

# Pre- and Postoperative Self-Reported Cognitive Effectiveness and Worry in Patients With Suspected Lung Malignancy

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Lung cancer is the leading cause of cancer mortality in the United States among men and women, making early detection, diagnosis, and treatment imperative (Bunyaviroch & Coleman, 2006; Siegal, Ward, Brawley, & Jemal, 2011). Increased sophistication in technology has enhanced early detection of minute solitary pulmonary nodules and improved diagnosis of very early-stage lung cancers (MacMahon et al., 2005; Smith et al., 2006). A diagnosis of suspected lung cancer is a cognitively and emotionally demanding experience that can occur when people feel healthy and are leading productive lives (Roth, Cox, & Hong, 2008). Worry, aversive perseverative cognitions that occur when threat is perceived (Brosschot, Gerin, & Thayer, 2006), can be a significant and sustained problem for individuals facing the possibility of a life-threatening illness such as lung cancer (Hay, Buckley, & Ostroff, 2005; Hill, Amir, Muers, Connolly, & Round, 2003). In addition, the need to learn about potential treatments and the life adjustments that come with a suspected diagnosis of cancer places additional demands on cognitive resources such as directed attention (Cimprich, 1992a, 1992b). Few research studies have examined worry and perceived cognitive effectiveness during the early postdiagnostic period following a suspected lung cancer diagnosis. Therefore, a purpose of the current exploratory study was to examine perceived cognitive effectiveness and worry among a select group of individuals with a suspected lung cancer diagnosis before and after surgical resection. A second purpose was to examine perceived cognitive effectiveness and worry among individuals who were and were not diagnosed with lung cancer after surgery.

## Background and Significance

Surgical resection is the treatment of choice for stages I and II non-small cell lung cancer, a disease that is often detected by incidental findings of an abnormal pulmonary nodule via chest x-ray or chest computerized

**Purpose/Objectives:** To examine perceived cognitive effectiveness and worry in individuals with suspected lung cancer before and after surgical resection and to determine any differences between individuals with and without a postoperative diagnosis of lung cancer.

**Design:** A repeated measures longitudinal design.

**Setting:** A comprehensive cancer center and a Veterans Administration medical center in the midwestern United States.

**Sample:** 15 men and 8 women aged 37–82 years ( $\bar{X}$  = 61.4, SD = 10.7) with suspected lung cancer.

**Methods:** Descriptive statistics were used to characterize data. Paired t tests and nonparametric correlation analysis were used to determine relationships among the main study variables.

**Main Research Variables:** Perceived effectiveness in cognitive function as well as general and cancer-specific worry.

**Findings:** Patients diagnosed with lung cancer were significantly older. Patients self-reported lowered perceived effectiveness in daily activities that require directed attention both pre- and postoperatively. Patients with nonmalignant postoperative reports had higher general worry at each time point, which was significant following surgery.

**Conclusions:** A diagnosis of suspected lung cancer may contribute to compromised perceived effectiveness in cognitive function. Nonmalignant pathology following a diagnosis of suspected lung cancer may be associated with continued worry.

**Implications for Nursing:** Nursing assessment and interventions aimed at supporting effective cognitive function and modifying worry for patients with suspected lung cancer are essential to optimize adjustment.

**Knowledge Translation:** Suspected lung cancer imposes high demands on cognitive and emotional function. Oncology nurses are in key positions to support patients during and following the diagnostic workup for lung cancer. Younger patients with nonmalignant postoperative reports may need continued follow-up.

tomography (CT) scan (Gilbert et al., 2012). The majority of all lung cancer is diagnosed at advanced stages, contributing to its high level of associated mortality;

however, about 25% of patients with non-small cell lung cancer present at the earliest stages (Reade & Ganti, 2009). If healthcare staff are concerned that a pulmonary nodule is cancerous, the patient will undergo additional tests such as positron emission tomography or percutaneous fine-needle aspiration biopsy (Bunyaviroch & Coleman, 2006). However, those tests may be nondiagnostic, in which case the provider must decide whether to monitor the lesion with serial CT scans or to recommend surgical resection (Gilbert et al., 2012). If the nodule is cancerous, serial CT scans entail the risk of disease progression; however, surgery may be an unnecessarily aggressive process for a nonmalignancy. A chance also exists that malignancies are classified pathologically as nonmalignant in earlier stages of disease (Butnor, 2008). Factors that increase the likelihood that a solitary pulmonary nodule will be malignant include age, nodule features, and smoking history (MacMahon et al., 2005).

