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Graphic Design in Public Health Research

A Multiyear Pictorial Health Warning Label Initiative and Recommendations for Sustained Interdisciplinary Collaboration

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Introduction

Graphic design is often deployed in public health research, intervention, and dissemination of information. In some cases, such as the studies shared in this article, graphic design artifacts are the public health intervention, developed and tested within a series of scientific study designs involving research teams with wide-ranging expertise. Relatively little attention has been paid, however, to the role graphic design plays in public health research or how graphic designers may contribute to the conduct of research beyond a production services role. Even within the health communication field, the benefits for scientific knowledge and public health emerging from interactions with graphic designers remain understudied. Furthermore, graphic designers have yet to make a substantive case to public health researchers that there is more to graphic design than the artifacts it produces. Therefore, the goals of this paper are to 1) provide an overview of methods employed to integrate graphic design into a multiyear series of public health research studies, 2) share key results from these studies relevant to graphic design, and 3) discuss the requirements for sustaining research collaborations between graphic designers and public health researchers in ways that effectively combine their fields of expertise and produce more genuine collaboration for the greater benefit of public health.

Keywords

health warning label;
smoking;
hookah;
prevention;
graphic design

Background

We (MS, TA, and WM) began working together in 2017, when a research team led by TA and WM secured five-year National Institutes of Health (NIH) grants from the Fogarty International Center and the National Institute on Drug Abuse (NIDA) to develop and test pictorial health warning labels (HWLs) for hookah (or waterpipe) smoking devices and products in two countries in the Eastern Mediterranean Region (EMR): Lebanon and Tunisia. A subsequent grant from the Florida Department of Health extended the work to the United States, where hookah smoking continues to grow in popularity (Jamal et al., 2017). This project is ongoing, and the team has since expanded its pictorial HWL work to electronic nicotine delivery systems (ENDS), or vaping devices and liquids, with a new five-year NIH grant from NIDA. Sustaining collaboration among the team's members, therefore, has been essential to conducting and expanding this research initiative and disseminating its results.

Our team members hail from a range of backgrounds, including medical science, epidemiology, the social and behavioral sciences, health communication, biostatistics, law (i.e., tobacco policy and regulation), social marketing, and graphic design. Most team members work at universities, including Florida International University, University of Miami, American University of Beirut, Université de Tunis El Manar, and The University of Memphis. Much of the prior experience and influence for this initiative grew out of the Syrian Center for Tobacco Studies, a pioneering research and capacity-building collaboration that was established with funding from the NIH's Fogarty International Center (Maziak et al., 2004). More recently, partners from Virginia Commonwealth University, University of North Carolina, and Georgetown University joined the team, which we named The Hookah and E-cigarettes Health Communication Group (2022).

As our team has grown, so has the public health field's interest in hookah smoking cessation and prevention, due to increasing hookah smoking rates around the world. Recent estimates place hookah prevalence among youths from 2.5% to 37.2% in EMR countries, 2.2% to 22.7% in Europe, and 1.0% to 11.4% in the US (Jawad et al., 2018). Any increase in hookah smoking is worrisome, considering its potential to increase the risk for lung cancer (Awan et al., 2017; Montazeri et al., 2017; Waziry et al., 2016), heart disease (Wu et al., 2013), respiratory disease (Waziry et al., 2016), esophageal cancer (Awan et al., 2017; Mamtani et al., 2017; Montazeri et al., 2017), and many other illnesses (Asfar et al., 2019; Bhatnagar et al., 2019).

Hookah smoking has grown in popularity partly due to the misperception that water, which is poured into the device's base (or vase), filters the tobacco smoke and makes hookah safer than cigarette smoking (Maziak, 2015; World Health Organization, & WHO Study Group on Tobacco Product Regulation, 2015). This misperception is understandable, given how the hookah device works. As the hookah smoker takes a draw, the tobacco smoke is pulled into the base and cooled as it bubbles through the water, giving the false impression that the water is filtering out harmful chemicals from the tobacco smoke. The smoke is produced by the coal-heated tobacco residing in the head of the device (see Figure 1). This operation is easily visible in hookahs with bases made from translucent glass, which dominate the market. Unlike prior hookah HWL research, which focused on tobacco package HWLs, our studies include the placement of an HWL directly over a large portion of the base since this position offers more visibility and extended contact with the user.

