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Improving health communication with photographic images that increase identification in three minority populations

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Abstract

The homophily principle, that perceived similarities among people produce positive reactions, is a cross-cultural, global phenomenon. This study aimed to test the prediction that photographs that depict models similar to the target population improve health communication by increasing perceived identification in three racial/ethnic populations. Three separate nationally representative stratified samples ($n = 1638$) of African American, Hispanic and Native American adults were drawn from GfK's Knowledge Panel®. Participants read a message advocating increased physical activity and improved diets and completed measures on behavioral intentions, outcome and self-efficacy expectations and identification. The message contained photographs from a stock photograph service or photographs created for the research project to match the three minority populations, Real Health Photos (RHP). Structural equation modeling confirmed the theoretical hypothesis that RHP which matched the minority population increased behavioral intentions and was mediated by identification ($P < 0.05$) in all three racial/ethnic minority samples. Messages with only half of the matched RHP images had these same positive indirect effects among African Americans and Hispanics ($P < 0.05$). The impact of matching visual images in health messages to recipients derived from identification with the characters in images. Homophily and identification are hardwired, evolutionary, biological phenomena that should be capitalized on health educators with minority populations.

Introduction

In the search for new paths to promote healthy lifestyles, particularly with special populations such as those defined by race/ethnicity, the visual image offers a promising avenue. Visual, nonverbal cues are a primary, powerful feature in persuasion [1, 2] for they bear a direct relationship with their referent, having an automatic validity for meaning [3, 4]. A picture of a starving child needs no definition; it is what it stands for. Visual images provoke attitudinal, recall, and mood–arousal processes, requiring little cognitive activity, and create immediate emotional reactions that affect behavior [4–10]. A source's appearance may be especially persuasive for individuals with low need for analytic cognition [11] and low literacy [12].

Humans worldwide are drawn to and influenced by people that are similar. The homophily principle, that perceived similarities among people produce positive reactions (e.g. knowledge, attitude and behavior changes), is a cross-cultural phenomenon [13, 14], is an important concept in Diffusion of Innovations Theory (i.e. transfer of new information

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occurs most among similar individuals) [14] and Social Cognitive Theory (i.e. vicarious learning occurs most when people observe the consequences of actions by models that appear similar to them) [15], and is true of personal and social characteristics [16–18]. Persons appear biologically predisposed to identify with others similar in observable physical characteristics, especially biological relatives and people who act and look similar to family and a person's culture [10]. Visual similarity has persuasive power by increasing recipients' identification with the referent and situation [10, 14, 19] and emotional engagement, leading them to emulate the behavior of homophilous sources [14, 20].

Visual health images can be effective in culturally targeting messages by increasing familiarity and identification [21]. Messages targeted to perceptions, characteristics and circumstances of at-risk populations [21–23] are more successful [21, 22, 24] across a range of interventions, especially for under-represented groups [21, 25–27]. Visual images have been matched to recipients, but their effectiveness has not been tested [28, 29]. This study directly evaluated the power of visual images matched to recipients of health communication using photographs that depicted 'real' racial/ethnic minority individuals engaged in health behaviors by testing the following hypotheses:

Hypothesis 1:

A health education message will be more effective (i.e. create stronger behavioral intentions to increase physical activity and eat a healthy diet) when incorporating photographs that match the target population on race and ethnicity than photographs that do not match the population.

Hypothesis 2:

The increased effectiveness of messages with photographs that match the population on race and ethnicity will be mediated by identification with persons in the photographs such that matched photographs will increase identification relative to unmatched photographs and increased identification will be associated with greater behavioral intentions.

The study also examined the following two research questions on whether positive effects, if any, generalize across different racial/ethnic groups and are dependent on all images being homophilous (i.e. matched) or only some of them. Theoretically, if homophily is a fundamental process, it should influence behavior in the same way across different racial/ethnic groups. Practically, there may be circumstances (e.g. due to cost, delivery channel or political considerations) where it is impossible or undesirable to use just images of a single population (i.e. match all photographs).

Research Question 1:

Will the positive effect of matching the photographs on race and ethnicity be replicated in three race/ethnic target populations: African American, Native Americans and Hispanics?

Research Question 2:

Are health messages more effective when participants are exposed to photographs half of which match the population on race and ethnicity versus photographs that all do not match the population?

