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Validating the Korean Impact of Future Events Scale: Assessing Pathological Imagery

Hyun Seok Jeong Jongmin Lim Mun-Seon Chang†

Department of Psychology, Kyungpook National University, Daegu, Korea

Psychological experiences and complex emotions, which are challenging to express in language can be more effectively conveyed through imagery. However, there are currently limited tools available to measure the psychological experiences associated with pathological imagery phenomenon adequately. This study validates the Korean Impact of Future Event Scale (K-IFES) and highlights the importance of considering mental imagery alongside linguistic aspects in mental health. The K-IFES's ability to identify emotional distress has practical implications, providing a reliable criterion for understanding cognitive vulnerability related to imagery. This was assessed by comparing emotional distress categories from self-reported Mini International Neuropsychiatric patient health survey between 127 individuals and 73 healthy controls. Further, this study establishes the K-IFES as a reliable and valid tool particularly in assessing pathological imagery through the Rasch model, convergent and discriminant validity analysis, and ROC analysis. It emphasizes the significance of measuring psychological experiences related to pathological imagery and introduces a novel tool for assessing intrusive prospective imagery.

Keywords: imagery, intrusive prospectiveimagery, pathological imagery, Korean impact of future event scale, Rasch model

Introduction

The way we perceive and understand experiences varies from person to person. Even when faced with a similar situation, some individuals may reconstruct the situation as a linguistic logic composed of sentences, while others may only comprehend the individual words or propositions that constitute the situation. Alternatively, they may visually perceive the scene, akin to a photograph. These cognitive operations involve the creation of imaginary entities assumed to represent perception, thought, memory, and more, known as mental representations (American Psychological Association [APA], 2022). We can posit that specific entities or information are generated to process stimuli and information during cognitive information processing. Mental representations can be categorized into verbal representations (or symbolic representations), which employ symbols, visual representations composed of visual stimuli like drawings or photographs, and propositions (Sternberg & Sternberg, 2016).

The verbal processes that contribute to the generation and persistence of unpleasant emotions and arousal tend to center around reasons and assumptions rather than addressing the underlying problem itself (Michael et al., 2007; as cited in Shin & Oh, 2017). Specifically, Key aspects of this process include worry (Borkovec et al., 1998; McLaughlin et al., 2007), encompassing everyday concerns to persistent anxiety, typically reflects an excessive fear of uncertainty associated with anxiety disorders. And rumination (Nolen-Hoeksema et al., 2008), involving repetitive and entrenched thought processes associated with self-blame and exces-

†Correspondence to Mun-Seon Chang, Department of Psychology, Kyungpook National University, 80 Daehak-ro, Buk-gu, Daegu 41566, Korea; E-mail: moonsun@knu.ac.kr

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sive contemplation of problems. Both of which have been shown to significantly influence negative emotions like depressed mood and anxiety (Taylor & Snyder, 2021; McLaughlin et al., 2007). These maladaptive verbal processes can perpetuate negative emotions and potentially worsen symptoms or hinder recovery. However, much of the research on cognitive processing of emotional issues has predominantly focused on verbal processing, with comparatively little attention given to mental imagery. Given that these mental representations in cognitive processing often occur in parallel or interact rather than in isolation (Paivio, 1971, 1986), this highlights a limitation in our comprehensive understanding of psychopathological phenomena. Fortunately, there has been a recent upsurge in research on nonverbal processes such as imagery.

As a representative mode of nonverbal processing, imagery encompasses a variety of mental representations accompanied by sensations (Hackman et al., 2011). Interest in mental imagery has been on the rise since the 1970s, and from the 1990s, it has emerged as a vibrant area of research in psychology, including its integration into cognitive-behavioral therapy (Hackman et al., 2011). Imagery has been shown to play a pivotal role in various mental disorders (Holmes & Mathews, 2010). In this context, intrusive prospective imagery, which refers to the involuntary experience of distressing mental imagery of future events, holds significant relevance in psychopathology research (Deeprose & Holmes, 2010). This focus on the experience of flash-forwards, or potentially intrusive imagery, distinguishes it from flashbacks to past traumatic events, a hallmark symptom of Post-Traumatic Stress Disorder (PTSD). In Imagery-related research, the focus on PTSD has often centered around involuntary and intrusive distressing memories, specifically flashbacks, related to past traumatic experiences. As the involuntary recall of traumatic events in the past can be 're-experiencing', imagination about the future can also be manifested involuntarily and intrusively as a form of 'pre-experiencing' (Schacter et al., 2007). In clinical settings, past memories can intrude into consciousness unintentionally, future events may also intrude into the mind involuntarily and distressingly (Deeprose et al., 2011). Flash-forwards have been extensively linked to various psychopathologies, including mood disorders (Holmes et al., 2008) and anxiety disorders (Deeprose & Holmes, 2010), and are particularly crucial in the context of suicide (Holmes et al., 2007; Crane et al., 2012). Individuals who have experienced suicidal ideation or attempted suicide commonly report significantly more vivid imagery related to the aftermath of suicide or death, as well as negative prospective imagery, compared to healthy individuals (Hales et al., 2011; Ng et al., 2016). These intrusive prospective imageries, or flash-forwards, may be considered a risk factor for suicide (Kroener et al., 2019).