Prior studies involving cigarette packaging have demonstrated that HWLs using text and images—variously termed pictorial warning labels, graphic warning labels, and graphic picture warnings—more effectively communicate health risks than HWLs employing text only (Brewer et al., 2016; Fong et al., 2009; Hammond, 2009; Noar, Francis, et al., 2016). Pictorial HWLs were recommended for use on cigarette packaging by the World Health Organization (World Health Organization, 2003). Canada was the first country to implement their use, and now 134 countries and territories require pictorial HWLs on cigarette packaging (Canadian Cancer Society, 2021). Meanwhile in the US, the Food and Drug Administration (FDA) created a rule to implement nine pictorial warning labels on cigarette packaging, using the authority of the Family Smoking Prevention and Tobacco Control Act of 2009. Five tobacco companies then sued the FDA to revoke the rule (*R.J. Reynolds Tobacco Co. V. Food & Drug Admin.*, 2012). Appeals proceeded, and at the date of this writing, pictorial HWLs on cigarette packages will be required in the US beginning April 9, 2023 (U.S. Food & Drug Administration, 2022a).

Presently, the FDA requirement for hookah tobacco packaging is a text-only label stating, "WARNING: This product contains nicotine. Nicotine is an addictive chemical." Charcoal and hookah device components are regulated by the FDA, but the agency only requires a verbal warning label on the tobacco packaging (U.S. Food & Drug Administration, 2022b). Bringing pictorial HWLs to hookah tobacco packaging, charcoal packaging, and devices will require more time and effort. Unfortunately, compared to cigarette packaging, little research and policy attention have been given to hookah tobacco and related product packaging, and no prior team has systematically researched the use of pictorial HWLs placed on hookah devices (Asfar et al., 2019). Where studies have tested the use of pictorial HWLs on hookah tobacco packaging and related products, labels were either adapted from pre-existing cigarette packaging HWLs or unscientifically developed (Jawad et al., 2015; Mostafa et al., 2019; Salloum et al., 2015). Our work addresses this gap by designing and testing pictorial HWLs—specifically for hookah tobacco packaging, charcoal packaging, and hookah devices—through a series of rigorous scientific studies.

Methods

Our study employed mixed-method approaches combining quantitative and qualitative assessments with members of the target population (Hammond, 2008). Quantitative methods were used to test for significant differences on label effectiveness criteria and label placement, as well as differences between groups of participants (i.e., males versus females, smokers versus nonsmokers). Qualitative methods helped us understand why participants ranked certain labels over others and how they thought visual and textual messages could be improved.

To rigorously develop and test the hookah HWLs according to a set of messaging effectiveness criteria derived from the literature, we conducted multiple quantitative and qualitative studies, intentionally ordered to progress from exploration and observation (devising, assessing, and revising possible design solutions) to experimentation (testing possible design solutions). Exploration refers primarily to the use of qualitative research methods, while observation refers to the use of quantitative methods. Experimentation refers strictly to those studies involving random selection, random assignment, and a control group/condition. For clarity, we have organized the explanations of our studies, and the integration of graphic design within those studies, into two phases: preparation for experimentation (the exploration & observation phase) and experimentation (the experimentation phase).

Exploration & Observation Phase

Literature Review

Consistent with scientific research studies, we began our process with an examination of the literature (see Asfar et al., 2019). As with most scientific literature reviews, ours was concerned with three main areas: content, theory, and methods. Content-related literature included studies on the harmful chemicals in smoke, tobacco, and charcoal products; chronic and communicable disease risk; nicotine addiction; passive smoking harms; and more. This state-of-the-art knowledge on health risks informed what we could and should say on the HWLs without over- or understatement of severity, prevalence, or risk, for example. Content areas covered in our literature review informed our choice of messaging themes.

Theory-related literature informed our understanding of how HWL messaging influences smokers' behavioral intentions (i.e., to quit smoking) and nonsmokers' behavioral intentions (i.e., to initiate smoking). This literature informed our selection of messaging effectiveness criteria, which we employed in survey measures to test our pictorial HWLs. These measures helped us understand the extent to which our warning label designs conveyed the health risk messaging themes on multiple indicators of effectiveness. We adopted the message impact framework, which is based on communication (McGuire, 1989; Petty & Cacioppo, 1986) and health behavior theories (Ajzen & Fishbein, 1980; Ajzen & Madden, 1986), and has been applied successfully in cigarette HWL research (Noar, Hall, et al., 2016). This model assumes that features of the HWLs will lead to behavioral change through a chain of psychological events including 1) attracting users, 2) influencing emotions (e.g., attention, fear), 3) affecting cognitive reactions such as thinking about the risk (harm perception), 4) inducing intention to change the behavior (intention to quit), and ultimately 5) behavior change (e.g., reducing or quitting use) (see Figure 2).

With respect to methods, the team assessed each reviewed study for steps taken to reduce random and systematic error, and threats to reliability and validity, respectively. Even highly reliable and valid studies have their limitations, particularly if those studies are cross-sectional (measuring exposure and outcome at a single time point) as opposed to longitudinal, or if they are observational (nonexperimental) compared to randomized controlled trials. Study characteristics sometimes limited how strongly we could word a given claim or how explicitly we could depict a health risk in an image.

