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심리학석사 학위논문

**Psychological Rigidity in  
Eating Disorders:  
Rigid Dietary Control and  
Cognitive Rigidity**

섭식장애와 심리적 경직성의 관계:  
섭식 절제 경직성과 인지적 경직성

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## **Abstract**

A broad range of psychological rigidity has been observed and studied in relations to eating disorders. However, studies have neglected to use measurements that are diet- and food-specific when studying problems of rigidity in eating and weight-related disorders. The current study aims to investigate two types of rigidity – rigid dietary control and cognitive rigidity – in relations to disordered eating symptoms using both self-reports and experimental tasks that are specifically diet and food related.

In study 1, the Flexible and Rigid Control scale (Westenhoefer, Stunkard, & Pudel, 1999) which distinguishes flexible dietary restraint from rigid dietary restraint was translated and validated. The scale's factor structure, psychometric properties, and the differential relationship of the two types of dietary control and the psychological, behavioral, emotional symptoms of eating disorders were investigated. Participants were 305 female university students who were on a diet. Results indicated that the Korean version of the Flexible and Rigid Control scale was best modeled to have a two factor structure with 11 and 13 items loading to Flexible Control and Rigid Control respectively. Consistent with previous research, the two subscales demonstrated concurrent and construct validity, and evidence for the separation of two constructs were found.

In light of previous research that linked cognitive rigidity with eating disorders, in study 2 the Food Picture Set-shifting Task (FPST) was developed to measure difficulties in set-shifting regarding calorie related rules and food pictures. A total of 89 female university students were recruited and assigned to three groups based on their dieting status and levels of eating disorder symptoms (32 low risk dieters; 29 high risk dieters; 29 non-dieters). The FPST, Wisconsin Card Sorting Test (WCST), self-report questionnaires on dietary restraint, and clinical variables were

assessed. Results showed that the FPST is a valid measure of set-shifting abilities. Although dieters and non-dieters did not differ in the overall FPST performances, dieters showed higher perseveration error in calorie to color shift than non-dieters. Intent to diet (dieting status) was more associated with food-specific set-shifting impairments while actual dietary restraint (EDEQ) was related to general set-shifting impairments as measured by WCST. The results suggest that the FPST can be a unique and useful tool in detecting cognitive rigidity related to food and may provide insight on the neuropsychological difficulties of maintaining a healthy diet.

The current study validated two diet- and food-specific rigidity measurement tools – the Korean version of the Flexible and Rigid Control scale and the Food Picture Set-shifting Task – and explored the relationships between rigidity and eating disorders. Consistent with previous research, the findings from the present study suggest that dietary restraint is not a homogenous construct and that intent to restrain and actual behavioral restraint may affect cognitive rigidity through different mechanisms. Limitations as well as suggestions for future research are discussed.

**Keywords:** restraint, flexible control, rigid control, cognitive rigidity, set-shifting, eating disorder

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# Introduction

Psychological rigidity has been studied as a fundamental ingredient that adversely affects both psychological and physical well-being (Kashdan, 2011). The concept of rigidity is not easily defined and has been studied under various contexts such as executive control, self-control, and self-regulation (Carver & Scheier, 1998; Posner & Rothbart, 1998). Found at the extreme end of the flexibility continuum, rigidity commonly reflects difficulties in a broad range of ability to understand changing situational demands, shift mental sets, appropriately adjust resources, and balance competing needs. Rigidity has been widely studied and found across different psychopathology. Rumination and worrying are forms of cognitive rigidity, and perseverative, stereotyped behaviors that are not context-appropriate are typical in many mental disorders (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Rigidity can describe a person's cognitive, behavioral, emotional, or physiological responses and likely reflects activities in different life domains. It is unclear whether there is a global, trait-like factor that underlies the multiple types of rigidity or if rigidity is manifested in distinctive and case-specific ways.

Eating behavior is an important life domain that directly impacts our mental and physical health. Guided by a complex interaction of metabolic, endocrine and psychosocial factors, eating behavior is particularly difficult to flexibly self-regulate for many people. Found in the extreme end of the spectrum of unhealthy eating are eating disorders. Eating disorders are characterized by a significant dysfunction in self-regulation with regards to eating behaviors such as excessive restriction in the case of anorexia nervosa, and loss of control binge eating found in bulimia nervosa or binge eating disorder. According to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013), various eating disorder symptoms can be described as behaviorally and cognitively rigid:



repetitive binge-eating, rigid body image, constant conflict in balancing appetite and weight loss goals, excessive worries about calorie, and etc.

In fact, there has been a large body of research that describes a broad range of rigidity as clinical features of eating disorders. Individuals with anorexia nervosa are commonly described in clinical reports and empirical research to exhibit rigid, constricted, and obsessional personality (Casper, Hedeker, & McClough, 1992; Vitousek & Manke, 1994). Anorexia nervosa and bulimia nervosa are both associated with perfectionism in various personality literature (Bastiani et al., 1995; Terry-Short, Owens, Slade, & Dewey, 1995). Psychological flexibility was found to be inversely related to disordered eating-related cognition and accounted for the variance in the link between disordered eating-related cognition and poor psychological health (Masuda, Price, Anderson, & Wendell, 2010). However, given the broad definition of rigidity, using global measurements may lead to a misunderstanding of its relationship to disordered eating behaviors. To better understand which aspects of rigidity are associated with and possibly contribute to rigidly practiced eating disorder symptoms, assessment of the construct in diet- and food-specific context is essential.

## **Dieting and eating disorders**

One of the symptoms of eating disorders that is highly relevant to rigidity is dieting. Weight regulation through restriction of energy intake and fasting is included in the diagnostic criteria of both anorexia nervosa and bulimia nervosa (American Psychiatric Association, 2013). In fact, being on a diet is one of the most robust predictors of eating disorders (Hsu, 1997; Polivy & Herman, 1985). At the same time, studies have reported that up to 40% of women were on a diet to control their weight at a given period indicating that dieting is a commonly practiced, if necessary, healthy behavior (Williamson, Serdula, Anda & Levy, 1992). According

to empirical research and clinical accounts, normal dieting precedes eating disorders (Jacobi et al., 2004), meanwhile, not all dieters end up developing eating disorders (Patton et al., 1997). Many people achieve their weight loss goals and no longer feel the need to be on a strict diet. Other people may be ineffective in reaching their weight loss goals but do not engage in pathological eating behaviors. This suggests that not all dieting are alike and the degree as well as the quality of dieting must be taken into account.

## **Psychological rigidity in dieting**

One way to explore this issue is to examine dieting from both the psychological and behavioral dimensions. Haynos, Field, Wilfley, and Tanofsky-Kraff (2015) proposed a classification paradigm that assesses the behavioral dimension (the amount of restriction or exercise efforts) and the psychological dimension (positive or negative beliefs and attitudes) of dieting. Behaviorally engaging in high amount of weight loss efforts with a positive psychological approach, also known as “effective dieting”, predicted successful weight regulation (Lowe & Timko, 2004). The researchers highlighted goal-directedness (Gorin, Phelan, Wing, & Hill, 2004), flexible dieting (Westenhofer, Broeckmann, Münch, & Pudel, 1994), and health-focus (Putterman & Linden, 2004) as key positive psychological aspects of dieting. Meanwhile, “driven dieting” – engaging in high amount of dieting efforts with a negative psychological approach – was found to be associated with increased risk of eating disorders (Fairburn, Cooper, Doll, & Davies, 2005). Negative psychological approaches to dieting are characterized by psychological rigidity (Westenhofer et al., 1994), perceived deprivation (Timmerman & Gregg, 2003), and dieting preoccupation (Timmerman & Gregg, 2003). Thus, rigid belief and attitude appear to be important factors that differentiate healthy, effective dieting from dysfunctional dieting.

## **Dietary restraint and disordered eating**

One of the most common and popular dieting strategies is food restriction. First highlighted in 1975 in eating behavior literature, restraint most commonly refers to an individual's intent to restrict food intake for weight loss or maintenance (Herman & Mack, 1975). Intermittent food restriction has been associated with problematic eating patterns such as greater appetite for sweets, binge eating, and hyperphagia under stress (Pudel & Westenhoefer, 1989). Moreover, Korean women with high levels of dietary restriction, compared to a control group, reported symptoms typical of eating disorders such as drive for thinness, body dissatisfaction, neuroticism, and binge eating history (Han & Yu, 1991). Bae and Choi (1997) found that individuals with high levels of restriction demonstrated elevated drive for thinness and attention to body shape that are comparable to individuals diagnosed with eating disorders. In experimental as well as naturalistic settings, restrained eaters exhibited overeating (Ruderman, 1986), and researchers have explained this classical phenomenon as an effect of counter-regulation (Rossiter, Wilson, & Goldstein, 1989). Therefore, restraint and disinhibition have long been studied as closely related constructs that are observed together because by definition, disinhibition implies prior restraint.

The restraint scale (Herman & Polivy, 1975) which was one of the first tools to assess dietary restraint also contributed to this mixed conceptualization and was later criticized for confounding cognitive restraint and susceptibility towards disinhibited eating. As a response, Stunkard and Messick (1985) developed the Three Factor Eating Questionnaire (TFEQ) to separate dietary restraint, disinhibition, and perceived hunger. They examined the disinhibition of unrestrained eaters to further separate the two constructs. Researchers also found a subgroup of restrained eaters who did not show counter-regulation in a laboratory setting (Lowe & Kleifield,

1988). Thus, restraint appears to be a necessary but not a sufficient condition for the development of disordered eating behaviors.

## **Flexible and rigid dietary control**

Studies on the separation of flexible and rigid dietary control stem from a vast and mixed literature on the influence of dietary restraint on disinhibition (overeating). In the backdrop of these findings, Westenhoefer (1991) found results indicating that restraint is not a homogenous construct in a study using the Three Factor Eating Questionnaire (TFEQ). He distinguished two dieting strategies – rigid control and flexible control – based on their association with disinhibition. Rigid control of eating behavior describes an all-or-nothing dieting mentality; whereas flexible control refers to a more moderate and conscious approach towards dieting. In a follow-up study, Westenhoefer, Stunkard, and Pudel (1999) added items to the TFEQ dietary restraint subscale to further develop and validate the Flexible and Rigid Control scale. Westenhoefer's subsequent studies as well as research by others have reported that rigid control was associated with higher body mass index, higher disinhibition, greater eating disorder symptoms, depression, and anxiety (Steward, Williamson, & White, 2002; Westenhoefer et al., 1999). Flexible control was associated with lower body mass index, better weight loss maintenance, and fewer binge-eating episodes, suggesting relevance to successful and effective dieting (Steward et al., 2002; Westenhoefer, Von Falck, Stellfeldt, & Fintelman, 2004).

Theoretical basis for the distinction of two types of restraint can be found in the boundary model for the regulation of eating proposed by Herman and Polivy (1984). In the classic experiment by Herman and Mack (1975), restrained eaters consumed more high calorie meal than nonrestrained eaters after consuming a preload (a strawberry milkshake). Herman and Polivy (1984) proposed the boundary model to explain the phenomenon that people on a diet cognitively establish a self-

imposed restraint (i.e., limit of amount or types of food that can be consumed), and when they pass this diet boundary (e.g., eating food that is considered fattening like a milkshake), they tend to eat more (overeat) than they usually would. Emphasizing the relevance of the type of restraint, Westenhoefer (1991) posited that when such boundaries are rigid and strict, the person becomes more vulnerable to feeling like they have blown their dieting goals and consume more than one's physiological satiety boundary.

Westenhoefer (1991) also observed the binge eating patterns in bulimia nervosa to support his distinction of the two types of dietary control. Individuals with bulimia nervosa go between extreme periods of strict food restriction and loss of control overeating. During the period of intermittent dieting, they adhere to a strict and rigid dieting rule which excludes all fattening and high caloric foods (Fairburn, 1985).

Several self-report questionnaires that measure dietary restraint have been translated and validated in Korea (Lee, 1997). Although TFEQ has been translated into Korean (Han & Yu, 1991) and has been widely used with the Korean population, the version does not include the newly developed items of the Flexible and Rigid Control scales. The literature outlined thus far suggests that rigidity is a key clinical feature of eating disorders and that rigid dietary restraint, as opposed to a flexible approach likely influences disordered eating patterns. Thus, it is highly recommended to use measurements that differentiate the types of dietary control when studying the relationship between dietary control and disordered eating.

## **Dietary restraint and cognitive functions**

Executive functioning is one of the key building blocks of psychological flexibility (Kashdan, 2011). For self-control and goal-directed behaviors, cognitive abilities such as attentional control and set-shifting are critical (Baumeister, 2002).

Memory is also relevant to a person's ability to respond sensitively to changing circumstances because working memory allows one to form mental representations of a complex situation as well as to recall past experiences, recognize cues, and learn (Kashdan, 2011). Inhibitory control which is another core executive function is crucial in managing behaviors and goals (Miyake et al., 2000). In fact, deficits in executive functioning is associated with several behavioral and psychiatric disorders that are especially relevant to self-regulation (Duijkers et al., 2016; Johnson, 2012).

Cognitive functioning is critical in flexible control of eating behaviors. However, there have been some mixed findings on the influence of food restriction on cognitive functioning. On a physiological level, studies on iron deficiency anemia and cognitive functions in children (Bayley 1969; Pollitt and Kim, 1988) and studies on serum ferritin levels and attentional, verbal functions (Tucker et al., 1984) provide sufficient evidence for the negative effect of restricted energy intake on cognitive functioning. Nonetheless, the influence of laboratory-induced food deprivation on cognitive functioning is less clear. In an 15-week experiment where obese individuals without eating disorders participated in a 50% caloric restriction, participants' sustained attention, immediate verbal recall, distractibility, simple reaction time, and motor speed significantly slowed over time (Kretsch et al., 1997). Yet, more complex cognitive functions remained intact. Green, Elliman, and Rogers (1995) also found that up to 24 hours of experimentally-induced food deprivation did not significantly affect sustained attention, attentional focus, simple reaction or immediate memory.

Meanwhile, outside the laboratory setting, spontaneous dieting which is often undertaken due to dissatisfaction with weight or body shape, has been clearly associated with poor cognitive function. Compared to non-dieters, individuals who report to be on a diet (dieters) performed poorly on vigilance task (Rogers & Green, 1993), immediate verbal recall (Green, Rogers, Elliman, & Gatenby, 1994) and

showed slower reaction time. To control for individual differences between subjects, the researchers also tested the same cognitive tasks within the same subjects when they were not dieting. They found that performance was poorer when tested while on a diet than when they were not dieting (Green & Rogers, 1995). Other studies have found evidence that current dieters showed impaired central executive function (random number generation, task switching) and these impairments were partially mediated by food and body related preoccupying cognitions (Kemps, Tiggemann, & Marshall, 2005).

## **Cognitive rigidity in eating disorders**

Studies on the neuropsychological profiles of individuals with eating disorders have reported that various forms of cognitive rigidity (i.e., simple alternation, mental flexibility, perseveration, and perceptual shift) are associated with eating and weight-related disorders (Tchanturia et al., 2004a). In the context of eating disorders, one major part of executive function that has been highlighted is set-shifting. Set-shifting refers to the mental ability to shift between multiple tasks, rules, and mental sets (Miyake et al., 2000). Inefficient set-shifting can have multiple implications in the form of cognitive rigidity (i.e., rigidity in problem-solving) and response rigidity (i.e., perseverative behaviors).

