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Attachment style and immunity: a 1-year longitudinal study

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Abstract

Previous cross-sectional studies suggested an association between attachment-related avoidance and altered immune function. We aimed at testing this hypothesis with longitudinal data. A random sample of 65 female nurses provided a blood sample and completed measures of perceived stress, social support, alexithymia, and attachment style. Immune assays included lymphocyte proliferative response (LPR) to Phytohemagglutinin and NK cell cytotoxicity (NKCC). State measures (perceived stress and support) and immune measures were collected again after 4, 8, and 12 months. Linear mixed effects models were used to examine the relationship between attachment and immunity. While low to moderate levels of attachment-related avoidance were not associated with NKCC, there was a significant negative association (Beta -.35; p=0.005) between high levels of avoidance and NKCC. No association was observed between NKCC and attachment-related anxiety, and between LPR and both attachment dimensions. While our findings should be interpreted with caution due to study limitations such as the relatively small sample size and the inclusion of only female participants, they corroborate the notion that attachment is linked to physiology and health.

1. Introduction

Attachment theory (Bowlby, 1969; Bowlby, 1973; Bowlby, 1980) is a lifespan developmental theory that has emerged as a major theoretical framework for studying close relationships and individual differences in emotion regulation. It postulates that humans are born with a disposition to form and conserve some important intimate relationships that are essential for survival and good health from early childhood to old age. Children rapidly build attachment bonds with their parents and maintain them across childhood and into adulthood, while in adolescence committed romantic relationships begin to develop and gradually become the primary attachment bond. The term 'attachment style' refers to individual differences in affect regulation and in perceptions of and beliefs about self and close others (Mikulincer & Shaver, 2003; Weinfield et al., 1999). Two main dimensions, named attachment-related anxiety (about abandonment or insufficient love) and attachment-related avoidance (of intimacy and emotional expression), underlie adult attachment style and conceptually correspond to similar dimensions that can be observed in infants in a laboratory procedure called 'Strange Situation' (Ainsworth et al., 1978). Relatively low levels of both attachment-related anxiety and avoidance characterize secure attachment.

In the psychoimmunology literature, it is recognized that personality and individual difference factors may exert an organizing influence on behavior and physiology and may modulate the immune system (Kemeny & Laudenslager, 1999; Segerstrom, 2003). Attachment style is a candidate to be one of these factors, as attachment insecurity is associated with impaired emotion regulation (Allen & Manning, 2007; Cassidy, 1994), altered physiological reactivity to stress (Feeney & Kirkpatrick, 1996; Powers et al., 2006; Rifkin-Graboi, 2008), and increased vulnerability to a variety of physical diseases, including diseases with immune system involvement (Ciechanowski et al., 2010; Janković et al., 2009; McWilliams & Bailey, 2010; Mrazek et al., 1987; Picardi et al., 2003; Picardi et al., 2005). Two recent investigations corroborated this notion. In a cross-sectional study, we observed an association between high attachment-related avoidance and

decreased natural killer cell cytotoxicity (NKCC) independent of perceived stress, social support, alexithymia, and various health-related behaviors (Picardi et al., 2007), while another study reported an association between attachment-related avoidance and higher IL-6 response to marital conflict among adults in long-term, committed relationships (Gouin et al., 2009). Our previous study (Picardi et al., 2007) had a significant limitation in the reliance on a single estimate of immune parameters and the resulting suboptimal measurement reliability. The present study aimed at establishing the reliability of the reported association between attachment-related avoidance and immunity. To this purpose, our previous study was extended to include three follow-up assessments over a 1-year period.

2. Methods

2.1. Participants and procedure

The study was carried out in Ancona on a random sample of female nurses from the local National Health Service Unit. Given that the staff included only few male nurses, and that small to moderate gender differences in attachment avoidance were observed in most cultures (Schmitt et al., 2003), we decided to restrict enrollment to women, as otherwise we would not have been able to control for the possible confounding effect of gender. Given that it was performed as part of the periodic occupational health examinations, the study needed no formal approval by the local ethical committee, which was nevertheless consulted and gave informal authorization. Participants were fully informed of the study objectives and procedures, were provided the opportunity to ask questions, and gave their written informed consent to take part in the study. There were no refusals, likely due to the fact that the study was incorporated into the periodic occupational health examinations. Inclusion criteria were age < 60 years, at least two years in current job, absence of infectious diseases and chronic medical diseases, no history of major psychiatric disorders, and no current or recent treatment with drugs influencing the immune system (e.g., corticosteroids,

cytostatics, immunosuppressors, immunomodulators). The study sample comprises the 61 nurses included in the cross-sectional study and four other nurses whose data became available later.