With the growing interest in mental imagery, as of 2021, 31 mental imagery studies have been published in Korea, with 17 published since 2016 alone (Song, 2021). These studies have primarily focused on mental disorders or psychological issues, but a limitation is that while studies on cognitive processes related to psychological problems have explored variables directly or indirectly linked to psychopathology, such as rumination or worry, not its function, research on nonverbal processes has primarily concentrated on the function of mental imagery (vividness, rate of generation, etc.). This limitation may impede the operationalization and accurate measurement of mental representations associated with psychopathology, highlighting the need to capture variables that better reflect the pathological experiences of individuals. With the increasing emphasis on early identification and treatment of mental health concerns (Ministry of Health and Welfare, 2022), intrusive flash-forwards may serve as a key variable reflecting cognitive vulnerability to emotional problems. In this study, adults aged 18 years and older who have been treated medical care at a medical institution for emotional problems were selected for capturing cognitive vulnerability of pathological imagery, and to ensure the reliability of the complaints, the self-reported MINI (Lim et al., 2007) was used to assess whether they met the DSM-5 criteria for major depressive disorder, generalized anxiety disorder, panic disorder, and social anxiety disorder.

Meanwhile, the Impact of future Events Scale was developed based on the Impact of Events Scale (Horowitz et al., 1979; Weiss, 2007), which measures symptoms associated with past traumatic experiences (Deeprose et al., 2011). The IFES changed the items of the IES related to invasive experiences of past events to those related to future events, and its psychometric properties have been confirmed to be good, allowing it to be used in a variety of contexts, including clinical settings, as opposed to scales that simply measure the functions (vividness, quantity, stimulus type) or everyday utilizationof imagery. For this reason, there is a lack of tools

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to assess the utilization of pathological imagery in Korea, and this study aims to validate the psychometric properties of the scale for domestic validation of the IFES. To achieve this, we translated the IFES into Korean to analyze the items, verifiedits validity and reliability, and found cut-off scores for identifying people with clinically significant cognitive vulnerability of imagery. Specifically, we used Rasch's Item Response Theory to analyze the IFES items to verify whether they have good item characteristics (i.e., item specificity and item difficulty) when translated from English into Korean. Rasch modelof item response theory is a theory that analyzes individual items based on their characteristics, and it was judged to be useful for validating the characteristics of the scale because it can be used to estimate item characteristics away from the invariance of item characteristics and examinee ability, which is one of the limitations of the classical test theory based on total scores. In addition, we verified the hypothesis that intrusive prospective imagery would have significant convergent validity with psychopathological concepts such as depression, anxiety, and bipolar symptoms as cognitive vulnerability, and discriminant validity with psychological health such as healthy imagery functioning and utilization, and life satisfaction.

Methods

Participants and Procedure

The primary objective of this study is to validate the psychometric properties of the Korean Impact of Future Event Scale (K-IFES) in assessing image utilization as a factor related to depressive vulnerability. To accomplish this, the author granted permission to use IFES for the domestic validation as part of the doctoral dissertation. And then data were collected by recruiting participants through the online survey company Invite (http://www.invight.co.kr) after obtaining Institutional Review Board (IRB) approval (2023-0251). In accordance with the approved IRB protocol, the researcher continuously monitored the sampling process by exchanging feedback with invite on the scales and sample construction. Furthermore, data was collected by sending IRB-approved questionnaires, research consent form, and study recruitment materials via e-mail from invite to the panelists, allowing for the administration of scales online. To identify individuals experiencing emotional problems, we recruited a total of 200 adults aged 18 years and older. This group consisted of 100 individuals currently seeking or who had previously received medical care for emotional issues. Given that self-reporting medical care can be subject to inaccuracies, we assessed whether they met the DSM-5 criteria for major depressive disorder, generalized anxiety disorder, panic disorder, or social anxiety disorder using the Korean version of the shortened self-report MINI (Lim et al., 2007). Participants who met at least one of these criteria were classified as the emotional distress group. In addition, patients with neuropsychiatric and degenerative mental illnesses were excluded from the study, and participants who had never been treated by a psychiatrist for emotional problems, who were not currently experiencing significant emotional symptoms, and who did not meet the diagnostic criteria of the MINI were categorized as healthy controls. This categorization resulted in 127 participants in the emotional distress-group and 73 participants in the healthy control group (Supplementary Table 1).

Materials

Korean version of the shortened self–report MINI (Korean Mini International Neuropsychiatric Interview patient health survey)

MINI is a short structured interview tool first developed by Sheehan in the United States and Lecruiber in France. Although it is simple and easy to use, it is difficult to administer in clinical settings without trained interviewers and is time-consuming, so it was adapted as a self-report questionnaire by HP Design in the Netherlands in 2001. It was designed to screen for current illustration of four disorders, including three highly prevalent anxiety disorders and major depressive disorders. Participants read the questionnaire, which is organized to reflect the diagnostic criteria for each disorder and respond directly with a "yes" or "no" answer, for a total of 39 questions. Based on the disorder-specific criteria, it is possible to determine whether a person is screened for that disorder. In validation study of self-rated Korean version of MINI (Lim et al., 2007), the overall consistency betweenself-rated MINI and psychiatric diagnosis using structured interview MINI has been reported to be good, with kappa coefficients ranging from 0.45 (major depressive disorder) to 0.65 (social anxiety disorder). This scale were used to classify participants into groups.

