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Activation of the Attachment System in Adulthood: Threat-Related Primes Increase the Accessibility of Mental Representations of Attachment Figures

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Three studies explored the effects of subliminal threat on the activation of representations of attachment figures. This accessibility was measured in a lexical decision task and a Stroop task following threat- or neutral-word primes, and was compared with the accessibility of representations of other close persons, known but not close persons, and unknown persons. Participants also reported on their attachment style. Threat primes led to increased accessibility of representations of attachment figures. This effect was specific to attachment figures and was replicated across tasks and experiments. Attachment anxiety heightened accessibility of representations of attachment figures even in neutral contexts, whereas attachment avoidance inhibited this activation when the threat prime was the word *separation*. These effects were not explained by trait anxiety. The discussion focuses on the dynamics of attachment-system activation in adulthood.

One of the basic assumptions of Bowlby's (1973, 1980, 1982) attachment theory is that physical or psychological threats (e.g., the appearance of a predator, the departure of an attachment figure) automatically activate the attachment system—a motivational system whose goal is maintenance of proximity to supportive others. Threats generally cause people to appeal to attachment figures—relationship partners who provide a haven of safety and a secure base—as a means of coping with the threat and protecting well-being. The studies reported here are intended to examine this important assumption while exploring the dynamics of attachment-system activation in adulthood. Specifically, we examined the effects of threat contexts on the accessibility of representations of attachment figures and explored whether and how this activation is affected by a person's global orientation toward attachment relationships—his or her attachment style.

Attachment-System Activation: Functions and Contextual Triggers

According to Bowlby's (1982) theory, infants' strong tendency to seek proximity to caregivers is the overt manifestation of the attachment behavioral system—an inborn system aimed at maintaining proximity to supportive others in times of need. In his view, this system has emerged over the course of evolution because it increases the likelihood of survival and eventual reproduction on the part of members of a species born with immature capacities for locomotion, feeding, and defense. Because human infants require a long period of care and protection, they are born with a repertoire of behaviors that help to assure proximity to supportive others. Bowlby (1982) labeled these supportive others "attachment figures" and argued that proximity maintenance to these figures provides comfort and relief, infuses a sense of basic trust and security, and facilitates activation of nonattachment behaviors (e.g., exploration). Although the attachment system is most critical during the early stages of life, Bowlby (1988) assumed that this system is active over the entire life span and is manifested in thoughts and behaviors related to maintaining proximity to attachment figures.

In conceptualizing the attachment system, Bowlby (1982) listed some of the major contextual triggers that activate the system, rendering the need for attachment figures more salient. In his terms, "A child seeks his attachment-figure when he is tired, hungry, ill, or alarmed and also when he is uncertain of that figure's whereabouts" (p. 307). In other words, Bowlby (1982) proposed that encounters with physical or psychological threats automatically activate the attachment system and the individual is driven to maintain or restore proximity to attachment figures. Under normal circumstances, this activation would be manifested in the actual seeking of proximity to attachment figures. However, there are cases in which these behaviors may be inhibited by the absence of attachment figures or by other contextual and personal factors. In such cases, thoughts about proximity to attachment figures may still be active in the cognitive system, and representations of these figures may still influence behavior.

Following Bowlby's (1982) assumptions about attachment-system activation, other scholars (e.g., Ainsworth, 1991; Hazan & Shaver, 1994; Hazan & Zeifman, 1994) have identified the functions of attachment figures. Specifically, a relationship partner should accomplish three functions to become an attachment figure. First, he or she should be a target for *proximity maintenance*. People tend to seek and enjoy proximity to their partner in times of need and to actively resist separations. Second, a relationship partner should function as a *safe haven* in times of need—he or she

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facilitates distress alleviation and is a source of support and comfort. Third, a relationship partner should function as a *secure base* from which people can engage in nonattachment behavior (e.g., exploration) and develop his or her unique, autonomous personality.

Examining Attachment-System Activation

Bowlby's (1982) conceptualization of attachment-system activation has been extensively supported in studies of infants and young children. In times of need, infants show a clear preference for their primary caregiver over other people (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Cummings, 1980). Accordingly, infants exhibit more intense protest when separated from their primary caregiver as compared with separation from other people (e.g., Ainsworth et al., 1978; Schaffer & Emerson, 1964). Findings also show that distress arousal heightens the likelihood of proximity-seeking behaviors (e.g., Ainsworth, 1973; Brooks & Lewis, 1974). Specifically, when tired or ill, infants tend to seek and maintain proximity to their primary caregiver (e.g., Ainsworth, 1973, 1991) and to be soothed in the presence of this person (e.g., Heinicke & Westheimer, 1966). Research has also provided supportive evidence for the secure-base function of attachment relationships. Infants and young children tend to explore the environment mainly when they know their attachment figure is nearby and available (e.g., Ainsworth et al., 1978; Ricciuti, 1974).

In recent years, several studies have examined the relevance and validity of Bowlby's conceptualization for peer relationships (friendship, romantic love) in adolescence and adulthood. Although these studies provide valuable information about the attachment system, the assumption that this system is activated under conditions of threat has remained untested in most adult attachment studies. Without testing this assumption, we cannot effectively validate Bowlby's conceptualization of attachment-system activation in adulthood. Furthermore, one cannot adequately deal with Kirkpatrick's (1998) challenging proposal that attachment figures in adulthood function as a target of long-term mating strategies rather than as a safe haven or secure base. In his view, adult attachments do not accomplish affect regulation and protective functions because adults can effectively regulate distress on their own and do not require the presence or availability of a partner while engaging in nonattachment behavior.

Research has consistently shown that separation from romantic partners is an important source of distress in adulthood (e.g., Fraley & Shaver, 1998; Vormbrock, 1993). For example, feelings of anxiety, anger, and sadness have been noted following brief separations from a romantic partner (e.g., Piotrkowski & Gornick, 1987; Vormbrock, 1993). Moreover, asking people to imagine their romantic partner leaving them has been found to heighten physiological arousal (Fraley & Shaver, 1997) and increase the accessibility of death-related thoughts (Mikulincer, Florian, Birnbaum, & Malishkevich, 2002). However, these signs of distress are probably due to the threat of separation and not necessarily to the reality of attachment-system activation.

Another relevant line of research has focused on the transfer of attachment relationships from parents to peers. For example, Hazan and Zeifman (1994) asked participants (using the WHOTO scale) to name persons who serve proximity-seeking, safe-haven, and secure-base functions, and assessed the extent to which peers were nominated as attachment figures in early childhood, adolescence, and young adulthood. Findings revealed that peers were nominated as targets of proximity seeking even in early childhood, but they were used as a haven of safety only in adolescence and as a secure base only in young adulthood. Hazan and Zeifman also reported that most adults in romantic relationships of 2 years or longer listed their partner as their main secure-base provider. Fraley and Davis (1997) replicated these findings in a sample of young adults while observing that the nomination of peers as attachment figures increased as a function of the duration and quality of the relationship (see Trinke & Bartholomew, 1997, for a similar set of findings). Again, these studies failed to provide direct evidence of attachment-system activation. They did not expose participants to threats, nor did they assess variations in either the actual seeking of proximity to the nominated attachment figures or the accessibility of representations of these figures.

In a more direct attempt to examine the hypothesized threat-attachment link, some researchers have assessed the association between global sense of attachment security (i.e., the expectation that others will be supportive in times of need) and the seeking of proximity to or support from attachment figures under threatening conditions. Specifically, this line of research has focused on a person's attachment style—stable patterns of relational cognitions and behaviors—and has compared persons who report a secure style with those who report insecure styles (for reviews, see Shaver & Clark, 1994; Shaver & Hazan, 1993). This relational construct seems to be organized around two major dimensions: avoidance and anxiety (Brennan, Clark, & Shaver, 1998). Whereas attachment avoidance involves negative representations of others and a tendency to avoid closeness, attachment anxiety refers to negative self-representations and a tendency to worry about rejection and abandonment. Persons scoring low on these two dimensions are said to possess a sense of security and are characterized by positive attachment relationships.

Studies of attachment style have consistently shown that securely attached persons, more than insecure individuals, react to threats with an increased tendency to seek support from relationship partners. In observational laboratory studies, Simpson, Rholes, and Nelligan (1992) and Rholes, Simpson, and Grich-Stevens (1998) told participants that they would be exposed to an anxiety-inducing procedure. Secure participants, as compared with insecure ones, more explicitly sought comfort and reassurance from their dating partner. These results were replicated in a study of dating and married couples who were separating at an airport (Fraley & Shaver, 1998). Similar findings have been obtained in studies that assessed participants' reports of the strategies they habitually use to cope with threatening circumstances. Specifically, securely attached persons reported higher reliance on support-seeking strategies than persons scoring high on attachment avoidance or anxiety (e.g., Birnbaum, Orr, Mikulincer, & Florian, 1997; Mikulincer & Florian, 1995; Mikulincer, Florian, & Weller, 1993).

