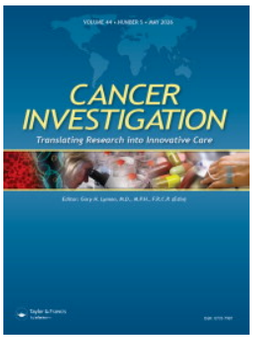

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Studying the Relations of Behavioral Inhibition and Activation System Sensitivities and Time Perspective Orientations with Skin Cancer Screening Behaviors in Older Adults: Do Skin Cancer Screening Perceptions Mediate These Relations?

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ABSTRACT

To advance current research on skin cancer screening perceptions and behaviors, we investigate two distinct but related theoretical perspectives: (1) the behavioral inhibition and activation system and (2) time perspective orientations. Utilizing a sample of older adults (age >55), our results show that behavioral activation system sensitivities do not relate to skin cancer screening perceptions or behaviors, whereas behavioral inhibition system sensitivities produce offsetting effects. Our results also show that Past Positive and Present Fatalistic orientations produce a positive and a negative relation with skin cancer screening behaviors, respectively, but Future orientation surprisingly does not relate to skin cancer screening perceptions or behaviors.

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Skin cancer screening, Behavioral inhibition system, Behavioral activation system, Time perspective orientations, Preventive health behavior, Perceived barriers, Older adults, Melanoma prevention

Skin cancer is the most commonly occurring type of cancer in the United States (1–3). About 9,500 people are estimated to be diagnosed with skin cancer and over 20 people are estimated to die from melanoma alone every day in the United States (4–7). Fortunately, when detected and treated early, the five-year survival rate of the deadliest form of skin cancer, melanoma, is 99 percent (8), and yearly full body skin cancer screenings with a medical professional are among the most effective preventative measures to identify early stages of skin cancer (9–14). While evidence is not robust enough to recommend annual skin cancer screenings with a medical professional for all individuals (15), many medical organizations recommend that at-risk individuals, such as those with a history of cancer and older adults, should undergo yearly screenings (16–21). Unfortunately, most at-risk people do not undergo yearly skin cancer screenings. Miller et al. (22) found that only 9% of cancer survivors underwent a physician-based skin cancer screening in the past two years, and Coups et al. (23) found that only 16% of men and 13% of women above the age of 50 had a skin cancer screening in the past year. From these observations and similar others (e.g., 24), recent authors have called for investigations into why at-risk people do not undergo potentially life-saving yearly skin cancer screenings, as significantly fewer deaths could occur each year with this simple practice.

To better understand why people do not receive yearly skin cancer screenings, Howard (25) developed the Perceptions of Annual Skin Cancer Screening Scale (PASCSS). This measure is intended to assess the primary perceived barriers to receiving yearly skin cancer screenings, and it contains 12 dimensions (Table 1). Howard (25) supported that these 12 dimensions relate to whether participants reported receiving a skin cancer screening beyond other relevant predictors, such as the perceived likelihood and severity of skin cancer. More recently, Howard (26)

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Table 1. Perceptions of skin cancer screening scale dimensions and definitions.

Dimension	Definition – each begins with, "the perception that annual skin cancer screening is.. ."
1) Cost	Expensive.
2) Time	Hard to fit in a schedule.
3) Not needed	Not useful for health.
4) Not at risk	Not needed for healthy people.
5) Inconvenient	Quite a hassle.
6) Forget	Easy to not remember.
7) Undesirable outcomes	Frightening because of potential bad news.
8) Undesirable interactions	Frightening due to interacting with doctors.
9) Access	Not available nearby.
10) Unknowledgable	Something that not known about.
11) Never recommended	Something that was never suggested.
12) Uncomfortable	Awkward.

supported that the PASCSS produces appropriate psychometric and validity evidence in the largest at-risk population for skin cancer, older adults (age $\geq$55) (27,28). The author also supported that the PASCSS relates to receiving a yearly skin cancer screening more strongly in older adults than the general population of adults (26). Therefore, the PASCSS is a promising approach to understand why people may or may not undergo yearly skin cancer screenings, including at-risk individuals.

A primary impetus of creating the PASCSS was to capture the appropriate nuance in perceptions of skin cancer screenings to meaningfully advance relevant theory. Due to its nascency, no theoretical perspective has been studied with the PASCSS, leaving it unclear how the multidimensional study of perceptions can alter theory – or how theory can enable a better understanding of skin cancer screening perceptions. To resolve this tension in the literature, the current article investigates two distinct but related theoretical perspectives that are particularly relevant to perceptions. We first assess whether the PASCSS dimensions mediate the relations of behavioral inhibition system sensitivities (BISS) and/or behavioral activation system sensitivities (BASS) with yearly skin cancer screening behaviors. The BISS and BASS are associated with the tendency to either avoid negative outcomes or approach positive outcomes, respectively, and we expect that the BISS but not BASS may produce significant indirect effects due to the desire to avoid skin cancer by undergoing a screening (29,30). We second assess whether the PASCSS dimensions likewise mediate the relations of Zimbardo and Boyd's (31,32) time perspective orientations with yearly skin cancer screening behaviors. These time perspectives include orientations associated with focusing on the past, present, or future (33). We anticipate that the orientation associated with the future will produce a significant indirect effect due to yearly skin cancer screenings primarily benefiting future selves (34,35). By studying these two theoretical perspectives, we determine whether focusing on negatives or positives and/or focusing on the past, present, or future causes people to be more likely to undergo skin cancer screenings. We also leverage theoretical perspectives of rational behavior to provide further justification for our proposed mediating effects, resulting in theoretical integrations that can guide future research.

To test these proposals, we report a study to assess whether the PASCSS dimensions mediate the relations of the BISS, BASS, and time perspective orientations with yearly skin cancer screening behaviors. We use a time-separated design to lessen method biases (36), and we collect a sample of older adults (age $\geq$55). As older adults are the largest at-risk population for skin cancer, understanding the dynamics of skin cancer screening in this population can provide exponentially larger benefits than investigating the general population (16,27,28,37).