Recently, set-shifting has been widely researched as a strong endophenotype across eating disorder subtypes (Bulik et al., 2007; Holliday et al., 2005) and in obesity literature, strongly indicating its relevance to eating and weight-related behaviors (Wu et al., 2014). By definition, a measurable and stable trait can be called an endophenotype when it can explain the pathway between disorder and genotype (Gottesman & Shields, 1973). Endophenotype is heritable, state-independent, and predictive of the disorder (Gottesman & Gould, 2003). Set-shifting fits this profile: Family and twin studies revealed that heritability of cognitive set-shifting is

moderate to large (Friedman et al., 2006). Set-shifting impairment has been observed in unaffected family members of women with anorexia nervosa (Holliday et al., 2005). Similar levels of set-shifting deficits have been reported in anorexia nervosa patients in full remission as those with acute anorexia nervosa (Tchanturia, Morris, Surguladze, & Treasure, 2002; Tchanturia et al., 2004b).

Poor set-shifting has been identified as a trans-diagnostic risk factor of eating disorders because it has been found in both women with anorexia nervosa and bulimia nervosa (Southgate, Tchanturia, & Treasure, 2005; Steinglass & Walsh, 2006). However, poor set-shifting is frequently observed across an array of other psychiatric disorders including obsessive compulsive disorder (Chamberlain et al., 2006), depression (Clark, Sarna & Goodwin, 2005), bipolar disorder (Robinson et al., 2006), and schizophrenia (Snitz, Macdonald, & Carter, 2005).

Inefficient set-shifting seems to be evident in unhealthy eating. For instance, labeling food as good or bad depending on calories or fat implies a plausible causal mechanism. Yet, despite the compelling evidence of the close link between general set-shifting impairment and eating disorders, previous research has not looked into how poor set-shifting ability is manifested in pathological symptoms of eating disorders. To date, no study has attempted to experimentally investigate set-shifting difficulties specifically in the context of food cues and rules.

## **Measuring set-shifting**

There are numerous valid and reliable neuropsychological tools that assess different types of set-shifting including the Trail Making Test (TMT), Wisconsin Card Sorting Test (WCST), Brixton Test, Haptic Illusion Test, CatBat, Picture Set Test, and Cantab Intra/Extra-dimensional Shift Task. According to a systematic meta-analysis of studies on set-shifting in eating disorders (Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007), TMT, WCST, CatBat and Haptic tasks



demonstrated acceptable effect sizes.

In the Trail Making Task (Kravariti et al., 2003), participants are asked to connect the dots of numbered circles to make a trail (trail A) or to connect numbers and letters into a trail (trail B). The CatBat task (Eliava, 1964) is a verbal task in which participants fill in missing letters in a short text with a 'C' (for CAT) or a 'B' (for BAT). In the Haptic Illusion task (Uznadze, 1966), participants evaluate the relative size of two balls and the number of trials where illusions are experienced measures the participant's perceptual set-shifting ability. In the Wisconsin Card Sorting Test (Grant & Berg, 1948), participants match the stimulus card with one of four cards: a red triangle, two green stars, three yellow crosses, and four blue circles. Participants need to shift between the sorting rules (to match the color, the shape, or the number of patterns) which change unpredictably during the task. Another visual set-shifting task that is similar to WCST is the CANTAB Intra/Extra-dimensional Shift Task (Downes et al., 1989). Participants select one of two stimuli which consist of color-filled shapes and white lines. The participant learns and shifts between two rules (shape or line) that change as the task progresses.

Using the available neuropsychological tasks, several studies have investigated set-shifting deficits in eating disorders. Compared to healthy control, individuals with anorexia nervosa committed more errors in the Wisconsin Card Sorting Test (Fassino et al., 2002), was slower on the Trail Making Task (Lauer, 2002), and presented poor perceptual shifting in the Haptic Illusion Task (Tchanturia et al. 2002). To date, attempts to measure set-shifting capability in individuals with eating disorders have been limited to using the aforementioned traditional neuropsychological tests. Systematic reviews and meta-analysis provided evidence that general set-shifting ability is a key executive functioning that is at work. Although this is a great place to start, studies have not incorporated eating and food specificity in the assessments of cognitive rigidity. Given the complexity and multi-

dimensionality of the rigidity construct, it is recommended that set-shifting deficits in food- and diet-specific context and cues should be explored in conjunction with traditional set-shifting measurements.

## **Purpose of the present study**

Psychological rigidity impacts unhealthy and unsuccessful self-regulation of eating behaviors. In the context of eating and weight-related disorders, rigidity in dietary control and cognitive rigidity appear to be highly relevant risk factors and distinctive features. Thus, the aim of the current study is to investigate two aspects of rigidity using measurements that are specific to diet and food. First, psychological rigidity in dietary control has been highlighted as an important risk factor for unsuccessful and problematic dieting. Although many self-report questionnaires that assess dietary restraint have been introduced in Korea, there is no valid and reliable tool that distinguishes the two psychologically different types of dietary control. The lack of such research tool creates mixed findings in the growing literature of the relationship between restraint and eating disorders in Korea. To address this problem, in study 1, the Flexible and Rigid Control scale was translated and validated with the Korean population. The study explored the differential relationship that the two types of dietary control have with psychological, behavioral, and emotional symptoms of eating disorders.

There are limitations in relying on self-report questionnaires to measure the operation of a dynamic concept like rigidity. Therefore, study 2 utilizes cognitive tasks to observe and measure rigidity in food-specific context. Given the importance of set-shifting as a strong cognitive marker of problems in eating and weight-related disorders, a set-shifting task using food pictures, called the Food Picture Set-shifting Task (FPST) was designed to measure difficulties in set-shifting regarding calorie related rule. The performance of the FPST and the performance of a traditional set-

shifting task were compared in terms of levels of eating disorder symptoms as well as restraint. The idea behind the study is to clarify the relationships between two different aspects of rigidity and disordered eating symptoms.

## **Study 1. Validation of the Korean version of the Flexible and Rigid Control Scale**

Previous studies on the relationship between dieting and disordered eating strongly support that being on a diet increases one's risk of developing disturbances in eating behaviors. Dietary restraint, which is one of the most common practices to control weight, has been strongly associated with failures in regulating eating behaviors including binge eating or emotional eating (Westenhoefer & Pudel, 1989). Meanwhile, studies have provided evidence that not all restrained eaters engage in unhealthy overeating (Lowe & Kleifield, 1988), highlighting the importance of the psychological quality of restraint.

Westenhoefer et al. (1999) distinguished two types of dietary restraint and developed the Flexible and Rigid Control scale. Based on the different relations rigid and flexible dietary control exhibited in regards to disturbed eating patterns and successful weight control, the researchers validated the two subscales with the German population. The Flexible and Rigid Control scale has been widely used in other populations including women in weight loss programs (Westenhoefer et al., 2013), women in treatment for personality disorder (Shearin et al., 1994), non-obese college students (Stewart et al., 2002; Timko, 2007), and sample from the Portuguese population (Poínhos et al., 2015). While these studies have partially supported Westenhoefer's initial findings, they only demonstrated that the two constructs have different associations with disordered eating and have not reported on the factor structure of the scale itself.

There have been growing interest and efforts to study dietary restraint and disordered eating in Korea. Several self-report questionnaires that measure dietary restraint have been translated and validated in Korea. Lee (1997) investigated the eating behaviors of Korean college students with the Dutch Eating Behavior

Questionnaire (DEBQ), Three Factor Eating Questionnaire (TFEQ), Restraint Scale (RS), and Eating Disorder Inventory (EDI-2). The researcher found positive correlations between these scales, and 31.4% of the sample were classified as 'restrained eaters' while 18.6% were classified as emotional eaters, 50% as normal eaters. However, there are no instruments validated for the Korean population to differentially assess the two types of dietary control.

Therefore, the aim of study 1 is to translate and validate the Flexible and Rigid Control scale for the Korean population. A more rigorous examination on the factor structure and the psychometric properties of the two subscales will enhance the construct validity and provide a better understanding of the phenomenon of dietary restraint. Further analysis on the relationship of the two types of dietary control with psychological and emotional variables related to disordered eating will clarify the role of rigidity in dietary control.

# Methods

## Participants

341 female participants who self-identified as being on a diet were recruited from a university and completed the survey online. Women who claimed to be currently on a diet were recruited with the goal to investigate the difference between healthy restraint and problematic restraint. 36 were excluded from the analysis for failure to meet the recruitment criteria or incomplete and poor response. A total of 305 participants were included in the analysis. 193 participants were recruited through a university student online community. 98 participants who were enrolled in the introductory psychology course at the university were recruited. 14 participants were recruited outside the university.

All participants were female because epidemiological studies found that women are more likely to endorse eating disorder symptoms such as loss of control eating, body checking and avoidance, binge eating, fasting, and vomiting than men (Striegel-Moore et al., 2009). The mean age of the sample was 22.88 years ( $SD = 4.16$ , range = 18 to 48 years). Level of education was distributed as follows: in college ( $n = 193$ ), college graduate ( $n = 23$ ), in graduate school ( $n = 27$ ), masters or higher ( $n = 8$ ). 54 failed to respond to the question. The mean body mass index was 20.81 ( $SD = 2.21$ ). 10.5% was underweight ( $BMI < 18.5$ ), 84.3% was healthy ( $18.5 < BMI < 24.9$ ), 4.5% was overweight ( $25 < BMI < 29.9$ ), and 0.7% was obese ( $30 < BMI$ ).

## Procedure

Prior to the start of the study, permission from Westenhoefer, the author of the scale was obtained to translate the Flexible and Rigid Control scale into Korean.

The initial translation was reviewed and edited by a licensed clinical psychologist. The revised Korean version was back-translated by a bilingual. The back-translation was reviewed alongside the original questionnaire to verify the validity of the Korean version of the Flexible and Rigid Control scale.

All participants completed the online survey which consisted of the translated version of the Flexible and Rigid Control scale as well as basic demographic and dieting information, body mass index, and other scales measuring related psychological variables used to analyze concurrent and convergent validity. Both study 1 and 2 were approved and carried out under the guidelines for the use of human subjects established by the Institutional Review Board at Seoul National University (IRB No. 1703/003-021).

## **Instruments**

### **The Flexible and Rigid Control Scale (FC12, RC16; Westenhoefer et al., 1999).**

Flexible and Rigid Control scale measures two types of dietary control. Flexible Control (12 items) which measures a flexible and graduated approach to dieting consists of 9 items responded in yes or no and 3 items scored on a 4-point Likert scale. Rigid Control (16 items) which measures a rigid and dichotomous approach to dieting consists of 11 items answered in yes or no and 5 items scored on a 4-point Likert scale. The Flexible and Rigid Control scale was first developed as an extension of the dietary restraint subscale of the Three Factor Eating Questionnaire based on an earlier study that distinguished two different types of dietary control (Westenhoefer, 1991). The two subscales showed satisfactory reliability and validity (Cronbach's  $\alpha$  = .83 for Flexible Control, .81 for Rigid Control; Westenhoefer et al., 1999).

**Eating Disorder Examination Questionnaire (EDEQ; Fairburn & Beglin, 1994).**

EDEQ was developed to measure psychopathology specific to eating disorders. Among the four subscales, restraint scale was used in the current study to assess the degree of dietary restriction. The subscale consists of 5 items scored on a 7-point Likert scale. For this study, participants completed the Korean version of the EDEQ (Lim et al., 2010). The Cronbach's  $\alpha$  was .80 in this study.

**Eating Disorder Inventory-2 (EDI-2; Garner, 1991).**

EDI-2 assesses problematic eating behaviors and perceptions on body image. For this study, the drive for thinness (7 items), body dissatisfaction (9 items), and bulimia (7 items) subscales from the Korean version of the EDI-2 (Lee et al., 2012) were used. 23 items are scored on a 6-point Likert scale. In this study, the internal consistency of the drive for thinness (Cronbach's  $\alpha$  =.84), body dissatisfaction (Cronbach's  $\alpha$ =.79), and bulimia subscale (Cronbach's  $\alpha$ =.78) was acceptable.

**Dutch Eating Behavior Questionnaire (DEBQ; Van Strien, Frijters, Bergers, & Defares, 1986).**

DEBQ measures eating behaviors of normal and overweight individuals and is comprised of three subscales. The 10-item restrained eating subscale from the Korean version of the DEBQ (Kim, Lee & Kim, 1996) was used. The internal consistency of the subscale in the current study was acceptable (Cronbach's  $\alpha$ =.86).

**Eating Attitude Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982).**

EAT-26 was developed to measure behaviors and attitudes related to anorexia nervosa. For this study, the Korean version of the EAT-26 oral control subscale which consists of 8 items scored on a 6-point Likert scale (Rhee et al., 1998) was used. The Cronbach's  $\alpha$  was .61 in this sample.



**Dichotomous Thinking Index-30 Revised (DTI-30R; Hwang, 2007).**

DTI-30R is a 30-item questionnaire that assesses dichotomous cognitive styles in 6 subscales: either-or decision, all-or-nothing thinking, success vs. failure thinking, social splitting, dichotomy in academic sphere, and dichotomy in verbal expression. The items are answered on a 5-point Likert scale. The internal consistency of the DTI-30R was excellent (Cronbach's  $\alpha=.94$ ) in this sample.

**Multidimensional Perfectionism Scale (MPS; Hewitt & Flett, 1991).**

MPS measures one's perfectionism tendency. The Korean version of the MPS self-directed perfectionism subscale (Han, 1993) which measures the degree to which one's own behaviors are subjected to perfectionism was used. The subscale consists of 15 items scored on a 7-point Likert scale. The internal consistency of MPS (Cronbach's  $\alpha=.88$ ) in this study was acceptable.

**Self-Control Scale (SCS; Tangney, Baumeister & Boone, 2004).**

SCS is a 26-item questionnaire that measures self-regulatory abilities. The scale produces three subscales: healthy habit/reliability, self-discipline, and non-impulsive action. The Korean version of the SCS (Cho & Kwon, 2011) that has been validated was used. In the study, the internal consistency (Cronbach's  $\alpha=.86$ ) was acceptable.

**Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977).**

CES-D measures the behavioral, physical, and cognitive symptoms associated with depression. 20 items are scored on a 4-point Likert scale. For this study, participants completed the Korean version of the CES-D (Chon, Choi & Yang, 2011). The Cronbach's  $\alpha$  was .81 in this study.

**State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).**

STAI is a self-report questionnaire that measures both state and trait anxiety. The Korean version of the 20-item trait anxiety inventory (Hahn, Lee, & Chon, 1996) that is scored on a 4-point Likert scale was used. The Cronbach's  $\alpha$  was .73 in the current study.

## **Statistical analysis**

Descriptive statistics analysis were conducted on the participants' demographic and psychological variables. Internal reliability of the Flexible and Rigid Control scale was confirmed by calculating the Cronbach  $\alpha$  coefficients.

Confirmatory factor analysis were performed using MPlus Version 7 to confirm the factor structure of the scale. Diagonally weighted least squares (WLSMV) was used as estimator in fitting the CFA model because the Flexible and Rigid Control scale is scored dichotomously. Alternative models were compared because although the Flexible and Rigid Control scale is well-founded on theory and robust validity studies with diverse population, prior research has not investigated the scale's factor structure. Model fit indexes of two models were compared: a) Unifactorial structures of the Flexible Control and Rigid Control scales separately; b) Two factor structure of the Flexible and Rigid Control scale as a whole. Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standardized Root Mean Square Residuals (SRMS) are reported to evaluate and compare the model fit as recommended by Kline (2011).

Correlational tests between the Flexible and Rigid Control scale and related psychological variables were performed to verify the validity of the scale and to examine the hypothesis about the relationship between two types of dietary control and the psychological, behavioral symptoms and emotional distress indexes

associated with eating disorders. The correlation coefficients were compared using *t*-statistics to test if the strengths of the associations are significantly different.

