was good at baseline (Cronbach $\alpha = .87$) and follow-up ($\alpha = .84$).

PTSD Symptom Scale – Self Report version (PSS-SR). The PSS-SR (Engelhard, Arntz, & van den Hout, 2007; Foa, Riggs, Dancu, & Rothbaum, 1993) consists of 17 items that correspond to the DSM-IV PTSD symptoms. Items are scored on a 4-point scale (0 = *not at all*, 1 = *once a week*, 2 = *2–4 times a week*, 3 = *5 times or more often*; range 0–51) At Baseline participants were asked to identify an aversive event that currently bothered them the most, and to rate the Dutch version of the PSS-SR (Engelhard et al., 2007) with respect to this event. Respondents were asked to rate how much each symptom had bothered them in the past month, using a 4-point scale (0 = not at all, 3 = almost always). This was used as an index of Baseline PTSD symptoms. At Follow-up participants were instructed to complete the PSS-SR with respect to the complicated pregnancy and birth. Internal reliability was excellent at Baseline ($\alpha = .93$) and Follow-up ($\alpha = .91$).

Impact of Event Scale (IES). The IES (Brom & Kleber, 1985; Horowitz, Wilner, & Alvarez, 1979) was administered to measure the frequency of intrusion and avoidance symptoms within the previous week about an identified negative stressful experience. As with the PSS-SR, Baseline ratings on the Dutch version of the IES (Brom & Kleber, 1985) were for the previous traumatic event causing the most current distress, and Follow-up ratings concerned the pregnancy/birth. Internal reliability for the IES was excellent at Baseline ($\alpha = .91$) and good at Follow-up ($\alpha = .81$).

Profile of Mood States (POMS). The POMS (de Groot, 1991; McNair, Lorr, & Droppleman, 1992) is a widely used instrument for measuring subjective mood state. Participants are asked to indicate how much they agree with adjectives describing current mood or feelings on a 5-point scale (0 = *not at all*, 4 = *extremely*). Adjectives include *annoyed*, *tense*, and *nervous*. Higher scores indicate more negative mood. This study used a short Dutch version of the POMS to provide an assessment of current mood (de Groot, 1991; Wald & Mellenbergh, 1992), and its internal reliability was excellent both at Baseline ($\alpha = .90$) and Follow-up ($\alpha = .92$).

Negative Life-Events Trauma Questionnaire (NLETQ). The NLETQ (Engelhard, van den Hout, & Kindt, 2003; Morgan & Janoff-Bulman, 1994) comprises a list of 21 discrete events (e.g., verbal, physical, and sexual abuse; serious accidents; disaster), and 11 events were added to this list, including 6 items about prior pregnancy complications (e.g., miscarriage, abortion, pre-eclampsia, premature or stillborn child) to compute a measure of prior pregnancy-related trauma. Participants were asked to indicate which events they had experienced in their lives.

Raven's Progressive Matrices. The progressive matrices (Raven, 2000) were used as a measure of executive functioning. Each page consists of a figure that is missing a piece. Participants are asked to choose the correct missing piece from eight alternatives. The test was carried out without time constraints, and the total number of correct answers was computed.

Trauma severity. Gestational age and birth weight, $r(34) = .85$, were used as an indicator of trauma severity with regard to the pregnancy

birth (cf. Engelhard et al., 2002; Engelhard, van den Hout, & Schouten, 2006).

Procedure

Shortly after admission to the hospital, women were given a brief oral explanation and written information about the study by a nurse. For those who expressed an interest in participating, an appointment was scheduled with a researcher or research assistant who then gave full oral and written information about the study. If a woman decided to participate and provided written informed consent, she enrolled in the study. The Baseline started with an interview about demographics, prior mental health (e.g., prior psychotherapy), pregnancy-related variables, and reasons for being hospitalised. Directly thereafter the PSS-SR was administered. Here the woman also indicated on a scale from 0 (not at all) to 3 (very much) how much fear, horror, and helplessness she had experienced during the event reported on the PSS-SR and IES (e.g., Criterion A2 of PTSD; APA, 1994). Then the NLETQ and Raven's Matrices were administered. After a break the AMT, POMS, IES, and BDI-II were administered. The Follow-up assessment was approximately 6 weeks after the birth (the birth date was provided by hospital records). At Follow-up the interview was administered by telephone and focused on the delivery and its aftermath. The PSS-SR, BDI-II, and IES were sent by mail.

