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# Evaluation of the Evidence for the Trauma and Fantasy Models of Dissociation

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The relationship between a reported history of trauma and dissociative symptoms has been explained in 2 conflicting ways. Pathological dissociation has been conceptualized as a response to antecedent traumatic stress and/or severe psychological adversity. Others have proposed that dissociation makes individuals prone to fantasy, thereby engendering confabulated memories of trauma. We examine data related to a series of 8 contrasting predictions based on the trauma model and the fantasy model of dissociation. In keeping with the trauma model, the relationship between trauma and dissociation was consistent and moderate in strength, and remained significant when objective measures of trauma were used. Dissociation was temporally related to trauma and trauma treatment, and was predictive of trauma history when fantasy proneness was controlled. Dissociation was not reliably associated with suggestibility, nor was there evidence for the fantasy model prediction of greater inaccuracy of recovered memory. Instead, dissociation was positively related to a history of trauma memory recovery and negatively related to the more general measures of narrative cohesion. Research also supports the trauma theory of dissociation as a regulatory response to fear or other extreme emotion with measurable biological correlates. We conclude, on the basis of evidence related to these 8 predictions, that there is strong empirical support for the hypothesis that trauma causes dissociation, and that dissociation remains related to trauma history when fantasy proneness is controlled. We find little support for the hypothesis that the dissociation–trauma relationship is due to fantasy proneness or confabulated memories of trauma.

Keywords: trauma, dissociative disorder, dissociation, suggestibility, fantasy

Scientific interest in the concept of dissociation and the etiology of the dissociative disorders has increased markedly in recent decades. Building on the foundational work of Janet (1889, 1919), researchers have empirically identified and investigated various types and categories of dissociation: the identity alterations and amnesias prominent in the dissociative disorders (Putnam, 1991),

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ported trauma and dissociation, but ascribe different reasons for the relationship. It is therefore important to clarify the true points of distinction in the two models. These appear to fall into eight

and suggestibility, and therefore predicts little to no relationship between dissociation and trauma if fantasy proneness and suggestibility are controlled. Alternatively, the TM clearly predicts an increment for trauma over fantasy proneness or suggestibility in the prediction of dissociation, and an increment for dissociation over fantasy proneness and suggestibility in the prediction of trauma history.

### Predictions Regarding Omission and Fragmentation of Memory

The TM posits that the dissociative individual is largely attempting to avoid recall of trauma by conscious and unconscious disavowal of the importance, implications, and/or accuracy or reality of the memory. According to the TM, the dissociative individual attempts to avoid thinking about the memory, disconnects from the emotional content of the memory, and ultimately may fail to recall some or all of the memory (e.g., DePrince & Freyd, 2004; Dorahy, 2006). The avoidance associated with dissociation may be both conscious and unconscious, or may be an initially conscious process that becomes unconscious over time (see Erdelyi, 1990). Automatic withdrawal of attention upon exposure to trauma or reminders of trauma, potentially resulting from dissociative episodes during encoding, may inhibit associative processing (Lyttle, Dorahy, Hanna, & Huntjens, 2010), and may result in a lack of the rich associative network typical of important emotional memories (cf. Spiegel & Cardeña, 1991; Stern, 1997). The result is a set of nonintegrated and fragmented memories (data driven/perceptual rather than autobiographical/conceptual; Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000; Holmes, Brewin, & Hennessey, 2004). This type of processing might account for omissions and poor agreement in detail across narrative recountings. Over the course of time, fragmented memories lacking associative networks may be more easily forgotten. This reasoning supports TM hypotheses regarding relationships between dissociation and fragmentation of memory and between dissociation and lost or recovered memory.

FM theorists make no claim for the relationship of fragmentation and dissociation. Omission, however, is thought by FM theorists to be negatively related to dissociation (cf. Giesbrecht et al., 2008). The FM argument here is that any elevation in trauma report by dissociative individuals is due to exaggeration and fantasy. Therefore, omission of data and loss of detail in severe trauma is less likely for dissociative individuals than is addition of detail and enhancement of the trauma description.

### Predictions Regarding the Biology and Neurobiology of Trauma

Both the TM and the FM are consistent with a biological or sociobiological foundation for dissociation. The TM predicts that the experience of trauma and high levels of stress are related to cognitive deficits (Vasterling et al., 2002). The effects will appear in individuals with clinical dissociative disorders, as well as in traumatized nondissociative individuals, and will include the errors of omission, commission, and narrative fragmentation mentioned earlier (Harvey & Bryant, 1999; Kleim, Wallott, & Ehlers, 2008). Further, TM theorists expect differences between dissociative and nondissociative individuals in neurobiological studies, such as in psychophysiological and functional neuroimaging of trauma survivors (Lanius et al., 2010), and expect these differences to reflect or broadly relate to known biologically based responses seen in animals.

In contrast, the causal path for the FM does not posit a role (or at least a significant role) for trauma in the neuropsychological or cognitive deficits seen in dissociative individuals. In Merckelbach et al.'s (2002) model, for instance, the relationship between dissociation and trauma self-report was hypothesized to be fully mediated by absent-mindedness and fantasy proneness, with no role for actual trauma. Cognitive deficiencies inherent to dissociation were thought to be a primary source of the trauma report.

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sion and increased fragmentation. The FM, which presents dissociation as related to exaggeration and false generation of trauma, predicts no relationship or a negative relationship between dissociation and fragmentation or omission.

7. The TM predicts that, over time, dissociative individuals will be more likely to "forget" or have difficulty accessing important facets of the memory. The FM states that those who claim recovery of a memory are unlikely to be recalling an actual trauma.

8. Both models predict some relationship between dissociation and neuropsychological measures such as working memory (similar to those seen in work with PTSD; Vasterling & Brewin, 2005). The TM holds that the biology of dissociation will ultimately fit with a theory of a brain-based regulatory response to fear or other extreme emotion (Lanius et al., 2010). Thus, the psychophysiology of the dissociative individual should be differentiable from the nondissociative individual in fear-relevant situations. The FM makes no prediction in this area.

## Measurement of Dissociation and Fantasy Proneness

Prior to the analysis of the evidence for the TM and FM of dissociation, attention should be given to the measurement of this construct. The DES (Bernstein & Putnam, 1986) has been used in over 2,000 studies of dissociation to date, as both the focus for reviews of positive findings and the central instrument cited by critics of dissociation and its measurement. The DES also has an adolescent variant (the Adolescent Dissociative Experiences Scale [ADES]; Armstrong, Putnam, Carlson, Libero, & Smith, 1997) and a checklist form for use by parents or other adults assessing young children (Child Dissociative Checklist [CDC]; Putnam, Helmers, & Trickett, 1993).

In addition to the DES and its variants, a number of alternative instruments have appeared, such as the Questionnaire of Experiences of Dissociation (Riley, 1988) and the Dissociation Questionnaire (Vanderlinden, Van Dyck, Vandereycken, Vertommen, & Verkes, 1993), but these alternatives have not received substantial research attention. Briere's (2002) Multiscale Dissociation Inventory (MDI) is a promising new addition to the library of dissociation measures, particularly given the availability of clinical norms, but again little is yet available to establish the ability of the measure to tap important dissociation-related phenomena.

Wright and Loftus (1999) have developed a creative alternative to the DES. Using the same items as the DES, Wright and Loftus's DES-C asks participants not to rate their dissociative symptoms, but instead to rate whether they are dissociating less or more than others whom they know. The contention that this capacity is within the skill set of the dissociative patient (or even the normal control) has yet to be demonstrated. Further, the DES-C correlates only .26 with the DES (Wright & Loftus, 1999), clearly raising questions about the similarity of the two measures. We could find no published evidence showing that the DES-C is in fact a measure of dissociation. In the review below, research focuses on the original DES and its child and adolescent variants.