Method

Sample

The sample contained three separate stratified samples of African American ($n = 568$), Hispanic ($n = 543$) and Native American ($n = 527$) adults drawn by GfK from its Knowledge Panel® (see CONSORT diagram in Fig. 1). These race/ethnic groups have physical characteristics that uniquely identify them and can experience health disparities [30, 31]. General inclusion criteria were being 18 or older, in the panel in August 2013, and consenting. Sample size quotas were set *a priori* to achieve 80% power for a 10% change in behavioral intentions. GfK used its sampling procedures to ensure the entire panel was representative of the US

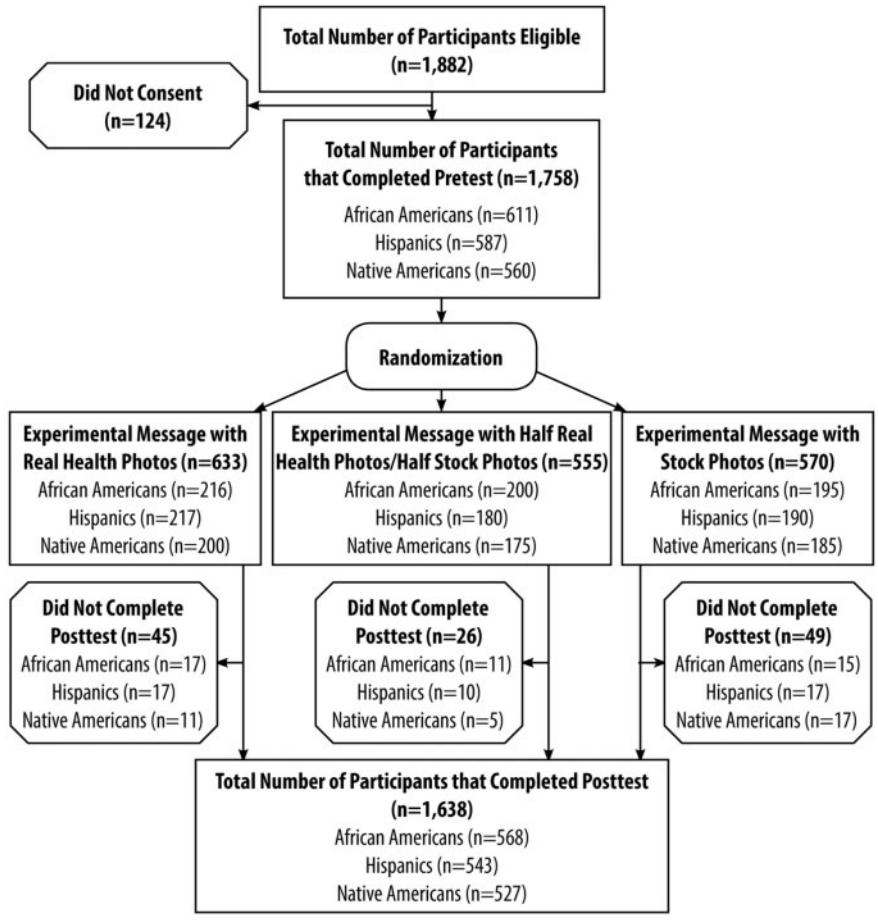


Fig. 1. Consort diagram for trail—ethnic minority samples.

population [32] and avoided Internet access issues by providing computer/Internet access to panel members, if needed. GfK predetermined panel members on race/ethnicity at panel enrollment. Any one participant was selected to represent a single population based on the racial/ethnic group quota being filled at the moment they were selected for participation. Participants completed an online consent form and were paid an incentive equivalent to $5.00. Only one adult per household was enrolled.

Experimental design and procedures

Participants were enrolled in a 3 (photographs) × 3 (target population) between subject factorial design. Target population was predetermined and the experimental session was conducted through the GfK's electronic survey system, taking approximately 16 min. The survey system randomized participants to the photograph condition within each population in which participants were shown a health education message with either standard stock photographs or photographs with models that matched their race/ethnicity, keeping researchers blind to condition. The message text was the same across photographic conditions and samples. Participants completed a brief pretest and then were presented with the experimental message containing the photographs. After reading the message and viewing the photographs, participants

completed posttest outcome items. Next, they were again presented with the same experimental message to view the photographs as they responded to questions measuring theoretic mediators. The mediators were assessed following the outcomes to avoid the chance that mediator measures would prime the behavioral intentions assessments given the short duration between pretest and posttest.

