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Attentional bias and metacognitions in cancer survivors with high fear of cancer recurrence

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Abstract

***Background*: Fear of cancer recurrence (FCR) is a common and severe problem amongst cancer survivors, but mechanisms to explain its development and maintenance are still lacking. The self-regulatory executive function (S-REF) model suggests that metacognitions and attentional bias to cancer-related words may explain high FCR. Thus, this study aimed to explore relationships between FCR, metacognitions and attentional bias in a mixed group of cancer survivors.**

***Method*: Sixty-three early-stage breast or prostate cancer survivors, diagnosed within 6 months to 5 years prior to participation and who had completed all hospital-based treatment with no evidence of cancer recurrence were recruited through two metropolitan oncology clinics. Participants completed a questionnaire battery and the dot-probe task.**

***Results*: Survivors with clinical FCR had significantly greater positive beliefs about worry (10.1 vs 7.4, $p = 0.002$) and beliefs about the uncontrollability and danger of worry (12.0 vs 7.7, $p = 0.000$) than those with non-clinical FCR, whereas the total metacognition score significantly predicted FCR in multiple regression analysis ($\beta = 0.371$, $p = 0.001$). No significant differences were detected between participants scoring above and below clinical FCR levels in attention bias indices.**

***Conclusions*: This study found partial support for the S-REF model of FCR, with metacognitions but not attentional bias found to be related to FCR. Further research is needed to explore attentional biases in more detail.**

Introduction

Fear of cancer recurrence (FCR) is the most prevalent concern reported by cancer survivors [1,2]. Forty-nine percent of prostate cancer survivors in one study, and between 29% and 97% of breast cancer survivors in others, report persistent FCR [3,4]. Although there is no widely accepted definition of FCR, two main definitions have been used. The first, defined as the 'fear that cancer could return or progress in the same place or in another part of the body' [5], adopts a patient's perspective of FCR and is relevant across the cancer trajectory. The second, 'the degree of concern reported by subjects about the chances of cancer returning at a future time', emphasises recurrence more than progression [6]. The variation in definition partially explains the wide ranges in prevalence noted earlier.

High levels of FCR have a negative impact on quality of life [3], psychological adjustment, planning for the future, dysfunctional behaviour (including preoccupation with cancer and intrusive checking for signs of cancer) and interpersonal difficulties [7,8]. FCR has also been associated with higher usage of medical services and increased medical costs [8]. Thus, the impact of high FCR is wide-ranging, with potential costs to the individual, family and wider society.

The absence of a strong theoretical framework for FCR has slowed progress in understanding and treating FCR. The self-regulation of illness/common sense model [9,10] has been applied in this setting; however, there is only partial and contradictory evidence for this model [11,12]. Further, although the model addresses the content of cognitive representations and their emotional consequences, it does not take into account existential issues and factors that may be specific to maintaining dysfunctionally high levels of FCR.

An alternative framework is provided by the self-regulatory executive function (S-REF) model [13], a trans-diagnostic model of emotional disorder that proposes that anxiety disorders are caused, maintained and exacerbated by maladaptive information processing styles [14,15] Specifically, the individual becomes more sensitive and attentive to salient information, which generates intrusive thoughts that initiate higher order worry and

rumination [13]. Worry is driven by positive and negative metacognitions (thinking about thinking), including positive beliefs about worry and threat monitoring (such as 'worrying about cancer recurrence will help me be prepared for it') and negative beliefs about the uncontrollability, danger and meaning of these thoughts (such as 'my worry is uncontrollable' or 'worrying is going to make me sick again'). Hence, the model predicts that people who worry uncontrollably will have (a) metacognitions that promote worry as a coping strategy and (b) attentional processes that facilitate the processing of threat-related information. Because the S-REF model is focused more on the process rather than content of cognitions, it is suited to a phenomenon such as FCR where beliefs are not irrational.

Research has provided promising support for the possible role of metacognitions in a variety of anxiety disorders [16,17], hypochondriasis [18] and Parkinson's disease [19]. However, the role of metacognitions in FCR has not previously been examined. Research has examined *attentional biases towards threat* in cancer, typically using the Stroop or dot-probe paradigms. Because the Stroop is not able to isolate the impact of attention from other aspects of performance, such as response bias [20,21], the dot probe has become more widely used. In the dot probe, pairs of words are presented: one target word and one neutral word randomly placed above and below the centre of the screen. A probe then replaces one of the words and participants indicate the position of the probe by pressing the corresponding key (e.g. p or q). It is assumed that if participants' attention is drawn to the target word, they will be faster to detect a probe appearing where the target word was (congruent trials) in comparison with the neutral word (incongruent trials) [22].

