Title: An experimental study to identify key psychological mechanisms that promote and predict resilience in the aftermath of treatment for breast cancer

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In press Psycho-Oncology

Submitted 26/3/2021

Resubmitted 29/6/2021

Accepted 2/8/2021

Acknowledgements:

RG, CH, JA & RM-M designed the study. RG and SF ran the study and collected the data. SF analyzed the data. CH, SF, RG, JA & RM-M interpreted the results and drafted the paper. All authors read and approved the final version of the manuscript. CH & RM-M receive salary support from the National Institute for Health Research (NIHR), Mental Health Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London. JA receives funding from the National Institute for Health Research (NIHR) Applied Research Collaboration Kent, Surrey, Sussex. The views expressed are those of the author and not necessarily those of the NHS, the NIHR, the Department of Health and Social Care, King's College London or the University of Surrey.

Conflicts of interest:

We have no conflicts of interest to declare.

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Data Availability Statement:

Research data are available in anonymized form from the lead author with ethical approval.

Abstract

Objective: Women living with and beyond breast cancer (BC) frequently encounter cancer-related information in day-to-day life. The extent they are emotionally resilient to this information differs between women. Identifying key modifiable psychological mechanisms predicting resilience in these women could highlight targets for interventions to improve resilience in others. This study investigates resilience over time in women living beyond BC and how this relates to individual differences in the way the brain processes information.

Methods: Seventy women within a year of finishing first-line treatment for BC (clinical and community recruitment) completed computerised tasks to assess the tendency to attend to cancer information (dot-probe task), the tendency to draw negative cancer-related interpretations from ambiguous information (ambiguous scenarios task) and extent of executive functioning (attentional network task). Questionnaires were completed assessing resilience, **and other clinically-relevant psychological variables (fear of cancer recurrence, distress, quality-of-life, and worry**) at the time of the laboratory tasks (T1) and again 6 months later (T2).

Results: The only cognitive process associated with self-reported resilience was interpretation bias. Generating more negative cancer-related interpretations of ambiguous information at T1 significantly predicted resilience at T2, whilst controlling for T1 resilience

and other clinically-relevant variables. Furthermore, resilience scores were stable over time and moderately correlated with other clinically-relevant variables.

Conclusions: This study is the first to identify a key cognitive mechanism that predicts resilience in women living beyond BC. This finding suggests interventions to reduce cancer-related interpretations of ambiguous information could promote resilience in women living beyond BC.

Key words: cancer, oncology, survivorship, cancer survivors, resilience, cognition, psycho-oncology, attentional bias, interpretation bias, executive function

Background

A breast cancer (BC) diagnosis can precipitate physical, psychological, social and existential challenges that remain long after treatment is completed[1]. Women living beyond BC, following treatment with curative intent, report concerns about loss of self, isolation, uncertainty and feeling under pressure to return to pre-cancer lives[2, 3]. Furthermore, many women experience emotional distress such as feeling low or anxious at times, as well as worrying and fearing cancer recurrence[3].

Following traumatic events, such as being diagnosed and treated for BC, people not only vary in levels of distress, but also emotional resilience (i.e. ability to adapt and cope with adversity). For example, **whilst it would be very understandable for women to find the build-up to scheduled check-ups unsettling**, individuals differ in the extent to which they remain generally resilient following successful treatment. Resilience in cancer patients is associated with lower levels of distress, as well as better quality-of-life (QoL)[4-6]. However, we still need to understand the extent to which resilience is associated with lower levels of depressed mood, anxiety, worry and fear of cancer recurrence (FCR) as well as better QoL in the challenging year after treatment with curative intent ends. Importantly, we also need to identify key modifiable mechanisms that promote resilience in the year after treatment, since this could provide new targets for psychological interventions to promote resilience and reduce distress. A psychological model of general resilience[7] identifies cognitive processes that may maintain resilience. We investigate three of these processes (attention bias, interpretation bias and executive control/functioning) in women living beyond BC.