To further test construct validity of the Flexible and Rigid Control scale, multiple regression analysis were conducted. Separation of two constructs is demonstrated when the two constructs concurrently and uniquely contribute to predicting a third variable, especially if the regression coefficients have opposite signs. All statistical analyses other than confirmatory factor analysis were performed using IBM SPSS statistics 23.

# Results

## Scale characteristics

The mean and standard deviation of each item in the Flexible and Rigid Control scale are summarized in Table 1. Each item is scored dichotomously, and the means for items FC5, FC9, and FC11 were particularly high.

Table 1. *Descriptive statistics of the Flexible and Rigid Control scale.*

item	mean ( <i>SD</i> )	item	mean ( <i>SD</i> )
FC1	.42 (.49)	RC1	.51 (.50)
FC2	.87 (.33)	RC2	.54 (.50)
FC3	.81 (.40)	RC3	.59 (.49)
FC4	.87 (.34)	RC4	.77 (.42)
FC5	.94 (.24)	RC5	.81 (.39)
FC6	.81 (.39)	RC6	.81 (.39)
FC7	.87 (.33)	RC7	.72 (.45)
FC8	.84 (.37)	RC8	.39 (.49)
FC9	.90 (.31)	RC9	.54 (.50)
FC10	.71 (.45)	RC10	.36 (.48)
FC11	.90 (.30)	RC11	.78 (.42)
FC12	.56 (.50)	RC12	.65 (.48)
		RC13	.81 (.39)
		RC14	.50 (.50)
		RC15	.56 (.50)
		RC16	.29 (.46)

*Note.* FC=Flexible Control; RC=Rigid Control

Initial Cronbach's  $\alpha$  values for the two scales were .63 for Flexible Control (12 item) and .64 for Rigid Control (16 items). The negative corrected item-total correlations suggested the exclusion of the items FC09 (-.35). FC05 (.11), RC09 (.03), RC10 (.06), RC11 (.11), RC16 (.11) also showed low corrected item-total correlations. Although corrected item-total correlations below .3 is recommended to

be considered for possible exclusion (Cristobal et al., 2007), because the Flexible and Rigid Control scale is relatively short and both constructs measure dietary control, significant increases in the reliability of the scale when items were excluded were considered. The content validity of the items was re-evaluated to see if the items capture related and moderately different phenomena and contribute to an enhanced conceptualization of the construct. Based on these criteria, FC09 was excluded while items which are not so heavily correlated were embraced to conserve the measurability capacity of the scale. The Cronbach's  $\alpha$  of the Flexible Control scale without FC09 increased to .70 (11 items) which suggests acceptable reliability. Subsequent confirmatory factor analysis were performed without FC09.

## **Factor structure of the scale**

In order to analyze whether Flexible Control and Rigid Control are independent constructs or are explained better as one scale, confirmatory factor analyses were performed to assess the fit of two competing factor models. First, confirmatory factor analyses on two separate unifactorial structures of Flexible Control and Rigid Control were performed. The model fit indexes of the unifactorial structure of Flexible Control suggested mediocre fit (RMSEA = .084, CFI = .765, SRMR = .061). All items loaded significantly on one factor and the loading ranged between .14 and .59 (Figure 1). In the unifactorial model of the Rigid Control scale, the factor loadings of RC9 (.11,  $p=.09$ ), RC10(.01,  $p=.94$ ), RC11 (.09,  $p=.21$ ), and RC16 (.08,  $p=.24$ ) were not significant. After exclusion of these items, the fit indexes of Rigid Control were mediocre (RMSEA = .084, CFI = .725, SRMR = .063). The factor loadings are presented in Figure 2.

Secondly, the two factor structure model of the Flexible and Rigid Control scale as a whole was analyzed. The factor loadings of RC10 (-.03,  $p=.66$ ), RC11 (.04,  $p=.52$ ), and RC16 (.09,  $p=.15$ ) were not significant and were excluded. The fit

indexes suggested reasonable fit (RMSEA = .070, CFI = .686, SRMR = .066). All items loaded significantly on the two factors and the loading ranged from .15 to .63 (Figure 3).

Model fit indexes are summarized in Table 2. According to the interpretation guideline that RMSEA between .05 and .08 suggests reasonable model fit, and RMSEA between .08 and 1 indicates mediocre fit (Browne & Cudeck, 1992), the two factor model appears to be a better model. Although the two factor model showed lower CFI, simpler models with fewer items tend to show higher CFI while RMSEA is a parsimony-adjusted index. SRMR lower than .08 indicates proper fit (Browne & Cudeck, 1992; Hu & Bentler, 1999). Therefore, the two factor model of the Flexible and Rigid Control scale better fits the data overall and demonstrates reasonable fit. The Cronbach's  $\alpha$  for the revised Korean version of the Flexible Control subscale (11 items) was .70 and .67 for Rigid Control subscale (13 items).

Table 2. *CFA fit indexes for the Flexible and Rigid Control scale.*

	Model	RMSEA	CFI	SRMR
1 factor	Flexible Control	.084	.765	.061
	Rigid Control	.084	.725	.063
2 factor		.070	.686	.066

*Note.* RMSEA=Root Mean Square Error of Approximation; CFI=Comparative Fit Index; SRMS=Standardized Root Mean Square Residuals

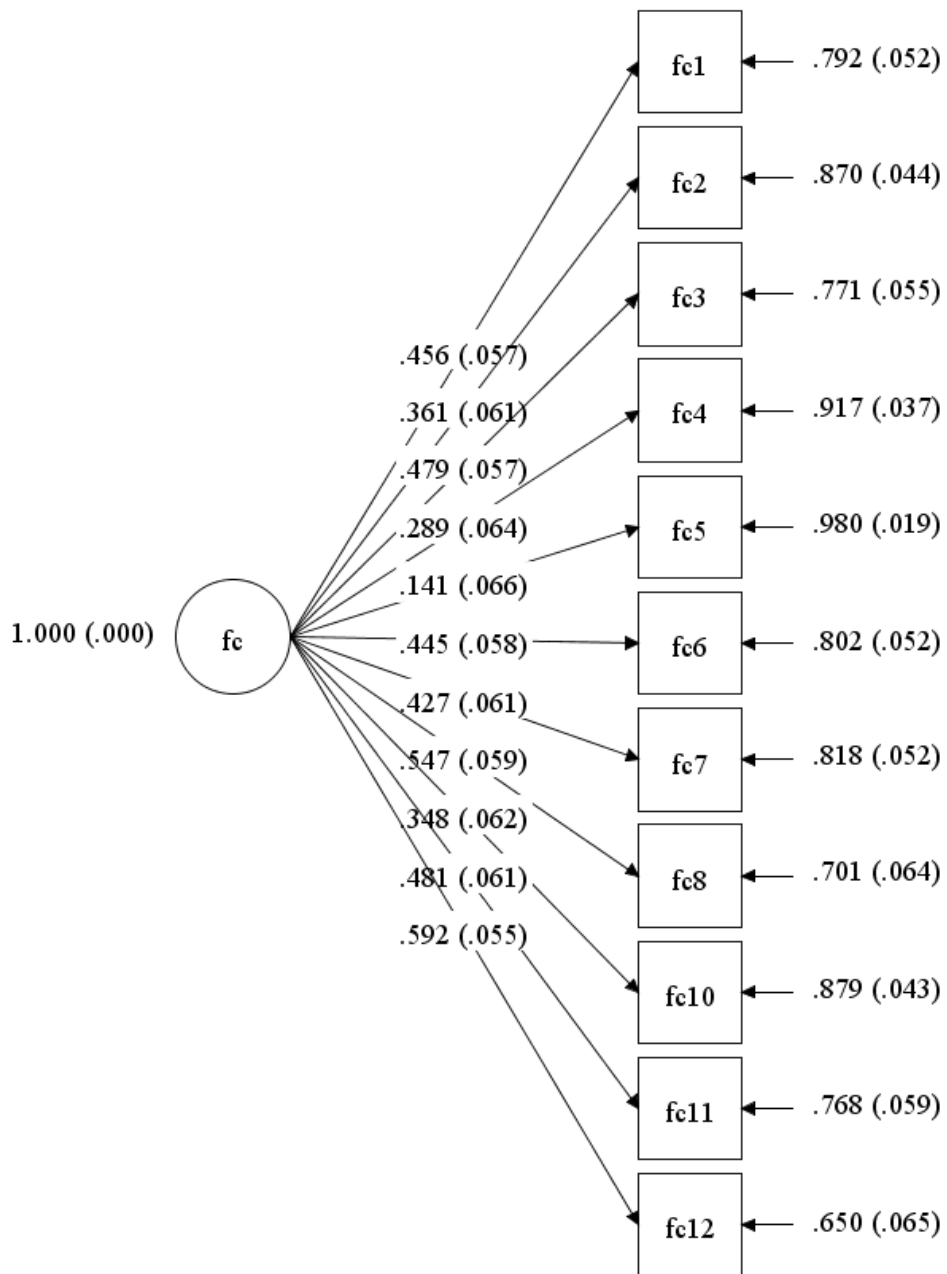


Figure 1. Factor structure of Flexible Control

Note. fc=flexible control

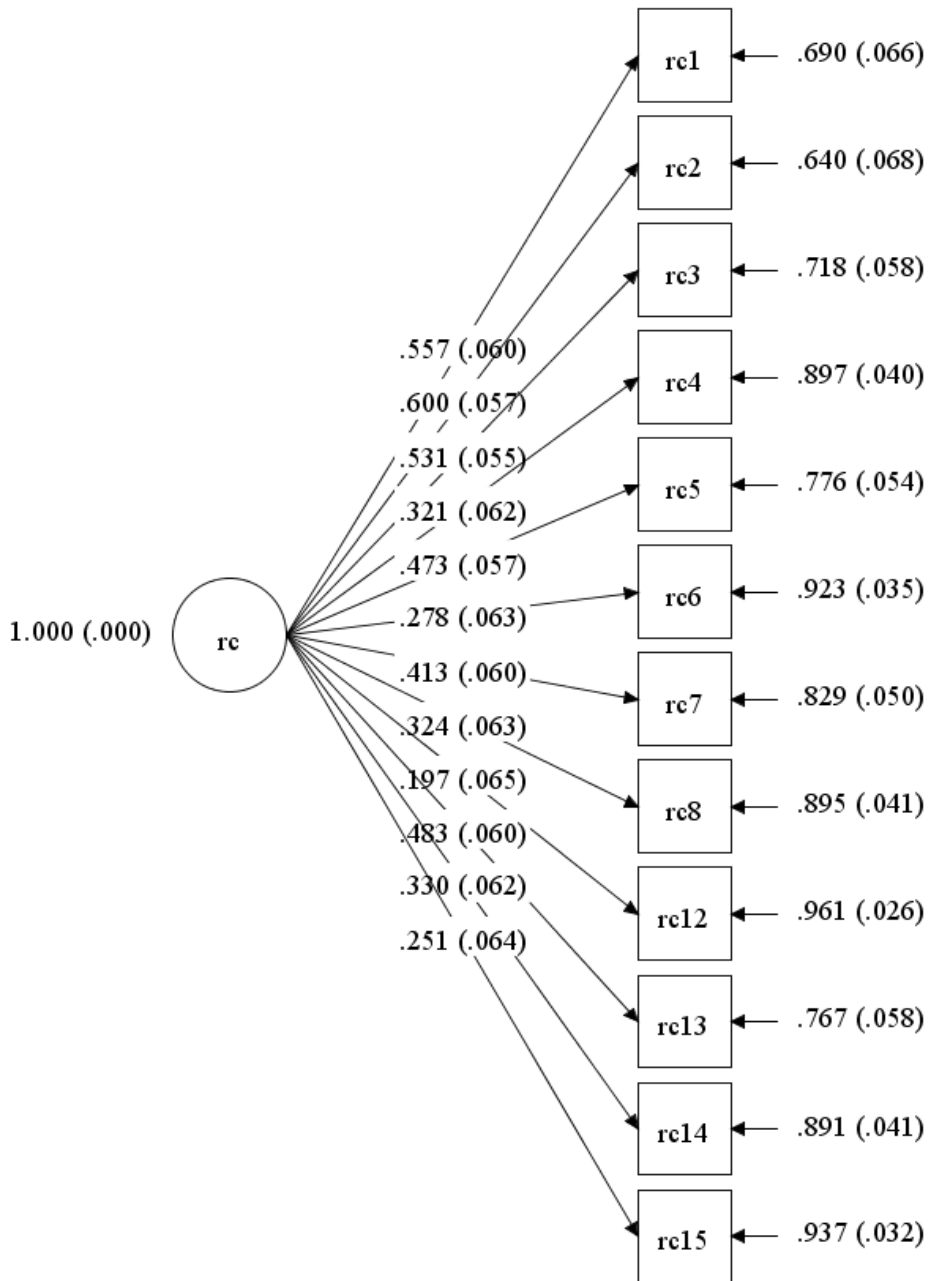


Figure 2. Factor structure of Rigid Control

Note. rc=rigid control



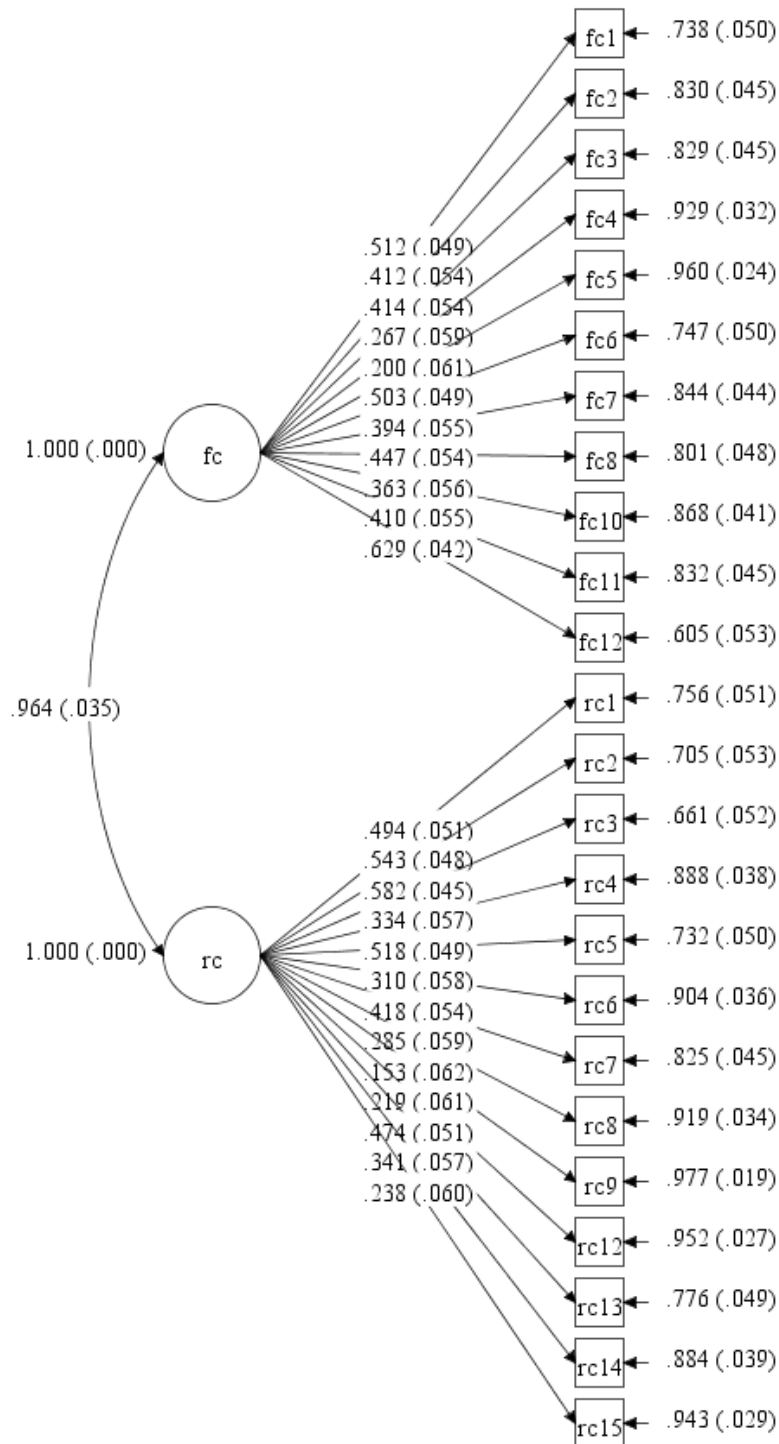


Figure 3. Factor structure of Flexible and Rigid Control

Note. fc=flexible control; rc=rigid control

## Validation of the scale and its relationship to eating disorders

Table 3 presents the means and standard deviations for all the related variables. Table 4 shows the correlations of Flexible Control, Rigid Control and related psychological variables. FC and RC were moderately correlated ( $r=.68$ ,  $p<.001$ ) which is reasonable considering that both measure a form of dietary restraint efforts. Both FC and RC were positively correlated to other scales that measure dietary restraint. FC was mildly correlated with the total EDI score ( $r=.24$ ,  $p<.001$ ) and EDI drive for thinness subscale ( $r=.39$ ,  $p<.001$ ). RC was strongly associated with the total EDI score ( $r=.39$ ,  $p<.001$ ) and all three EDI subscales including drive for thinness ( $r=.51$ ,  $p<.001$ ), body dissatisfaction ( $r=.22$ ,  $p<.001$ ), and bulimia ( $r=.23$ ,  $p<.001$ ). Correlations between RC and the total EDI ( $r$  difference  $z$ -score =  $-3.49$ ,  $p<.001$ ), between RC and the drive for thinness subscale ( $r$  difference  $z$ -score =  $-3.00$ ,  $p<.001$ ) were significantly stronger than their correlations with FC.

