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# Incorporating Immersive Virtual Environments in Health Promotion Campaigns: A Construal Level Theory Approach

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In immersive virtual environments (IVEs), users may observe negative consequences of a risky health behavior in a personally involving way via digital simulations. In the context of an ongoing health promotion campaign, IVEs coupled with pamphlets are proposed as a novel messaging strategy to heighten personal relevance and involvement with the issue of soft-drink consumption and obesity, as well as perceptions that the risk is proximal and imminent. The framework of construal level theory guided the design of a 2 (tailoring: other vs. self) × 2 (medium: pamphlet only vs. pamphlet with IVEs) between-subjects experiment to test the efficacy in reducing the consumption of soft drinks over 1 week. Immediately following exposure, tailoring the message to the self (vs. other) seemed to be effective in reducing intentions to consume soft drinks. The effect of tailoring dissipated after 1 week, and measures of actual soft-drink consumption 1 week following experimental treatments demonstrated that coupling IVEs with the pamphlet was more effective. Behavioral intention was a significant predictor of actual behavior, but underlying mechanisms driving intentions and actual behavior were distinct. Results prescribed a messaging strategy that incorporates both tailoring and coupling IVEs with traditional media to increase behavioral changes over time.

Sugar-sweetened beverages (SSBs) have garnered much negative attention with the increasing concern for rising rates of obesity (Hu & Malik, 2010). The concern regarding obesity lies not solely in weight gain but also in that obesity has been demonstrated as a strong predictor of potentially fatal noncommunicable diseases including cardiovascular diseases and type 2 diabetes (World Health Organization, 2000). In response, a flood of health promotion campaigns have been developed and launched in an effort to counteract the prevalence of SSB consumption. Perhaps one of the greatest challenges that these health promotion campaigns face is communicating the risk of SSB consumption. First, a temporal distance lies between present behaviors and future health consequences, making it difficult to communicate the necessity to regulate present behaviors to avoid negative future consequences. Second, there is a social distance between the individual and the risk presented in the message wherein the individual does not feel that the risk

is relevant to the self. This challenge is magnified with the tendency of individuals to underestimate the self's susceptibility to various diseases relative to others (Weinstein & Lyon, 1999).

Immersive virtual environments (IVEs), digital devices that simulate multiple layers of sensory information so that users are able to see, hear, and feel as if they are in the real world (Blascovich & Bailenson, 2011), offer novel means of addressing the challenges presented by both the temporal and social distances of risk perception. With the help of simulated sensory information, users are able to transcend temporal and physical boundaries of the real world (Ahn, Le, & Bailenson, 2013; Lombard & Ditton, 1997) and experience the negative future consequences of present health behaviors in a personally involving way. The current study explored the potential of taking advantage of such novel affordances of IVEs to augment the effects of an ongoing health promotion campaign to discourage SSB consumption, and investigated the underlying mechanisms that drive behavior change. Furthermore, the persistence of the effects of IVEs on health behaviors was assessed at a delay of 1 week to observe changes in messaging effects over time.

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## THE CONSTRUAL LEVEL THEORY APPROACH TO RISK PERCEPTION

Risk perception, or the subjective evaluation of the likelihood of a negative event, stands at the core of most health behavior research because of its strong correlation to behavioral modification (Brewer et al., 2007). Construal level theory (Liberman & Trope, 1998), which posits that people have distinct psychological associations with events and objects based on perceived temporal and social distances, brings an interesting wrinkle to the discussion of risk perception. According to the theory, merely adjusting the temporal or social frame of a message may lead to different perceptions of the risk without altering message contents.

In terms of temporal distance, the theory has demonstrated that temporal distance enhances positivity toward an event as individuals have a more “rosy” view of distant futures (Trope, Liberman, & Wakslak, 2007). Conversely, individuals who perceive a risk to be temporally proximal intend to modify their behaviors sooner than individuals who perceive the risk to be temporally distant, as they perceive greater urgency. In a related study, a health message on the risk of heart disease was presented to individuals using either a day (proximal) or a year (distant) temporal frame (Chandran & Menon, 2004). Results demonstrated that when exposed to a message describing negative outcomes and an individual’s susceptibility to succumb to heart disease, participants who read the message with the day frame expressed greater intentions to engage in preventive behaviors. On the other hand, when the message described positive outcomes and an individual’s opportunity to avoid heart disease, participants who read the message with the year frame expressed greater intentions to engage in preventive behaviors. Thus, the results support the stipulations of construal level theory in that a message that presented the risk (i.e., a negative consequence) to be temporally proximal was more effective in behavioral modification.

The theory also suggests that the social distance perceived between an event and the self influences how the event is represented in the mind. The concept of psychological associations in the dimension of social identity is fundamentally egocentric, with the self as the reference point (Trope & Liberman, 2010). Studies show that individuals describe the self’s behaviors in concrete, proximal terms whereas other people’s behaviors are described in abstract, distant terms (Fiedler, Semin, Finkenauer, & Berkel, 1995). Others have indicated that associating information with the self leads to faster information processing than associating information with an unfamiliar other (Rogers, Kuiper, & Kirker, 1977). This implies that health messages that involve the self rather than an unfamiliar other may contribute to reducing the perceived social distance between the risk of SSB consumption and the self. Such tailored messages have been shown to increase personal relevancy of the message (Noar, Harrington, Van Stee, & Aldrich, 2011) and are likely to

encourage the individual to feel greater involvement with the issue of SSB consumption and obesity than nontailored messages.