In addition, several diagnostic inventories and interviews have been developed for the diagnosis of clinical dissociative disorders. They are not discussed in detail here. However, they include two diagnostic interviews, the Structured Clinical Interview for DSM–IV–TR Dissociative Disorders (SCID-D; Steinberg, 1994) and the Dissociative Disorders Interview Schedule (Ross et al., 1989), as well as a self-report measure, the Multidimensional Inventory of Dissociation (Dell, 2006; see Carlson, 2008, for a review of the main measures).

## The Dissociative Experiences Scale

The DES is a 28-item self-report measure. In the original Bernstein and Putnam (1986) measure, the frequency of each item was rated along an 11-point visual analog scale. In a revision by E. B. Carlson and Putnam (1993), the scale was changed to a Likert model with choices ranging from 0% (never) to 100% (always) at 10 percentage point increments. A sample item is "Some people have the experience of finding themselves in a place and having no idea how they got there" (Item 3). The DES has also been shown to measure both a taxon, often described as "pathological" dissociation, typically measured by the eight-item dissociative taxon, or DES-T (Waller, Putnam, & Carlson, 1996), and a continuum, measured by the total scale or by the "nonpathological" absorption subscale (Waller et al., 1996). The DES-T consists of lower base rate items targeting measurement of depersonalization and derealization, identity fragmentation, and amnesia. The absorption subscale is a subset of higher base rate DES items assessing normal experiences of deep focal attention as well as lapses in attention.

Critics of the current measurement of dissociation and, in particular, of the DES tend to focus on three issues: the inclusion of absorption in the domain of dissociation, the reliability and meaning of the taxon, and the more general issue of giving a unitary label (dissociation) to a wide range of topics, often symbolized by the argument of whether the DES is unifactorial or multifactorial (Bernstein, Ellason, Ross, & Vanderlinden, 2001; Giesbrecht et al., 2008; Watson, 2003). The argument against the inclusion of absorption in the measurement of dissociation can be made in two ways: (a) that high absorption is not a symptom of dissociative disorders, because it is more common in the general population than DES taxon items, and (b) that absorption is normal and nonpathological at all levels. The first assumption is not supported by the empirical evidence. For example, approximately 75% of patients with diagnosed dissociative disorders in Leavitt's (2001) sample had high scores on absorption scales. Dalenberg and Paulson (2009), using a version of the DES corrected for skewness, found that over 95% of taxon-positive individuals were also above the cutoff for high absorption. Further, the correlation between the taxon and absorption factors is very high (e.g., .80 in Levin & Spei, 2004; $r = .36–.72$ in six psychiatric groups in Leavitt, 1999). These findings call into question the contention that "cleaner" measures of dissociation should exclude absorption. Instead, the data support the inclusion of items that measure capacities that may be facilitators, precursors, or lower level symptoms of dissociation.

With reference to the second assumption, high absorption has been shown repeatedly to be a marker for severe psychopathology. Indeed, Allen, Coyne, and Console (1997) reported surprise that the nonpathological absorption facets of dissociation were more related to psychosis than were the taxonic items. Absorption correlated more highly with severe psychopathology on the Minnesota Multiphasic Personality Inventory and the Millon Multiaxial Inventory than did the amnesia and depersonalization factors (Allen et al., 2002).

TM theorists and FM theorists both share the concern that the DES-T yields unacceptably high false-positive rates if used as a sole diagnostic instrument (cf. Cardeña, 2008), and that it has modest reliability in nonclinical samples when dissociative disorder should be rare or nonexistent (r = .62 over 2 months; Watson,

Table 1
Relationship of Trauma and Dissociation

| Study | Participants | Trauma type | Trauma measure | Dissociation measure[a] | r |
|---|---|---|---|---|---|
| | | | Nonclinical samples | | |
| Akyüz et al., 2005 | 251 adult women | PA | CANQ | DES (Turkey) | .06 |
| | See above | SA | CANQ | DES | .18 |
| | See above | TOT | CANQ | DES | .22 |
| Chu & DePrince, 2006 | 72 adult mothers | BT | UCLA–PTSD Index | DES | .34** |
| Collin-Vézina & Hebert, 2005 | 67 children evaluated for abuse and matched controls | SA | Hospital evaluation and interview | CDC | .38*** |
| DePrince et al., 2008 | 97 children | TOT | Guardian report on UCLA–PTSD Index | ADES | .21* |
| | 97 children | TOT | Guardian report on UCLA–PTSD Index | CDC | .25* |
| Dorahy et al., 2007 | 66 adults | DV | TEC | DES | .40** |
| Dutra et al., 2009 | 56 young adults | DMC | Behavioral codes on AMBIAC | DES | .38** |
| | 56 young adults | TOT | CTES–R | DES | .16 |
| Geraerts et al., 2005 | 98 adults[b] | SA | Self-report | DES (Netherlands) | .31* |
| Kisiel & Lyons, 2001 | 114 wards of DCFS | PA | Reported by DCFS caretaker | ADES | .20* |
| | 114 wards of DCFS | SA | Reported by DCFS caretaker | ADES | .24** |
| | 114 wards of DCFS | PA | Reported by DCFS caretaker | CDC | .32*** |
| | 114 wards of DCFS | SA | Reported by DCFS caretaker | CDC | .30** |
| Macfie et al., 2001a | 198 children | SA | CPS records | CDC | .11 |
| | 198 children | PA | CPS records | CDC | .39*** |
| Macfie et al., 2001b | 88 children | TR | Coded from CPS records | CDC | .42*** |
| McNally et al., 2000 | 68 adults[b] | SA | Self-report | DES | .32* |
| McNally et al., 2006 | 166 adults[b] | SA | Self-report | DES | .42** |
| Narang & Contreras, 2005 | 76 mothers | PA | CHQ | DES | .37** |
| Näring & Nijenhuis, 2005 | 147 adults | TOT | TEC | DES (Netherlands) | .27** |
| Nilsson & Svedin, 2006 | 391 adolescents | TOT | DIS-Q | ADES (Sweden) | .28*** |
| Noll et al., 2003 | 166 children | SA | Substantiated by CPS | CDC | .36*** |
| Ogawa et al., 1997 | 168 young adults | TR[c] | Home observation, CPS records, parent interview | DES | .26*** |
| Sayar et al., 2005 | 173 adolescents | PA | Self-report | ADES (Turkey) | .31*** |
| Smith et al., 2010 | 50 adults | TOT | THS | DES | .44** |
| Somer, 2002 | 90 adults | TOT | TEQ | DES (Israel) | .39** |
| Trickett et al., 2001 | 166 children | SA | Verified through DCFS | CDC at 6 months (Time 1) | .34*** |
| | 158 young adults | SA | Verified through DCFS | ADES at 7 years after Time 1 | .16* |
| Twaite & Rodriguez-Srednicki, 2004 | 284 adults | PA | Self-report | DES | .24*** |
| | 284 adults | SA | Self-report | DES | .18** |
| Zoroğlu et al., 2003 | 839 adolescents | TR | CANQ | ADES (Turkey) | .33** |
| | | | Clinical samples | | |
| Brunner et al., 2000 | 198 adolescent inpatients | SA | Therapist reports based on guardian report, DCFS records, and self-report | ADES (Germany) | .36*** |
| | See above | PA | See above | ADES | .22*** |
| E. B. Carlson et al., 2001 | 178 adult inpatients | Violent SA | Structured interview | DES | .52*** |
| | See above | Other SA | See above | DES | .49*** |
| | See above | Violent PA | See above | DES | .35*** |
| | See above | Other PA | See above | DES | .28*** |
| Dell, 2006 | 204 clinical and nonclinical | PA | TEQ | DES | .34*** |
| | See above | SA | TEQ | DES | .44*** |
| | See above | TOT | TEQ | DES | .47*** |