Although these studies have not compared threat conditions with control conditions, they have provided important information about the dynamics of the attachment system in threat contexts by showing that the chronic accessibility of the sense of attachment security is associated with support-seeking attempts. In the current studies, we followed this line of research, but instead of looking at the threat-attachment link in terms of individual differences, we

focused on Bowlby's premise about the innate protective function of the attachment system and examined differences between threat and nonthreat conditions in the cognitive accessibility of thoughts about attachment figures—that is, their readiness to be used in information processing. This strategy is based on the notion that a thought can become neurologically active and influence mental processes before it is recognized in one's stream of consciousness (Wegner & Smart, 1997). Hence, the extent to which a thought influences performance on a cognitive task can serve as a measure of activation (e.g., Bargh, Chen, & Burrows, 1996; Sherman, Mackie, & Driscoll, 1990). On this basis, we examined whether a threat context heightens the readiness of representations of attachment figures to influence information processing.

This cognitive research strategy has recently been applied in the study of the accessibility of proximity-related thoughts (Mikulincer, Birnbaum, Woddis, & Nachmias, 2000). In a series of three studies, participants reported on their attachment style, after which the accessibility of proximity themes and worries was assessed in a lexical decision task following priming with a threat-related or neutral word. Findings supported Bowlby's (1982) hypothesis about the effects of threat on attachment-system activation: Priming with a threat word (e.g., *failure, death*) led to faster identification of proximity-related words (e.g., *closeness*). This heightened accessibility of proximity-related thoughts occurred regardless of individual variations in attachment style. The findings also included some interesting attachment-style differences. First, persons scoring high on attachment anxiety exhibited relatively high accessibility of proximity-related thoughts in both neutral and threat contexts. Second, whereas persons scoring high on attachment anxiety showed high accessibility of words denoting proximity worries (e.g., *separation*) regardless of priming context, persons scoring high on avoidance evinced relatively high accessibility of these worries only when a threat context was primed and the lexical decision task was completed under conditions of high cognitive load.

Although Mikulincer et al.'s (2000) findings provide the first direct examination of the cognitive substrate of attachment-system activation in adults, they do not include evidence concerning the accessibility of representations of attachment figures. In fact, attachment-system activation does not entail only accessibility of proximity-related thoughts, but also that these thoughts be directed toward specific attachment figures. That is, thoughts about love, support, and closeness should be associated with or directed toward significant others who serve proximity-seeking, safe-haven, and/or secure-base functions. Therefore, showing that proximity-related thoughts are accessible under conditions of threat is an important but insufficient step in testing Bowlby's (1982) hypothesis about attachment-system activation. To provide a more valid test of this hypothesis, one should show that threat heightens the accessibility of representations of specific attachment figures. This is the purpose of the studies reported here, which focus on the accessibility of the names of people whom participants list as serving proximity-seeking, safe-haven, and/or secure-base functions. Our main hypothesis is that threat-related contexts will increase the accessibility of these representations.

Beyond testing this hypothesis, we also explored attachment-style differences in the accessibility of representations of attachment figures. We expected to find that the effects of threat on the accessibility of these representations would appear regardless of variations in attachment style. This prediction is derived from Bowlby's (1982) assumption that all human beings possess an attachment system and are potentially responsive to threat contexts. As a result, all of them may react to these contexts with heightened accessibility of representations of attachment figures. That is, threat should activate the system even among insecure persons, who may have learned that proximity often fails to provide relief. Our prediction is also derived from findings showing that people possess multiple attachment schemas, and memories of specific, good attachment figures may coexist within the semantic associative network with memories of frustrating relationship partners (e.g., Baldwin, Keelan, Fehr, Enns, & Koh-Rangarajoo, 1996; Mikulincer & Arad, 1999; Pierce & Lydon, 2001). Therefore, even a person with a global insecure attachment style might have, or have had in the past, partners who function as security-enhancing attachment figures, and representations of these figures may become accessible in threatening contexts.

Of course, this is not to say that individual differences in attachment experiences would not affect attachment-system activation. In fact, attachment theory claims that particular proximity-related thoughts reflecting a person's attachment history may be made accessible by activation of the attachment system (e.g., Bowlby, 1973). These cognitive by-products may shape the way people experience the activation of the attachment system and may determine the extent to which they engage in proximity-seeking behavior (e.g., Collins & Read, 1994). In fact, the encounter with threats may activate the system, but these cognitive products may inhibit support-seeking behaviors.

Moreover, the affect-regulation strategies comprised by a person's attachment style may make a crucial contribution even to the accessibility of representations of attachment figures. First, attachment theory proposes that attachment anxiety is organized around hyperactivating strategies of affect regulation, which heighten the monitoring of threat- and attachment-related cues, and then lead to exaggerated threat appraisal and chronic accessibility of attachment-related thoughts (e.g., Cassidy & Kobak, 1988; Shaver & Mikulincer, in press). In support of this view, persons scoring high on attachment anxiety have been found to appraise normal life circumstances in threatening terms and show a resulting hyperactivation of attachment-related thoughts and worries regardless of the level of objective threat (e.g., Mikulincer et al., 2000). Therefore, we explored the possibility that such individuals may show heightened accessibility of representations of attachment figures in both threat-related and neutral contexts.

Second, attachment theory proposes that attachment avoidance is organized around deactivating strategies of affect regulation, which inhibit the appraisal and monitoring of threat- and attachment-related cues, and then lead to the dismissal of threats and the suppression of thoughts concerning threat- and attachment-related themes (e.g., Cassidy & Kobak, 1988; Shaver & Mikulincer, in press). In support of this view, persons who score high on attachment avoidance have been found to deal with threats by inhibiting proximity-seeking behaviors and suppressing distress-related thoughts (for a review, see Fraley, Davis, & Shaver, 1998). This distress-regulation strategy may inhibit attachment-system activation, thereby reducing the accessibility of representations of attachment figures in threat contexts. This possibility was examined in our studies.

Study 1

In Study 1 we examined attachment-system activation in a computerized lexical decision task (Meyer & Schvaneveldt, 1971), which allows exploration of the accessibility of representations of attachment figures in threatening contexts. In this task, participants read a string of letters and tried to identify as quickly as possible whether it was a word or a nonword. Reaction times (RTs) served as a measure of the accessibility of thoughts related to the target words—the quicker the RT, the higher the accessibility (e.g., Fischler & Bloom, 1979). In our studies, the target words were names of attachment figures, which were embedded within a threatening or a neutral context.

Previous findings highlight the suitability of a lexical decision task for exploring the link between threat context and attachment-system activation. First, research has documented a context-relatedness effect: RTs for identifying target words are quicker if these words are primed by relevant contexts (e.g., Stanovich & West, 1983). Second, this RT facilitation has been found mainly when the target word is the most available association activated by the primed context (e.g., Fischler & Bloom, 1979). Third, this effect has also been found when the primed context was presented subliminally, so that participants could not consciously process its connection with the target word (Forster, 1981). Thus, variations in RTs may reflect the extent to which a target word is mentally activated by a context, even when the context-target link is not consciously processed. Fourth, the lexical decision task has been found to be an effective means for exploring attachment-related representations (e.g., Baldwin, Fehr, Keedian, & Seidel, 1993; Mikulincer et al., 2000).

The accessibility of names of attachment figures was assessed under threatening or neutral conditions. To manipulate context, we used a subliminal priming procedure in which a threat-related word (*failure*, in Hebrew) or a neutral word (*hat*, in Hebrew) was presented on a computer screen immediately before each target name. The word *failure* was chosen because, compared with words such as *death* and *illness* used in other studies involving subliminal priming (Mikulincer et al., 2000), it has the least obvious attachment connotations. In addition, the Hebrew word for failure refers to a grade of *F* and is extremely ego-relevant.

The priming technique we used has been found to activate associates of the primed word, and to make related thoughts accessible, without requiring conscious recognition of the word (e.g., Baldwin & Holmes, 1987; Bargh & Pietromonaco, 1982). We reasoned that if psychological threat automatically activates the attachment system, thereby also activating cognitive representations of attachment figures, priming with a threat-related word would heighten the accessibility of these figures' names and speed lexical decisions about whether the names are words.

In the lexical decision trials, participants were exposed to a prime word (threat-related or neutral) for 20 ms and then to one of 32 target letter strings, which could be either a nonword or one of the following four kinds of Hebrew words: (a) names of persons who were mentioned by participants as serving attachment functions (referred to here as attachment figures), (b) names of close persons who were not mentioned as serving attachment figures (close persons), (c) names of persons whom a participant knew even though he or she was not close to them and did not view them as attachment figures (known persons), or (d) names of unknown persons. The lists of names were uniquely constructed for each participant on the basis of his or her responses to three name-generation tasks. The names of attachment figures were the focal target words for examining the hypothesized association between the threat-related word and the automatic accessibility of representations of attachment figures. The other categories of names were introduced to control for possible nonspecific effects of the threat-related word on lexical decisions. In addition, the introduction of names of close persons and names of known persons was intended to control for the possible effects of the familiarity of the names.

The lexical decision task was constructed according to a within-subject 2 × 5 factorial design defined by prime word (threat, neutral) and type of target stimuli (names of attachment figures, names of close persons, names of known persons, names of unknown persons, nonwords). The dependent variable was the RT to each stimulus. Our main prediction was that a threat-related word prime would lead to faster RTs for names of attachment figures than a neutral word prime, but would have no significant effect on RTs for names of close and unknown persons or for nonwords.