The participants were evaluated at baseline and 4, 8, and 12 months after baseline. All assessment sessions were conducted between 8.30 and 9.30 a.m. in a quiet and comfortable room. Participants were requested to refrain from exercising, smoking, eating, drinking alcohol, and taking medication for at least 12 hours before each session. After participants had rested for at least 5 minutes in the sitting position, a blood sample was taken from a forearm vein and processed within 3 hours at the INRCA institute laboratory, as described below. Then, participants ate breakfast and were administered a standardized form to collect information about health-related habits, and a number of self-completed questionnaires with established validity and reliability in counterbalanced order. Trait measures were completed only at baseline, whereas state measures were completed on each occasion. Therefore, except for attachment and alexithymia, all the other study variables were measured longitudinally. All immune assays were performed blinded to all other measures collected in the study.

2.2. Assessment

2.2.1. Psychometric instruments

The Experiences in Close Relationships (ECR) questionnaire is a self-report instrument with established reliability and validity in non-clinical (Brennan et al., 1998) as well as psychiatric (Picardi et al., 2011) samples, which consists of 36 items, each scored on a 7-point scale. The instrument provides scores on two dimensions, named ‘Anxiety’ and ‘Avoidance’. Individuals scoring high on Anxiety tend to be preoccupied with their romantic relationships, to worry about being abandoned, to desire a high level of closeness to their partner, and to ask the partner for more feeling and commitment. Individuals scoring high on Avoidance tend to avoid emotional closeness and intimacy, to feel uncomfortable opening up to or depending on their partner, and to be reluctant to ask their partner for comfort, advice, or help.

The 20-item Toronto Alexithymia Scale (TAS-20) is a self-report questionnaire with demonstrated reliability and validity (Parker et al., 2003) which comprises 20 items, each scored on a 5-point scale. It measures the difficulty identifying and describing feelings, and the tendency to concentrate on the concrete details of external events rather than on feelings, fantasies, and other aspects of one's own inner experience. Higher scores denote higher alexithymic characteristics.

The Perceived Stress Scale (PSS) (Cohen et al., 1983) is a self-report questionnaire that has been thoroughly validated and widely used. The items are scored on a 5-point scale and summed to provide a total score. Higher scores reflect greater perceived stress. We used the 10-item version.

The Multidimensional Scale of Perceived Social Support (MSPSS) is a validated self-report questionnaire (Zimet et al., 1988) which consists of 12 items, each scored on a 7-point scale. Higher scores indicate greater perceived adequacy of support from family, friends, and significant others.

2.2.2. Cytotoxicity assay

The K562 tumor cell line was used as target. NKCC was assayed using a fluorimetric method described previously (Provinciali et al., 1992). Briefly, a stock solution (20 mg/ml acetone stored at -20°C) of carboxyfluorescein diacetate (c'FDA, Molecular Probes, USA) was diluted in PBS to a final concentration of 75 μg/ml. K562 cells were washed twice with PBS and then labeled with c'FDA by incubation at 37°C in a humidified 5% CO_2 incubator for 30 minutes. Subsequently, they were washed 3 times in PBS containing 1% bovine serum albumin and resuspended at a final concentration of $1x10^5$ cells/ml. C'FDA-labeled K562 cells ($1x10^4$) were incubated with effector cells in 200 ml total volume per well of a round microtiter plate. Effector target cell ratios from 100:1 to 12.5:1 were tested in triplicate. The plates were kept at 37°C in a humidified 5% CO_2 incubator for 3 hours and then centrifuged at 1,500 rpm for 5 minutes. The supernatant was separated by rapidly inverting the plate and flicking the supernatant out. Then, 100 ml of 1% Triton X-100 in 0.05 M borate buffer, pH 9.0, was added to each well. The plate was kept for 20 hours at

4°C to allow for solubilization and then it was read for fluorescence with a Titertek Fluoroskan II (Flow Laboratories, USA). The proportion of specific lysis was calculated as follows:

$$\% \text{ Specific Lyses} = F \text{ med} - F \text{ exp}/F \text{ med}$$

where F is the fluorescence of solubilized cells after the supernatant has been removed, med = F from target cells incubated in CM medium alone, and exp = F from target cells incubated with effector cells.