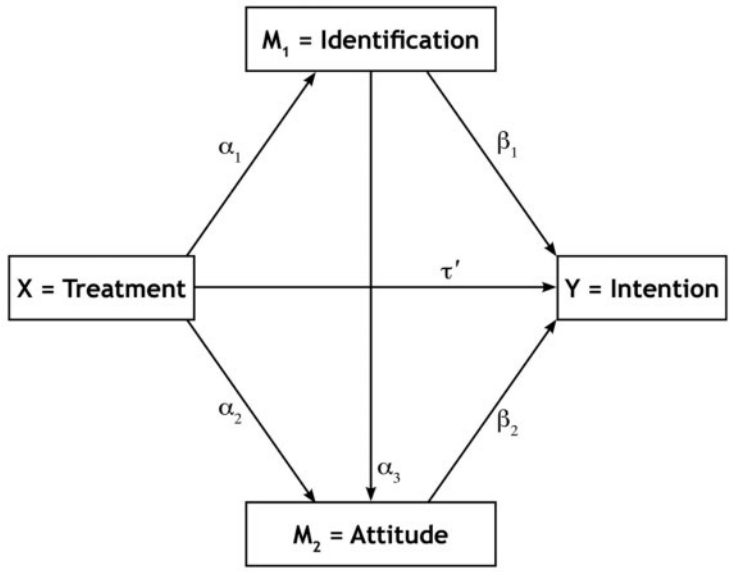
Experimental message and photographs

Photographs were embedded in a health message advocating that adults increase their physical activity and improve their diet. The text was identical across all conditions and target populations. It contained 1684 words, 2 data tables and 7 call-out boxes with text in 12-point condensed type and half-inch margins in 8.5" × 11" format. Text was obtained from US Department of Health and Human Services, National Institutes of Health and US Centers for Disease Control and Prevention websites and combined into a cohesive message advocating maintaining a healthy weight by engaging weekly in at least 150 min of physical activity and muscle strengthening activities and eating a diet low in fat, sugar and carbohydrates. A graphic designer formatted the text and photographs as a full-color five-page newsletter article in which content covered full pages.

The message contained eight photographs, four depicting adults engaged in physical activity (two female and two male characters) and four, healthy dietary behavior (two female and two male characters), constituting 21% of the message layout. To create the experimental conditions, photographs were selected from either standard stock photographs available from a major stock photography service (*iStock Photo*) or a stock photography collection created by the research team that matched the three race/ethnic target populations, named Real Health Photos (RHP). A previous evaluation of stock photography services established that stock photographs lacked diversity and primarily displayed young, attractive, healthy and affluent-appearing persons [33].

Three versions of the experimental message were created for each race/ethnic sample: (i) eight stock photographs (non-Real Health Photos [RHP] condition), (ii) four stock photographs and four RHP (half-RHP condition) and (iii) eight RHP (all RHP condition). A graphic designer formatted the text and photographs in all three versions into an identical five-page newsletter article layout. Eight stock photographs were selected by the researchers depicting models typically found in stock photograph services. All models were young and non-Hispanic white, and appeared affluent and fit. None of these models matched participants on race/ethnicity; to control for gender matching, half were female and half were male.

The RHP collection of photographs of the three target populations was developed by recruiting and photographing individuals diverse in socioeconomic levels in a variety of settings from homes to parks to clinics and engaged in physical activity, healthy dietary behaviors (i.e. shopping, cooking and eating healthy) or medical examinations (Fig. 2). Photographs were taken by professional photographers; photographs had to meet pre-established quality criteria equivalent in quality to stock photographs. To select the photographs, a pilot study that included ten participants from each target population not enrolled in the factorial design ($n = 30$) reviewed 24 RHP depicting persons from their race/ethnic population selected by the authors: (i) six photographs of females physically active (defined as lifestyle physical activity); (ii) six photographs of females with food; (iii) six photographs of males physically active and (iv) six photographs of males with food. Each photograph was evaluated on five Likert-type questions about the similarity of the person in the photograph to the race/ethnic population and six Likert-type questions about the quality of the photograph. Scores were averaged and the two highest-ranked photographs in each activity/gender group were selected. Another highly ranked photograph was selected if the highest-ranked photographs contained the same model or similar activities. Each selected RHP matched only the race/ethnicity of the sample. Gender was controlled by displaying half female and half male models in each experimental message.



Key to Paths Modelled in Structural Equation Modelling

Direct Effects:

α_1: Path coefficient relating the independent variable (X = Treatment) to the first step mediator (M_1 = Identification).

α_2: Path coefficient relating the independent variable (X = Treatment) to the second step mediator (M_2 = Attitude).

α_3: Path coefficient relating the first step mediator (M_1 = Identification) to the second step mediator (M_2 = Attitude).

β_1: Path coefficient relating the first step mediator (M_1 = Identification) to the dependent variable (Y = Intention), adjusted for the independent variable (X = Treatment).

β_2: Path coefficient relating the second step mediator (M_2 = Attitude) to the dependent variable (Y = Intention), adjusted for the independent variable (X = Treatment).

τ': Direct effect of independent variable (X= Treatment) on dependent variable (Y = Intention)

Indirect Effects:

Indirect effect through M_1: $\alpha_1\beta_1$

Indirect effect through M_2: $\alpha_2\beta_2$

Indirect effect through M_1 and then M_2: $\alpha_1\alpha_3\beta_2$

Total indirect effect: $\alpha_1\beta_1+\alpha_2\beta_2+\alpha_1\alpha_3\beta_2$

Fig. 2. Illustration of structural equation models estimated.

Measures

The pretest assessed baseline physical activity (how physically active are you [five-point scale of not at all to extremely]; have you been regularly physically active in the past 6 months [yes, no]), diet (how many servings of fruits and vegetables do you eat each day), smoking status (smoke cigarettes every day, some days, not at all but in the past, not at all or never smoked) and health status (five-point scale from poor to excellent).