Cognitive processes and cancer

Attention bias: This is a tendency to have your attention captured by cancer-related information **and/or difficulty disengaging attention from this information**. One study found an association between general distress and attention bias towards cancer-related information[8] in women recently diagnosed with BC. Furthermore, they reported a relationship

in the reverse direction for positive affect. However, two recent studies found no relationship between attention bias and outcomes, including FCR (a specific anxiety experienced by people following cancer treatment)[9] and general distress[10]. Despite mixed results **(potentially due to the selection of task stimuli not specific to BC**), **emotional resilience and its relationship to attention bias for BC-related information will be investigated in this study for the first time using BC-related stimuli[11].**

Interpretation bias: This is the tendency to draw negative cancer-related conclusions from unclear/ambiguous but potentially cancer-related information. Only one study has investigated interpretation bias in individuals living beyond cancer[10]. Women who had BC were asked to write the first word that came to mind on hearing cue word homophones (i.e., words which sound the same, but have different spellings and meanings, e.g., dye/die). They found a non-significant increase in the number of general somatic or illness-related words produced (i.e., a negative interpretation bias) in high versus low distress groups. The lack of significant findings may relate to the homophone task being subject to demand (where participants deliberately respond in a manner they think the experimenter expects). In addition, the stimuli words were related to general illness, rather than being BC specific. Given this, the current study will utilise the most commonly used interpretation assessment task (ambiguous scenario task[12]) which is less subject to demand[13]. We will also increase ecological validity by utilising materials tailored specifically to women living beyond BC[11], to investigate associations between interpretation bias and resilience for the first time.

Executive functioning: Executive functioning is the limited capacity resource required to successfully complete effortful tasks that involve planning, organising and paying deliberate attention. Good executive functioning enables people to remain focused on tasks and respond flexibly when needed[14]. Executive functioning is reduced in women living beyond BC who have completed chemotherapy and/or are on Tamoxifen[15, 16], but whether executive functioning is also related to resilience in these women will be investigated for the first time.

Current study

We aimed to investigate psychological and cognitive processes associated with resilience in the first-year post-curative treatment for BC and determine whether cognitive processes predict resilience at follow-up. **Factors pertinent to the population and resilience were assessed as covariates using questionnaires: emotional distress, FCR, worry and QoL.**

Hypotheses:

1) During the first 12 months after treatment (T1) women living beyond BC with higher levels of resilience will experience less **emotional distress,** FCR, worry and greater QoL.
2) During the first 12 months after treatment (T1) more resilient women living beyond BC will demonstrate: less attentional bias to cancer-related information, less negative cancer-related interpretation bias for ambiguous cancer-related information and greater executive functioning.
3) Six months after initial assessment (T2): cognitive processes associated with resilience at T1 will predict levels of resilience at T2 (controlling for T1 resilience levels).

Methods

Participants

One hundred and thirty-two women were approached. Seventy-three women gave written informed consent; recruited from the end-of-treatment clinic (EoT) in the specialist BC unit at Guy's and St Thomas' NHS Foundation Trust (*n*=50) and via online cancer support forums and UK charities (Breast Cancer Now *n*=15; Breast Cancer Haven *n*=8). Eligibility included: **women ≥18 years, who had** completed first-line treatment for BC with curative **intent**

(stage I-III, no metastatic disease) within the previous twelve months **and able to read and understand English.**

Sample Size

A convenience sample size of 70 women meeting criteria for the study was set prior to the study.

Outcome measures

Demographic and clinical characteristics: Data on age, marital status, employment status, number of children, cancer stage, type of BC, treatment type, months since diagnosis and months since first-line treatment finished were collected.

Resilience: Emotional resilience was assessed using the 25-item Connor-Davidson Resilience Scale (CD-RISC; [17]). Items are rated on a 5-point Likert-type scale, with scores ranging from 0 to 100. Higher scores indicate greater resilience in general and cancer populations[18]. It has good internal consistency, test-retest reliability and sensitivity to change over time[19, 20]. The internal consistency in our sample using Cronbach's alpha (α) was high (.91 [T1] and .92 [T2]).