(table continues)

Table 1 (continued)

| Study | Participants | Trauma type | Trauma measure | Dissociation measure[a] | r |
|---|---|---|---|---|---|
| El-Hage et al., 2002 | 140 adult outpatients | TR | CAPS | DES (France) | .49*** |
| Francia-Martínez et al., 2003 | 100 adult inpatients | SA | BSAE | DES (Puerto Rico) | .14 |
| Freyd et al., 2005 | 99 adults with chronic illness or pain | BT | BBTS | DES | .43** |
| Gast et al., 2001 | 102 adult inpatients | PA | CTQ | DES (Germany) | .47*** |

with no trauma of the type studied were included; (c) sample size was 50 or greater; and (d) the study used a community sample or a clinical sample including a range of psychiatric diagnoses. Thus, samples consisting entirely of dissociative disordered patients or those with PTSD, which may have restricted values on trauma likelihood or dissociation, were not included, but consecutive psychiatric admissions samples of groups of children in therapy are represented. College samples, which are likely to be biased in favor of low impairment, were not included. Lev-Wiesel, Daphna-Tekoah, and Hallak's (2009) large sample of pregnant women was not included given the complex literature on the relationship of pain, stress, and dissociation (cf. Ludascher et al., 2007). Studies using only certain subscales of the DES also were not included. Studies that appeared to test the same sample in different publications and studies that limited trauma effects to emotional abuse were excluded. The effect size *r* was chosen, since the majority of studies reported this figure.

Table 1 presents the results of 38 studies that met our criteria. The average weighted effect size was .31 for the 19 sexual abuse samples, .27 for the 12 physical abuse studies, and .34 for the 16 total trauma score studies (for the E. B. Carlson et al., 2001, study, the two relevant values were averaged). The overall weighted *r* estimate was .32. Fixed-point estimates were made via Comprehensive Meta-Analysis software. All values are moderate effect sizes. *Q* values were between 24.59 (for sexual abuse) and 63.71 (for all studies), indicating heterogeneity of effect sizes.

The table also illustrates that large population studies and well-controlled comparison studies do exist that test the relationship of trauma and dissociation. Collin-Vézina and Hébert's (2005) study of 134 children (abused children, evaluated in a hospital, and their matched controls) found a statistically significant relationship between sexual abuse and dissociation with a large effect size. Zoroğlu et al. (2003), who examined the relationship between trauma and dissociation in 839 Turkish high school students, found that trauma and dissociation were strongly related, with stepwise increments in dissociation based on the number of types of trauma experienced (i.e., one trauma vs. no trauma Hedges's *g* = 0.56, two traumas vs. no trauma Hedges's *g* = 0.84, and three traumas vs. no trauma Hedges's *g* = 1.12). E. B. Carlson et al. (2001) found large magnitude correlations for both sexual abuse and physical abuse in their inpatient sample, with violent sexual abuse showing an increment over family environment variables in predicting dissociation and PTSD. Thus, in summary, the TM Predicti]TJ /F2 p0olo1.1dt'sillustgatween

that would allow an effect size computation, presenting instead large samples of dissociative disorder or dissociative identity disorder (DID) patients. Trauma history was found in 50%–100% of such individuals in all studies (with the exception of the Turkish study by Şar, Akyüz, & Doğan, 2007). These results also support the TM, but differ from the data in Table 1. For Table 1, all clinical samples showed a general relationship between trauma and level of dissociativity on the DES. However, the base rate of DID in most clinical samples is low (1.3% in Ross's, 1991, nonclinical sample); thus, the correlation coefficient can be misleading. For instance, in a large sample ($N = 618$), Briere's (2006) correlation of .11 between trauma and clinical elevation on the MDI accounts for less than 2% of the variance. If the same results are translated into the language of binomial probability to make base rates more visible, as Briere made possible through cross-tabulation charts, the probability of clinical elevation in the MDI is 4 times greater in the trauma-exposed compared with a nonexposed sample (8% vs. 2%). Further, the probability of a trauma history given an elevated MDI in this sample was 90%. Similarly, in the study with the weakest effect size in Table 2 (Şar et al., 2007), the probability of abuse within the dissociative disorder samples were still 2–4 times higher than the rates within psychiatric controls. The heterogeneity of effect sizes are reflected in the very high $Q$ values of 263.63 ($p < .001$) for physical abuse and 270.40 ($p < .001$) for sexual abuse. The mean-weighted $r$ was .54 for the five sexual abuse samples and .52 for the five physical abuse samples. Again, with diagnosis rather than dissociation as a continuum, the hypothesis of the consistent relationship between trauma and dissociation in Prediction 1 is supported.

### Evidence for Prediction 2: Does the Trauma–Dissociation Relationship Disappear in Studies With "Objective" Measures of Trauma?

In Table 1, 10 studies included external criteria for determination of maltreatment status. Ten graduate student raters—blind to the hypotheses of this review and blind to the results of each study—made this judgment with 100% agreement. The "objective" data included confirmation by therapists (with access to guardians and Child Protective Services [CPS] reports), protective agency report determined by researchers, or, in the case of Dutra, Bureau, Holmes, Lyubchik, and Lyons-Ruth (2009), observer behavioral codes of mothers' treatment of their infants. In Dutra et al., disrupted maternal communication included ratings of sexualized behavior, hostile and intrusive behavior, contradictory cues, withdrawal, and fearful-disoriented behavior on the part of the mother in the Ainsworth Strange Situation task. Nine of these 10 studies tested the correlation between dissociation and sexual abuse, whereas three also tested the correlation between dissociation and physical abuse. The FM prediction that objectively determined trauma would show lower correlations with dissociation than self-reported trauma thus could be tested by comparing the effect size of the objective studies with the studies using a standardized self-report measure or a single-item self-label of sexual abuse. Using a weighted mean effect size, the objective studies on sexual abuse had a weighted average $r$ of .30, whereas the self-report, standardized measure, or structured interview studies had a weighted average effect size of 32. The three objective measure studies on physical abuse had a weighted average $r$ of .30, compared with the average weighted $r$ for the remaining physical abuse studies of .26. The objective physical abuse analysis yielded a nonsignificant $Q$ value of 3.67 ($p > .05$), with the remaining analyses showing $Q$ values at or greater than 23.32 ($p < .01$). These results contradict the FM prediction, and go to the heart of the FM argument. If the trauma–dissociation relationship were largely due to fantasy proneness and subsequent exaggeration of trauma, clearly the relationship should be weaker when trauma is measured with greater objectivity. This argument has been made explicitly in Giesbrecht et al.'s (2008) recent review. They were able to locate two studies with objective criteria, both with small and nongeneralizable samples, noting that neither reached statistical significance. The 10 studies with larger and more generalizable samples, all of which did support the TM hypothesis, were not discussed by those authors. In this full review comparing studies with self-report to those using objective measures, studies with self-report measures of trauma did not show a greater relationship to dissociation than those with objective measures. Again, these findings support the TM position, not the FM view.

There have been no large-scale studies of the objective evidence for trauma reported by dissociative disordered patients including control groups. Longitudinal studies are less realistic here, given the base rate of dissociative disorders. However, the smaller studies that have followed up on the evidence for child trauma history in DID patients have confirmed the existence of such trauma. Coons (1994) found documented corroboration (e.g., CPS and police records) for 20 of his 21 child and adolescent DID and dissociative-disorder-not-otherwise-specified patients. Similarly, Coons and Milstein (1986) found documentation through medical records or family testimony in 17 of 20 adult DID patients (see also Lewis, Yeager, Swica, Pincus, & Lewis, 1997). Further, Hornstein and Putnam (1992) described two samples of children and adolescents with dissociative disorders totaling 74 participants, all of whom had reported histories of a wide variety of types of maltreatment, including physical abuse, sexual abuse, witnessing parental death, and/or neglect. Social service investigation substantiated 95% of these histories.