Taken together, these findings imply that health promotion campaigns are likely most effective when messages are able to encourage a concrete representation of the risk by reducing its perceived temporal and social distance. Reducing the temporal distance is likely to increase the perceived imminence of the risk, whereas reducing the social distance is likely to increase the personal relevancy of the risk. Social distance is relatively simple to operationalize within the context of a health message by specifically targeting the self in a message, rather than an unfamiliar other (Liberman, Trope, McCreary, & Sherman, 2007). Temporal distance has been operationalized in earlier research by manipulating time-relevant words such as “day” or “year” in a message (Chandran & Menon, 2004). The current study aims to expand prior research by exploring the possibility of using IVEs to reduce the perceived temporal distance of a risk through a virtual “fast-forwarding” of time.

## USING IMMERSIVE VIRTUAL ENVIRONMENTS TO EXPERIENCE FUTURE CONSEQUENCES

Scholars have suggested that how individuals learn about their susceptibility to a risk may make a meaningful difference in risk perception (Weber, 2006). In particular, personal experiences can significantly affect the evaluation of risk (Hertwig, Barron, Weber, & Erev, 2004). As recent experiences are given more weight than distant ones (Murdock, 1962), if an individual has not had a recent personal experience of the negative consequence of a risky event, it is likely that he or she may not perceive the risk as a serious threat.

In IVEs, individuals are able to virtually experience health changes without incurring damage to their health in the real world. As such, scholars have prescribed the use of IVEs in treating a variety of health problems, particularly for obesity-relevant problems (Lu et al., 2010), but very few randomized clinical trials testing their efficacy have been conducted to date. Digital simulations via IVEs that present future negative consequence (e.g., obesity) of a present risky behavior (e.g., SSB consumption) may be a more vivid illustration of health consequences than the print descriptions in traditional pamphlets that may seem abstract and temporally distant. Hence, when coupled with traditional health promotion messages, IVEs may serve to augment message effects by reducing the temporal distance of a risk and emphasizing its urgency.

In addition, scholars have noted that the use of virtual human representations that represent individuals within IVEs may be an effective means of applying IVEs in health communication (Persky, 2011). The bulk of the research on IVEs and the use of virtual humans in the health context has been concentrated on training students and clinicians (Fox,

2012). Surprisingly little work has explored the possibility of applying IVEs as a means of intervention or prevention and presenting the virtual human as agents of change in health behaviors (c.f. Fox & Bailenson, 2009).

The use of virtual humans in IVEs offers opportunities to rapidly and accurately create tailored messages by incorporating photorealistic virtual representations of the self (Blascovich & Bailenson, 2011). Several studies have demonstrated the persuasive advantage of using virtual selves over generic or unfamiliar virtual others in the realms of advertising (Ahn & Bailenson, 2011), health (Fox & Bailenson, 2009), and financial decisions (Hershfield et al., 2011). If the use of IVEs to present future consequences may be considered an operationalization of the reduction of temporal distances, the use of virtual selves within IVEs may be considered an operationalization of the reduction of social distances.

Most experimental studies on health messages have investigated the effects of a single message, independently of exposure to any other messages. However, as many health promotion campaigns in the real world involve an extensive multimedia effort, the current study explored the potential of coupling IVEs with traditional health messages. IVEs' capacity to reduce the perceived temporal distance of negative consequences of SSB consumption was tested with an existing pamphlet from an ongoing health promotion campaign—*Pouring on the Pounds*.

### THE EFFECT OF PSYCHOLOGICAL ASSOCIATIONS OVER TIME

Perhaps one of the most important questions to ask about the effectiveness of a health message is how the effects change over time. To the best of our knowledge, no study to date has explored the persistence of psychological associations over time, despite scholars lamenting the lack of longitudinal studies that empirically examine the relationship between message-based factors, perceived personal relevance, and behavioral change (Noar, Harrington, & Aldrich, 2009). Many studies investigating behavioral change also stop at assessing behavioral intentions immediately following experimental treatments, rather than evaluating actual behavioral change.

A number of behavioral change studies have shown intention to have strong correlations with future behavior (Armitage & Conner, 2001). However, a meta-analysis of the causal relationship between behavioral intentions and actual behavior following experimental treatments found that mid to strong behavioral intentions following experimental treatments resulted in small to mid future behavioral modification (Webb & Sheeran, 2006). Other studies have shown that individuals tend to underestimate the influence of contextual cues at the time of prediction (Loewenstein, 1996). For example, an individual may overestimate his or her will

power to reduce SSB consumption immediately following experimental treatments, but the will power may subside significantly when he or she comes across a vending machine on a hot day. Thus, the current study aims to explore not only the effects of perceived temporal and social distances on behavioral intentions immediately following experimental treatments but also the change in actual consumption behavior 1 week after experimental treatments.