Together, content, theory, and methods established the initial basis for what we could state and depict in the HWLs, how conclusively a message could be conveyed, the messaging themes we should include, and how to design measures (e.g., survey questions) to elicit and assess participant responses regarding the effectiveness of the HWLs' messages in each theme. The literature review also informed the initial design, providing guidance for image choices, copywriting, and even tentative impressions for aggressive use of color, shape, contrast, and image cropping.

Initial Text, Image, and Layout Decisions

Specific verbal messages were informed by the literature reviews' investigation of content. From these reviews, five messaging themes were selected: health risks associated with hookah smoking, addiction, harm to others, waterpipe (WP)-specific harm, and WP harm compared with cigarettes. Text statements for each theme were paired in tables with prospective images, mainly drawn from copyright-free medical image repositories and existing pictorial HWLs from the FDA and other available sources. The statements and images were then shared with the team. Team members completed several rounds of copywriting to arrive at the initial set of verbal messages. Establishing the wording became a negotiation among accurately representing the science, translating the science into easily comprehensible and succinct statements, logically connecting the statements to

their corresponding images, and copyfitting the text to the space available for each HWL.

Visual elements of the layout design were influenced by current FDA warning label requirements (see U.S. Food & Drug Administration, 2022b) specifically the use of Helvetica (we chose Helvetica Neue) and maximal use of packaging surface area, which led to our choice of a horizontal orientation. These influences, though subtly applied, were intended to create uncomplicated comparisons between our experimental labels and the FDA textual HWL (our control). We also required a clear delineation between the verbal and visual messages since these were to be assessed separately and in conjunction. For this reason, we decided not to superimpose text over image or place text in the image area. Furthermore, practicality dictated a standardized format that allowed us to explore the use of varying lengths of text across an initial set of 80 messages/layouts.

Various font colors and backgrounds were explored. The graphic designer recommended black text on a white background for readability—a recommendation employed in the first years of the study. Later, however, viewer expectations became an overriding consideration: many visual warning labels on cigarette packages, including those implemented in our project's study regions, used black backgrounds (see Hammond, 2009). We decided to take advantage of existing conventions to grab viewers' attention and avoid confusion. The penultimate format of the warning label was based on the root 2 rectangle and used a black background in the text area. We eventually allocated the larger portion of space to the image area since the key difference of interest between our labels and the current hookah FDA HWL was the use of imagery. We subsequently widened the rectangle when broadening the text area to increase point size and improve readability. As an additional prompt, we used white text against a red field for the word, "warning." We decided to set "warning" off from the text block and the image area to improve visual hierarchy with the use of triangulation (see Figure 3).

Vetting the Initial Labels

Team members engaged in regular meetings to review HWL designs. These meetings were not unlike design critiques. Concepts, image usage, and overall layout choices were discussed. Revisions continued over a three- to four-month period, generating numerous layout options and over 80 HWLs. After further vetting by the team, a set of 28 HWLs was deployed in a Delphi study with experts in tobacco control, health communication, and tobacco policies and regulations.

Delphi Study with Subject Matter Experts

Though a great deal of expert knowledge had already gone into the HWLs' development, thanks to the literature reviews and the team's prior experience, our modified Delphi study served to assess how effectively other experts thought the current scientific knowledge was being communicated and which labels they agreed best conveyed health risks in each theme. In the first round of our modified Delphi study, 30 experts rated each label on a set of effectiveness criteria derived from our theoretical framework: attention, relevance, communication, harm perception, and intention to quit. Labels were presented by theme, and rankings were conducted using a 10-point Likert scale. In the second round, participants viewed the results from the first round, now ranked in order of importance according to mean effectiveness scores of all participants, and then were asked to provide their own ranking on a five-point Likert scale (1 = most important to 5 = least important). In the third round, participants viewed the overall rankings from round 2 compared to their individual rankings and were given the chance to change their rankings (for a full description of study rounds, see Asfar et al., 2019).

Additionally, the study participants suggested text and image changes. This qualitative feedback on surveys from each Delphi study round informed further design iterations. Recommendations were collected, translated by the team into design specifications, and implemented prior to each subsequent round.

Initial Quantitative Study with Smokers and Nonsmokers

The 12 HWLs selected by the Delphi study participants were then deployed in quantitative and qualitative studies with hookah smokers and nonsmokers. Initial data for quantitative analysis were collected via survey methodology. Survey respondents viewed each of the 12 HWLs, which were grouped into themes as previously mentioned. Respondents rated each HWL on measures of effectiveness using a four-point Likert scale, and then ranked the HWLs within each theme by order of perceived effectiveness (as shown in Figure 2). This study design enabled us to see how each label scored on specific and overall measures of effectiveness and how each HWL in a theme ranked in relation to other HWLs in the same theme. Additionally, we were able to compare ratings and rankings between hookah smokers and nonsmokers. Data analysis further revealed which labels in a theme scored significantly higher or lower compared to other labels in the same theme, as rated within the smoker and nonsmoker groups (see Nakkash et al., 2021). These results provided an initial empirical basis for identifying the final four labels to use in the second experimental study.