Although we did not make ad hoc predictions about the effects of attachment style, we explored its possible contribution to the effects of threat on the accessibility of representations of attachment figures. For this purpose, participants completed a Hebrew translation of the Experiences in Close Relationships Scale (ECR; Brennan et al., 1998), which assesses variations in attachment anxiety and attachment avoidance. This allowed us to examine associations between the two attachment-style dimensions and RTs for target stimuli in the different priming conditions. Participants also completed the trait form of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) to control for the contribution of attachment-unrelated sources of anxiety.

Method

Participants. Forty-two psychology students (32 women and 10 men ranging in age from 19 to 31 years, median = 23 years) from Bar-Ilan University, Ramat Gan, Israel, participated in the study as part of the requirements for their undergraduate degree.[1]

Materials and procedure. Students were invited to participate individually in an experiment on social cognition in which they would complete a series of computerized tasks. Upon receiving these general instructions, participants completed computerized measures designed to elicit lists of names (attachment figures, other close persons, known persons, unknown persons) to be used subsequently in the lexical decision task.

In the first measure, participants received a list of 100 Hebrew first names in an EXCEL worksheet and marked the names of persons whom they knew and the names of persons whom they did not know personally. They were instructed to press *3* after the name of a person they knew and *1* after the name of a person they did not know.

The second measure was a computerized version, in Hebrew, of the six-item WHOTO scale developed by Fraley and Davis (1997). This scale asked participants, in effect, to provide the first names of close persons

[1] Across the three studies, there were no significant gender differences in attachment scores or RTs. Moreover, there were no significant interactive effects of gender and other independent variables on RTs.

who serve attachment functions.[2] For convenience, we refer to these people as "attachment figures," even though there is no clean qualitative distinction between "full-blown attachment figures," to use Hazan and Zeifman's (1994) phrase, and people who serve one or more attachment functions without being a person's primary attachment figure. Bowlby (1982) talked about "a hierarchy of attachment figures," suggesting that some are primary whereas others are less so. See Trinke and Bartholomew (1997) for a good discussion of the complexity of this issue. Here, as the results of our various studies indicate, our procedure for identifying attachment figures worked sufficiently well to distinguish those figures from other close relationship partners.

In the WHOTO scale, participants were asked to write in a separate EXCEL worksheet the first names of people with whom they sought proximity and whom they used as a safe haven and/or secure base. Two items tapped the proximity-seeking function, with one of these items tapping separation protest (Who is the person you most like to spend time with?; Who is the person you don't like to be away from?). Two items tapped the safe-haven function (e.g., Who is the person you would count on for advice?), and two items tapped the secure-base function (e.g., Who is the person you can always count on?). For each item, participants were instructed to write the first name of the person who best served the targeted attachment-related function and to label that person's relational role (e.g., mother, father, friend, romantic partner).[3] The average number of names generated in this way was 3.51 ($SD = 1.38$).

In the third measure, participants were asked to write in a separate EXCEL worksheet the first names of close persons. Specifically, participants were asked to write the first names of their father, mother, brothers, sisters, best friend, current romantic partner, grandfathers, and grandmothers without making any reference to the actual attachment functions they did or did not serve. They also provided first names of other friends, famous actors, and politicians as distractor or filler items.

Following completion of the three measures, all participants received a 20-item paper-and-pencil questionnaire concerning leisure activities and lifestyle. This questionnaire was used as a distractor and filler activity, which provided time for the computer to prepare the name lists for the subsequent lexical decision task. Completing this questionnaire should also have reduced any residual activation of attachment figures' and nonattachment-figures' names.

Participants were then told they would perform a computerized lexical decision task. The task was based on the apparatus and procedure used by Baldwin et al. (1993) and was similar to the task used by Mikulincer et al. (2000). It was run on a Pentium IBM-PC, with an SVGA color monitor, and was programmed using Superlab software (Christopher, 2001). Brightness and contrast were set somewhat low and the primes and target letter strings were displayed in black lettering on a white background in the middle of the monitor. Participants worked at their own pace. They first completed 10 practice trials and then 192 experimental trials. The words and nonwords in the practice trials were different from those in the experimental trials.

Each trial of the task consisted of a rapid subliminal presentation of one of two primes (threat word, neutral word) followed, after a pause of 500 ms, by the presentation of one of 32 target letter strings (for 1,000 ms). Participants judged as quickly as possible whether the letter string was a word or not by pressing *1* on the keyboard number pad if they thought the string was a word or *3* if they thought it was a nonword. Participants were explicitly told that names counted as words.

On each trial, the prime was presented for 20 ms, which was not long enough to allow participants to recognize it. They were told that each trial would begin with an *x* in the middle of the screen, on which they should keep their eyes fixed, followed by a light flash, which they should ignore, and then, after a brief pause, the target letter string. It is important to mention that even when a prime is presented for as little as 20 ms, the afterimage may remain temporarily active in the peripheral parts of the visual system. To avoid this problem, we masked the primes with an *XXX* pattern immediately after their presentation. The parameters used in stimulus presentation were similar to those used in prior studies (e.g., Mikulincer et al., 2000; Murphy & Zajonc, 1993). An earlier study using the same procedure (Mikulincer et al., 2000) revealed that participants were not able to detect the subliminal primes even after repeated presentation.

The threat-related word prime was the Hebrew word for *failure* [*nichshal*], which was presented in 96 of the trials. The neutral word was the Hebrew word for *hat* [*kova*], which was presented in the remaining 96 trials. In Hebrew, these words have equal numbers of letters. The 32 target letter strings were uniquely constructed in accordance with the first names of persons provided in the WHOTO scale, the first names of other close persons provided by the participant (parents, romantic partner, friends), the first names of people the participant knew, and the first names of people the participant did not know. Specifically, each participant's target word list contained five categories: (a) *names of attachment figures*: four names of people listed by the participant in response to the WHOTO scale. In the case of people who provided fewer than four names in the WHOTO scale ($N = 14$), the names of the nominated attachment figures were repeated in the four-names-of-attachment-figures category; (b) *names of close persons:* four names of a participant's close-relationship partners who were *not* nominated as supplying any of the attachment provisions mentioned in the WHOTO scale; (c) *names of known persons:* four names of people whom a participant said he or she knew, but who were not mentioned among the names of his or her close-relationship partners or among the names of people named in the WHOTO scale; (d) *names of unknown persons*: four names of persons whom a participant said he or she did not know; (e) *nonwords:* 16 nonwords that were generated by taking common Hebrew words and scrambling their letters. These nonwords were identical for all participants. Thus, there were 64 pairs of primes and target letter strings (2×32), which were presented three times for a total of 192 trials. The different kinds of trials were randomly ordered across participants.

Following the lexical decision task, participants received a distractor scale on social issues, followed by two randomly ordered self-report scales tapping attachment style and trait anxiety. Attachment style was assessed using a Hebrew version of the ECR (Brennan et al., 1998). This scale is a 36-item self-report instrument tapping the dimensions of attachment anxiety and avoidance. Participants rated the extent to which each item was descriptive of their feelings in close relationships on a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*). Eighteen items tapped attachment anxiety (e.g., "I worry about being abandoned"; "I worry a lot about my relationships") and 18 items tapped attachment avoidance (e.g., "I prefer not to show a partner how I feel deep down"; "I get uncomfortable when a romantic partner wants to be very close"). The reliability and construct validity of the two subscales have been demonstrated (Brennan et al., 1998).

The ECR was translated into Hebrew by Mikulincer and Florian (2000), who also validated its two-factor structure in an Israeli sample. In the current sample, Cronbach alphas were high for the 18 anxiety items (.86) and the 18 avoidance items (.92). Two scores were computed by averaging items on each subscale. These scores were not significantly associated,

[2] In a pretest ($N = 10$), we compared Fraley and Davis's (1997) version of the WHOTO scale with another version of the scale, in which participants were allowed to provide more than one person for each item. The pool of generated names was similar in the two versions, so the simpler method was adopted.

[3] Across the three studies, a close friend was nominated as an attachment figure in 36% of the responses (across WHOTO items), a romantic partner was nominated in 23% of the responses, mother in 22% of the cases, father in 7% of the cases, and other family members in 11% of the cases. These findings are similar to Fraley and Davis's (1997) results and imply that most of the persons identified in the WHOTO by our Israeli undergraduates were extrafamilial figures.

$r(40) = .15$, *ns*, supporting Brennan et al.'s (1998) claim about the orthogonality of the anxiety and avoidance dimensions.[4]

Trait anxiety was assessed using a Hebrew version of the trait form of the STAI (Spielberger et al., 1970). This scale comprised 20 statements tapping the cognitive, affective, and behavioral manifestations of anxiety. Participants rated the extent to which they agreed with each statement on a 4-point scale, ranging from 1 (*totally disagree*) to 4 (*totally agree*). The Cronbach alpha coefficient for the 20 items in the current sample was high (.88), allowing us to compute a trait anxiety score by averaging the 20 items. Following completion of the self-report scales, participants were debriefed and thanked for their participation.