RESULTS

Table 1 presents the self-report questionnaire data at Baseline and Follow-up. At Baseline, 24 women (69%) completed the PSS-SR and IES in relation to the current hospitalisation or pregnancy complications. Three women related symptoms to prior pregnancy experiences, and the remaining eight indicated various experiences, including death or illness of loved ones or work-related problems. Mean scores for fear, horror, and helplessness experienced during the identified stressful event were, 1.85 ($Mdn = 2$; $SD = 1.18$), 0.71 ($Mdn = 0$; $SD = 1.17$), and 2.17 ($Mdn = 3$; $SD = 1.12$), respectively. There were no differences on these variables between the subgroups of women who did versus did not rate the PSS-SR and IES with respect to being hospitalised or pregnancy complications, ts < 1.

TABLE 1
Self-reported symptoms

	Baseline during hospitalisation	*Follow-up 6 weeks after child birth*
PSS-SR	14.65 (11.79)	7.64 (6.45)
IES total	18.31 (15.03)	8.21 (8.92)
IES intrusion subscale	11.49 (9.49)	5.03 (5.41)
IES avoidance subscale	6.83 (7.38)	3.18 (4.81)
BDI-II	12.31 (7.73)	8.64 (6.17)
BDI-II somatic symptoms	8.54 (4.20)	5.88 (3.57)
BDI-II affective symptoms	1.53 (2.06)	.88 (1.29)
BDI-II cognitive symptoms	2.09 (2.74)	1.79 (2.39)
POMS	27.83 (16.27)	29.63 (16.11)

Means (*SD*) of self-reported symptoms of depression (BDI-II), post-traumatic stress (PSS-SR), intrusions and avoidance (IES), and mood (POMS) at Baseline during hospitalisation and at Follow-up 6 weeks after child birth ($N = 35$).

BDI-II = Beck Depression Inventory; PSS-SR = Post-traumatic Symptoms Scale-Self-Report; IES = Impact of Event Scale; POMS = Profile of Mood States.

Characteristics related to giving birth

A total of 22 women (63%) had a Caesarean birth, 8 women (23%) delivered after medical induction, and 5 women (14%) had a normal childbirth. The mean hospital stay during pregnancy was 18.34 days ($SD = 13.50$; range: 2–56 days), with a delivery at a mean gestational age of 35.43 weeks ($SD = 3.66$; range: 28.40–42.00 weeks), and a mean birth weight of 2402.49 grams ($SD = 880.58$; range: 740–4340 grams). A total of 21 women (60%) had a premature delivery (< 37 weeks; Steer, 2005), with a mean of 33.2 weeks ($SD = 2.47$), and 14 women (40%) had a term delivery ($M = 39.1$ weeks, $SD = 1.69$). A total of 19 babies (54%) had low birth weight (< 2500 grams; Frederick, Williams, Sales, Martin, & Killien, 2008), with a mean of 1739.32 grams ($SD = 512.72$), and 16 babies (46%) did not ($M = 3190.00$ grams, $SD = 472.83$).

Hypothesis 1

Autobiographical memory specificity is negatively correlated with concurrent depressive and post-traumatic stress symptoms and positively correlated with executive functioning.

Table 2 presents the data for the different autobiographical memory-specificity variables. Correlation analyses showed that total numbers of specific memories ($df = 33$) were significantly or near-significantly negatively correlated with scores on the BDI-II, $r = -.31$, $p = .08$, PSS-SR, $r = -.48$, $p = .004$, IES total, $r = -.44$, $p = .008$, IES intrusion, $r = -.41$, $p = .02$, and IES avoidance, $r = -.38$, $p = .03$, and positively correlated with scores on Raven's Matrices, which provides an estimate of executive functioning, $r = .47$, $p = .005$. Overall, these results support Hypothesis 1.[1]

TABLE 2
Memories

	Positive cue	*Negative cue*	*Total*
AMT-S	3.23 (1.40)	2.31 (1.59)	5.54 (2.73)
AMT-NPR	2.00 (1.46)	1.66 (1.45)	3.66 (2.54)
AMT-PR	1.23 (1.14)	.66 (1.03)	1.89 (1.66)
AMT-GC	.60 (.81)	.63 (.91)	1.23 (1.42)

Mean (*SD*) numbers of pregnancy-related and -unrelated specific memories, and general categoric memories, to positive and negative cue words on the Autobiographical Memory Test (AMT) at Baseline ($N = 35$).

