

Psychometric validation of the Environmental Reward Observation Scale (EROS) in breast cancer survivors

Concepción Fernández-Rodríguez*, Sonia González-Fernández, and Ignacio Pedrosa

University of Oviedo, Dept. of Psychology, Oviedo (Spain)

Título: Validación psicométrica de la Environmental Reward Observation Scale (EROS) en supervivientes de cáncer de mama

Resumen: La pérdida de gratificaciones, como resultado de la enfermedad y tratamiento oncológico, se relaciona con problemas emocionales en supervivientes. Environmental Reward Observation Scale (EROS) es una escala para evaluar reforzamiento ambiental, desarrollada a partir de modelos conductuales que muestran la relación entre reforzamiento ambiental y estado emocional. Este estudio valida esta escala con supervivientes de cáncer de mama y analiza su utilidad para discriminar entre supervivientes con y sin trastornos emocionales. Un total de 219 mujeres supervivientes ($M_{edad} = 52.97$; $DT_{edad} = 7.50$) completaron medidas de reforzamiento ambiental, activación y evitación conductual, y estado emocional. Los datos se ajustan a una estructura esencialmente unidimensional, mostrando una consistencia interna elevada y de moderadas a altas con todas las medidas empleadas. Fueron estadísticamente significativas las diferencias en las puntuaciones entre participantes con y sin trastorno emocional. Mediante curvas ROC se estableció el punto de corte óptimo para discriminar ansiedad y depresión. Aplicando la Teoría de Respuesta al Ítem, se encontró que todos los ítems muestran un poder de discriminación de moderado a alto para evaluar reforzamiento ambiental. La EROS se presenta como una medida fiable y válida que puede emplearse para mejorar la evaluación del estado emocional de supervivientes oncológicos.

Palabras clave: Supervivientes, Cáncer, Environmental Reward Observation Scale (EROS); Depresión, Ansiedad.

Abstract: The loss of rewards resulting from oncological disease has been associated with emotional problems in cancer survivors. The Environmental Reward Observation Scale (EROS) evaluates environmental reinforcement and is based on behavioral models which show the relationship between environmental reinforcement and emotional state. The aim of this study is to analyze the psychometrical properties of this scale in breast cancer survivors and its usefulness in discriminating between survivors with and without emotional disorders. A total of 219 women survivors ($M_{age} = 52.97$; $SD_{age} = 7.50$) completed measures of environmental reinforcement, behavioral activation and avoidance, and emotional state. Data fit an essentially unidimensional structure, showing high internal consistency and correlations, varying from moderate to high, with all the measures used. In the EROS scores, statistically significant differences were found between participants with and without emotional disorders. Optimum cut-off point to discriminate between anxiety and depression was established via Receiver Operating Characteristic curve. Using the framework of the Item Response Theory model, all the items were found to have a power of discrimination for measuring environmental reinforcement ranging from moderate to high. The EROS is a psychometrically sound instrument, which can be used to improve assessment of emotional state in breast cancer survivors.

Keywords: Cancer survivors; Environmental Reward Observation Scale (EROS); Depression; Anxiety.

Introduction

Most cancer survivors adjust well to life after cancer but some experience emotional disorders. Anxiety and depression are the most frequent problems, with a prevalence superior to that found in healthy control groups (Yi & Syrjala, 2017). It is common for cancer survivors, having completed oncological treatment, to suffer from physical complaints, tiredness and a reduction in attention span and ability to concentrate. These or other physical repercussions frequently lead to patients reducing their involvement in relevant roles and/or pleasant activities (Cataldo & Brodsky, 2013; Fernández, Padierna et al., 2011). Moreover, when faced with the oncological process and fear of cancer recurrence, survivors frequently experience unpleasant thoughts, feelings and memories (McGinty, Small, Laronga, & Jacobsen, 2016). A common reaction to these experiences, encouraged and reinforced by the cultural context, is to try to avoid them. These attempts not only do not achieve the desired relief but generate more discomfort, contribute to perpetuating it, and limit involvement in important areas of life (Bardeen, 2015). Distancing oneself from day-to-day

activities reduces the chances of maintaining contact with the rewarding situations and valuable conditions of life. This situation may be at the root of their emotional problems (González-Fernández et al., 2017).