In a meta-analysis, Bar-Haim *et al*. [20] found that high anxious participants showed an attentional bias towards threatening stimuli, across a range of diagnoses. Attentional biases have been reported in health-related anxiety [23], chronic pain [24] and chronic fatigue syndrome [25]. More specifically, attentional biases to cancer-related stimuli have been observed in women with newly diagnosed and treated breast cancer [26], women with insomnia following cancer diagnosis [27] and well women at high breast cancer risk [28]. However, the relationship of attentional biases to FCR has not been studied.

Thus, the aims of the current study were to examine if a high level of FCR in people who have survived cancer is associated with a higher level of maladaptive metacognitions and attentional bias towards cancer-specific threat-related information. Following from the reviewed literature, it was hypothesised that

1. participants with clinical levels of FCR would show more maladaptive metacognitions than those with non-clinical levels;
2. participants with clinical levels of FCR would show a stronger attentional bias towards cancer words compared with non-cancer words than those with non-clinical levels;
3. participants with **clinical levels of** FCR would show a stronger attentional bias towards cancer-*threat* words, compared with cancer-*neutral* or cancer-*positive* words, whereas participants with lower FCR would show equal attention bias to all cancer words; and
4. higher levels of metacognitions and attentional bias indicators would be associated with higher levels of FCR when controlling for potential confounders.

Method

Participants

Eligibility criteria for the study included >18 years of age, diagnosis of early-stage breast or prostate cancer 6 months to 5 years prior to participation and completion of hospital-based treatment with no evidence of cancer recurrence. These cancer groups were selected as they are common, ensure representation of both genders and have been shown to engender moderate levels of FCR [2,3]. People not fluent in reading English or with an intellectual or mental impairment or psychosis were excluded.

Ethical approval was provided by the participating site's ethics committee. Participants were free to withdraw from the study at any time.

Procedure

Participants were recruited from outpatient cancer clinics at two metropolitan cancer centres. The study was introduced by the treating oncologist; interested patients met with a researcher who explained that the study was exploring whether FCR was related to how people processed information and that participants would be completing a computer task where they would be presented with pairs of words, some of which related to cancer and others not. Patients were then given as much time as required to decide on participation. Those that gave informed consent then completed the dot-probe task with a total of 200 trials; the presentation of a word pair was considered one trial. They then completed a self-report questionnaire.

We chose to present all dot-probe trials before the questionnaire because we did not want to prime participants to attend to cancer-related stimuli by focusing them on the FCR. That is, answering explicit questions about FCR may have increased the salience of the cancer-related stimuli and affected implicit responses. However, it must be acknowledged that the dot-probe task may also have altered participants' responses to questionnaires. The fact that stimuli were positive, negative and neutral in valence and only briefly presented reduces the risk of contamination of explicit responses.

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Materials

Experimental stimulus

A modified version of the dot-probe test [29], which has been utilised in previous cancer research [26,27], was used, as described earlier. The dot-probe task was presented on a Dell laptop computer with a high-resolution screen and run using the Exp Sampling program, with stimuli presented for 500 ms.

Word pairs included the following: (a) one cancer related (positive, e.g. cure; negative, e.g. death; or neutral, e.g. blood) or cancer unrelated (positive, e.g. holiday; or negative word, e.g. conflict) and (b) one neutral (cancer unrelated) word, for example, cupboard. Word pairs were matched for word length and frequency of usage in the English language using Carroll, Davis and Richman's [30] norms, to control for attentional bias effects that are produced by heightened sensitivity to frequently used words and/or uncommon, unusual words (e.g. [31]). Cancer-related word lists were identical to those used by Cavenett [32], developed in consultation with oncology specialists and rated for salience and valency. Non-cancer-related word lists were derived from previous studies examining attentional bias [20,31]. The full list of words is presented in the Appendix.