The posttest measured the primary outcomes of intentions to improve health behaviors (sum of six 5-point likelihood scales [1 = extremely unlikely, 5 = extremely likely] assessing intention to increase moderate to vigorous physical activity and to improve diet by decreasing intake of high-fat, -sugar and -carbohydrate foods) immediately after participants read the experimental message. Physical activity intentions were assessed by two items: how likely are you to: (i) do 150 min of moderate to vigorous physical activity each week over the next

month and (ii) be more physically active in the next month than you have been in the past 6 months. Dietary intentions were measured by four items. See items for the two intention scale, factor loadings from exploratory factor analysis, and Cronbach alpha coefficients in Table I.

Identification with persons in the photographs and attitudes towards physical activity and diet were assessed as mediator variables. Identification was measured using seven-point bi-polar adjective questions, adapted from published scales [18, 34] (see items, factor loadings from exploratory factor analysis, and Cronbach's alpha coefficients in Table I). Attitude towards physical activity and diet was measured separately by creating single composites combining positive and negative outcome expectations and self-efficacy expectations (five-point Likert-type items), suggested by Social Cognitive Theory (see Table I for items, factor loadings and Cronbach's alpha coefficients). GfK provided demographic information on participants (see Table II).

Statistical analysis

The hypotheses on the effectiveness of images matched to race/ethnicity of the target population was tested by structural equation modeling [35, 36], with alpha criterion set at $P = 0.05$ (two-tailed). Mplus was used to analyze the direct and indirect effects of RHP (i.e. treatment group—'*X*' in Fig. 1) on primary outcomes of intentions ('*Y*' in Fig. 1) as well as on the theoretic mediators of identification with characters in photographs ('M_1' in Fig. 1) and attitudes towards physical activity and healthy diet (i.e. positive outcome, negative outcome and self-efficacy expectations; M_2 in Fig. 1). Two planned comparisons on the RHP factor were performed: (i) RHP versus non-RHP to test H1 and H2 and (ii) Half-RHP versus non-RHP to explore RQ2 on the influence of amount of matched images. Separate models were estimated for each primary outcome (i.e. intentions to increase physical activity and improve their diet). Also, analyses were performed separately within each race/ethnic sample as replicates to examine RQ1 on the generalizability of the effect of RHP.

Results

Profile of the sample

The profile of the sample is presented in Table II. The overall sample was middle-aged, had more females than males, and was diverse in education and employment status. Only one-third lived with children. The largest percentage of participants lived in the South and in metropolitan areas. Most participants had Internet access when first recruited to the Knowledge Panel®. The three race/ethnic samples differed on demographic characteristics (Table II). The Native American sample had many individuals who identified as more than one race. The African American subsample had the most females, fewer married individuals, most individuals residing in the South and metropolitan areas, and highest home ownership. The Hispanic subsample was youngest, least educated, had most males, most working individuals, largest households, most households with children, most heads of households, and tended to live in the South, West, and metropolitan areas.

Overall comparison of non-RHP versus RHP conditions (H1 and H2)

The results of the structural equation modeling for the physical activity and healthy diet intentions are shown in Tables III and IV, respectively. The direct effect of RHP (*X*) on both behavioral intentions (*Y*) was nonsignificant in all models, failing to support H1. Instead, the models revealed a consistent, significant, indirect effect of the RHP on both intentions via identification and attitude, supporting H2 (see Tables III and IV). Compared with the non-RHP, RHP consistently increased participants' identification with the persons in the photographs (M_1). Greater identification was associated indirectly with increased physical activity and intentions through improvements in attitudes towards physical activity and healthy diet (M_2).

Table I. *Items and Cronbach coefficient alpha reliabilities for intention, identification and attitude scales*

	Standardized Cronbach coefficient alpha
Intention to improve physical activity	
How likely are you to do 150 min of moderate to vigorous physical activity each week over the next month?	0.64
How likely are you to be more physically active in the next month than you have been in the past 6 months?	
Intention to improve diet	
How likely are you to eat healthy in the next month by reducing high-fat foods?	0.87
How likely are you to eat healthy in the next month by reducing high-sugar foods?	
How likely are you to eat healthy in the next month by reducing high-carbohydrate foods?	
How likely are you to make changes to your diet that will improve your health?	
Identification with persons in the photographs[a]	
I cannot/can relate to them.	0.91
I see them as different/similar from me.	
They do not look like/look like me.	
I do not feel/feel connected to them.	
Positive outcome expectations for physical activity	
Physical activity makes me feel better.	0.81
Physical activity gives me a sense of personal accomplishment.	
Physical activity will aid in weight control.	
If I increase my physical activity, I expect to be happier.	
If I increase my physical activity, I expect to have more self-respect.	
Negative outcome expectations for physical activity	
Physical activity makes me extremely tired.	0.64
Doing physical activity is boring.	
I experience a lot of pain when I am physically active.	
When I am physically active, I become resentful of those that are more fit than me.	
Self-efficacy for physical activity	
If I increase my physical activity, I expect to have control of my overall health.	0.70
I feel I have control over my physical activity levels.	
How certain are you that you can be physically active?	
How confident are you that you can do moderate or vigorous intensity physical activity for at least 10 min a day?	
Positive outcome expectations for dietary changes	
Eating healthy makes my mood better, in general.	0.87
Eating healthy gives me a sense of personal accomplishment.	
Eating healthy increases my energy.	
If I improve my diet, I expect to enjoy life more.	
If I improve my diet, I expect to feel self-confident.	
Negative outcome expectations for dietary changes	
Eating healthy is boring.	0.69
I still have cravings for junk food when I eat healthy.	
Healthy foods like fruits and vegetables just do not fill me up.	
Finding healthy foods is inconvenient and hard to do.	
Self-efficacy for dietary changes	
If I improve my diet, I expect to be in control of my health.	0.75
I feel that I have control over the changes I make to my diet.	
How certain are you that you can eat healthy foods such as those that are low in fat, sugar and carbohydrates?	
How confident are you that you will be able to improve your diet in the future?	