By conducting this study, the current article provides several benefits for research and practice. First, we provide evidence of whether two important theoretical perspectives can inform research on skin cancer screening. If the associated constructs relate to either skin cancer screening perceptions or behaviors, we broaden possibilities for future research directions by enabling more nuanced applications of these theories, as these perspectives have yet to be linked to either skin cancer screening perceptions or

behaviors. Second, if the constructs do not relate to our studied outcomes, then we redirect future researchers to other perspectives that may be more fruitful. Third, researchers have called for more integrative tests of theory, as too often constructs significantly relate to relevant outcomes in isolation but produce non-significant results when studied together. By simultaneously investigating our two theoretical perspectives, we provide a more robust assessment and better ensure that our observed relations are replicable. Fourth, by also integrating theoretical perspectives of rational behavior, we provide insights into whether conscious perceptions may be pivotal explanatory mechanisms between antecedent and skin cancer screening behaviors. If supported, these perspectives may be essential to developing further models of skin cancer screening and broader preventive behaviors. Fifth, because the PASCSS was only recently created, the current article provides much-needed support for the benefits of its underlying conceptualization, as we assess whether it relates to pertinent outcomes beyond other relevant predictors. Sixth, our results are informative for the creation of interventions. Any significant relations can be targeted in attempts to encourage people to undergo yearly skin cancer screenings, providing actionable implications for practice.

Background

Skin cancer screening perceptions and behaviors

Due to the benefits of yearly skin cancer screenings for high-risk individuals, many authors have investigated predictors of engaging in this preventive behavior (24,38–40). These studies have used large datasets to identify subsets of people who are less likely to receive yearly skin cancer screenings, testing predictors such as age, gender, ethnicity, and location (38,41). Recent studies have followed trends in broader research on preventive behaviors to investigate psychological processes that influence whether people receive yearly skin cancer screenings, recognizing that these processes provide deeper insights and predictive utility than individual differences alone (25,26,39,40).

The study of skin cancer screening perceptions has shown to be particularly promising. Perceptions are immediate antecedents to behavior in an array of supported models of behavioral decision-making, and they are particularly relevant to theoretical perspectives of rational behavior (discussed below) (42–44). Authors have empirically supported that perceptions strongly predict related behaviors beyond other relevant predictors (45–47). For this reason, understanding the role of perceptions in undergoing yearly skin cancer screenings can enable researchers to better understand why people may or may not engage in this behavior, potentially resulting in the development of increasingly effective interventions to target these perceptions.

Further, perceptions regarding specific behaviors are known to be multidimensional, and people can have multiple – and even conflicting – perceptions about the same behavior. Recognizing this, Howard (25) developed the PASCSS. The PASCSS contains twelve distinct dimensions, each representing a different perception about yearly skin cancer screening. Table 1 includes descriptions of dimensions. In their original study, the author found that the dimensions of Cost, Unknowledgable, Forget, and Inconvenient were the strongest predictors of skin cancer screening behaviors (25). In a more recent investigation, Howard (26) found that Unknowledgable, Forget, and Not Recommended were the strongest predictors.

In the current article, we assess whether all dimensions of the PASCSS are mediators between the constructs of our theoretical perspectives and skin cancer screening behaviors, which aligns with theories of rational behavior (48,49). This theoretical perspective suggests that people rationally weigh the costs and benefits of their actions. While cognitive biases cause some deviations to occur, people nevertheless largely follow their positive or negative perceptions regarding a behavior. For this reason, it could be expected that any broader antecedent effect to skin cancer screening would influence this outcome via perceptions. That is, individual differences may paint how people view skin cancer screening, causing people to systematically hold better or worse perceptions of the behavior. These systematic

impacts on perceptions may ultimately impact the performance of skin cancer screening behaviors, as people cognitively choose whether to participate in yearly skin cancer screenings. Therefore, it is expected that the individual differences discussed below produce an indirect effect on skin cancer screening behaviors via the mediators of skin cancer screening perceptions.

Of the PASCSS, we expect the dimensions of Cost, Unknowledgable, Forget, Inconvenient, and Not Recommended to produce mediating effects between our predictors and skin cancer screening behaviors, due to the support for these dimensions in Howard (25,26). At the same time, we holistically investigate these constructs. We test whether each dimension produces specific indirect effects, but we also test whether the dimensions together produce total indirect effects. By doing so, we determine whether certain skin cancer screening perceptions and/or perceptions in general mediate our studied relations. This approach has been increasingly recommended by methodologists, as it simultaneously allows for the investigation of individual mediators and the broad assessment of all mediators together (50–52).

Behavioral inhibition and activation systems

Gray (53,54) proposed that humans possess two primary neurobiological systems that determine their reactions to relevant environmental cues (55,56), which has been repeatedly supported across a multitude of studies and methodological designs. These two systems are the behavioral inhibition system and the behavioral activation system (53,54). The behavioral inhibition system regulates responses to punishment and nonreward, whereas the behavioral activation system regulates responses to reward and nonpunishment (30,57–59). When discussing these systems, punishments and rewards refer to negative and positive environmental cues, whereas nonpunishment and nonrewards refer to the removal of negative and positive environmental cues. To clarify, the behavioral inhibition system would activate if a person stopped receiving a reward for a behavior for which they typically receive a reward (nonreward), whereas the behavioral activation system would activate if a person stopped receiving a punishment for a behavior for which they typically receive a punishment (nonpunishment). Further, humans have differing brain structures that are separately dedicated to the behavioral inhibition system and the behavioral activation system, which enables these two neurobiological systems to operate relatively independently (60–62). In turn, a person could have separate neurological responses simultaneously occurring to both receiving a reward and a punishment, such as for example, a teenager receiving praise from one parent and criticism from the other.

