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Cancer Information Overload: Discriminant Validity and Relationship to Sun Safe Behaviors

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Abstract

Objective: Past research suggests a large number of adults feel overwhelmed by the amount of cancer information – a phenomenon labeled cancer information overload (CIO). The current study

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examines whether CIO is discriminant from other negative message perceptions (reactance, information avoidance) and related to sun safe behaviors.

Methods: U.S. adults (N = 2,219) completed survey questions assessing CIO, dispositional reactance, defensive/information avoidance, sun safe behavior, and knowledge.

Results: The results demonstrated that CIO was discriminant from dispositional reactance, information avoidance, and defensive avoidance, and individuals with higher overload were more likely to tan, less likely to have an annual checkup with a healthcare provider, and less knowledgeable about sun safe protection. Unexpectedly, individuals with higher CIO were more likely to wear wide-brimmed hats.

Conclusion: CIO is distinct from reactance and avoidance, and related to performance/knowledge of sun safe behaviors, and receiving annual healthcare checkups.

Practice Implications: The correlation between CIO and sun safe behavior differs by behavior; a pattern which suggests practitioners might benefit from adapting their communication strategy based on the target population and behavior.

Keywords

cancer information overload; dispositional reactance; defensive avoidance; information avoidance; discriminant validity; sun safe behavior; tanning

1. Introduction

A U.S. adult encounters information about cancer from a variety of sources, including conversations with friends, posts on social media, news stories, and medical appointments. Individual pieces of information might generate a number of state-based reactions (fear, excitement, sadness, surprise), but researchers are also interested in the cumulative effect of this information flow over the course of years, decades, or a lifetime. There is a growing concern that the cancer information flow may be problematic as a large number of U.S. adults are indicating frustration and confusion in national surveys [1,2]. This frustration takes many forms, but the most prevalent appears to be a feeling that there is too much information to process – a phenomenon that researchers have labeled cancer information overload (CIO) [3].

CIO consistently manifests in survey data, but researchers are still trying to determine if it is a distinct construct of interest or a reflection of other underlying forces [4,5]. If the latter, then communicators may be able to better understand variations in CIO scores or even engage it by targeting the underling construct. To that end, a research program is underway that examines the discriminant validity of CIO compared to other traits, dispositions, and message perceptions [3,5].

The veracity of CIO as a construct is juxtaposed against its immediate value in cancer prevention efforts. For example, the U.S. Preventive Services Task Force (USPSTF) recently reviewed skin cancer prevention research and concluded that there was good evidence to support interventions targeting sun safe behaviors notably for high risk groups [6]. Yet, those interventions will necessarily be communication-based which positions individual-level CIO

as a potential obstacle. Indeed, a previous study suggested a negative link between overload and sunscreen use [7]. Tailoring has been shown to be effective at reaching populations with higher CIO scores, but it can be time and cost prohibitive as a communication strategy, and might be optimal when pursued with smaller, well-defined segments [8]. At present, researchers designing sun safe interventions are trying to determine if they need to engage CIO for all audiences or develop distinct approaches for particular subsegments (e.g., high risk populations).

The current study advances understanding of individual-level CIO using data from a national survey of U.S. adults. Discriminant validity is examined between CIO and several individual difference/message perception variables (reactance, avoidance). Moreover, we examine the relationship between CIO scores and sun safe behavior and knowledge, with a focus on high risk individuals.

2. CIO: Discriminant Validity & Sun Safe Behavior

Cancer information overload (CIO) is an aversive motivational disposition defined as "feeling overwhelmed by the amount of cancer-related material in the information environment" [3] or "a perception of being overwhelmed and confused by (cancer) information … that might hinder learning or impair users' ability to make informed decisions" [1]. Research on the construct to date suggests that CIO may reduce compliance with cancer prevention recommendations. It has been associated with poorer perceived health status [1], avoidance of cancer information [4], reduced cancer prevention behavioral intentions [9], and reduced likelihood to get a colonoscopy [8]. In general, higher perceptions of information overload are related to the non-performance of a variety of preventive health behaviors, including smoking cessation, regular exercise, and sunscreen use [2,7].