Surgery is the first line of curative treatment for definitive lung cancer (Roth et al., 2008). However, as the disease advances, the likelihood that surgery will remain a viable option decreases (Catarino & Goldstraw, 2006). Therefore, many individuals with suspected early-stage non-small cell lung cancer have resections without a confirmed pathologic diagnosis, and a significant percentage will receive nonmalignant postoperative reports despite sophisticated diagnostic technologies (Smith et al., 2006).

Patients who undergo surgical resection for a lesion that is later proven nonmalignant face monetary costs and risks such as physical and psychological morbidity as well as infection (Smith et al., 2006). In addition, patients who choose surgery without an actual diagnosis may not only experience uncertainty about whether or not they actually have cancer, but also uncertainty related to the magnitude of the procedure and postoperative course (Cooper, 2002).

Studies have documented the stressful and cognitively challenging nature of a new lung cancer diagnosis (Barlési et al., 2006; Graves et al., 2007). During the pretreatment period, patients with suspected lung cancer who also may have underlying comorbid medical conditions undergo multiple tests to assess their eligibility for the rigors of surgery (Roth et al., 2008). Those tests may entail multiple trips to hospitals or clinics and long wait periods between scheduled tests. Patients who are active smokers also experience the added stressor of smoking cessation at the time of a potentially life-threatening diagnosis (Walker, Larsen, Zona, Govindan, & Fisher, 2004). The pretreatment period places demands on patients' cognitive resources, including directed attention capacity, a form of selective attention critically important for focus and concentration regarding diagnosis and treatment decisions and for maintaining a sustained train of thought following

a new diagnosis of cancer (Cimprich, 1992a, 1992b; Hayes, Hirsch, & Mathews, 2008; MacLeod & Rutherford, 2004). Directed attention capacity is necessary for learning and cognitively integrating essential new information, as well as engaging in important decision making, while inhibiting nonessential information (Cimprich, Visovatti, & Ronis, 2010). Excessive demands on cognitive resources may lead to directed attention fatigue, which inhibits focus and concentration and leads to a decrease in effective cognitive function (Cimprich, 1992a, 1993).

Worry refers to an involuntary and repetitive aversive cognitive activity regarding anticipated threats or concerns that occurs when people are in anxiety-provoking circumstances (Gould & Edelstein, 2010; Mathews, 1990). Worry is distinguished from anxiety as dynamic cognitive activity that has two important aims: (a) manage or resolve the anxiety-provoking threat stimulus and (b) decrease or avoid the negative emotional arousal associated with anxiety (Brosschot et al., 2006; Kertz & Woodruff-Borden, 2011; Laguna, Ham, Hope, & Bell, 2004). Worry is an adaptive short-term response to threatening situations during which threat information becomes a cognitive priority to find potential solutions (Kertz & Woodruff-Borden, 2011; Mathews, 1990). However, worry also is a self-perpetuating process characterized by selective information-processing biases that increase the tendency to appraise, distort, and interpret events as threats and to subjectively overestimate potential negative outcomes (Brosschot et al., 2006; Kertz & Woodruff-Borden, 2011). Individuals with sustained worry seek out and monitor information for threat content, a response that actually exacerbates worry in uncertain, uncontrollable, but personally relevant threatening contexts such as lung cancer (Davey, 1994; Lehto & Cimprich, 2009; Verkuil, Brosschot, Putnam, & Thayer, 2009).

Worry is distracting and involuntary and, as such, may compete with purposeful cognitive activity (Borkovec, Ray, & Stöber, 1998; Krebs, Hirsch, & Mathews, 2010; Leigh & Hirsch, 2011; MacLeod & Rutherford, 2004). Severe worry could fatigue directed attention capacity and reduce cognitive effectiveness because of its ongoing distressing nature, the active effort required to inhibit its distracting effect, and its capacity to interfere with rest and contribute to insomnia (Hayes et al., 2008; Ree, Harvey, Blake, Tang, & Shawe-Taylor, 2005; Valentine & Meyers, 2001).