In support of the call for further research with more sophisticated models, it should be emphasized here that prospective longitudinal studies have found that objective trauma leads to heightened dissociation in children who have disorganized attachment (e.g., Lyons-Ruth, Dutra, Schuder, & Bianchi, 2006; Ogawa et al., 1997), been victims of corroborated sexual abuse (Noll, Trickett, & Putnam, 2003; Trickett, Noll, Reiffman, & Putnam, 2001), or experienced verified painful medical procedures (Diseth, 2006). For example, in an ongoing, case-controlled longitudinal study of girls with a substantiated history of child sexual abuse (CSA; Trickett et al., 2001), participants were assessed with a variety of biological, psychometric, and educational measures, as well as measures of social functioning. They were assessed within 6 months of the initial report of CSA to protective services and again 7 years later. The abused girls had higher levels of caregiver-rated dissociation at intake than nonabused controls. Furthermore, the abused girls who had experienced more severe forms of abuse (i.e., earlier onset, fain70.9(Put26.3(for)-226.i6 r.)for

related with self-reported dissociation at age 19. Within the disorganized group, higher dissociation scores were found for the group that had experienced documented traumas in childhood and adolescence. Ogawa et al. also reported a statistically significant correlation between trauma (with both objective and parent self-report documentation) and dissociation at Time 1 (infancy), Time 4 (age 16–17), and Time 5 (age 19) with a sample of 168. In Diseth's (2006) smaller study of children who had experienced repeated and painful medical procedures ($N = 42$), an objective trauma, dissociation in both adolescence and young adulthood correlated with number of hospitalizations ($r = .59$ with the ADES and $r = .79$ with the DES, 10 years later).

Many prospective studies follow at-risk samples in order to have realistic probability of finding traumatized individuals with varying symptom levels. Barring the random (and unethical) assignment of individuals to traumatizing conditions, the optimal deter-

Over longer time spans, the TM prediction would be that traumatized individuals would be temporarily elevated in dissociative symptoms as a group, and that these symptoms would diminish for most individuals over time as the trauma becomes more integrated into cognitive systems and trauma-related emotions (e.g., fear and anxiety) dissipate. In studies in which participants were followed after trauma—as in Cardeña and Spiegel (1993); E. B. Carlson et al. (2011); Feeny, Zoellner, Fitzgibbons, and Foa (2000); and Feeny, Zoellner, and Foa (2000)—large and statistically significant drops in dissociative symptom severity occur over time without intervention in most individuals. Two to 10 days after trauma exposure in E. B. Carlson et al., 40% of the sample showed elevated levels of dissociation when compared with a normative sample of adults with no prior trauma exposure. One week later, 39% still reported dissociation at elevated levels. At 2 months postevent, only 27% of participants reported dissociative symptom elevation. This pattern also fits the TM and not the FM prediction.

In summary, the increase in state dissociation after exposure to high stressors or traumatic events and trauma reminders is consistent with TM Prediction 3. Similarly, findings support the TM prediction of the short-term decrease in dissociation (relative to comparison groups) with trauma-relevant psychological or pharmacological treatment and the long-term decrease in dissociation over time. If dissociation were a stable outgrowth of fantasy proneness and mild neurocognitive disturbance (cf. Giesbrecht et al., 2008), such patterns would be much harder to explain. These findings clearly support TM Prediction 3, that dissociation is temporally related to trauma and trauma treatment.

## Evidence for Prediction 4: Does Dissociation Show an Increment Over Fantasy Proneness in the Prediction of Trauma?

Both the TM and the FM predict a relationship between the measures typically used for the dissociation and fantasy proneness concepts, because both types of scales were developed from a theoretical base that included an etiological role for psychological absorption and trauma. Fantasy proneness is acknowledged to be a "close cousin" of absorption by Geraerts, Merckelbach, Jelicic, Smeets, and Van Heerden (2006, p. 1143). The authors of both of the most commonly used fantasy proneness scales report that they developed their measures from a theoretical framework that includes absorption (Merckelbach et al., 2001; S. C. Wilson & Barber, 1983). Similarly, absorption items were purposely included in the DES, the most commonly used dissociation scale (Bernstein & Putnam, 1986). It is easy for theoreticians from all perspectives to lose track of this history, reifying the scale totals, and reporting as an independent and surprising finding that absorption correlates strongly with each measure.

Merckelbach et al.'s (2001) CEQ and S. C. Wilson and Barber's (1983) ICMI do correlate with dissociation (Merckelbach et al., 2002; Pekala et al., 1999–2000; Rauschenberger & Lynn, 1995; Waldo & Merritt, 2000), but the reason for the correlation is unclear. Highly fantasy-prone individuals have been reported to be diagnosed with dissociative disorders more often than low- or medium-level fantasy-prone individuals (Rauschenberger & Lynn, 2002–2003). The inclusion of absorption within each scale type is the most obvious explanation. Merckelbach et al., the developers of the CEQ, also noted that there is overlap between the item content of the CEQ and the DES. They suggested:

> Two CEQ items (i.e., "I often confuse fantasies with real memories" and "I sometimes feel that I have an out of body experience") clearly overlap with some DES items (e.g., "not sure whether one has done something or only thought about it" and "feeling as though one's body is not one's own," respectively). (p. 989)

Such similar items would contribute to correlations between measures of fantasy proneness and dissociation.

Further, it is consistent with prior theory and research on fantasy proneness scales that trauma is one cause, although not the sole cause, of fantasy proneness. In early articles on the CEQ, Merckelbach et al. (2001) conceded there are different paths to fantasy proneness, including coping with childhood adversity: "Other fantasy prones," they wrote, "reported a heightened frequency of aversive childhood events. In these cases, a profound fantasy life may have become a means to cope with or escape from negative experiences" (p. 988). Rhue and Lynn (1987, p. 121), for instance, noted that fantasy-prone participants reported "greater frequency and severity of physical punishment, greater use of fantasy to block the pain of punishment, more thoughts of revenge toward the person who punished them, greater loneliness, and a preference for punishing their own children less severely" than those lower in fantasy proneness. Lynn and Rhue (1986) and S. C. Wilson and Barber (1983) also reported that fantasizers acknowledged more severe and more frequent childhood punishment. In keeping with the TM hypothesis of use of fantasy as escape, fantasy proneness is related to the five scales of the Childhood Trauma Questionnaire (Pekala et al., 1999–2000).

Therefore, dissociation and fantasy proneness may correlate spuriously in part through their common connection to trauma history. Again, from the TM perspective, those who voluntarily and (over time) involuntarily shift attention from stimuli that trigger unwanted memories (dissociate) will also use other techniques to escape from unwanted environments (such as voluntary shifts of attention to internally generated images in the form of fantasizing or daydreaming). A definitive answer to the question of the etiology of this relationship awaits more sophisticated studies that include all relevant variables. Particularly helpful would be studies that track these relationships over time.

Although the relationship of fantasy proneness and dissociation is not incompatible with either model, the FM does make a prediction of the relative relationship of these variables to trauma self-report. In the FM given by Merckelbach et al. (2002), and replicated in Figure 1, a statistical prediction can be made that fantasy proneness will produce an increment over dissociation in the prediction of trauma self-reports, whereas dissociation will produce no significant increment over fantasy proneness. Because the TM posits a causal role for trauma in producing dissociation, an increment for dissociation is predicted.