Research on CIO has come from multiple sources including the Health Information National Trends Survey (HINTS) and the CIO scale. HINTS includes a single-item assessing CIO: "There are so many recommendations about preventing cancer, it's hard to know which ones to follow" [1,2]. Analysis of HINTS data suggest that 75% of U.S. adults endorse feelings of CIO [2] and that individuals reporting CIO have less formal education, lower income, poorer perceived health status, lower numeracy, and lower cancer literacy [1,10]. A parallel line of research has examined cancer-related information overload using a multi-item CIO scale that includes the original HINTS item [3]. The CIO scale is discriminant from cancer fatalism, positively related to cancer information avoidance and trait anxiety, negatively related to cancer information seeking and scanning, and able to predict colonoscopy screening across time [3–5,8,11].

Feelings of CIO appear to be widespread, but there is still reason to question whether it even exists. During the initial phase of explicating a construct, such as CIO, and validating a measure, it is important to frequently return to the basic question, "does this construct exist and is it unique from other, known constructs?" For example, it is possible that the feeling of CIO is a reaction to the paternalistic nature of the health communication environment. Feelings of CIO could reflect underlying dispositional psychological reactance [12].

Alternatively, CIO may be an alternative form of defensive avoidance [13] or information avoidance [14]. If CIO is a distinct construct, then it should demonstrate discriminant validity from reactance and avoidance.

For similar reasons, researchers need to demonstrate that CIO scores matter by investigating whether, and how, it is related to health behaviors. The cancer information overload model postulates that increased CIO levels should be negatively related to the performance of cancer-related behaviors [3]. Psychological reactance theory [12] and the extended parallel process model [15] postulate similar relationships between reactance, avoidance, and health behavior.

A related theoretical question is the relationship between levels of CIO and knowledge. Are feelings of CIO a byproduct of knowledge deficits (deficit model) or a reaction of those who possess higher quantities of knowledge (saturation model)? Avoidance is assumed to be negatively related to knowledge as theories like the extended parallel process model postulate that individuals seek to protect themselves by discarding, ignoring, or rejecting information about the threat [15]. Past research has demonstrated that individuals with higher CIO are more likely to avoid cancer information and media outlets in general [4,5,11]. Do CIO levels have a similar relationship with knowledge?

The current study extends research on the construct of CIO by examining whether it is (1) distinct from reactance and avoidance and (2) related to health behaviors (sun safe behavior, annual checkups) and knowledge.

3. Method

3.1. Participants

Qualtrics enrolled 2,219 adults (age range: 18-89, M_{age} = 43.49, SD = 15.82) from their national panel into an online survey experiment. More than half of the participants (55%) were females. Almost half of the participants (49.1%) had some type of vocational training or college degree. A majority of the participants (81.7%) identified themselves as Caucasian or White. Compared to U.S. Census data, our sample is more female, educated, and White [16]. The participants filled out a consent form before proceeding to the actual survey. Qualtrics paid a small incentive to the participants for completing the survey. The protocol was approved and monitored by a University IRB.

3.2. Study Design

The current data is extracted from a larger study that assesses the impact of visual message features on sun-safe behavior expectations [17]. The analysis reported here is based solely on the pre-test data of that larger study.

3.3. Measures

3.3.1. Demographics.—Participants reported age, sex, race, ethnicity, and political ideology. Additionally, skin cancer risk was assessed using the brief risk assessment tool (BRAT) [18]. The BRAT is a nine-item measure that categorizes adults as low, moderate, or

high risk for developing skin cancer. In the current sample, 47% of participants were categorized as low risk, 30% as moderate risk, and 23% as high risk.

3.3.2. CIO.—A five-item measure of CIO was utilized in the current study [3,19]. All CIO items are measured on a five-point scale ranging from *strongly disagree* (1) to *strongly agree* (5) (see Table 1 for items, means, and standard deviations): (M = 3.68, SD = 1.41, α = .88).

