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Correlates of Cancer Information Overload: Focusing on Individual Ability and Motivation

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ABSTRACT

The present study defined cancer information overload (CIO) as an aversive disposition wherein a person is confused and overwhelmed by cancer information, which occurs when he or she fails to effectively categorize new information due to a lack of resources for effective learning. Based on the definition and informed by previous studies on information overload and the cognitive mediation model, we hypothesized that low ability and motivation to process cancer information would lead to CIO. We used education level and trait anxiety as factors related to ability. Cancer history and the use of active media channels (such as the Internet and print media) were adopted as motivational factors. Four samples (three from the United States and one from South Korea) were used to explore the relationship between ability/motivation and CIO. Among them, only Sample 4 participants answered questions about stomach cancer, and other participants were asked about cancer in general. In all four samples, trait anxiety was positively associated with CIO. Health information use from active media channels (print or the Internet) was negatively associated with CIO in three samples. The associations between family history and CIO, and between education and CIO, were found in two samples. In short, the present study demonstrated that CIO partly depends on individual ability and motivation, thereby showing that CIO is influenced by personal characteristics as well as environmental factors.

In the United States, cancer is one of the leading causes of death (Siegel, Ma, Zou, & Jemal, 2014), which also makes it a common topic in the media and in Internet searches (Viswanath, 2005). The widespread availability of cancer information would seem to be a benefit to cancer control efforts, because cancer information use increases cancer knowledge and thus promotes cancer screening behaviors (Hornik et al., 2013; Kelly et al., 2010). However, other research has revealed that a large number of Americans are confused and overwhelmed by the amount of information—a phenomenon called cancer information overload (CIO; Jensen et al., 2014; Kim, Lustria, Burke, & Kwon, 2007).

However, not all people experience CIO. The causes of information overload include not only the quantitative or qualitative aspects of information (i.e., the amount or characteristics of information), but also personal factors, such as information-processing capacity, motivation, personal traits (e.g., age, skill, and experience), and personal situation (e.g., time, noise; for details, see Eppler & Mengis, 2004). In other words, an individual with certain characteristics is less likely to suffer from information overload regardless of the quantity or quality of information. In line with this perspective, Jensen et al. (2011) postulated that information overload occurs when an individual does not have sufficient resources to categorize new information. With a lack of proper resources, it is difficult to integrate new cancer information into the person's existing knowledge, and thus that person does not know how to react to the new information (Jensen et al., 2011).

Based on previous studies (Jensen et al., 2014; Kim et al., 2007), we conceptualize CIO as an aversive disposition wherein a person is being confused and overwhelmed by cancer information, which occurs when he or she fails to effectively categorize new information due to a lack of resources for effective learning. However, researchers have not fully theorized or tested factors that influence the hypothesized resource-overload relationship. Thus, this study investigates personal factors that might cause CIO and seeks to theorize the relationship between those factors and CIO. As previously stated, there are many factors that can influence the occurrence of information overload (see Eppler & Mengis, 2004), and all of those factors are resources that affect the learning process. We focus on two individual differences: ability and motivation. To learn from new information, an individual must make a cognitive effort, and the level of cognitive effort mainly depends on the person's ability and motivation (Petty & Cacioppo, 1986). That is, for effective learning, an individual must be able and willing to process information.

Regarding ability, the information overload literature has supported the negative relationship between ability and CIO. Individuals are likely to suffer from information overload when incoming information is beyond their information-processing

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capacities (Iselin, 1993; Owen, 1992; Schneider, 1987). For this reason, CIO also may be related to low cognitive ability, which can be assessed by education and literacy (Jensen et al., 2014).

Ability aside, motivation may influence information overload. The cognitive mediation model (CMM; Eveland, 2001; Eveland, Shah, & Kwak, 2003).[1] posits that surveillance motivation—the desire to know more about one's environment—predicts higher attention, higher elaboration, and learning. Consistent with this idea, surveillance motivation was found to predict better comprehension of cancer information—through increased elaboration—in an experiment based on the CMM framework (Jensen, 2011). In other words, individuals with lower surveillance motivation are more likely to experience CIO because they elaborate less about the content, and they cannot connect new cancer information to what they already know (Eveland et al., 2003), which is consistent with the conceptualization of CIO in Jensen et al. (2011).