AMT-S = number of specific memories; AMT-NPR = specific memories *un*related to pregnancy; AMT-PR = specific memories related to pregnancy; AMT-GC = categoric memories. The mean (SD) numbers of extended memories, no memories, and omissions were 1.74 (1.52), .57 (1.01), and .66 (.91), respectively.

Hypotheses 2 and 3

Autobiographical memory specificity predicts later post-traumatic stress and depression symptoms.

To address Hypotheses 2 and 3 we first examined correlations between our various Baseline variables and the relevant Follow-up outcome measures (PSS-SR, IES, BDI-II; see Table 3). For each outcome measure we next examined a regression model including our four AMT variables as predictors (i.e., specific pregnancy-related memories to positive [AMT-PR-pos] and negative [AMT-PR-neg] cues, and specific non-pregnancy-related memories to positive [AMT-NPR-pos] and negative [AMT-NPR-neg] cues) to examine whether memory specificity was related to outcome and in particular which aspects of memory specificity, if any, independently accounted for variance in the outcome measures. Finally, for each outcome measure we repeated this first regression this time with the measures of post-traumatic stress (on the PSS-SR) and depression (on the BDI) at Baseline entered as a first step, along with any demographic or delivery-related variables that had shown a significant partial correlation with the outcome variable, once baseline scores on the outcome variable were covaried. In a second step we entered the four AMT variables to investigate whether they would significantly explain incremental variance. In this way we investigated which aspects of memory specificity, if any, accounted for significant additional variance in the outcome variable while controlling for Baseline mood and other significant zero-order predictors.

For all regressions we verified that the variables were not significantly collinear.

PSS-SR data. The Follow-up PSS-SR data contained one outlier (z-score > 3), which was truncated into a value that was one point higher than the second highest value (Tabachnick & Fidell, 2007). The mean level of post-traumatic stress as indicated by the PSS-SR (range: 0–20) at Follow-up was below previously reported clinical cut-off scores (e.g., cut-off < 14; Coffey, Gudmundsdottir, Beck, Palyo, & Miller, 2006; see also Brewin, 2005). However, eight (23%) women reported a number of symptoms that was above the clinical cut-off score.

Table 3 presents the zero-order correlations between Baseline and Follow-up measures. As can be seen, BDI-II, PSS-SR, and IES scores at Baseline and the number of pregnancy-related specific memories (AMT-PR) to positive cues were all significantly correlated with Follow-up PSS-SR. The zero-order correlation between birth weight and follow-up PSS-SR became non-significant when Baseline PSS-SR was partialled out, $pr\ (31) = -.20$, $p = .27$. Birth weight was therefore not included in the regression analyses. The first regression model, with PSS-SR scores at Follow-up as the dependent variable and the four AMT scores as predictors, was significant, $F(4,\ 30) = 2.91$, $p = .04$, $R^2 = .28$, indicating that total reduced memory specificity was related to higher subsequent post-traumatic stress. However, AMT-PR-pos scores were the only significant independent predictor, $\beta = -.63$, $t = 2.89$, $p = .007$, indicating that reduced specificity for positive pregnancy-related memories was

[1] The pattern of results was similar when correlations were computed on the basis of all 54 women who completed the Baseline measurement, rs(52) $> |.25|$, ps $< .08$.

TABLE 3
Zero-order correlations

	PSS-SR	*IES*	*BDI-II*
Raven accuracy	−.29	−.48**	−.29
BDI-II	.36*	.12	.37*
PSS-SR	.50**	.23	.27
IES total	.45**	.33*	.46**
IES avoidance	.31	.42*	.34*
IES intrusions	.46**	.19	.42*
POMS	.29	.09	.30
Prior therapy (psychologist or psychiatrist)	−.17	−.33	.02
Prior trauma (NLETQ)	.08	.18	.19
Prior pregnancy trauma (NLETQ)	.21	.29	.20
Birth weight	−.39*	−.32	−.29
AMT-PR-pos	−.38*	−.34*	−.57**
AMT-PR-neg	−.02	.02	−.18
AMT-NPR-pos	−.07	−.04	.07
AMT-NPR-neg	−.26	−.39*	−.15