These two differing cognitive systems also cause BISS and BASS (63–65). BISS represents a person's habitual tendency to be attuned to punishments and nonrewards, whereas BASS represents a person's habitual tendency to be attuned to rewards and nonpunishments (57,66,67). A person high in BISS would be more likely to strive to avoid punishments, such as failing a test. They would also be more sensitive to punishments, and they may have more detrimental effects on their psychological well-being from punishments. A person high in BASS would be more likely to strive to obtain rewards, such as receiving a perfect score on a test. They would also be more sensitive to rewards, and they take greater satisfaction from receiving a reward. Because the behavioral inhibition and activation systems operate via separate cognitive structures, a person can simultaneously possess both greater BISS and BASS.

Some authors have linked certain preventive behaviors to these sensitivities, such as exercise and vaccination (68,69). In general, these authors have argued that people with greater BISS are more likely to engage in preventive behaviors, as these behaviors are often performed to avoid some future negative outcome. For instance, a person exercises to reduce their risk of chronic disease, and a person receives a vaccine to avoid being sick in the future. We propose the same is true for yearly skin cancer screenings. People undergo yearly skin cancer screenings because they are concerned about the possibility of having skin cancer, which would be a punishment. Because those with greater BISS are more sensitive to punishments and go to greater lengths to avoid punishments, we suggest that those greater

in BISS are less likely to have negative perceptions about yearly skin cancer screenings.

In agreement with theories of rational behavior (48,49), we also argue that individuals with greater BISS are more likely to undergo yearly skin cancer due to their fewer negative perceptions. That is, these individuals systematically hold fewer negative perceptions of skin cancer screening behaviors, as they are particularly focused on the potential punishment of having undetected skin cancer. Theories of rational behavior suggest that people weigh the benefits and detriments of their actions (48,49). Because those with greater BISS hold fewer negative perceptions of skin cancer screening behaviors, they are more likely to view skin cancer screening as having greater benefits and fewer detriments, being more likely to choose to perform the behavior. Therefore, we hypothesize that skin cancer screening perceptions mediate the positive relation of BISS and skin cancer screening behaviors.

Alternatively, skin cancer screenings have fewer associations with rewards, and fewer authors have associated preventive behaviors with sensitivities to rewards (i.e., BASS). For these reasons, we do not expect this sensitivity to relate to skin cancer screening perceptions or behaviors, and we do not propose a hypothesis regarding BASS. Instead, we include BASS in our analyses in an exploratory manner and to control for variance it may explain in our outcome.

Hypothesis 1: Behavioral inhibition system sensitivities indirectly relate to yearly skin cancer screening behaviors via the skin cancer screening perception dimensions.

Authors have long recognized that people differ in how they think about time (70–72). Some people may be particularly focused on the past, such as reflecting on good times or ruminating on how decisions could have been made differently. Others may be wholly engrossed in the present moment, which has become more popular with the rise of mindfulness. Finally, the remaining people may be especially concerned about the future, and they may look forward to or even worry about their future lives.

These differing orientations are a basis of Zimbardo and Boyd's (31,32) time perspective orientations, which they considered "often nonconscious process whereby the continual flows of personal and social experiences are assigned to temporal categories, or time frames, that help to give order, coherence, and meaning to those events" (31, p. 18). The authors suggested that people base their perceptions and make decisions based on temporal orientations, such that people are either immersed in memories (past), the immediate situation (present), or impending events (future) (33,73).

A person's time perspective partially determines their reactions and behaviors (73–75). A person with a strong past orientation may reflect on outcomes of their prior behaviors, whereas a person with a strong Future orientation may anticipate outcomes of their future behaviors. While less research has associated time perspectives with preventive behaviors than behavioral inhibition and activation sensitivities, authors have initially supported that those with a stronger Future orientation are more likely to engage in preventive behaviors (76,77). These individuals may think more about the consequences of their actions for their future selves, and they may be more willing to engage in behaviors to protect their future selves than others.

We propose that the same is true for yearly skin cancer screening. Those with a stronger Future orientation are more likely to see benefits in behaviors that benefit their future selves (31,32). While skin cancer screening behaviors may require people to devote time in the present moment, these behaviors benefit future selves by maintaining health and preventing future developments of skin cancer. For this reason, those with a stronger Future orientation may be more likely to have more positive perceptions of yearly skin cancer screening, as they particularly value the positive outcomes for future selves. Further, we suggest that those with a stronger Future orientation are more likely to undergo yearly skin cancer screenings due to their more favorable perceptions, aligning with theories of rational behavior (48,49). Because these people are believed to particularly value benefits to future selves, these people are more likely to see positives in yearly skin cancer screenings, which are likewise more likely to outweigh the perceived detriments. When consciously weighing these features, those with a stronger Future orientation are more likely to undergo

yearly skin cancer screenings. Therefore, skin cancer screening perceptions are proposed to mediate the relation of Future orientation and skin cancer screening behaviors.

Researchers have intermittently found relations between past and present orientations with preventive behaviors (76,77), but fewer justifications are evident for these findings. For this reason, we do not provide hypotheses regarding past or present time perspective, as we do not particularly expect them to relate to skin cancer screening perceptions or behaviors. We do include past or present time perspective in our analyses in an exploratory manner and to control for variance they may explain in our outcome.

Hypothesis 2: Future time perspective indirectly relates to yearly skin cancer screening behaviors via the skin cancer screening perception dimensions.

Method

Participants

Participants[1] (Age_{mean} = 63.11, Age_{SD} = 6.45, 62% female, 95% white, 1% Asian, 3% other races, 100% United States) were recruited from Prolific for monetary compensation. Prolific is an online platform that connects researchers with potential participants (in addition to other services). This platform regularly requires participants to provide proof of identification to ensure authenticity in responses, and prior research has supported that it provides high-quality data when certain precautions are taken (78–80). We took those precautions in the current study. We removed participants that failed more than one attention check (e.g., "Please mark agree to show that you are paying attention"), and we restricted participation to our desired sampling frame. Participants must have been above the age of 55, located in the United States, and did not self-identify as Black to participate.