The behavioral theories of depression posit that decrease in access to environmental rewards and/or the reinforcement of depressive behaviors and the punishment of healthy ones are causal factors predicting the beginning and the maintenance of clinical depression (Lewinsohn, 1974). The relationship between response-contingent positive reinforcement (RCPR) and emotional distress has been established (Cuijpers, van Straten, & Warmerdam, 2007; Manos, Kanfer, & Bush, 2010); in particular, a low level of RCPR is one of the critical predictors of clinical depression. Lewinsohn, Sullivan and Grosscup (1980) explain the decrease in RCPR as a consequence of the combination of the following conditions: a decrease in the number of reinforcement events; a decrease in the availability of these reinforcers in the environment; the absence of appropriate instrumental behaviors to experience gratifying contingencies; and an increase in exposure to aversive environmental experiences. For many cancer survivors, these four conditions are assimilated in their own experience of the oncological process. In line with this model, behavioral treatments for depression have been developed to facilitate increased access to reward while decreasing the intensity and frequency of punishing events

* Correspondence address [Dirección para correspondencia]:
Concepción Fernández-Rodríguez, Department of Psychology, University of Oviedo. Plaza Feijoo, 33003 Oviedo (Spain).
E-mail: frconcha@uniovi.es
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(Lewinsohn, 1974). Currently, Behavioral Activation (BA) is a behavioral intervention for depression that shows promise in effectively treating depression by increasing goal and value-based activity levels, thereby eliciting increased response-contingent reinforcement (Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011; Martell, Adis, & Jacobson, 2001). The use of BA in treating emotional problems in cancer patients has also been supported by controlled studies (Fernández, Villoria, Fernández, González, & Pérez, 2017; Hopko et al., 2013; 2008; 2003).

In order to assess the relationship between RCPR and emotional state, it is vital to carry out an objective and valid evaluation of the former. During the therapy, observation and behavior reports (e.g. daily diaries, activity schedules, home observations) represent invaluable strategies with regard to programming activities aimed at recovering reinforcement (Hopko & Mullane, 2008). However, it is not easy to measure RCPR directly as this involves observation of relevant behaviors in the person's day-to-day environment over extended periods of time (Manos et al., 2010). Those researchers who have developed measures of RCPR have focused on measuring environmental rewards and exposure to pleasurable events. With the same objective in mind, Armento and Hopko (2007) developed the *Environmental Reward Observation Scale* (EROS). This scale is intended to be a proxy measure of RCPR by assessing the subjective experience of reinforcement. Items were designed to evaluate RCPR according to the formulation of Lewinsohn (1974). In its original version, with a sample of American students, the scale showed a unidimensional structure. Compared to commonly used depression and anxiety measures, as Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996), The Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977), or The State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983), correlations with the EROS ranged between medium and large. In other validation studies which included the general population and also populations with emotional disorders, carried out with participants who were Spanish (Barraca & Pérez-Álvarez, 2010), Colombian (Valderrama-Díaz, Bianchi-Salguero, & Villalba-Garzón, 2016), or French-speaking Belgians (Wagener & Blairy, 2015), in all cases there were found to be appropriate levels of internal consistency and also consistent validity evidence of internal structure. These findings indicate that the EROS could be a valid tool of environmental reinforcement, is congruent with the behavioral theories of depression and can facilitate the implementation and measuring of BA interventions. Indeed, the EROS has been used both to measure the notion of environmental reinforcement (Becoña et al., 2017; MacPherson et al., 2010), and to evaluate the effect of behavioral treatment of emotional disorders in subjects with health problems (Bombardier et al., 2017). In oncological populations, the EROS has been used when carrying out behavioral interventions and as a measure of the efficacy of Behavioral Activation in the treatment of emotional

disorders (González-Fernández, Fernández-Rodríguez, Paz-Caballero & Pérez-Álvarez, 2018; Lejuez et al., 2011, 2001). Despite this, and despite its evident usefulness, the EROS has not, however, been validated with this population.

Given this fact, the aim of this study is to obtain data regarding the reliability and validity evidence of the Spanish version of the EROS in a representative and relatively numerous sample of breast cancer survivors. At the same time, given the aforementioned peculiarities of populations of cancer survivors, the study also aims to analyze the sensitivity, specificity and ability of this scale to discriminate between survivors with and without depressive disorders.

Method

Participants

The participants recruited as cancer survivors attended the Oncology Department of the San Agustín Hospital (Avilés, Spain) or the Radiotherapy Department of the Central University Hospital of Asturias (Oviedo, Spain) for a scheduled medical review. The following inclusion criteria were established: breast cancer survivors, aged between 18 and 70 years, whose clinical situation was that of an oncological disease-free stage, confirmed by up-to-date medical report. The exclusion criterion was physical and/or cognitive deterioration which might hinder understanding and completing of measuring instruments.

The sample was made up of 219 women, aged between 31 and 67 years of age ($M = 52.97$; $SD = 7.50$). Regarding marital status, 72.6% were married/living with their partner, 24.7% single/divorced and 2.6% widows. Only 9.3% lived alone and the rest lived with relatives. All the participants had undergone surgery, 82.5% had received hormonal treatment, 80% had received radiotherapy and 57.2% chemotherapy. The time elapsed since the end of treatment ranged from 1 month to 8 years.