Results and Discussion

Psychological threat and the accessibility of attachment figures. For each person, RTs (only for correct responses) were averaged according to type of target stimuli (names of attachment figures, names of close persons, names of known persons, names of unknown persons, and nonwords) and prime word (threat, neutral).[5] These RTs were approximately normally distributed. We conducted a two-way analysis of variance (ANOVA) for prime word (threat, neutral) and target stimuli (names of attachment figures, names of close persons, names of known persons, names of unknown persons, nonwords) on these averaged RTs. This analysis yielded a significant main effect for type of target stimuli, $F(4, 164) = 12.94$, $p < .01$, $\eta^2 = .24$. A Scheffé post hoc test for repeated measures revealed that participants responded with faster RTs to names of attachment figures ($M = 523.20$) than to names of close persons ($M = 558.61$), names of unknown persons ($M = 569.52$), nonwords ($M = 572.75$), or names of known persons ($M = 584.02$). No significant differences were found between names of close persons, names of unknown persons, and nonwords. However, participants reacted significantly faster to names of close persons than to names of known persons. The main effect of prime word was not significant, $F(1, 41) = 2.05$, *ns*, $\eta^2 = .05$, but the interaction between prime word and type of target stimuli was significant, $F(4, 164) = 4.02$, $p < .01$, $\eta^2 = .10$.

Simple main effects tests for repeated measures revealed the following pattern of differences. As expected, a threat word prime led to faster RTs for names of attachment figures than a neutral word prime, $F(1, 164) = 10.90$, $p < .01$ (see means in Table 1), but had no significant effect on RTs for names of close persons, names of known persons, names of unknown persons, and nonwords ($F < 1$; see means in Table 1). The findings clearly differentiated between attachment figures and close persons who did not serve attachment functions: Whereas a threat word prime significantly increased the accessibility of names of attachment figures, it had no significant effect on the accessibility of names of close persons.[6]

The contribution of attachment style. In exploring the possible contribution of attachment style, multiple hierarchical regressions were conducted separately on RTs for each kind of target stimuli in each prime word condition. In the first step, attachment anxiety and attachment avoidance were introduced as predictors and their unique main effects were examined. In the second step, the multiplicative product of attachment anxiety and attachment avoidance was introduced to assess the effect of the two variables' interaction.

The regressions conducted on RTs for names of attachment figures revealed a significant main effect for attachment anxiety following the priming of either a neutral or a threat word—$\beta = -0.46$, $t(39) = -2.98$, $p < .01$ and $\beta = -0.31$, $t(39) = -2.15$, $p < .05$, respectively. These regressions revealed no significant main effect for attachment avoidance and no significant interaction (βs ranging from -0.05 to -0.17). Of importance, additional regressions conducted on RTs for other target stimuli (names of close persons, names of known persons, names of unknown persons, nonwords) revealed no significant unique or interactive effects of attachment anxiety or attachment avoidance. Overall, attachment anxiety was significantly associated with faster RTs for names of attachment figures regardless of the primed context (threat or neutral) and this was not the case with respect to RTs for other target stimuli.

To provide a more powerful test of possible interactions between attachment scores and prime word, we conducted three-way

Table 1
Means and Standard Deviations of Reaction Times in the Lexical Decision Task as a Function of Prime Word and Target Stimuli (Studies 1 and 2)

	Prime word			
	Threat		Neutral	
Target stimuli	*M*	*SD*	*M*	*SD*
	Study 1			
Names of attachment figures	508.89_{a}	54.57	537.51_{b}	63.46
Names of close persons	557.64_{c}	59.76	559.59_{c}	59.70
Names of known persons	580.44_{d}	63.82	587.60_{d}	78.42
Names of unknown persons	$572.31_{c,d}$	65.19	$566.73_{c,d}$	73.14
Nonwords	$577.34_{c,d}$	58.84	$568.15_{c,d}$	56.90
	Study 2			
Names of attachment figures	503.20_{a}	63.72	540.99_{b}	53.95
Names of close persons	$579.44_{c,d}$	73.42	$579.19_{c,d}$	75.74
Names of known persons	601.15_{d}	74.65	596.51_{d}	76.16
Names of unknown persons	$583.07_{c,d}$	76.85	568.74_{c}	69.06
Nonwords	$595.80_{c,d}$	66.69	$589.67_{c,d}$	65.64

Note. For each study, a mean is different from other means in its row and/or column at $p < .05$, according to Scheffé tests, if their subscripts differ.

[4] In the three studies, there were no significant associations between attachment scores and the number of persons nominated as attachment figures. Moreover, the two attachment scores were not significantly associated with the number of times that parents, friends, or romantic partner were nominated as attachment figures.

[5] In all three studies, analyses were conducted on RTs for correct responses only. Long RTs (greater than 1,200 ms) were excluded from the analyses. The use of other common cutoff criteria (e.g., three standard deviations from the mean) did not meaningfully change the reported results. The average percentage of trials on which incorrect responses or long RTs were recorded was low (2.4%, 2.8%, respectively). These trials were randomly distributed across target stimuli and prime words.

[6] In all three studies, ANOVAs for Prime Type × Target contrasts (attachment figures vs. close others or attachment figures vs. average of all other persons) yielded identical results to these obtained in the reported analyses.

ANOVAs for attachment anxiety (above or below the median), attachment avoidance (above or below the median), and prime word (threat, neutral) on RTs for each of the target stimuli. The last factor was a within-subject measure. The ANOVA conducted on RTs for names of attachment figures revealed the already reported significant main effect of prime word, $F(1, 38) = 13.65$, $p < .01$, $\eta^2 = .19$. In addition, the main effect for attachment anxiety was significant, $F(1, 38) = 13.58$, $p < .01$, $\eta^2 = .18$; participants who scored above the mean in attachment anxiety reacted faster to names of attachment figures ($M = 497.09$, $SD = 48.52$) than participants who scored below the mean in attachment anxiety ($M = 549.28$, $SD = 60.63$). Neither the main effect for attachment avoidance nor any of the interactions were significant. Of importance, ANOVAs performed on RTs for other target stimuli yielded no significant main effects or interactions. Overall, these analyses revealed that the effect of prime word on RTs for names of attachment figures was not significantly qualified by attachment style.[7]

The contribution of trait anxiety. In examining the contribution of trait anxiety, Pearson correlations revealed significant associations between trait anxiety and the two attachment scores—$r(40) = .54$, $p < .01$ for attachment anxiety; $r(40) = .43$, $p < .01$ for attachment avoidance. However, none of the correlations between trait anxiety and RTs for the various target stimuli in each of the two priming conditions were significant (rs = ranging from .04 to .17). In fact, a three-way ANOVA for target stimuli, prime word, and trait anxiety (above or below the median) showed that neither the main effect for trait anxiety nor its interactions with target stimuli and/or prime word were significant ($F < 1$). Moreover, regressions performed on RTs for names of attachment figures revealed that the effect of attachment anxiety was still significant after controlling for trait anxiety, $\beta = -0.45$, $t(38) = -3.02$, $p < .01$ for the neutral word prime; $\beta = -0.32$, $t(38) = -2.22$, $p < .05$ for the threat word prime. The regressions also showed that none of the interactions of trait anxiety with attachment anxiety and/or attachment avoidance made a significant contribution to RTs for the various target stimuli in either of the two priming conditions.

Overall, although trait anxiety was significantly related to attachment scores, it had no significant effect on lexical-decision RTs. Moreover, trait anxiety did not significantly moderate the effects of target stimuli and prime word and could not explain the effect of attachment anxiety on the accessibility of names of attachment figures.

Conclusions. Overall, the findings were in line with our main prediction. The priming of a psychological threat context heightened the accessibility of the names of attachment figures, interpreted here as components of the mental representations of attachment figures, and speeded up the lexical decision RTs for these names. Of importance, a threat word prime had no significant effect on the lexical decision RTs for names of other close persons who did not serve an attachment function, names of persons whom participants knew but to whom they were not close and who did not serve as attachment figures, and unknown persons, implying that the facilitating effect of a threat word prime on RTs for names of attachment figures was unique to the attachment domain. This conclusion was reinforced by findings showing that (a) RTs for names of attachment figures were facilitated by attachment anxiety, (b) this facilitating effect of attachment anxiety was not significant with regard to other target stimuli, and (c) variations in RTs for names of attachment figures were not significantly explained by nonattachment-related sources of anxiety (individual differences in trait anxiety).

The findings also showed that the link between psychological threat and activation of mental representations of attachment figures did not significantly depend on a person's attachment style. With regard to attachment style, the findings showed only that attachment anxiety was significantly related to faster RTs for names of attachment figures in both neutral and threatening contexts. The fact that this effect was not significant for RTs of the other categories of names implied that this effect was limited to persons who accomplish attachment functions. The effect for attachment anxiety was compatible with Mikulincer et al.'s (2000) finding that attachment anxiety had a facilitating effect on the accessibility of attachment themes even in a neutral context. Of importance, this effect was not significantly explained by trait anxiety.

We should note that the threatening context used in Study 1—the word *failure*—was not an explicitly attachment-related threat. One may thus wonder whether the activation of mental representations of attachment figures would also be facilitated by an attachment-related threat prime (e.g., *separation*). Bowlby (1982) wrote both about the distress caused by external threats (e.g., predators), which he called "alarm," and the distress caused by being separated from an attachment figure, which he called "anxiety" or "separation anxiety." Both are important forms of threat that can be reduced by increasing one's proximity to an attachment figure. Therefore, it is important to determine whether representations of attachment figures are cognitively activated by actual or symbolic encounters that threaten proximity maintenance and prevent the provision of a secure base. This is the main question addressed by Study 2.