Qualitative Study with Smokers and Nonsmokers

We then conducted focus groups with these same participants to understand why they rated and ranked certain HWLs higher than others. Participants were asked to discuss the perceived effectiveness of each label's text and image for encouraging smoking cessation and discouraging smoking initiation. Facilitated discussion followed a semi-structured format and focused on wording, image selection, word and image correspondence, and overall clarity of the HWL layout. Participants were encouraged to critically assess the HWLs and offer input for changes. The results informed text and image changes, as well as the need to tailor messages from the literature to a younger audience (see Asfar et al., 2022). Focus group results were used to make improvements to the 12 HWLs prior to their use in the first experimental study.

Language Translations

The initial set of HWLs used in the Delphi study were designed in English, but their survey and focus group testing in Beirut and Tunis required translation to the local Arabic dialects. First, translations were conducted by team members fluent in English and Arabic. Then, translations were made to each HWL and backchecked. An important consideration was font choice. As stated, the English HWLs were set in Helvetica Neue. Arabic HWLs were found to vary considerably in font usage, from faces resembling script to sans serif. Recognizing we had yet to settle on Helvetica Neue regular or bold for the English HWLs, we searched for a typeface with multiple font choices, ranging from ultralight to black. We chose Shilia, which was designed to pair Arabic letters with Roman/Latin letters set in Univers—an interesting option should we need bilingual HWLs in the future.

Experimentation Phase

Our team conducted two separate experiments. The first experiment, conducted using a web-based survey application, involved comparisons among 13 HWLs (12 experimental and one control) across label placement conditions. Participants were exposed to HWLs displayed in three conditions: pictorial HWLs on the tobacco package, pictorial HWLs on three hookah parts (device, tobacco package, and charcoal package) and text-only HWLs on the tobacco package (control), in random and counterbalanced order. Participants rated each of the 12 experimental HWLs and the control HWL according to our five effectiveness criteria—attention, reaction, perceived harm, intention to quit (for smokers), and intent to initiate (for nonsmokers)—using a five-point Likert scale.

This design allowed us to test the following hypotheses: 1) pictorial HWLs on all three parts (device, tobacco, charcoal) will be more effective than on one part (tobacco package); and (2) pictorial HWLs will be more effective than text-only HWLs on the tobacco package (Jebai et al., 2022). Furthermore, by recruiting male and female smokers and nonsmokers, this approach allowed us to compare smokers to nonsmokers, and males to females, on all rating measures. The result was a very rich dataset that informed warning label selection and placement and provided reliable, valid insights should we wish to target different subgroups, or audience segments, with different HWLs.

The second experiment is an ongoing lab-based study design comparing smoking behaviors and experiences between beginning and advanced smokers when they are exposed to HWLs vs. no-HWLs (control) in two separate sessions. Pre- and post-measurements were taken on smokers' chemical exposure, their harm perception, their intention to quit, and their puff topography during two 45-minute sessions that differed by the presence (experiment) or absence (control) of one of four pictorial HWLs on the hookah device. This design also allows for multiple comparisons in one study, as we will be able to compare the control to each of the experimental HWLs (the four different HWLs) within each smoking group and between beginning and advanced smokers on each HWL exposure (for an example of our preceding pilot experiment, see Maziak et al., 2019).

Overall, our methods predominantly involved making numerous comparisons as efficiently as possible. Consequently, the graphic design of the labels required numerous permutations. The use of themes helped us group these permutations in ways relevant to motivating health behavior intentions while providing an organizational structure to manage complexity. The identification and adoption of specific effectiveness criteria provided clear messaging targets for the HWLs to meet, while the modified Delphi study, surveys, and focus groups helped inform which HWLs to prioritize and how to improve them. Therefore, the process of developing the permutations was iterative. These characteristics will likely sound familiar to graphic and other designers, given their similarities to design practices and curricula—particularly those influenced by the Hochschule für Gestaltung Ulm (Ulm School of Design) (see Brennan, 2015).

Dissemination Phase

While the first experiment tested 12 new HWLs, and the second experiment tested the top four, results from our exploratory studies yielded 24 HWLs for potential use in other studies. We are sharing these HWLs with other research teams. Informing and changing policy decisions, like the implementation of new types of warning labels or novel warning label placements (i.e., on smoking devices) requires a critical mass of evidence beyond the scope of any one study, team, or multiyear initiative.