3.3.3. Other Measures.—Dispositional reactance (14 items) [12], information avoidance (8 items) [14], and defensive avoidance (3 items) [13] were all measured on scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Defensive avoidance and information avoidance were focused on the avoidance of skin cancer information specifically. Sun safe behavior was measured using a modified version of a seven-item measure developed by Aspinwall and colleagues [20] on a scale ranging from 1 (*never*) to 7 (*always*). Two additional items asked about prior tanning behavior in a tanning bed and outdoors. Annual checkup was measured using a single item measure that asked if the participant had been to a healthcare provider for a checkup in the last 12 months (*No* = 0, *Yes* = 1). Knowledge about sun safe behaviors was measured using a 9-item scale (M = 6.39, SD = 2.08, α = .75) from several sources [21–23].

4. Results

4.1. Discriminant Analysis

The heterotrait-monotrait (HTMT) method has been developed to assess discriminant validity [24,25]. Constructs have discriminant validity issues if they load .90 or higher with other constructs that are thought to be unique. HTMT analysis revealed that the CIO scale was discriminant from reactance, information avoidance, and defensive avoidance as none of the variables loaded higher than .61 (see Table 2).

4.2. Bivariate Analysis

Table 3 reports bivariate correlations between all study variables. CIO scores were positively correlated with dispositional reactance, information avoidance, defensive avoidance, tanning bed use, outdoor tanning, wearing hats, and skin cancer risk (measured with BRAT). This indicates that individuals with higher CIO were more likely to engage in both tanning behavior and, curiously, one sun safe behavior (wearing a hat). Dispositional reactance and defensive avoidance exhibited similar patterns. Information avoidance performed differently: positively related to tanning but negative related to sun safe behaviors.

CIO scores were negatively correlated with going for an annual checkup, sex, and sun safe knowledge. Concerning sex, men had higher CIO scores compared to women.

Some readers might wonder how sun safe knowledge was related to sun safe behavior as the former is thought to drive the latter. Knowledge was negatively correlated with using tanning beds, and positively correlated with wearing sunscreen, reapplying sunscreen, avoiding peak exposure, wearing a hat, and wearing sunglasses). These relationships were small, but statistically significant.

4.3. Partial Correlations

Partial correlations were calculated between CIO scores and behavioral outcomes, controlling for age, sex, education, income, race, and BRAT. With controls in place, CIO scores were positively correlated with tanning bed use, outdoor tanning, and wearing a hat. CIO scores were also negatively correlated with receiving an annual checkup and knowledge (see Table 4).

4.4. Partial Correlations Split by Sex, Education, Race, and Risk

Partial correlations were also examined split by sex, education, race, and risk levels (low, moderate, high). These splits revealed several patterns.

For female participants, CIO scores were negatively correlated with sunscreen use, reapplication of sunscreen, and annual checkups. For males, CIO scores were positively related with tanning bed use, and several preventive behaviors (pants/sleeves, hat, glasses, seeking shade).

For individuals with more than a high school education, CIO scores were positively correlated with tanning behaviors and negatively correlated with annual checkups.

For White participants, CIO scores were positively correlated with tanning bed use and wearing hats, and negatively related to sunscreen use, reapplication, and annual checkups. For participants not identifying as White, CIO measures were positively correlated with wearing pants/sleeves.

For high risk participants, CIO scores were positively correlated with tanning bed use and wearing hats and glasses. It was negatively related to annual checkups.

5. Discussion and Conclusion

5.1. Discussion

In the current study, CIO scores were positively correlated with dispositional reactance and two forms of avoidance. The largest relationship was between CIO and dispositional reactance ($r = .56$, $p < .001$). Though related, discriminant validity analysis indicated CIO, reactance, information avoidance, and defensive avoidance were all distinct constructs. This finding builds on past work which has shown that CIO is distinct from cancer fatalism and related to cancer information avoidance, anxiety, and information seeking/scanning [3–5,8,]. Collectively, this research underscores CIO as a unique construct that is related to, but distinct from, other negative perceptions about the message environment and/or cancer.