Instruments

Environmental Reward Observation Scale (EROS; Armento & Hopko, 2007). The EROS is a 10-item self-administered questionnaire answered using a 4-option Likert, where 1 implies *totally disagree* and 4 means *totally agree*, which supplies information regarding the quantity and availability of reinforcement received from the patient's environment. It was designed to evaluate the RCPR according to the formulation of Lewinsohn (1974). The items evaluate both the number of events that are potentially reinforcing and the availability of reinforcement in the environment (e.g., "*A lot of activities in my life are pleasurable*", "*Activities that used to be pleasurable are no longer gratifying*", "*My life is boring*"), and the competence of the subject to obtain reinforcement from the environment (e.g., "*It is easy for me to find enjoyment in my life*", "*I am satisfied with my accomplishments*", "*The activities I engage in usually have positive consequences*"). In its original version (Ar-

mento & Hopko, 2007), it showed a unidimensional structure with adequate internal consistency ($\alpha = .85$) and correlations, from moderate to strong, with different depression and anxiety scales (BDI-II = $-.78$; CESD = $-.79$; STAI-T = $-.71$; STAI-S = $-.80$). Here, the Spanish version of the EROS was used (Barraca & Pérez-Álvarez, 2010), for which data is available confirming its adequate reliability ($\alpha = .86$) and validity evidence in relation to other variables (significant correlations with the BDI-II = $-.73$; STAI-S = $-.80$; STAI-T = $-.70$; BADS-T = $.69$) and power to discriminate between clinical and non-clinical population.

Behavioral Activation for Depression Scale (BADS; Kanter, Mulick, Busch, Berlin, & Martell, 2007). Consists of 25 items measuring four dimensions: Activation, Avoidance / Rumination, Work/School Impairment and Social Impairment. The emphasis is placed on behaviours that are directed toward the accomplishment of goals that the individual has determined to be important in each area. The scale provides scores for each of the dimensions and also a total score. High scores in Activation and in the total score show a higher level of activation, whilst higher scores in the other dimensions indicate greater avoidance patterns. The total score demonstrated acceptable internal consistency ($\alpha = .79$). The internal consistency for each subscale was also acceptable. Initial validity evidence of internal structure was established through significant correlations in the expected directions with different depression, anxiety and behavioral activation scales. The Spanish adaptation of the BADS (Barraca, Pérez-Álvarez, & Lozano-Bleda, 2011) proved to be valid (significant correlations with the BDI-II = $-.63$; STAI-S = $-.68$; STAI-T = $-.70$; EROS = $.69$) and had adequate internal consistency (between $\alpha = .76$ and $\alpha = .90$). Factor analysis confirmed the four-dimensional structure of the original instrument.

Acceptance and Action Questionnaire - II (AAQ-II; Bond et al., 2011). This is a 7-item, self-rating questionnaire designed to measure experiential avoidance and psychological inflexibility. The items reflect an unwillingness to experience unwanted emotions and thoughts and the inability to be in the present moment and behave towards values-directed actions when experiencing psychological events that could undermine them. High scores indicate a greater degree of experiential avoidance and psychological inflexibility. The AAQ-II showed adequate internal consistency ($\alpha = .84$), and also demonstrates appropriate discriminant validity (correlations ranged between $.60$ and $.82$ with different depression, anxiety and behavioral activation scales). The Spanish translation of this questionnaire showed adequate internal consistency ($\alpha = .88$) and scores showed significant correlations with general scales measuring psychopathological state and quality of life (Ruiz, Langer-Herrera, Luciano, Cangas, & Beltrán, 2013).

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) is a 14-item scale with 2 subscales, Anxiety (HADS-A) and Depression (HADS-D). In the depression and anxiety subscales, scores of 8-10 indicate probable cases

and scores over 10 indicate clinical cases. For anxiety (HADS-A) this gave a specificity of $.78$ and a sensitivity of $.90$. For depression (HADS-D) this gave a specificity of $.79$ and a sensitivity of $.83$. Compared to commonly used depression and anxiety measures (BDI-II, CESD, STAI-T) correlations with the HADS-D and HADS-A ranged between $.60$ and $.80$ (Smarr & Keefer, 2011). In psycho-oncology, the HADS score has been proven to be an accurate instrument in identifying cancer patients with depression and anxiety (Walker et al., 2007).

18-item Brief Symptom Inventory (BSI-18; Derogatis, 2001) was specifically developed as a highly sensitive and efficient screen for psychological distress. Consists of 18 items. Responses to the items allow scores to be obtained in 3 dimensions (Somatization, Depression and Anxiety) and a Global Severity Index (GSI), which resumes the general level of psychological distress. The inventory presents satisfactory reliability indexes (specifically Cronbach's α), both for the dimensions (ranging from $.74$ to $.84$) and for the General Distress Index ($.89$). A T score ≥ 63 in the GSI or in two of the dimensions indicates a clinical case. Several studies show adequate reliability and validity of the inventory and endorse its use with Spanish samples (Galdón et al., 2008).