## Objectives

Although an increasing body of research is focused on the psychological impact of lung cancer, perceived cognitive effectiveness and worry in individuals with suspected lung cancer have not been examined extensively.

Given the complex stressors that individuals with suspected lung cancer diagnoses face, examining worry and perceived cognitive effectiveness in that group is highly relevant. The current study examined pre- and postoperative self-reported cognitive effectiveness and worry in patients with suspected lung malignancy who received either a postoperative diagnosis of lung cancer or a nonmalignant report. The research questions included: (a) Do differences occur in perceived cognitive effectiveness before and following surgery for suspected lung cancer? (b) What are the differences between pre- and postoperative worry in patients with suspected lung cancer? And (c) after surgery, do differences occur in perceived cognitive effectiveness and worry in patients with a confirmed diagnosis of cancer versus those without?

## Methods

A repeated-measures longitudinal design was used to examine perceived worry and effectiveness in cognitive function before and after surgery. Participants were part of a larger study that examined worry and its effects on cognitive representations of illness in lung cancer. The current sample represented a group of patients who were coping with suspected disease and needed surgery for a tissue diagnosis. Observations were made at the time of treatment planning following diagnosis (time 1) and about 3–4 weeks after surgical resection (time 2). The time interval coincided with the early pre- and post-treatment phases following a diagnosis of cancer, a particularly worrisome and cognitively challenging period (Barlési et al., 2006; Weisman & Worden, 1976).

## Sample

Participants were recruited from a comprehensive cancer center and a Veterans Administration healthcare system from a population of English-speaking patients with suspected lung cancer undergoing surgical evaluation. Exclusion criteria included any previous history of cancer, known cognitive or psychiatric disorders, history of a debilitating or advanced medical disorders, and any psychoactive medication that would impair participation in the study.

The sample included 23 individuals with suspected lung cancer. The majority of the sample was male and married. Most participants had at least a high school education, although they ranged from 8–18 years of education. One individual had never smoked; however, 96% (n = 22) had a history of smoking and 39% (n = 9) were smokers at the time of study. Of the individuals with a history of smoking, 70% (n = 16) reported more than a 20 pack-year history. Table 1 shows descriptive demographic and health characteristics of the sample.

**Table 1. Sample Characteristics (N = 23)**

Characteristic	$\bar{X}$	SD	Range
Age (years)	61.4	10.7	37–82
Education (years)	13	2	8–17

  

Characteristic	n
<b>Gender</b>	
Male	15
Female	8
<b>Race</b>	
Caucasian	22
African American	1
<b>Marital status</b>	
Married	17
Divorced	3
Widowed	3
<b>Employment status</b>	
Currently employed	9
Retired	8
Disabled	3
Unemployed	2
Homemaker	1
<b>Stage of disease</b>	
I	7
II	7
IIIa	1
Nonmalignant	8

The majority of the sample had a postoperative diagnosis of non-small cell cancer (n = 16, 70%). From that, 15 participants were diagnosed with early-stage disease. Eight participants had a noncancerous postoperative report; however, of those participants, two had postoperative diagnoses of hamartoma, three had granulomas, one had fibrotic pulmonary change, and two had atypical changes in tissue. Hamartomas are considered benign tumors made up of pulmonary tissue that present in a disorganized way. Granulomas are an inflammatory response to fungi such as aspergillus. Pulmonary fibrosis is a progressive and serious inflammatory lung condition. Atypical tissue is an abnormal presentation that cannot be diagnosed (Smith et al., 2006).

## Instruments

**Attentional Function Index:** Perceived effectiveness in cognitive function was measured using the **Attentional Function Index (AFI)**, a theoretically congruent instrument developed to measure perceived effectiveness in daily tasks that are supported by attention and working memory (Cimprich, 1992a, 1992b, 1993). The AFI consists of 16 linear analog scales, each 100 mm in length and labeled at each end with polar opposite phrases (e.g., “not at all,” “extremely well”) (Cimprich, 1992a). The instrument measured three important domains of effective cognitive function including effective action, attentional

lapses, and interpersonal effectiveness (Cimprich et al., 2010). Therefore, the content included items that pertain to finishing tasks once they are started, forgetting to do important things, maintaining train of thought, difficulty focusing and concentrating, being patient, and getting easily annoyed or irritated. Participants placed a mark on the line to depict where they perceived their function was in relation to the specific activity. Each line on the AFI is scored individually by measuring the distance from the lower end to the higher end. A composite mean for the total 16 items (range = 0–100) represented the total score. The AFI has demonstrated consistent reliability in studies of women with breast cancer as well as studies of healthy adults (Cimprich et al., 2010). The alpha reliability for the AFI in the current study was 0.89 at time 1 and 0.91 at time 2, which indicated good reliability for the measure.