Korean version of the Beck Depression Inventory, 2nd edition (K–BDI–II)

The Beck Depression Inventory (BDI), one of the most widely used self-report scales, was first introduced by Beck et al. in 1961, and later revised to the BDI-II in 1996 after it was noted that the BDI-IA only met six of the nine major depressive symptoms. The BDI-II removed four items (weight loss, body image changes, difficulty working, and preoccupation), added four new items (agitation, difficulty concentrating, feelings of worthlessness, and loss of motivation), and changed questions about sleep and appetite, which were problematic in the BDI, to allow for assessment of both increases and decreases. The BDI-II consists of 21 items (e.g., "I am sad all the time" of sadness, "I feel guilty over many things I have done or should have done" of guilty feelings) on a 4-point (0-3) Likert scale, with higher scores indicating more current depressed mood. In a Korean standardization study (Lim et al., 2014), the internal consistency was 0.89, and in this study, it was 0.95. This scale was used to verify convergent validity.

Korean version of the Beck Anxiety Inventory (K–BAI)

The BAI is a test used to measure anxiety and consists of 21 questions on a 4-point (0-3) Likert scale. Each item describes thoughts, physical condition, and panic related to anxiety symptoms. It can be used in a variety of clinical populations. The scale can be used to assess agoraphobic anxiety, social anxiety, obsessive-compulsive anxiety, and generalized anxiety, with higher scores indicating higher levels of anxiety. In a study by Lee et al. (2016), the internal consistency was 0.91, and in this study, it was 0.97. This scale was used to verify convergent validity.

Korean version of the Beck Hopelessness Scale (K–BHS)

A test to predict accidental suicide by measuring three important aspects of hopelessness: expectations, loss of motivation, and feelings about the future (e.g., "I might as well give up because there's nothing I can do to make things better for me"). By answering true or false (i.e., 0 or 1) to 20 statements on the BHS, patients can endorse a pessimistic state or deny a positive state. Higher scores indicate higher levels of hopelessness. In a study by Kim et al. (2015), the internal consistency was found to be 0.85, and in this study, it was 0.91. This scale was used to verify convergent validity.

Korean version of the Impact of Future Events Scale (K–IFES)

The IFES is a 24-item self-report questionnaire derived from the Impact on Events Scale (IES) that assesses post-traumatic PTSD symptoms of re-experiencing, avoidance, and hypersensitivity. The first 22 items are on the same 5-point (0-4) Likert scale as the IES, with an additional question to assess symptoms related to future events. IFE Scontains items about intrusive prospective imagery (e.g., "I thought about the future when I didn't mean to", "I found myself acting or feeling like it was really happening"). In this study, the instructions and items of the IFES were translated into Korean to create an initial questionnaire. This questionnaire was then back translated by two bilingual speakers to ensure linguistic equivalence with the original scale and to guarantee the faithful conveyance of the original scale's intended meaning. Higher scores indicate higher levels of intrusive preoccupation. In the study by Deeprose et al. (2012), the internal consistency was 0.87, and in the present study it was 0.93.

Spontaneous Use of Imagery Scale (SUIS)

The SUIS was developed by Reisberg et al. (2003) to assess spontaneous use of imagery, which is the degree to which a person spontaneously utilizes imagery in everyday life (e.g., "When going to a new place, I prefer directions that include detailed descriptions of landmarks (such as the size, shape and color of a gas station) in addition to their names.", "Before I get dressed to go out, I first visualize what I will look like if I wear different combinations of clothes."). It is a 12-item, 5-point (1-5) Likert scale, reflecting the extent to which individuals use visual mental imagery in their daily lives. The items describe everyday situations where visual mental imagery might arise or be beneficial. Higher scores indicate a greater use of mental imagery in daily life. Although no validation studies have been conducted in Korea, the internal consistency of the scale was reported to be 0.80 in a study by Gong et al. (2017). In this study, the internal consistency of the SUIS translated by Gong et al. (2017) was 0.83. This scale was used to verify discriminant validity.

Questionnaire upon Mental Imagery (QMI)

Developed by Betts (1909; as cited in Sheehan, 1967) to assess the vividness of mental imagery, the original 150-item instrument was shortened to 35 items by Sheehan (1967) to measure seven sensory

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modalities of mental imagery (visual, auditory, tactile, kinesthetic, gustatory, olfactory, and somatosensory). Participants rate how vividly they can imagine different situations on a 7-point (1-7) Likert scale, with higher scores indicating more vivid imagery. Internal consistency was found to be 0.97 in a study of hemodialysis patients (Kim, 1996) and 0.95 in a study of mentally ill patients (Cho & Yoo, 1996). In this study, the internal consistency was 0.98. This scale was used to verify discriminant validity.

Korean Satisfaction with the Life Scale (K–SWLS)

This scale was developed by Diener et al. (1985) to evaluate the level of overall satisfaction with one's life and consists of five items on a 7-point (1-7) Likert scale (e.g., "In most ways my life is close to my ideal."). Higher scores reflect higher life satisfaction, and in Lim's study (2012), internal consistency was reported as 0.91 (police officers), 0.84 (university students), and 0.86 (adolescents). In this study, it was 0.90. This scale was used to verify discriminant validity.