We were able to locate four studies with samples greater than 50 (to allow sufficient power) that included the three relevant correlations allowing partial correlation to be computed. Support for the TM contention (statistically significant partial correlation of trauma and dissociation controlling for fantasy proneness) occurred in all four studies: research by Merckelbach et al. (2002); Pekala, Angelini, and Kumar (2001); Pekala et al. (1999–2000); and Thomson, Keehn, and Gumpel (2009). Specifically, in each

case, fantasy proneness did relate to trauma history and dissociation, but trauma history did have an increment over fantasy proneness in the equation predicting the DES. Dissociation does relate to report of trauma history controlling for fantasy proneness.

Furthermore, the few studies on fantasy proneness in dissociative disordered samples do not indicate the strong elevations in fantasy proneness that would be expected if their trauma histories were entirely fantasized. Huntjens et al. (2006) found that DID patients scored higher on fantasy proneness than controls and nonclinical DID simulators. However, the DID mean score on the CEQ (9.92) was very similar to means of male and female college students reported in Merckelbach et al.'s (2001) psychometric article on the CEQ ($M = 9.2, SD = 4.4$, and $M = 8.7, SD = 4.0$, respectively). Using the ICMI, Levin, Sirof, Simeon, and Guralnick (2004) also found elevated levels of fantasy proneness in patients with depersonalization disorder (DPD) compared with nonsymptomatic controls. However, as Levin et al. wrote, the total scores for the DPD group were well below typically used thresholds for high fantasy proneness. The DPD mean was 19.7 ($SD = 7.3$), which falls at the low end of the range for medium fantasy proneness on this instrument (14–36 in Levin et al., 2004). These findings in general support the TM prediction (Prediction 4) regarding the independent contribution of dissociation over fantasy proneness in the prediction of trauma history.

## Evidence for Prediction 5: Are Dissociative Research Participants at High Risk for Suggestibility and False Memory?

Research on suggestibility is also central to the FM contentions about the dissociation–trauma connection. The controversial contentions of the FM are not only that the dissociation and trauma report connection is mediated by fantasy proneness, which appears unfounded as discussed earlier, but also that dissociation produces enhanced probability of confabulation of trauma memory itself. Giesbrecht et al. (2008) repeatedly cited their concern that dissociative individuals will overreport trauma on standardized questionnaires unless provided with a context that "discourages reporting of traumatic experiences" (p. 622). It seems ill-advised and potentially harmful to discourage patients from reporting trauma exposure due to fears of high rates of false report without strong support for this hypothesis.

**Suggestibility paradigms.** In the standard FM argument of dissociation as a risk factor for suggestibility, many nonequivalent forms of suggestibility are mentioned and tested (Giesbrecht et al., 2008; Merckelbach & Muris, 2001). To extend the range of studies reported, all research with samples greater than 25 are presented in Table 4. The best known are clustered under event suggestibility studies, and represent forms of suggestion that include acceptance of the false suggestion that one has seen or experienced an event. In the nonautobiographical studies of this type, participants are typically shown slides or read paragraphs, and pressed at a later point to agree to a false statement about a slide seen or fact heard. The Gudjonsson (1997) suggestibility paradigm is a standardized form of this type of suggestibility. In this paradigm, participants are read paragraphs and then (through social pressure or misleading questions) pushed toward acceptance of false statements about the information heard. An overall suggestibility score, a yield score (degree of acquiescence to leading questions), and a shift score (the number of times the individual changed an answer in response to interpersonal pressure) are then calculated.

The methodology in autobiographical event suggestibility studies is more varied. In studies typically referred to as "false memory" studies (e.g., Hyman & Billings, 1998), participants are told that a knowledgeable person (typically the individual's mother) recalls an event in the person's life. The dependent variable is the degree to which the research participant appears to accept the truth of this false memory. In misinformation studies, the dependent variable is the same, but the procedures typically involve less powerful suggestion (misleading questions, varying in terms of source, number, and strength).

In source monitoring or source confusion studies, the task of the participant is typically to discriminate between competing sources for an alleged memory (e.g., whether information came from a picture seen, a paragraph read, or a new story heard). Alternatively, in the Deese–Roediger–McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995), the participants read a series of words that relate to an overarching nonpresented word (e.g., read the words *nap*, *doze*, and *dream*—all words related to the concept "sleep"). The dependent variable is whether the individual recalls or falsely assents to seeing the nonpresented concept word.

Finally, in the imagination inflation studies, participants imagine a series of incidents and are asked about their feeling of remembering the event, as opposed to merely knowing or believing that the event might have happened. The events are typically plausible or known events from childhood.

The degree to which each of these paradigms is linked to a general "suggestibility" trait is unknown, but sets of studies are reviewed in turn as examples of suggestibility as defined within the FM. Historically, false memory has been fairly loosely defined in such paradigms (cf. DePrince, Allard, Oh, & Freyd, 2004). Research testing general memory skills of dissociative individuals, or errors on event memory tasks in the absence of suggestion, are not considered as examples of suggestibility paradigms.

**Nonautobiographical event suggestibility.** Table 4 contains data from eight studies with 10 samples investigating suggestibility for nonautobiographical events, all using the Gudjonsson methodology, and the examination of suggestibility relationship with dissociative experiences. The clinical samples—a small group of anxious patients reported by Wolfradt and Meyer (1998) and the larger mixed sample by Little (1996)—and the only abuse sample (Schultz, Passmore, & Yoder, 2003) produced nonsignificant results. The weighted estimate for the correlation between dissociation and suggestibility in this category is .12. Further, the pattern of correlations on the Gudjonsson subscales varied across the few studies reporting statistically significant results. Wolfradt and Meyer in their nonclinical sample found DES correlations with both Shift and Yield scales; Merckelbach, Muris, Rassin, and Horselenberg (2000) reported DES correlations with the Shift (but not Yield) score; and Merckelbach, Muris, Wessel, and Van Koopen (1998) found correlations with the Yield (but not Shift) score. Horselenberg et al. (2000) came to the conclusion that "the relation between dissociative tendencies and memory distortions is not as impressive as some authors have suggested" (p. 136), noting that the few previous studies that had found positive associations had significant methodological limitations. Gudjonsson (2003) himself specifically noted with surprise the lack of consistent relationship

Table 4
Relationship of Dissociation and Suggestibility

| Study | Sample | Dissociation measure | Suggestibility task | r |
|---|---|---|---|---|
| | | Nonautobiographical event suggestibility | | |
| Haraldsson, 2003 | 30 children, half with reincarnation beliefs | CDC | E; GSS | .11 |
| Hekkanen & McEvoy, 2002 | 111 UG | DES | E; acceptance of false suggestions regarding slides | .00 |
| Horselenberg et al., 2004 | 38 UG | DES | E; GSS | .08 |
| Merckelbach, Murrin, Rassin, & Horselenberg, 2000 | 56 female UG | DES | S; GSS | .37** |
| Merckelbach et al., 1998 | 40 UG in Study 1 | DES | S; GSS | .32* |
| Schultz et al., 2003 | 51 CM and 31 RM sexual abuse survivors | DES | E; GSS | −.06 and .06 |
| Torrens, 2005 | 146 UG | DES | E; GSS | .06 |
| Wolfradt & Meyer, 1998 | 45 controls and 37 anxious patients | DES | E; GSS | .34* and −.04 |
| | | Autobiographical events | | |
| Drivdahl & Zaragoza, 2001 | 149 UG | DES | E: errors after suggestion regarding staged event | .07 |
| Eisen & Carlson, 1998 | 130 UG | DES | E; agreement with misleading information after staged event | .21** |
| Eisen, Morgan, & Mickes, 2002 | 111 UG | DES | E; agreement with misleading information after staged event | .13 |
| Eisen, Qin, et al., 2002 | 49 children | CDC | E; agreement with misleading information after abuse assessment | .01 |
| Horselenberg et al., 2004 | 38 UG | DES | E; false recognition of foils regarding autobiographical events | .19 |

but also may occur under event suggestibility paradigms that convince the participant of the truth of a nonremembered event and encourage general attempts to remember (Hyman & Billings, 1998; Ost et al., 1997).