Results were then normalised by conversion to lytic units, calculated as the number of effector cells required to lyse 20% of target cells and reported as the number of lytic units contained in 10^7 cells (Bryant et al., 1992).

2.2.3. Lymphocyte proliferative response

Ficoll-Hypaque enriched peripheral blood MNCs at the concentration of 1x106/ml in RPMI (GIBCO, USA) containing 10 % FCS (GIBCO), penicillin (100 U/ml) and streptomycin (10 µg/ml), were used. Aliquots of 0.1 ml were distributed in microwells (Nunc, Denmark). Phytohemagglutinin (PHA) (Difco, USA) to reach the final concentrations of 0.0125 µg/ml and 0.05 µg/ml was added in the amount of 10 µL/well. After 48 hours of incubation in a 5% CO2-air environment at 37°C, H3-Td (Amersham, UK: specific activity, 2 Ci/ml) was added in the amount of 1 µCi/well. After additional 18 hours of incubation in CO2 atmosphere, cultured were killed by means of a cell harvester (Skatron, Norway) and radioactivity was measured by a scintillator counter (Packard, Italy). All cultures were performed in quadruplicate. The results, referring to the highest responses regardless of the mitogen concentration used, are expressed in counts per minute (cpm) per culture (Mocchegiani et al., 1994).

The INRCA institute laboratory is ISO 9000 certified, and the inter-assay reliability of NKCC and lymphocyte proliferation assays as calculated from the replicate samples is consistently higher than 95% as previously reported (Provinciali et al., 1992). In the present study, the inter-assay reliability of NKCC was 96%.

2.3. Statistical analysis

The analysis were based on Linear Mixed Effects (LME) models, and was performed with STATA software, version 12 (Stata Corporation, College Station, Texas, USA) and with R software version 2.14.2 (R Foundation for Statistical Computing, http://www.R-project.org). All tests were two-tailed, with alpha set at .05. Prior to analysis, data were screened for outliers. Two outliers with extremely high and fluctuating NKCC values were found and excluded from the analysis. Time was coded as 0, 1, 2, 3 at baseline, 4-, 8-, and 12-month follow-up, respectively. The effect of time was not statistically significant when considered as a categorical variable in the model, then in the reported results time was treated as a continuous variable, assuming that the change in the response variable is linear in time in order to gain statistical power. As a few missing data were deemed to be inevitable with this study design, no attempt was made to impute missing values; all collected data were included in the analyses. Longitudinal data were analysed by jointly considering all four follow-up measurements (baseline, 4-, 8- and 12-month data) and using a random intercept model to accommodate within-subject correlation across time. NKCC was regressed upon attachment-related anxiety and avoidance, time, age, NK cell number per mm3, TAS-20 score at baseline, quality of sleep, exercise, NSAIDS intake, tobacco and alcohol consumption, MSPSS and PSS scores. Given theoretical considerations about the relevance of attachment-related avoidance levels high enough to suggest attachment insecurity, and given that our previous cross-sectional study (Picardi et al., 2007) suggested a possible threshold effect, we looked for a non-linear relationship between attachment-related avoidance and NKCC. We first modeled the exposure variable as a cubic penalized spline, and then we approximated the smoothed curve into two linear splines to simplify the overall relationship (Hastie & Tibshirani, 1995; Wood, 2006). The numbers of knots and the smoothness of the curves, were chosen to minimize the Akaike information criterion (AIC) index. Similar analyses were also performed with lymphocyte proliferative response as dependent

variable, and with attachment-related anxiety in place of avoidance as independent variable. In all models, the interaction between attachment dimensions and time was also tested. As none of the models indicated a statistically significant interaction term between attachment dimensions and time, the interaction term was removed from the final models to increase parsimony.

3. Results

The 65 nurses included in this study were all Caucasian, had a mean age of 36.8±7.4 years (range 24-58) and their mean score on the ECR Anxiety and Avoidance scales was 64.6±20.7 and 40.6±17.3, respectively. Such mean scores are comparable to those observed among females in this age range in the Italian ECR validation study (Picardi et al., 2002). NKCC data were available for 62 participants at baseline and for 61, 61, and 60 participants at the 4-, 8-, and 12-month follow-up assessment, respectively. Lymphocytes proliferative response data were available for 57 participants at baseline and for 42, 59, and 60 participants at the 4-, 8-, and 12-month follow-up assessment, respectively. It can be estimated by a power calculation that a study with such a sample size can detect a moderate effect size (rho^2=0.32) with alpha set at 5% and beta at 80%.