Quality-of-life: The Functional Assessment of Cancer Therapy for Breast Cancer (FACT-B) was used to assess QoL [21]. Scale range is 0-148, with high scores denoting better perceived QoL. It has good test-retest reliability and validity[22] **and has been validated in post-treatment populations[23].** Internal consistency in the current sample was high (α = .93 [T1] and α = .94 [T2]).

Emotional distress: This was assessed using the Hospital Anxiety and Depression Scale (HADS; [24]), which has been used extensively in similar populations with excellent psychometric properties[25]. This 14-item measure comprises two sub-scales measuring anxiety and depression, with items assessed on a 4-point scale (total score ranges from 0-42; higher scores indicate more distress). Internal consistency in the current sample was high (α = .91 [T1] and α = .91 [T2]).

Fear of cancer recurrence: The 7-item Fear of Recurrence Scale (FCR; [26]) [26], range 6-40, is rated on a 5-point response scale. Higher scores indicate greater fear of recurrence. **The scale includes 6 items used to measure worries and fears regarding recurrence risk and the impact of these, along with an estimate of the intrusiveness of these thoughts (0-10). The measure has good psychometric properties in women with BC[27]** and internal consistency for the current sample was high (α = .90 [T1] and α = .88 [T2]).

Worry: The Penn-State Worry Questionnaire (PSWQ; [28]), is a 16-item scale assessing **general** trait worry on a 5-point rating scale (scores 16-80);higher scores indicate more worry. It has **good psychometric properties in the general population[29]** and high internal consistency in the current sample (α = .96 [T1]; α = .95 [T2]).

Cognitive Tasks

Three computerised tasks were administered at T1. We developed and extensively tested the words and statements selected for use in the dot-probe task (attention) and ambiguous scenarios task (interpretation)[11]. See Supplementary Materials A for further details for all the tasks and examples.

Dot Probe Task (DPT; [30]): Cancer-neutral word pairs were presented in 96 **randomised** trials. Trials start with a fixation cross (500ms), then two words appeared, one above and one below the fixation. After 500ms the words disappeared, and one of these was replaced by an arrow. Participants indicated the direction of the arrowhead by pressing specified keys **('C' & 'M')** as quickly and accurately as possible.

Ambiguous Scenarios task[12]: Participants read 12 ambiguous scenarios **in a random order,** describing situations cancer survivors may encounter, each headed with a short title, followed by answering a simple yes/no comprehension question. After reading all 12 scenarios, participants rated statements on how similar in meaning they were to the original. One statement matched a cancer-related interpretation and one matched a more benign interpretation.

Attention Network Test (ANT; [31, 32]): The short version of the ANT was used to measure executive attentional control consisting of 72 experimental trials. Participants were presented with a string of five congruent (i.e., arrows in same direction '→→→→→') or incongruent (i.e. central arrow in opposite direction '→→←→→') arrows and were required to determine the direction of the central arrow as quickly and accurately as possible **by pressing the 'C' and 'M' keys.**

Procedure

Ethical approval was given by London-Dulwich Research Ethics Committee and the Health Research Authority (REC 16/LO/0266). **At T1 first participants completed a 30-minute online survey of baseline questionnaires (CD-RISC; HADS; FACT-B; FCR; PSWQ) and demographics.** Within 48-hours they attended a lab-based session at King's College London to complete the dot-probe, ambiguous scenarios, and attentional network tasks in set order on a 15.6 cm screen laptop (Toshiba Satellite Pro) using E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). A six-month follow-up assessment of the online questionnaires completed at T1 was sent via email (T2), though some women **required reminders and** completed this up to nine months after T1. **Participants were reimbursed £30 for their time/travel.**

Data preparation and statistical analysis

Analysis was completed using IBM SPSS version 25.0. Mean scores were imputed if the minimum number of questions were answered on the standardized questionnaires[33,34]. Data processing for the cognitive tasks is presented in Supplementary Materials B. A significance level of $p < .05$ was set for all analyses. Paired sample *t*-tests were used to determine whether the psychological outcomes varied over time. Questionnaire and cognitive task data were analysed using Pearson's correlations and one-way ANOVAs, testing potential covariates. Hierarchical regression (run with a bootstrap of 1000 iterations due to the small sample) assessed relationships with resilience over time. Relevant demographics and

baseline self-report measures were entered in Step 1 and correlated cognitive tasks in Step 2.