In explicating the relationship between ability/motivation and CIO, the present study extends previous research on CIO. CIO is an important research topic since it causes negative health outcomes, such as fewer screening behaviors (Jensen et al., 2014). Nevertheless, CIO has been underresearched, and there exist only a few studies about predictors of CIO. For example, Kim et al. (2007) explored the predictors of CIO using 2003 Health Information National Trends Survey (HINTS) data, but CIO was measured with a single item: "There are so many recommendations about preventing cancer, it's hard to know which ones to follow." Also, they dichotomized all items and compared those with CIO and without CIO. Han et al. (2009) examined 2005 HINTS data and discovered the role of sociodemographic factors and media exposure in causing CIO. They also used the aforementioned single statement, and called it "perceived ambiguity." Recently, Jensen et al. (2014) developed and validated an eight-item CIO scale, which includes the statement just given.

Building on these prior studies, we adopted a newly validated scale of CIO and used four samples that complemented each other. The 2012 HINTS data were used as Sample 1 (N = 3,959). Although HINTS provides nationally representative data, CIO was assessed with a single item. Thus, we used three more samples. Sample 2 (N = 309) consisted of U.S. undergraduate students. As results from undergraduates are not generalizable, we added Sample 3 (N = 308), from the U.S. general population. Finally, to learn whether the relationship between individual characteristics and CIO can apply to a more specific context, we used Sample 4 (N = 813), which consisted of Korean people aged 40 years or over, who were asked specifically about stomach cancer, one of the most common types of cancer in Korea (National Cancer Center, 2012).

Predicting cancer information overload

For predictors of information overload, scholars have stressed a multidimensional approach that considers quality of information—such as uncertainty, ambiguity, and complexity—as well as quantity (Eppler & Mengis, 2004). The use of cancer information has tremendously increased (McHugh et al., 2011). Besides, health information in general, and cancer information in particular, is sometimes inaccurate, misleading (Kline, 2006; MacKenzie, Chapman, Barratt, & Holding, 2007), and difficult to understand (Friedman, Hoffman-Goetz, & Arocha, 2004; Kaphingst, Zanfini, & Emmons, 2006). Cancer information is highly arousing, and thus results in more cognitive overload than other types of information (Lang, 2006). These characteristics might contribute to the increase of uncertainty, and cause CIO.

However, surrounded by a wealth of health information, not everyone struggles with CIO. When exposed to information, some people can reduce uncertainty by accepting the recommendation of the message; for others, information raises new concerns or information overload (Brashers, 2001, 2007; Hogan & Brashers, 2009). In other words, some people are more likely to experience CIO due to their individual characteristics. Thus, rather than quantity or quality of information, we focus on personal factors, specifically, ability and motivation to process cancer information.

First, we expect that education is related to the ability to process cancer information, and thus lower education will predict CIO. According to Kim et al. (2007), low levels of education and lack of cancer literacy account for CIO but they operationalized CIO with one statement.

Cancer information is often lexically complex (Eysenbach, Powell, Kuss, & Sa, 2002; Walsh & Volsko, 2008), which can cause poor comprehension, especially for those with literacy deficits (Friedman & Hoffman-Goetz, 2007). Education is also related to motivation. For example, research based on the CMM has revealed that education level is positively associated with surveillance motivation that produces higher elaboration (Eveland, 2001, 2002). Therefore, it is likely that individuals with lower education have less ability to categorize new information than their more educated counterparts, and consequently, they are more vulnerable to CIO.

H1: Education level will be negative associated with cancer information overload.

Second, trait anxiety impairs information-processing ability, and therefore increases CIO. Psychology literature has provided evidence that trait anxiety influences level of performance, especially when the conditions are stressful (Eysenck, 1982; Eysenck & Calvo, 1992). More specifically, anxiety increases the degree to which information processing is driven by threat-related stimuli rather than by knowledge and goals (Eysenck, Derakshan, Santos, & Calvo, 2007).

It should be noted that the negative effects of high anxiety are especially problematic in the cancer context due to the nature of cancer information. Cancer-related information can arouse uncertainty, because causes and treatments of cancer are complex, and individuals are not sure about their own

[1]We chose the cognitive mediation model (CMM) to explain the role of motivation in effective learning. Although there are other theories, such as the elaboration likelihood model (ELM; Petty & Cacioppo, 1986), that can theorize the relationship between ability/motivation and information processing, ELM has been tested mainly via experimental studies, while CMM has been used mainly in survey studies. Moreover, CMM views elaboration as an individual trait, consistent with the present study, which focuses on individual factors.

chance of getting the disease (Babrow, Hines, & Kasch, 2000; Brashers et al., 2000). For this reason, cancer information poses threats to people with high trait anxiety, because anxious people tend to interpret ambiguous events in a more threatening way (Eysenck et al., 2007; Mathews, 1990). Media representations may magnify the threatening aspects of cancer. U.S. mainstream media have focused more on cancer treatment than on prevention and detection (Slater, Long, Bettinghaus, & Reineke, 2008) and associated cancer with fear (Clarke & Everest, 2006). As individuals with high trait anxiety selectively focus on and process threat-related information (MacLeod & Rutherford, 1992), when exposed to cancer information, their anxiety is likely to impair their information-processing ability.