Short form of the 1978 Beck Depression Inventory (BDI-LA) based on the cognitive-affective subscale (BDI-LA-SCA; Beck & Steer, 1993). Consists of the first thirteen items of the BDI-IA, referring to affective-cognitive symptoms of depression. Beck and Steer (1993) recommended its use when evaluating depression in patients with medical conditions. This instrument showed an adequate degree of criterion-related validity when distinguishing between those hospitalized patients with medical conditions who were and were not suffering from depressive disorders. Sanz and García-Vera (2007) found alpha coefficients $> .70$ in three Spanish samples and an acceptable index of diagnostic precision (area under the ROC curve = $.81$).

Procedure

Over a 6-month period, a consecutive preselection of cancer survivors was made from patients with a scheduled hospital appointment. All those women who fulfilled the selection criteria were informed, verbally and in writing, of the objectives and procedures of the study and of the guarantees regarding confidentiality in the evaluation and treatment of data. They were then asked to give their written consent. Each participant filled in the evaluation tests individually. All the participants, in line with a written protocol, were given the same instructions. The evaluation room was suitable, in terms of facilities and privacy, to allow the tests to be carried out adequately. None of the participants received additional help to fill in the questionnaires. The tests took approximately 20-30 min. The subjects received no remuneration for participating in the study.

Statistical and Psychometric Analysis

Data quality was assessed in terms of mean with confidence interval, variance, percentage of missing data, and extent of ceiling and floor effects. Floor and ceiling effects between 1% and 15% were defined as optimal (McHorney & Tarlov, 1995).

To analyze the internal structure of EROS, a Confirmatory Factor Analysis (CFA) was conducted because of previous dimensionality confirmed among several studies and the absence of cross-loading factors based on the hypothesis of unidimensionality (Lloret-Segura, Ferreres-Traver, Hernández-Baeza, & Tomás-Marco, 2014). Given the difficulty in predicting all the empirical relationships that may exist between the items, the Modification Indices (or measurement errors) were taken into account in order to find the best fit of the data to the model. As the original EROS states, a one-dimensional structure was proposed (Armento & Hopko, 2007). All variables were categorical. Therefore, Weighted Least Squares Means and Variance adjusted estimation (WLSMV) was used as the extraction method (Muthén & Muthén, 2012). The evaluation of the goodness of fit of the data to the model was performed via the χ^2 divided by degrees of freedom, Root Mean Squared Error of Approximation (RMSEA), and Comparative Fit Index (CFI). Acceptable fitting models are achieved when the coefficient χ^2 /degrees of freedom is lower than 3, $RMSEA \leq .06$, $CFI \geq .90$, and $SRMR \leq .08$ (Asparouhov & Muthén, 2009). In the present study, adequate model fit was assumed if at least two of these fit indices supported model fit (Mosewich, Hadd, Crocker, & Zumbo, 2013). CFA was carried out using software Mplus 7.3 (Muthén & Muthén, 2012).

Closeness to unidimensionality was assessed through Unidimensional Congruence (UniCo), Explained Common Variance (ECV), and Mean of Item Residual Absolute Loadings (MIREAL) based on Pearson product-moment correlation matrix (Ferrando & Lorenzo-Seva, 2014). Attending to standards, UNICO's values larger than .95, ECV's values larger than .85, and MIREAL's values lower than .30 suggest that data can be treated as essentially unidimensional (Lorenzo-Seva & Ferrando, 2017). Additionally, a standardized solution is graphically represented. Cronbach's α coefficient was used to estimate the reliability of each subscale.

In the framework of Item Response Theory models (IRT), the Samejima's Graded Response Model (GRM) was used (Samejima, 1970). The slope (discrimination parameter, a) and threshold (difficulty parameter, b) were estimated.

According to Baker (2001), a values ranging between 0.01-0.24 are very low, 0.25-0.64 are low, 0.65-1.34 are moderate, 1.35-1.69 are high, and above 1.7 are very high. While a -parameter shows discrimination power of the item, b -parameter represents, for a given level of the trait (θ), the probability of selecting a specific response category or higher. The difference between the values of these parameters ($b_j - b_i$) can be interpreted as an indicator of the ease with which a person may change his or her response from one category to another. Furthermore, the Information Function (IF) was estimated, showing the measurement accuracy of the instrument across different levels of trait (i.e. reinforcement received from the patient's environment). When observing IF, the solid line represents the information provided by the instrument, while the dotted line represents the standard error on the measurement. To study the relationships between EROS and the other variables of the study, Pearson's correlation was carried out.

Fit of the data to the normal distribution was tested using the Kolmogorov-Smirnov-Lilliefors test. A study of differences was performed based on clinical-non clinical cut-off points on the HADS instrument. Owing to the violation of the assumption of normality, Mann-Whitney U test was carried out (CL=95%), using Cliff's Delta as effect size because of non-normal distribution.

A Receiver Operating Characteristic (ROC) curve was plotted to analyze the ability of the test to correctly classify those with and without emotional distress. Area under the curve (AUC) was estimated to determine the overall performance of the instrument to discriminate between those subjects with and without distress, where an area of 1 represents a perfect test. Estimation of optimal cut-off points were based on the relative costs of false negative and false positive results (Halpern, Albert, Krieger, Metz, & Maidment, 1996).