Results

Seventy-three women consented to participate. Three were excluded (one ended treatment >12 months; one had stage 4 cancer; one was unclear of her BC status [**could not confirm eligibility criteria]**).

Participant characteristics

A summary of the participants demographic and clinical characteristics (see Table 1) shows most were employed, had children, were diagnosed a year earlier and completed treatment on average 4.5 months previously.

Resilience and other psychological measures

Descriptive statistics for questionnaire measures at both timepoints are presented in Table 2. At baseline, mean resilience score indicated similar levels to and slightly below the general population[17]. Participants reported moderate FCR and worry, mild levels of distress and moderate to high QoL. Of 70 participants who completed T1, 60 completed T2, a retention rate of 86%[ab]. Paired samples *t*-tests were run to compare questionnaire scores at T1 and T2, with no significant changes observed (see Table 2).

Covariate analysis

Months since diagnosis, months since primary treatment concluded, and treatment type (chemo vs no chemo) were not associated with resilience at T1 or T2 (see Supplementary

[a] There was no statistical difference on questionnaire scores at T1 between those who completed T2 and those who did not; see Supplementary Materials C for further details.
[b] T2 questionnaires were completed 6-9 months later, and duration of interval between T1 and T2 was not associated with resilience, see Supplementary Materials D.

Materials D); age was significantly correlated with resilience at T2, thus was included in the final model. No other demographic or clinical variables were significantly associated with T2 resilience (one-way ANOVAs; see Supplementary Materials D).

Resilience was significantly negatively correlated with self-reported worry, distress, and FCR and positively correlated with better QoL (see Table 3). The correlations were mostly moderate, suggesting some independence in the constructs; they were all included as covariates in subsequent analyses.

Resilience and cognitive processes

Descriptive statistics for the cognitive tasks are presented (see Table 2), as are correlations with resilience (see Table 3). Cancer-related interpretation bias at T1 was significantly and moderately negatively correlated with resilience scores at T1 and T2, supporting the hypothesis that interpretation bias and resilience are associated. In contrast, cancer-related attention bias at T1 was not significantly correlated with resilience at T1 or T2; similarly, there was no significant relationship between executive functioning at T1 and resilience at T1 or T2, failing to support the hypotheses relating to resilience and attention bias or executive control.

The only cognitive process associated with resilience at T1 and T2 was interpretation bias. To investigate whether negative cancer-related interpretation bias predicted resilience at T2 when controlling for resilience at T1, a hierarchical linear regression was run with resilience at T2 as the dependent variable; with age, resilience at T1, and other T1 outcome measures which correlated with resilience at T1 (worry, distress, quality-of-life and FCR) included in step 1, and interpretation bias included in step 2 (see Table 4).

Step 2 of the regression indicated interpretation bias was a significant independent predictor of resilience at T2 accounting for all other covariates, including resilience at T1 (B＝-5.36, $t(58) = -3.41$, $p = .001$). Interpretation bias significantly explained an additional 6% of the variance in resilience at T2 (r^2=0.71, F=21.38, p<.001).

Discussion

This study of women in their first year living beyond BC demonstrated, as hypothesized, a clear relationship between higher levels of resilience and lower levels of **emotional** distress, FCR and worry, as well as increased QoL. We also investigated whether modifiable cognitive mechanisms are associated with emotional resilience in this population. As predicted, as the tendency to make cancer-related interpretations increases, resilience decreases, and this interpretation bias helped predict resilience at 6-months follow-up. However, counter to our predictions, resilience was not associated with a tendency for these women to attend to cancer-related information (attention bias) or their ability to complete effortful tasks involving remaining focused and paying deliberate attention (executive control/functioning).