No previous study has explored the relationship between trait anxiety and CIO. However, one study found that depression, which was measured with HINTS items similar to trait anxiety (e.g., sadness, nervousness, and hopelessness), is positively associated with negative information-seeking experiences (Beckjord, Rutten, Arora, Moser, & Hesse, 2008). Information-seeking experiences that Beckjord et al. (2008) measured—for example, feeling frustrated, having difficulties in understanding the information, being concerned about quality of information, taking a lot of efforts to get necessary information[2]—are very similar to symptoms of information overload (Eppler & Mengis, 2004). Thus, what Beckjord et al. found might be similar to the relationship between trait anxiety and CIO.

H2: Trait anxiety will be positively associated with CIO.

Third, we pose a research question about the role of cancer history in CIO. On the one hand, it is possible that cancer history will increase the *motivation* to process cancer information. People with cancer history would want to know more about cancer, and in the CMM framework, this type of surveillance motivation predicts effective learning (Eveland et al., 2003). Dutta and Feng (2007) found that personal cancer history as a situational motivation is positively associated with the use of an online health community. In addition to personal cancer history, family cancer history can be an indicator of motivation. Family members of critically ill patients need information and knowledge (Verhaeghe, Defloor, Van Zuuren, Duijnstee, & Grypdonck, 2005). For example, James et al. (2007) reported that caregivers of cancer patients more actively seek cancer information than patients. Only 4.8% of patients (N = 800) used the Internet for cancer information, but 48% of caregivers (N = 200) did so.

On the other hand, it is also possible that cancer history results in CIO. Those with a personal/family cancer history have a higher level of risk perception as well, which is positively related to anxiety and cancer worry (DiLorenzo et al., 2006; Hopwood, Shenton, Lalloo, Evans, & Howells, 2001; Katapodi, Lee, Facione, & Dodd, 2004). Additionally, past experiences of serious illness are associated with information avoidance (Barbour, Rintamaki, Ramsey, & Brashers, 2012), which is related to CIO (Gurmankin & Viswanath, 2005). In sum, if we view cancer history as a motivational factor, it should reduce CIO, but that motivation can be related to worry and anxiety, which are connected to CIO.

RQ1: How is personal/family cancer history associated with CIO?

Fourth, we anticipate that health information use from active media channels will be inversely associated with CIO. There are two reasons. One is that health information use from active channels already reflects users' greater motivation, that is, health orientation, which refers to the extent to which individuals are motivated toward health issues (Dutta-Bergman, 2004). Television is a passive outlet, while print media and the Internet are actively oriented channels. Dutta-Bergman indicated that people who use print media and the Internet as their primary source of health information are more health-oriented than those who do not. Thus, we can view the use of active channels for health information as a proxy for dispositional motivation. Second, compared to passive channels, use of active channels requires more cognitive efforts and involvement. Thus, users of those channels are more fully engaged in information processing than those of passive channels (Dutta-Bergman, 2004). In sum, users of active media channels have greater motivation to process cancer information, and they are more likely to elaborate on this issue. Based on CMM, they are less vulnerable to CIO.

Previous research yielded results that support our expectation. Han et al. (2009) tested the association between media health news use and CIO (i.e., "perceived ambiguity" measured with an aforementioned statement) with the 2005 HINTS data. In bivariate associations, television health news exposure was positively, and Internet/print health news was negatively, related to CIO. The effect of Internet health news exposure survived to the multivariable model.

H3: Health information use from print media or the Internet will be negatively associated with cancer information overload.

Method

Sample 1

HINTS is a nationally representative survey conducted by the National Cancer Institute. The current survey (2012 HINTS, cycle 1) was conducted from October 2011 to February 2012 through a self-administered mailed questionnaire (National Cancer Institute, 2012). In total, 3,959 people completed the questionnaire with a response rate of 36.7% based on the American Association for Public Opinion Research response rate 2 (RR2) formula.

[2]The 2012 HINTS also has these four items, but we did not use them to predict CIO. The items describe the feelings that an individual has after information exposure. Thus, they are outcomes of CIO rather than its predictors.