**Penn State Worry Questionnaire:** Participants' worry was measured with the **Penn State Worry Questionnaire (PSWQ)**. The PSWQ is a 16-item, self-report instrument developed to measure the intensity and frequency (i.e., severity) of worry activity (Molina & Borkovec, 1994). The PSWQ is scored on a five-point scale with response options of 1 (not at all typical) to 5 (very typical) and a calculated summed composite score (range = 16–80). Internal consistency and test-retest stability consistently are satisfactory, and the tool has been used extensively in college samples, mixed anxiety disorder samples, and general population groups (Meyer, Miller, Metzger, & Borkovec, 1990; Molina & Borkovec, 1994; Ruscio, Borkovec, & Ruscio, 2001). Alpha reliability for the PSWQ was 0.92 at time points 1 and 2, which indicated good reliability.

**Cancer-specific worry:** In addition to the PSWQ, three cancer-specific worry questions commonly used for studies regarding worry in cancer-screening populations also were used in the current study. On a five-point scale labeled from 3 (not at all) to 15 (a lot), participants rated their levels of worry about cancer, cancer treatment, and the impact of cancer-related worrying on daily functioning (Hay et al., 2005). Alpha reliability for the cancer-related questions in the current study was 0.84 for time points 1 and 2, which indicated satisfactory reliability.

## Procedures

Scientific review and human subject protection committees at the respective institutions approved all study procedures. The first observation (time 1) occurred an average of 14 days before surgery ( $SD = 16.73$ ). The second observation (time 2) occurred during a scheduled outpatient appointment about 3–4 weeks following surgical resection ( $\bar{X} = 25.5$ ,  $SD = 6.24$  days). The measures were administered using standard instructions. To avoid distractions, testing was done in private locations such as outpatient consultation rooms.

## Data Analyses

Descriptive statistics were computed for the study measures to characterize the sample and results at the two time points. Paired *t* tests were used to compare scores before and after surgery. Spearman's product rho correlation coefficients (Plichta & Kelvin, 2013) were calculated to determine the strength of the relationships among main study variables given the small sample size.

## Results

As a group, the sample self-reported lowered effectiveness in cognitive function at time 1 ( $\bar{X} = 57.16$ ,  $SD = 16.86$ , range = 29–87) and at time 2 ( $\bar{X} = 55.52$ ,  $SD = 16.98$ , range = 26–91) (see Table 2). Some individuals reported very poor perceived effectiveness and others reported very good perceived effectiveness at time points 1 and 2, demonstrating good variance. However, overall scores ranging from the mid- to high-50s suggested poor or modest perceptions of cognitive effectiveness in daily activities before and after surgical resection (Cimprich, 1992a). No significant differences were observed in the group with cancer and the nonmalignant group in perceived cognitive effectiveness between the two time points; however, the group with cancer reported lower scores at the two time points.

In general, the overall sample reported moderate worry as measured by the PSWQ at times 1 and 2. However, some individuals scored at the higher end of the scale at time points 1 and 2. Eight individuals preoperatively and six individuals postoperatively had scores higher than 45 on the PSWQ, meeting criteria for higher levels of worry. Cancer-related worry was moderately high for the overall sample prior to surgery with significant declines following surgery ( $df = 21$ ,  $t = 3.34$ ,  $p < 0.005$ ). The findings from the two worry measures show that general worry was a problematic issue for a significant subgroup of the sample before and after surgical resection.

The group with nonmalignant postoperatives reported higher worry based on PSWQ scores at time points 1 and 2, which became significant following surgery. Therefore, a trend ( $p = 0.08$ ) toward more general worry occurred in the nonmalignant group preoperatively, although each group had small declines in mean worry following surgery. Less variance in the mean general worry scores occurred in the group diagnosed with cancer. Significant declines in cancer-related worry occurred in the group postoperatively diagnosed with cancer ( $df = 15$ ,  $t = 2.52$ ,  $p < 0.05$ ) as well as in the nonmalignant group after surgery ( $df = 6$ ,  $t = 4.54$ ,  $p = 0.006$ ).