The observation that lower levels of resilience do not relate to a tendency to attend to cancer-related information is in keeping with other studies examining attention bias and negative psychological outcomes, such as distress or FCR, which also failed to observe an association in women living beyond cancer[9,10]. **Hence, it seems women living beyond cancer attend to cancer-related information, irrespective of their levels of resilience or distress. It should be noted, however, that reliability of dot-probe tasks are poor in some populations, and thus could explain the absence of findings in the current study.** Higher levels of resilience were not associated with better executive functioning in women living beyond BC. Hence, our data did not support the role of attention bias and

executive functioning proposed in the model of resilience[7], however, the role of interpretation bias was in keeping with the model.

This is the first study to assess cancer-specific interpretations and their relationship with resilience. It builds on previous work[10] which reported a trend towards distressed women living beyond BC generating more negative interpretations of general somatic or general illness homophones. However, they did not investigate resilience nor cancer-specific interpretations. The stronger effect in our study may be due to the selection of our interpretation test (i.e., ambiguous scenarios task), which is one of the most common tasks used to assess interpretation bias; as well as the materials being systematically developed and piloted[11] in collaboration with women living beyond BC. This ensured scenarios closely matched situations individuals frequently encounter in everyday life which have the potential to trigger more or less resilient reactions and responses.

Clinical implications

Given that resilience did not change significantly over time, less resilient women living beyond BC are unlikely to spontaneously improve without intervention. Furthermore, interpretation bias helped predict later levels of resilience, suggesting a causal role in maintaining resilience. Resilience bolstering interventions may appeal to these women who are not particularly resilient. Hence, psychological interventions that target negative interpretations may be effective in fostering resilience in women living beyond BC who are less resilient. One such approach, cognitive behaviour therapy (CBT), targets interpretation bias (amongst other things). Another approach would be to focus an intervention specifically on BC-related interpretations using multiple sessions of online interpretation training. This approach was found to be effective in promoting more positive interpretations, which in turn reduce levels of worry, anxiety and depression, in non-cancer populations suffering from anxiety and depression [35-37]. This could be adapted to promote more resilient interpretations in women living beyond BC and tested in future efficacy trials.

Study limitations

There are several limitations of the research. Firstly, whilst T2 was intended to be 6-months after T1, some participants completed up to 9 months after T1. However, time between assessments was not associated with levels of resilience. We were also unable to determine whether those who were more resilient at baseline, were also resilient prior to or during cancer treatment. Another question for future research is whether a general (non-cancer specific) interpretation bias also predicts resilience in our population, or whether the effect is specific to ambiguous cancer-related information. Future studies should look at women currently in treatment, as well as those with metastatic disease, to see if negative cancer-related interpretations are associated with lower levels of resilience in these groups. **Another limitation is the small sample size, hence replicating the interpretation bias findings in a larger sample is warranted.**

Conclusions

This study is the first to establish that lower levels of resilience in women during the year following curative treatment for BC are associated with a tendency to make more negative cancer-related interpretations and these interpretations maintain lower levels of resilience in the longer-term in this population.

References

1. Landmark BT, Wahl A. Living with newly diagnosed breast cancer: a qualitative study of 10 women with newly diagnosed breast cancer. Journal of Advanced Nursing. 2002;40(1):112-21.

2. Fenlon D, Powers C, Simmonds P, Clough J, Addington-Hall J. The JACS prospective cohort study of newly diagnosed women with breast cancer investigating joint and muscle pain, aches, and stiffness: pain and quality of life after primary surgery and before adjuvant treatment. BMC Cancer. 2014;14(1):467.

3. Lethborg CE, Kissane D, Burns WI, Snyder R. “Cast Adrift”. Journal of Psychosocial Oncology. 2000;18(4):73-90.

4. Bitsika V, Sharpley CF, Bell R. The Buffering Effect of Resilience upon Stress, Anxiety and Depression in Parents of a Child with an Autism Spectrum Disorder. Journal of Developmental and Physical Disabilities. 2013;25(5):533-43.