Individuals with higher overload were more likely to use tanning beds and tan outdoors. Split analysis revealed that the relationship between CIO and tanning bed use was significant among males, those with more than a high school education, White participants, and those at higher risk of developing skin cancer. Why this relationship would be significant for males and those with more education is not immediately clear. For males, it is imperative to examine the attitudes and characteristics of male tanners. For example, past research has shown that sexual minority men are more likely to engage in indoor tanning and to develop

skin cancer [26]. Relatedly, research has shown that tanning dependence is higher for sexual minority men, and related to increased indoor tanning [27]. Measuring sexual identity and tanning dependence may help to explain this finding. For education, it is possible that the partial correlation observed here is a byproduct of the relationship between education and income. Future analysis should examine income as a control given the cost of indoor tanning.

For females and White participants, CIO scores were negatively correlated with sunscreen use and reapplication of sunscreen. As context, past research has shown that both groups are typically more likely to engage in these behaviors [28]. There are at least two possible explanations for this relationship. It could be a ceiling effect. Sunscreen use is higher in both groups, though neither is close to perfection. Overload could be one barrier or perceptual correlate for those in that group that demonstrate lower adherence. Alternatively, it could be representative of a perceptual shift. For example, overload could be increasing in female populations and slowly undermining adherence. A longitudinal design tracking CIO and sun safe behavior across several years would be an ideal way to investigate both possibilities.

CIO scores were negatively correlated with receiving an annual checkup and sun safe knowledge. For annual checkups, split analysis revealed that the relationship was significant for females, those with more than a high school education, White participants, and those with higher risk. For knowledge, no significant differences materialized when splitting by sex, education, race, or risk. Thus, individuals with higher overload are less likely to receive annual healthcare exams and less knowledgeable about sun safe behaviors.

One curious finding from the current study is that CIO scores were positively related to wearing a wide-brimmed hat, a form of sun safe behavior. This relationship held even after controlling for demographics and skin cancer risk. The relationship is not large, but it is unexpected as CIO has previously been negatively related to preventive behaviors (i.e., individuals with higher overload were less likely to screen for colorectal cancer). Split analyses revealed that this relationship was significant for males, White participants, and those with higher risk. As context, past research has shown that males are more likely to wear hats for sun protection [29] and that question wording – notably the exclusion of baseball style caps – can influence response [28]. Future research should try to replicate this finding with more nuanced questions about hat wearing. For instance, some researchers have utilized visual aids to clarify what is meant by a wide-brimmed hat [28]. Other questions might examine the motivation and purpose behind hat wearing (e.g., to cover a bald spot, to support a team, as part of a uniform) to identify and control for unrelated behavior. Researchers should also be mindful that CIO scores were positively related to four sun protective behaviors in males (wearing long sleeve shirts/pants, hats, sunglasses, and seeking shade). It is tempting to search for an explanation for hats specifically, but the data in hand are more nuanced. Is it possible that males are responding to feelings of information overload in different, and unexpected, ways? CIO was found to be more prevalent in males, and that creates the opportunity for greater diversity in perception and response.

The current study had several limitations. First, the survey was cross sectional so it was not possible to establish variable ordering. Second, the participants were recruited from an

online panel which may not represent the U.S. population as a whole. Participants in this study were significantly more likely to be White and highly educated than the population as a whole, which raises concerns about self-selection bias. To address this concern, analyses controlled for several demographics, including race and education. Future research could further address this concern through stratified sampling that mirrors U.S. demographics. Third, the measures were self-reports of behavior rather than assessments of actual behavior. Fourth, the CIO measure was cancer-specific, but it is not skin cancer specific like the measures of information and defensive avoidance used in this analysis. This mismatch in focus could reduce correlations between the measures.