The methodological decision to not include Black participants should be clarified. It is common to perform separate studies on white and Black participant when studying predictors of skin cancer screening (23,81,82), as rates of skin cancer differ greatly between these populations. For instance, it is estimated that the lifetime risk of developing melanoma is 1 in 1,000 for Black participants and 1 in 38 for white participants (83). Due to these large differences in base rates, the predictors of skin cancer screening are likely to differ between the two populations. Because skin cancer is more common for white participants, they may be more likely to have routine skin cancer screening recommended to them later in life, and they may have more general awareness about skin cancer screenings; because skin cancer is less common for Black participants, they may not have skin cancer screenings recommended to them, and they may have less general awareness about skin cancer screenings. These potential differences in experiences regarding skin cancer screening may cause theories to function differently between the two populations

Any differences in predictors of skin cancer screening would not be observed if both populations were included in the same sample. For this reason, it is more common for researchers to investigate predictors for each population in separate articles, such that sufficient attention could be provided to each population. By doing so, researchers can more fully model relevant predictors and theoretical perspectives for each population, rather than their effects being obfuscated when tested together in a single study. This approach is also preferred to assuming that results obtained with a certain population generalize to other populations, as these generalizations cannot be assumed. Therefore, studying predictors of skin cancer screenings is important for both populations, and researchers should study the currently tested predictors in both populations separately. While our study investigates white participants, a clear direction for future research is to assess the same relations with a sample of Black participants.

Measures

Behavioral inhibition and activation systems

We administered the widely used 20-item scale of Carver and White (57), which has been

[1]The present sample was also used in XXXXXX (masked for blinded peer review), which did not report any relations of BISS, BASS, or the time perspective orientations.

supported across multiple studies. This scale includes 7 items for BISS and 13 items for BASS. An example item is, "I worry about making mistakes" (BISS), and the Cronbach's alphas of the two dimensions were .88 or above.

Time perspectives

We used a 15-item version of the Zimbardo Time Perspective Inventory, which was created and supported by Zhang et al. (33) in a multiple study process. This measure includes three items for each of five dimensions: Past Positive, Past Negative, Present Hedonism, Present Fatalism, and Future. We removed one item from the Present Fatalism dimension to improve its Cronbach's alpha, as the initial estimate was low. An example item is, "I complete projects on time by making steady progress" (Future). Aside from Present Fatalism ($\alpha = .47$), all dimensions produced a Cronbach's alphas of .72 or larger.

Skin cancer screening perceptions

We used the PASCSS, which includes four items for each of 12 dimensions (Table 1). Howard (25,26) provided ample psychometric and validity evidence for this measure across multiple samples. This measure asks participants to read each item as if it began with, "If I do not get a yearly full-body skin cancer screening with either a primary care provider or dermatologist, it is because … " An example item is, "I do not have the money to do so" (Cost). All dimensions produced a Cronbach's alpha of .83 or larger.

Yearly skin cancer screening behavior

Participants were asked "Have you had a full body skin cancer screening in the past year with a primary care provider, dermatologist, or any other medical professional?" This item was coded as Yes (1) and No (0). We also asked participants whether they had undergone a skin cancer screening with a dermatologist specifically, but this item correlated .91 ($p < .01$) with the item above. Due to being almost statistically identical, we only provide results for skin cancer screening in general, and all results are consistent when studying skin cancer screening with a dermatologist as the outcome.

Procedure

Participants enrolled via the Prolific and completed the first survey, which included the measures of behavioral inhibition and activation systems and time perspectives ($n = 282$). One week later, participants completed a second survey including the measure of skin cancer screening perceptions ($n = 256$). One week after the second survey, participants completed a third survey the included the yearly skin cancer screening behavior item ($n = 233$). Our dataset is provided in Supplemental Material A.

Analysis

We calculated correlations and binominal regression analyses in jamovi 2.3.18 to assess the relation of our predictors with yearly skin cancer screening behaviors. Our primary analyses were conducted using partial least squares structural equation modeling (PLS–SEM) in SmartPLS 4. PLS–SEM effectively models non-continuous outcomes, such as our indicator of skin cancer screening behaviors. We followed modern recommendations when performing these analyses (51,84–86). We first tested the measurement portion of our model via confirmatory composite analysis (87), and we then tested the structural portion approaches once the measurement portion was confirmed. We utilized a percentile bootstrapping approach when calculating our estimates.

In testing our model, we simultaneously assessed all relations. Our model included BISS, BASS, and the time perspective dimensions predicting each skin cancer screening perception, and each skin cancer screening perception predicted yearly skin cancer screening behavior. Because we did not have a firm rationale for full or partial mediation, we also modeled BISS, BASS, and the time perspective dimensions to predict yearly skin cancer screening behaviors, as this approach tests for full or partial mediation. Via these analyses, we estimate each relation while accounting for each construct, providing robust assessments of our hypotheses. Lastly, we tested three models. Our primary text reports our results when simultaneously testing all relations.

Supplemental Material B reports our model results when only testing the relations of BASS and BISS with skin cancer screening perceptions and behaviors, whereas Supplemental Material C reports our model results when only testing the relations of time perspective with skin cancer screening perceptions and behaviors. By testing these alternative models, we provide focused results for readers who may be interested in one theoretical perspective alone.

Results

Measurement model

Table 2 provides the correlations and Cronbach's alphas, whereas Table 3 provides binominal regression analysis results. In our PLS-SEM model, we began by inspecting our factor loadings. A BASS item produced a weak factor loading (<.40), which we removed. The AVE of each construct was strong (≥.61), with the exception of BASS (.38). Because BASS was measured using an established scale (57), we chose not to remove any further items to reduce the potential of substantially altering the representativeness of the measure (e.g., construct deficiency)[2]. The composite reliability of each construct was strong (≥.78), supporting the measures' internal consistency. The confidence interval of each HTMT ratio excluded 1.00, supporting the measures' discriminant validity. Together, these results support the measurement portion of our model and indicate that assessing the structural portion is appropriate.

Structural model

No VIF statistics were above the standard cutoff of 3.00, indicating that multicollinearity was not an issue in our analyses (51,84,86).