DTI and its subscales were not significantly associated with FC. RC was positively correlated with the total DTI ( $r=.15$ ,  $p<.05$ ) as well as with three of DTI subscales: all-or-nothing thinking ( $r=.16$ ,  $p<.05$ ), success vs. failure thinking ( $r=.16$ ,  $p<.05$ ), and dichotomy in academic sphere ( $r=.15$ ,  $p<.05$ ). Both FC ( $r=.14$ ,  $p<.05$ ) and RC ( $r=.18$ ,  $p<.05$ ) showed a small correlation with MPS self-oriented perfectionism subscale. SCS showed a small correlation with FC ( $r=.18$ ,  $p<.05$ ) but not with RC. The healthy habit/reliability subscale of SCS was positively associated with both FC ( $r=.22$ ,  $p<.001$ ) and RC ( $r=.19$ ,  $p<.05$ ). The non-impulsive action subscale was significantly related to FC only ( $r=.13$ ,  $p<.05$ ). Both FC and RC were associated with CESD ( $r=.16$ ,  $p<.05$ ;  $r=.18$ ,  $p<.05$ ) and STAI ( $r=.13$ ,  $p<.05$ ;  $r=.16$ ,  $p<.05$ ).

Multiple linear regression model further verified the separation of FC and RC in relation to EDI. The results of the regression indicated that the two predictors

explained 15.4% of the variance ( $R^2=.15$ ,  $F(2,302)=27.42$ ,  $p<.001$ ). RC significantly predicted EDI ( $\beta= .43$ ,  $p<.001$ ), whereas FC did not ( $\beta= -.05$ ,  $p=.48$ ). In addition, the multiple regression model of FC and RC in relation to EDI drive for thinness subscale was also significant ( $R^2=.26$ ,  $F(2,302)=53.93$ ,  $p<.001$ ). RC predicted drive for thinness ( $\beta= .46$ ,  $p<.001$ ), but FC did not ( $\beta= .07$ ,  $p=.27$ ).

Table 3. *Descriptive statistics of all variables*

	Mean (SD)
FC	8.60 (2.12)
RC	8.21 (2.72)
EDEQ_Restraint	2.86 (1.30)
DEBQ_Restrained Eating	38.51 (5.93)
EAT_Oral control	5.01 (3.62)
EDI	25.65 (12.30)
Drive for thinness	10.37 (5.23)
Body dissatisfaction	11.28 (5.59)
Bulimia	4.01 (3.92)
MPS	73.07 (13.26)
DTI-30R	2.32 (.68)
Either or decision	2.62 (.75)
All or nothing thinking	1.90 (.74)
Success vs. failure thinking	2.58 (.87)
Social splitting	2.25 (.86)
Dichotomy in academic sphere	2.03 (.91)
Dichotomy on verbal expressions	2.38 (1.06)
SCS	82.02 (13.16)
Healthy habit/reliability	29.99 (4.97)
Self-discipline	25.40 (5.54)
Non-impulsive action	26.63 (5.59)
CES-D	20.04 (7.93)
STAI	46.95 (6.85)

*Note.* FC=Flexible Control; RC=Rigid Control; EDEQ\_Restraint=Eating Disorder Examination Questionnaire Restraint subscale; DEBQ\_Restrained Eating=Dutch Eating Behavior Questionnaire Restrained eating subscale; EAT\_Oral control=Eating Attitude Test Oral control subscale; EDI=Eating Disorder Inventory-2; MPS=Multidimensional Perfectionism Scale Self-directed perfectionism subscale; DTI-30R=Dichotomous Thinking Index-30 Revised; SCS=Self-Control Scale; CES-D=Center for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory

Table 4. Correlation coefficients (pearson's *r*) and *r* difference *z*-scores of the Flexible and Rigid Control scale and other variables

	FC	RC	<i>z</i>
age	-.06	-.05	
BMI	-.02	.02	
EDEQ_Restraint	.54***	.58***	-1.09
DEBQ_Restrained Eating	.66***	.60***	1.78
EAT_Oral control	.38***	.44***	-1.46
EDI	.24***	.39***	-3.49***
Drive for thinness	.39***	.51***	-3.00***
Body dissatisfaction	.10	.22***	
Bulimia	.08	.23***	
DTI-30R	.03	.15*	
Either or decision	-.00	.11	
All or nothing thinking	.05	.16*	
Success vs. failure thinking	.08	.16*	
Social splitting	.03	.09	
Dichotomy in academic sphere	-.01	.15*	
Dichotomy on verbal expressions	-.04	.04	
MPS	.14*	.18*	-.88
SCS	.18*	.08	
Healthy habit/reliability	.22***	.19*	.67
Self-discipline	.09	-.00	
Non-impulsive action	.13*	.02	
CES-D	.16*	.18*	-.44
STAI	.13*	.16*	-.66

*Note.* FC=Flexible Control; RC=Rigid Control; BMI=Body mass index; EDEQ\_Restraint=Eating Disorder Examination Questionnaire Restraint subscale; DEBQ\_Restrained Eating=Dutch Eating Behavior Questionnaire Restrained eating subscale; EAT\_Oral control=Eating Attitude Test Oral control subscale; EDI=Eating Disorder Inventory-2; MPS=Multidimensional Perfectionism Scale Self-directed perfectionism subscale; DTI-30R=Dichotomous Thinking Index-30 Revised; SCS=Self-Control Scale; CES-D=Center for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory; \**p*<.05, \*\*\**p*<.001

## Discussion

In study 1, the factor structure of the Flexible and Rigid Control scale was investigated and the subscales were validated with a sample of Korean women who are on a diet. The Korean version of the Flexible and Rigid Control scale was revised and consisted of 11 and 13 items loaded on each factor respectively. Confirmatory factor analysis confirmed that a two factor structure of the Flexible and Rigid Control scale as a whole is more appropriate than two separate unifactorial models. The two subscales inherently share a high correlation because they originate from one scale (cognitive restraint subscale from TFEQ), and both measure some type of dietary restraint. It is possible that some restrained eaters engage in all possible control strategies, both rigid and flexible. This might make the separation of the two constructs complicated and challenging.

Despite some of the scale's limitations, the differential relationships that flexible control and rigid control have with other psychological variables and emotional distress indexes were in line with previous research. Firstly, the concurrent validity of both subscales was verified by the positive correlations found with other scales that measure dietary restraint. Correlation analysis revealed that only rigid control was related to dichotomous thinking, whereas only flexible control was related to self-control. The Self Control scale measures a positive type of self-regulatory skills. Together, these results confirm criterion-related validity of the two restraint scales.

The results regarding the two types of dietary restraint and disordered eating were consistent with previous findings. Although both flexible control and rigid control were found to have positive simple correlations to eating disorder symptoms such as drive for thinness, the correlations between rigid control and eating disorder symptoms were significantly stronger than the correlations between

flexible control and eating disorder symptoms. Moreover, results from the multiple regression analysis support discriminant construct validity of flexible control and rigid control. Rigid control had significant positive regression weights indicating that individuals with higher scores on RC were expected to have higher eating disorder symptoms, after controlling for FC. Flexible control did not show a significant regression weight, indicating that after accounting for the Rigid Control scores, FC scores did not predict EDI symptoms. Therefore, after method variance and overlapping effects have been controlled, the results provide further evidence of the separation of flexible control and rigid control in relation to disordered eating symptoms.

Both depression and anxiety are common emotional distress indexes that accompany eating problems and may have affected the level of eating disorder symptoms found in the sample. The results showed that both flexible control and rigid control showed small but similar levels of correlation with depression and anxiety, further demonstrating that the relationships between disordered eating and restraint are uniquely attributable to the type of dietary restraint.

The Cronbach's  $\alpha$  values of the final Korean versions of the Flexible and Rigid Control scale were relatively low. The Cronbach's  $\alpha$  values reported by the original authors in their studies with different samples (different gender, diet status, weight range) range from .69 to .83 for Flexible Control, and from .55 to .81 for Rigid Control (Westenhoefer, 1991; Westenhoefer et al., 1999). The reliability was especially low in his original study of individuals participating in a weight reduction program. In an effort to distinguish the types of restraint, the current study also recruited women who identified as currently being on a diet, and this homogeneity may explain why respondents varied little in their answers. It is suggested that Cronbach's  $\alpha$  should not be interpreted in strict terms, and when dealing with complex psychological constructs, values below .7 can be expected (Kline, 1999;

Widaman, 1993). Furthermore, several items from the original scale showed low item-total correlations and did not load on a factor. Nevertheless, the Flexible and Rigid Control scale measures two sets of restraint behaviors, cognitive strategies and attitudes. In other words, these are complex and dynamic constructs, and some items may not statistically correlate as heavily but theoretically add to the conceptualization of the phenomenon of interest.

The current study confirmed the factor structure and introduced the Korean version of the Flexible and Rigid Control scale as a valid tool to study restrained eating in a differentiated way. Further validation of the subscales with a sample from a general population (including non-dieters) will help ascertain their reliability.

## **Study 2. Relationship between disordered eating and cognitive rigidity using a food-specific set-shifting task**

Executive functioning is a key component that is required for psychological flexibility and successful self-regulation (Kashdan, 2011). Impaired executive functioning and cognitive rigidity have been associated with disordered eating symptoms (Tchanturia et al., 2004a). One of the chief cognitive functionings that has been studied in the context of eating regulation is the ability to set-shift. Set-shifting refers to the mental ability to shift between multiple tasks, rules, and mental sets, and its impairment is interpreted as a marker of cognitive rigidity (Miyake et al., 2000). Set-shifting has been widely researched as a strong endophenotype across the spectrum of eating disorders and obesity, indicating that it is a major executive function in eating and weight-related behaviors (Wu et al., 2014). Meanwhile, dieting has also been consistently linked to poor executive functioning (Green et al., 1994; Rogers & Green, 1993) even after controlling for individual differences (Green & Rogers, 1995). The mixed findings on the influence of experimentally-induced food deprivation on cognitive functioning (Kretsch et al., 1997) further complicate the growing body of research. No studies have explicitly explored whether the observed set-shifting impairments associated with eating disorders can be attributed to the influence of food restriction (dieting) or the presence of eating disorder symptoms.

To address this gap, a new assessment tool that is specifically designed to measure set-shifting in regards to food cues is necessary in capturing inefficient set-shifting that is evident in unhealthy eating and weight-related behaviors (i.e., labeling food as good or bad depending on calories or fat). In study 2, a new cognitive task called the Food Picture Set-shifting Task (FPST) was developed to measure



difficulties in set-shifting using food pictures and calorie/color rules. The performance on the FPST was compared to the performance on the classic Wisconsin Card Sorting Test (WCST) not only to confirm the validity of the FPST but also to compare general and food-specific set-shifting impairments. In addition, the severity and patterns (calorie to color rule versus color to calorie rule) of set-shifting difficulties are analyzed in relation to eating disorder symptoms and dieting status. The analysis on the patterns of set-shifting impairments will shed light on whether the performance on the FPST task is sensitive to detecting actual set-shifting deficits or is affected by responsivity of attention in response to images of food due to food restriction (Stice, Burger, & Yokum, 2013).

The hypotheses of the study were as follows:

Hypothesis 1. Dieting would be associated with difficulties in shifting away from  
calorie rule

Prediction 1. Dieters would show more errors in the calorie to color shifts in the  
FPST than non-dieters.

Hypothesis 2. Eating disorder symptoms would be associated with impairments in  
general and food-specific set-shifting abilities

Prediction 2-1. High risk eating disorders dieters would perform poorly on the  
FPST and WCST compared to low risk eating disorders dieters and  
non-dieters.

Prediction 2-2. High risk eating disorders dieters would show more errors in the  
calorie to color shifts than in color to calorie shifts in the FPST.

Hypothesis 3. Rigid dietary control, but not flexible dietary control would be  
associated with poor food-specific set-shifting ability.

Prediction 3. Rigid Control scale would be positively correlated to errors in the  
FPST.

# Methods

## Participants

60 participants who identified as being on a diet and who scored above or below the cutoff of the Eating Disorder Inventory-2 drive for thinness subscale (mean score  $7.13 \pm 5.74$  (*S.D.*); Lee et al., 2011) were either screened from study 1 or were newly recruited. 30 women who self-identify as not being on a diet were also recruited as a control group. 90 female university students participated in the study. Data from one participant was excluded due to poor participation. A total of 89 participants (age= $21.43 \pm 2.92$ , bmi= $20.57 \pm 2.14$ ) were included in the analysis. Because some participants' scores had changed since they completed the screening questionnaire, they were re-grouped based on their EDI scores that they completed at the time of their participation of the research. Low risk dieter group consisted of 32 women, high risk dieter group consisted of 29 women, and non-dieter group consisted of 28 women. Participants' characteristics by group are listed in Table 7.

## Procedure

Participants were assigned to three groups based on their scores on the Eating Disorder Inventory drive for thinness subscale and their answer on their current dieting status. Low risk dieter group consisted of individuals who were currently on a diet and scored below the cutoff of the EDI in the screening process. Respondents who were on a diet and scored above the cutoff of the EDI in the screening process were assigned to the high risk dieter group. Lastly, participants who were not currently on a diet were assigned to the non-dieter group regardless of their EDI scores.

In the lab, participants completed the FPST and WCST and a set of

questionnaires which included the EDEQ restraint subscale, EDI-2, Flexible and Rigid Control scales, CESD, and STAI. All experiments and self-report surveys were administered using a computer. The recruitment and experimental procedure is outlined in Figure 4. Both study 1 and 2 were approved and conducted by the guidelines for the use of human subjects established by the Institutional Review Board at Seoul National University (IRB No. 1703/003-021).