TABLE 1 ABOUT HERE

Table 1 reports the correlations at baseline between all the variables that were considered in the study. We conservatively used Spearman's correlation coefficient as some variables (i.e., sleep, exercise) were dichotomous. In general, the pattern of correlations was as expected; NKCC was positively correlated with NK cell number, while attachment-related avoidance was positively correlated with attachment-related anxiety and negatively correlated with perceived social support.

FIGURE 1 ABOUT HERE

TABLE 2 ABOUT HERE

Before fitting the final mixed regression models, we inspected the smoothed plot of the attachment-related avoidance–NKCC association and we identified the level of avoidance at which NK cell cytoxicity started to decrease in a nonlinear way, and the point along the curve where the avoidance–NKCC relationship assumed a steep linear trend. The curve is non-linear with a turning point at a value of avoidance equal to 60 (Figure 1). Given this finding, we decided to approximate the smoothed curve into two linear splines to simplify the overall relationship. Alternative models were also inspected with a higher number of degrees of freedom and different location of the knots. The model with two linear splines turned out to be the best in terms of Akaike Information Criterion index. In an univariate model including only avoidance and time, there was a significant association between high levels of attachment-related avoidance and NKCC (regression coefficient -1.87, 95% C.I. -3.12—0.63; Beta -.35; p=0.003). The multivariate model estimates are reported in Table 2. While low to moderate levels of attachment-related avoidance were not associated with NKCC, high levels of avoidance, that were present in one fifth of participants (N=13), were significantly negatively associated with NKCC (p=0.005). As expected, NK cell number was associated with NKCC, though just short of significance (p=0.054). Also, greater perceived stress (p=0.065) was borderline associated with lower NKCC. To address the issue of the possible influence of the differences observed at baseline on the overall results, we repeated the analyses including only the 4-, 8-, and 12-month data. The results were consistent with the main analysis, as low to moderate levels of attachment-related avoidance were not associated with NKCC (p=0.22), whereas high levels of avoidance were significantly negatively associated with NKCC (p=0.03).

Figure 2 shows mean NKCC at each assessment point as a function of scoring above threshold on attachment-related avoidance or not. While this figure refers to a simple mean

comparison between groups, which is conceptually quite different from mixed regression analysis, it serves illustrative purposes as it shows that NKCC is consistently lower over time among participants with high attachment-related avoidance.

Consistently with cross-sectional findings at baseline, no association between attachment-related avoidance and lymphocyte proliferative response, and between attachment-related anxiety and both NKCC and lymphocyte proliferative response was found. In all four mixed regression models, no significant changes in NKCC or lymphocyte proliferative response over time were observed.

4. Discussion

Consistently with our previous cross-sectional study (Picardi et al., 2007), higher attachment-related avoidance was found to be independently associated with lower NKCC throughout a 1-year period including three other assessments. The association was independent of shared variance with attachment-related anxiety (Cameron et al., 2012) and of several factors that may affect immunity, such as perceived stress, social support, alexithymic characteristics, and health-related behaviors including the use of external regulators of affect such as nicotine and alcohol. A non-linear relationship was observed, suggesting that only high levels of avoidance, suggestive of attachment insecurity, are associated with altered immune function. This finding suggests that our cross-sectional results were not to ascribe to measurement unreliability due to the reliance on a single estimate of immune parameters. The relationship with the other measure of cellular immunity, i.e., lymphocyte proliferative response, was not statistically significant. It should be noted that we used only a particular mitogen, and that other mitogens may have yielded different results.