Zero-order correlations of Follow-up post-traumatic stress and depressive symptoms (top row), with Baseline depressive and post-traumatic symptoms as well as with prior (pregnancy) trauma, prior therapy, birth weight and measures of autobiographical memory specificity (first column) ($N = 35$). *<.05; **<.01

BDI-II = Beck Depression Inventory; PSS-SR = Post-traumatic symptoms scale self-report; IES = Impact of Event Scale; POMS = Profile of Mood States; NLETQ = Negative Life-Events Trauma Questionnaire; AMT-NPR-pos = specific memories non-pregnancy-related to positive cues; AMT-NPR-neg = specific memories non-pregnancy-related to negative cues; AMT-PR-pos = specific memories pregnancy-related to positive cues; AMT-PR-neg = specific memories pregnancy-related to negative cues.

associated with greater later post-traumatic stress. The beta coefficients for AMT-PR-neg, AMT-NPR-pos, and AMT-NPR-neg were, $\beta = .26$, $t = 1.34$, $p = .19$, $\beta = -.29$, $t = 1.28$, $p = .21$, $\beta = -.06$, $t < 1$, respectively.

A second regression was conducted with Baseline PSS-SR and BDI-II entered on Step 1 and the four AMT variables on Step 2. Step 1 was significant, $F(2, 31) = 8.50$, $p = .001$, $R^2 = .35$, with beta coefficients for baseline PSS-SR and BDI, $\beta = .22$, $t = 2.27$, $p = .03$ and $\beta = .27$, $t = 1.56$, $p = .13$, respectively. The increase in explained variance accounted for by Step 2, with the four AMT variables entered, was a near-significant trend, $F_{change}(4, 27) = 2.51$, $p = .065$, $R^2_{change} = .18$. As with the first regression, in this final model reduced specificity of positive pregnancy-related memories (AMT-PR-pos) was the only significant independent predictor of higher later post-traumatic stress, $\beta = -.51$, $t = 2.62$, $p = .01$. The beta coefficients for AMT-PR-neg, AMT-NPR-pos, and AMT-NPR-neg were $\beta = .23$, $t = 1.41$, $p = .17$, $\beta = -.09$, $t < 1$, $\beta = -.02$, $t < 1$, respectively. The beta coefficients for Baseline PSS-SR and BDI-II were now $\beta = .36$, $t = 1.97$, $p = .06$, $\beta = .22$, $t = 1.35$, $p = .19$, respectively. These data tentatively suggest that after taking the relevant Baseline variables into account, autobiographical memory specificity, and in particular the number of specific pregnancy related memories to positive cue words, was related to more symptoms on the PSS-SR.

IES data. The mean level of post-traumatic stress as indicated by the IES-total at Follow-up (range: 0–34) was also below previously reported clinical cut-off scores (e.g., cut-off < 19, Wohlfarth, van den Brink, Winkel, & ter Smitten, 2003; see also Brewin, 2005). As can be seen from Table 3, Follow-up IES scores correlated with two of the AMT specificity variables at Baseline, along with the Baseline IES scores and scores on Raven's Matrices. The correlation between Raven's scores and follow-up IES scores remained significant once Baseline IES scores were partialled out and so Raven's scores were carried forward into the regression analyses as a predictor variable. The first regression examining the predictive value of the four AMT variables was again significant $F(4, 30) = 3.00$, $p = .04$, $R^2 = .28$, indicating that reduced total specific memories was associated with later post-traumatic stress. There were some trends for AMT-PR-pos, $\beta = -.40$, $t = 1.87$, $p = .07$, and AMT-NPR-neg, $\beta = -.36$, $t = 1.74$, $p = .09$. Furthermore, AMT-PR-neg, $\beta = .12$, $t < 1$, and AMT-NPR-pos, $\beta = -.01$, $t < 1$, were non-significant predictors. As the sample size is small and the p-levels show only trends towards

significance, we should be careful about drawing strong conclusions. Nevertheless, the pattern is similar to the (significant) pattern found for the PSS-SR, which suggests the trends may be meaningful.