Study 2

Study 2 was an attempt to replicate the findings of Study 1 while priming a different threat-related word. Whereas Study 1 used an attachment-unrelated threat word prime (*failure*), Study 2 used an attachment-relevant threat word prime (*separation*). The Hebrew word for separation used in this study [*preida*] is used primarily in interpersonal contexts to indicate distance between relationship partners or the breakup of a relationship. A different word is used in Hebrew to characterize, for example, a wall or barrier "separating" pieces of property or stacks of paper.

Participants completed the three measures described in Study 1 that were designed to elicit lists of names of attachment figures (WHOTO scale), other close persons, known persons, and unknown persons. They then performed a 192-trial lexical decision task similar to the one described in Study 1. This task was constructed according to a within-subject 2 × 5 factorial design defined by prime word (separation, neutral) and type of target stimuli (names of attachment figures, names of close persons,

[7] In all three studies, ANOVAs for Attachment Dimensions × Prime Type × Target contrasts (attachment figures vs. close others or attachment figures vs. average of all other persons) yielded identical results to those obtained in the reported analyses.

names of known persons, names of unknown persons, nonwords). Following the lexical decision task, participants completed the ECR scale and the trait anxiety form of the STAI.

Method

Participants. Another independent sample of 48 psychology students (35 women and 13 men ranging in age from 19 to 37 years, median = 24) from Bar-Ilan University participated in the study as part of the requirements for their undergraduate degree.

Materials and procedure. Participants were run individually and completed the three measures described in Study 1 that were designed to elicit names of attachment figures, other close persons, known persons, and unknown persons. The average number of names generated in the WHOTO scale was 3.39 ($SD = 1.31$).

Following completion of the three measures, all participants received the filler 20-item questionnaire described in Study 1. Then they performed the computerized 192-trial lexical decision task described in Study 1. The single difference from the lexical decision task used in Study 1 was the threat word prime. Whereas the Hebrew word for failure was used as the threat word prime in Study 1, we used the Hebrew word for separation as the threat word prime in Study 2. The Hebrew word for separation [*preida*] was presented in 96 of the trials and compared against the Hebrew word for umbrella ([*mitria*] neutral word prime), which was of equal length and was presented in the remaining 96 trials.

Following the lexical decision task, participants received a distractor scale on social issues and then two randomly ordered self-report scales tapping attachment style and trait anxiety. Attachment style was assessed using the ECR scale described in Study 1. In the current sample, Cronbach alphas were high for the 18 anxiety items (.85) and the 18 avoidance items (.90). These scores were not significantly associated, $r(46) = .14$, *ns*. Trait anxiety was assessed using the trait form of the STAI described in Study 1. In the current sample, the Cronbach alpha coefficient for the 20 items was high (.90). Following completion of the self-report scales, participants were debriefed about the procedure and thanked for their participation.

Results and Discussion

Psychological threat and the accessibility of attachment figures. For each person, RTs (for correct responses) were averaged according to type of target stimuli and prime word. We then conducted the two-way repeated measures ANOVA described in Study 1. This analysis yielded a significant main effect for target stimuli, $F(4, 188) = 23.16$, $p < .01$, $\eta^2 = .31$. A Scheffé test for repeated measures revealed that participants responded with faster RTs to names of attachment figures ($M = 522.09$) than to names of unknown persons ($M = 575.90$), names of close persons ($M = 579.32$), nonwords ($M = 592.74$), or names of known persons ($M = 598.83$). The main effect of prime word was not significant ($F < 1$, $\eta^2 = .01$), but the interaction between prime word and target stimuli was significant, $F(4, 188) = 8.73$, $p < .01$, $\eta^2 = .16$. Replicating findings of Study 1, simple main effects tests for repeated measures revealed that the separation word prime led to faster RTs for names of attachment figures than a neutral prime, $F(1, 188) = 11.19$, $p < .01$ (see means in Table 1), but had no significant effect on RTs for names of close persons, names of known persons, names of unknown persons, or nonwords ($F < 1$; see means in Table 1).

The contribution of attachment style. In examining the contribution of attachment style, we conducted the hierarchical regressions described in Study 1. For names of attachment figures, the regression revealed the following significant effects. First, as in Study 1, attachment anxiety made a significant unique negative contribution to RTs for names of attachment figures following the priming of either the word *separation* or a neutral word—$\beta = -0.33$, $t(45) = -2.48$, $p < .05$ and $\beta = -0.42$, $t(45) = -3.09$, $p < .01$, respectively. Second, unlike what happened in Study 1, attachment avoidance made a significant unique positive contribution to RTs for names of attachment figures following the priming of the word *separation*, $\beta = 0.49$, $t(45) = -3.76$, $p < .01$, but not following the priming of a neutral word, $\beta = -0.19$, $t(45) = -1.47$, $p > .10$. Third, the interaction of anxiety and avoidance was not significant in either priming condition. Regressions conducted on RTs for other target stimuli revealed no significant effects of attachment scores.

A three-way ANOVA for attachment anxiety (above or below the median), attachment avoidance (above or below the median), and prime word (threat, neutral) on RTs for names of attachment figures revealed the already reported significant main effect for prime word, $F(1, 44) = 25.85$, $p < .01$, $\eta^2 = .24$, and a significant main effect for attachment anxiety, $F(1, 44) = 13.15$, $p < .01$, $\eta^2 = .16$. Replicating findings of Study 1, persons scoring high on attachment anxiety reacted faster to names of attachment figures ($M = 498.59$, $SD = 59.95$) than persons scoring low on this attachment dimension ($M = 546.59$, $SD = 53.63$). The main effect for attachment avoidance was not significant, but the interaction between prime word and attachment avoidance was significant, $F(1, 44) = 31.21$, $p < .01$, $\eta^2 = .29$. No other interactions were significant. ANOVAs performed on RTs for other target stimuli yielded no significant main effects or interactions.

Simple main effects tests revealed that the separation word prime led to faster RTs for names of attachment figures ($M = 465.71$, $SD = 49.44$) than a neutral prime ($M = 536.72$, $SD = 57.23$) among persons who scored low on attachment avoidance, $F(1, 44) = 43.54$, $p < .01$. However, the prime word had no significant effect on the RTs of persons scoring high on attachment avoidance, $F(1, 44) = 1.46$ ($M = 540.67$, $SD = 54.05$ for separation word prime; $M = 534.27$, $SD = 58.58$ for neutral word prime). Overall, these analyses revealed that attachment avoidance significantly qualified the effect of the separation word prime on RTs for names of attachment figures.

The contribution of trait anxiety. Pearson correlations revealed significant associations between trait anxiety and the two attachment scores, $r(46) = .62$, $p < .01$ for anxiety; $r(40) = .44$, $p < .01$ for avoidance. However, none of the correlations between trait anxiety and RTs for the various target stimuli were significant (*r*s = ranging from .09 to .15). In fact, a three-way ANOVA for target stimuli, prime word, and trait anxiety (above or below the median) showed that neither the main effect for trait anxiety nor its interactions with target stimuli and/or prime word were significant ($F < 1$). Moreover, regressions revealed that the statistical control of trait anxiety did not influence the observed effects of attachment scores. That is, the effects of attachment anxiety on RTs for names of attachment figures following the separation word prime or the neutral word prime—$\beta = -0.36$, $t(44) = -3.27$, $p < .05$; $\beta = -0.47$, $t(44) = -2.85$, $p < .01$, respectively—as well as the effect of attachment avoidance on RTs for attachment names following the separation word prime—$\beta = 0.50$, $t(44) = 3.45$, $p < .01$—were still significant after controlling for trait anxiety. In addition, none of the interactions of trait anxiety with attachment scores made significant contributions to lexical decision RTs. The find-

ings replicated those of Study 1, indicating that trait anxiety did not significantly explain the effects of prime word and attachment scores.

Conclusions. Taken together, the findings replicated and extended the findings of Study 1. First, the priming of an attachment-related threat word (*separation*) heightened the accessibility of the names of attachment figures. Second, this effect was specific to the attachment domain, because the separation word prime had no significant effect on RTs for names of other close persons who did not serve attachment functions, names of persons whom participants knew but who were not close to them and not viewed as attachment figures, and unknown persons. Third, attachment anxiety was associated with higher accessibility of names of attachment figures regardless of the primed context (separation or neutral). Fourth, the analyses also revealed a previously unobserved effect: Attachment avoidance was found to be significantly associated with *lower* accessibility of names of attachment figures following the priming of a separation context. This result was compatible with Fraley and Shaver's (1997) and Fraley, Garner, and Shaver's (2000) findings that attachment avoidance reduced the accessibility of attachment themes related to separation from attachment figures. Fifth, none of these effects were significantly explained by individual variations in trait anxiety.