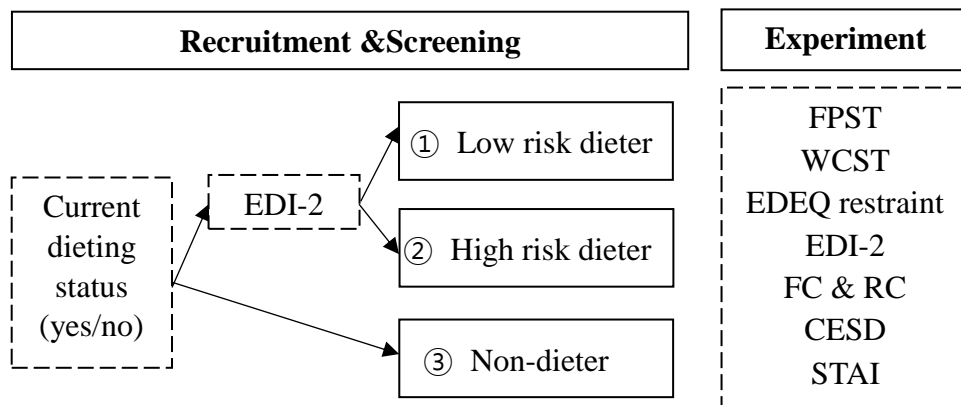


Figure 4. Recruitment and experimental procedure

*Note.* EDI-2=Eating disorder inventory-2; FPST=food picture set-shifting task; WCST=Wisconsin Card Sorting Test; EDEQ=Eating disorder examination questionnaire; FC=flexible control; RC=rigid control; CESD=Center for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory

## Instruments

### Food Picture Set-shifting Task (FPST)

Participants were shown two food pictures and were required to select the correct one without knowing the rules. The rules changed without notice, and the participant needed to demonstrate the ability to shift within and between the calorie rule (high vs. low calorie) and the color rule (i.e., yellow vs. green) based on the feedback shown on screen. At the start of the task, the following instruction appears on the screen: “Now, two pictures will be presented. One is correct, the other is

wrong. Click on the picture that you think is correct. The correct answer is based on the food's color or calorie. The computer will keep track of how you are doing, and once you've figured out the rule, the rule will change. However, the rule will not change very often. When the rule changes, you will have to figure out the new rule. When you start the task, you will not know which picture is correct so you will need to simply guess. Each time you make a choice, the computer will tell you if you are right or wrong. Please start."

The task was designed so that the rule changed 12 times, once in every 6 trials. Estimates measured were reaction time (ms), total number of errors, number of perseveration errors, number of calorie to color shift errors, and number of color to calorie shift errors. Errors were counted as "perseveration error" when the participant continues to make an error after the rule has changed and was given feedback (Figure 5). At the end of the task, participants were asked to rate the difficulty level of the task on a 7-point Likert scale (range=1-7, 1 being very easy, 7 being very difficult).

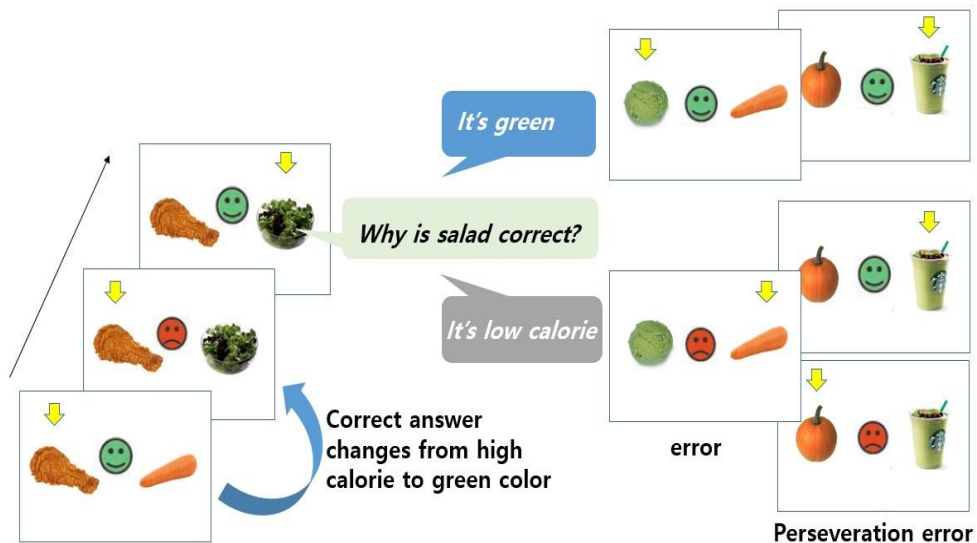


Figure 5. Example sequence of the FPST and its perseveration error

The WCST and CANTAB Intra/Extra-dimensional (IDED) Set-shift task were used as reference in the development of FPST. Food pictures were partially selected from food-pics (Blechert, Meule, Busch, & Ohla, 2014), a database of food images for experimental research and the FPST was designed using e-Prime. The full list of food pictures used in the task can be found in the appendix.

### **Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948)**

The Wisconsin Card Sorting Test is a neuropsychological test that measures set-shifting impairments. The study utilized the online version provided by PsyToolkit which is a web-based software for psychological experiments (Stoet, 2010; Stoet, 2017). Participants are asked to match the stimulus card with one of four cards with varying shapes, numbers, and colors. The rule (shape, number, color) changes unexpectedly during the course of the task, and each time the participant selects a card, a feedback is given. The rule is set to change once in every ten trials. The task consists of 60 trials. The WCST yields reaction time (ms), number of errors, number of perseveration errors, and number of non-perseveration errors as estimates.

### **The Korean version of the Flexible and Rigid Control Scale (FC11, RC13; Westenhofer et al., 1999).**

The Korean version of the Flexible and Rigid Control scale validated in Study 1 was used to measure two types of dietary control. Flexible control (11 items) which measures a flexible approach to dieting consists of 8 items responded in yes or no and 3 items scored on a 4-point Likert scale. Rigid control (13 items) which measures a rigid and dichotomous approach to dieting consists of 8 items answered in yes or no and 5 items scored on a 4-point Likert scale. In this study, the internal consistency of Flexible Control (Cronbach's  $\alpha=.85$ ) and Rigid Control (Cronbach's  $\alpha=.86$ ) was both acceptable.

**Eating Disorder Examination Questionnaire (EDEQ; Fairburn & Beglin, 1994).**

EDEQ measures psychopathology specific to eating disorders. Among the four subscales, the restraint scale was used in the current study to assess the degree of dietary restriction. The subscale consists of 5 items scored on a 7-point Likert scale. For this study, participants completed the Korean version of the EDEQ (Lim et al., 2010). The internal consistency of the EDEQ restraint subscale was acceptable (Cronbach's  $\alpha=.90$ ).

**Eating Disorder Inventory-2 (EDI-2; Garner, 1991).**

EDI-2 assesses eating behaviors and perceptions on body image. For this study, the drive for thinness (7 items), body dissatisfaction (9 items), and bulimia (7 items) subscales from the Korean version of the EDI-2 (Lee et al., 2012) were used. 23 items are answered on a 6-point Likert scale. The internal consistency of the drive for thinness (Cronbach's  $\alpha=.89$ ), body dissatisfaction (Cronbach's  $\alpha=.88$ ), bulimia (Cronbach's  $\alpha=.84$ ) was acceptable.

**Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977).**

CES-D measures the behavioral, physical, and cognitive symptoms associated with depression. 20 items are scored on a 4-point Likert scale. For this study, participants completed the Korean version of the CES-D (Chon, Choi & Yang, 2011). The Cronbach's  $\alpha$  was .81 for the current study.

**State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).**

STAI is a self-report questionnaire that measures both state and trait anxiety. The Korean version of the 20-item trait anxiety inventory that is scored on a 4-point Likert scale (Hahn, Lee, & Chon, 1996) was used. The Cronbach's  $\alpha$  was .68 for the current study.

## **Statistical analysis**

To test the validity of the FPST, correlational tests between the estimates yielded from the FPST and WCST were performed. Next, *t*-tests were conducted to compare the between and within group differences of the performances of FPST and WCST between dieters and non-dieters. The second hypothesis was investigated with the ANOVA analysis to compare the three groups on the differences in the performances on the FPST and WCST as well as psycho-behavioral variables. Lastly, correlational tests were carried out to study the association between flexible and rigid control and the performances in the FPST and WCST. All statistical analyses were performed using IBM SPSS statistics 23.

# Results

## FPST performance and set-shifting

The means and standard deviations of the estimates from the FPST are summarized in Table 5. Correlation analysis were performed on the performances in the FPST and WCST to confirm if FPST is a valid instrument that measures set-shifting abilities. The estimates from the FPST were significantly associated with the equivalent estimates of the WCST. The number of errors in the FPST showed a positive correlation with WCST error ( $r=.34, p<.001$ ) and perseveration error ( $r=.24, p<.05$ ), and non-perseveration error ( $r=.34, p<.001$ ). The average reaction time of FPST showed a positive correlation with the average reaction time of WCST ( $r=.25, p<.05$ ). The number of perseveration errors in the FPST showed a positive correlations with WCST error ( $r=.26, p<.05$ ), perseveration error ( $r=.22, p<.05$ ), and non-perseveration error ( $r=.23, p<.05$ ). The number of calorie to color shift errors in the FPST showed a positive correlation with the error ( $r=.25, p<.05$ ) and perseveration error ( $r=.24, p<.05$ ) in the WCST but not with non-perseveration error ( $r=.17, p=.11$ ). On the other hand, the number of color to calorie shift errors was not significantly correlated with the performances in the WCST. The average perceived difficulty level was 4.57 ( $SD=1.10$ ).

Table 5. *Descriptive statistics of the FPST (n=89)*

	mean ( <i>SD</i> )
error	24.51 (6.38)
average RT	1370.8117(419.65)
FPST perseveration error	2.75(2.05)
calorie to color error	1.07(.90)
color to calorie error	1.20(1.06)

*Note.* FPST=Food Picture Set-shifting Task; RT=reaction time



## Dieting status and FPST, WCST performance

To test the first hypothesis, *t*-test analysis were performed to compare group differences in self-identified dieters and non-dieters (Table 6). Dieters made more errors in calorie to color shifts in the FPST than non-dieters (mean difference = .46,  $t(87)=2.30$ ,  $p<.05$ ) but not in other estimates. *Cohen's d* suggested a medium effect size (.53). Although results of the *t*-test did not reveal statistical difference between dieters and non-dieters in the WCST performance, *Cohen's d* suggests small to medium effect sizes. According to Cohen (1988), *d* above .80 is interpreted as large effect, .50 as medium, and .20 as small effect. Non-dieters performed better in calorie to color shifts than in color to calorie shift (mean difference = -.52,  $t(28)= -2.64$ ,  $p<.05$ ). Such within-subject difference was not found in the dieter group. The statistical significance of the between-group difference did not change after controlling for BMI. The perceived difficulty level of the task did not differ by group.

Table 6. *T-test statistics and effect sizes (cohen's d) of task performance by group: dieter (n=61); non-dieter (n=28)*

		group		<i>t</i>	<i>d</i>
		dieter	non-dieter		
		mean ( <i>SD</i> )	mean ( <i>SD</i> )		
	error	24.89(6.70)	23.68(5.63)	.83	.20
	average RT	1334.48(414.88)	1449.95(426.61)	-1.21	.27
FPST	perseveration error	2.84(1.98)	2.57(2.24)	.56	.13
	calorie to color error	1.21(.90)	.75(.84)	2.30*	.53
	color to calorie error	1.20(1.05)	1.21(1.10)	-.07	.01
	average RT	1420.41(287.27)	1421.16(282.44)	-.01	<.01
WCST	error	9.31(3.51)	8.36(2.04)	1.34	.33
	perseveration error	6.80(2.29)	6.04(1.29)	1.66	.41
	non-perseveration error	2.51(1.81)	2.32(1.16)	.50	.12

*Note.* FPST=Food Picture Set-shifting Task; RT=reaction time; WCST=Wisconsin Card Sorting Test; \* $p<.05$

## **Eating disorders symptoms and FPST, WCST performance**

Higher eating disorder symptom was negatively associated with average reaction time in FPST ( $r = -.23, p < .05$ ) but not with other estimates of the FPST and WCST. ANOVA analysis were conducted for the three groups – low-risk dieters, high-risk dieters, and non-dieters – in order to test the second hypothesis that high eating disorder symptoms would be associated with poorer general and food-specific set-shifting abilities. Contrary to the hypothesis, the ANOVA analysis revealed that low-risk dieters performed worst in the FPST and WCST (Table 7). The statistical significance of the group difference in task performance did not change after controlling for BMI. The perceived difficulty level of the FPST did not differ significantly by group. Thus, to confirm if the groups fit the appropriate profile, the means of the EDEQ and EDI scores were compared. As seen in Table 7, low risk dieters' restraint level ( $1.96 \pm 1.22$ ) demonstrated by the scores in EDEQ was significantly lower than high risk dieters ( $3.55 \pm 1.21$ ) obscuring the effect of eating disorder levels that was intended to differentiate these two groups. Therefore, additional analysis were performed on the relationship between the level of restraint (low EDEQ vs. high EDEQ) and the FPST, WCST performances.

## **Restraint and FPST, WCST performance**

Based on the results that self-identified dieters differed on the level of dietary restraint, additional *t*-test analysis were conducted to compare the FPST, WCST performances of individuals who scored above the 70 percentile of the EDEQ (high restraint) and those who scored below the 30 percentile of the EDEQ (low restraint) (Table 8). The high restraint group performed poorly on the FPST overall than the low restraint group but the difference was not statistically significant. The effect sizes were small (*cohen's d* between .18 and .36). The high restraint group

performed significantly poorly on the WCST than the low restraint group, and the effect sizes were medium to large (*cohen's d* between .54 and .68).