Sample 2

Undergraduate students (N = 309) who enrolled in a communication course in a large public university participated in Study 2 for extra credit. Interested students visited the online survey website and read a consent form; those who agreed to participate completed an online survey questionnaire.

Sample 3

Participants (N = 308) were collected from Amazon Mechanical Turk, which is a crowdsourcing online marketplace where individuals choose a task and are paid to complete it. This website has frequently been used by researchers because it is possible to collect samples more diverse than college students or other online samples (Buhrmester, Kwang, & Gosling, 2011). A task asking for participation in the online survey was posted with a link to the survey. Individuals who clicked the link could read a consent form, and if they agreed, they could proceed to the questionnaire. To compare Sample 3 with Samples 1 and 2, we limited participants to U.S. residents.

Sample 4

Korean people aged 40 years or over (N = 813) were collected by an online survey company located in Korea. The company sent e-mails to its online panels, and those who wished to participate completed an online questionnaire to receive points that could later be exchanged for cash. The current data is part of a two-wave survey about stomach cancer, which is the most common cancer in Korean males and the fourth most common in females (National Cancer Center, 2012). For this research, the survey company sent invitation e-mails to 5,900 people, and 1,130 participated in the first wave (participation rate: 19%). Among Wave 1 participants, 813 participated in the second wave (participation rate: 72%). As Wave 1 did not include a CIO scale, we used only Wave 2 for this study. For descriptive statistics for all samples, see Table 1.

Measures

For means, standard deviations, and response options, see Table 1.

Independent variables

First, participants reported their level of education. Education was originally measured on an ordinal scale, but recoded as the number of years required to obtain the degree. For example, a college graduate (6) was recoded as 16 (years).

Second, trait anxiety level was assessed. For Sample 1 (nationally representative U.S. sample), the four items in HINTS that measure how often respondents had been bothered by "little interest or pleasure in doing things," "feeling down, depressed or hopeless," "feeling nervous, anxious or on edge," and "not being able to stop or control worrying" were used (α = .90). The four items were averaged. Although this scale has been labeled as "psychological distress" (Kiviniemi, Orom, & Giovino, 2011), "negative affect" (Beckjord et al., 2008), or "emotional health" (Ye, 2014), the items bear similarities to those included in the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). To establish the convergent validity of this operationalization, Sample 2 participants (U.S. undergraduates) indicated their anxiety level both on the four HINTS items and on STAI. As expected, trait anxiety was highly correlated with the four-

Table 1. Descriptive statistics.

	Sample 1 (U.S. nationally representative sample) (N = 3,959)	Sample 2 (U.S. undergraduates) (N = 309)	Sample 3 (U.S. general population) (N = 308)	Sample 4 (korean general population) (N = 813)
		M (SD) or %		
Age	46.47 (18.06)	20.17 (2.04)	33.34 (11.31)	51.91 (8.21)
Gender (1 = female)	51.5% female	58.6% female	42.9% female	48.2% female
Race/ethnicity (1 = White)	80.4% White	65% White	76.6% White	—
Employment (1 = employed)	55.8% employed	—	65.3% employed	64.3% employed
Marital status (1 = married)	51.3% married	—	28.9% married	82.9% married
Years of education	13.82 (2.61)	—	15.07 (1.69)	14.73 (2.29)
Income (U.S. dollar)	$63,149 ($58,153)	$113,035 ($65,074)	$54,544 ($43,370)	$54,863.46 ($26,946.96)
Personal cancer History (1 = yes)	8.53% "yes"	1.6% "yes"	2.6% "yes"	6.3% "yes"
Family cancer history (1 = yes)	64.66% "yes"	80.6% "yes"	73.5% "yes"	63.1% "yes"
Health status[a]	3.47 (0.96)	3.50 (0.88)	3.3 (0.92)	3.24 (0.67)
Current smoking (1 = yes)	17.8% "yes"	9.67% "yes"	18.5% "yes"	23.4% "yes"
Health info use[b] Print media	—	0.55 (.71)	0.69 (.87)	0.67 (.70)
Television	—	0.73 (.79)	0.85 (.95)	1.39 (.81)
The Internet	63% "yes"	0.86 (.81)	1.12 (.89)	0.85 (.78)
Interpersonal	—	2.06 (.78)	0.96 (.76)	0.68 (.67)
Trait anxiety[c]	1.59 (.078)	2.14 (0.46)	2.17 (0.65)	2.19 (0.43)
Cancer information overload[d]	2.90 (0.90)	3.69 (1.52)	3.13 (0.67)	3.02 (0.50)

Note. Multiple items were averaged.