A challenge for suggestibility theorists is the differentiation of acquiescence and false memory. If the task is to remember an

(2007) found spontaneously recovered memories to be similarly likely to have corroboration (37%) when compared with continuous memories (corroborated in 45%). However, memories recovered in therapy, which represent a small proportion of the total recovered memory reports (Eliott, 1997; Wilsnack, Wonderlich, Kristjanson, Vogeltanz-Holm, & Wilsnack, 2002), were never corroborated in Geraerts small sample ($N = 16$).

Longitudinal studies also support the TM. Mechanic, Resick, and Griffin's (1998) study of amnesia postrape found that 37% of assaulted women reported some degree of amnesia at the 2-week point. At the 3-month marker, this number had dropped to 16%.

& Schacter, 1997), rather than immediately following the presentation of trauma-related words in the directed forgetting paradigm.

**Interidentity amnesia studies.** Interidentity amnesia in DID is a separate issue from that of dissociative amnesia in general. Authors from both TM and FM positions, including several of the authors of this review, have contributed to the general finding that implicit memories often cross dissociative identity barriers.

Interidentity amnesia has been studied as a paradigm for memory in DID since the late 19th and early 20th centuries (Prince & Peterson, 1908; see Dorahy, 2001). With renewed interest in multiple personality disorder and DID, this phenomenon has been examined to attempt to understand the nature of memory and amnesia in DID, often with contradictory findings (Eich, Macauley, Loewenstein, & Dihle, 1997). In a series of studies designed to overcome these contradictions, Huntjens and others (Huntjens, 2003; Huntjens, Peters, Woertman, Van der Hart, & Postma, 2007) compared DID patients reporting mutually amnestic identities with simulator and normal controls. Studies included tests of neutral episodic information, perceptual and conceptual priming, procedural memory, transfer of trauma-related words, and stimulus valence as shown by affective priming. These researchers reported no objective evidence of interidentity amnesia in any of these studies. Huntjens (2003) concluded that dissociative amnesia in DID may have more to do with subjective appraisal and "metamemory" than actual lack of accessibility of memory between alternate identities.

Despite the amount of effort put into these studies, they have limitations. First, the notion of relatively stable, fixed "two-way" amnestic identities is based in the classical notion of DID as a small set of relatively unchanging, structured "personalities" with separate memory subsystems. This review is not the place to detail the TM-based view of the phenomenology of DID. Suffice it to say that the TM views DID as a posttraumatic developmental disorder with a relatively dynamic self-state system derived from a variety of developing intrapsychic, interpersonal, and psychosocial needs over time, and a phenomenology usually based in, overlap, interference, intrusion, and shifting (not simply switching) among personality states (Dell, 2006; Putnam, 1997). Further, this phenomenological model contrasts with the classical notion of well-defined identities with characteristics that can be reliably reproduced across clinical interviews and research trials (Dell, 2006; Putnam, 1997; Putnam, Zahn, & Post, 1990). Proponents of the TM—and, for that matter, proponents of the FM—do not take at face value DID identities' prevalent beliefs that they actually are "real people" with varying demographic and psychological characteristics, including differing ages, genders, etc. Nor would proponents of either model take at face value other common beliefs that alternate identities are animals, mythical beings, internalized "outside" people, demons, or omniscient beings. Therefore, it is unclear why claims of two-way amnesia between identities should also be accepted at face value preferentially by either set of model theorists.

Thus, Forrest (1999, 2001), in a study of explicit memory in identities claiming coconsciousness, or shared memory, found evidence of interidentity amnesia, compared with normal and simulating controls, despite the identities' beliefs in their coconsciousness. In additional support of the notion that alternate identities may not accurately assess their own subjective psychological characteristics, Loewenstein, Hamilton, Alagna, ReintalRe.5(LoleVruratsubjep)-247.5(yy)-408.8B5(Lol0.88897.6(clrest9.8(1997).)ders,)-3e

Table 5
Review of Psychobiological Studies of Dissociation

| Study | Sample description | Measures and method | Measures of dissociation and diagnosis | Results of interest in brief |
|---|---|---|---|---|
| | | Heritability and genetics | | |
| Becker-Blease et al., 2004 | 75 unrelated adoptive siblings, 91 related siblings, 218 MZ twins, and 173 DZ twins | Twin study of $h^2$ of trait dissociation; parent and teacher rated trait dissociation | 6 trait dissociative items from CBCL | $h^2$ of dissociation = .60, $c^2$ = .00 |
| Jang et al., 1998 | General population sample of 177 MZ twins and 152 DZ twins | Twin study of $h^2$ of trait dissociation | DES-T, DES | $h^2$ of DES-T and DES = .48 and .55, respectively; $c^2$ = .00 for both DES-T and DES |
| Lochner et al., 2007 | 83 OCD participants | Genetic study of 5-HTTLPR, childhood trauma history and trait dissociation | DES-T, DES, CTQ | Childhood trauma and 5-HTT genotype predicted 22% of the variance in DES-T scores. Moderate correlations between CTQ and DES-T scores with SS genotype; association nonsignificant with LL genotype. |
| Pieper et al., 2011 | 184 twin pairs | Twin study of $h^2$ of trait dissociation, 5-HTTLPR, trauma history and trait dissociation | DES-T, DES | $h^2$ of DES-T and DES = .43 and .44, respectively; $c^2$ = .00 for both DES-T and DES. Participants with the SS genotype who also had high depressive symptoms and trauma had highest DES-T scores. |
| Savitz et al., 2008 | 178 individuals from 35 families bipolar proband and one additional first-degree relative with bipolar disorder | Study of genes related to COMT, polymorphism, trauma and trait dissociation | DES | DES scores predicted by the interaction of COMT genotype with childhood trauma; DES scores highest in individuals with the Val/Val genotype with childhood trauma |
| Tellegen et al., 1988 | 217 MZ and 114 DZ adult twins reared together and 44 MZ and 27 DZ adult twins reared apart | Twin study of $h^2$ of trait absorption | MPQ | $h^2$ of absorption = .50, $c^2$ = .03 |
| Waller & Ross, 1997 | 280 MZ and 148 DZ twins | Twin study of $h^2$ of trait dissociation | DES-T | $h^2$ of DES-T scores = .00; $c^2$ = .45 |
| | | Psychophysiology (trait dissociation) | | |
| Bonanno et al., 2003 | 103 women, 48 with documented CSA | HR while participants spoke of the "most distressing event" was contrasted with baseline HR | ADES-T | ADES-T scores correlated negatively with increases in HR ($r = -.24$) and facial expressions ($rs = -.21$) during discussion of distressing events (relative to baseline). |
| Giesbrecht et al., 2007 | 62 undergraduates | Viewed a provocative video while SCRs was measured | DES | DES correlated with SCRs to the video ($r = -.34$); fantasy proneness showed null effects ($rs = -.18$, ns). |
| Hauschildt et al., 2011 | 26 trauma exposed with PTSD, 26 trauma exposed without PTSD, 18 nontrauma controls | HRV recorded during videos of varying emotional valence | DES, DSS, PDEQ | Within trauma groups, higher DES ($r \leq -.24$) and DSS ($r \leq -.20$) related with lower HRV, whereas PDEQ was not correlated with either. |
| Koopman et al., 2004 | 41 delinquent adolescents | Randomly assigned to either talk about their most stressful life experience or talk freely while HR was measured | SCID-D | Lower HR was associated with higher derealization ($r = -.29$) and higher identity alteration ($r = -.33$). |
| Sierra et al., 2002 | 15 DD patients, 15 HC, 11 anxiety controls | | | |