Results

Data quality analysis

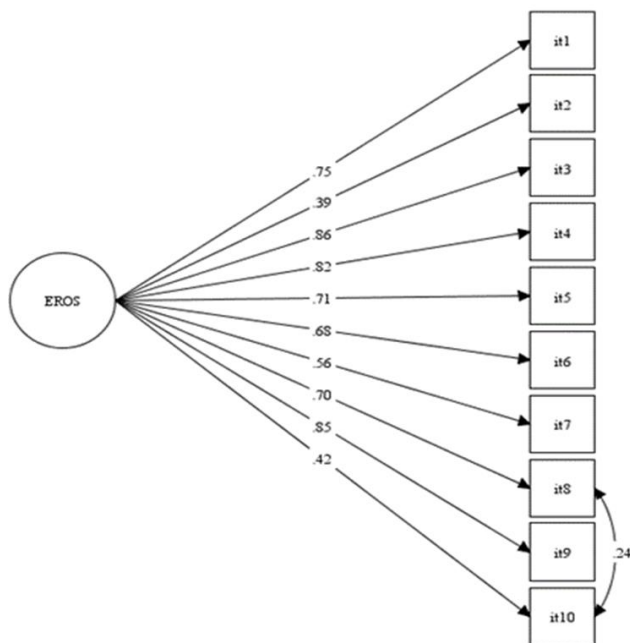
Comparing all items means and standard deviations are like almost all the items except items 5 and 7. The item response was high with a small number of missing answers (1.4–1.8%). Floor effect was small in almost all the items (range 2.3–14.4% in eight out of ten cases. Floor effects were found in the cited items 5 and 7) and all items had a ceiling effect larger than 15% (range 18.6–56.3%), and all the response choices were used in all items.

Table 1. Data quality analysis.

	Mean	Variance	Missing (%)	Floor (%)	Ceiling (%)
	Confidence Interval (95%)				
Item 1	3.219 (3.05-3.39)	0.952	1.8	7.4	52.6
Item 2	3.093 (2.90-3.29)	1.210	1.4	14.4	50.9
Item 3	2.874 (2.70-3.05)	1.003	1.8	10.7	34.4
Item 4	3.028 (2.84-3.21)	1.097	1.4	12.0	44.0
Item 5	2.433 (2.21-2.65)	1.557	1.8	36.3	29.8
Item 6	3.093 (2.90-3.29)	1.266	1.4	14.4	53.7
Item 7	2.372 (2.16-2.59)	1.536	1.8	36.3	28.8
Item 8	3.102 (2.93-3.27)	0.920	1.4	8.3	43.5
Item 9	3.200 (3.02-3.38)	1.016	1.8	10.7	52.6
Item 10	3.233 (3.09-3.37)	0.653	1.8	2.3	44.2

Psychometric properties of the EROS

First of all, validity evidence based on internal structure was checked via CFA, showing the following indexes: $\chi^2/df = 3.90$; CFI = .95; RMSEA = .116 [.096 - .137; CL = 90%]; UniCo = .896; ECV = .819; MIREAL = .270. Additionally, factor loadings of each item, and measurement errors (represented by a double-headed arrow) are shown in Figure 1. This unidimensional solution shows a reliability coefficient of $a = .91$.

**Figure 1.** Standardized solution of unidimensional model of EROS.*IRT Analysis*

Parameters a and b were estimated for the EROS instrument (Table 2). As can be seen, all items have a moderate to very high discrimination power (a -parameter). More specifically, half of the items exhibit a very high discrimination (values larger than 1.7). In relation to b -parameters, when using Samejima's GRM, the number of b -parameters derives from 1 minus the number of alternatives for that item. As there are four alternatives for the items in the EROS, there are three b -parameter values for each item. The largest differences ($b_3 - b_1$) in the EROS were found in items 10 and 2, and the smallest differences correspond to items 5, 9 and 6.

Table 2. Item Response Theory (IRT) parameter estimates for Environmental Reward Observation Scale (EROS).

Items	a	b_1	b_2	b_3	$b_3 - b_1$
1	2.23	-1.80	-0.90	-0.05	1.75
2	0.72	-2.79	-1.71	-0.15	2.64
3	3.13	-1.35	-0.36	0.49	1.84
4	2.71	-1.36	-0.57	0.21	1.57
5	1.65	-0.49	0.03	0.77	1.26
6	1.59	-1.51	-0.74	-0.12	1.39
7	1.03	-0.65	0.24	1.06	1.71
8	1.97	-1.78	-0.79	0.25	2.03
9	2.94	-1.38	-0.85	-0.06	1.32
10	0.95	-4.26	-1.81	0.35	4.61

Note. a = discrimination parameter; b_1, b_2, b_3 = difficulty parameters.