Skin cancer screening perceptions

Three skin cancer screening perceptions significantly related to skin cancer screening behaviors: Unknowledgable ($\beta = -.07$, $SD = .03$, $t = 2.34$, $p = .02$), Never Recommended ($\beta = -.07$, $SD = .03$, $t = 2.28$, $p = .02$), and Forget ($\beta = -.07$, $SD = .03$, $t = 2.59$, $p < .01$). Any significant total indirect effects of our predictors are primarily through these three dimensions, and any significant specific indirect effect would be through one of these three dimensions.

BISS and BASS

Table 4 provides our estimates of indirect effects. BISS significantly related to 8 of 12 skin cancer screening perception dimensions (all $p < .05$), and it significantly related to skin cancer screening behaviors ($\beta = .06$, $SD = .02$, $t = 2.46$, $p = .01$). BISS produced a significant total indirect effect on skin cancer screening behaviors ($estimate = -.06$, $SD = .02$, $t = 3.43$, $p < .01$) but not in the anticipated direction. These results fail to support Hypothesis 1, as BISS produced a negative indirect effect on skin cancer screening behaviors. To probe this finding, we tested specific indirect effects. BISS did not produce a significant indirect effect via any specific skin cancer screening perception (all $p > .05$). This finding indicates that the total indirect effect was produced by the cumulative indirect effects via multiple dimensions, rather than one dimension producing a large specific indirect effect. Lastly, the total effect of BISS on skin cancer screening behaviors was not statistically significant ($estimate = -.01$, $SD = .03$, $t = 0.01$, $p = 1.00$), indicating that the negative total indirect effect offset the positive direct effect.

BASS did not significantly relate to any skin cancer screening perception dimensions or skin cancer screening behaviors, and it did not produce any significant total or specific indirect effects (all $p > .05$). Likewise, BASS's total effect was not statistically significant ($p = .62$).

Time perspectives

Future orientation did not significantly relate to any skin cancer screening perception dimensions (all $p > .05$) or skin cancer screening behaviors (all $p > .05$). Future orientation did not produce a significant total indirect effect on skin cancer screening behaviors ($estimate = -.02$, $SD = .02$, $t = 1.49$, $p = .14$). Hypothesis 2 was not

[2]We reanalyzed our results when removing BASS items to improve the scale's AVE. All inferences were consistent between our primary analyses and these alternative analyses, supporting the robustness of our results.

Table 2. Correlations and Cronbach's alphas of study variables.

	1	2	3	4	5	6	7	8	9	10
1) BISS	.89									
2) BASS	.06	.88								
3) Past negative	.55**	.03	.90							
4) Past positive	−.07	.20**	−.18**	.80						
5) Present fatalism	.16**	.04	.28**	−.09	.47					
6) Present hedonism	−.04	.62**	.01	.10	.15*	.75				
7) Future	−.16**	.21**	−.23**	.20**	−.26**	−.10	.72			
8) Cost	.09	−.03	.10	−.03	.10	.00	.03	.97		
9) Time	.12	.05	.14*	−.04	.15*	.17**	−.10	.42**	.93	
10) Not needed	.00	.08	−.03	−.07	.03	.11	−.00	.26**	.37**	.88
11) Not at risk	.08	.08	−.09	−.10	−.02	.06	.08	.19**	.24**	.62**
12) Inconvenient	.18**	.04	.17**	−.07	.14*	.10	−.09	.32**	.61**	.58**
13) Forget	.14*	.03	−.01	−.09	.04	.04	.04	.34**	.35**	.61**
14) Undes. Outcomes	.32**	.10	.30**	−.03	.25**	.13*	−.15*	.31**	.35**	.16**
15) Undes. Interactions	.18**	.07	.19**	−.09	.20**	.07	−.10	.41**	.48**	.50**
16) Access	.14*	.03	.13*	−.13*	.21**	.08	−.10	.52**	.55**	.32**
17) Unknowledgable	.22**	.07	.12	−.11	.11	.14*	−.03	.29**	.22**	.33**
18) Never recommended	.19**	−.01	.14*	−.17**	.07	.01	.01	.25**	.16*	.32**
19) Uncomfortable	.23**	.03	.16**	−.11	.08	.08	−.10	.21**	.36**	.36**
20) Any screening	.02	.05	−.03	.13	−.12	.01	−.09	−.30**	−.22**	−.35**

	11	12	13	14	15	16	17	18	19	20
11) Not at risk	.91									
12) Inconvenient	.40**	.92								
13) Forget	.65**	.58**	.93							
14) Undes. Outcomes	.21**	.35**	.24**	.97						
15) Undes. Interactions	.48**	.58**	.48**	.46**	.86					
16) Access	.22**	.55**	.36**	.34**	.48**	.83				
17) Unknowledgable	.37**	.34**	.56**	.34**	.25**	.38**	.96			
18) Never recommended	.42**	.31**	.53**	.34**	.30**	.32**	.69**	.97		
19) Uncomfortable	.32**	.52**	.40**	.41**	.52**	.43**	.30**	.31**	.93	
20) Any screening	−.43**	−.34**	−.53**	−.22**	−.34**	−.33**	−.50**	.51**	−.27**	–

Note. Cronbach's alpha is listed on the diagonal.
Undes. = Undesirable
*$p < .05$.
**$p < .01$.

Table 3. Binominal regression results of study variables.

	OR	OR	OR	OR	OR	OR	OR
1) BISS	1.02			1.03	1.37		1.33
2) BASS	1.14			1.41	1.45		2.03
3) Past negative		.99		.95		1.08	.88
4) Past positive		1.44*		1.39		1.08	.96
5) Present fatalism		.67*		.66*		.67	.63
6) Present hedonism		1.01		.81		1.34	.91
7) Future		.61*		.55*		.51*	.39*
8) Cost			.84		.89	.89	.97
9) Time			1.38		1.34	1.19	1.14
10) Not needed			1.11		1.16	1.12	1.10
11) Not at risk			.87		.90	.86	.85
12) Inconvenient			.82		.82	.84	.93
13) Forget			.60*		.60*	.61*	.58*
14) Undes. Outcomes			1.20		1.12	1.19	1.18
15) Undes. Interactions			.89		.84	.85	.82
16) Access			.73		.70*	.79	.76
17) Unknowledgable			.68*		.65*	.62*	.60**
18) Never recommended			.81		.81	.80	.79
19) Uncomfortable			1.09		1.09	.73	1.05
McFadden R^2	.00	.04*	.39**	.05	.43**	.44**	.46**

Note. OR = odds ratio; Undes. = Undesirable.
*$p < .05$.
**$p < .01$.