In the realm of traditional health messages, a number of studies have demonstrated the shorter term success of tailored messages (Noar, Benac, & Harris, 2007; Rimer & Kreuter, 2006). One study looking at a spectrum of tailored messages ranging from a very simple element of the self (e.g., name) to an extensively personalized material with approximately 50 self-relevant elements found that even the most basic level of tailoring enhanced perceived message relevance immediately following exposure (Webb, Simmons, & Brandon, 2005). Thus, we may anticipate the following:

H1: Immediately after exposure, health messages tailored to the self will lead to lower intentions for SSB consumption in the near future than nontailored messages.

However, few studies, if any, have explored the short-term effect of IVE messages compared against traditional health messages. One recent study comparing the persuasive power of IVEs against traditional media messages in the context of an environmental promotion campaign found that traditional media seemed to be just as persuasive as IVEs immediately following experimental treatments in terms of increasing behavioral intentions (Ahn, Bailenson, & Park, in press). As a nonsignificant difference between traditional media and IVE is insufficient evidence to derive a hypothesis about the short-term effects of IVE on health behavior, the following research question will be asked:

RQ1: Immediately after exposure, will a traditional pamphlet alone be just as persuasive as a traditional pamphlet coupled with IVEs in promoting lower intentions for SSB consumption?

Perceiving close social distance as a result of tailoring is likely to increase perceived personal relevance of the risk (Noar et al., 2011; Webb et al., 2005) and lead to high involvement with the issue at hand. The increase in involvement, in turn, is expected to lead to successful persuasion (Petty & Cacioppo, 1981) by reducing intentions for SSB consumption.

H2: Immediately after exposure, perceived social distance and involvement with the issue of SSB consumption and obesity will mediate the relationship between tailoring and SSB consumption.

Although the effect of IVEs seemed no different from traditional messages immediately following experimental treatments, a recent study found that the effect of traditional messages dissipated over time (Ahn, Bailenson, &

Park, in press). The effects of IVE messages on actual behavior, on the other hand, persisted for up to 1 week. Thus, we hypothesize that:

H3: One week after exposure, a coupled message (pamphlet and IVE) will lead to less SSB consumption than the noncoupled message (just a pamphlet).

On the other hand, long-term data on tailoring are mixed. Some studies suggest that the effect of tailoring in a single-shot message may dissipate quickly over time (Strecher et al., 2005). Another study looking at smoking cessation found that different tailoring strategies were not any better than nontailored messages over time (Dijkstra, De Vries, & Roijackers, 1998). However, a meta-analysis found tailored interventions to be effective over both short and long term, particularly for the promotion of healthy eating behaviors (Kroeze, Werkman, & Brug, 2006). Thus, we also ask the following research question:

RQ2: One week after exposure, will tailoring a coupled message (pamphlet and IVE) lead to less SSB consumption than the nontailored but coupled message?

The reduced perceived temporal distance from coupling the pamphlet with IVEs is anticipated to increase the perceived imminence of the risk related to SSB consumption and obesity, ultimately leading to greater behavioral change:

H4: One week after exposure, perceived temporal distance and risk perception will mediate the relationship between medium and SSB consumption.

Finally, although the bulk of investigations on the relationship between intention and behavior change has been based on correlational evidence, some scholars have confirmed causal relationships between experimentally elicited behavioral intentions and actual future behaviors (Webb & Sheeran, 2006). The current study aims to extend the earlier findings to explore the relationship between experimentally derived intentions and resultant behaviors:

H5: Intentions to reduce SSB consumption as a result of tailored health messages will be a predictor of actual SSB consumption.

## METHODS

### Participants and Design

A convenience sample of 73 undergraduate and graduate students (13 males) was recruited from a large public university in the southern United States. Participants received class credit for participation. In total, eight participants (one male) dropped out during the 3-week period. The mean age of the sample was 20.83 ( $SD = 1.05$ ). The study employed a  $2 \times 2$  between-subjects design whereby medium (pamphlet

only vs. pamphlet with IVEs) and tailoring (other vs. self) were crossed. SSB consumption was assessed at three different times: 1 week before, immediately after, and 1 week after the experimental treatment.

The IVE system implemented a head-mounted display (HMD) providing three-dimensional perception through stereoscopic views of the virtual world. An orientation sensor was attached to the HMD to allow participants to control their field of view using naturalistic head movements. This enabled them to look around in the virtual world as they would in the physical world. Finally, stereo audio information was delivered through the headphones of the HMD to present realistic sounds.

### Stimuli

For the pamphlet-only conditions, the Health Bulletin (volume 8, number 6) issued by the New York City Department of Health and Mental Hygiene as a part of the *Pouring on the Pounds* campaign was used. The six-page full color pamphlet provides specific information on SSBs with an emphasis on soft drinks and how SSBs lead to weight gain, and provides specific guidelines to follow in terms of reducing SSB consumption. In particular, the pamphlet depicts the future consequence of SSB consumption by presenting a picture of a cup filled with fat, ostensibly being poured from a soft drink bottle.