Furthering this effort, each stage of the study, from literature review to randomized controlled trial, provides an important opportunity to disseminate results. Additionally, we are working with social marketing firm Golin to frame messages using our findings and disseminate these messages through public health campaigns.

Results

Many of the scientific results from our multinational initiative have been published elsewhere (see Asfar et al., 2019, 2022; Jebai et al., 2022; Maziak et al., 2019; Nakkash et al., 2021). Therefore, we wish to use this opportunity to briefly highlight and discuss results specific to the graphic design of the pictorial HWLs. For those readers interested in our scientific study results, we highly recommend consulting our published manuscripts.

Much of our data on participant responses to and feedback regarding the labels' graphic design arose from qualitative studies or qualitative components of studies, like the open questions on our modified Delphi study. Results were deemed pertinent to graphic design if they involved data on either formal or conceptual aspects of the HWLs. Formal aspects included color, font choice, image quality, placement, scale, orientation, and the like. Conceptual aspects included word–image correspondence, rhetorical device usage (i.e., metaphor, simile, index, synecdoche), denotation and connotation, tone of voice (e.g., respectful versus authoritative), and text and image choice. Since word–image juxtaposition was the key device employed, many participants focused their feedback on the relationships they perceived, or thought missing, between the words and their corresponding image.

Focus groups with smoking and nonsmoking males and females ages 18–34 took place in Beirut, Tunis, and Miami. Regardless of smoking status or sex, participants preferred "gross" images depicting people, particularly their mouths, severely impacted by disease (see Figure 3) compared to images that did not explicitly show people suffering severe disease outcomes (see Asfar et al., 2022). Clear depictions of harm to newborns and children, i.e., an intubated baby or a child surrounded by smoke, also resonated with emotional impact. Most participants stated or inferred that "gross" medical images were emotionally provocative. Furthermore, they believed this provocativeness would cause smokers and nonsmokers to take seriously the health risks shown and stated on the HWL. Many of these participants, in fact, advised making other images in the set more disgusting. Importantly, our participants' advice contradicts a key legal argument from major tobacco companies fighting pictorial HWLs, which purports that appeals to emotion fail to convey health risk information (see *R.J. Reynolds Tobacco Co. v. Food & Drug Admin.*, 2012). Participants emphasized how our use of particularly graphic and disgusting images actually focused their attention on the health risks.

Notably, the gross images were literal representations of disease drawn from photographs of actual patients. In contrast, images showing a side-by-side, before-and-after comparison of skin wrinkles or premature aging were assumed to be manipulated photos, and were rejected by participants. Participants overwhelmingly recommended gross, literal representations, indicating they preferred both the emotional appeal of grossness and the factual appeal of literalness. This may help explain why participants rejected our use of rhetorical devices in other HWLs: the rhetorical images were neither gross nor literal. While our data show that participants understood rhetorical devices like metaphor, simile, and index, they often described such images as unrealistic. Even connotation seemed a bridge too far (e.g., darkening a photo to make the mood feel sad or depressing).

Further examination of focus group data revealed three meanings for "unrealistic." Participants used that word to mean our use of Photoshop was short of photo-realistic (with some humorous criticisms), the scene depicted could not take place in actual physical space (e.g., a person cannot fit into a jar), or the scene depicted was not perceived true to their personal experience (e.g., not believing a health outcome is true or that it occurs with the severity depicted). These multiple meanings for one word made a careful analysis of the qualitative data critical to informing both image and text changes.

With respect to text, participants wanted the wording to be affirmative, which could also be interpreted as more assertive. For example, participants rejected words like "may" or "can" when preceding "cause." They inferred we were weakening the impact of the message. It was apparent, then, that participants wanted the wording to be as provocative as the imagery. Science, however, rarely speaks in absolutes. This feedback reinforces the challenge we faced from the outset: to deliver a convincing message without over- or understating the health risk evidence.

Regarding text in combination with image, participants wanted the words to explicitly describe what was shown in the image, like captions, or the image to explicitly illustrate the words in the text. This was evident in the way participants discussed the relationship between text and image, stating the text and image did not "correlate" in those instances where we used words to indicate, rather than repeat, what was happening in the image. Our assumption that the words would direct participants' interpretations of the image proved faulty, despite this assumption's wide acceptance in graphic design education (see Meggs, 1989, pp. 41–43).

Additionally, we found a few images, including one previously used in a smoking cessation campaign, elicited responses counter to our intentions. In these rare but nonetheless relevant cases, what

we thought looked scary, some participants thought looked "cool"—like a music poster they would hang on their wall, as one participant shared. Specifically, apocalyptic imagery, e.g., gas masks, gritty environments, and decay or destruction elicited this response. In still other cases, a person we thought looked sad or in pain, some participants thought looked happy or like they were having a good time. These responses further indicated that participants thought literal images communicated more clearly than nonliteral images.