Regarding the measurement precision of the EROS, the IF exhibits maximum information between -1.5 and 0.5 trait levels, with the accuracy diminishing particularly in individuals with a latent trait level above +1 (Figure 2).

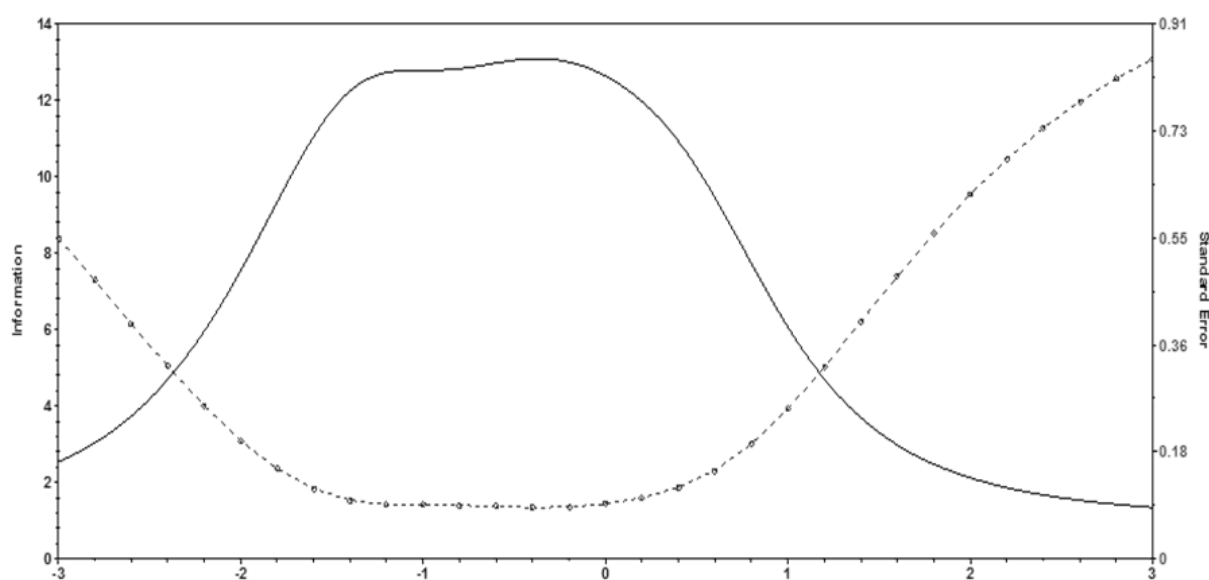


Figure 2. Environmental Reward Observation Scale Information Function.

Validity evidence in relation to other variables

Table 3 shows the Pearson correlations between the EROS and the rest of the instruments described previously, considering their subscales in those cases in which the instruments are multidimensional. Medium to large correlations were found between the EROS and almost all the dimensions assessed in this sample.

Table 3. Pearson correlation coefficients between the Environmental Reward Observation Scale (EROS) and scales of anxiety, depression, general distress and psychological flexibility.

	EROS
AAQ-II	-.723**
BADS-Activation	.436**
BADS-Avoidance/Rumination	-.539**
BADS-Work/School Impairment	-.570**
BADS-Social Impairment	-.588**
BADS-Total	.727**
BDI-IA-SCA	-.667**
BSI-18-Somatization	-.346**
BSI-18-Depression	-.631**
BSI-18-Anxiety	-.535**
BSI-18-Global Severity Index	-.581**
HADS-Anxiety	-.608**
HADS-Depression	-.727**
HADS-Total	-.724**

Note: $p < .001 = (**)$. AAQ-II: Acceptance and Action Questionnaire-II. BADS: Behavioral Activation for Depression Scale. BDI-IA-SCA: Short form of the 1978 Beck Depression Inventory (BDI-IA) based on the cognitive-affective subscale. BSI-18: Brief Symptom Inventory. HADS: Hospital Anxiety and Depression Scale.

Study of differences based on clinical and non-clinical condition

As assumption-of-normality-test was not confirmed ($p < .001$), a Mann-Whitney U -test was carried out to analyze statistically significant differences in the EROS scores of the

participants. Participants were split into two subsamples (clinical and non-clinical groups) based on the standard HADS cut-off point. On the basis of the HADS instrument, statistically significant differences were found between both groups in anxiety ($p < .001$; $\delta = 0.66$), depression ($p < .001$; $\delta = 0.92$) and total HADS score ($p < .001$; $\delta = 0.62$). As can be seen, effect sizes were medium for anxiety and total HADS score, while this effect is especially large related to the depression subscale.

Estimation of diagnostic-test sensitivity and specificity

Clinical instruments require the establishment of a cut-off point from continuous data, which will give information about sensitivity and specificity of the instrument. To achieve this, ROC curve and AUC were carried out to analyze sensitivity, specificity and overall performance of the EROS, using the HADS as gold standard to define the dichotomous true clinical state. From the results obtained, the overall performance can be considered to range from good to very good: Anxiety ($AUC_{anxiety} = .832$ [.767-.897; CL = 95%]), Depression ($AUC_{depression} = .958$ [.930 - .985; CL = 95%]), and Total Score ($AUC_{total} = .809$ [.743 - .874; CL = 95%]).