5.2. Conclusion

Many U.S. adults exhibit signs of CIO. Whether that is meaningful is the focus of an emerging research line. The current study provides further evidence that CIO is both distinct from other constructs and related to health behaviors.

5.3. Practice Implications

The results of the current study highlight the complexity of communicating sun safe behavior recommendations to patients and the public at large. Adherence to sun safe behavior recommendations is low [28], which suggests the need for educational campaigns and interventions. Unfortunately, information overload is common and correlated in problematic ways with sun safe behaviors for different groups (e.g., males and tanning bed use, females and sunscreen use). Yet, there is also evidence that overload is positively correlated with particular sun safe behaviors in certain groups (e.g., males and long sleeve shirts/pants, hats, sunglasses, and seeking shade) and that knowledge is negatively correlated with CIO. This complex perceptual landscape highlights two directions forward for researchers and communication practitioners. First, CIO scores were not negatively correlated with the following sun safe behaviors: wearing long sleeve shirts/pants, hats, sunglasses, and seeking shade. Indeed, CIO scores were sometimes positively correlated with these behaviors. This suggests that it might be useful to develop campaigns which only target wearing long sleeve shirts/pants, hats, sunglasses, and avoiding peak exposure. Past campaigns have often focused on all sun safe behaviors as a group or highlighted sunscreen use and/or tanning behavior as the focus of the campaign. The current data suggest these approaches may be suboptimal; a possibility that that practitioners and researchers could explore. Second, past research has found that some message strategies are more effective for populations with higher information overload. Jensen, King, and colleagues [8] found that tailored messages were more effective at increasing colorectal cancer screening for individuals with higher CIO scores. Practitioners and researchers should explore whether message tailoring is more effective at increasing sun safe behaviors for individuals with higher overload. A good first step would be to examine the value of message tailoring for concerning groups and behaviors identified in the current study (e.g., females and sunscreen use).

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Highlights

- Cancer information overload (CIO) was discriminant from reactance and avoidance.
- CIO was positively correlated with tanning bed use and outdoor tanning.
- Those with higher CIO scores are less likely to attend an annual health checkup.
- Individuals with higher overload scores had less knowledge of sun safe behaviors.
- CIO was negatively correlated with tanning for males and sunscreen use for females.

Table 1.

Summary Statistics for CIO Items

	M (SD)
There is so much cancer information, I don't even care to hear new things about cancer. (CIO1)	3.20 (1.73)
There is so much information about cancer, it all starts to sound the same after a while. (CIO2)	3.83 (1.71)
There is so much cancer information, I forget most of it right after I learn it. (CIO3)	3.44 (1.67)
I feel overloaded by the amount of cancer information I am supposed to know. (CIO4)	3.71 (1.76)
There are so many different recommendations about cancer, it's hard to know which ones to follow. (CIO5)	4.19 (1.70)

Note. Means and standard deviations for all CIO items.

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Table 2.

Discriminant Validity Analysis

	CIO	Reactance	Info. Avoidance
CIO	----		
Reactance	.41	----	
Info. Avoidance	.61	.42	----
Def. Avoidance	.38	.33	.41

Note. Scores greater than .90 exhibit discriminant validity issues. No variables in this study had discriminant validity issues.

Table 3.