Table 7. *Group characteristics and task performance: Low-risk dieter (n=32); high-risk dieter (n=29); non-dieter (n=28)*

	group			<i>F</i>	
	low-risk dieter mean ( <i>SD</i> )	high-risk dieter mean ( <i>SD</i> )	non-dieter mean ( <i>SD</i> )		
age	22.59(3.48)	21.52(2.77)	20.00(1.49)	6.66**	
BMI	20.64(2.10)	21.40(2.33)	19.64(1.59)	5.33**	
	error	26.00(7.28)	23.66(5.88)	23.68(5.63)	1.39
FPST	average RT	1430.50 (493.96)	1228.54 (276.66)	1449.95 (426.61)	2.58
	perseveration error	3.41(1.98)	2.21(1.80)	2.57(2.24)	2.88
	calorie to color error	1.47(.92)	.93(.80)	.75(.84)	5.80**
	color to calorie error	1.38(1.13)	1.00(.93)	1.21(1.10)	.96
	average RT	1433.15 (323.21)	1406.35 (246.55)	1421.16 (282.44)	.07
WCST	error	9.03(2.92)	9.62(4.10)	8.36(2.04)	1.15
	perseveration error	6.59(1.86)	7.03(2.69)	6.04(1.29)	1.72
	non-perseveration error	2.44(1.63)	2.59(2.03)	2.32(1.16)	.19
EDEQ	restraint	1.97(1.22)	3.55(1.21)	.74(.78)	47.04***
EDI		16.69(6.15)	39.62(9.38)	13.71(13.94)	56.60***
	drive for thinness	6.16(2.92)	15.38(2.73)	3.57(4.03)	104.98***
	body dissatisfaction	7.81(3.51)	17.76(5.13)	7.93(6.82)	34.68***
	bulimia	2.72(2.47)	6.48(4.74)	2.21(4.47)	10.034***
FC		7.59(2.26)	9.03(1.76)	3.43(2.55)	49.51***
RC		6.13(2.94)	9.17(3.08)	3.00(2.80)	31.30***
CESD		17.81(6.82)	22.76(8.79)	17.43(6.82)	4.56**
STAI		45.63(5.28)	48.03(7.08)	45.18(6.52)	1.73

*Note.* BMI=Body mass index; FPST=Food Picture Set-shifting Task; RT=reaction time; WCST=Wisconsin Card Sorting Test; EDEQ\_Restraint=Eating Disorder Examination Questionnaire Restraint subscale; EDI=Eating Disorder Inventory-2; FC=Flexible Control; RC=Rigid Control; CES-D=Center for Epidemiologic Studies Depression Scale; STAI=State-Trait Anxiety Inventory; \*\**p*<.01, \*\*\**p*<.001

Table 8. *T*-test statistics and effect sizes (Cohen's *d*) of task performance by group: low restraint (*n*=31), high restraint (*n*=27)

	group		<i>t</i>	<i>d</i>
	low restraint mean ( <i>SD</i> )	high restraint mean ( <i>SD</i> )		
error	23.42(4.68)	25.48(7.94)	-1.22	.32
average RT	1413.24(415.15)	1323.26(325.16)	.91	.25
FPST				
perseveration error	2.32(1.64)	2.96(2.71)	-1.10	.29
calorie to color error	.81(.79)	1.15(1.10)	-1.37	.36
color to calorie error	1.06(.89)	1.26(1.29)	-.68	.18
average RT	1435.32(320.56)	1415.52(242.37)	.26	.07
WCST				
error	7.90(1.96)	10.11(4.13)	-2.54*	.68
perseveration error	5.90(1.19)	7.04(2.71)	-2.01*	.54
non-perseveration error	2.00(1.18)	3.07(2.15)	-2.31*	.62

Note. FPST=Food Picture Set-shifting Task; RT=reaction time; WCST=Wisconsin Card Sorting Test; \**p*<.05

### Flexible, rigid control and FPST, WCST performance

Higher score on Flexible Control was correlated with more errors in calorie to color shifts in FPST ( $r=.24, p<.05$ ), more errors ( $r=.28, p<.05$ ), more perseverative errors ( $r=.25, p<.05$ ), and more non-perseverative errors in WCST ( $r=.22, p<.05$ ). Higher score on Rigid Control was correlated with more errors ( $r=.24, p<.05$ ) and more perseveration errors ( $r=.22, p<.05$ ) in the WCST. Correlation coefficients are presented in Table 9. Flexible control and rigid control were highly correlated ( $r=.82, p<.001$ ) thus, partial correlations with the performance indexes were calculated. When RC was controlled, only the correlation between FC and calorie to color shift error in FPST remained significant ( $r=.28, p<.05$ ).

Table 9. Simple and partial correlation coefficients of the Flexible and Rigid Control scale and task performance

		FC		RC	
		<i>r</i>	partial <i>r</i>	<i>r</i>	partial <i>r</i>
	error	.16	.13	.11	-.04
	average RT	-.05	-.05	-.02	.02
FPST	perseveration error	.18	.19	.09	-.10
	calorie to color error	.24*	.28*	.10	-.17
	color to calorie error	.15	.16	.08	-.09
	average RT	.03	.10	-.04	-.10
WSCT	error	.28*	.15	.24*	.01
	perseveration error	.25*	.13	.22*	.03
	non-perseveration error	.22*	.14	.18	-.01

*Note.* FPST=Food Picture Set-shifting Task; RT=reaction time; WCST=Wisconsin Card Sorting Test; FC=Flexible control; RC=Rigid control; \* $p < .05$

## Discussion

In study 2, set-shifting difficulties regarding food pictures and rules were measured with an experimental task. Results from the correlational analysis suggest that the newly developed FPST appears to be a valid instrument for measuring set-shifting abilities that can be assessed with another traditional neuropsychological tool. The perceived difficulty level of the FPST task was adequate and did not differ significantly by group, excluding the presence of a floor or ceiling effect.

The first hypothesis that dieters will have more difficulty in shifting away from calorie rule to color rule compared to non-dieters was confirmed. Moreover, non-dieters performed better in shifting away from calorie to color rule than from color to calorie rule. This may imply that for those who are not on a diet, noticing the color of the food is generally more salient than the caloric information of the food. Whereas, for self-identified dieters, the caloric information is as salient as the color of the food.

The second hypothesis posited that among those who are on a diet, individuals high in eating disorder symptoms (high risk dieters) will perform the worst in both FPST and WCST. However, the hypothesis that the level of eating disorder symptoms may affect the performance in set-shifting tasks was difficult to verify with the three groups because the high risk dieters and low risk dieters significantly differed in the level of dietary restraint (EDEQ scores). Contrary to the hypothesis and previous research that identified set-shifting impairments as an endophenotype of eating disorders, high eating disorder symptom was related only to the average reaction time in FPST. It is possible that set-shifting impairments may not be observed in non-clinical population with mild eating problems.

Although the initial hypotheses were partially confirmed, additional analysis were needed because clearly, there was a difference in the perceived dieting

status and actual dietary restraint. Regardless of identifying oneself as being on a diet, those who engaged in high levels of dietary restraint (above 70 percentile in EDEQ) compared to those with low levels of restraint (below 30 percentile in EDEQ), performed poorly on the FPST and WCST, yet only the differences in WCST were statistically significant with medium to large effect sizes. EDEQ asks participants to reflect on the past 28 days and indicate the frequency of their dietary restrictions. Although it is based upon memory, it is a closer estimate to the degree of actual food restriction and behavioral restraint efforts than a simple question about the current dieting status (“Are you currently on a diet to lose or maintain weight or body shape?”) which reflects one’s intention to diet.

The different results of the FPST and WCST performances in relations to restraint versus dieting status invite new interpretations. First, results show that there was a big variance in actual restraint among those who identify as being on a diet. In other words, the perceived dieting status is related to the person’s subjective intent and may not reflect the actual food restriction or restriction efforts that the person act upon. From the results of the FPST task performance, the intent to be on a diet appears to be more important in food-related cognitive rigidity, notably in one’s difficulty in mentally moving away from the calorie rule when looking at food pictures. In contrast, actual restraint seems to be more important in predicting overall set-shifting ability that is not specific to food. This may be explained by the fact that restriction in energy intake affects general cognitive performances.

Lastly, contrary to the third hypothesis, both flexible control and rigid control were associated with inefficient general set-shifting. One possible explanation is that any type of self-control requires a person to inhibit thoughts and behaviors and focus attention. Excessive self-control efforts is cognitively straining and is likely to impair one’s performances in cognitive and behavioral tasks (Muraven & Baumeister, 2000). Experimental studies have found that subsequent to

tasks that require substantial amount of self-control efforts, individuals have more difficulty in a following task that also demands self-regulation. Flexible control and rigid control showed high positive correlations in this sample suggesting that these individuals are practicing a lot of self-control in their eating behavior in their daily lives which may hinder their overall cognitive performances. Interestingly, only flexible control remained related to more difficulties in calorie to color shifts even after controlling for rigid control. Although it is currently difficult to determine why flexible control might be related to more sensitivity to calorie rule, this result is somewhat in line with a recent study by Westenhoefer et al. (2013) in which they found that flexible control correlated with impaired working memory and diet-related preoccupying cognitions such as awareness of sugar, fat and energy content of foods. Rigid control is a relatively passive and automatic strategy while flexible control may require more conscientious consideration of the context (Kashdan, 2011). Although it may not be healthy, relying on a default strategy may impose less cognitive burden than flexibly responding to a situation.

Taken together, the results from study 2 underlines again the importance of using the right measurement tools that are specific to diet and food when studying dietary restraint, dieting, and eating behaviors. A simple question on the current dieting status or a self-report questionnaire reflecting on the past 28 days both may not be enough to accurately assess a person's dietary restraint. More and more researchers are relying on diet diaries, ecological momentary assessment tools, and even wearable e-health devices to get more accurate data on actual food consumptions when studying eating behaviors. Comparing the effects of actual food restriction versus cognitive intent on disordered eating or food-related cognitive rigidity tests will provide further clarification.



## General Discussion

This study aimed to examine how two aspects of rigidity – rigid dietary restraint and cognitive rigidity – may be related to disordered eating patterns by using diet- and food-specific questionnaire and experimental task. Dietary restraint describes an individual’s tendency to restrict food consumption to control their weight (Herman & Mack, 1975). A long line of empirical research reports that restraint precedes disordered eating, especially the tendency to overeat. Theoretical models such as the boundary model (Herman & Polivy, 1984) also describes how the regulation of eating may push one to overeat beyond his or her normal physiological satiety. At the same time, overeating happens without prior restraint, and there are some restrained eaters who are successful in controlling their food restriction. Therefore, dietary restraint does not appear to be a one-dimensional construct. This highlights the importance of using a valid tool that measures the complexity of dietary restraint.

In light of previous research that the type of dietary restraint needs to be considered, the aim of study 1 was to validate the Korean version of the Flexible and Rigid Control scale. The results of the confirmatory factor analysis provide evidence for a two-factor structure for the Korean version of the Flexible and Rigid Control scale. One item from the flexible control and three items from the rigid control subscales did not load. The original authors did not report on the factor structure of the scale, therefore it is difficult to conclude if this is attributed to cultural differences and remains as a limitation to this study. The Korean version of the Flexible and Rigid Control scale demonstrated good construct validity attesting to its utility in distinguishing two types of dietary restraint. As predicted, and in line with previous research, rigid control was more strongly related to eating disorder symptomology than flexible control. The findings confirmed that both types of dietary restraint were

similarly associated with dietary control in general. The subscales were also associated with indexes of emotional distress that are often cited in eating disorder research such as depression and anxiety that might have confounded the results. These findings indicate that the separation of the two types of restraint in eating disorders research is crucial. Although the reliability of the two subscales were not high in study 1, it was comparable to the reliability that was reported from the study by the original authors conducted with a sample of a similar profile (women who are on a diet). In addition, the internal consistency of both subscales increased to above .85 when tested in study 2 which included non-dieters in the sample. Validation of the subscales with a broader range of participants will likely increase the reliability of the scale.

Study 2 investigated the relationship of cognitive rigidity and disordered eating by measuring general set-shifting and food-specific set-shifting impairments using experimental tasks. Previous research has been active in describing the cognitive profiles of individuals with eating and weight-related problems. Studies have highlighted that inefficient set-shifting ability is a strong predictor and a maintenance factor of eating disorders (Bulik et al., 2007). Meanwhile, set-shifting impairment is reported in a wide range of pathology not exclusive to eating disorders. Furthermore, as key building blocks of flexible and healthy self-regulation, cognitive flexibility and executive functioning are negatively affected by dieting and deprivation of food intake. Thus, it is unclear whether the cognitive rigidity that is present in individuals with eating disorders can be attributed to the uniqueness of eating disorder psychopathology or to high levels of dietary restriction that is often accompanied in eating disorders patients.

In order to address this gap in the literature, this is the first study that examined set-shifting impairments that is specific to food. Although the level of eating disorder symptoms did not show significant association with inefficient set-

shifting, different patterns on the performances of FPST and WCST were found depending on the definition of dietary restraint. Intent to diet (current dieting status) was more important in cognitive rigidity specific to food. Meanwhile, dietary restraint behavior (EDEQ) was more associated with general set-shifting impairments. The findings suggest that the intent to diet and actual behavioral restriction efforts may affect performances in cognitive tasks through different mechanisms. This might also explain why in the large body of previous research, cognitive impairments were consistently found in dieters but are not always found under laboratory-induced restraint conditions. The intention to diet, even when it is not acted upon may have implications for cognitive rigidity regarding food. Therefore, strong or compulsive intent to diet may be a possible target for individuals at-risk of eating disorders. The FPST proved to be a valid and sensitive measure that can detect such differences in set-shifting difficulties.

Findings from study 1 and 2 converge in attesting to the idea that restraint is not a homogeneous construct, and that the intent to restrain (reported dieting status) is not synonymous to actual restraint behavior. Although restrained eaters do in reality restrict food intake, not all restrained eaters have the effective behavioral skills to regulate their eating. Moreover, it is possible to be a restrained eater without being a dieter (without having the intent to be on a diet). Lee (1997) also found that among Korean women, 4.9% of normal eaters, 25.5% of emotional eaters, and 57.8% of the restrained eaters reported to be currently on a diet. Although intent is not interchangeable with actual amount of calorie restriction or effective strategies to regulate eating behaviors, the existing pool of questionnaires that measure dietary restraint differ in their conceptualization of restraint. Stice et al., (2004, 2007, 2010) have consistently questioned the validity of dietary restraint scale as a measure of dietary restriction. Thus, when interpreting results from previous research, the measurement tools that have been used need to be carefully monitored so as not to

confound the relationship between restraint and disordered eating.

There are several limitations of study 2. If the observed differences in the FPST and WCST performances are indeed differentially sensitive to current dieting status and behavioral restraint level, adding a measure that keeps track of actual caloric intake (in the form of daily meal diary or EMA tools) will further clarify the relationship between restraint and cognitive impairments. Moreover, contrary to the study's hypothesis and a body of research that indicate set-shifting impairments as a distinctive feature in eating disorders, the results did not find significant relationships between disordered eating symptoms and performances in the FPST and WCST. This may be due to the fact that the study's sample exhibited sub-clinical levels of eating disorder symptoms. Future research may look into the performances of the FPST in different subgroups of eating and weight-related disorders. Further research should explore the nature of the cognitive deficit that is affected by dietary restraint or dieting status. The current study only looked at set-shifting abilities, but the cognitive deficit may not be restricted to a specific executive function. It will be also important to distinguish if the measured cognitive impairments are due to factors other than set-shifting abilities such as distraction in attentional focus or reduction in working memory capacity. Including non-food stimuli in the FPST could increase the information that can be inferred and improve the cognitive task.

Despite these limitations, the newly developed FPST task, paired with the WCST appear to be sensitive to detecting the differences between dieting intent and restraint behavior when it comes to food-specific set-shifting impairments. The use of an appropriate dietary restraint questionnaire and the FPST would serve as convenient and complementary tools to identify and possibly target unhealthy dieting and disordered eating patterns for treatments and interventions.