Korean Ruminative Response Scale (K–RRS)

Developed by Nolen-Hoeksema (1991; as cited Kim et al., 2010), this scale was created using items from the Response Style Questionnaire (RSQ) to measure reactions to depressive moods that correspond to the ruminative response style that has been most strongly associated with depression. It is a 4-point Likert scale ranging from 1 to 4, consisting of 22 items, and focuses on the meaning of rumination, emotions related to depression, and symptoms (e.g., "think about how alone you feel", "go away by yourself and think about why you feel this way"). Higher scores indicate a more severe manifestation of these issues. In Korea, a validation study was conducted by Kim et al. (2010), and Cronbach's α was reported to be .89. In this study, it was found to be .95. This scale was used to verify convergent validity.

Korean Mood Disorder Questionnaire (K–MDQ)

The MDQ was developed to aid in the diagnosis of bipolar disorder (Hirschfeld et al., 2000). It consists of three components: criterion 1, consisting of manic or hypomanic symptoms; criterion 2, asking whether the symptoms occurred at the same time; and criterion 3, asking how much functional impairment or problems the symptoms caused. Participants self-report their symptoms and rate the questions as "yes" or "no". A person may be considered to have bipolar disorder if they answer "yes" to seven or more of the 13 items in criterion 1, have the same time frame in criterion 2, and have moderate or greater problems in criterion 3. In a domestic validation study by Jon and colleagues (2005), internal consistency was high at 0.88, and optimal sensitivity and specificity were found for a total score of 7 or more on criterion 1. In this study, the internal consistency was 0.80. This scale was used to verify convergent validity.

Korean Penn State Worry Questionnaire (K–PSWQ)

A 16-item, 5-point (1-5) Likert scale developed to assess worry-related problems common in generalized anxiety disorder (Meyer et al., 1990). The scale assesses pathological symptoms of excessive and uncontrollable worry (e.g., "My worries overwhelm me", "I am always worrying about something"), with higher scores indicating higher levels of worry. In a Korean validation study (Lim et al., 2007), internal consistency was reported to be .91, and in this study, it was .86. This scale was used to verify convergent validity.

Korean version of the Cognitive Avoidance Questionnaire (K–CAQ)

This scale was developed to measure various cognitive avoidance strategies and consists of five factors: thought suppression, thought substitution, distraction, threat stimulus avoidance, and mental image transformation (e.g., "I think about things that concern me as if they were occurring to someone else", "I replace threatening mental images with things I say to myself in my mind"), with higher scores reflecting higher cognitive avoidance. It is a 5-point (1-5) Likert scale with a total of 25 items. In Korean validation study (Song & Kim, 2009), the internal consistency was .94, and in this study, it was .95. This scale was used to verify convergent validity.

Data Analysis

The data collected in this study underwent analysis using SPSS 23.0 and Winsteps version 5.6.3.0. Initially, descriptive statistics and frequency analysis were performed to present the means and variances of both the subjects' demographic characteristics and the questionnaire measures, and reliability analysis was performed

to internal consistency, item discriminatory. Following this, exploratory factor analysis (principal component analysis with varimax rotation) andunidimensionality analysis were carried out to testunidimensionality of the Rasch model. In the Rasch model, it is imperative to fulfill the assumption of unidimensionality before proceeding with the analysis. Unidimensionality entails that the constructs assessed by a test align with a single trait. The rationale behind conducting a verification of unidimensionality lies in ensuring the statistical validity of item fit analysis when the diagnostic tool conforms to a unidimensional structure (Lim & Lee, 2021). In general, a unidimensional structure is indicated when the eigenvalue of the first factor is notably larger than those of other factors. It is suggested that item response theory can be applied when the first factor explains approximately 20% of the total variance of the test score (Hattie, 1985; Reckase et al., 1988). Then, individual item fit and response scales of the K-IFES were also scrutinized. The extent to which an individual's response to a specific item deviate from the probability value estimated by the model can be assessed to determine the fit of the item response to the model (Seol & Yoo, 2015). Infit index is more sensitive to items that do not align with the attribute level of the individuals who responded positively, whereas outfit is more sensitive to items with extreme values (Hong & Cho, 2006). A good item is expected to have an index equal to 1. An index greater than 1 suggests that the item has a weak relationship with the psychological trait being measured, while an index less than 1 indicates that the item likely overlaps in content with other items (Bae et al., 2015). In addition, if the point-measure correlation is equal to 0 or negative, it indicates a reverse meaning compared to other items. In/outfit indices within the range of 0.75 to 1.30 are generally considered good (McNamara, 1996). In this study, we adopted a cutoff range of 0.6 to 1.4 for the Likert scale, based on previous research (Wright & Linacre, 1994).

Subsequently, a multivariate analysis of variance was conducted to investigate whether there were significant differences in the measures between the emotional distress group and the comparison group. ROC analysis was then employed to establish cutoff points using Youden's index. Correlation analyses were performed between each scale to assess the validity of the scales.

Results

Demographic Analysis

The overall mean age was 43.7 years, and the healthy control group and the emotional distress group were 45.58 and 42.62 years, respectively. It shows significant difference between groups, but the small effect size (Cohen's $d = 0.359$). Furthermore, there were no significant differences in gender, education, or marital status between the groups. The descriptive analysis of the participants is presented in Supplementary Table 2.