Key formal and conceptual takeaways from these results include literal representation of subject matter; text/image reiteration; limited Photoshop manipulation; realistic settings and scenarios; and shocking, gross, or otherwise disgust-inducing medical photos. Most participants did not have criticisms of the layout design, color choices, or fonts.

Discussion

Belying the ordered articulation of our research methods and results are the many complexities inherent in sustaining long-term collaborations between public health researchers and graphic designers. These challenges, we feel, are pertinent to research scientists and designers from many fields. We attempt next to share what we believe are the core challenges to sustained collaboration and solutions developed while planning and conducting our multiyear collaboration, discussed here.

Aligning Public Health and Design Outcomes

Obtaining data to inform design decisions can be stymied in a research science context by a research team's understandable focus on the specific variables of scientific interest. Even when the intervention is a set of graphic design artifacts, questions asked on surveys and in interviews or focus groups may yield few answers applicable to formal and conceptual design decisions. In such cases, the variables of interest need to expand to include design variables, particularly the aesthetic, visual, rhetorical, and experiential preferences of participants, as well as their existing knowledge and attitudes regarding related visual communication encountered in similar contexts. Design readers will rightly argue for multiple considerations here, beyond the scope of this paper, likely stemming from design thinking, design anthropology, social and behavioral design, experience design, service design, systems design, transformation design, health communication, and, of course, human factors. Indeed, design has much to offer, and when this knowledge is overlooked or subordinated, collaborations between designers and research scientists can become strained, and public health research is no exception. These strains are likely to emerge when design process activities are forced to operate in parallel, rather than in conjunction with, scientific data gathering and analysis protocols. Absent a parallel process, designers may find themselves in the awkward position of broadly extrapolating from the study's evidence to guess at design requirements.

Including designers in survey and interview instrument design is one way to ensure needed data are obtained to inform design. Additionally, involving designers in data analysis can help identify data relevant to design, as well as interpret findings in a manner meaningful to changing or adapting to participant input. Inclusion of designers in qualitative data analysis is particularly important, because designers will likely bring an additional set of "sensitizing concepts" (knowledge of concepts from a given field) (Blumer, 1954; Bowen, 2006) to data analyses. We have found these approaches useful to sustaining our multiyear collaboration while generating outcomes that met or exceeded our research goals. This approach to including designers in the research for which they are designing also feeds back into grant writing, where the qualifications of each team member, as well as their prior collaborations with one another, are an important part of demonstrating our team's capabilities to grant reviewers.

Bridging the Knowledge Divide

The present lack of a shared knowledge base for public health researchers and graphic designers poses serious issues for sustaining long-term collaborations between the two groups. Patience with each other can be worn thin as public health researchers focus on threats to internal, external, construct, and statistical validity while graphic designers are concerned with threats to ecological validity, e.g., whether warning label text will be readable in lower light, and at greater distances, outside the controlled environment of a lab experiment. Ecological validity, literally a footnote in research methods texts (see Shadish et al., 2002 p. 37), is not a form of scientific validity, per se. It is, however, a consideration not unlike those of user-centered design, where the needs, preferences, and characteristics of the user and the advantages and limitations of the user's context guide design decisions (see Dumas & Redish, 1999; Norman, 2013). Meanwhile, threats to scientific validity are numerous and can arise at nearly every point of a study's execution. Therefore, a great deal of attention is paid to monitoring each step of a study protocol.

Scientific validity is crucial to establishing whether exposure to the experimental conditions of an intervention result in statistically and clinically significant outcomes, whereas ecological validity is crucial to ensuring that the environmental conditions of an intervention's implementation do not interfere with that intervention's success. This inherent difference in validity concerns is a product of legitimate, albeit sometimes

competing, emphases stemming from the very different academic and professional training experiences of scientists and designers. These emphases do, however, complement one another. For example, we have found that concerns regarding word and image readability in a warning label's use context, if presented early enough in the study to influence initial data collection, appear to elicit participant feedback relevant to both scientific and ecological validity. Image pairings that would be too small to see, or too complex to decode, are called out, mitigating validity concerns while also prototyping a better fit to the eventual use context. These benefits would not have accrued to our project if we did not listen to each other's concerns and learn from each other's backgrounds.