Table 5 (continued)

| Study | Sample description | Measures and method | Measures of dissociation and diagnosis | Results of interest in brief |
|---|---|---|---|---|
| | | Neuroendocrinology | | |
| State dissociation | | | | |
| Morgan et al., 2001 | 44 healthy male soldiers | NE, EPI, NPY, and plasma/salivary cortisol assessed before, during, and after exposure to physical and mental stress | CADSS | Increased CADSS associated with decreased cortisol during stress ($r = -.49$) and increased cortisol 24 hr subsequently ($r = -.46$) |
| Trait dissociation | | | | |
| Koopman et al., 2003 | 49 women with PTSD related to CSA | Five salivary cortisol samples collected at the beginning, end, and 1, 24, and 48 hr after an interview about stress and childhood trauma | SASRQ | High dissociators had elevated salivary cortisol 24 hr after the interview. |
| Schechter et al., 2004 | 41 mothers of young children, the mothers of whom had PTSD from interpersonal trauma | Maternal perception of children and maternal behavior assessed during separation–reunion sequences. Salivary cortisol collected from mothers before and 30 min after reunions | HADSI | Baseline salivary cortisol negatively correlated with severity of trait dissociation ($r = -.31$), but cortisol reactivity to separation–reunion was nonsignificant correlated with severity of dissociation ($r = .15$, ns) |
| Simeon et al., 2007 | 46 DD without PTSD, 35 PTSD, 58 HC | 24-hr urine and serial blood samples collected before and after DST and TSST | DES | DD had higher basal cortisol in urine (but not plasma) compared with HC. DD group had greater resistance to and faster escape from DST. No differences in cortisol reactivity. DES correlated negatively with peak cortisol reactivity to the TSST ($r = -.43$). |
| Simeon et al., 2008 | 21 high exposure and 10 nontrauma HC without major exposure to the World Trade Center attack | 24-hr urine cortisol after DST. During TSST, plasma cortisol changes, HR, and BP assessed during rest and at peak response | DES | DES negatively correlated with plasma cortisol levels at 08.00 h post-DST ($r = -.56$), but not with baseline urinary cortisol ($r = -.29$, ns), DST suppression ($r = .12$), or cortisol reactivity to the TSST ($r = -.18$). DES negatively correlated with resting systolic BP ($r = -.54$) and peak HR during the TSST ($r = -.48$) but unrelated to other BP and HR measures during rest and TSST. |
| | | Neuroimaging | | |
| Structural imaging | | | | |
| Irle et al., 2009 | 10 PTSD with either DA or DID, 25 HC | MRI of total brain volume, bilateral amygdala, and bilateral hippocampus | SCID-D diagnosed DID and DA | Volumes of left 31% and right 29% amygdala and left 17% and right 11.0% hippocampal volumes were reduced when compared with HCs, but correlated with PTSD symptom severity rather than DA/DID symptoms. |
| Vermetten et al., 2006 | 15 DID, 23 HC | MRI determined hippocampal and amygdala volume | SCID-D diagnosed DID | Hippocampal volume 19% less in DID but confounded by age differences. Amygdala volume 32% less in DID, but only the effect of right amygdala volume still significant after covarying age. |
| Weniger et al., 2008 | 13 DID or DA, 25 HC, 10 PTSD | MRI scan of amygdala and hippocampal size | SCID-D diagnosed DID and DA | Neither amygdala nor hippocampal volumes differed between the DID/DA group and HC. |
| Functional imaging | | | | |
| Brand et al., 2009 | 14 DA, 19 HC | PET scan acquired during eyes-closed resting state | DA diagnosis made according to DSM–IV | DA participants showed less metabolism in the right inferolateral PFC. |
| Elzinga et al., 2007 | 16 DID or DDNOS, 16 HC | fMRI scanning during verbal n-back test of working memory | DES | Working memory nonsignificant. DID/DDNOS greater response as a function of increasing task difficulty, relative to HC, within left anterior PFC, DLPFC, and parietal lobe (BA 40). |

(table continues)

Table 5 (continued)

| Study | Sample description | Measures and method | Measures of dissociation and diagnosis | Results of interest in brief |
|---|---|---|---|---|
| Felmingham et al., 2008 | 12 PTSD displaying dissociative reactions,11 PTSD who did not dissociate | | | |

Table 5 (continued)

| Study | Sample description | Measures and method | Measures of dissociation and diagnosis | Results of interest in brief |
|---|---|---|---|---|

trauma exposure and response to both idiographic and standardized stimuli (e.g., McTeague et al., 2010).

A growing number of studies have examined cortisol response as a measure of stress reactivity and functioning of the hypothalamic–pituitary–adrenal axis in individuals as a function of dissociative symptoms. However, most studies to date have examined peritraumatic dissociation only (e.g., Ladwig et al., 2002; Neylan et al., 2005; Nixon et al., 2005). Higher (Simeon et al., 2007), lower (Schechter et al., 2004), and null effects have been observed for basal cortisol in comparisons of individuals high versus low in dissociative symptoms. Cortisol reactivity to psychological stressors was decreased in response to combat training as a function of state dissociation (Morgan et al., 2001), but Simeon et al. (2007, 2008) did not find decreased (or increased) cortisol reactivity in response to the Trier Social Stress Test. Finally, Koopman et al. (2003) observed increased salivary cortisol in individuals reporting greater trait dissociative symptoms only 1 day (but not immediately or 2 days) after being interviewed about traumatic life events. Discrepant findings across studies may suggest that patterns of arousal differentiating high and low dissociators within PTSD groups may change over time. In addition, future studies of cortisol reactivity to psychological stressors as a function of trait dissociation should examine the extent that individuals experience state dissociation in response to the stressor.

The significance of documented psychophysiological and neuroendocrine correlates of self-reported dissociative symptoms can be interpreted from either the FM or the TM perspective. FM theorists can maintain that objective psychophysiological responses to stimuli reminiscent of trauma may represent solely individuals' belief that they have experienced trauma, a belief that may be unfounded in reality. For example, McNally et al. (2004) found that heart rate, SCR, and left frontal electromyography increased more significantly in individuals believing themselves to be alien abductees than in comparison volunteers when exposed to auditory recounting of alien abduction experiences. However, McNally et al. did not distinguish between high and low dissociation groups in their analysis.

In comparison, TM theorists may note that behavioral and psychophysiological responses observed in reportedly traumatized dissociative subjects closely match those often observed in animals within the context of inescapable predatory threat, a behavioral pattern referred to in the animal literature as tonic immobility (Bracha & Maser, 2008; Bracha, Ralston, Matsukawa, Williams, & Bracha, 2004; Marx, Forsyth, Gallup, Fuse, & Lexington, 2008; Moskowitz, 2004). Within the state of tonic immobility, an animal takes upon itself an outwardly passive defensive response involving inhibition of movement, muscular rigidity or limpness, and evidently unfixed concentration (e.g., unfocused gaze, eye closure), a behavioral and psychophysiological state that has been associated with increased analgesia.