[a]A single item based on 5-point scale (1 = *poor* to 5 = *excellent*) in all four samples.

[b]In Sample 1, a single item about the use of the Internet for health information (1 = yes). In Samples 2, 3, and 4, nine items based on a 5-point ordinal scale (1 = *not at all* to 5 = *4 or more times per week*). Before the analysis, they were transformed to frequency (0 = *not at all* to 4 = *4 or more times per week*).

[c]In Sample 1, four items based on a 4-point scale (1 = *not at all* to 4 = *nearly every day*). In Samples 2, 3, and 4, 20 items based on a 4-point scale (1 = *almost never* to 4 = *almost always*).

[d]In Sample 1, a single item based on a 4-point scale (1 = *strongly disagree* to 4 = *strongly agree*). In Sample 2, 3, and 4, eight items based on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*).

item scale from HINTS (r = .67), supporting our decision to operationalize it as trait anxiety in Sample 1.

For Sample 2 (U.S. undergraduates), Sample 3 (U.S. general population), and Sample 4 (Korean general population), trait anxiety was measured using the 20 items of STAI (Spielberger et al., 1970), such as "I feel nervous and restless," and those 20 items were averaged (α = .89 in Sample 2, α = .96 in Sample 3, and α = .89 in Sample 4). For the Korean participants (Sample 4), the Korean version of STAI as validated by Hahn, Lee, and Chon (1996) was used.

Third, all participants reported their personal/family cancer history.

Fourth, for health information use, Sample 1 (nationally representative U.S. sample) participants reported only the use of the Internet for health information. HINTS did not ask health information use from various sources. Sample 2 (U.S. undergraduates) and Sample 3 (U.S. general population) participants reported how often in the past 30 days they had used health information from the following nine sources: newspapers, magazines or newsletters, television news, television health programs, online newspapers, professional health-related websites, social networking sites or online communities, family and friends, and health care professionals. All nine items were then transformed to ratio variables (i.e., the frequency). For example, no use (= 1) was recoded as 0, and 2 (= once a week) as 1. Sample 4 participants (Korean general population) were asked about the use of cancer information only, not health information in general, because this sample was used to test CIO specifically in the context of stomach cancer. All items were averaged to create an index of print media (newspaper and magazine), television (television news and television health programs), the Internet (online newspapers, professional health-related websites, and social networking sites or online communities), and interpersonal communication (family or friends, and health care professionals).

Dependent variable

In Sample 1 (nationally representative U.S. sample), CIO was operationalized by the previously mentioned statement that was also used in the Han et al. studies (Han, Moser, & Klein, 2006, 2007; Han et al., 2009). For Sample 2 (U.S. Undergraduates), Sample 3 (U.S. general population), and Sample 4 (Korean general population), we used the Jensen et al. eight-item CIO scale (2014), including "There is not enough time to do all of the things recommended to prevent cancer" (α = .83 in Sample 2, α = .81 in Sample 3, and α = .80 in Sample 4). All eight items were averaged.

Control variables

We used two types of control variables. First, for sociodemographics, we included participants' age, gender, race/ethnicity, employment status, marital status, and income. Second, as health-related variables, we adopted health status, which influences CIO (Kim et al., 2007), and current smoking (1 = *yes*, 0 = *no*) that makes individuals worried about cancer (Rutten, Blake, Hesse, Augustson, & Evans, 2011). In Han et al. (2006, 2007), cancer worry was positively associated with CIO (i.e., what they call "perceived ambiguity"). Thus, current smoking could be a factor that affects CIO.

Results

We hypothesized that lower education (H1), higher trait anxiety (H2), and less use of health information from active media channels (H3) would be associated with CIO, and asked whether personal/family cancer history would be related to CIO (RQ1).

Table 1 shows the descriptive statistics of four samples. On average, participants were 46, 20, 33, and 52 years old, respectively, in each sample, which shows that this study covers diverse age groups. The ratio of females in each sample ranged 42.9% to 58.6%, and education years ranged from 13.8 to 15.1 years. In all samples, participants' health status was around the average level. CIO was the lowest in Sample 1 (nationally representative U.S. sample), but as CIO was measured on a 4-point scale only in Sample 1 (a five-point scale in the other three), in fact, CIO level was largely similar in all samples. For details, see Table 1.