Congruent with what is known about lung cancer, individuals with an actual cancer diagnosis were significantly older ( $\bar{X} = 64.5$ ,  $SD = 10.22$  years) compared to the individuals with nonmalignant postoperative reports ( $\bar{X} = 54.29$ ,  $SD = 8.58$  years,  $t = 2.3$ ,  $df = 21$ ,  $p < 0.05$ ).

**Table 2. Descriptive Statistics of Worry, Cancer-Related Worry, and Attentional Function Index Scores**

Measures by Group	Time 1			Time 2		
	$\bar{X}$	SD	Range	$\bar{X}$	SD	Range
<b>All participants (N = 23)</b>						
PSWQ	41.43	13.39	20–72	39	11.14	19–65
Cancer worry	11	3.99	3–15	8.45	2.82**	3–13
AFI	57.16	16.86	28.56–87.41	55.52	16.98	26.28–90.85
<b>Malignant group (n = 15)</b>						
PSWQ	38.25	11.5	20–60	35.69	6.79	19–47
Cancer worry	11.31	3.86	3–15	8.87	2.58*	4–13
AFI	54.93	16	28.56–76.07	53.56	15.51	26.28–82.13
<b>Nonmalignant group (n = 8)</b>						
PSWQ	48.71	15.43	26–72	46.57	15.61	23–65
Cancer worry	10.29	4.5	3–15	7.33	3.38**	3–10
AFI	62.24	18.93	39.31–87.41	59.99	20.56	28.25–90.85

\* $p < 0.05$ ; \*\* $p < 0.005$ 

AFI—Attentional Function Index; PSWQ—Penn State Worry Questionnaire

Past history of smoking and smoking status at time of study were not related to worry or perceived cognitive effectiveness at either time point.

To determine the relationships between worry and self-reported cognitive effectiveness, Spearman's rho nonparametric correlation analyses were conducted (Plitchta & Kelvin, 2013). The PSWQ was significantly and negatively related to the AFI at time 1 ( $r = -41$ ,  $p < 0.05$ ) but not at time 2 ( $r = -35$ ,  $p = 0.1$ ). Cancer-related worry was not related to AFI scores at either time point.

## Discussion

More individuals are surviving lung cancer with five-year survival rates, about 50%–60% for those diagnosed in the early stages (Roth et al., 2008). The exploratory study examined perceived worry and effectiveness in daily cognitive tasks that required directed attention in a small sample of individuals with suspected lung cancer. Overall, perceived cognitive effectiveness in essential daily activities was poor before and after surgery. Given the demanding nature of diagnostic testing, needs related to treatment and illness issues, and psychological stress associated with a suspected life-threatening illness, it was not surprising that perceived cognitive effectiveness was negatively impacted. The findings were limited because objective data on cognitive function parameters such as attention, memory, and executive functions were not obtained. However, the participants as a group reported deficiencies in their perceived ability to perform complex but basic tasks essential to functioning effectively in daily living before and after surgery. Those impairments in subjective cognitive effectiveness challenge daily function in the most basic areas (e.g., maintaining patience,

following through on plans, keeping focused) and have a direct negative bearing on perceived quality-of-life indices.

The findings from the current study indicated that general worry occurred at moderate levels and was slightly lower following surgical resection of the suspicious nodule. However, 35% of the sample preoperatively and 26% postoperatively reported higher levels of general worry, indicating that worry was a problem for a significant portion of the

sample facing suspected lung cancer. However, cancer-related worry was significantly lower following surgery but was not related to perceived cognitive effectiveness either before or after surgery.

Results from the current study were contrary to the expectation that a nonmalignant postoperative report would be characterized by lower overall worry. Worry was higher among individuals with nonmalignant postoperative diagnoses prior to and following surgery, a significant finding at time 2. Individuals with nonmalignant postoperative reports were significantly younger, a finding associated with higher worry and number of concerns in other research involving patients with lung cancer (Hill et al., 2003)

The nonmalignant reports carried an assortment of postoperative diagnoses that may require additional monitoring and treatment. For example, a diagnosis of pulmonary fibrosis is a progressive and very serious condition. An atypical pathologic report could be worrisome because the individual would not know what the diagnosis was. In addition, an unwarranted major surgery for a nonmalignant condition would be stressful, particularly for individuals with underlying pulmonary vulnerability. Surgical resection compromises pulmonary function and demands recuperation while potentially raising questions about the need for additional treatment (Gilbert et al., 2012).