Table 4. Estimates of specific and total indirect effects.

	BISS	BASS	PN	PP	PF	PH	*F*
1) Cost	−.00	.00	−.00	.00	−.00	.00	−.00
2) Time	.00	−.00	−.00	.00	.00	.00	−.00
3) Not needed	.00	.00	−.00	−.00	.00	.00	.00
4) Not at risk	−.01	−.00	.01	.01	.00	−.00	−.00
5) Inconvenient	−.00	−.00	−.00	.00	−.00	−.00	−.00
6) Forget	−.02	−.00	.01	.01	−.00	−.00	−.01
7) Undes. Outcomes	.00	.00	−.00	−.00	.00	−.00	.00
8) Undes. Interactions	−.00	−.00	−.00	.00	−.00	.00	−.00
9) Access	−.00	−.00	.00	.00	−.00	−.00	.00
10) Unknowledgable	−.02	.00	.00	.01	−.00	−.01	−.00
11) Never recommended	−.01	.00	−.00	.01	−.00	−.00	−.01
12) Uncomfortable	−.00	−.00	.00	.00	.00	−.00	.00
13) Total indirect effect	−.06**	−.00	.02	.04**	−.02	−.02	−.02

Note. First 12 rows represent the specific indirect effect estimate, whereas final row represents the total indirect effect estimate. Predictor listed in column, and mediator listed in row.
PN = Past Negative; PP = Past Positive; PF = Present Fatalistic; PH = Present Hedonistic; F = Future.
*$p < .05$.
**$p < .01$.

supported, as Future orientation did not produce a significant indirect effect on skin cancer screening behaviors. Future orientation did produce a significant total effect (*estimate* = −.07, *SD* = .03, $t = 2.27$, $p = .02$), indicating that the modest direct and indirect effects cumulatively produced a sizable total effect.

Past Negative orientation significantly related to Not at Risk ($\beta = -.21$, *SD* = .07, $t = 3.01$, $p < .01$) and Forget ($\beta = -.16$, *SD* = .07, $t = 2.25$, $p = .02$); Past Positive orientation significantly related to

Access ($\beta = -.11$, $SD = .05$, $t = 2.02$, $p = .04$), Not at Risk ($\beta = -.15$, $SD = .06$, $t = 2.39$, $p = .02$), Not Needed ($\beta = -.12$, $SD = .06$, $t = 2.03$, $p = .04$), Never Recommended ($\beta = -.17$, $SD = .06$, $t = 2.77$, $p < .01$), and Forget ($\beta = -.14$, $SD = .06$, $t = 2.35$, $p = .02$); Present Fatalism orientation significantly related to Access ($\beta = .15$, $SD = .06$, $t = 2.42$, $p = .02$) and Undesirable Outcomes ($\beta = .15$, $SD = .06$, $t = 2.44$, $p = .01$); and Present Hedonistic significantly related to Unknowledgable ($\beta = .17$, $SD = .08$, $t = 2.54$, $p = .01$). No time perspectives produced a significant direct effect on screening behaviors (all $p > .05$).

Present Fatalism, Present Hedonistic, and Past Negative orientation did not produce significant total indirect effects on skin cancer screening behaviors (all $p > .05$), but Past Positive orientation produced a significant total indirect effect on screening behaviors (*estimate* = .04, $SD = .02$, $t = 2.60$, $p < .01$). No time perspective dimension produced a significant specific indirect effect (all $p > .05$), which indicates that the total indirect effect of Past Positive orientation was produced by the cumulative specific indirect effects via multiple dimensions. Past Positive (*estimate* = .05, $SD = .03$, $t = 2.18$, $p = .03$) and Present Fatalist orientation (*estimate* = −.05, $SD = .02$, $t = 2.16$, $p = .03$) both produced significant total effects, whereas Past Negative and Present Hedonic orientation did not (all $p > .05$).

Discussion

The primary goal of the current article was to assess whether representative constructs of two distinct but related theoretical perspectives produce indirect effects on skin cancer screening behaviors via skin cancer screening perceptions in a sample of older adults. We hypothesized that BISS but not BASS indirectly relates to skin cancer screening behaviors via skin cancer screening perceptions. We also hypothesized that Future orientation likewise indirectly relates to skin cancer screening behaviors via skin cancer screening perceptions, but we also proposed that no other time perspective orientation significantly relates to skin cancer screening behaviors.

We conducted a time-separated survey of older adults to test our hypotheses. Our results supported that BISS produced a positive direct effect and a negative total indirect effect via the skin cancer screening perceptions together, resulting in a non-significant total effect on skin cancer screening behaviors. These results suggest that BISS causes people to perceive both positives in preventing skin cancer from undergoing a skin cancer screening (positive direct effect) and negatives in the screening itself (negative indirect effect via PASCSS dimensions). In other words, people may see negatives in both skin cancer and skin cancer screenings, discussed in further detail below. Because the significant indirect effect was not in the anticipated direction, Hypothesis 1 was not supported. Consistent with our expectations, BASS did not significantly relate to any skin cancer screening perception or skin cancer screening behaviors.

Our results also supported that Future orientation did not produce a significant direct or total indirect effect via the skin cancer screening perceptions; however, these modest effects together produced a significant and negative total effect, the direction of which was also contrary to expectations. This finding indicates that no specific mediating effect was predominant in explaining the relation of Future orientation on skin cancer screening behaviors, but multiple small indirect effects together explain this relation. Nevertheless, Hypothesis 2 was not supported, as the effect direction did not align with expectations. The other time perception orientations each related to several screening perceptions, but only Past Positive orientation produced a significant total indirect effect on skin cancer screening behaviors via the PASCSS dimensions. Likewise, only Past Positive and Present Fatalism produced significant total effects on skin cancer screening behaviors, which were positive and negative, respectively. These results, both expected and unexpected, provide several implications for research and practice.