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# Appendix

Appendix A. The Flexible and Rigid Control Scale

Appendix B. The Flexible and Rigid Control Scale – Korean version

Appendix C. Eating Disorder Examination Questionnaire Restraint subscale – Korean version

Appendix D. Eating Disorder Inventory-2 – Korean version

Appendix E. Dutch Eating Behavior Questionnaire Restrained eating subscale – Korean version

Appendix F. Eating Attitude Test Oral control subscale – Korean version

Appendix G. Dichotomous Thinking Index-30 Revised

Appendix H. Multidimensional Perfectionism Scale Self-directed perfectionism subscale – Korean version

Appendix I. Self-control Scale – Korean version

Appendix J. Center for Epidemiologic Studies Depression Scale – Korean version

Appendix K. State-Trait Anxiety Inventory – Korean version

Appendix L. Food images in the Food Picture Set-shifting Task (FPST)

## Appendix A. The Flexible and Rigid Control Scale

### Flexible Control (FC12)

1. When I have eaten my quota of calories, I am usually good about not eating any more. (true – false)
2. I deliberately take small helpings as a means of weight control. (true – false)
3. While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it. (true – false)
4. I consciously hold back at meals in order not to gain weight. (true – false)
5. I pay a great deal of attention to changes in my figure. (true – false)
6. How conscious are you of what you are eating? (not at all – slightly – moderately – extremely)
7. How likely are you to consciously eat less than you want? (unlikely – slightly unlikely – moderately likely – very likely)
8. If I eat a little bit more on one day, I make up for it the next day. (true – false)
9. I pay attention to my figure, but I still enjoy a variety of foods. (true – false)
10. I prefer light foods that are not fattening. (true – false)
11. If I eat a little bit more during one meal, I make up for it at the next meal. (true – false)
12. Do you deliberately restrict your intake during meals even though you would like to eat more? (always – often – rarely – never)

### Rigid Control (RC16)

1. I have a pretty good idea of the number of calories in common food. (true – false)
2. I count calories as a conscious means of controlling my weight. (true – false)
3. How often are you dieting in a conscious effort to control your weight? (rarely – sometimes – usually – always)
4. Would a weight fluctuation of 5 lb affect the way you live your life? (not at all – slightly – moderately – very much)
5. Do feelings of guilt about overeating help you to control your food intake? (never – rarely – often – always)
6. How frequently do you avoid “stocking up” on tempting foods? (almost never – seldom – usually – almost always)
7. How likely are you to shop for low calorie foods? (unlikely – slightly unlikely – moderately likely – very likely)
8. I eat diet foods, even if they do not taste very good. (true – false)
9. A diet would be too boring a way for me to lose weight. (true – false)
10. I would rather skip a meal than stop eating in the middle of one. (true – false)
11. I alternate between times when I diet strictly and times when I don’t pay much attention to what and how much I eat. (true – false)
12. Sometimes I skip meals to avoid gaining weight. (true – false)
13. I avoid some foods on principle even though I like them. (true – false)
14. I try to stick to a plan when I lose weight. (true – false)
15. Without a diet plan I wouldn’t know how to control my weight. (true – false)
16. Quick success is most important for me during a diet. (true – false)

## Appendix B. The Flexible and Rigid Control Scale – Korean version

각 문항을 잘 읽어보신 후, 자신에게 가장 적합한 부분에 표시해 주십시오.

### 유연한 조절 (FC11)

1. 내가 정한 칼로리만큼 먹었을 경우 그 이상은 잘 먹지 않는다 (예 - 아니오)
2. 체중을 조절하기 위해 식사할 때 일부러 적은 양을 담는다 (예 - 아니오)
3. 다이어트 중 허용되지 않은 음식을 먹으면, 그 대신 일정기간 동안 의식적으로 음식을 적게 먹는다 (예 - 아니오)
4. 체중 증가를 막기 위해 의식적으로 식사를 억제한다 (예 - 아니오)
5. 체형 변화에 상당히 신경을 쓴다 (예 - 아니오)
6. 당신이 무엇을 먹고 있는지를 얼마나 의식합니까? (전혀 하지 않는다 - 약간 한다 - 중간 정도로 한다 - 매우 많이 한다)
7. 먹고 싶은 양보다 의식적으로 적게 먹으려 합니까? (전혀 그렇지 않다 - 약간 그렇지 않다 - 중간 정도로 그렇다 - 매우 그렇다)
8. 평소보다 약간 더 많이 먹었다면, 그 대신 다음 날 좀 덜 먹는다 (예 - 아니오)
9. 살이 찌지 않는 가벼운 음식을 선호한다 (예 - 아니오)
10. 평소보다 약간 더 많이 먹은 끼니 후에는 다음 끼니 때 좀 덜 먹는다 (예 - 아니오)
11. 좀 더 먹고 싶더라도 의식적으로 식사 양을 제한합니까? (거의 그렇지 않다 - 때때로 그렇다 - 대개 그렇다 - 항상 그렇다)

### 경직된 조절 (RC13)

1. 일상적으로 먹는 음식의 칼로리 수치를 잘 알고 있다. (예 - 아니오)
2. 체중을 조절하기 위해서 의식적으로 칼로리를 계산한다. (예 - 아니오)
3. 체중을 조절하기 위해 의식적으로 식단조절을 하는 적이 많습니까? (거의 그렇지 않다 - 때때로 그렇다 - 대개 그렇다 - 항상 그렇다)
4. 약 2kg의 체중 변화가 당신의 생활 방식에 영향을 미칩니까? (전혀 아니다 - 약간 그렇다 - 중간 정도로 그렇다 - 매우 많이 그렇다)
5. 과식했다는 죄책감이 음식 섭취를 통제 하는데 영향을 줍니까? (전혀 그렇지 않다 - 거의 그렇지 않다 - 자주 그렇다 - 항상 그렇다)
6. 먹고 싶은 유혹이 드는 음식을 집에 사놓지 않으려 합니까? (전혀 그렇지 않다 - 거의 그렇지 않다 - 자주 그렇다 - 항상 그렇다)
7. 저칼로리의 음식을 잘 사는 편입니까? (전혀 그렇지 않다 - 약간 그렇지 않다 - 중간 정도로 그렇다 - 매우 그렇다)
8. 맛이 별로 없어도 다이어트 음식을 먹는다 (예 - 아니오)
9. 살을 빼기 위해 식단 조절을 하는 것은 너무 지루한 방법이다 (예 - 아니오)
10. 살 찌지 않으려고 때때로 식사를 거른다 (예 - 아니오)
11. 식단 조절 규칙 때문에 좋아하면서도 피하는 음식이 있다 (예 - 아니오)
12. 살을 뺄 때 계획을 철저히 지키려고 노력한다 (예 - 아니오)
13. 식단조절 계획이 없다면 체중을 어떻게 조절할지 모르겠다 (예 - 아니오)

## Appendix C. Eating Disorder Examination Questionnaire Restraint subscale – Korean version

지난 28일 중 며칠 동안 다음과 같은 일이 있었습니까?

전혀  
없었다    1~5일    6~12일    13~15일    16~22일    23~27일    매일  
1 ..... 2 ..... 3 ..... 4 ..... 5 ..... 6 ..... 7

---

문항

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- |  |   |   |   |   |   |   |   |
|--|---|---|---|---|---|---|---|
| 1. 몸매나 체중을 조절하기 위해 의식적으로 먹는 음식 양을 제한하려고 시도한 적이 있었습니까?  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. 당신은 8시간이상의 긴 시간을 몸매나 체중을 조절하기 위해서 아무것도 먹지 않고 보낸 적이 있습니까?  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. 당신은 몸매나 체중을 조절하기 위해 어떤 음식이건 특정 음식을 먹는 것을 피하려고 한 적이 있습니까?  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. 당신은 몸매나 체중을 조절하기 위해 특정한 규칙을 정해 놓고 그 규칙을 쫓아 한적이 있습니까? (예를 들면, 열량제한이나 음식 양의 제한 혹은 무엇을 먹어야 한다던지 언제 먹어야 한다던지와 같은 규칙들) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. 당신은 당신의 위가 비어 있기를 원했습니다습니까?   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
-

## Appendix D. Eating Disorder Inventory-2 – Korean version

다음 문항들은 당신의 태도와 느낌 및 행동에 대한 것입니다. 몇몇 항목들은 음식 혹은 식이 행동과 관련되어 있습니다. 각 질문을 읽고 자신과 가장 가깝다고 생각되는 정도를 선택하여 주십시오.

전혀 그렇지 않다	대부분 그렇지 않다	가끔 그렇다	자주 그렇다	대부분 그렇다	항상 그렇다	
1	2	3	4	5	6	
문항		해당하는 정도				
1. 나는 별로 신경 쓰지 않고 단 음식과 탄수화물을 먹는다	1	2	3	4	5	6
2. 나는 내 위가 너무 크다고 생각한다	1	2	3	4	5	6
3. 나는 화가 날 때 많이 먹는다	1	2	3	4	5	6
4. 나는 다이어트에 대해 생각한다	1	2	3	4	5	6
5. 나는 내 허벅지가 너무 굵다고 생각한다	1	2	3	4	5	6
6. 나는 과식을 하는 편이다	1	2	3	4	5	6
7. 나는 과식을 한 후에 심각한 죄책감을 느낀다	1	2	3	4	5	6
8. 나는 내 위가 적당한 크기라고 생각한다	1	2	3	4	5	6
9. 나는 멈출 수 없다고 느낄 때까지 폭식을 한 적이 있다	1	2	3	4	5	6
10. 나는 내 몸매에 만족한다	1	2	3	4	5	6
11. 나는 과식에 대해서 생각한다	1	2	3	4	5	6
12. 나는 체중이 늘어나는 것이 두렵다	1	2	3	4	5	6
13. 나는 내 엉덩이 모양에 만족한다	1	2	3	4	5	6
14. 나는 남 앞에서는 적당히 먹지만 그들이 가고 나면 잔뜩 먹는다	1	2	3	4	5	6

15. 나는 체중이 중요하다는 것을 강조한다	1	2	3	4	5	6
16. 나는 내 허리 굽기가 중요하다는 것을 강조한다	1	2	3	4	5	6
17. 나는 체중을 줄이기 위해 토하려고 생각한 적이 있다	1	2	3	4	5	6
18. 나는 내 허벅지가 적당한 크기라고 생각한다	1	2	3	4	5	6
19. 나는 더 날씬해지고 싶은 욕구에 사로잡혀 있다	1	2	3	4	5	6
20. 나는 음식을 몰래 먹거나 마신다	1	2	3	4	5	6
21. 나는 내 엉덩이가 너무 크다고 생각한다	1	2	3	4	5	6
22. 나는 체중이 조금만 늘어도 살이 찢 까봐 걱정한다	1	2	3	4	5	6
23. 나는 내 허리가 적당한 굽기라고 생각한다.	1	2	3	4	5	6



## Appendix E. Dutch Eating Behavior Questionnaire

### Restrained eating subscale – Korean version

다음은 귀하의 음식 섭취와 관련하여 음식 섭취에 대한 행동적, 심리적 태도를 알아보는 문항입니다. 음식 섭취 태도와 관련하여 각 문항에 대해 자신이 가진 성향과 일치하는 정도를 체크하여 주십시오.

전혀                  그렇지                                  매우  
 그렇지 않다      않다                  보통이다      그렇다                  그렇다  
 1 ..... 2 ..... 3 ..... 4 ..... 5

문항	해당하는 정도				
1. 체중이 늘 때에는 평소보다 적게 먹습니까?	1	2	3	4	5
2. 식사 때 먹고 싶은 양 보다 적게 먹으려고 노력합니까?	1	2	3	4	5
3. 체중 증가가 염려되어 원하는 음식이나 음료를 거절하는 때가 있습니까?	1	2	3	4	5
4. 당신이 무엇을 먹고 있는 지를 정확히 알고 있습니까?	1	2	3	4	5
5. 의도적으로 살이 덜 찌는 음식을 먹습니까?	1	2	3	4	5
6. 전날 너무 많이 먹은 경우 다음날에는 평소 보다 적게 먹습니까?	1	2	3	4	5
7. 살이 찌지 않기 위해 일부러 적게 먹습니까?	1	2	3	4	5
8. 체중 때문에 간식을 먹지 않으려고 노력한 적이 많습니까?	1	2	3	4	5
9. 체중 때문에 저녁식사 후에는 아무 것도 먹지 않으려고 노력한 적이 많습니까?	1	2	3	4	5
10. 체중을 고려해서 먹는 음식을 선택합니까?	1	2	3	4	5

## Appendix F. Eating Attitude Test Oral control subscale – Korean version

다음 문항을 읽고 자신의 평소 느낌이나 생각, 경험과 일치한다고 생각하는 곳에 O 표 해 주십시오.

	전혀 그렇지 않다	거의 그렇지 않다	가끔 그렇다	자주 그렇다	거의 그렇다	항상 그렇다
	1	2	3	4	5	6
문항	해당하는 정도					
1. 음식을 작은 조각으로 나누어 먹는다	1	2	3	4	5	6
2. 자신이 먹고 있는 음식의 영양분과 열량을 알고 먹는다	1	2	3	4	5	6
3. 빵, 감자 같은 탄수화물이 많은 음식은 특히 피한다	1	2	3	4	5	6
4. 먹고 난 다음에 토한다	1	2	3	4	5	6
5. 식사시간이 다른 사람들보다 더 길다	1	2	3	4	5	6
6. 설탕이 든 음식은 피한다	1	2	3	4	5	6
7. 체중을 줄이기 위해 운동이나 다른 것을 하고 있다	1	2	3	4	5	6
8. 식사 후 토하고 싶은 충동을 느낀다	1	2	3	4	5	6

## Appendix G. Dichotomous Thinking Index-30R

다음은 사람들의 개인적 성향에 대한 것입니다. 각 문항을 주의 깊게 읽으시고 자신이 느끼는 정도를 잘 나타내는 적절한 숫자에 표시해 주시기 바랍니다.

전혀 그렇지 않다	대체로 그렇지 않다	보통이다	대체로 그렇다	매우 그렇다	
1	2	3	4	5	
문항					
해당하는 정도					
1. 내가 수행한 일에 대해 완전한 성공이 아니면 완전한 실패로 보는 편이다	1	2	3	4	5
2. 잘할 수 없는 일은 아예 시작할 필요가 없다	1	2	3	4	5
3. 세상에는 좋은 사람과 나쁜 사람, 그렇게 두 종류만이 있다	1	2	3	4	5
4. 나쁜 성적을 받느니 아예 시험을 안보는 편이 더 낫다	1	2	3	4	5
5. 흡연자가 금연 결심을 하고 한동안 담배를 피우지 않다가 실수로 한대를 피우게 되었다면 그 금연은 끝난 것이다	1	2	3	4	5
6. 수업이나 회의에 지각하느니 차라리 결석하거나 참석하지 않는 편이 낫다	1	2	3	4	5
7. 내가 원하거나 계획하는 상태에서 뭔가 하나라도 흐트러지면 전체가 엉망이 된 듯하다	1	2	3	4	5
8. 내가 삶을 살아가는 방식은 모가 아니면 도이다	1	2	3	4	5
9. 내게는 실수를 하는 것이 완전히 실패하는 것처럼 나쁜 일이다	1	2	3	4	5
10. 다른 사람들에 대해 판단할 때, 사실 동지가 아니라면 적인 것으로 봐도 무방하다	1	2	3	4	5
11. 사람이나 사물에 대해 판단할 때 선한 대상과 악한 대상을 분명히 판가름한다	1	2	3	4	5
12. 판단할 때 흑과 백, 선과 악처럼 둘로 나누고 그 중 하나를 고르기를 좋아한다	1	2	3	4	5
13. 절반의 실패는 전부 실패한 거나 다름없다	1	2	3	4	5
14. 잘한 것이 아니면 곧 못한 것이다	1	2	3	4	5
15. 누군가와 갈등이 있을 때, 나는 전적으로	1	2	3	4	5

옳고 상대방은 전적으로 그르다는 결론(혹은 그 반대 결론)에 도달하곤 한다					
16. 이것 아니면 저것으로 분명히 구분 짓기를 좋아한다. 중간은 애매하고 불편하다	1	2	3	4	5
17. 대인관계의 구도를 파악하는 요령은 누가 누구의 편인지를 따져 보는 것이다	1	2	3	4	5
18. 나에 있어서 사람이나 일에 대한 평가는 뺑점과 만점이 있을 뿐이다	1	2	3	4	5
19. 사람이나 상황에 대해 판단할 때 머릿속에 떠오르는 범주(혹은 구분)의 수가 적을수록 편하다	1	2	3	4	5
20. 판단하는 방식이 극단적인 편이라는 소리를 듣는다	1	2	3	4	5
21. 주변 사람들에 대해 판단할 때 나의 편인지 아닌지를 먼저 가린다	1	2	3	4	5
22. 최선이 아니면 차선을 택하라는 말을 받아들이기 어렵다	1	2	3	4	5
23. 복잡한 생각 끝에 내리는 결론이 의외로 단순하다는 것을 발견하곤 한다	1	2	3	4	5
24. 나는 좋아하는 것과 싫어하는 것의 구분이 분명하다	1	2	3	4	5
25. 본래 이주일 정도 공부해야 하는 시험인데 실제로 준비할 시간이 대여섯 시간밖에 남지 않았다면 그 시간 동안 다른 일을 하는 편이 낫다	1	2	3	4	5
26. 사람이나 상황에 대해 비교할 때 어떤 특성이 가장 강한 것과 가장 약한 것을 나란히 대비시키는 방법을 좋아한다	1	2	3	4	5
27. 판단을 내릴 때 ‘이것일 수도 있고 저것일 수도 있다’는 방향보다는 ‘이것 아니면 저것이다’는 쪽을 선호한다	1	2	3	4	5
28. 어떤 사람이나 상황을 설명하거나 평가할 때 최상급 표현을 자주 쓴다	1	2	3	4	5
29. 어떤 대상이나 사람에 대해 좋아하는 마음과 싫어하는 마음이 섞여 있으면 불편하다. 그래서 좋거나 싫은 것 중 어느 한쪽을 택한다	1	2	3	4	5
30. 사람이나 상황에 대해 설명할 때 “절대적으로”, “반드시”, “꼭”, “틀림없이”와 같은 단정적인 표현을 잘 사용한다	1	2	3	4	5

## Appendix H. Multidimensional Perfectionism Scale Self-directed perfectionism subscale – Korean version

다음 문항들은 개개인의 성격과 특징을 기술해 놓은 것입니다. 주의 깊게 읽고 자신과 얼마나 비슷한지 표시해 주십시오. 정답이 있거나 좋고 나쁜 답이 있는 것이 아니므로, 평소의 자신을 잘 나타내는 쪽으로 쉽고 편안하게 표시하십시오.