[a]Identification was measured with bipolar adjective scales; opposing adjectives are listed within each item.

Table II. *Demographic profile of the sample*

Demographics	African American	Hispanic	Native American	Overall
N	568	543	527	1638
Age[a] (SD)	48.38 (15.81)	42.88 (15.57)	49.38 (15.39)	46.88 (15.84)
Education[a]				
Less than high school	8.5%	19.7%	5.7%	11.3%
High school	27.3%	33.5%	19.0%	26.7%
Some college	36.4%	27.8%	38.1%	34.1%
Bachelor's degree or higher	27.8%	19.0%	37.2%	27.9%
Race and ethnicity[a]				
White, non-Hispanic	0.0%	0.0%	0.0%	0.0%
Black, non-Hispanic	100.0%	0.0%	0.0%	34.7%
Other, non-Hispanic	0.0%	0.0%	20.3%	6.5%
Hispanic	0.0%	100.0%	13.5%	37.5%
More than one race, non-Hispanic	0.0%	0.0%	66.2%	21.3%
Gender[a]				
Female	61.8%	46.2%	57.5%	57.3%
Male	38.2%	53.8%	42.5%	44.7%
Household head[a]				
No	23.2%	29.1%	17.8%	23.4%
Yes	76.8%	70.9%	82.2%	76.6%
Household size[a] (SD)	2.58 (1.56)	3.20 (1.68)	2.77 (1.46)	2.85 (1.59)
Income				
Less than $25 000	28.5%	22.5%	26.4%	25.8%
$25 000–$49 999	29.6%	28.5%	28.7%	29.0%
$50 000–$99 999	29.6%	33.0%	29.0%	30.5%
$100 000 or more	12.3%	16.0%	15.9%	14.7%
Marital status[a]				
Married or living with partner	41.4%	58.0%	62.0%	53.5%
Widowed/divorced/separated	25.2%	14.9%	19.4%	19.9%
Never married	33.4%	27.1%	18.6%	26.6%
MSA status[a]				
Non-metro	10.0%	7.0%	14.8%	10.6%
Metro	90.0%	93.0%	85.2%	89.4%
Region[a]				
Northeast	15.5%	9.7%	11.8%	12.4%
Midwest	17.6%	9.2%	19.4%	15.4%
South	58.1%	40.0%	41.7%	46.8%
West	8.8%	41.1%	27.1%	25.4%
Ownership status of living quarters[a]				
Rent	45.6%	39.0%	36.2%	40.4%
Own	54.4%	61.0%	63.8%	59.6%
Have kids under 18 years old?[a]				
No	70.1%	57.1%	69.1%	65.5%
Yes	29.9%	42.9%	30.9%	34.5%
Current employment status[a]				
Not working	50.0%	42.4%	47.6%	46.7%
Working	50.0%	57.6%	52.4%	53.3%
Household Internet access[a]				
No	29.2%	19.0%	9.7%	19.5%
Yes	70.8%	81.0%	90.3%	80.5%

[a]Indicates statistically significant difference across the three subsamples ($P < 0.05$).

Table III. *Path coefficients (standardized and unstandardized regression coefficient) from structural equation modeling comparing non-RHP versus RHP and non-RHP versus half-RHP on behavioral intentions related to physical activity by race/ethnic sample*