Younger individuals with postoperative nonmalignant reports were less worried about cancer; however, they had increased general worry perhaps because of a context that shifted from what was expected but still remained threatening. Worry occurs in situations that are characterized by ambiguity and uncertainty when individuals feel less confident about their abilities to predict and manage circumstances (Davey, 1994).

Unlike the nonmalignant group, individuals with cancer have plans to follow, which become more stable and coherent from the initial diagnosis to the treatment. Although a systematic treatment plan does not eliminate worry about having cancer, it specifies a course of action expected to have an endpoint or even cure.

Individuals with high worry and nonmalignant pathology reports may be a vulnerable group. Providers should recognize the psychological toll that potential lung cancer may have on individuals who are affected, particularly if they are younger (Onishi et al., 2003). Because of the inherent difficulties in diagnosing lung cancer at the earliest stages, those psychological effects warrant attention and additional research.

As expected, general worry was associated with lowered perceived cognitive effectiveness before surgery, which continued after surgery but did not reach significance. No relationship occurred between worry and self-reported cognitive effectiveness in the group with nonmalignant postoperative reports despite elevated worry. Those findings may be explained by the significantly younger age of that group. However, the small sample size in the current exploratory study precludes conclusions in that regard.

## Implications for Practice

The exploratory study points to the importance of nurses' assessment of worry and cognitive function in patients who are facing suspected lung cancer in the early postdiagnostic period. Given that worry is subjectively experienced, patients should be asked about their worry and concerns. Patients' perceptions about the effectiveness of their cognitive function can be ascertained by assessing for any compromise in typical activities of daily living (e.g., balancing the checkbook, remembering to follow through on important tasks, heightened distractibility). A consequence of heightened worry is the tendency to monitor the environment and seek as much information as possible, a behavior that may exacerbate worry and place demands on attentional capacity. Attending to patient concerns, answering questions as clearly as possible, and providing reassurance may modify worry intensity and also may offset the need for more information. It takes effort to inhibit the involuntary and distracting nature of worry; therefore, by assisting patients with worry management, nurses also support patients' cognitive function. Other supportive strategies include making lists and conveying information as concretely and economically as possible, as well as reducing noise, irritating distractions, and barriers in the physical environment to reduce cognitive demands and deter unnecessary stress. Patients can be encouraged to participate in activities that provide contact with the natural environment,

providing reflection, rest, and the opportunity to restore directed attention capacity (Cimprich, 1993).

## Limitations

Interpretations of the current study's findings are limited by the small convenience sample and lack of associated racial and ethnic diversity. In addition, the two groups are unequal in size, which limited statistical interpretation and group comparisons. However, patients who have nonmalignant postoperative reports represent a small subsample of patients with suspected lung cancer who undergo surgery.

Given the subjective measures, whether perceptions of cognitive effectiveness would be qualified by performance on objective tests is not known. The study also is limited because it only tests individuals on those measures once at diagnosis and once during their postoperative course. As developments in diagnostic sophistication and surgical techniques continue to evolve and advance, the possibility of treating lung cancer at its most curable point will increase. Therefore, more research is recommended with larger samples and the inclusion of easy-to-administer objective measures of cognitive function to evaluate this important problem in that patient population.

## Conclusions

Worry is an aversive involuntary cognitive activity that impairs quality of life and is a ubiquitous accomplice to suspected cancer diagnoses. Individuals who have a suspected diagnosis of lung cancer already perceive decrements in their cognitive effectiveness as demonstrated by their lower self-reported attentional function scores prior to surgery. The exploratory study provides an early but important contribution by identifying the problem of worry and reduced effectiveness in cognitive function among individuals with suspected lung cancer. In addition, the results suggest the importance of cognitive preservation and restorative activities even prior to treatment. Nursing interventions such as listening for and identifying concerns, building therapeutic alliances, and determining needs for mental health referral also may be beneficial for management of worry.

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