Study 3

Study 3 was an attempt to replicate and extend the findings of Studies 1 and 2 using a different cognitive task and a different experimental design. First, whereas Studies 1 and 2 examined the cognitive accessibility of representations of attachment figures in a lexical decision task, Study 3 used a Stroop (1938) color-naming task. Research consistently indicates that the activation of a specific mental representation increases attention to representation-congruent elements, thus leading to a slowing of color naming of representation-relevant words in the Stroop task (e.g., Mathews & McLeod, 1985; Warren, 1972). That is, interference with color-naming responses in the Stroop task is viewed as a valid indicator of the accessibility of cognitive material. Therefore, if a threatening context activates the representation of attachment figures, one should expect slower color naming (longer RTs) in the Stroop task for names of attachment figures following the priming of threat than neutral words.

Second, whereas Studies 1 and 2 used a within-subject design to manipulate the specific primes, Study 3 used a between-subjects design. Instead of exposing a participant to different primes within the Stroop task, each participant in Study 3 was exposed to a single prime that recurred in all of the trials of the Stroop task. Specifically, participants were randomly divided into three conditions according to the specific prime word to which they were subliminally exposed during the Stroop task: the *failure* word prime, the *separation* word prime, or a neutral word prime.

In Study 3, participants completed the three measures described in Studies 1 and 2 that were designed to elicit lists of names of attachment figures, other close persons, known persons, and unknown persons. They then performed a computerized 128-trial Stroop task in which they were asked to name the color in which a target stimulus was presented on the monitor. These target stimuli consisted of four names of attachment figures, four names of close persons, four names of known persons, and four names of unknown persons. The target names were individually constructed for each participant on the basis of responses to the WHOTO scale and the name-generation tasks carried out before the Stroop task. In all trials of the Stroop task, participants were subliminally exposed to one of three word primes (*failure*, *separation*, or *hat*) before being exposed to the target stimulus. The dependent variable was the color-naming RT to each target stimulus. Following the Stroop task, participants completed the ECR scale and the trait anxiety form of the STAI.

Method

Participants. Another independent sample of 120 psychology students (88 women and 32 men ranging in age from 18 to 34 years, median = 22 years) from Bar-Ilan University participated in the study as part of the requirements for their undergraduate degree. Participants were randomly divided into three priming conditions, with 40 participants in each.

Materials and procedure. Participants were run individually and completed the three measures described in Study 1 that were designed to elicit names of attachment figures, other close persons, known persons, and unknown persons. The average number of names generated on the WHOTO scale was 3.28 (SD = 1.23). Participants then received the 20-item filler questionnaire described in Study 1.

Following these measures, participants performed a computerized 128-trial Stroop task in which they were asked to name the color in which a target stimulus was presented on the monitor. The task was conducted on the apparatus described in Study 1 (Pentium IBM-PC with an SVGA color monitor). The word primes were displayed in black lettering and the target stimuli were displayed in one of four colors (red, blue, green, yellow) on a white background in the middle of the monitor. Each of the four colors was used in 32 trials. Participants worked at their own pace. They were first given 10 practice trials and then 128 experimental trials. The target stimuli in the practice trials were different from those in the experimental trials.

Each trial of the task began with an *x* in the middle of the screen followed by a 20-ms subliminal presentation of a prime word, and then by an *XXX* pattern, which was presented for 500 ms and served as a backward mask. Immediately following this mask, 1 of 16 target stimuli was presented for 1,000 ms, and participants named as quickly as possible the color of the target stimulus by pressing an appropriately labeled key on a four-key response box. The trial then ended and the next trial began.

The target stimuli consisted of 16 people's names that were generated for each participant in the way described in Study 1: four names of attachment figures, four names of close persons, four names of known persons, and four names of unknown persons. Each combination of 1 of the 16 names and one of the four colors (green, blue, red, yellow) was shown twice, resulting in eight presentations of each name in a total of 128 trials (8×16). The order of presentation and the color of the target names were randomly determined for each participant, subject to the constraint that no two consecutive target names were displayed in the same color.

During the Stroop task, participants were randomly divided into three conditions according to the prime word that was subliminally presented for 20 ms in each of the 128 trials. In the failure condition, the prime word was the Hebrew word for *failure*. In the separation condition, participants were exposed to the Hebrew word for *separation*. In the neutral priming condition, the prime word was the Hebrew word for *hat*. In each condition, the same prime word appeared in all 128 trials of the Stroop task.

Following the Stroop task, participants received a distractor scale that asked about social issues and then two randomly ordered self-report scales tapping attachment style and trait anxiety. Attachment style was assessed using the ECR scale described in Study 1. In the current sample, Cronbach alphas were high for the 18 anxiety items (.91) and the 18 avoidance items (.91), so two scores were computed by averaging items on each subscale. These scores were not significantly associated, $r(118) = .03$. Trait anxiety was assessed using the Hebrew version of the trait form of the STAI

(Spielberger et al., 1970) described in Study 1. In the current sample, the Cronbach alpha coefficient for the 20 items was high (.89), allowing us to compute a trait anxiety score by averaging the items. No significant differences were found in attachment scores and trait anxiety between the three priming conditions ($F < 1$).

Results and Discussion

Psychological threat and the accessibility of attachment figures. For each person, color-naming RTs (for correct responses) were averaged according to type of target stimuli. We then conducted a two-way ANOVA for prime word (failure, separation, neutral) and target stimuli (names of attachment figures, names of close persons, names of known persons, names of unknown persons) on the averaged RTs. The last factor was a within-subject repeated measure. This analysis yielded a significant main effect for type of target stimuli, $F(3, 351) = 18.23$, $p < .01$, $\eta^2 = .19$. A Scheffé post hoc test for repeated measures revealed that participants responded with longer color-naming RTs to names of attachment figures ($M = 719.66$) than to names of close persons ($M = 694.98$), names of known persons ($M = 695.74$), or names of unknown persons ($M = 693.51$). No significant difference was found between other target stimuli categories. The main effect of prime word was not significant ($F < 1$, $\eta^2 = .02$), but the interaction between prime word and type of target stimuli was significant, $F(6, 351) = 4.62$, $p < .01$, $\eta^2 = .11$.

Simple main effects tests revealed that the source of the significant interaction resided in the differential effects of priming condition across kinds of target stimuli. On the one hand, priming condition had a significant effect on RTs for names of attachment figures. In this case, participants in the failure and separation priming conditions reacted with longer color-naming RTs to names of attachment figures than the participants in the neutral priming condition, $F(2, 351) = 12.31$, $p < .01$ (see means in Table 2). No significant difference was found between the failure and separation priming conditions. On the other hand, priming condition had no significant effect on color-naming RTs for names of close persons, names of known persons, or names of unknown persons ($F < 1$; see means in Table 2). In these cases, neither the *separation* nor the *failure* word prime significantly affected color-naming RTs in comparison with the neutral priming condition. These effects were conceptually similar to those of Studies 1 and 2 and fit our predictions about the effects of threat on the activation of representations of attachment figures.

The contribution of attachment style. In examining the contribution of attachment scores, we conducted a hierarchical regression analysis predicting color-naming RTs. This regression was separately conducted for each target stimulus category. In this regression, the predictors were attachment anxiety, attachment avoidance, two dummy variables—threat context (a contrast of the two threat prime conditions, failure and separation, to the neutral prime condition) and type of threat context (a contrast of the separation prime condition and the failure prime condition)—and the interactions of anxiety with avoidance and of each dummy variable with the attachment scores. In these regressions, the main effects of the predictors were introduced in Step 1. The two-way interactions were introduced in Step 2. The three-way interactions were entered in Step 3.[8]

The regressions conducted on RTs for names of close persons, names of known persons, and names of unknown persons yielded no significant main effects or interactions. Only the regression conducted on RTs for names of attachment figures revealed significant effects of the priming manipulations and attachment scores. This regression yielded the following results. First, significant main effects were found for threat context, $\beta = 0.30$, $t(115) = 3.72$, $p < .01$, and attachment anxiety, $\beta = 0.39$, $t(115) = 4.72$, $p < .01$. Both the priming of a threat context (either failure or separation) and having higher scores on attachment anxiety were associated with higher cognitive activation (longer color-naming latencies) of names of attachment figures. Second, the main effects for type of threat context and attachment avoidance were not significant ($t < 1$). Third, the interaction between anxiety and avoidance as well as all the interactions between threat context and attachment scores were not significant ($t < 1$). Fourth, the interaction between type of threat context and attachment anxiety as well as the interaction between types of threat context, attachment anxiety, and attachment avoidance were not significant ($t < 1$). Fifth, only the interaction between type of threat context and attachment avoidance was statistically significant, $\beta = -0.74$, $t(110) = -2.15$, $p < .05$.

In examining the source of the significant interaction between type of threat context and attachment avoidance, we computed partial correlations (controlling for attachment anxiety) between attachment avoidance and RTs for names of attachment figures within each threat condition. These analyses revealed that avoidance was significantly and inversely related to RTs for names of attachment figures in the separation prime condition, $r(37) = -.31$, $p < .05$, but not in the failure priming condition, $r(37) = .13$. Only following the separation word prime was avoidance significantly related to decreased accessibility of names of attachment figures (shorter color-naming RTs).