Our finding that the relationship between high attachment-related avoidance and reduced NKCC is maintained over a 12-month period, together with the findings of another recent study that

reported an association between attachment-related avoidance and higher IL-6 response to marital conflict discussion among adults in long-term committed relationships (Gouin et al., 2009), corroborate the notion that immune function is altered among individuals with insecure attachment in the form of high attachment-related avoidance. Interestingly, the high levels of avoidance associated with altered immune function were present in 20% of participants, a percentage very similar to that of women in the general population categorically classified as insecure avoidant (Mickelson et al., 1997). This suggests that immune correlates may be present only in individuals with levels of attachment-related avoidance sufficiently high to be classified as insecurely attached. Individuals with high attachment-related avoidance have negative expectations about their partner's availability for support, are less effective in seeking support and tend to perceive lower support from their partner (Collins & Feeney, 2000), and are reluctant to share their thoughts and feelings with their partner. These characteristics may be related to the finding of lower NKCC, as self-disclosure is associated with cellular immune function and health (Pennebaker et al., 1988), while increased stress and lower support in close relationships are correlated with poorer health and lower cellular immunity (Kiecolt-Glaser et al., 1993; Robles & Kiecolt-Glaser, 2003). Also, individuals high in attachment-related avoidance display altered hypothalamic-pituitary-adrenal axis reactivity to attachment-related stress tasks (Powers et al., 2006; Rifkin-Graboi, 2008), which may be relevant to the finding of reduced NKCC given the inhibitory effect of cortisol on NK cell-mediated lysis of target cells (Mavoungou et al., 2005; Zhou et al., 1997).

Given that attachment style develops in childhood, is postulated to be related to the quality of interaction with the primary caregiver, and is characterized by substantial stability and continuity across the lifespan (Fraley, 2002; Grossmann et al., 2005; Mikulincer & Shaver, 2007), our findings may also be interpreted as consistent with the body of animal literature suggesting that early life factors such as quality of maternal care may have long-term effects on physiology (Coe, 1993; Liu et al., 1997). However, this interpretation remains speculative, as causation cannot be determined in our observational study.

Besides attachment-related avoidance, perceived stress was also significantly correlated with NKCC. This association was not unexpected given previous similar findings (Naito et al., 2003) and the established correlation between decreased NKCC and naturally occurring stressors (Zorrilla et al., 2001). On the other hand, alexithymia was not significantly associated with NKCC and lymphocyte proliferative response, consistently with the literature that points to a link with alterations in cytokine levels and production (Pedrosa et al., 2007; Temoshok et al., 2008) rather than in lymphocyte function (Guilbaud et al., 2009; Mandarelli et al., 2011).

Given the pivotal role of NK cells in host defense against virally infected cells and neoplastic transformation through cytolytic activity and release of cytokines (Papamichail et al., 2004), a reduction in NKCC may have clinical relevance and may lead to poorer health (Ogata et al., 2001). The possible clinical relevance of the link between attachment-related avoidance and immune dysregulation observed in this and previous studies (Gouin et al., 2009) is also suggested by the findings of an association between high attachment-related avoidance and greater susceptibility to diseases with presumed immune pathogenesis such as alopecia areata (Picardi et al., 2003) and psoriasis (Janković et al., 2009; Picardi et al., 2005), as well as increased mortality in patients with another disease with immune system involvement such as diabetes (Ciechanowski et al., 2010). However, it should be emphasized that a link between attachment insecurity, impaired immunity, and poorer health has yet to be determined. Further studies including not only immune measures but also measures of participants' health status would be needed to investigate whether the alterations in immune function observed in individuals with high attachment-related avoidance are associated with increased disease susceptibility and poorer health.

This study has several limitations that suggest caution in interpreting and generalizing the results. First, the sample size is relatively small, which increases the risk of both Type I and II errors. Also, sleep and health-related behaviors were assessed by self-reports, which may have lower reliability than observer-rated measures. Furthermore, the sample consisted of only female Caucasian nurses, which prevents generalizability to men and other ethnic groups. Also,

participants' fairly high educational level and young-to-middle-age range further reduce the generalizability of our findings. Moreover, our findings are limited to adult attachment as measured by self-report measures of adults' perceptions and views about themselves and others in romantic relationships. Given that results from these measures and interview-based measures of adults' current state of mind regarding childhood attachment experiences with parents are not interchangeable (Roisman et al., 2007), further studies using interview-based measures of attachment would provide a valuable complement to our study.

Keeping these limitations in mind, this study corroborated the notion that attachment is linked to physiology and health. As attachment style dimensions are not redundant, despite being related in a theoretically consistent way, with higher-order personality constructs (Noftle & Shaver, 2006), psychoimmunological studies focusing specifically on attachment or incorporating the assessment of attachment style dimensions along with other personality traits may help advance the understanding of the relationships between individual differences and immune function.