Four different presentation combinations are possible where the target word and probe appear in the upper or lower position. In two of these combinations, the target and probe are congruent (in the same position), and in the remaining trials, they are incongruent (in a different position). Ten words in each category listed above were used, resulting in 40 trials per category. Participants were given a 1-min break between each set of 40 words, which were presented in randomised blocks. Five practice trials were presented before the start of each new set, and the entire task took approximately 12–15 min to complete.

Questionnaires

Meta-beliefs measure: The Metacognitions Questionnaire 30 [33] has 30 items measuring five factors: positive beliefs about worry, negative beliefs associated with uncontrollability and danger of worry, cognitive confidence, beliefs about harmful consequence of not controlling thoughts and preoccupation with thought processes [31].

Psychological distress measure: The Depression Anxiety Stress Scale (DASS-21) [34] is a short form of the original 42-item questionnaire. Three self-report scales, composed of seven items each, are designed to measure the negative emotional states of depression (e.g. dysphoria, hopelessness and devaluation of life), anxiety (e.g. autonomic arousal, skeletal muscle effects and situational anxiety) and stress (e.g. difficulty relaxing, nervous arousal and being easily upset/agitated). Subjects rate the extent to which they have experienced each state over the past week. Summed scores indicate greater levels of distress on each subscale. The scales of the DASS have been shown to have high internal consistency and to yield meaningful discriminations between anxiety, stress and depression in a variety of settings.

Fear of cancer recurrence measure: The Fear of Cancer Recurrence Inventory severity subscale [35] has nine items measuring the presence and severity of FCR. The severity subscale has been recommended for use as a separate scale for screening [35], with a cut-off score of 13 or higher obtaining a sensitivity of 88% and specificity of 75% in correctly identifying those with clinical levels of FCR [36].

Data analysis

T-tests were used to compare those with clinical versus non-clinical FCR on metacognitions.

Individual reaction times on the dot probe <200 and >2000 ms were considered outliers [25] and were replaced by the mean score of the participants' other responses. Indices of attentional bias were calculated for each word set, using the following formula, where t = target word, p = probe location and l = lower location: Index = $((\text{tupl} - \text{tlpl}) + (\text{tlpu} - \text{tupu}))/2$.

A positive numerical value indicates an attentional bias towards the target word, whereas a negative numerical value indicates a bias away from the target. An attentional bias score was calculated for each participant for the five different word sets: (1) cancer threat, (2) cancer positive, (3) cancer neutral, (4) non-cancer positive and (5) non-cancer negative.

A series of one-way repeated measures analyses of variance (ANOVAs) with simple contrasts were conducted across attentional bias indices. Finally, a 2 (word category: cancer vs. non-cancer) $\times$ 2 (valence: positive vs. negative) $\times$ 2 (FCR level: clinical vs. non-clinical) mixed, repeated measures ANOVA was performed with FCR level as the between-subjects factor, to examine if patterns of attentional biases differ in participants with high levels of FCR compared with non-clinical levels. Finally, a hierarchical multiple regression was performed to examine the contribution of attentional biases and maladaptive metacognitions in predicting FCR levels, including variables found to be significant in univariate analyses.

Results

Sixty-six patients were eligible and 63 consented, a recruitment rate of 95%. Refer to Table 1 for demographic and disease characteristics of participants, which are similar to previous samples of breast and prostate cancer survivors [37]. Participants had a mean age of 64 years.

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Table 1. Demographic and disease characteristics ($n = 63$)

Variable	Mean	Standard deviation
Age	64.05	11.80
Time since diagnosis	2.79	1.47
	Frequency (percentage)	
Gender		
Male	30 (47.6%)	
Female	33 (52.4%)	
Cancer type		
Breast cancer	30 (47.6%)	
Prostate cancer	33 (52.4%)	
Stage at diagnosis		
Localised	46 (73%)	
Locally spread	16 (25.4%)	
Do not know	1 (1.6%)	
Treatment type		
Breast $n = 33$		
Radiotherapy	26 (78.8%)	
Chemotherapy	30 (90.9%)	
Hormonal therapy	28 (84.8%)	
Herceptin	7 (21.2%)	
Surgery	33(100%)	
Prostate $n = 30$		
Radiotherapy	29(96.7%)	
Chemotherapy	3 (10%)	
Hormonal therapy	10 (33.3%)	
Surgery	10 (33.3%)	
Marital status		
Single	5 (8.1%)	
Married	38 (60.3%)	
De facto	6 (9.5%)	
Widowed	2 (3.2%)	
Divorced/separated	12 (19 %)	
Education level		
Year 10 or below	16 (25.4%)	
Year 12/HSC	12 (19%)	
TAFE certificate/diploma	13 (20.6%)	
University degree	13 (20.6%)	
Postgraduate degree	9 (14.3%)	
Employment status		
Full time	12 (19%)	
Part time	11 (17.5%)	
Unemployed	3 (4.8%)	
Retired/pensioner	34 (54%)	
Home duties	3 (4.8%)	
Children		
None	14 (22.2%)	
One	5 (7.9%)	
Two	21 (33.3%)	
More than two	23 (36.5%)	
Language		
English	47 (74.6%)	
Other	16 (25.4%)	
Country of birth		
Australia	40 (63.5%)	
Other	23 (36.5%)	