To operationalize the tailoring variable in the pamphlet-only conditions, the pamphlet was manipulated so that the second-person pronoun “you” was used where appropriate in the pamphlet only-self condition ( $n = 16$ ) (e.g., “Are You Pouring On the Pounds?”). In the pamphlet only-other condition ( $n = 18$ ), the third person pronouns “people” or “they” were used where appropriate (e.g., “Are People Pouring On the Pounds?”). The pamphlet warned that an average of 10 pounds a year might be gained as a result of consuming the extra calories through SSBs. The first two pages of the tailored pamphlet are presented in the appendix.

For the IVE simulation, a virtual room was shown with either a virtual self (pamphlet with IVEs-self condition,  $n = 16$ ) or a virtual other (pamphlet with IVEs-other condition,  $n = 15$ ) standing, consuming one soft drink a day for 2 years and consequently gaining weight. No specific brand name or logo was used on the bottle to avoid the confounding effects of preexisting brand attitudes. Within the IVE, 2 years was portrayed in 2 minutes and the passing of time was represented by a digital calendar flipping through the years and a clock with its hands rapidly turning. As the virtual human consumed the soft drink throughout the 2 years, its body grew larger due to weight gain. The 10 pounds a year in fat that the virtual human gained was also visually and aurally depicted as piles of fat splattering onto a digital scale. This was comparable to the cup full of fat depicted on the pamphlet. In the pamphlet with IVEs-self condition, the virtual human gaining weight was a photorealistic virtual self. In the

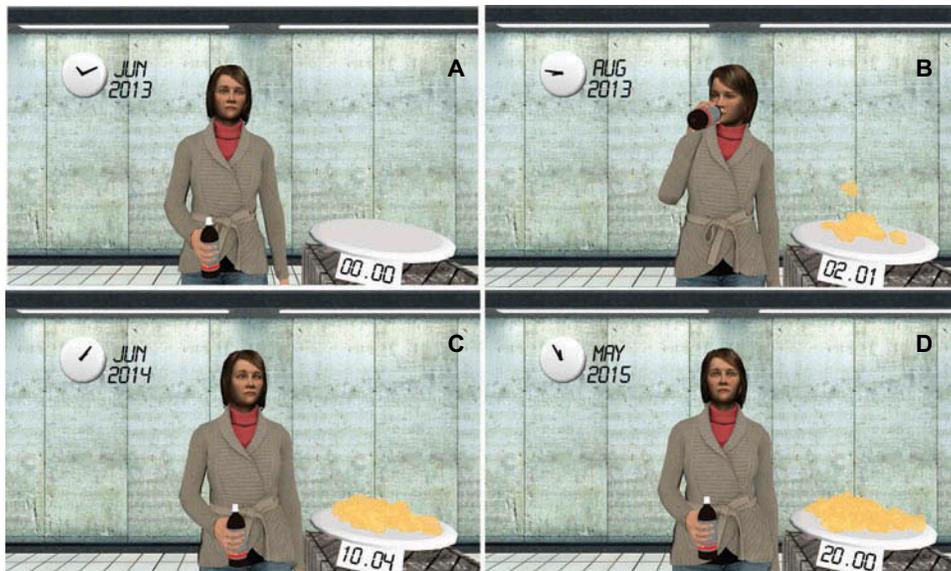


FIGURE 1 Participants entered the virtual world and saw either their virtual self or a virtual other standing in a room, holding a soft drink bottle (A). As the virtual human began drinking from the bottle, the calendar and clock in the background portrayed the rapid passing of time, and fat began to fall on the digital scale (B). After 1 year of consuming soft drinks, the virtual human gained 10 pounds (C). At the end of 2 years, the virtual human gained a total of 20 pounds, as shown on the scale (D).

pamphlet with IVEs—other condition, the virtual other was the representation of the participant preceding the current participant that matched the participant's sex and ethnicity. To minimize the potential confounding effects of different physical features, no participant was used more than once as a virtual other. Figure 1 depicts the sequence of events within the IVE world.

### Procedure

The experiment was conducted in three phases. One week before the experiment (Time 1), participants received an online pretest measuring their baseline consumption levels of soft drinks as well as demographic information. All participants were also instructed to visit the laboratory to have their photograph taken for the creation of photorealistic virtual selves for those assigned to the pamphlet with IVE-self condition. One week following the pretest (Time 2), participants were brought into the laboratory. All participants received either the tailored or nontailored *Pouring on the Pounds* pamphlet in color and were instructed to read the pamphlet carefully, taking as much time as they needed to finish reading the pamphlet. Participants in the pamphlet-only conditions then answered a series of questions regarding the pamphlet.

Participants in the pamphlet with IVEs conditions were taken to the IVE station after reading the pamphlet. Wearing the HMD, participants were instructed to look around the room first and take note of the digital scale on a table and the calendar and the clock on the wall. The virtual human then began drinking the soft drink for 2 minutes (i.e.,

2 years). After the 2 years passed in the IVE, participants were instructed to take one last look around the IVE, taking note of their changed virtual self or virtual other representation. Then the participants were led to the survey station to complete the survey measures. One week following the experiment (Time 3), all participants received an e-mail asking about the perceived imminence of the risk presented in the message earlier and their soft drink consumption during the past week.