One obvious limitation shared by many designers interested in interdisciplinary collaboration with public health researchers is the lack of training in both clinical and social and behavioral research methods. Quantitative and qualitative research methods can take years to master, as there are many threats to reliability and validity in the former (Grimes & Schulz, 2002) and trustworthiness in the latter (Lincoln & Guba, 1985; Rolfe, 2006). Yet, that very complexity is why public health research is overwhelmingly collaborative. After all, you can take a string of PhD courses in biostatistics, but unless you use that knowledge on a near-daily basis, you probably are not the right person to handle the team's statistical analyses. And that is fine; someone else will be happy to do it. Collaboration brings together different areas of expertise. It also helps catch oversights and mistakes before they compromise the research. Still, it can be challenging for graphic designers to share their insights without knowing how to frame their input in ways meaningful to public health researchers. Absent an understanding of social and behavioral theory, data collection and analysis methods, and threats to scientific validity, it can be difficult to convince other members of the team why specific design decisions should be made. This can also be disorienting for graphic designers accustomed to working with clients reliant on their advice.

The scope of this challenge to interdisciplinary collaboration is clearly bigger than our collaboration, and it will likely be many years before graphic design education incorporates scientific research methods to an extent sufficient to prepare students for opportunities in public health research. Financial pressure to develop doctoral programs and institutional demands to generate external funding may accelerate change, but that promise does not fill the current need. The way we bridged the knowledge divide was by recruiting a graphic designer who is also a public health researcher—a person with a PhD in social and behavioral sciences. In other words, we cheated.

While it has certainly proven helpful to have a graphic designer on the team who is also a public health researcher, bridging the knowledge divide may not require a PhD, or even a Master's in Public Health, to bring graphic designers more fully into public health research. Public health already employs methods, like community organization/community building and participatory problem solving (see Bartholomew et al., 2011), to thoroughly involve stakeholders from other backgrounds in public health research. Conversely, most graphic designers involved in consumer research are already familiar with descriptive, and some inferential, statistics. Additionally, graphic designers do engage in interviewing and conducting focus groups, or at least using qualitative results to inform their work. In other words, many graphic designers already possess the basic skills, or can obtain them rather quickly, to participate in the interpretation of survey, interview, and focus group results. Some do this on a regular basis.

We do not wish, however, to understate the difficulty of conducting public health research. For example, when it comes to designing and conducting surveys, say to inform design decisions, numerous things can go wrong (see Fowler, Jr., 2014). And some of those things, like threats to validity from systematic error (bias), cannot be statistically corrected for later. Likewise, developing interview guides and conducting qualitative data analyses—particularly grounded theory methodology, directed qualitative content analysis, and phenomenological research—can lead to extremely misleading results if not handled expertly (see Charmaz, 2006; Starks & Brown Trinidad, 2007; Tolley et al., 2016). If our points sound contradictory, that's because there is no single way to design a research study any more than there is one single graphic design process. The extent to which any team member, from biostatistician to graphic designer, can effectively participate in multiple stages of scientific research depends on that person's knowledge and the fit between that knowledge and the methods required to conduct the research. That fit is going to vary with each project, dependent on the research aims, and between individuals, dependent on their training and experience.

Recognizing Graphic Design's Potential to Contribute

Public health researchers, typically, are not trained or experienced graphic designers. And, while it would be helpful, they do not need a BA, BFA, MFA, MGD, MDes, PhD, etc., to meaningfully contribute to design decisions. Just as graphic designers have some familiarity with research data, public health researchers have some familiarity with graphic design. In fact, many public health researchers have employed graphic designers at some point. For instance, prevention efforts rely heavily on visual communication. These products can be found in medical exam rooms, health department campaigns, employee health competitions, and at public health fairs. Public health researchers, working with graphic designers, among other partners,

developed those communications and programs. These activities generally involve the dissemination of existing public health knowledge.

When it comes to generating new knowledge, public health researchers again interact with graphic designers. However, public health researchers typically develop plans for the study before involving graphic designers. While graphic designers working just across campus could be involved in conceiving how design might aid prevention or intervention, they are often unaware the opportunity exists. Likewise, public health researchers are often unaware how graphic designers' insights can benefit problem identification and project planning.

While public health researchers have a degree of familiarity with graphic design and experience working with graphic designers, they, like much of the public, often define graphic design as the artifacts they see, missing the intellectual and creative processes behind the design of those artifacts. Therefore, despite the familiarity, graphic designers are at risk of being regarded by public health researchers as production specialists rather than research collaborators. For non-designers, graphic design is, understandably, considered a means to an end, but that conception truncates designers' roles in the means to get to that end and thereby limits the range of skills and insights they bring. The resultant collaboration, then, often positions the designer as a contractor, rather than a co-investigator.

This is not a case of familiarity breeding contempt, but familiarity breeding assumptions. One way we avoided assumptions about graphic design and the role of the graphic designer was to allow our collaboration to evolve through a mutual learning process. Though we had clearly specified roles and project leaders, we did not behave hierarchically with each other, which allowed team members from different disciplines, not just graphic design, the comfort they needed to share their opinions in team meetings and communications. Graphic design decisions were discussed frequently in team meetings, allowing all members the opportunity to experience how the warning label designs were developed.