About half had breast cancer, were female and employed. Nearly half (44%) had high school qualifications only, whereas 35% had a university degree. Most (64%) were born in Australia, and 75% spoke English as a first language. On average, time since diagnosis was 2.79 years (standard deviation (SD) = 1.46). All patients who consented completed all aspects of the study.

Self-reported outcomes and attentional bias indices for those with clinical (44%) versus non-clinical (66%) FCR scores are summarised in Table 2. Mean DASS-21 scores for the whole sample were within the normal range. Both DASS-21 and FCR-I scores were comparable with those of cancer survivors examined in previous research [35].

Metacognitions

The MCQ-30 mean total score and associated subscales (Table 2) were all comparable with those found within a non-clinical sample (MCQ-30) [17]. Those with clinical FCR scored significantly higher on the MCQ-30 total score (57.6 vs 45.0), positive beliefs about worry (10.1 vs 7.4) and beliefs about the uncontrollability and danger of worry (12.0 vs 7.7) than those with non-clinical FCR. Group differences on the harmful consequence of not controlling thoughts subscale of the MCQ-30 were also close to reaching significance ($t(38) = -2.01$, $p = 0.051$).

There was a significant and positive correlation between FCR score and total MCQ-30 ($r = 0.489$, $p < 0.01$), as well as with a number of the MCQ-30 subscales (the harmful consequence of not controlling thoughts ($r = 0.336$, $p < 0.01$), positive beliefs about worry ($r = 0.470$, $p < 0.01$) and beliefs about the uncontrollability and danger of worry ($r = 0.564$, $p < 0.01$)).

Selective attentional biases

Dot-probe data from eight participants were excluded because of high error rate, impaired vision or extreme hand tremor, leaving 55 participants (Table 3).

One-way repeated measures ANOVA showed no significant main effect for word category (cancer vs non-cancer) or valence (positive vs negative) or significant interaction effect, indicating that for all participants, there was no attentional bias towards positive or negative cancer-related words versus non-cancer-related words (contrary to hypothesis 1).

Exploring cancer words alone, with neutral cancer words included, one-way repeated measures ANOVA also showed no significant main effect for valence (Wilks' Lambda = 0.914, $F = (2, 53) = 2.50$, $p = 0.091$).

Simple contrasts revealed a significant difference in attentional bias indices between cancer-neutral versus cancer-positive words $F = (1, 54) = 5.09$, $p < 0.05$. All participants demonstrated a bias towards positive cancer words ($M = 13.90$, $SD = 53.09$) in comparison with neutral cancer-related words ($M = -9.68$, $SD = 56.97$).

In two final ANOVAs using clinical versus non-clinical FCR as a between-subjects factor, there was no significant main effect for word category or valence or any significant interaction effects for word category and FCR level, valence and FCR levels, word category and valence, or

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Table 2. Group mean, standard deviations and *t*-scores on demographic, patient-reported measures and attentional biases ($n = 63$)