	전혀 그렇지 않다	1	2	3	그저 그렇다	4	5	6	매우 그렇다	7
문항	해당하는 정도									
1. 일단 일을 시작하고 나면, 완전히 마칠 때까지 쉬지 않는다	1	2	3	4	5	6	7			
2. 내가 하는 모든 일에서 완벽해지는 것이 내 목표 중 하나이다	1	2	3	4	5	6	7			
3. 나는 일을 하면서 완벽을 기하지는 않는다	1	2	3	4	5	6	7			
4. 나는 완벽해지고자 하는 욕구가 거의 없다	1	2	3	4	5	6	7			
5. 나는 가능한 한 완벽 하려고 애쓴다	1	2	3	4	5	6	7			
6. 모든 일을 완벽하게 하는 것이 나에게서 매우 중요한 일이다	1	2	3	4	5	6	7			
7. 나는 내가 하는 모든 일에서 최선을 다한다	1	2	3	4	5	6	7			
8. 나 자신이 완벽하기를 바란다	1	2	3	4	5	6	7			
9. 내가 한 실수를 발견하게 되면 아주 속이 상한다	1	2	3	4	5	6	7			
10. 나는 목표를 세울 때, 완벽하게 세우려고 한다	1	2	3	4	5	6	7			
11. 나는 항상 나의 잠재 능력을 충분히 발휘하도록 일해야 한다	1	2	3	4	5	6	7			
12. 내가 하는 모든 일에서 최고일 필요는 없다	1	2	3	4	5	6	7			
13. 나 자신에게 매우 높은 목표를 세우지 않는다	1	2	3	4	5	6	7			
14. 나는 나 자신에게 높은 기준을 부여한다	1	2	3	4	5	6	7			
15. 나는 학업에서나 일에서나 항상 성공해야만 한다	1	2	3	4	5	6	7			

## Appendix I. Self-control Scale – Korean version

다음 척도를 보고 각각의 문항이 여러분에게 얼마나 해당되는지를 표기를 해주시기를 바랍니다. (해당번호에 O 표시를 해주십시오)

전혀  
 아니다  
 1 ..... 2 ..... 3 ..... 4 ..... 5  
매우  
그렇다

문항	해당하는 정도				
1. 게으르다	1	2	3	4	5
2. 부적절한 말을 한다	1	2	3	4	5
3. 절대로 내 자신의 통제를 잃도록 내버려 두지 않는다	1	2	3	4	5
4. 재미있는 것이면 나에게 해로운 일도 한다	1	2	3	4	5
5. 일정을 잘 맞춰서 다른 사람으로부터 신뢰를 받는다	1	2	3	4	5
6. 내 생각을 자주 바꾼다	1	2	3	4	5
7. 아무거나 마음에 떠오르는 대로 불쑥 말한다	1	2	3	4	5
8. 사람들은 내가 충동적이라고 말하곤 한다	1	2	3	4	5
9. 돈을 너무 많이 쓴다	1	2	3	4	5
10. 모든 것을 깔끔하게 정돈해 둔다	1	2	3	4	5
11. 이따금 방종하게 내 멋대로 한다	1	2	3	4	5
12. 내가 더 자제력이 있으면 좋겠다	1	2	3	4	5
13. 나는 믿어도 좋은 사람이다	1	2	3	4	5
14. 내 감정에 휩쓸린다	1	2	3	4	5
15. 비밀을 잘 지키지 못한다	1	2	3	4	5
16. 사람들은 내가 강인한 자제력을 가지고 있다고 말한다	1	2	3	4	5
17. 막판에 가서 밤새워 일하거나 공부한 적이 있다	1	2	3	4	5
18. 건강에 좋은 활동을 한다	1	2	3	4	5
19. 건강에 좋은 음식을 먹는다	1	2	3	4	5
20. 즐거움과 재미 때문에 일을 끝내지 못할 때가 있다	1	2	3	4	5
21. 장기적 목표를 위해 효율적으로 일할 수 있다	1	2	3	4	5

22. 잘못된 일이라는 것을 알아도, 그 일을 중단 할 수 없을 때가 있다	1	2	3	4	5
23. 너무 쉽게 화를 낸다	1	2	3	4	5
24. 종종 사람들이 하는 일에 끼어든다	1	2	3	4	5
25. 때때로 과음을 하거나 약물을 남용한다	1	2	3	4	5
26. 항상 시간을 잘 지킨다	1	2	3	4	5

## Appendix J. Center for Epidemiologic Studies Depression Scale – Korean version

아래에 적혀 있는 각 문항을 잘 읽으신 후, 오늘을 포함하여 지난 일주일 동안 당신이 느끼고 행동한 것을 가장 잘 나타내는 숫자에 표시해 주시기 바랍니다.

극히 드물다 1일 이하 0 .....	가끔 자주 1~2일 1 .....	거의 대부분 3~4일 2 .....	5~7일 3
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나는 지난 1주일 동안...	해당하는 정도			
1. 평소에는 아무렇지도 않던 일들이 귀찮게 느껴졌다	0	1	2	3
2. 먹고 싶지 않았다; 입맛이 없었다	0	1	2	3
3. 가족이나 친구가 도와주더라도 울적한 기분을 떨쳐버릴 수 없었다	0	1	2	3
4. 다른 사람들만큼 능력이 있다고 느꼈다	0	1	2	3
5. 무슨 일을 하든 정신을 집중하기가 힘들었다	0	1	2	3
6. 우울했다	0	1	2	3
7. 하는 일마다 힘들게 느껴졌다	0	1	2	3
8. 미래에 대하여 희망적으로 느꼈다	0	1	2	3
9. 내 인생은 실패작이라는 생각이 들었다	0	1	2	3
10. 두려움을 느꼈다	0	1	2	3
11. 잠을 설쳤다; 잠을 잘 이루지 못했다	0	1	2	3
12. 행복했다	0	1	2	3
13. 평소보다 말을 적게 했다; 말수가 줄었다	0	1	2	3
14. 세상에 홀로 있는 듯한 외로움을 느꼈다	0	1	2	3
15. 사람들이 나에게 차갑게 대하는 것 같았다	0	1	2	3
16. 생활이 즐거웠다	0	1	2	3
17. 갑자기 울음이 나왔다	0	1	2	3
18. 슬픔을 느꼈다	0	1	2	3
19. 사람들이 나를 싫어하는 것 같았다	0	1	2	3
20. 도무지 무엇을 시작할 기운이 나지 않았다	0	1	2	3








## Appendix K. State-Trait Anxiety Inventory – Korean version

이 항목들은 사람들이 자신을 표현하는데 사용되는 문장들입니다. 각 항목을 주의 깊게 읽고 자신이 평소에 느끼는 상태를 가장 잘 나타내는 것에 O표 해 주십시오.

전혀                  가끔                  자주                  거의  
 그렇지 않다      그렇다              그렇다              항상 그렇다  
 1 ..... 2 ..... 3 ..... 4

문항	해당하는 정도			
1. 기분이 좋다.	1	2	3	4
2. 쉽게 피로해진다.	1	2	3	4
3. 울고 싶은 심정이다.	1	2	3	4
4. 다른 사람들처럼 행복했으면 한다.	1	2	3	4
5. 마음을 빨리 정하지 못해서 실패를 한다.	1	2	3	4
6. 마음이 놓인다.	1	2	3	4
7. 차분하고 침착하다.	1	2	3	4
8. 너무 많은 어려운 문제가 밀어닥쳐서 할 수 없을 것 같다.	1	2	3	4
9. 하찮은 일에 너무 걱정을 많이 한다.	1	2	3	4
10. 행복하다.	1	2	3	4
11. 무슨 일이건 힘들게 생각한다.	1	2	3	4
12. 자신감이 부족하다.	1	2	3	4
13. 마음이 든든하다.	1	2	3	4
14. 위기나 어려움을 피하려고 애쓴다.	1	2	3	4
15. 울적하다.	1	2	3	4
16. 만족스럽다.	1	2	3	4
17. 사소한 생각이 나를 괴롭힌다.	1	2	3	4
18. 실망을 지나치게 예민하게 받아들이기 때문에 머릿속에서 지워버릴 수가 없다.	1	2	3	4
19. 착실한 사람이다.	1	2	3	4
20. 요즈음 걱정거리나 관심거리를 생각만하면 긴장되거나 어찌할 바를 모른다.	1	2	3	4

## Appendix L. Food images in the Food Picture Set-shifting Task

image	calorie	color	source
	Low 2Kcal	Black	google
	Low 12Kcal	Black	foodpics
	Low 16Kal	Green	foodpics
	Low 25Kcal	Orange	google
	Low 72Kcal	White	google



Low  
85Kcal

Green

foodpics

---



Low  
87Kcal

Orange

google

---



Low  
94Kcal

Yellow

foodpics

---

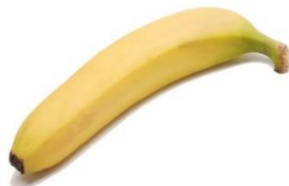


Low  
95Kcal

Green

google

---



Low  
128Kcal

Yellow

foodpics

---



Low  
158Kcal

White

google

---



High  
200Kcal

Green

google



High  
212Kcal

Black

google



High  
240Kcal

Green

google



High  
415Kcal

White

google



High  
422Kcal

Orange

google



High  
435Kcal

Yellow

foodpics



High  
540Kcal

Orange

google



High  
766Kcal

Yellow

foodpics



High  
847Kcal

black

google



High  
1626Kcal

white

foodpics

## 국문초록

### 섭식장애와 심리적 경직성의 관계: 섭식 절제 경직성과 인지적 경직성

심리적 경직성은 상황적 요구를 판단하여 적절하게 사고와 행동 양식을 전환하지 못하며 다양한 장/단기 목표들 간의 균형을 유지하지 못하는 유연성의 부족을 의미한다. 선행연구에 따르면, 개인의 심리적 경직성은 여러 정신장애와 밀접한 관련이 있으며 섭식장애 연구에서도 여러 유형의 경직성이 보고된 바 있다. 그러나 섭식장애와 심리적 경직성의 관련성은 아직 명확하지 않은데, 그 이유 중 하나는 선행연구에서 섭식-특정적인 척도와 인지과제를 사용하지 않았기 때문이다. 따라서 본 연구에서는 섭식장애와 심리적 경직성의 관계를 직접적으로 살펴보고자 유연한/경직된 섭식 절제 척도를 번안 및 타당화 하고 섭식-특정 인지적 경직성 과제를 개발하였다.

연구 1에서는 Westenhoefer 등(1999)이 개발한 유연한/경직된 섭식 절제 척도(Flexible and Rigid Control scale)를 한국어로 번안하고 다이어트 중인 한국 여성 집단을 대상( $n=305$ )으로 타당화하였다. 또한, 섭식장애 관련 심리적, 정서적 척도들을 통해 두 섭식 절제 유형이 섭식장애 증상에 미치는 차별적 영향도 함께 탐색하였다. 분석 결과, 한국판 유연한/경직된 섭식 절제 척도는 2요인을 갖는 하나의 척도로서 가장 설명력이 높았으며 유연한 섭식 절제 척도는 11문항, 경직된 섭식 절제 척도는 13문항으로 수정되었다. 타당도는 양호하였으며 선행 연구와 같이 유연한 조절에 비교하여 경직된 조절은 섭식장애 증상과 관련이 높아 섭식 절제가 단일한 개념이 아님이 나타났다.

연구 2에서는 섭식장애의 심리적 경직성 중 세트 전환의 어려움을 확인하기 위해 섭식-특정 인지과제 (Food Picture Set-shifting Task;

FPST)를 개발함으로써 자기 보고 연구의 한계점을 보완하고자 하였다. 세트 전환이란 집행 기능 중 하나로 여러 가지 과제, 규칙, 사고의 틀 사이를 전환할 수 있는 인지적 능력을 칭한다. 연구 참여자들은 다이어트 여부와 섭식장애 증상 수준을 기준으로 모집한 89명의 여성(낮은 섭식장애 다이어트 참가자 32명, 높은 섭식장애 다이어트 참가자 29명, 비다이어트 참가자 29명)으로 구성되었으며 FPST, Wisconsin Card Sorting Test (WCST), 섭식 절제와 섭식장애 관련 자기보고 척도가 실시되었다. 분석 결과, 다이어트 여부와 전반적인 FPST 수행은 관련이 없었지만, 다이어트 중인 여성은 비다이어트 여성보다 칼로리에서 색깔 차원에서의 전환에서 더 많은 오류를 범했다. 보고된 다이어트 여부는 음식 특정한 세트 전환 결함과 더 관련이 있었고 섭식 절제 수준 (EDEQ 기준)은 전반적인 세트 전환 경직성과 더 관련이 있었다.

본 연구는 여러 심리적 경직성 중 섭식 절제 경직성과 음식 관련 인지적 경직성이 섭식장애와 갖는 관계를 탐색하였다. 먼저 섭식 절제의 유연성과 경직성을 구분할 수 있는 타당한 자기 보고형 측정도구를 확보하였으며, 섭식-특정 세트 전환 실험 과제의 개발을 통해 다이어트 여부와 섭식 절제가 인지적 경직성에 미치는 영향이 차별적일 수 있음을 밝혔다. 이는 건강한 다이어트를 위해 섭식-특정 세트 전환 어려움에 대한 개입의 필요성을 시사한다. 마지막으로 본 연구가 지니는 한계점과 후속 연구를 위한 제언에 대해 논의하였다.

**주요어:** 섭식 절제, 유연한 조절, 경직된 조절, 인지적 경직성, 세트 전환, 섭식장애

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