5. Gotay CC, Isaacs P, Pagano I. Quality of life in patients who survive a dire prognosis compared to control cancer survivors. Psycho-Oncology: Journal of the Psychological, Social and Behavioral Dimensions of Cancer. 2004;13(12):882-92.

6. Zhang H, Zhao Q, Cao P, Ren G. Resilience and Quality of Life: Exploring the Mediator Role of Social Support in Patients with Breast Cancer. Medical Science Monitor. 2017;23:5969-79.

7. Parsons S, Kruijt A-W, Fox E. A cognitive model of psychological resilience. Journal of Experimental Psychopathology. 2016;7(3):296-310.

8. Glinder JG, Beckjord E, Kaiser CR, Compas BE. Psychological adjustment to breast cancer: Automatic and controlled responses to stress. Psychology & Health. 2007;22(3):337-59.

9. Butow P, Kelly S, Thewes B, Hruby G, Sharpe L, Beith J. Attentional bias and metacognitions in cancer survivors with high fear of cancer recurrence. Psycho-Oncology. 2015;24(4):416-23.

10. Lam WWT, Ng D, Wong S, Lee TMC, Kwong A, Fielding R. The role of cognitive bias in relation to persistent distress among women diagnosed with breast cancer. Psycho-Oncology. 2018;27(3):983-9.

11. Hughes AM, Gordon R, Chalder T, Hirsch CR, Moss-Morris R. Maximizing potential impact of experimental research into cognitive processes in health psychology: A systematic approach to material development. British Journal of Health Psychology. 2016;21(4):764-80.

12. Mathews A, Mackintosh B. Induced emotional interpretation bias and anxiety. Journal of abnormal psychology. 2000;109(4):602.

13. Hirsch CR, Meeten F, Krahé C, Reeder C. Resolving Ambiguity in Emotional Disorders: The Nature and Role of Interpretation Biases. Annual Review of Clinical Psychology. 2016;12(1):281-305.

14. Diamond A. Executive functions. Annu Rev Psychol. 2013;64:135-68.

15. Chen X, Li J, Zhang J, He X, Zhu C, Zhang L, et al. Impairment of the executive attention network in premenopausal women with hormone receptor-positive breast cancer treated with tamoxifen. Psychoneuroendocrinology. 2017;75:116-23.

16. Chen X, Li J, Ren J, Hu X, Zhu C, Tian Y, et al. Selective impairment of attention networks in breast cancer patients receiving chemotherapy treatment. Psycho-Oncology. 2014;23(10):1165-71.

17. Connor KM, Davidson JR. Development of a new resilience scale: the Connor-Davidson Resilience Scale (CD-RISC). Depression and anxiety. 2003;18(2):76-82.

18. Alarcón R, Cerezo MV, Hevilla S, Blanca MJ. Psychometric properties of the Connor-Davidson Resilience Scale in women with breast cancer. International Journal of Clinical and Health Psychology. 2020;20(1):81-9.

19. Ahern NR, Kiehl EM, Lou Sole M, Byers J. A review of instruments measuring resilience. Issues in comprehensive Pediatric nursing. 2006;29(2):103-25.

20. Windle G, Bennett KM, Noyes J. A methodological review of resilience measurement scales. Health and quality of life outcomes. 2011;9(1):8.

21. Brady MJ, Cella DF, Fei Mo AE, Bonomi DS, Tulsky SR, Lloyd SD, et al. Reliability and Validity of the Functional Assessment of Cancer Therapy-Breast Quality-of-Life Instrument. Journal of Clinical Oncology. 1997;15(3):974-86.

22. Brady MJ, Cella D, Fei Mo AE, Bonomi DS, Tulsky SR, Lloyd SD, et al. Reliability and validity of the functional assessment cancer therapy breast quality-of-life instrument. Journal of Clinical Oncology. 1997;15(3):974-86.