	Non-clinical FCR		Clinical FCR		*t*	*p*	*d*
	Mean	*SD*	*Mean*	*SD*			
Age	66.17	12.11	61.22	10.96	1.69	0.096	
Cancer duration	2.94	1.53	2.58	1.39	0.96	0.342	
DASS: stress	5.83	6.83	12.22	8.64	−3.28	0.002	
DASS: anxiety	2.67	3.61	8.15	8.00	−3.32	0.002	
DASS: depression	3.17	5.52	10.67	10.29	−3.44	0.001	
MCQ-30 Total	45.03	8.53	57.56	16.00	−3.69	0.001	
MCQ-30 CC	9.67	3.47	11.93	4.63	−2.21	0.031	
MCQ-30 PB	7.42	1.96	10.11	3.93	−3.27	0.002	
MCQ-30 CSA	11.69	4.04	13.07	4.39	−1.29	0.201	
MCQ-30 UD	7.69	1.83	12.04	4.93	−4.36	0.000	
MCQ-30 NC	8.56	2.44	10.41	4.29	−2.01	0.051	
Index cancer neutral	−4.53	63.93	−16.83	47.06	−0.777	0.445	0.21
Index cancer negative	−7.10	63.63	−1.20	52.21	−0.359	0.721	0.10
Index cancer positive	18.07	53.93	6.87	53.44	0.753	0.455	0.20
Index negative	−9.10	87.10	−5.83	30.10	−0.196	0.846	
Index positive	−1.66	54.31	−1.11	45.36	−0.039	0.969	

DASS-21, Depression Anxiety Stress Scale; MCQ-30 total, total score for Metacognition Questionnaire; MCQ-30 PB, positive beliefs about worry; MCQ-30 CC, cognitive confidence; MCQ-CSA, cognitive self-awareness/preoccupation with though process; MCQ-30 UD, negative beliefs about the uncontrollability and danger of worry; MCQ-NC, beliefs about the harmful consequence of not controlling thoughts; FCR, Fear of Cancer Recurrence Inventory.

Table 3. Hierarchical multiple regression predicting fear of cancer recurrence levels ($n = 63$)

Criterion variable: fear of cancer recurrence		R^2	β	*t*	*p*
Step 1	Gender	0.223	−0.206	−0.924	0.360
	Chemotherapy		−0.559	−2.596	0.012
	Radiotherapy		0.174	1.302	0.199
Step 2	Gender	0.565	0.096	0.529	0.599
	Chemotherapy		−0.330	−1.935	0.059
	Radiotherapy		0.089	0.864	0.392
	DASS: depression		0.384	3.585	0.001
	MCQ total		0.359	3.537	0.001
Step 3	Gender	0.570	. 089	0.474	0.638
	Chemotherapy		−0.325	−1.808	0.077
	Radiotherapy		0.083	0.776	0.442
	DASS: depression		0.380	3.434	0.001
	MCQ total		0.371	3.514	0.001
	Cancer neutral index		0.000	0.007	0.994
	Cancer negative index		−0.063	−0.622	0.537
	Cancer positive index		−0.043	−0.417	0.678

DASS-21, Depression Anxiety Stress Scale; MCQ-30 total, total score for metacognition questionnaire.

for word category, valence and FCR level, indicating that there was no difference in attentional biases between participants with clinical versus non-clinical FCR, across word categories.

Similarly, in cancer words alone and including neutral words, there was no significant main effect for cancer valence or significant interaction effect for FCR levels. Thus, hypotheses 2 and 3 were not supported.

A series of hierarchical multiple regressions were conducted to investigate the contribution of metacognitions and attentional biases in predicting FCR levels, after controlling for variables found to be associated with FCR in univariate analyses (gender and treatment type and depression). In these univariate analyses, women, those who had had chemotherapy and those with higher depression scores had higher FCR scores**.** Gender, chemotherapy and radiotherapy were entered into the regression model at step 1, depression and the total metacognitions score were entered at step 2, and the attentional bias indices for cancer-related words (positive, negative and neutral) were entered at step 3 (Table 3).

At Step 2, both depression ($\beta = 0.384$, $p < 0.05$) and metacognitions ($\beta = 0.359$, $p < 0.05$) were significant independent predictors of FCR levels, accounting for 56.5% of the variance, whereas chemotherapy (significant at step 1) no longer made a unique contribution. Thus, hypothesis 4 was supported. In line with earlier analyses, no additional proportion of variance in FCR levels were accounted for when attentional biases indices were entered at step 3 (all p's > 0.05) (Table 4).