Four ordinary least squares regression analyses were performed. In Sample 1 (nationally representative U.S. sample), to reflect two types of weights that HINTS participants received (a full-sample weight and a set of 50 replicate weights; for details, see Rutten et al., 2012), analyses of the data were conducted using Stata 12.1. All the reported numbers about Sample 1 are weighted. In other three samples, SPSS 21 was used.

The first model to predict CIO, in Sample 1, was significant (F = 5.26, p < .001) and explained 5.27% of the variance in CIO. As expected, education and Internet use for health information were negatively associated with CIO. Trait anxiety was positively associated with CIO. All hypotheses (H1 through H3) were supported. Regarding RQ1, family cancer history was positively related to CIO, while personal cancer history was not related to CIO.

The second model, using Sample 2 (U.S. undergraduates), was significant (F = 2.52, p < .01) and accounted for 11.5% of the variance in CIO. Education was not measured in this sample because the participants were all undergraduates. Trait anxiety was positively related to CIO, and print media use for health information was negatively related to CIO, supporting H2 and H3. Personal/family cancer history was not linked to CIO (RQ1).

The third model was tested with Sample 3 (U.S. general population) and was significant (F = 2.81, p < .01), and the explained variance in CIO was 11%. People with less education and higher trait anxiety were more likely to suffer from CIO, supporting H1 and H2. Cancer history was not linked to CIO.

Finally, the fourth model (Korean general population) tested the relationship between individual characteristics and CIO in the stomach-cancer context, and it was also significant (F = 2.02, p < .05), accounting for 3.7% of the variance in CIO. Individuals who had higher trait anxiety (H2) and used less print media for health information (H3) were likely to have CIO. Family cancer history was negatively associated with CIO, contrary to Sample

Table 2. Predicting cancer information overload.

	Sample 1 (U.S. nationally representative sample)		Sample 2 (U.S. undergraduates)		Sample 3 (U.S. general population)		Sample 4 (Korean general population)	
	Zero-order	b (SE)	Zero-order	b (SE)	Zero-order	b (SE)	Zero-order	b (SE)
Controls								
Age	.00	.00(.00)	−.04	−.02(.03)	.07	.01(.00)	−.04	.00(.00)
Femaleness	.02	.07(.06)	.05	−.02(.08)	.15**	.12(.09)	.00	.00(.04)
Being white	.03	.06(.07)	−.03	.06(.10)	.08	.07(.11)		
Employed	.03	.12(.07)	—	—	−.01	.01(.10)	−.03	−.04(.05)
Married	−.01	.01 (.07)	—	—	.05	.09 (.11)	.01	.07 (.05)
Income	−.03	.01 (.02)	−.04	.00 (.02)	.00	.01 (.02)	−.04	.00 (.01)
Health status	−.08*	−.03 (.03)	−.12*	−.04 (.05)	−.16**	−.05 (.05)	−.07	−.01 (.03)
Smoking	.09**	.14 (.08)	−.02	−.08 (.14)	.07	.04 (.11)	.06	.06 (.05)
IV								
Education	−.08**	**−.03 (.01)***	—	—	−.12**	**−.06 (.03)***	−.02	.00 (.01)
Trait Anxiety	.13***	**.13 (.04)*****	.20**	**.32 (.10)****	.17**	**.19 (.08)***	.12**	**.14 (.05)****
P-cancer	−.02	−.08 (.06)	−.03	−.13 (.33)	−.01	−.46 (.31)	.01	.03 (.07)
F-cancer	.10***	**.18 (.04)*****	.04	.13 (.11)	.06	.12 (.10)	−.09*	**−.08 (.04)***
Print	—	—	−.19**	**−.16 (.07)***	.00	.03 (.06)	−.06	**−.07 (.03)***
Television	—	—	−.11	−.02 (.07)	.05	−.03 (.06)	−.02	.02 (.03)
Internet	−.05*	**−.13 (.05)***	−.15**	−.07 (.07)	.01	−.02 (.06)	−.01	.04 (.03)
Interpersonal	—	—	−.05	.01 (.06)	−.01	−.05 (.06)	−.04	−.02 (.03)
Total R^2 (%)		5.26***		11.5**		11.0*		3.7*
N		3,175		267		258		813

Note. Regarding Sample 1, displayed values are weighted correlation coefficients, weighted unstandardized regression coefficients, jackknife standard errors (in parentheses), and explained variances. For all other samples, displayed values are correlation coefficients, unstandardized regression coefficients, standard errors (in parentheses), and explained variances. P-cancer = personal cancer history, F-cancer = family cancer history. In Samples 1–3, four variables about media use (print, television, Internet, and interpersonal) mean the use of each medium for health information. In Sample 4, they refer to the use of each medium for cancer information. Significance: *$p < .05$; **$p < .01$; ***$p < .001$.