### Measures

**Soft drink consumption.** Soft drink consumption was measured using the beverage intake questionnaire (Hedrick, Comber, Estabrooks, Savla, & Davy, 2010). The item assessed beverage intake in two parts—frequency and amount. Participants were asked the number of times per day (1 = *never*; 7 = *more than three times a day*) and how much each time (1 = *less than 6 fl. oz. or 3/4 cup*, 5 = *more than 20 fl. oz. or 2 1/2 cups*) they drink water, whole milk, vegetable juice, and regular soft drinks. The frequency and amount were then multiplied to create a series of single indices of soft drink consumption base rate, consumption intentions, and actual consumption. Non-SSBs were included in the measure to reduce demand characteristics and were not analyzed. Soft drink consumption was measured at three different time points. Baseline measures were collected at Time 1 to control for individual differences in existing soft drink consumption patterns in ensuing analyses. Consumption intentions were measured at Time 2 to assess how the treatments may have influenced intentions

TABLE 1  
Descriptive Statistics for Dependent Measures: Means (Standard Deviations)

	Time 1	Time 2, Pamphlet Only-Other	Time 2, Pamphlet Only-Self	Time 2, Pamphlet and IVE-Other	Time 2, Pamphlet and IVE-Self	Time 3, Pamphlet Only-Other	Time 3, Pamphlet Only-Self	Time 3, Pamphlet and IVE-Other	Time 3, Pamphlet and IVE-Self
Base rate consumption	3.80 (4.32)	—	—	—	—	—	—	—	—
Consumption intentions	—	3.87 (3.26)	1.66 (1.63)	3.91 (3.00)	3.44 (4.56)	—	—	—	—
Consumption	—	—	—	—	—	2.52 (1.99)	2.47 (3.36)	1.63 (1.55)	1.65 (2.64)
Social distance	—	3.39 (1.04)	4.05 (.77)	3.71 (.82)	4.23 (.45)	—	—	—	—
Temporal distance	—	2.59 (1.34)	3.08 (1.34)	2.89 (1.39)	3.92 (.77)	—	—	—	—
Involvement	—	3.25 (3.19)	3.30 (3.28)	2.70 (2.77)	3.49 (3.50)	—	—	—	—
Risk imminence	—	—	—	—	—	2.30 (1.19)	2.53 (.58)	2.47 (1.13)	2.70 (1.03)

to consume soft drinks in the following week. Finally, consumption was measured at Time 3 to assess actual soft drink consumption during the week.

**Social distance.** Perceived social distance was assessed at Time 2 using a single 5-point interval scale item, “To what extent did the experiment make you focus your thoughts on yourself?” This item has been used elsewhere to detect the degree to which traditional media messages (Debevec, 1995) and IVE-based messages (Ahn & Bailenson, 2011) elicit self-relevant thoughts.

**Temporal distance.** Perceived temporal distance was measured at Time 2 with a single 5-point interval item, “To what extent did the experiment make you think about drinking soft drinks in the near future (e.g., this evening, tomorrow)?” This item has been used elsewhere (Chandran & Menon, 2004) to gauge perceived temporal proximity.

**Involvement.** Issue involvement was measured at Time 2 with three 5-point interval scale items asking participants how personally relevant is the issue of obesity as a result of drinking SSBs; how important is the issue of obesity as a result of drinking SSBs; and how likely do they feel it is that they may also become obese as a result of drinking SSBs. The reliability for the three items was Cronbach’s  $\alpha = .83$ .

**Risk imminence.** Perceived imminence of risk was measured at Time 3 with a single 5-point interval scale item, “To what extent do you think you are at risk of gaining weight and becoming obese as a result of drinking sugar-added beverages (e.g., soda)?” This item has been used elsewhere (Chandran & Menon, 2004) to gauge risk perception.

**Gaming hours (covariate).** The average number of hours participants spent each week playing games was selected as a control variable to control for prior experiences in virtual environments. A single open-ended item asked participants the average number of hours a week they spend playing video, computer, iPhone, iPod, and arcade games, and this variable was controlled for in the ensuing analyses.

The students in the current population spent an average of 2.61 hours ( $Min = 0$ ,  $Max = 24$ ,  $SD = 4.59$ ) per week playing games, and this may be more relevant to how participants react to IVEs than sex to control for the sex imbalance of the sample.

## RESULTS

All assumptions for an analysis of covariance (ANCOVA) were met. Homogeneity of the regression effect was evident for the covariates, and they were linearly related to at least one dependent variable. Means and standard deviations for all measures are presented in Table 1.

### Soft Drink Consumption Intentions (Time 2)

A univariate ANCOVA was conducted with medium and tailoring as the independent variables, soft drink consumption intentions measured at Time 2 as the dependent variable, and the base rate soft drink consumption measured at Time 1 and gaming hours as covariates. Results revealed that the main effect of tailoring was significant,  $F(1, 58) = 5.59$ ,  $p = .02$ , partial  $\eta^2 = .09$ . Immediately following experimental treatments, messages targeting the self led to significantly lower intentions to consume soft drinks ( $M = 2.55$ ,  $SD = 3.53$ ) than messages targeting the general public ( $M = 3.89$ ,  $SD = 3.12$ ). Thus, H1 was supported. No other effects were significant, and the effect of the coupled message (pamphlet and IVE) on soft drink consumption intentions did not differ significantly from that of the noncoupled message (RQ1).