Discussion

To our knowledge, this is the first study to examine the application of the S-REF model to FCR in cancer survivors. The study incorporated more than one cancer group and both genders, strengthening the generalisability of findings**.** Consistent with predictions, the results showed that, controlling for depression, higher levels of maladaptive metacognitions were positively correlated with FCR. Individuals with high FCR tended to perceive their worry as being more beneficial, but also dangerous and uncontrollable, and important to control than those with lower FCR. However, high FCR was

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Table 4. Mean response latencies and attention bias index scores across word categories ($n = 63$)

Word category	Target upper		Target lower		Averaged incongruent	Averaged congruent	Bias index score
	Probe upper	Probe lower	Prove upper	Probe lower			
Cancer negative	687.20 (167.86)	691.52 (163.14)	693.37 (175.97)	704.98 (179.70)	692.44 (165.50)	696.09 (168.19)	−3.65 (58.77)
Cancer positive	672.69 (164.67)	705.36 (176.84)	678.46 (166.28)	683.34 (172.21)	691.91 (166.44)	678.01 (162.12)	13.90 (53.09)
Cancer neutral	675.68 (154.30)	675.65 (176.45)	682.81 (172.90)	702.14 (169.68)	679.23 (166.75)	688.91 (155.64)	−9.68 (56.97)
Positive	680.16 (177.64)	705.53 (187.82)	658.21 (172.99)	685.21 (171.48)	681.87 (177.30)	682.68 (169.58)	−0.81 (50.15)
Negative	706.00 (176.41)	682.31 (174.66)	701.40 (185.92)	698.36 (177.30)	691.86 (175.47)	702.18 (169.34)	−10.32 (71.19)

Times are displayed in milliseconds. Standard deviations are shown in parentheses.

not associated with having a higher level of awareness or focus on thought processes.

These findings are similar to those reported in a range of disorders, including GAD and Parkinson's [19]. However, inconsistent with the present findings, awareness of one's thoughts and worries was one of the best predictors in hypochondriasis [18], suggesting that the specific type of metacognitive thinking underlying FCR may be more akin to GAD than hypochondriasis. Previous research [35] found that anxiety disorders, particularly GAD, were the most frequent co-morbid diagnosis in high FCR patients. In contrast, no patients met criteria for hypochondriasis.

The results showed no significant differences for attentional bias indices between clinical and non-clinical FCR groups nor were attentional bias indices predictive of FCR. These results are inconsistent with some previous findings in cancer patients, linking attentional bias to distress [26–28]. However, these previous findings have been mixed, with attentional bias in one study predicting more severe depressive and anxiety symptoms post-diagnosis [28] and in another study [26] lower levels of psychological distress.

Possibly attentional biases vary with degree of threat. In a study of war civilians during the Israel–Gaza war, Bar-Haim *et al*. [39] found that those living in close proximity to the border (high threat) displayed attentional avoidance of threat words correlating with psychological distress; however, this association was not seen for participants living outside of rocket range (low threat). Similarly, women in the MacLeod and Hagan [38] study were awaiting confirmation of cancer diagnosis (high threat, significant results), whereas those in the study of Glinder *et al*. [26] were 3 months post-diagnosis (low threat, non-significant results). In our study, participants' state anxiety may have been low at testing, because they had just seen their oncologist. The reassurance provided may have reduced bias towards cancer-related stimuli or increased the salience of positive cancer words.

Alternatively, methodological limitations may have prevented the detection of associations with attentional biases. The dot probe provides only a 'snapshot' of attentional biases at the exact time that the probe appears (at 500 ms). Possibly, participants switched their attention fixation during the word pair presentation; thus, timing may be critical. For example, Glinder *et al*. [26] showed a bias away from cancer words when stimuli were presented at 20 ms but a bias towards these words when presented at 1000 ms. Switches in anxious people may occur either because they are initially vigilant to threat but then avoid it to reduce anxiety [20] or because once threat is detected, they have difficulty in disengaging attention away from it [40]. Future studies could explore this by using an eye tracker, which tracks participants' attention across the entire task.

Although the dot probe has been widely used, a few studies have questioned its sensitivity, reliability and validity. Schmukle [41] found that when the dot probe was administered at two time points across a 1 week period, the bias index was not internally consistent or stable and relationships with trait anxiety and attentional biases were inconsistent. As such, null findings may reflect the dot probe's lack of sensitivity in detecting such differences.

Overall, our results offer partial support for the S-REF model. The finding that metacognitions are associated with FCR is consistent with the S-REF model. As there was no evidence for any relationship between attentional biases and FCR level, or between attentional biases and metacognitive style, questions about the mechanism that underlies the association between metacognitions and FCR levels are raised. However, as noted previously, methodological limitations may have prevented the detection of attentional biases. Future research is needed to explore this further.