The follow-up regression with Baseline IES-total, BDI-II, and Raven's Matrices scores on Step 1 and the AMT variables on Step 2 demonstrated a significant Step 1, $F(3, 29) = 4.67$, $p = .009$, $R^2 = .33$, with beta coefficients for baseline IES, BDI, and Raven's Matrices, $\beta = .34$, $t = 1.81$, $p = .08$, $\beta = -.09$, $t < 1$, and $\beta = -.45$, $t = 2.90$, $p = .007$, respectively. However, Step 2 did not explain significant additional variance, $F_{change}(4, 25) < 1$, providing no support for the hypothesis that memory specificity would account for variance in Follow-up IES scores once variance accounted for by the other relevant baseline variables was taken into account.

BDI-II data. The mean level of depressive symptoms as indicated by the BDI-II at Follow-up (range: 0–21) was in the normal range (BDI-II scores < 09; e.g., Beck et al., 1996). Nevertheless, 15 (43%) women reported a number of symptoms that were above this level. Table 3 shows that Follow-up BDI-II scores correlated with reduced specificity of positive pregnancy memories on the Baseline AMT as well as symptoms scores. The regression model with the four AMT predictors was significant, $F(4, 29) = 4.76$, $p = .004$, $R^2 = .40$, indicating once more that reduced total AMT specificity was associated with higher later levels of depression symptoms. Again, AMT-PR-pos was the only significant independent predictor, $\beta = -.83$, $t = 4.04$, $p < .001$, although there was a trend in the case of AMT-PR-neg, $\beta = .33$, $t = 1.84$, $p = .08$, showing that reduced specificity in positive pregnancy-related memories was associated with higher levels of subsequent depressive symptoms. The beta coefficients for AMT-NPR-pos and AMT-NPR-neg were $\beta = -.36$, $t = 1.64$, $p = .11$, and $\beta = .09$, $t < 1$, respectively.[2]

As before, the follow-up regression was conducted with Baseline PSS-SR and BDI-II entered on Step 1 and the four AMT variables entered on Step 2. Step 1 approached significance, $F(2, 30) = 2.84$, $p = .07$, $R^2 = .16$. Step 2 accounted for significant additional variance, $F_{change}(4, 26) = 3.96$, $p = .01$, $R^2_{\text{change}} = .32$. As with the initial regression, reduced specificity of positive pregnancy-related memories (AMT-PR-pos) was the only significant independent predictor of higher later depression scores, $\beta = -.77$, $t = 3.61$, $p = .001$. The beta coefficients for AMT-PR-neg, AMT-NPR-pos, and AMT-NPR-neg were $\beta = -.28$, $t = 1.18$, $p = .25$, $\beta = .11$, $t < 1$, $\beta = .33$, $t = .08$, respectively. Again, this result indicates that when the relevant Baseline variables were taken into account, autobiographical memory specificity and in particular the number of specific pregnancy related memories to positive cue words was related to more symptoms on the BDI-II. Furthermore, the beta coefficients for Baseline PSS-SR and BDI-II were $\beta = .06$, $t < 1$, $\beta = .24$, $t = 1.38$ $p = .18$, respectively.[3]

DISCUSSION

The main aim of this study was to investigate whether autobiographical memory specificity, assessed pre-delivery, would independently predict levels of post-traumatic stress, assessed post-trauma, in a sample of pregnant women admitted to hospital in advance of anticipated late-pregnancy and delivery complications. In line with prior research (e.g., Williams et al., 2007), the data supported our first hypothesis that prepartum memory specificity would be negatively related to concurrent symptoms of depression and post-delivery stress, and positively related to a measure of executive functioning, thus validating the AMT for this sample at the Baseline assessment.

The data also confirmed our second and principal hypothesis, demonstrating that reduced pre-delivery memory specificity predicted greater, later post-traumatic stress symptoms (on the PSS-SR). Interestingly, it was the number of

[2] Somatic symptoms (e.g., lack of sleep, loss of concentration) may be related to late pregnancy and postpartum rather than to a mood disturbance. Therefore we repeated this regression using only the cognitive and affective items of the BDI. The model remained significant $F(4, 29) = 3.13$, $p = .02$, $R^2 = .31$, with AMT-PR-pos as the only significant independent predictor, $\beta = -.72$, $t = 3.26$, $p = .003$, with a trend for AMT-NPR-neg, $\beta = .35$, $t = 1.80$, $p = .08$.