Boldface numbers indicate statistically significant results in the regression analyses. IV = independent variable.

1 (nationally representative U.S. sample). For regression coefficients and significance, see Table 2.

Discussion

This study examined the relationship between individual ability/motivation and CIO in four samples. Overall, the results were consistent across the four samples. To elaborate on the results, first, trait anxiety was the most consistent predictor and its effect was found in all four samples regardless of the difference between samples. Kim et al. (2007) found CIO's associations with depression, which was measured with items similar to ones assessing trait anxiety, in the bivariate analysis, but not in the multivariate analysis. Moreover, they reported that people with lower depression are more likely to experience CIO, contrary to this study. Kim et al. (2007) explored CIO only among cancer-information seekers, because they saw CIO as a by-product of cancer-information seeking. However, it is possible that nonseekers of cancer information also suffer from CIO. Even if an individual does not actively seek cancer information, he or she is still exposed to cancer information through scanning (see Niederdeppe et al., 2007). Moreover, cancer-information seekers have lower levels of CIO compared to nonseekers (Han et al., 2009). Thus, CIO might be a more pronounced problem among nonseekers of cancer information. In this sense, the present study is the first to establish a relationship between trait anxiety and CIO. Trait anxiety negatively influences information-processing ability, which leads to a negative health outcome in the form of CIO, not only in a general cancer context but also in a specific context.

Second, Internet use was negatively associated with CIO in Sample 1 (nationally representative U.S. sample), and print media were negatively related to CIO in Sample 2 (U.S. undergraduates) and Sample 4 (Korean general population). No media effect was found in Sample 3 (U.S. general population). As Sample 1 participants reported only their use of the Internet for health information, the result in Sample 1 and Sample 2 is essentially the same. When we deleted print media from the regression analysis in Sample 2, less Internet use was negatively related to CIO. However, in Sample 4 (Korean general population), only print media had an effect, and even when we deleted print media use from the analysis, Internet use was not associated with CIO. Because Sample 4 is in a different context from the other samples, direct comparison is impossible. At least for Koreans aged 40 years and over, only print media had the potential to decrease CIO. One speculation about this result is that, given their age, these individuals are more likely to be familiar with print media and can process cancer information better when using print media. Overall, consistent with Dutta-Bergman (2004), the finding suggests that use of active media channels implies greater motivation toward health, which has the potential to reduce CIO.

Third, the relationship between cancer history and CIO was not consistent. A family history of cancer could facilitate (Sample 4, Korean general population) or hinder (Sample 1, nationally representative U.S. sample) cancer information processing. This inconsistent result requires further investigation. The negative association between family history and CIO in Sample 4 can be explained by CMM; family cancer history served as a surveillance motivation because, in this sample, family cancer history was positively related to cancer information use from all sources ($r = .07$, $p < .05$), which can imply greater motivation.

However, in Sample 1 (nationally representative U.S. sample), the effect of family cancer history on CIO was the opposite. This was not consistent with CMM, because greater motivation was not associated with effective learning, but

rather related to CIO. This might be due to the difference between the two samples. Of note, only Sample 4 (Korean general population) answered questions about stomach cancer, and Sample 1 and Sample 4 participants were Americans and Koreans, respectively. In addition, we speculate that trait anxiety may play a role here. A family cancer history was positively associated with trait anxiety ($r = .07$, $p < .01$) in Sample 1, but it was not related to trait anxiety in Sample 4. Thus, people with a family history of cancer in Sample 1 might be more anxious about cancer, making them susceptible to CIO, while those in Sample 4 are not.

Notably, a personal cancer history was not associated with CIO in any of the samples. Future research should examine how direct and indirect experiences of cancer work differently concerning cancer-related affect and cognition. One explanation could be that only a small percentage of participants (8.53%, 1.6%, 2.6%, and 6.3% in each sample, respectively) had a personal cancer history, which offers limited variance for identifying relationships. This explanation also addresses why family cancer history did not have an effect in Sample 2 (U.S. undergraduates) and Sample 3 (U.S. general population). Unlike Sample 1 (nationally representative U.S. sample) and Sample 4 (Korean general population), where 63–64% had a family history of cancer, in Sample 2 and Sample 3, 74–81% of participants had a family history of cancer.