23. Hahn EA, Segawa E, Kaiser K, Cella D, Smith BD. Health-related quality of life among women with ductal carcinoma in situ or early invasive breast cancer: validation of the FACT-B (version 4). Expert Review of Quality of Life in Cancer Care. 2016;1(1):99-109.

24. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta psychiatrica scandinavica. 1983;67(6):361-70.

25. Smith AB, Selby PJ, Velikova G, Stark D, Wright EP, Gould A, et al. Factor analysis of the Hospital Anxiety and Depression Scale from a large cancer population. Psychology and Psychotherapy: Theory, Research and Practice. 2002;75(2):165-76.

26. Ghazali N, Cadwallader E, Lowe D, Humphris G, Ozakinci G, Rogers SN. Fear of recurrence among head and neck cancer survivors: longitudinal trends. Psycho-oncology. 2013;22(4):807-13.

27. Humphris GM, Watson E, Sharpe M, Ozakinci G. Unidimensional scales for fears of cancer recurrence and their psychometric properties: the FCR4 and FCR7. Health and Quality of Life Outcomes. 2018;16(1).

28. Meyer TJ, Miller ML, Metzger RL, Borkovec TD. Development and validation of the penn state worry questionnaire. Behaviour research and therapy. 1990;28(6):487-95.

29. van Rijsoort S, Emmelkamp P, Vervaeke G. The Penn state worry questionnaire and the worry domains questionnaire: Structure, reliability and validity. Clinical Psychology & Psychotherapy: An International Journal of Theory & Practice. 1999;6(4):297-307.

30. MacLeod C, Mathews A, Tata P. Attentional bias in emotional disorders. Journal of abnormal psychology. 1986;95(1):15.

31. Fan J, McCandliss BD, Sommer T, Raz A, Posner MI. Testing the efficiency and independence of attentional networks. Journal of cognitive neuroscience. 2002;14(3):340-7.

32. Fan J, McCandliss BD, Fossella J, Flombaum JI, Posner MI. The activation of attentional networks. Neuroimage. 2005;26(2):471-9.

33. Connor KM, Davidson, JR. The Connor-Davidson Resilience Scale http://www.connordavidson-resiliencescale.com/faq.php [Available from: http://www.connordavidson-resiliencescale.com/faq.php.

34. Bell ML, Fairclough DL, Fiero MH, Butow PN. Handling missing items in the Hospital Anxiety and Depression Scale (HADS): a simulation study. BMC Research Notes. 2016;9(1):479.

Table 1. *Demographic and clinical characteristics (n=69)*[1]

Age *(M, SD)*	53.53 (11.38)
Marital status *(n, %)*	
Single	19 (27.50)
Married	35 (50.70)
Other	15 (21.70)
Employment status *(n, %)*	
Employed	41 (59.40)
Unemployed	6 (8.70)
Other	22 (31.90)
Children *(n, %)*	
No children	24 (36.40)
1-4 children	42 (63.70)
Tumour stage *(n, %)*	
Stage 1	16 (23.50)
Stage 2	23 (33.80)
Stage 3	9 (13.20)
Unsure	20 (29.40)
Tumour type *(n, %)*	
ER+	30 (46.20)
PR+	1 (1.50)
HER2+	5 (7.70)
ER+ PR+	9 (13.80)
ER+ HER2+	9 (13.80)
ER+ PR+ HER2+	2 (3.10)
Unsure	9 (13.80)
Treatment type *(n, %)*	

Lumpectomy	2 (2.90)
Mastectomy	4 (5.80)
Lumpectomy and radiotherapy	19 (27.50)
Mastectomy and chemotherapy	2 (2.90)
Radiotherapy and chemotherapy	1 (1.40)
Lumpectomy, radiotherapy and chemotherapy	24 (34.80)
Mastectomy, radiotherapy and chemotherapy	14 (20.30)
Lumpectomy, mastectomy, radiotherapy and chemotherapy	2 (2.90)
Received chemotherapy	43 (62.30)
Months since diagnosis *(M, SD)*	12.16 (4.20)
Months since primary treatment concluded *(M, SD)*	4.47 (2.77)