Item Analysis

Overall, the item analysis showed good levels of skewness (-0.37-0.52), Kurtosis (-1.16~-0.43), and internal consistency; however, items 1, 23, and 24 had low discriminatory power (i.e., Item-Scale correlation coefficient $< .3$) and, unlike the other items, the internal consistency increased when they were excluded (Table 1).

Estimating Item Fit with the Rasch Model

First, we conducted a unidimensionality test as part of the Rasch analysis. Using Winsteps, our unidimensionality test revealed that the Rasch measurement model could account for 40.1% of the total observed variance. The eigenvalue of the first factor was 4.49, the second factor was 2.88, and the third factor was 1.81, with none of the remaining factors exceeding 3.0. Given these results, we assumed unidimensionality and proceeded with the analysis.

Next, we examined the distribution of item responses. We present examiner ability estimates and the difficulty estimates of the 24 items (Supplementary Figure 3). The analysis revealed that the fit of items 1 ('I believed my thoughts about the future would definitely happen and would become real'), 23 ('I felt energetic and excitable'), and 24 ('I felt elated and optimistic') was inadequate from the analysis as their fit exceeded the criteria, and these items were consequently excluded. Convergent and discriminant validity, sensitivity, and specificity were evaluated with these questions (i.e., questions 1, 23, and 24) excluded from the analysis.

Convergent and Discriminant Validity

Prior to assessing convergent and discriminant validity, we conducted an analysis of descriptive statistics and between-group

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Table 1. *Descriptive Information of K-IFES Items*

Item	Mean (SD)	Item-Scale correlation coefficient	α If item deleted	Infit	Outfit	Point-measure correlation
1	2.14 (1.07)	-0.043	0.932	1.95	2.16	0.03
2	1.57 (1.14)	0.541	0.923	1.01	1.00	0.59
3	2.04 (1.01)	0.367	0.925	1.10	1.09	0.44
4	1.57 (1.18)	0.631	0.921	0.91	0.87	0.66
5	1.38 (1.06)	0.621	0.922	0.77	0.75	0.66
6	1.94 (1.11)	0.481	0.924	1.06	1.05	0.54
7	1.75 (1.10)	0.635	0.921	0.77	0.74	0.67
8	1.19 (1.15)	0.695	0.920	0.83	0.77	0.71
9	1.46 (1.19)	0.707	0.920	0.80	0.79	0.73
10	1.38 (1.25)	0.701	0.920	0.92	0.86	0.72
11	1.35 (1.18)	0.695	0.920	0.83	0.78	0.72
12	1.55 (1.06)	0.612	0.922	0.76	0.74	0.66
13	1.49 (1.07)	0.505	0.923	0.97	0.99	0.55
14	1.42 (1.10)	0.693	0.920	0.71	0.70	0.72
15	1.38 (1.23)	0.659	0.921	0.97	0.94	0.69
16	1.27 (1.13)	0.752	0.919	0.67	0.64	0.76
17	1.17 (1.17)	0.734	0.919	0.79	0.73	0.75
18	1.36 (1.11)	0.616	0.922	0.85	0.95	0.64
19	1.10 (1.16)	0.707	0.920	0.86	0.78	0.72
20	1.30 (1.13)	0.514	0.923	1.08	1.13	0.56
21	1.34 (1.19)	0.707	0.920	0.82	0.80	0.73
22	1.26 (1.18)	0.690	0.920	0.85	0.82	0.71
23	1.51 (1.18)	0.140	0.930	1.84	1.97	0.23
24	1.57 (1.15)	0.116	0.930	1.83	1.96	0.20

comparisons for each scale (Table 2). The emotional distress group exhibited significantly higher scores on most scales, including the K-IFES, when compared to the healthy control group. However, the emotional distress group scored significantly lower on the K-SWLS. No significant differences were found on the image-related scales, SUIS, and QMI.

In terms of validity, the K-IFES exhibited a lack of significant correlation with SUIS, which pertains to the use of imagery in daily life. However, it showed a significant negative correlation with QMI, which relates to the functioning of imagery in various sensory dimensions (e.g., vividness). The K-IFES also demonstrated significant positive correlations with the K-BDI-II and K-BAI, which are indicative of one's current affective state. Furthermore, it exhibited significant positive correlations with the total score of criterion 1 in the K-MDQ, reflecting (mild) manic symptoms, as well as with rumination (K-RRS), worry (PSWQ), and cognitive avoidance (K-CAQ), all of which signify cognitive vulnerability to these issues. In contrast, K-SWLS, a measure of life satisfaction, was significantly and negatively correlated with the K-IFES. These results are detailed in Table 3.

Sensitivity and Specificity Analysis

The area under the curve for K-IFES was found to be significant at .766 ($p < .001$) in Figure 1. Sensitivity and specificity were observed