Theoretical implications and future research directions

Behavioral inhibition and activation systems

The current study found that BISS's effects are more nuanced than expectations (68,69), as it

produced a non-significant total effect from a negative total indirect effect and a positive direct effect. This finding aligns with extant theoretical perspectives on BISS (63–65). Namely, this result suggests that people focus on the detriments of having undetected skin cancer (producing the positive direct effect), and they also focus on the negative aspects of receiving a skin cancer screening (producing the negative indirect effect). Because people who score highly on measures of BISS are known to be more sensitive to punishments, these people may be particularly focused on all the punishments associated with skin cancer screenings – punishments associated with both skin cancer itself and skin cancer screenings. Because these people are sensitive to the negatives of both, they ultimately are no more or less likely to undergo skin cancer screenings than others. Now that our results have provided support for a complex relation between BISS and skin cancer screening perceptions and behaviors, future researchers should perform finer grained analyses of this relation. They should assess explanatory mechanisms of the positive direct effect to ensure that this relation is explained by the fear of skin cancer rather than alternative perceptions or subconscious motivators (88,89). While our suggestions for these effects align with extant research, they must be supported with future empirical data before they can be considered reliable explanations for our observed effects.

Because the current study provided evidence that punishment is a motivator of skin cancer screening perceptions and behaviors, our findings provide justifications for future authors to apply further theories associated with punishment. A multitude of reinforcement theories propose specific effects for punishment that differ from reward, such that people may go to extreme lengths to avoid minor punishments despite the potential for greater reward (89–91). These theories also involve broader explanatory mechanisms, such as the inclusion of emotional responses. For instance, avoidance theories (88,92,93) often suggest that the primary purpose of emotions is to direct humans away from harmful stimuli, which has been generalized to include more abstract concepts (e.g., skin cancer) (94,95). For those high in BISS, their enhanced emotional reactions to skin cancer may motivate them to receive a screening, but their cognitive perceptions about the screening itself may discourage them from engaging in the behavior (producing the overall non-significant effect observed in the current study). This assertion is only a suggestion without data, and future research should test these theories to understand which perspectives are pertinent for annual skin cancer screening.

Our predictions were supported regarding the effects of BASS, as it did not significantly relate to skin cancer screening perceptions or behaviors. People may not see rewards in skin cancer screenings, and those who are focused on rewards are not more likely to undergo annual skin cancer screenings. Theories of rewards may be relatively ineffective in understanding skin cancer screening perceptions and behaviors (96,97). Therefore, our results are not only important because they open directions for future research, but they also narrow directions to enable future research to progress in a more directed manner.

Time perspective orientations

Regarding time perspectives, our findings regarding Future orientation ran contrary to prior results and extant theorizing. Those with a Future orientation are more likely to perform preventive health behaviors because they are concerned with future ramifications, as supported by prior empirical studies (76,77,98). It should be questioned why, not only did Future orientation not positively relate to skin cancer screening behaviors, but it produced a negative total effect on this outcome. Because no PASCSS dimension transmitted a strong indirect effect, our results suggest that a portion of this negative effect was due to those with a stronger Future orientation having more negative perceptions in general about skin cancer screenings. Researchers should seek the explanatory mechanism for the remaining – and larger – portion of variance in this relation.

The results regarding Past Positive and Present Fatalism orientations were also unexpected. Skin

cancer screening perceptions together explained most of the total effect of Past Positive on skin cancer screening behaviors, but no specific perception transmitted a specific indirect effect. Based on this finding, it is possible that those with a Past Positive orientation are more likely to view preventive behaviors more positively in general, and future researchers should assess whether Past Positive positively relates to broader preventive behaviors. Alternatively, Present Fatalism did not produce a significant total indirect effect, indicating that its negative influence on skin cancer screening behaviors was not due to poorer perceptions of this preventive behavior. Those with stronger Present Fatalism orientations are more likely to believe that life outcomes are due to random chance rather than intentional behavior, as this is a core characteristic of the Present Fatalism orientation (31–33). While these people did not report worse perceptions for the efficacy of skin cancer screenings, they may be more likely to feel that their life outcomes are predetermined, and the utility of preventive behaviors may only delay the inevitable. Future researchers should perform focused studies on Present Fatalism, now that we identified it as a time perspective of interest.

Additional theoretical considerations

We applied our two theoretical perspectives because, in part, they both relate to habitual tendencies of reacting to stimuli. Behavioral sensitivities relate to whether people focus on rewards or punishments (30,57,59), whereas temporal orientations relate to whether people focus on the past, present, or future (31–33). Our supplemental analyses testing each theoretical perspective independently produced many marginally significant effects that were not significant in our primary analyses. This finding indicates that our decision to study the frameworks together was appropriate, as these marginally significant effects would be difficult to replicate if interpreted as substantive relations; however, it also suggests that prior research investigating these frameworks in isolation should be reanalyzed. Many investigations may have produced marginal effects that were interpreted as meaningful, but the small portions of variance explained in outcomes by these relevant predictors may become not statistically significant when other relevant – and potentially more relevant – predictors are included. Researchers should perform similar investigations to assess the potential for this occurrence, but they should also develop integrative theories by joining these perspectives. People may be unable to disentangle whether they consider rewards or punishments from whether they consider the past, present, or future (and vice versa), demanding these theoretical perspectives to be integrated.

The present results provided further support for the validity and utility of the PASCSS. This multidimensional conceptualization of skin cancer screening perceptions explains a large portion of variance in reported skin cancer screening behaviors (25,26). Future researchers should continue to integrate novel theoretical perspectives with the PASCSS, as perceptions are central to many theories on preventive behaviors and behavioral decision making. For instance, the COM-B model has been repeatedly used to understand why people (do not) engage in preventive behaviors (99), and the PASCSS can be applied to understand the role of perceptions as a central feature within this model. By performing these investigations, future researchers can identify which theories may lend themselves to understanding skin cancer screening perceptions and behaviors, which may ultimately enable the development of more effective interventions – a practical implication that is discussed below.