### Soft Drink Consumption (Time 3)

A univariate ANCOVA was conducted with medium and tailoring as the independent variables, soft drink consumption measured at Time 3 as the dependent variable, and the same covariates. Results revealed that the main effect of medium approached significance,  $F(1, 56) = 3.72$ ,  $p = .06$ , partial

TABLE 2

Regression Weights, Indirect Effects Showing Mediation, Bootstrap 95% Confidence Interval, and Lower and Upper Bounds for Social Distance

Regression Weights for Direct Effects	Coefficient	SE	Bootstrap 95% CI	
			Lower	Upper
Tailoring → social distance**	.67	.20	.27	1.07
Tailoring → involvement	.10	.26	-.43	.62
Tailoring → consumption intention*	-1.56	.86	-3.28	.17
Social distance → involvement**	.40	.15	.10	.70
Social distance → consumption intention	.13	.52	-.91	1.18
Involvement → consumption intention*	.87	.41	.05	1.69
Regression Weights for Indirect Effects	Effect Size	Bootstrap SE		
Tailoring → social distance → consumption intention	.09	.37	-.68	.80
Tailoring → social distance → involvement → consumption intention*	.23	.15	.05	.67
Tailoring → involvement → consumption intention	.08	.24	-.36	.64

Note. SE = standard error; CI = confidence interval. Bootstrap resampling = 1000.

\*\* $p < .01$ , \* $p < .05$ .

$\eta^2 = .06$ . One week after exposure, experiencing the IVE simulation in addition to reading the pamphlet led to significantly lower soft drink consumption ( $M = 1.64$ ,  $SD = 2.13$ ) than only reading the pamphlet ( $M = 2.49$ ,  $SD = 2.63$ ). Thus, H3 was supported. No other effects were significant, and the effect of tailoring observed at Time 2 seems to have dissipated over time (RQ2).

### Underlying Mechanisms—Multiple Mediation Analyses

In order to test the underlying mechanisms that led to the support of H1 and H3, two sets of multiple mediation analyses were conducted with the PROCESS path-analysis macro for SPSS (Hayes, 2012). The first model tested the effect of tailoring (0 = *other*; 1 = *self*) on consumption intentions. Tailoring was entered as the independent variable, social distance and involvement as the mediators, and soft drink consumption intentions measured at Time 2 as the dependent variable. The inclusion of all mediators in the same model is recommended, as it facilitates the estimation of the magnitudes of the indirect effects associated with all relevant mediating variables. Bootstrapping methods were used, and results of the direct and indirect effects are reported in Table 2. Based on the upper and lower boundaries of confidence intervals that did not include zero values, the results indicated that regardless of the medium involved, tailoring the message to the self led to perceptions of closer social distance. This perception, however, did not directly lead to a decrease in intentions to consume soft drinks, but was first mediated by the level of involvement with the issue of soft drink consumption. The increased level of involvement ultimately led to a decrease in intentions to consume soft drinks. Tailoring the message to the self also did not directly lead to involvement but was mediated by perceived social distance. Thus, H2 was supported.

The next model tested the effect of media (0 = *pamphlet only*; 1 = *pamphlet with IVEs*) on actual consumption. Medium was entered as the independent variable, perceived temporal distance and risk imminence as mediators, and soft drink consumption at Time 3 as the dependent variable. Results of the direct and indirect effects are reported in Table 3. Results indicated that coupling pamphlets with IVEs led to the reduction of perceived temporal distance between the message and the participant immediately following exposure to both the pamphlet and the IVE. This reduction in temporal distance did not directly reduce soft drink consumption. The reduced temporal distance led participants to perceive greater imminence of the risk presented in the message. Then, the increased perception of risk imminence ultimately led to lower consumption of soft drinks even 1 week following the experimental treatments. Thus, H4 was supported.

### Intention as a Predictor of Behavior

The role of consumption intention as a predictor of actual consumption was tested with linear regression. Intention to reduce soda consumption at Time 2 was entered as the independent variable and soft drink consumption at Time 3 as the dependent variable. Intention to reduce soda consumption as a result of tailored health messages was a significant predictor of future behavior,  $\beta = .41$ ,  $t(59) = 5.45$ ,  $p < .001$ . Thus, H5 was supported.

## DISCUSSION

Psychological associations in the dimensions of time and social identity meaningfully influenced health message effects on behavior change. Simple tailoring strategies,

TABLE 3  
Regression Weights, Indirect Effects Showing Mediation, Bootstrap 95% Confidence Interval, Lower and Upper Bounds for Temporal Distance

<i>Regression Weights for Direct Effects</i>	<i>Coefficient</i>	<i>SE</i>	<i>Bootstrap 95% CI</i>	
			<i>Lower</i>	<i>Upper</i>
Medium → temporal distance*	.66	.33	.003	1.31
Medium → risk imminence	.01	.28	-.55	.57
Medium → consumption	-.78	.60	-1.97	.41
Temporal distance → risk imminence*	.22	.11	.01	.43
Temporal distance → consumption	.33	.23	-.14	.79
Risk imminence → consumption	.41	.27	-.13	.95
<i>Regression Weights for Indirect Effects</i>	<i>Effect Size</i>	<i>Bootstrap SE</i>		
Medium → temporal distance → consumption	.21	.20	-.02	.81
Medium → temporal distance → risk imminence → consumption*	.06	.05	.002	.28
Medium → risk imminence → consumption	.00	.12	-.24	.26

Note. SE = standard error; CI = confidence interval. Bootstrap resampling = 1000.