Table 2. *Comparison between Groups*

	HC ($n = 73$) Mean (SD)	ED ($n = 127$) Mean (SD)	Total ($n = 200$) Mean (SD)	Skew	Kurt	Statistics	
						t	Cohen's *d*
K-IFES	20.82 (13.09)	35.64 (15.62)	30.23 (16.36)	0.34	-0.42	-6.839***	-1.005
K-BDI-II	7.71 (5.92)	21.72 (11.49)	16.61 (11.92)	0.95	1.10	-9.697***	-1.424
K-BAI	4.64 (5.57)	19.69 (13.06)	14.20 (13.11)	0.91	-0.13	-9.356***	-1.374
K-BHS	5.79 (4.73)	9.57 (5.89)	8.19 (5.78)	0.39	-0.90	-4.671***	-0.686
SUIS	35.73 (7.24)	36.23 (7.46)	36.05 (7.37)	0.32	-0.06	-0.463	-0.068
QMI	181.23 (41.72)	178.93 (33.05)	179.77 (36.36)	-0.39	0.44	0.430	0.063
K-SWLS	21.89 (5.50)	17.89 (6.30)	19.35 (6.31)	-0.21	-0.14	4.524***	0.665
K-RRS	38.71 (10.31)	52.53 (11.29)	47.48 (12.79)	0.14	-0.75	-8.593***	-1.262
K-MDQ	4.25 (3.42)	5.82 (3.21)	5.25 (3.37)	0.25	-0.74	-3.254**	-0.478
K-PSWQ	36.67 (9.23)	47.08 (8.95)	43.28 (10.34)	-0.05	-0.84	-7.826***	-1.149
K-CAQ	66.40 (17.44)	80.04 (15.99)	75.06 (17.76)	-0.23	-0.03	-5.619***	-0.825

HC = Healthy Control; ED = Emotional Distress; K-IFES = Korean Impact of Future Events Scale; K-BDI-II = Korean Beck Depression Second ed; K-BAI = Korean Beck Anxiety Inventory; K-BHS = Korean Beck Hopelessness Scale; SUIS = Spontaneous Use of Imagery Scale; QMI = Quality upon Mental Imagery; K-SWLS = Korean Satisfaction with the Life Scale; K-RRS = Korean Ruminative Response Scale; K-MDQ = Korean Mood Disorder Questionnaire; K-PSWQ = Korean Penn State Worry Questionnaire; K-CAQ = Korean version of the Cognitive Avoidance Questionnaire.
$^{**}p < .01$, $^{***}p < .001$.

Table 3. *Correlation Coefficients between Measurements*

	KIFES[1]	KBDI[2]	KBAI[3]	KBHS[4]	SUIS[5]	QMI[6]	KSWLS[7]	KRRS[8]	KMDQ[9]	PSWQ[10]	KCAQ[11]
1	1										
2	.614**	1									
3	.758**	.756**	1								
4	.455**	.671**	.465**	1							
5	.139	-.040	.100	-.165*	1						
6	-.149*	-.076	-.080	-.122	.440**	1					
7	-.284**	-.497**	-.243**	-.612**	.338**	.264**	1				
8	.668**	.684**	.683**	.525**	.152*	-.037	-.373**	1			
9	.210**	.221**	.301**	.087	.095	.107	-.097	.330**	1		
10	.565**	.586**	.621**	.474**	.149*	-.037	-.308**	.724**	.299**	1	
11	.475**	.479**	.499**	.499**	.173*	.117	-.257**	.618**	.367**	.573**	1

HC = Healthy Control; ED = Emotional Distress; K-IFES = Korean Impact of Future Events Scale; KBDI = Korean Beck Depression Second ed; KBAI = Korean Beck Anxiety Inventory; KBHS = Korean Beck Hopelessness Scale; SUIS = Spontaneous Use of Imagery Scale; QMI = Quality upon Mental Imagery; KSWLS = Korean Satisfaction with the Life Scale; KRRS = Korean Ruminative Response Scale; KMDQ = Korean Mood Disorder Questionnaire; KPSWQ = Korean Penn State Worry Questionnaire; KCAQ = Korean version of the Cognitive Avoidance Questionnaire.
**p < .05, **p < .01.*

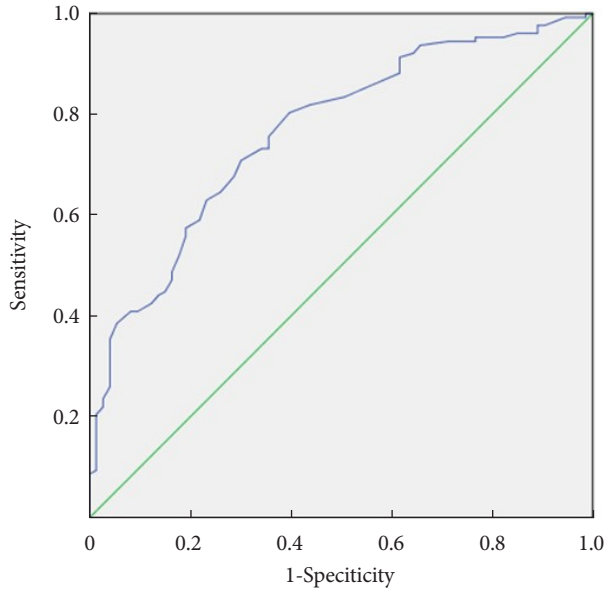

Figure 1. *ROC curve of K-IFES.*

at .709 and .699 respectively with a Youden's index of .407. The optimal cutoff point determined to be 27.5 points, rounded to 28 points for clinical application. Conversely, QMI and SUIS were not found to be significant at .475 ($p = .549$) and .516 ($p = .708$) and displayed a lower area under the curve compared to K-IFES.