These characteristics bear a resemblance to certain dissociative states as discussed above (Frewen & Lanius, 2006; Nijenhuis, Vanderlinden, & Spinhoven, 1998). Tonic immobility to date has been examined primarily in its relevance to trauma and PTSD as opposed to dissociative symptoms specifically, although researchers have discussed its particular relevance to dissociative symptoms in PTSD (Bovin, Jager-Hyman, Gold, Marx, & Sloan, 2008; Fiszman et al., 2008; Heidt, Marx, & Forsyth, 2005; Humphreys, Sauder, Martin, & Marx, 2010; Rocha-Rego et al., 2009). Furthermore, psychometrically measured tonic immobility correlates with dissociative symptoms (Abrams, Carleton, Taylor, & Asmundson, 2009). In short, the animal literature on tonic immobility affords a translational model informing the psychophysiological study of dissociative symptoms. These studies support the basic principle of the TM that traumatic stress plays a causal role in dissociative symptoms.

## Neuroimaging

Neuroimaging studies have examined emotional processing in subjects with DPD, and trauma memory and/or pain processing in individuals with PTSD or borderline personality disorder (BPD) with prominent dissociative symptoms, with a common finding being either increased or decreased response in medial prefrontal cortex and limbic regions accompanying dissociative symptoms (see Table 5). Phillips et al. (2001) observed less difference in emotional processing regions of the brain, most notably the insula, and a greater frontal response, in people with DPD when viewing valenced photographs.

Among PTSD patients, individuals exhibiting state depersonalization in response to trauma reminders also showed an increased response within midline anterior regions including the dorsal and rostral anterior cingulate cortex and the medial prefrontal cortex (Hopper, Frewen, Sack, Lanius, & Van der Kolk, 2007; Lanius et al., 2010, 2005, 2002). In comparison, null effects were observed for the contrast of encoding emotional relative to neutral sentences in 10 participants with DPD, although during a subsequent recognition test for emotional words, healthy controls activated the medial prefrontal cortex more so than individuals with DPD (Medford et al., 2006). Less response within medial prefrontal cortex was also observed in PTSD patients reporting dissociative symptoms in response to threatening facial expressions (Felmingham et al., 2008). Increased midcingulate and insula response in patients with BPD and comorbid PTSD was observed in conjunction with reduced pain sensitivity during script-induced dissociative states (Ludäscher et al., 2010).

Thus, functional neuroimaging studies increasingly implicate a frontocingulate and limbic basis for positive symptoms of dissociative disorders and dissociative symptomatology, most notably those of depersonalization and analgesia. Recently, neuroimaging studies have also sought to investigate the basis of negative symptoms of dissociation, including dissociative amnesia and interidentity amnesia. Findings in 14 individuals with dissociative amnesia tested with fluorodeoxyglucose PET in a resting state showed decreased metabolism within the right inferolateral prefrontal cortex (Brand et al., 2009). These findings complement a neuropsychological case series showing reduced response in the frontotemporal cortex typically within the right hemisphere, in individuals whose amnesia was documented to have been provoked by traumatic and/or stressful events (review by Staniloiu & Markowitsch, 2010; see also Staniloiu, Markowitsch, & Brand, 2010). Vermetten, Schmahl, Lindner, Loewenstein, and Bremner (2006) observed reduced volume of the hippocampus and amygdala in individuals with DID. This result was not replicated in a subsequent study, where brain morphological changes were reported to be associated with a PTSD diagnosis, not with a dissociative disorder diagnosis without PTSD (Irle, Lange, Sachsse, & Weniger, 2009; Weniger, Lange, Sachsse, & Irle, 2008). However, in

these latter studies, only four of 13 trauma-exposed individuals met SCID-D diagnostic criteria for DID. Most met diagnostic criteria for dissociative amnesia, and no data are reported on which dissociative patients met diagnostic criteria for PTSD. Accordingly, further studies will be needed to more completely elucidate whether the Vermetten et al. findings can be better explained by comorbid PTSD, by DID, or by both disorders.

The reviewed neuroimaging studies were not designed to address the present question regarding the degree to ccord-o291.3(rpH1cqe T* [od41o9va]TJ -n2d41o9v2on)-353.8(e2(r(present)3.8(e3(the

that each of these additions to the TM are proposed as moderators of the dissociation–trauma relationship, not as mediators of the relationship. Future researchers would be better served by designs that include relevant variables as independent grouping factors (e.g., intrafamilial vs. extrafamilial abuse, low vs. high family pathology) so that simple effects and interactions can be examined.

Recent studies have begun to answer this question. Data from the National Comorbidity Study–Replication report that multiple forms of childhood adversity, including childhood maltreatment and family dysfunction, covary strongly together, such that it may not be possible to separate the effects of maltreatment from a pathogenic family environment in which multiple forms of neglect and abuse occur (Green et al., 2010; McLaughlin et al. 2010; Scott, Varghese, & McGrath, 2010). Trickett et al. (2011) came to a similar conclusion in their review of the many pathological outcomes of childhood sexual abuse, including increased dissociation. These adverse outcomes are difficult to completely parcel out from the manifold harms caused by the pathogenic family environment in which childhood sexual abuse, physical abuse, emotional abuse, and neglect occur.

## Should We Discount the Nonobjective Trauma Studies?

Regarding the issue of objective and subjective measures of trauma in general, it is certainly true that much research on trauma is conducted with participants whose traumatic background has not been independently verified. This, however, is the norm rather than the exception in most areas of psychology. In comparing nonsmokers with light and heavy smokers on rates of varying diseases, seldom are there external documents verifying the number of cigarettes per week actually consumed. Salivary cotinine levels have been used to document abstinence after intervention, but are used less now because of the high correspondence between these levels and self-report (Yeager & Krosnick, 2010). The number of binging or purging episodes for the bulimic are virtually never verified, nor is there an objective verification that the fantasy-prone individual actually spends more time fantasizing. Thus, in a wide range of fields, it is understood that self-report contains measurement error, and independent studies are conducted to show that the criterion-positive group (e.g., alcoholic, sexually abused, bulimic) is reliably more likely to contain criterion-positive individuals than the self-reported criterion-negative group.

Unfortunately, longitudinal studies cannot provide a full answer to the question here, since the individual who first reports sexual abuse as an adult cannot dependably be labeled as a false report (even if the same individual denied it as a child), because alternative hypotheses of shame or fear serving to silence the child from disclosing abuse are viable possibilities. Twenty-year follow-ups of a large sample of abused children and matched controls revealed large omission rates for those asked if they had experienced prior physical abuse (38%–40% in Widom & Shepard, 1996) and prior

time should be slow or nonexistent and unrelated to trauma or trauma treatment. Instead, as the TM suggests, dissociation drops over the course of the 1st year after trauma for most individuals (e.g., Feeny, Zoellner, Fitzgibbons, & Foa, 2000; Feeny, Zoellner,

## Psychobiology of Dissociation as a Regulatory Response to Trauma

Extant research supports the TM of dissociation as a regulatory response to fear or other extreme emotion with measurable biological correlates. The strong caveat here is that, to our knowledge, most research has not been done with FM and TM theories in mind, and thus has not included measures of fantasy proneness or suggestibility. Nonetheless, biological researchers have found trauma-related theories (e.g., tonic immobility) to be useful in synthesizing findings from animal and human samples. Compelling alternative heuristics that are not trauma related have yet to appear.

## Summary

Finally, in future research, we recommend the careful analysis of varying alternative causal models; attempts to differentiate mediators, moderators, and risk factors; the avoidance of use of outlier studies to make theoretical arguments; and attention to measurement issues in all conceptual areas (dissociation, fantasy proneness and false memory) to further this complicated and fascinating dialogue. Our review of current research suggests that trauma and dissociation are connected for psychological and neurobiological reasons, and fantasy proneness is not the explanation.

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