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Table 1. Correlations between study variables at baseline

	NKCC	LPR	ECR avoidance	ECR anxiety	Age	NK cell number	PSS	TAS-20	Alcohol	Tobacco	NSAIDS	MSPSS	Sleep	Exercise
NKCC [a]	1													
LPR [b]	.01	1												
ECR avoidance	-.06	-.10	1											
ECR anxiety	-.07	.05	.33**	1										
Age	.15	-.16	.08	-.12	1									
NK cell number	.31**	-.05	.22	.18	.11	1								
PSS	-.09	.18	.13	.39**	.13	.19	1							
TAS-20	-.01	-.10	.23	.43***	-.22	.19	.20	1						
Alcohol [c]	.05	.03	.05	.08	.06	-.13	.03	-.12	1					
Tobacco [d]	.17	.27*	-.13	-.02	.07	.17	.09	-.18	-.14	1				
NSAIDS [e]	.16	.26*	-.15	.07	.10	.18	.31**	-.08	.03	.21	1			
MSPSS	-.04	.07	-.41***	-.07	-.21	-.17	-.19	-.11	-.12	.09	-.03	1		
Sleep [f]	-.06	-.23	-.14	-.13	-.01	-.07	-.27*	-.09	-.15	-.02	-.15	.15	1	
Exercise [g]	-.01	.07	.21	.09	-.27*	-.10	-.15	.24	.11	-.18	-.09	-.03	.15	1

[a] Natural Killer Cell Cytotoxicity
[b] Lymphocyte Proliferative Response
[c] drinks per day
[d] cigarettes per day
[e] pills per week
[f] sleeping well=1, not well = 0
[g] regular physical exercise = 1, no regular physical exercise = 0
* p<.05 ** p<.01 *** p<.001

Table 2

Multiple regression of NK cell cytotoxicity on attachment-related avo anxiety, age, time, NK cell number, psychosocial factors associated or health, and health-related behaviors possibly influencing immuni

Independent variable	Dependent variable
	NK cell cytotoxicity
Attachment-related avoidance	
Lower or equal to 60	
Regression coefficient (95% C.I.)	0.22 (-0.14 — 0.58)
P	0.224
Higher than 60	
Regression coefficient (95% C.I.)	-1.71 (-2.90 — -0.51)
p	0.005
Attachment-related anxiety	
Regression coefficient (95% C.I.)	-0.04 (-0.26 — 0.18)
p	0.747
Time	
Regression coefficient (95% C.I.)	-0.54 (-2.70 — 1.62)
p	0.623
Age	
Regression coefficient (95% C.I.)	0.26 (-0.29 — 0.82)
p	0.353
NK cell number	
Regression coefficient (95% C.I.)	0.03 (-0.00 — 0.06)
p	0.054
Sleeping well[a]	
Regression coefficient (95% C.I.)	-1.87 (-8.51 — 4.76)
p	0.580
Regular physical exercise[a]	
Regression coefficient (95% C.I.)	-3.48 (-10.35 — 3.38)
p	0.320

NSAIDS intake (pills per week)	
Regression coefficient (95% C.I.)	1.52 (-4.38 — 7.42)
p	0.614
Tobacco consumption (cigarettes per day)	
Regression coefficient (95% C.I.)	0.21 (-0.35 — 0.77)
p	0.467
Alcohol consumption (drinks per day)	
Regression coefficient (95% C.I.)	-0.61 (-5.94 — 4.71)
p	0.821
TAS-20 score at baseline	
Regression coefficient (95% C.I.)	-0.02 (-0.44 — 0.40)
p	0.935
MSPSS score	
Regression coefficient (95% C.I.)	-0.17 (-0.48 — 0.14)
p	0.279
PSS score	
Regression coefficient (95% C.I.)	-0.47 (-0.98 — 0.03)
p	0.065
Intraclass correlation coefficient (95% C.I.)	0.22 (0.10 — 0.40)