Note: M=Mean, SD=standard deviation, ER+ = oestrogen receptor positive, PR+ = progesterone receptor positive, HER2+ = HER2 positive. [1]*One participant did not complete all demographic and clinical questions.*

Table 2. *Mean scores on questionnaire measures and cognitive tasks*

Outcome measures	T1 *(n=70)* *(M, SD)*	T2 *(n=60)* *(M, SD)*	*t statistic*	*p value*
CD-RISC	73.47 (12.74)	71.70 (13.60)	*t(59)= 1.32*	.19
FCR	19.57 (8.27)	19.53 (7.10)	*t(56)= .72*	.48
HADS T	10.08 (7.63)	10.36 (7.41)	*t(58)= -.56*	.58
PSWQ	47.81 (17.41)	48.35 (16.68)	*t(59)= -.06*	.96
FACT-B	112.58 (20.67)	112.56 (22.20)	*t(58)= .17*	.87
Dot-probe bias score	14.62 (40.62)	-	-	-
Ambiguous scenarios bias score	.74 (.66)	-	-	-
Attention network task score	128.17 (43.50)	-	-	-

Note: Baseline, n=69 for FCR due to one person not completing the scale and for HADS as one person was missing 2 items on one subscale. Follow-up, n= 59 for FACT-B and n=57 for FCR; T1 = baseline; T2 = 6 month follow-up; CD-RISC = Connor Davidson Resilience Scale; FCR = Fear of Cancer Recurrence scale; HADS T = emotional distress total score; PSWQ = Penn State Worry Questionnaire; FACT-B = quality-of-life scale.

Table 3. *Correlations for questionnaire measures and cognitive tasks with resilience, with p values in parentheses*

Baseline (T1) measures	T1 CD-RISC *(n=70)*	T2 CD-RISC *(n=60)*
CD-RISC	**-**	**.82*** **
FCR	**-.35****	**-.39****
HADS T	**-.58*****	**-.57*****
PSWQ	**-.52*****	**-.52*****
FACT-B	**.64*****	**.58*****
Age	.19	**.28***
Dot probe task - bias score	-.07	-.04
Ambiguous scenarios task - bias score	**-.40****	**-.55*****
Attention network task - score	.05	.24

*Note: T1 = baseline; T2 = 6 month follow-up; CD-RISC = Connor Davidson Resilience Scale; FCR = Fear of Cancer Recurrence scale; HADS = emotional distress total score; PSWQ = Penn State Worry Questionnaire; FACT-B = quality-of-life scale; *p<.05; **p<.01; ***p<.001*

Table 4. *Regression model to predict resilience scores at follow-up (T2) from baseline data (T1)*

	B	Sig.	Lower 95% CI	Upper 95% CI	Adj R^2
Step 1					.65
Age	.12	.30	-.11	.30	
CD-RISC T1	.76	**.001**	.53	.93	
FACT-B T1	-.02	.86	-.25	.16	
FCR T1	-.12	.49	-.48	.20	
PSWQ T1	-.01	.86	-.15	.17	
HADS T T1	-.19	.53	-.93	.24	
Step 2					.71
Age	.18	.06	-.03	.35	
CD-RISC T1	.69	**.001**	.45	.85	
FACT-B T1	-.03	.77	-.24	.14	
FCR T1	-.08	.62	-.40	.23	
PSWQ T1	-.03	.74	-.12	.24	
HADS T T1	-.13	.64	-.86	.29	
Negative cancer related interpretation bias score	-5.36	**.001**	-8.71	-2.33	

Note: T1 = baseline; T2 = 6 month follow-up; CD-RISC = Connor Davidson Resilience Scale; FACT-B = Quality-of-life; FCR = Fear of Cancer Recurrence scale; PSWQ = Penn State Worry Questionnaire; HADS T = emotional distress total score