Limitations of the current study

A number of methodological issues should be noted when interpreting the current findings. This study employed a cross-sectional design, which means that causality cannot be determined. Whilst higher levels of FCR were statistically associated with higher levels of maladaptive metacognitions, it is not clear which preceded which. Furthermore, as all dot-probe tasks preceded questionnaire completion, it is possible that the experience of completing the dot-probe task influenced questionnaire responses, possibly magnifying associations. Longitudinal research is warranted to explore potential causal contributions of metacognitions in the development and maintenance of clinical FCR.

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The S-REF model specifies that the major attentional problem is disengaging from conceptual processing of threat-related material, rather than orientation towards threat. Indeed, it may be the case that there is a rapid orientating response, but the problem is continued conceptual processing. To some extent, initial versus ongoing processing can be explored using the dot-probe task by systematically varying the time of exposure to probe words; however, this was beyond the scope of the current study. Five hundred milliseconds is the most commonly used presentation time in dot-probe research [20] and is not restricted to initial orientation responses but is able to tap into early sustained attentional processes. Nonetheless, if the primary difficulty is in difficulty disengaging from the stimuli, a longer presentation of stimuli may have been better able to detect this pattern. Therefore, conclusions need to be tempered by our uncertainty regarding whether participants had moved from initial orientation to conceptual processing within the exposure time.

The sample size limited power to detect effects. However, the effect size of cancer words was small (0.1–0.2) and would require between 199 and 787 patients to find the effect, suggesting that any potential differences in attentional biases would have little clinical significance within this sample. Further, previous research has demonstrated attentional biases with smaller sample sizes than the current study.

Patients with prostate and breast cancer were included, to ensure a relatively even mix of genders and FCR levels. However, the specificity of gender to each type of cancer means it was impossible to tease out gender and cancer-type effects. As neither variable was significant when other variables were controlled for, this is of less concern. Future studies, however, should seek to include mixed-gender cancer types to avoid this problem.

All participants completed the study following consultation with their oncologist to maximise participant response rate; however, participants may have experienced relief following their appointment and so experienced lower levels of state anxiety and perceived threat than normal. Future studies may better enrol participants at some set time interval following the consultation (e.g. a month) so that any effects of reassurance would be reduced.

Conclusions and future directions

Overall, the results offer partial support for the S-REF model, with associations found for metacognitions but not attentional biases. The need for future research to explore these associations further is clear. These findings suggest that screening for maladaptive metacognitions may be useful to identify individuals at risk of high FCR who may require additional support. Wells [42] proposes metacognitive therapy (MCT) for GAD that aims to counter maladaptive metacognitions and provide alternative strategies for dealing with situations that trigger worry. This model may be a useful framework for psychological interventions for FCR. However, MCT also involves training individuals to modify their attention away from threat [40]. Given that there was no clear evidence of attention biases associated with FCR in the current sample, and the significant uncertainty in the literature about how attentional biases manifest in anxious individuals, care should be taken in applying such treatment components.

Appendix. Word pairs used in the dot-probe task

Cancer threat/neutral	Cancer Neutral/neutral	Cancer positive/neutral	Threat/neutral	Positive/neutral
Death/queen	Blood/radio	Brave/fence	Angry/curve	Freedom/kitchen
Grief/video	Cancer/pillow	Cure/tree	Bomb/crew	Adore/lounge
Fear/line	Chemotherapy/refrigerator	Fight/stand	Hatred/fitted	Joyful/teapot
Loss/view	Disease/outside	Healthy/weather	Terrifying/innovative	Calm/corn
Pain/laws	Hospital/national	Hopeful/harvest	Ignore/napkin	Laugh/clock
Palliative/appliances	Malignant/defendant	Life/raft	Murder/junior	Beautiful/component
Relapse/ancient	Needle/farmer	Recovery/sandwich	Tease/aisle	Compassionate/differentiate
Sick/bowl	Nurse/topic	Relief/reason	Strangled/signature	Pleasure/interior
Recurrence/dishwasher	Oncologist/television	Remission/whatever	Violent/thereby	Smile/cover
Suffering/magazines	Tumour/wedge	Survival/alphabet	Evil/hill	Exciting/flooring

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