Importance of unexpected and nonsignificant results

The importance of unexpected and nonsignificant results should also be highlighted, as the current study included several of both. Our study closely applied modern theory and cited relevant prior results in developing our arguments and hypotheses. In finding unexpected results, our findings indicate that further investigations are needed on these theoretical perspectives to better understand and anticipate the effects of their representative constructs, as extant theorizing is not comprehensive enough to accurately model their effects.

By producing unexpected results, we identify avenues where more research is needed, providing direction for future researchers.

Nonsignificant effects have a five percent likelihood of producing statistically significant results based on random chance alone, due to the nature of frequentist statistics (100). Because academic outlets favor statistically significant results, it is likely that many published findings reflect effects that are nonsignificant in the population but spuriously produced significant findings in a collected sample, which has spurred growing calls for the more frequent publication of nonsignificant results (101,102). These authors argue that our understanding of many relations is inaccurate and overestimates their size, as our interpretations are biased from favoritism toward statistically significant results. By publishing nonsignificant effects, we can ensure a more complete and accurate understanding of our studied constructs, and we echo prior calls for authors to publish more nonsignificant effects.

Practical implications

Three antecedents were supported to have a significant total effect and/or total indirect effect: BISS, Past Positive orientation, and Present Fatalist orientation. Practitioners can focus on these three antecedents to encourage skin cancer screening behaviors. For instance, the negative influence of BISS on skin cancer screening behaviors was via multiple perceptions, but BISS also produced an independent positive effect. Practitioners can identify people who may be particularly sensitive to punishments (i.e., high BISS), and they could relax their concerns regarding skin cancer screenings to address their potential heightened negative perceptions. By doing so, practitioners can harness the positive benefits and negate the negative detriments of BISS, potentially resulting in heightened skin cancer screening behaviors. Similar strategies can be devised for the two time perspective orientations.

Our results provide insights into the creation of adaptive interventions, which apply components to specific participants based on their characteristics to maximum intervention efficacy while reducing cost (103,104). A potential benefit of the PASCSS is to serve as a mechanism to identify when to apply intervention components. We found that Unknowledgable, Never Recommended, and Forget produced significant relations with skin cancer screening behaviors. A practitioner could create an adaptive intervention that began with asking participants their standing on these three dimensions. Those who score highly on any dimension could be provided an intervention to counteract its negative effects. For instance, a person who scores highly on Unknowledgable and Forget could be provided explanatory information about skin cancer screenings (to address Unknowledgable) and a reminder before their appointment (to address Forget); however, they would not be recommended a skin cancer screening if they did not also score highly on Never Recommended, as administering too many intervention components could reduce the efficacy of each and expend more resources (103,104). Therefore, practitioners should investigate these avenues to develop more effective and cost saving interventions.

Limitations

We chose to study two theoretical perspectives together to improve the robustness of our analyses, as authors have lamented that too often constructs produce significant relations in isolation that become non-significant when tested alongside other relevant predictors (105,106). We also provided analyses when testing each theoretical perspective separately. Our inferences were consistent between our primary analyses and these alternative analyses, but these alternative analyses produced many marginally significant relations that were not significant in our primary analyses. Researchers should replicate our findings when integrating further theoretical perspectives. Future research may discover differing findings when studied alongside other theoretical perspectives, and these efforts could satisfy broader calls for replication efforts (105,106).

We applied widely supported scales of our studied constructs, but certain dimensions of these measures did not demonstrate desired psychometric properties. Namely, the Present Fatalism produced a modest Cronbach's alpha,

and the Behavioral Activation Scale produced a modest AVE value. Prior studies (33,57) have made similar observations regarding these two dimensions, suggesting that our sample does not pose idiosyncratic concerns. While this finding supports the robustness of our results, future researchers should replicate the current study with alternative measures. We expect consistent results when utilizing alternative measures, but these replication studies could provide significant support for the robustness of our findings. Future researchers should likewise refine these measures. Although they are widely utilized, revisions may result in scales that produce satisfactory psychometric information, further enhancing the accuracy of these measures.

We used a time-separated research design to reduce method biases, but this design cannot provide robust inferences regarding causal effects. Future researchers should reinvestigate our results using a research design that can better assess causality, such as a panel design (107). By doing so, a more complete assessment of our mediated effects can be obtained.

While yearly screenings may benefit those with a high risk of skin cancer, most organizations do not recommend that all individuals undergo yearly skin cancer screenings with a medical professional, including the United States Preventive Services Task Force (15). Authors have suggested that yearly skin cancer screenings can be problematic if too widespread, as it could result in overdiagnosis and unneeded patient anxiety (108,109). For this reason, the current inferences and suggestions should not be overgeneralized to the general adult population, who should instead perform regular self-examinations for skin cancer (110,111). A Future research direction could be to investigate the relations of self-check perceptions and behaviors in general adults, as this is indeed an important preventative health behavior for the broader population.

Conclusion

The goal of the current article was to test whether two distinct but related theoretical perspectives could provide insights into skin cancer screening perceptions and behaviors. Our results provided a mix of expected and unexpected findings, but they demonstrated that both theoretical perspectives include constructs that are related to both skin cancer screening perceptions and behaviors. These initial results provide significant support for continuing the study of these two perspectives with skin cancer screening perceptions and behaviors, and we identified many directions for future research. Therefore, we believe that the current article is only the first of many on behavioral inhibition and activation systems, Zimbardo's time perspectives, skin cancer screening perceptions and behaviors, and their intersection.

Compliance with ethical standards

- The authors have no conflicts of interest to disclose.
- All research procedures were approved by the IRB of the primary author's institution.
- Written informed consent was not obtained. All procedures were conducted over the internet, and obtaining written informed consent would be the only identifying information that would link participants to the study. To ensure maximum confidentiality and anonymity, we did not obtain participants' written informed consent. By doing so, we were able to ensure that participants could not be traced back to the present investigation, minimizing any harm that could be caused to participants. Not obtaining informed consent for a low-risk online survey study is standard practice.

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