	African Americans			Hispanics			Native Americans		
	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value
Direct effects									
β_1 ($M_1 \rightarrow Y$)	−0.04 (0.06)	−0.03 (0.05)	0.464	0.07 (0.05)	0.07 (0.05)	0.146	−0.03 (0.06)	−0.03 (0.05)	0.639
β_2 ($M_2 \rightarrow Y$)	0.62 (0.07)	1.04 (0.14)	0.000	0.56 (0.06)	0.93 (0.11)	0.000	0.62 (0.09)	0.96 (0.15)	0.000
α_3 ($M_1 \rightarrow M_2$)	0.23 (0.05)	0.11 (0.02)	0.000	0.12 (0.04)	0.07 (0.03)	0.008	0.24 (0.05)	0.14 (0.03)	0.000
τ_1 ($X_1 \rightarrow Y$)[b]	0.07 (0.12)	0.05 (0.09)	0.549	0.04 (0.11)	0.03 (0.08)	0.719	0.03 (0.12)	0.02 (0.09)	0.828
α_{11} ($X_1 \rightarrow M_1$)[b]	0.68 (0.10)	0.59 (0.09)	0.000	0.37 (0.10)	0.31 (0.09)	0.000	0.54 (0.10)	0.45 (0.09)	0.000
α_{12} ($X_1 \rightarrow M_2$)[b]	−0.24 (0.10)	−0.10 (0.04)	0.020	0.05 (0.09)	0.03 (0.04)	0.560	0.04 (0.11)	0.02 (0.05)	0.697
τ_2 ($X_2 \rightarrow Y$)[b]	0.06 (0.12)	0.04 (0.09)	0.605	−0.05 (0.11)	−0.04 (0.08)	0.660	0.06 (0.12)	0.04 (0.09)	0.653
α_{21} ($X_2 \rightarrow M_1$)[b]	0.62 (0.10)	0.53 (0.09)	0.000	0.31 (0.11)	0.26 (0.09)	0.005	0.13 (0.11)	0.11 (0.09)	0.255
α_{22} ($X_2 \rightarrow M_2$)[b]	−0.11 (0.10)	−0.05 (0.04)	0.290	−0.07 (0.10)	−0.03 (0.05)	0.483	0.00 (0.10)	0.00 (0.05)	0.970
Indirect effects									
$\alpha_{11}\beta_1$ ($X_1 \rightarrow M_1 \rightarrow Y$)	−0.03 (0.04)	−0.02 (0.03)	0.467	0.03 (0.02)	0.02 (0.02)	0.178	−0.02 (0.03)	−0.01 (0.02)	0.640
$\alpha_{12}\beta_2$ ($X_1 \rightarrow M_2 \rightarrow Y$)	−0.15 (0.07)	−0.11 (0.05)	0.025	0.03 (0.05)	0.02 (0.04)	0.560	0.03 (0.07)	0.02 (0.05)	0.698
$\alpha_{11}\alpha_3\beta_2$ ($X_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$)	0.10 (0.03)	0.07 (0.02)	0.000	0.03 (0.01)	0.02 (0.01)	0.039	0.08 (0.03)	0.06 (0.02)	0.003
$\alpha_{21}\beta_1$ ($X_2 \rightarrow M_1 \rightarrow Y$)	−0.03 (0.04)	−0.02 (0.03)	0.468	0.02 (0.02)	0.02 (0.01)	0.194	0.00 (0.01)	0.00 (0.01)	0.664
$\alpha_{22}\beta_2$ ($X_2 \rightarrow M_2 \rightarrow Y$)	−0.07 (0.06)	−0.05 (0.05)	0.294	−0.04 (0.05)	−0.03 (0.04)	0.484	0.00 (0.06)	0.00 (0.05)	0.970
$\alpha_{21}\alpha_3\beta_2$ ($X_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$)	0.09 (0.03)	0.06 (0.02)	0.001	0.02 (0.01)	0.02 (0.01)	0.058	0.02 (0.02)	0.01 (0.01)	0.276

Key to variables modeled: X_1: RHP versus non-RHP. X_2: Half-RHP versus non-RHP. M_1: Identification with people in the photographs. M_2: Attitude towards physical activity. Y: Intention to improve physical activity.

[a]Standardized coefficient for binary predictors was standardized with respect to the outcomes only.

[b]Covariates controlled in the models: current physical activity level, smoking status, general health status, number of servings of fruits and vegetables per day, age, education, gender and income.

Table IV. *Path coefficients (standardized and unstandardized regression coefficient) from structural equation modeling comparing non-RHP versus RHP and non-RHP versus half-RHP on behavioral intentions related to healthy diet by race/ethnic sample*