Discussion

In terms of the study's findings, the K-IFES demonstrated robust internal consistency, with a Cronbach's α coefficient of 0.94. This level of internal consistency aligns with the original version's results, which utilized a psychologically healthy sample (Cronbach's α = 0.87), as well as the German version that incorporated a clinical sample (Cronbach's α = .93). Furthermore,when compared to the classical test theory, the Rasch model exhibits distinctive strengths. Classical test theory suffers from a lack of accuracy because item characteristics vary across participants' group, and participants' ability is estimated differently depending on the characteristics of the test instrument. It also compares participants' ability based on total scores, which may not take into account the characteristics of individual items (Shin et al. 2021). The Rasch model, on the other hand, overcomes these limitations by simultaneously assessing the difficulty of individual items and the examinee's ability, taking into account the interaction between individual items. Therefore, it is more appropriate to use the Rasch model to provide a more accurate and consistent measure that overcomes the limitations of fluctuating across examinee populations or specific ability levels whenverifying the characteristics of each item in translated scale. Following the scale's validation using item response theory through the Rasch model, it became necessary to exclude items 1, 23, and 24 due to their inadequate discriminant power and fit. The analysis identified the most difficult item for respondents (i.e., the most severe item) as item 19: 'Reminders of the future caused me to have physical reactions, such as sweat-

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ing, faster breathing, or a racing heart' whereas the easiest item (i.e., the most common item) was item 1: 'I believed my thoughts about the future would definitely happen and would become real'. All items were distributed at or above the average ability of the examinees. Considering the response categories, 79% of examiners answered, "not at all," "somewhat," or "moderately," and 21% answered "quite a bit," or "very much," across all items, making the scale a good candidate for identifying examiners with intrusive prospective imagery problems. However, after the removal of these three items, internal consistency notably improved, and the remaining items demonstrated favorable difficulty and fit characteristics. These observations collectively underscore the K-IFES as a dependable instrument for the assessment of phenomena associated with mental imagery.

Subsequently, we conducted an analysis to evaluate the convergent and discriminant validity of the K-IFES. To assess convergent validity, we examined its associations with current depressive, anxiety, and bipolar symptoms using the K-BDI-II, K-BAI, and MDQ, and with verbal vulnerability related to emotional issues through the K-RRS, PWSQ, and K-CAQ. The findings revealed that the K-IFES exhibited significant positive correlations with a range of emotional and mood symptoms as well as cognitive vulnerabilities, supporting its validity as a measure of psychopathology. In a preliminary study by Deeprose and Holmes (2010) involving mildly dysphoric and non-dysphoric individuals, the IFES demonstrated significant static correlations with the BDI-II but not with the STAI-T. However, in a study involving clinically distressed individuals, significant static correlations were observed with both the BDI-II and STAI-T (Kroener et al., 2019). Especially, intrusive imagery can lead to depression-related disorders, factors such as a paucity of positive imagery, reduced vividness and speed in generating mental imagery, and episodic memory alterations have been suggested as contributors to long-term depressive symptoms (Holmes et al., 2016). Furthermore, the K-IFES displayed a significant and positive correlation with the K-MDQ. Bipolar disorder is characterized by an elevated presence of intrusive thoughts about the future, indicating that intrusive prospective thoughts contribute to mood instability (Deeprose et al., 2011; McGill & Moulds, 2014).

On the other hand, we assessed discriminant validity by examining the associations of the K-SWLS with other scales measuring psychological health, the SUIS and QMI. The K-IFES exhibited a significant negative correlation with life satisfaction, implying that it assesses psychological well-being or pathological variables. Moreover, the K-IFES did not demonstrate a significant correlation with the SUIS, a scale reflecting daily imagery use. However, it displayed a significant negative correlation with the QMI, a measure of the functionality of imagery, as well as with life satisfaction, confirming its discriminant validity. While the QMI has been associated with delayed imagery generation and reduced vividness in individuals with depression (Holmes et al., 2016), inconsistent findings have been observed in previous studies regarding significant correlations with the SUIS (Deeprose et al., 2011; Kroener et al., 2019; Ko & You, 2020; Kim et al., 2016). Additionally, sensitivity and specificity analyses in this study indicated that both the SUIS and QMI were unable to significantly distinguish between the dysphoric group and normal controls. These findings suggest that the SUIS may have limitations in measuring pathological variables.

Lastly, we conducted an analysis of the sensitivity and specificity of the K-IFES to determine its ability to accurately distinguish emotional distress. To achieve this, we compared the results between the emotional distress group and the normal control group, and we observed that the emotional distress group displayed significantly negative outcomes on all scales, except for SUIS and QMI. Additionally, the K-IFES demonstrated a relatively accurate ability to distinguish emotional distress with a moderate level of accuracy. This stands in contrast to other scales related to imagery that did not significantly discriminate emotional problems.

The contributions and limitations of this study are as follows. First, we were able to operationally define and measure a phenomenological aspect of mental imagery related to emotional distress. Although cognitive vulnerability has been studied in the clinical field, it has mainly been related to verbal processing. Despite the fact that mental images are as frequent in everyday life as verbal processing, there are limited conceptualization scales that can validly measure them. Furthermore, experimental studies have demonstrated that imagery has a more potent impact on mood compared to verbal processing (Holmes & Mathews, 2005; Holmes et al., 2006). As a pathological variable, mental images cannot be ad-

equately measured by low scores on mental images scales that reflect everyday use or psychological functioning. Therefore, a scale that reflects phenomenological issues related to mental images is needed. It is essential to systematically validate a scale related to the pathological use of imagery, which will help future research address imagery-related variables in this area. Second, the results of this study show that the IFES in English- or German-speaking Western cultures can be appropriately adapted for use in South Korea. Psychological phenomena can be experienced differently depending on one's culture, as the language and culture used can influence perception or thought systems. Therefore, this study suggests that the concept of intrusive prospective imagery can be applied in Korea and can be utilized as a tool to measure it. Third, this study does not directly sample patients with psychiatric problems and should be applied with caution. Although we used the self-reported MINI to categorize mood problems, it is limited by the fact that it does not represent a directly validated patient population. In particular, the use of cut points in clinical populations or risk stratification should be considered with caution. Future studies should validate the scale in clinical populations.