The lack of significant interactions of threat context or type of threat context with attachment anxiety implied that the effect of attachment anxiety did not significantly depend on prime words. In fact, within-condition partial correlations (controlling for attachment avoidance) revealed significant positive associations between attachment anxiety and RTs for names of attachment figures in the three priming conditions: $r(37) = .32$, $p < .05$ in the neutral priming condition; $r(37) = .34$, $p < .05$ in the failure priming condition; $r(37) = .35$, $p < .05$ in the separation priming condition. Replicating the findings of Studies 1 and 2, attachment anxiety was found to facilitate the accessibility of representations of attachment figures even under nonthreat conditions.

The contribution of trait anxiety. In examining the contribution of trait anxiety, Pearson correlations revealed significant associations between trait anxiety and the two attachment scores—$r(118) = .45$, $p < .01$ for attachment anxiety; $r(118) = .20$, $p < .05$ for attachment avoidance. However, none of the correlations between trait anxiety and color-naming RTs for the various target stimuli were significant (rs = ranging from $-.01$ to .06). In fact, a three-way ANOVA for target stimuli, prime word, and trait anxiety (above or below the median) showed that neither the main effect of trait anxiety nor its interactions with target stimuli and/or

[8] Three-way ANOVAs for attachment anxiety (above or below the median), attachment avoidance (above or below the median), and priming condition revealed identical results to those obtained in the regression analysis.

Table 2
Means and Standard Deviations of Color-Naming Reaction Times in the Stroop Task as a Function of Prime Word and Target Stimuli (Study 3)

	Prime word					
	Failure		Separation		Neutral	
Target stimuli	*M*	*SD*	*M*	*SD*	*M*	*SD*
Attachment figures	734.47_a	84.70	734.23_a	63.36	690.27_b	65.05
Close persons	698.13_b	73.16	698.28_b	67.14	688.53_b	66.63
Known persons	693.76_b	76.59	700.05_b	72.12	693.41_b	65.07
Unknown persons	699.33_b	72.45	694.31_b	67.91	686.89_b	64.85

Note. A mean is different from other means in its row and/or column at $p < .05$, according to Scheffé tests, if their subscripts differ.

priming condition were significant ($F < 1$). Moreover, regressions revealed that the main effect for attachment anxiety and the interaction of type of threat and attachment avoidance on RTs for names of attachment figures were still significant after controlling for trait anxiety—$\beta = 0.37$, $t(114) = 4.48$, $p < .01$; $\beta = -0.81$, $t(114) = -2.15$, $p < .05$, respectively. These regressions also revealed that interactions of trait anxiety with threat context, attachment anxiety, and attachment avoidance made no significant contribution to color-naming RTs. Overall, trait anxiety did not significantly explain the effects of priming condition and attachment scores on color-naming RTs.

Conclusions. The findings of Study 3 replicated the findings of Studies 1 and 2 using a different cognitive task (Stroop task) and a between-subjects priming manipulation. In line with our predictions, the priming of threat-related words, either *failure* or *separation*, heightened the accessibility of representations of attachment figures, thereby interfering with designation of the color in which those figures' names were printed (longer RTs). Replicating our previous studies, this significant priming effect was unique to attachment representations and did not significantly generalize to other target stimulus categories. The findings also replicated the effects of attachment style observed in Studies 1 and 2: Whereas attachment anxiety heightened the accessibility of representations of attachment figures (longer color-naming RTs) even in neutral priming conditions, attachment avoidance seemed to inhibit this accessibility (shorter color-naming RTs) following a *separation* (but not a *failure*) word prime. None of these effects were significantly explained by trait anxiety.

General Discussion

The findings reported here provide important information about attachment-system activation in adulthood. First, they consistently show that threat contexts automatically activate cognitive representations of attachment figures. That is, representations of people who are a source of comfort may be neurologically active and may preconsciously influence mental processes during the encounter with a threat, even when this threat is irrelevant to interpersonal relationships or to the frustration of attachment needs. Second, the findings delineate attachment-style differences in attachment-system activation. Whereas attachment anxiety heightened the accessibility of representations of attachment figures even in nonthreatening contexts, attachment avoidance inhibited this accessibility in an attachment-related threat context. Taken as a whole, the current studies constitute one of the first systematic attempts to directly examine the contextual triggers and individual-difference factors underlying attachment-system activation in adulthood.

Across the three studies, the findings indicated that participants reacted to threat contexts with heightened accessibility of the names of the people they listed as serving attachment functions in the WHOTO scale (i.e., the names of attachment figures). Of importance, this effect was replicated using two different cognitive techniques: lexical decisions and Stroop color naming. As compared with subliminal neutral priming, the subliminal priming of threat words led to (a) faster identification of names of attachment figures in the lexical decision task and (b) slower RTs in naming the color of names of attachment figures. In both cases, fast lexical decision RTs and slow color-naming RTs were interpreted as manifestations of heightened activation of representations of attachment figures in threatening contexts. In addition, this pattern of accessibility was replicated in both within-subject and between-subjects designs, and was not constrained to the priming of a specific threat word. Rather, it occurred both when attachment-unrelated (*failure*) and when attachment-related (*separation*) threat words were primed. As a whole, the replicability of the findings across cognitive techniques and threat contexts contributes to the robustness of the findings and strengthens their internal validity.

The idea of attachment-system activation under conditions of threat has been central to attachment theory and has been studied in infants by observing their behavior in the Strange Situation (Ainsworth et al., 1978). The current studies may be the first to show that, when threatened (even if only unconsciously), the adult mind turns automatically to representations of attachment figures. Presumably, this is the first step in a process that often results in actually searching for these figures and increasing physical and/or psychological proximity to them. Our findings provide support for the protective function of the attachment system in adulthood and increase our confidence in the psychological reality of the attachment system.

To fully appreciate the protective function of attachment relationships, we need to integrate various sets of findings. First, our findings fit with those of Mikulincer et al. (2000): Whereas our findings indicate that threats heighten the accessibility of representations of attachment figures, Mikulincer et al. (2000) found that threats heightened the accessibility of proximity-related con-

cepts (e.g., love, closeness). In both cases, the encounter with threats seems to have activated not only thoughts about the threatening event but also attachment-related thoughts. That is, people exposed to a threatening event may be consciously occupied with this event, but their mental processes may also be affected by highly accessible representations of attachment figures and themes. Second, Mikulincer, Hirschberger, Nachmias, and Gillath (2001) found that the contextual activation of representations of attachment figures has positive affective connotations, produces a "spill over" of positive affect, and buffers the detrimental effects of threatening events. Thus, we conclude that automatic activation of the attachment system during a threatening encounter may act as an inner resource, promoting emotional adjustment and protecting a person's well-being.

It is important to note that threat contexts did not have a significant effect on the accessibility of the names of known persons and unknown persons, thereby enabling the rejection of a familiarity explanation. Furthermore, the priming of threat words had no significant effect on representations of close persons who did not serve attachment functions. That is, the effects of threat seemed to be specific to persons who accomplished attachment functions. However, one can still alternatively suggest that these persons may be the partners with whom one experiences high relationship closeness or relationship quality and that these feelings are the key explanatory constructs rather than attachment. One problem with this interpretation is that it fails to take into account differences between accomplishment of attachment functions and relationship closeness and quality. In fact, relationship closeness and quality are not solely derived from the attachment functions a partner serves. One can feel very close to a relationship partner (e.g., a friend) with whom one enjoys many exploratory and affiliative activities without turning to this partner as a source of support in times of need. Moreover, Trinke and Bartholomew (1997) found that attachment relationships, measured with a modified version of the WHOTO questionnaire used in our studies, differed considerably from research participants' closest relationships, defined by interdependence of activities. Future studies should attempt to identify persons with whom a participant feels relationship closeness without nominating them as attachment figures and explore the accessibility of their representations in threatening contexts. We would expect closeness not to work in the same way as attachment.

There are additional reasons for doubting that the WHOTO measures closeness or intimacy or other such alternatives to attachment. First, the WHOTO scale was specifically designed to identify attachment figures. Its items stem directly from attachment theory, not from theories of closeness or intimacy. Second, RTs for identifying names of attachment figures differed systematically as a function of attachment-related anxiety and avoidance, which were also measured with scales derived from attachment theory. There would be no obvious reason for this result to have occurred if the WHOTO measured something other than attachment, such as closeness or intimacy. In other words, there is no alternative theory that predicts the results we obtained, no alternative theory that would have generated either these particular kinds of measures or our particular experiments. Third, at least one measure of closeness has been shown not to relate very highly to a version of the WHOTO measure (Trinke & Bartholomew, 1997). Thus, attachment and closeness seem not to be the same. Fourth, in two of our three studies, close relationship partners other than those mentioned in the WHOTO questionnaire did not produce RTs that differed from RTs for nonclose acquaintances, or even for people with whom the participant had no relationship at all. Thus, it would be difficult to argue that we were simply measuring the high end of a closeness continuum. Other alternative constructs, such as trust and support, are more difficult to discount, because they are so conceptually interwoven with attachment that they may not be real alternatives. Further research is needed to compare the WHOTO with measures targeting trust and support.

Of course, there are still alternative explanations of the findings that can be tested in future studies. For example, it is possible that attachment targets are all figures with whom the individual has communal relationships and that they are the first ones that come to mind when needs become salient. Similarly, from an inclusion of other in the self-perspective (Aron, Aron, & Norman, 2001), the failure prime is also a threat to one's closest others and making separation salient makes salient those with whom separating self from others would be most painful. However, given that all of our measures derived from attachment theory and that the results were highly consistent with the theory, researchers with other perspectives should develop systematic and coherent programs of research testing alternative explanations of the findings.