	African Americans			Hispanics			Native Americans		
	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value	Standardized regression coefficient[a] (S.E.)	Unstandardized regression coefficient (S.E.)	*P*-value
Direct effects									
β_1 ($M_1 \rightarrow Y$)	0.02 (0.05)	0.02 (0.04)	0.635	0.06 (0.04)	0.06 (0.04)	0.143	0.04 (0.05)	0.04 (0.05)	0.396
β_2 ($M_2 \rightarrow Y$)	0.63 (0.05)	0.84 (0.08)	0.000	0.67 (0.04)	0.86 (0.07)	0.000	0.55 (0.06)	0.94 (0.12)	0.000
α_3 ($M_1 \rightarrow M_2$)	0.28 (0.05)	0.19 (0.03)	0.000	0.25 (0.05)	0.20 (0.04)	0.000	0.21 (0.05)	0.13 (0.03)	0.000
τ_1 ($X_1 \rightarrow Y$)[b]	0.16 (0.10)	0.13 (0.08)	0.102	0.06 (0.09)	0.05 (0.07)	0.526	−0.10 (0.10)	−0.08 (0.09)	0.325
α_{11} ($X_1 \rightarrow M_1$)[b]	0.68 (0.10)	0.59 (0.09)	0.000	0.37 (0.10)	0.31 (0.09)	0.000	0.53 (0.10)	0.45 (0.09)	0.000
α_{12} ($X_1 \rightarrow M_2$)[b]	−0.30 (0.10)	−0.18 (0.06)	0.003	0.07 (0.10)	0.04 (0.07)	0.512	0.02 (0.11)	0.01 (0.05)	0.883
τ_2 ($X_2 \rightarrow Y$)[b]	0.07 (0.10)	0.06 (0.08)	0.448	0.02 (0.09)	0.02 (0.08)	0.801	−0.12 (0.10)	−0.10 (0.09)	0.246
α_{21} ($X_2 \rightarrow M_1$)[b]	0.61 (0.10)	0.53 (0.09)	0.000	0.31 (0.11)	0.26 (0.09)	0.005	0.12 (0.11)	0.10 (0.09)	0.264
α_{22} ($X_2 \rightarrow M_2$)[b]	−0.12 (0.10)	−0.07 (0.06)	0.241	−0.09 (0.11)	−0.06 (0.07)	0.397	−0.01 (0.10)	−0.01 (0.05)	0.898
Indirect effects									
$\alpha_{11}\beta_1$ ($X_1 \rightarrow M_1 \rightarrow Y$)	0.02 (0.03)	0.01 (0.03)	0.636	0.02 (0.02)	0.02 (0.01)	0.175	0.02 (0.03)	0.02 (0.02)	0.402
$\alpha_{12}\beta_2$ ($X_1 \rightarrow M_2 \rightarrow Y$)	−0.19 (0.07)	−0.15 (0.05)	0.004	0.05 (0.07)	0.04 (0.06)	0.513	0.01 (0.06)	0.01 (0.05)	0.883
$\alpha_{11}\alpha_3\beta_2$ ($X_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$)	0.12 (0.03)	0.10 (0.02)	0.000	0.06 (0.02)	0.05 (0.02)	0.004	0.06 (0.02)	0.05 (0.02)	0.004
$\alpha_{21}\beta_1$ ($X_2 \rightarrow M_1 \rightarrow Y$)	0.01 (0.03)	0.01 (0.02)	0.636	0.02 (0.02)	0.02 (0.01)	0.192	0.01 (0.01)	0.00 (0.01)	0.498
$\alpha_{22}\beta_2$ ($X_2 \rightarrow M_2 \rightarrow Y$)	−0.08 (0.06)	−0.06 (0.05)	0.243	−0.06 (0.07)	−0.05 (0.06)	0.398	−0.01 (0.06)	−0.01 (0.05)	0.898
$\alpha_{21}\alpha_3\beta_2$ ($X_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$)	0.11 (0.03)	0.09 (0.02)	0.000	0.05 (0.02)	0.04 (0.02)	0.014	0.02 (0.01)	0.01 (0.01)	0.286

Key to variables modeled: X_1: RHP versus non-RHP. X_2: Half-RHP versus non-RHP. M_1: Identification with people in the photographs. M_2: Attitude towards physical activity. Y: Intention to improve physical activity.

[a]Standardized coefficient for binary predictors was standardized with respect to the outcomes only.

[b]Covariates controlled in the models: Current physical activity level, smoking status, general health status, number of servings of fruits and vegetables per day, age, education, gender and income.

Model estimates within race/ethnic samples (RQ1)

The effects of RHP were estimated within each race/ethnic sample to answer RQ1 (see Tables III and IV). The positive impact of RHP over non-RHP on both behavioral intentions was mediated by increased identification with persons in the photographs that in turn produced more favorable attitudes towards physical activity and healthy diet in each race/ethnic sample. In the African American sample, RHP also indirectly increased physical activity and healthy diet intentions through improved attitudes, but this relationship was nonsignificant among Hispanics and Native Americans.

Comparison of no-RHP versus half-RHP (RQ2)

The half-RHP condition was compared with the non-RHP to explore whether the positive effects of RHP could be achieved by incorporating some but not all photographs that matched the race/ethnic sample to answer RQ2. The results of the structural equation modeling in Tables III and IV showed that in some cases half-RHP had the same indirect effect on behavioral intentions through increased identification with persons in the photographs and attitudes towards physical activity and diet. This effect occurred on both behavioral intentions for African Americans and for healthy diet intentions for Hispanics. However, the half-RHP condition had no effect in Native Americans.