\*\* $p < .01$ , \* $p < .05$ .

regardless of IVE use, seemed immediately effective in promoting intentions to reduce SSB consumption. The results also indicated that using IVEs to depict the negative future consequences of SSB consumption described in the pamphlet was effective in reducing soft drink consumption 1 week following experimental treatments. Different underlying mechanisms drove the effects at different times. Social distance seemed to be driving results immediately following experimental treatments to influence behavioral intentions; temporal distance seemed to be driving results to influence actual behavior after the effect of social distance has dissipated over 1 week.

Theoretically, the results of the current study contribute to expanding earlier findings from health communication research by successfully predicting health behavior changes based on the framework of construal level theory over a span of 1 week and confirming the underlying mechanisms driving these effects. Following the recommendation for health communication research to move toward exploring optimal message design rather than individual differences in message effects (Noar, 2011), the current study yields preliminary insights into constructing messages to increase behavioral changes over time. Furthermore, the results suggest the potential of coupling IVEs with traditional messages in health promotion campaigns to augment the effects of tailoring and yielding longer lasting message effects.

Two distinct pathways led to short-term and long-term success. Immediately following experimental treatments, intentions to consume soft drinks were significantly lower for participants who were exposed to messages that were tailored to the self than for those who received generic messages, regardless of the use of IVEs. Tailoring the message to the self decreased the social distance perceived between the message and the self. As a result, participants felt more involved with the issue of SSB consumption and obesity as presented in the message, which ultimately led to the

reduction in intentions to consume soft drinks. As construal level theory posits that distant perceptions lead to abstract thoughts and proximal perceptions lead to concrete thoughts (Trope & Liberman, 2010), it seems that messages that are not tailored to the self make the issue of SSB consumption and obesity seem abstract and irrelevant to the self. Personal relevance of a message is critical in the ultimate impact of tailored health interventions (Rimer & Kreuter, 2006), and the current results demonstrate that something as simple as inserting the second person pronoun “you” in a pamphlet can be effective immediately following exposure.

Coupling IVEs with traditional pamphlets helped to reduce the perceived temporal distance of the message, but it did not have immediate effects on intentions for soda consumption. One week following the experimental treatment, however, the reduction of temporal distance led participants to consider that the risk of soft drink consumption and obesity was imminent, ultimately leading to a reduction in soft drink consumption. One explanation for the delayed effect may be that there was simply more information provided in the coupled message than the pamphlet alone, thus further accentuating the negative consequences of soda consumption. However, the earlier study comparing the effects of IVE only, video, and print messages on environmental behaviors found similar delayed effects of IVE even when it was not coupled with another form of message (Ahn, Bailenson, & Park, in press). In this study, the effects of IVE messages were not initially different from the effects of traditional messages, but IVE effects persisted for a week following experimental treatments, whereas the effects of traditional messages subsided rapidly. The current results imply that it is more likely a consequence of increase salience of the risk following the visual and aural experience of the negative future consequence in IVE than a result of more information.

An earlier study also demonstrated that having individuals experience vivid symptoms within IVEs in

addition to reading about schizophrenia elicited greater empathy toward persons with schizophrenia than did just reading about the illness (Kalyanaraman, Penn, Ivory, & Judge, 2010). The current findings expand these earlier findings in two ways, by confirming the underlying mechanisms of actual behavior change via temporal distance and risk perception and by testing the persistence of these effects. Although coupling IVEs with traditional messages may not seem powerful immediately, its influence lingers and peaks over time.

What is more intriguing is the lack of immediate effects of IVE. One possibility might be that the negative future consequences accentuated by the IVE message may have brought forth the perception of persuasion knowledge—the negative attitude change as a result of recognizing the persuasive nature of a message (Friestad & Wright, 1994). Even if the IVE message was more impactful, individuals may have been offended by overt attempts at persuasion, thereby eliminating the persuasive advantage of the IVE message. However, over time, the salience of risk may have offset the initial negative reactions, resulting in behavioral modification. Future research should measure the degree to which individuals recognize persuasion attempts and their attitudes toward them, as this may be a boundary condition of the persuasive effects of IVEs.

On the other hand, the effect of tailoring dissipated 1 week following exposure. One explanation may be found in prior findings that indicate that when individuals are asked to think about their past selves in an unfavorable light, they attempt to psychologically distance their current selves from their past selves (Ross & Wilson, 2002). It may be that the social distance was initially reduced by the message tailored to the self but dissipated rapidly as individuals attempted to push negative thoughts about the self away.