[3] We again repeated this regression using only the cognitive and affective items of the BDI. The model with the baseline cognitive and affective symptoms of the BDI and baseline PSS entered on Step 1 was non significant, $F(2, 29) = 2.33$, $p = .12$, $R^2 = .14$. However, entering the four AMT variables on Step 2 accounted for significant additional variance, $F_{change}(4, 25) = 3.05$, $p = .04$, $R^2 = .28$, with AMT-PR-pos, $\beta = -.71$, $t = 3.17$, $p = .004$, and AMT-NPR-neg, $\beta = .40$, $t = 2.05$, $p = .05$, as significant independent predictors.

specific memories to positive cues that were thematically related to the pregnancy that was especially predictive of later post-traumatic stress symptoms. In other words, women who recalled fewer specific pregnancy-related memories to positive cues before their complicated delivery were more likely to have increased levels of post-traumatic stress afterwards. Moreover, pregnancy-related specific memories to positive cues still accounted for a substantial portion of additional variance (18%) after entering baseline symptoms into the analysis. Although this additional effect just fell short of attaining statistical significance, the overall pattern of results replicates and extends the findings of Bryant et al. (2007) showing that pre-trauma reduced memory specificity to positive cues predicted post-traumatic stress within a sample of male fire firefighters. The present data are also consistent with the findings of Harvey et al. (1998) who showed that fewer specific accident-related memories produced on the AMT in the first few weeks after an MVA predicted post-traumatic stress severity 6 months later. The current data demonstrate this longitudinal relationship after taking into account a range of other variables previously associated with reduced memory specificity, including prior trauma, history of psychopathology and executive functioning (Williams et al., 2007).

Similar analyses in the present study using the IES, as opposed to the PSS-SR, as the outcome variable also revealed that reduced memory specificity predicted higher later levels of post-traumatic stress. However, the key findings were no longer significant once the influence of Baseline symptoms was covaried, although the findings were in the expected direction. Finally, we confirmed our third hypothesis that fewer specific memories would predict an increase in later depressive symptoms, thus replicating and extending previous longitudinal findings examining the prediction of depressed mood (see Williams et al., 2007). As with the PSS-SR data, this predictive relationship was carried by the association between pregnancy-related specific memories to positive cues and later BDI-II scores, which explained additional variance after the relevant Baseline variables were taken into account.

The data raise a number of interesting questions. First, why did the predictive effects pertain exclusively to reduced pregnancy-related specific memories to positive cues? The majority of these memories[4] had a positive content. Therefore, one possible explanation is that a relative inability to retrieve positive pregnancy-related memories might have hindered the expectancy of or belief in a positive outcome to the pregnancy, thus making it more difficult to cope with any complications (Van Minnen et al., 2005). Similarly, we know that reduced memory specificity is related to poorer social-problem solving (Williams et al., 2007). The idea is that coping with new (social) situations benefits from the ability to retrieve memories of previous instances in which similar problems were effectively solved. Perhaps such a strategy may also be used to alleviate negative mood after childbirth. For example, it has been found (Joormann, Siemer, & Gotlib, 2007) that the deliberate recall of positive memories during experimentally induced negative mood makes psychologically healthy people feel better. Perhaps such a mood-repair strategy played a role here: the ability to retrieve specific pregnancy related positive memories may be protective because people can use them when they encounter post-partum negative situations involving their child. Another possible explanation of the findings is that the relationship between retrieving positive specific pregnancy-related memories and better outcome is due to the fact that women actually had more positive pre-hospitalisation pregnancy-related experiences. In order words, perhaps the underlying ''database'' of experiences is problematic rather than the memory style.[5] The data are silent about this issue, but earlier studies have shown that positive experiences and emotions may increase resilience to trauma (e.g., see Bonnano, 2004). This is in line with cognitive stress theory in a recent revised form (e.g., Folkman, 2001), which highlights meaning-based coping and the importance of positive affect in sustaining the coping process and furthering recovery. Along the same lines, individuals who express difficulties in recalling positive pregnancy-related experiences may also be less likely to report positive reappraisals or

[4] As a double check to see whether the specific memories retrieved to positive cue words were indeed positive memories, we scored the valence of the specific memories on the AMT. The large majority (86.6%) of specific memories retrieved in response to positive cue words did indeed have a positive content. Similarly, 81.6% of specific pregnancy-related memories to positive cue words had a positive content. We should note here that these valence scores are based on scoring by an independent rater. The memories were not scored by the participants themselves.