Our findings contribute to the validity of the WHOTO scale. A review of adult attachment literature reveals that only a few studies have used WHOTO kinds of measures (e.g., Fraley & Davis, 1997; Hazan & Zeifman, 1994; Trinke & Bartholomew, 1997), and no one has known whether these measures are valid and tap a construct that has psychological reality. The fact that a participant mentions the name of a person in the WHOTO scale as someone who provides a safe haven does not automatically imply that this person actually functions as an attachment figure in real-life threatening situations or occupies a special place in the participant's semantic network. Our findings indicate that the WHOTO scale is surprisingly construct valid, and they allow us to say with some confidence that the people identified by the WHOTO scale are psychologically special. These people seemed to be differentiated from other close persons within participants' minds during a threatening encounter. That is, adults can name the members of a specific category of close persons who accomplish attachment functions and become mentally salient in threat contexts. However, one should take into account that the WHOTO scale is biased towards security-enhancing attachment figures and may miss figures to whom a person is more insecurely attached (Trinke & Bartholomew, 1997). Further research should use other scales, such as the Attachment Network Questionnaire (Trinke & Bartholomew, 1997), to identify a broader range of attachment figures and examine the accessibility of their representations in threatening contexts.

It is also important to note that the effects of threat were not significantly explained by trait anxiety, although this individual-difference factor was consistently and systematically associated with attachment-related anxiety and avoidance. Of course, there are other individual-difference factors, such as self-esteem, that may be correlated with attachment style and may explain the effects of threat on the accessibility of representations of attachment figures. In fact, self-esteem is closely related to Bartholomew and Horowitz's (1991) self-model dimension and to Brennan et al.'s (1998) attachment anxiety dimension. However, there is ac-

cumulating evidence that although self-esteem correlates with attachment anxiety, it consistently fails to explain the psychological effects of this attachment dimension (e.g., Mikulincer & Florian, 2000).

The design of the studies reported here allowed us to explore the possible role that variations in attachment style may play in affecting attachment-system activation. On the one hand, the findings documented a general trend whereby the accessibility of representations of attachment figures under attachment-unrelated threat contexts did not significantly depend on variations in attachment avoidance or attachment anxiety. This finding implies that everyone has an attachment system that is responsive to attachment-unrelated threats. Even insecurely attached persons seem to have special attachment figures and to activate the representations of these figures under threatening conditions. On the other hand, attachment style was still relevant for explaining attachment-system activation in nonthreat contexts as well as attachment-related threat contexts. Whereas attachment anxiety significantly facilitated the activation of representations of attachment figures in neutral contexts, attachment avoidance significantly inhibited this activation under attachment-related threat conditions.

Persons scoring high in attachment anxiety were found to have heightened activation of representations of attachment figures in both neutral and threat contexts. This finding fits with Mikulincer et al.'s (2000) results and can be explained by anxiously attached individuals' affect-regulation strategies and working models. Specifically, people with high attachment anxiety have been found to exhibit a hyperactivation of the attachment system and to appraise daily transactions with the environment in threatening terms (for reviews, see Mikulincer & Florian, 2001; Shaver & Clark, 1994). As a result, they may fail to differentiate between neutral and threatening contexts, therefore activating representations of attachment figures even in neutral contexts. Furthermore, their negative models of self (Shaver & Hazan, 1993) and their tendency to ruminate on negative thoughts (Mikulincer & Florian, 2001) may color this activation with basic insecurities, thereby facilitating the accessibility of worries about rejection.

These findings tentatively suggest chronic, dysfunctional activation of the attachment system. First, anxiously attached individuals tend to exhibit high accessibility of representations of attachment figures even when there is no external threat. Second, this activation is colored by attachment-related worries, which may compound the distress when there actually is a threatening event. Third, a cognitive linkage between representations of attachment figures and thoughts about rejection may deter anxiously attached persons from actually seeking support. In short, although attachment-anxious persons may experience heightened accessibility to representations of attachment figures, this activation may exacerbate distress rather than serving as a coping resource and a source of comfort. Of course, these notions about chronic activation of the attachment system are speculative and need to be examined in future studies that track anxious persons' accessibility of attachment-related representations across time.

Persons scoring high on attachment avoidance showed a complex pattern of accessibility of representations of attachment figures. When the threat context (i.e., failure) was not directly related to attachment themes, avoidant individuals did not differ significantly from people who scored low on this attachment dimension. In this threat context, heightened activation of representations of attachment figures was found even among highly avoidant persons. However, in an attachment-related threat context (i.e., separation), persons scoring high on attachment avoidance showed less activation of representations of attachment figures than persons scoring low on this dimension.

Avoidant individuals' heightened activation of representations of attachment figures in attachment-unrelated threat contexts seems to be inconsistent with findings that these people tend to deactivate the attachment system and distance themselves from others (e.g., Fraley & Shaver, 1997; Fraley et al., 2000). However, this pattern of accessibility fits with Mikulincer et al.'s (2000) finding that thoughts about proximity are activated in threatening contexts even among highly avoidant persons. This discrepancy may be due to basic differences in the assessment of avoidant individuals' responses. Whereas past studies have relied on self-reports or behavioral observations, we and Mikulincer et al. (2000) relied on cognitive techniques that do not involve conscious deliberation about proximity seeking. We tentatively conclude that avoidant individuals react to threats with preconscious activation of the attachment system, but this activation may not reach consciousness and may not be transformed into behavioral intentions to seek proximity. This conclusion comports with findings concerning avoidant persons' regulatory strategies (Fraley et al., 1998), by which they repress any need for love and dissociate preconscious activation from conscious thoughts and intentions.

Avoidant individuals' preconscious activation of the attachment system seems to be automatically, and very quickly, inhibited in contexts that present a direct threat to attachment relationships—for example, the threat of separation. In this case, their responses in the lexical decision and Stroop tasks resemble their self-reported thoughts and their actual behavior in interpersonal situations. That is, their attachment system seems to be either deactivated even at a preconscious level or activated and then quickly deactivated. This finding implies that attachment avoidance has an inhibitory effect on the activation of representations of attachment figures in contexts that threaten proximity maintenance and portend the removal of a secure base. It seems that avoidant persons have learned not to appeal to attachment figures when those figures are threatening to leave—in fact, they have learned to inhibit the natural tendency to seek proximity, which at a fundamental level they possess, as indicated by their performance in nonattachment-related threat contexts.

This possibility is compatible with suggestions made by Ainsworth et al. (1978) concerning the behavior of avoidant infants, whose mothers seem angrier than the mothers of infants with other attachment classifications, less comfortable with physical contact, less expressive of positive emotion, and less tolerant of their infants' expressions of anxiety, vulnerability, and neediness. Ainsworth et al. (1978, p. 320) claimed, for example, that "avoidance short circuits direct expression of anger to the attachment figure, which might be dangerous, and it also protects the baby from reexperiencing the rebuff that he has come to expect when he seeks close contact with his mother." Perhaps when this "short circuiting" is practiced for a long time, it can become an automatic process.

It would be interesting to explore further how avoidant persons' inhibitory processes work, what they are designed to accomplish (e.g., protection from a potentially angry, punitive attachment

figure; reduction of the attachment figure's tendency to threaten abandonment or decrease support if a particular separation is resisted), and when they arise—either in the course of development or in the course of a particular long-term relationship. Other findings suggest that avoidant individuals' tendency to suppress thoughts about separation (Fraley & Shaver, 1997; Fraley et al., 2000) is automatically extended to representations of attachment figures that may be associated with this threat.

Before closing the discussion, some possible limitations should be considered. In all three studies, participants received the ECR scale after the cognitive tasks, so their answers might have been affected by thoughts and feelings elicited in the experimental situations. However, this limitation should not be seen as a major problem because a distracter task was included before the attachment measure. In addition, no significant differences in attachment scores were found between the three priming groups of Study 3. In fact, measuring attachment style before the manipulations would have been more problematic, because it might have activated chronic attachment-related schemas that could have affected responses in the cognitive tasks. In future studies, it would be worthwhile to attempt to replicate the current findings after measuring attachment style in a separate session.

We should also note that our threat contexts were relatively benign and participants were exposed only to threat-inducing words, not to actual threats. In fact, the history of measures rooted in the verbal/semantic system not predicting behavior has to make us cautious. Further research should examine the activation of representations of attachment figures in real-life threatening contexts. However, in the attachment area, verbal measures have been consistently related to many kinds of behavior (for reviews, see Shaver & Clark, 1994; Shaver & Hazan, 1993), and Bowlby's attachment working models are semantic representations of attachment relationships (Bowlby, 1973). In addition, we should note that most of the threats people face in real-life situations seem to be of a supraliminal kind. Subliminal threats are useful in research because they eliminate alternative hypotheses about people's deliberate, conscious attempts to shape their responses in a self-enhancing or hypothesis-confirming way. But further research is needed to illuminate the psychodynamics of attachment-system activation following exposure to supraliminal threats. Despite these caveats about our preliminary studies, we view our findings as an important step in studying the cognitive substrate of the attachment system and exploring the protective functions of this system in adulthood.

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