When estimating the optimal cut-off points of the EROS based on the gold standard established, the following results were found in terms of sensitivity and specificity of the instrument. For the HADS anxiety subscale, a score of 29 points can be defined as the optimal cut-off point, showing a sensitivity of 74.80% and specificity of 80.00%. Regarding the HADS depression subscale, a score of 25 points can be defined as the optimal cut-off point, showing a sensitivity of 82.70% and specificity of 100.00%. For the total HADS score, 33 points can be defined as the optimal cut-off point, showing a sensitivity of 70.60% and specificity of 81.70%.

Discussion

The emotional problems of cancer survivors have been related to a progressive loss of rewards resulting from adverse experiences in the oncological process. With this in mind, the aims of this study were, firstly, to determine whether the Environmental Reward Observation Scale is a valid and reliable instrument for evaluating the notion of environmental reinforcement in breast cancer survivors and, secondly, to examine the capacity of this scale to discriminate between survivors with and without depressive disorders.

With a clinically and socio-demographically representative sample of breast cancer survivors containing an adequate representation of participants with and without emotional disorders, the results obtained confirm the psychometric guarantees of the EROS in this population. Regarding evidence of construct validity, the confirmatory factor analysis indicates the unidimensionality of the scale. This result coincides with those reported by Armento and Hopko (2007) and by other validation studies (Barraca & Pérez-Álvarez, 2010; Valderrama-Díaz et al., 2016; Wagener & Blairy, 2015). It should be noted that, in our study, most of the fit indexes were observed to be below the standard criterion, and only the MIREAL and CFI indexes can be considered appropriate. The literature in general recommends a flexible approach to evaluating overall model fit, using a global analysis rather than a strict reliance on arbitrary cut-off values that may not be relevant to the specific research context (West, Taylor, & Wu, 2012). Consequently, in this case, considering fit indexes as a whole, the adequate factor loading shown by all items, the adequate reliability, which demonstrates a high relationship between all the items, and the fit indexes found in other papers, it seems plausible to define EROS as an essentially unidimensional instrument. It is, therefore, a test with sufficient psychometric guarantees, in the field of Psycho-oncology, for use in research into the relationships between the loss of response-contingent positive reinforcement and depression (Hopko et al., 2003; Lewinsohn, 1974; Martell, Addis, & Jacobson, 2001).

With regard to the reliability of the test, it is to be underlined that this was greater than that found in the aforementioned previous validation studies. Not only was there found to be a high relationship between the individual items, but also, when analyzed within the Item Response Theory, all have a moderate to very high power of discrimination regarding the perception of available environmental reinforcement of breast cancer survivors. Those items which would allow a particularly precise differentiation between survivors with a greater or lesser subjective perception of environmental reinforcement are: “*In general I am very satisfied with the way I spend my time* (item 3)”, “*My life is boring* (item 9)”, “*It is easy for me to find enjoyment in my life* (item 4)”, “*A lot of activities in my life are pleasurable* (item 1)”. As might be expected, these items are the ones which have the

highest factor loadings and item-test correlations (>.80). It should be pointed out that, in line with Lewinsohn’s formulation of RCPR (Lewinsohn, 1974), these items would be evaluating both the quantity and potential availability of environmental reward (items 9 and 1) and the competence of the person to obtain reinforcement from her environment (items 3 and 4). These results offer further evidence of the consistency of the concept of RCPR. Furthermore, in light of the relationship existing between emotional state and RCPR (Cuijpers, van Straten, & Warmerdam, 2007; Manos et al., 2010), they would support the effectivity of behavioral interventions aimed at increasing reinforcement in order to reduce levels of emotional distress. With regard to future studies, the question arises as to whether evaluating only those items which have shown the greatest discriminatory capacity may be sufficient in order to make a precise estimation of the survivor’s subjective perception of environmental reinforcement. If this were so, it would be possible to elaborate a briefer instrument and reduce evaluation time. The test would in turn be made simpler and more efficacious.