[5] We thank an anonymous reviewer for raising this issue.

post-traumatic growth from pregnancy-related complications (e.g., I feel closer to others, I've changed for the better). Such appraisals are commonly reported after traumatic events, but it is inconclusive whether they may facilitate recovery (e.g., Linley & Joseph, 2004).

A second issue is why we found predictive effects for post-traumatic stress measured with the PSS-SR, but less convincing effects for the IES. One possibility is that the PSS-SR covers a greater time period (1 month) than the IES (1 week). Consequently, responses on the PSS-SR at 6 weeks postpartum would have captured the greater part of the participant's post-traumatic stress response whereas this may not have been the case for the IES. Furthermore, the IES only assesses symptom frequency and not severity, and it may be that *independent* relationships between post-traumatic stress and memory specificity involve the severity of symptoms.

The present study was a preliminary investigation and is not without limitations. First, although the study design was longitudinal the participants were aware that potentially traumatic experiences were imminent, as they had recently been hospitalised in anticipation of such eventualities. One could therefore argue that the ''trauma phase'' had already started. However, we took care to ask participants at Baseline to generate memories from *prior* to their hospitalisation, and to assess post-traumatic stress at Follow-up for the difficulties and problems that occurred *after* this Baseline assessment. In other words, memory assessment was carried out before the event that led to the later symptoms of post-traumatic distress that we assessed.

Second, we did not assess premorbid psychiatric difficulties, nor post-traumatic stress, using structured clinical interviews, relying instead on self-report measures. We were therefore not able to derive formal psychiatric diagnoses such as major depressive disorder or PTSD. That said, the data on memory specificity and post-traumatic stress are strikingly similar for case-control studies (e.g., PTSD versus no-PTSD) and correlational studies using variation on self-report questionnaire measures (see Moore & Zoellner, 2007), so this seems less of a concern for the current study. Third, although an objective measure of trauma severity (birth weight, gestational age at delivery; cf. Engelhard et al., 2002, 2006) was used and most women reported intense fear and helplessness related to the childbirth, we did not directly measure whether the delivery itself was a Criterion A trauma according to the DSM-IV (APA, 1994).

Fourth, we do not have detailed information about the infant's condition during the first 6 weeks postpartum, and for some women the stressful event might still have been happening at the time of the follow-up assessment. Thus, our findings may indicate that nonspecific pregnancy-related positive memories might be related to coping less well with *ongoing* rather than *post-traumatic* stress. Although this would be interesting in its own right, including information on postpartum stressors in future research might settle this issue and enhance our understanding of the development of post-traumatic stress symptoms after complicated childbirth. Fifth, one may question the qualification of the memories into the pregnancy-related and non-pregnancy-related categories because it creates a logical relationship between the two. For example, when more specific pregnancy-related memories are retrieved, fewer non-pregnancy-related memories are reported, and vice versa. As a suggestion for future research it might be interesting to distinguish between pregnancy-related and -*un*related cues. At the same time, one should be aware that pregnancy-*un*related cues for one person can be related cues for another person.

Finally, the present study included a relatively small and specific sample. All participants were hospitalised women with pregnancy complications and childbirth as a potential cause for post-traumatic stress symptoms. As a result, generalising from the present results should be done with caution. Nevertheless, the present data replicate the very few predictive studies that have been done so far in the field of reduced memory specificity and post-traumatic stress symptoms (e.g., Bryant et al., 2007) and encourage future prospective research in the field memory specificity and PTSD.

In conclusion, the present study showed that retrieval of fewer specific pregnancy-related autobiographical memories to positive cue words during complicated pregnancy predicted post-traumatic stress and depressive symptoms 6 weeks postpartum. This relation remained significant after taking into account baseline variables commonly related to autobiographical memory specificity and baseline symptoms. The data indicate that memory specificity predicts later post-traumatic stress symptoms, even after controlling for initial stress symptoms.

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