In conclusion, this study has successfully validated the K-IFES in terms of reliability and validity through Rasch analysis, affirming its effectiveness in measuring pathological imagery. These findings hold significant relevance for the exploration of mental health phenomena within the field of mental health. Furthermore, this study provides an operationalized definition of mental images and sets criteria for their measurement using the K-IFES, ultimately offering a valuable tool for enhanced assessment and comprehension of image-related phenomena associated with emotional problems.

Author contributions statement

Hyun Seok, Jeong, graduate student at Kyungpook National, collected and analyzed data, and led manuscript preparation. Jongmin, Lim, graduate student at Kyungpook National University who is now Ph.D and lecturer at Kyungpook National University, assisted in data collection and analysis. Mun-Seon, Chang, professor at Kyungpook National University, served as the principal investigator of the research and supervised the research process. All authors provided critical feedback, participated in revision of the manuscript, and approved the final submission.

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Supplementary Table 1. *Participant Classification Based on MINI Assessment*

MINI	Screened-In *n* (%)	Screened-Out *n* (%)
MDD	135 (67.50)	65 (32.50)
GAD	84 (42.00)	116 (58.00)
Panic	156 (78.00)	44 (22.00)
SAD	177 (88.50)	23 (11.50)
Result	77 (38.50)	127 (61.50)

MINI = Mini international neuropsychiatric interview patient health survey; MDD = Major depressive disorder; GAD = General anxiety disorder; Panic = Panic disorder; SAD = Social anxiety disorder.

Supplementary Table 2. *Demographic Information about Participants*

	HC (*n*=73) *n* (%)	ED (*n*=127) *n* (%)	Total (*n*=200) *n* (%)	Statistics[†]
Age				2.443*
Mean (SD)	45.58 (7.80)	42.62 (8.47)	43.70 (8.33)	
Gender				0.427
Male	42 (57.53)	67 (52.76)	109 (54.50)	
Female	31 (42.47)	60 (47.24)	91 (45.50)	
Education				0.223
Below high school	7 (9.59)	11 (8.66)	18 (9.00)	
Associate degree	10 (13.70)	15 (11.81)	25 (12.50)	
Above college degree	56 (76.71)	101 (79.53)	157 (78.50)	
Marriage state				0.435
Single	20 (27.40)	37 (29.13)	57 (28.50)	
Married	49 (67.12)	82 (64.57)	131 (65.50)	
Separated	1 (1.37)	1 (0.79)	2 (1.00)	
Divorced/Widowed	3 (4.11)	7 (5.51)	10 (5.00)	

HC = Healthy Control; ED = Emotional Distress.

$^{*}p<.05$.

[†]*Age was analyzed by paired t-test; gender, education, and marital status by $\chi 2$ or Fisher's exact test.*

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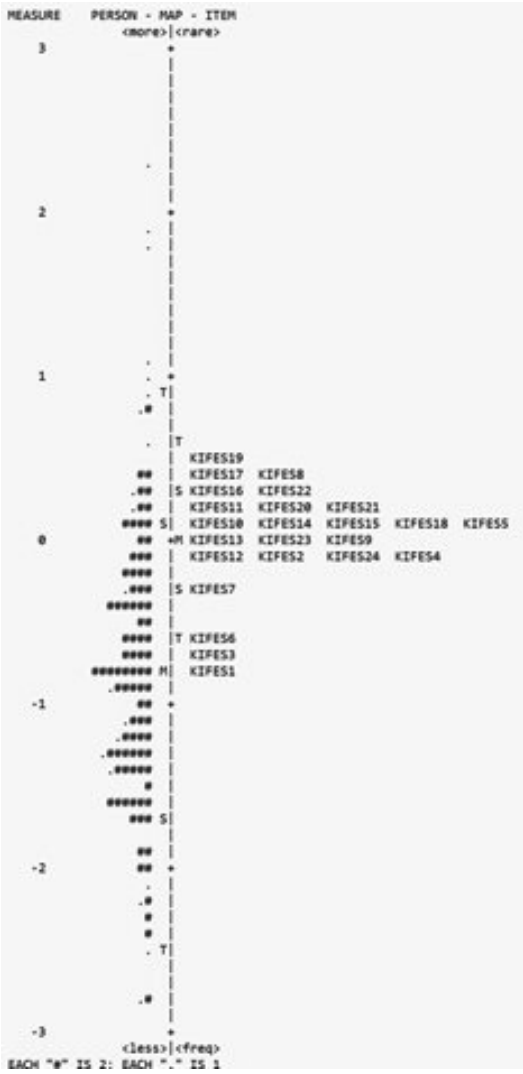

Supplementary Figure 1. *Participants*item distribution.*