Intentions and behaviors, although driven by distinct underlying mechanisms, were interconnected in that the intention to reduce soda consumption predicted future reduction in consumption. These results echo earlier studies that demonstrate the causal relationship between intentions and behavior (Webb & Sheeran, 2006). Despite two distinct pathways, it seems that change in behavior is preceded by change in intentions. This implies that both tailoring and coupling strategies incorporating IVEs are critical in eliciting behavior change.

Practically, these results imply the importance of using a multimedia approach for successful health promotion campaigns. As IVE systems are becoming more accessible and affordable through gaming platforms and consumer-grade devices, tailored health promotion messages may be sent directly to individuals' homes to existing infrastructures (Blascovich & Bailenson, 2011). For instance, the Microsoft Kinect Xbox console, which automatically detects individual players using motion sensing input devices, is the fastest selling consumer electronics, with more than 24 million units sold since its launch in late 2010 (Epstein, 2013). Sophisticated HMDs, similar to the one used in the current

experiment, are now available for a few hundred dollars and easily incorporated into everyday computing systems as a plug-and-play device. Delivering tailored IVE-based messages so that individuals are able to experience negative future consequences in the comforts of their own living rooms, or in their physician's office as they consult with their doctors, or in the classroom as an effective means of health education would be a relatively easy yet potent approach to reducing SSB consumption. Another option may be to develop affordable and transportable kiosks using consumer grade devices and to set them up in high traffic areas to expose individuals to tailored messages that are coupled with IVEs (Ahn et al., in press).

In addition, the IVE stimulus used in the current experiment is scalable in that it offers much more flexibility than traditional pamphlets in terms of message format. The IVE depiction of future negative consequences may be redesigned to be employed in mobile devices such as the iPhone or the iPad or to be launched on desktop computers or websites. As virtual selves are constructed with digital photographs, they may easily be integrated into traditional health promotion campaigns that involve social media platforms as well, where profile photographs needed to tailor the virtual human may easily be found.

Future research should address some of the limitations of the current experiment. Although the current study was based on an ongoing health promotion campaign, participants only received a single exposure to health messages for experimental control whereas they would receive repeated exposures in the real world. Future studies should explore the effects of multiple exposures to IVE messages. In addition, although the relatively young sample of research participants is highly relevant for studying SSB consumption (West et al., 2006), populations of different ages may respond differently to IVEs and limits the generalizability of these results. Also, the current IVE simulation was focused on soft drinks among all SSBs because they are the most commonly consumed SSB (West et al., 2006). However, SSBs include seemingly benign beverages such as fruit juice and sports drinks. Future research should consider including a wider range of SSBs in the IVE simulation. Furthermore, the current results were assessed via self-reports of beverage consumption, qualifying their accuracy. Also, the measure of risk imminence, although both the pamphlet and the IVE messages referred to weight gain and obesity as tightly linked issues, may have been perceived as a doubled-barreled question. Future studies should parse out the perceived risk of weight gain and obesity as separate variables and include an observation of actual soda consumption to complement self-reported consumption behaviors. Finally, the IVE simulation in the current study did not allow participants to actively control or change the content of the virtual experience for experimental control. As high interactivity with the mediated message is one of the unique characteristics of advanced digital technology that has been shown to influence user perceptions (Southwell, Anghelescu, Himelboim, & Jones, 2007), future

studies should explore other affordances of IVEs, including high interactivity.

In sum, the current experiment provides strong preliminary evidence for the potential of incorporating IVEs into multimedia health promotion campaigns. IVE technology is still in its infancy and the experience may still be far from the “real thing.” However, the current results suggest exciting potentials for the integration of the traditional and the new, speaking to the promise of IVE technology in health communication as it continues to advance.

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APPENDIX

VOLUME 2, NUMBER 2

# Health Bulletin

NEW YORK CITY DEPARTMENT OF HEALTH AND MENTAL HYGIENE

872 in a series of Health Bulletins on issues of pressing interest to all New Yorkers



## ARE YOU POURING ON THE POUNDS?

**DON'T DRINK YOURSELF FAT.**  
How to cut back on soda, juice and other sugary beverages.

**TAKE CARE SERVICE** • Available in Spanish and Chinese call 211 or visit [nyc.gov/health](http://nyc.gov/health)  
• Disponible en español llame al 211 o visite [nyc.gov/health](http://nyc.gov/health)  
• 中文服務 請電 211 或瀏覽 [nyc.gov/health](http://nyc.gov/health)

**NYC**  
Health

[nyc.gov/health](http://nyc.gov/health)

Are you pouring on the pounds? Volume 2 - Number 2



**Most of us consume too much sugar.**

- Sugar in sweetened drinks contains extra calories you don't need.
- The extra calories can lead to obesity and diabetes.
- Sugar is also bad for your teeth. It causes cavities in kids and adults.

**I don't eat a lot of sweets but I still gain weight!**

Are you pouring on the pounds?  
How much sugar do you drink?

- Americans consume 200 to 300 more calories each day than we did 30 years ago.
- Nearly half of these extra calories come from sugar-sweetened drinks.
- Teens who consume sugary beverages drink an average of 360 calories per day. Someone would have to walk about 70 city blocks to burn that many calories.