[a] coded as 0 = no, 1 = yes

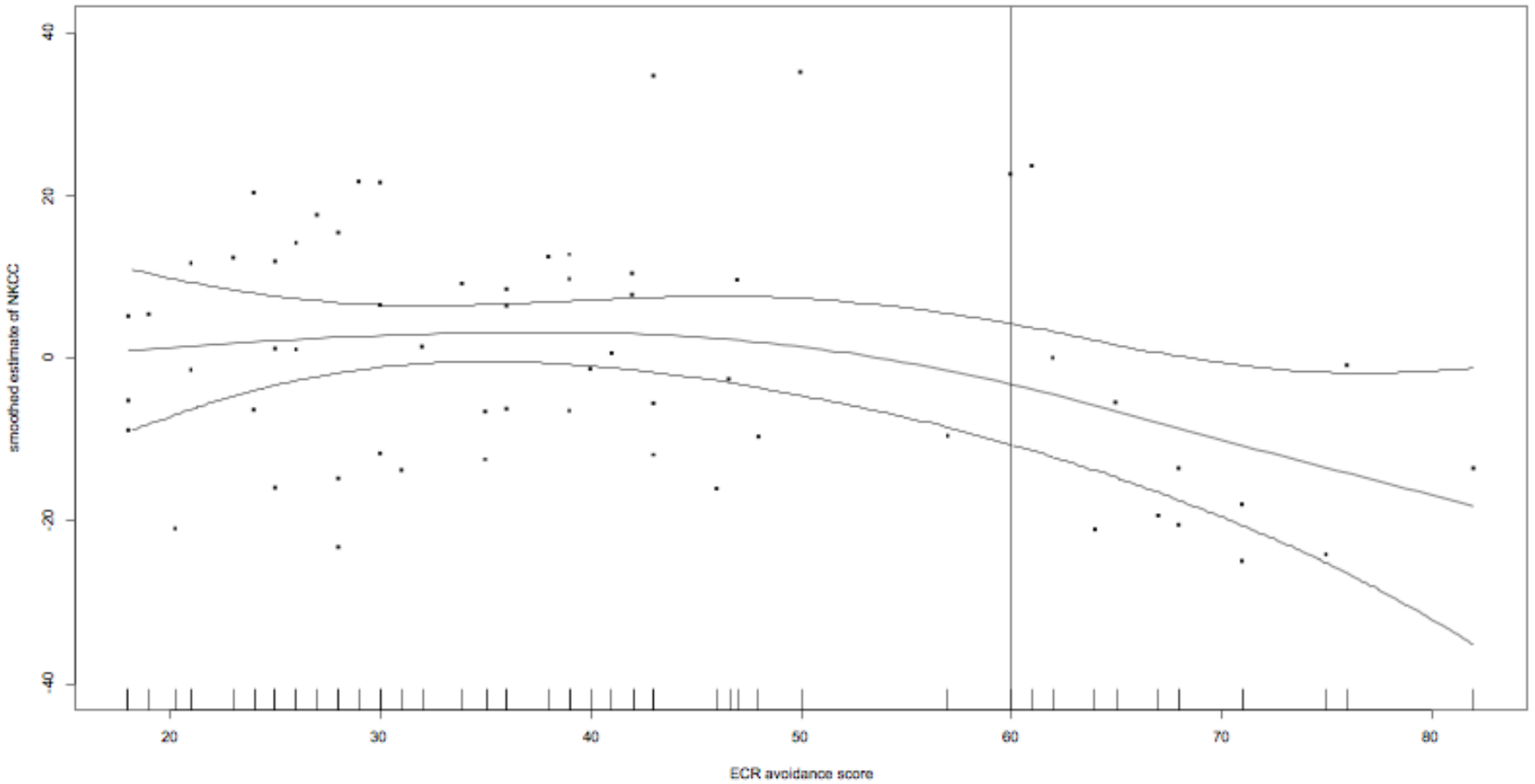
C.I. = Confidence Intervals; TAS-20 = 20-item Toronto Alexithymia Scale; MSPSS = Multidimensional Scale of Perceived Social Support; PSS=Perceived Stress Scale

Figure captions

Figure 1. Relationship between ECR avoidance and smoothed estimate of NKCC

Figure 2. Mean NKCC at the four time points in participants with high attachment-related avoidance (squares, dotted line) and other participants (circles, solid line)

Figure 1. Relationship between ECR avoidance and smoothed estimate of NKCC



ECR = Experiences in Close Relationship questionnaire
NKCC = Natural Killer Cell Cytotoxicity

Figure 2. Mean NKCC at the four time points in participants with high attachment-related avoidance (squares, dotted line) and other participants (circles, solid line)