Bivariate Correlations

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1.	CIO	----																			
2.	Reactance	.56*	----																		
3.	Info. Avoid	.29*	.27*	----																	
4.	Def. avoid	.37*	.39*	.25*	----																
5.	Tann. Bed	.13*	.21*	.13*	.27*	----															
6.	Tanning	.11*	.14*	.08*	.31*	.49*	----														
7.	Sunscreen	.00	.05*	−.14*	.03	.15*	.24*	----													
8.	Reapply	−.01	.09*	−.11*	.04	.22*	.26*	.83*	----												
9.	Pants/Sleev	.04	.10*	−.08*	−.02	.09*	−.01	.42*	.45*	----											
10.	Peak Exp.	.04	.10*	−.08*	−.04	.06*	−.04*	.36*	.42*	.58*	----										
11.	Shade	.02	.08*	−.14*	−.05*	−.04	−.14*	.29*	.29*	.47*	.60*	----									
12.	Hat	.10*	.19*	.01	.09*	.15*	.07*	.39*	.43*	.47*	.42*	.38*	----								
13.	Sunglasses	.04	.06*	−.14*	.07*	.09*	.14*	.40*	.39*	.26*	.28*	.27*	.32*	----							
14.	Ann. Chck	−.05*	−.06*	−.15*	−.04	.07*	.06*	.13*	.15*	.13*	.12*	.09*	.11*	.12*	----						
15.	Age	−.02	−.09*	−.13*	−.06*	−.21*	−.21*	−.11*	−.10*	−.05*	.06*	.01	.05*	.10*	.16*	----					
16.	Sex	−.11*	−.13*	−.13*	−.10*	−.06	.03	.12*	.08*	−.08*	.01	.06*	−.16*	.07*	.03	−.08*	----				
17.	Education	.02	.05*	−.02	.01	.10*	.13*	.23*	.21*	.13*	.13*	.09*	.15*	.14*	.08*	.02	−.06*	----			
18.	Income	.02	.01	−.06*	.05*	.16*	.20*	.28*	.25*	.12*	.10*	.07*	.14*	.20*	.09*	.03	.00	.44*	----		
19.	White	.04	−.01	−.05*	.04*	.03	.14*	.17*	.12*	−.01	.04*	−.02	−.02	.12*	.05*	.19*	.03	.06*	.15*	----	
20.	BRAT	.09*	.12*	−.03	.06*	.22*	.17*	.24*	.22*	.13*	.17*	.09*	.19*	.13*	.07*	.04	.00	.13*	.16*	.36*	
21.	Knowledge	−.14*	−.14*	−.32*	−.08*	−.15*	.01	.17*	.11*	.04	.08*	.14*	−.03	.16*	.09*	.21*	.20*	.08*	.11*	.28*	.16*

Note. Bivariate correlations between study variables. Spearman's rho was calculated for all analyses including tanning bed or tanning. Tann. Bed = Tanning Bed, Pants/Sleev = Pants/Sleeves, Peak Exp. = Peak Exposure, Ann. Chck = Annual Check-up.

* $p < .05$

Table 4.

Partial Correlations between CIO and Behavioral Variables

	Split Variable	Tann. Bed	Tanning	Sunsc	Reapply	Pants/Sleev	Peak Exp.	Shade	Hat	Glasses	Ann. Chck	Know
CIO												
		.11*	.10*	−.01	−.03	.02	.03	.02	.07*	.04	−.05*	−.14*
	Male	.16*	.11*	.05	.05	.06*	.06*	.06*	.10*	.08*	−.03	−.14*
	Female	.06*	.08*	−.08*	−.10*	−.03	−.02	−.02	.03	−.01	−.06*	−.12*
	HS or less	.08	.05	−.03	−.01	.07	.04	.07	.09*	.04	−.04	−.08*
	Beyond HS	.12*	.10*	−.01	−.03	−.01	.02	.01	.06*	.03	−.05*	−.16*
	White	.12*	.08*	−.05*	−.05*	.01	.02	.03	.08*	.03	−.06*	−.14*
	Not White	.04	.13*	.13*	.07	.11*	.07	.01	.05	.08	.01	−.13*
	Low Risk	.04	.08*	−.01	−.03	.03	.03	.02	.01	−.01	−.03	−.13*
	Mod. Risk	.04	.09*	−.02	−.08*	−.05	−.04	−.03	.06	.00	−.06	−.06
	High Risk	.19*	.07	−.02	.02	.04	.07	.07	.17*	.14*	−.10*	−.22*

Note. Partial correlations between CIO and behavioral variables controlling for age, sex, education, income, race, and BRAT.

* $p < .05$