Discussion

This study underscored the power of visual images to capitalize on the homophily principle in health communication with race/ethnic minority recipients (i.e. portraying persons of similar race/ethnicity to recipients improves message effectiveness) [21]. Physical appearance of models in the RHP may be a primary communication signal of its referent (e.g. models' ethnicity/race) [3, 4], whose automatic validity in terms of meaning may have affected attitudes about [3, 12, 37–40] and affective reactions to health messages [4–9]. Source–receiver similarity has enhanced personal relevance and effectiveness of health messages previously [41–44].

This study also supported the explanation that the persuasive power of photographs which convey similarity (i.e. RHP) occurs by increasing recipients' identification with the persons depicted [14, 19]. When recipients identify with sources and situations they should become emotionally engaged and seek to emulate the behavior of the similar-appearing sources [14, 20]. Identification may be especially strong for distinctive characteristics that define recipients as in the same race/ethnic minority that is a relevant self-identity [45–47] and future research should compare minority to majority groups.

Targeted and tailored matching to recipients' characteristics previously has improved message effectiveness [22, 23, 25–27, 48], but current recommendations on visual images are overly broad, vague and not empirically based [49]. Tailoring visual images (i.e. photographs of 'real' individuals matched to recipients' ethnicity) increased health message effectiveness just as can tailoring text and language [46]. Homophily and resulting identification may be a hardwired, evolutionary, biological phenomenon across species and cultures and a proxy for interpersonal familiarity [10, 13, 50, 51]. This may explain why the effects replicated across the three race/ethnic populations and two health behavior intentions. These fundamental processes should be considered in health communication, especially for visual content. The effect of RHP occurred by matching photographs on a single characteristic and were small to moderate in size. Future research should explore whether matching visual content on additional variables increases effectiveness.

The RHP stock photograph library of 'real' people from diverse race/ethnic groups engaged in common health behaviors (e.g. physical activity, healthy eating and medical examinations) may improve messages and reduce campaign costs by sharing photographs among planners (see www.realhealthphotos.com). The largest stock photograph services do have some images that depict individuals with which race/ethnic minority recipients can identify, but the services are so large that it can be difficult to locate similar-appearing models.

Unless campaign planners develop their own photographs, they may be inclined to use mostly photographs that depict attractive, young and affluent-appearing individuals from available stock photograph services [33] that do not match the race/ethnic minority groups. People may be less likely to seek help from highly attractive sources because identification is low [52].

The finding that just half, compared with all, RHP may be effective at least with African American and possibly Hispanic adults suggests it is not necessary to match all photographs or create entirely different communications for every population. Populations, especially African Americans and Hispanics, may find any photographs showing similar persons to be attention-getting, create identification and react positively. Also, African Americans and Hispanics may not want to appear segregated by seeing only photographs of people like themselves, or singled out if the message addresses a socially less-desirable behavior. Designers often tend to completely segregate visual images for racial/ethnic minorities [49]. Such segregation may be unwarranted with African Americans and Hispanic populations; just presenting some homophilous persons increases message effectiveness. This also makes message production and dissemination potentially more cost-effective, as it may reduce the variety of messages that need to be created (assuming text can be found that is appropriate across populations). In contrast, Native American recipients responded to the all RHP images but not the half-RHP. It may be that Native Americans have a strong sense of familial and tribal familiarity and prefer to see themselves as separate from others. Future research should investigate if there is a threshold for the number of similar-appearing models (e.g. if the proportion of race/ethnic minorities represented is very low, it might be perceived as tokenism) and identify reasons for why Native Americans only responded positively to messages with all images matching their race/ethnicity.

The study had strengths and limitations. In terms of strengths existing literature confirming the homophily principle (including biological evidence) made the pre-specified hypotheses highly probable and hypotheses were replicated in large samples from three race/ethnic populations drawn from a high-quality national panel that provided ampled statistical power [53]. The randomized between-subjects design avoided threats to internal validity. However, the study was limited by its short duration (in which some participants may have only skimmed the message) and focus on immediate reactions to the message. A sizable proportion of the minority participants had college educations, incomes above $50 000, and owned a home, suggesting that they were unlikely to be experiencing health disparities. The outcome variable for all three samples was behavioral intentions not actual behavior, so future studies should examine actual physical activity and eating behavior. However, two meta-analyses have shown that behavioral intentions are a strong predictor of actual behavior [54, 55]. Subsequent research has affirmed the relationship between intention and physical activity [56, 57], weight loss [58] and other health behaviors [59–62]. Self-report measures can be affected by social desirability and demand biases and, being cognitions, at best have construct validity.

The visual image may be an especially promising means for enhancing health communication designed for race/ethnic minority populations. Certain physical features are strongly indicative of race/ethnicity groups visually [3], so visual images can stimulate the fundamental processes of homophily and identification. The RHP image collection capitalized on the power of visual images to increase health communication impact, specifically with race/ethnicity minority populations.

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Conflict of interest statement

We are disclosing that Ms Mary K. Buller is the President and owner of Klein Buendel, Inc. and that

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