Finally, education was a significant predictor, except in Sample 4 (Korean general population). Since Sample 4 participants answered questions about stomach cancer in particular, it seems that a more specific measure for processing ability, such as health literacy or health knowledge about stomach cancer, could better capture this relationship (Viswanath & Emmons, 2006).

Theoretical and practical implications

This study has several important implications. First, it demonstrated the role of individual factors on CIO, and theorized the relationship between those factors and CIO focusing on ability and motivation. As our definition of CIO suggests, CIO means being confused and overwhelmed by external factors, such as information quantity or quality, but some people are more likely to experience CIO due to personal factors. Individual differences in ability and motivation to process health information play an important role in the occurrence of CIO. Previous studies that measured CIO with one statement (e.g., Han et al., 2009; Kim et al., 2007) also detected CIO's associations with education and media exposure. However, the present study extended those studies; using multiple-item measures of CIO and its predictors, we theorized predictors of CIO. Based on previous studies that have emphasized external and environmental factors as predictors of CIO (Jensen et al., 2014; Kim et al., 2007), along with the results of the current study, we conclude that CIO is the result of interplay between external and internal factors.

Second, unlike previous health information studies that explored predictors of health information seeking or the results of health information seeking, we focused on information processing, and conceptualized CIO as problems caused by less effective information processing. Previous studies have identified factors that increase health information use—for example, female gender and higher socioeconomic status (e.g., Hesse et al., 2005). Studies also have reported positive effects of health information use on healthy behaviors and cancer screening (e.g., Hornik et al., 2013; Kelly et al., 2010). However, little attention has been paid to difficulties in cancer information processing, which can cause CIO.

Third, practically, the most important contribution of the present study was to call our attention to CIO. This study made it clear that more health information use itself does not cause CIO. Therefore, to reduce CIO, health educators must pay attention to individual characteristics and target people with lower education, high trait anxiety, family cancer history, and less media use, who are more vulnerable to CIO. In particular, we focused on the commonality among these factors: the negative effects experienced when processing cancer information. High trait anxiety was not only the most consistent predictor, but also related to lower education (Samples 1, 2, and 4) and a family history of cancer (Samples 1 and 2). Thus, health educators should primarily target individuals with a high level of trait anxiety. This point also applies to health reporters. Cancer information in the media should not arouse excessive fear. For example, mass media frequently emphasize scary statistics (Clarke & Everest, 2006). This type of reporting may increase negative affect especially among people with high trait anxiety and family cancer history. In addition, health reporters need to include hedging in cancer news. Although uncertainty can lead to CIO, when uncertainty is expressed by scientists[3] it can help health consumers to categorize health information and to avoid information overload (Jensen, 2008; Jensen et al., 2011).

Limitations and suggestions for future research

Surveys conducted by national institutions like HINTS can collect large samples and have more statistical power to detect small effects; thus, a secondary analysis of such surveys is a cost-effective way to conduct health-related research. Yet a secondary analysis has its own disadvantages. As researchers do not have any control over the collection of data, the measures in the survey may not be well suited for research purposes, may not reflect recent advancements in the field, or may not be defined or categorized in the way that the researcher intends (Boslaugh, 2007). Sample 1 was nationally representative, but most important variables in the analysis were measured with a single item. The other three were convenience samples, but addressed measurement issues. By using multiple samples, we tried to compensate for the defects in each sample. In addition, as we used cross-sectional data, causal relationships cannot be

[3]It remains unclear whether hedging should be attributed to affiliated or unaffiliated scientists. Jensen (2008) demonstrated a positive association between hedging attributed to primary scientists and trustworthiness for scientists and journalists. On the other hand, Jensen et al. (2011) found that outside experts increased trust in medical professionals.

established. However, it is reasonable to say that education, trait anxiety, and a family cancer history might predict CIO, because it is difficult to claim the reverse causality. The relationship between health information use and CIO needs further investigation.

Another limitation is that in all of the samples in this study, R^2s were very small. However, these small R^2s were expected. This study specifically investigated personal factors among the causes of CIO. Information overload researchers have identified five factors that cause information overload, including information characteristics and information technology. Thus, we focused on only a part of the causes, and the small R^2 is not surprising. If we had included situational factors in the analysis, R^2 would have become much larger.

Based on the results, we make suggestions for future research. Future research should identify other correlates of CIO. Given that the study of CIO is in its early stages, future research should identify other situational factors that lead to CIO, which will help reduce CIO for the benefit of public health. A longitudinal design or an experimental study will help demonstrate the causal relationship that we could not establish.

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