In the analysis of those items with the smallest b_3-b_1 difference values, it is also worth noting that the conditions which appear to be most susceptible to change are: “*Other people seem to have more fulfilling lives* (item 5)”, “*My life is boring* (item 9)”, “*Activities that used to be pleasurable are no longer gratifying* (item 6)”. In contrast, those in which change appears less probable are: “*Lately I have found that many experiences make me unhappy* (item 2)”, “*The activities I engage in usually have positive consequences* (item 10)”, “*I am satisfied with my accomplishments* (item 8)”. These results have clear clinical implications. It can be concluded that, when dealing with emotional disorders in breast cancer survivors, it would be more effective and efficacious to focus the first sessions of the intervention on that condition which can be more easily modified (according to items 5, 9 and 6), that is, on promoting an increase in rewarding activities which ensure the availability of environmental rewards. However, ultimately, the efficacy of the intervention depends on being able to modify also those conditions which are less probable to change (according to our results, items 2, 10, 8) as this would imply that subjects had acquired competences to ensure the contingent reinforcement of their actions. These findings are totally coherent with the principles and procedures of behavioral therapies of depression, and in particular of Behavioral Activation (Lejuez et al., 2001; Martell et al., 2001). From the very first sessions, this therapy establishes a program of rewarding activities which are consistent with the person’s values with a view to facilitating an increase in RCPR. As in any contextual therapy, the ultimate aim is to provide the person with competences which enable him/her to identify and change those response patterns which lead to depression and/or anxiety. For that reason, special attention is paid to identifying and modifying strategies of behavioral avoidance. Avoidance patterns distance the person from those day-to-day situations in which his/her rewards depend and reduce the possibilities of

undertaking other healthier strategies of interaction with the environment (Bardeen, 2015; Trindade, Ferreira & Pinto-Gouveia, 2017).

A similar interpretation can be made of the strong and negative correlation of this measure with measures of depression (HADS-D, BSI-D; BDI-IA-SCA), of behavioral avoidance (AAQ-II, BADS-A/R, BADS-WSI, BADS-SI) and of anxiety (HADS-A, BSI-A). There is an equally strong, but positive, correlation with measures of activation (BADS-T). These results coincide with those reported by other authors, who, with different clinical populations and general population, have identified a relationship between depression and RCPS (Folke & Kanter, 2016; Hill, Buitron, & Pettit, 2017), and between patterns of behavioral avoidance and emotional state (Brem, Shorey, Anderson, & Stuart, 2017; González-Fernández et al., 2017). Both conditions, as pointed out previously, are principal objectives of behavioral therapies for depression. Consequently, we suggest that the EROS could also be a suitable instrument for evaluating the results of behavioral treatment of emotional disorders in breast cancer survivors. This belief is also supported by the results, which confirm that participants with and without emotional problems differ with regard to their levels of perceived environmental reward. Furthermore, as predicted by the model on which the scale is based, the particularly large effect size of the differences between the scores of survivors with and without depression are especially noteworthy.

In our study, the Information Function of the EROS indicates that it would be for those breast cancer survivors with a score around the mean of the population (approximately between 17 and 27) for whom the scale would best estimate perception of available environmental reinforcement. It is precisely within this range that the cut-off point for depression (25) is extremely sensitive and most specific. The use of the Hospital Anxiety and Depression Scale as a gold standard measure is endorsed by its properties and by its widespread application in evaluating emotional distress free from the bias of physical symptomatology. Walker et al. (2007) found somatic symptoms of depression to be confounding factors in patients with medical illnesses. The same could occur in cancer survivors. It is, nevertheless, true that some authors have questioned the suitability of this instrument for differentiating between depression and anxiety (Burns, Hoffer, Curry, Sexton, & Doyle, 2014). In light of the lack of other studies into this matter, one possible subject of future study could be the use of other measures and/or procedures of clinical diagnosis as gold standard comparison criteria for confirming the adjustment of cut-off points in the EROS.

The degree of similarity shown between the survivors' experiences during the oncological process would suggest that the results of this study could be extended to other cancer patient populations. However, the fact that this population is mainly female raises the question of whether the same observations could be applied to a population of male survivors. Although it appears unlikely that gender would affect the unidimensional structure of the scale, as has been shown in previous validation studies using samples with an adequate representation of both men and women, it could affect the scores. It is known that women suffer from and/or seek help for more emotional distress than men (Kuehner, 2017). In oncological survivors, gender has also been related to different levels of depression (Bevilacqua et al., 2018), emotional distress and fear of a relapse (Koch-Gallenkamp et al., 2016). Furthermore, some studies suggest that women appear to be more sensitive to reinforcement and rewards (Ryba & Hopko, 2012; Tull, Gratz, Litzman, Kimbrel, & Lejuez, 2010). To sum up, due to the great clinical value that use of this scale appears to have with oncological patients, and also in order to gain more profound insights into the relationships between RCPR and emotional distress, it would be of interest to carry out further studies using adequately-balanced samples in terms of gender and at different stages of different types of cancer. In order to overcome some of the limitations of this study, it would be recommendable to use a longitudinal evaluation design to examine the guarantees offered by the instrument.

Conclusion

The EROS is shown to be a valid and reliable measure for the evaluation of environmental rewards in breast cancer survivors. Its use is recommended for estimating the degree of loss of contact with reinforcers of day-to-day life which patients undergo as a result of the oncological treatment and disease and which increase the probability of emotional disorders.

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Ethical Approval: The study was conducted in accordance with codes of ethics and conduct specified by the Research Ethics Committee of the Principality of Asturias, Spain (Ref.:45/14). Informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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