Our solution may seem simplistic, even trite, but this flexibility to adapt and change as potentialities are identified is difficult to accommodate given that in order to conduct and obtain funding for research studies, every detail of every study protocol must be defined in advance. This extensive forethought is not only dedicated to ensuring scientific rigor, but is also essential to ensure human subjects' protection. Invariably, project leaders—principal investigators (PIs) and co-PIs—experience tremendous pressure, from their institutions and their funders, to execute their studies efficiently and as planned. Accommodating new perspectives can be overwhelming when under pressure to keep every component of a multiyear research initiative moving forward in a way consistent with the initial plans. Yet, we found the benefits for sustained collaboration outweighed the costs.

Positioning Design Within the Study

Our development and testing of graphic design artifacts—pictorial HWLs—took place inside a series of study designs, and each study design consisted of a protocol for executing that design with scientific reliability and validity. How well we ensured reliability and validity determined the rigor of our study, and thereby its likelihood of contributing to the literature and to public health. Interestingly, all these standards can be met while designing a failure. In other words, one can rigorously develop and test just about anything. By this we mean the graphic design outcome can fail at influencing participant behavior while the study outcomes can succeed at meeting scientific requirements for rigor. Why are we making this obvious point? Because this is perhaps the best place to illustrate the similarity between research science, public health or otherwise, and design, graphic or otherwise: neither wants to design failures. Moreover, research science and design agree that avoiding failure requires iterating (see Cross, 2011; Kuhn, 1996).

One important way we (TA and WM) have maintained our collaboration with our designer (MS) over several years is by developing a series of study designs that facilitate iteration. This structure serves both scientific and design requirements for success. It also facilitates the consistent engagement of our designer throughout the project, creating a more integrated team environment. Critically, iteration makes research science more like design and design more like research science. This shared ground fosters familiarity despite our many differences.

As our collaborations continued, procedures developed and evolved. One key change moved the designer from reading qualitative results to coding qualitative data and communicating the results. This change in role led to the generation of design briefs as an additional data analysis outcome. These briefs, which examined participant responses for data to inform changes to text and image, helped the team operate from a shared understanding of the visual and conceptual changes required to each HWL. In this fashion, a design process was integrated into a research study design. Moreover, the design briefs informed the final changes to the top four participant-ranked labels, which were subsequently used in the experimental lab study.

Positioning the Designer Within the Study

One easily overlooked point of collaboration is data collection with human subjects—particularly interviews, focus groups, and participant observation. These forms of data gathering require interaction with people, including protected populations. While many graphic and other designers prototype and test their designs with purposive or convenience samples of the

intended audience, their skills in this area may not be readily apparent to public health researchers. In our case, geographic distance prevented our graphic designer from participating in focus group facilitation. When feasible, however, involving the graphic designer in qualitative data collection can yield valuable benefits. For instance, designers are careful observers of personalities and preferences, experienced in ascertaining latent needs and priorities. They are also aware of what information they need from participants to inform design decisions. Much of this information can be obtained with the use of a good interview guide, but unexpected responses and conversational directions arise during semi-structured interviews and focus groups, requiring probing on the newly introduced experiences, ideas, or concepts.

Important too, however, is additional training for designers in human subjects research. Scientific studies like ours require certifications in biomedical and clinical trials research. These certifications are attainable for nonscientists. However, while the certification modules provide necessary training in bioethics, they are not sufficient preparation for the responsible conduct of qualitative study protocols, for example. This is where team building requires further collaboration between scientists and designers. While working as a graphic designer with a research team at St. Jude Children's Research Hospital, the first author (MS) was trained by a nursing researcher in focus group facilitation in a hospital setting. Each participant group (doctors, nurses, parents, and patients) required a different approach to questioning and listening.

Not only are the contexts of medical and public health studies uniquely challenging, but designing protocols for ensuring participant safety and mitigating emotional distress requires prior familiarization with the research context. For example, MS spent several months immersed in a domestic violence trauma recovery agency before designing a protocol to interview the agency's clients. That time allowed MS to observe best practices for securing participant safety, mitigating emotional distress, and establishing rapport.

Data gathering collaborations between public health researchers and graphic designers can further serve to integrate design considerations into early phases of research with downstream benefits. A graphic designer with firsthand experience of the target group will have a better sense of how to visually present information to that group. Some of the reasons why are admittedly difficult to explain, as they are products of empathy—tacit and impressionistic in nature.

Adjusting Where Possible

As the methods section demonstrated, our studies proceeded from pre-established protocols. This extensive amount of pre-contemplation and planning can yield an inflexible plan and set of expectations that stifle creativity. Over time, we became more comfortable making room for design variables, like font choice and color, in our exploratory research phase. We adjusted plans to make time to consider the potential moderating role of formal design variables to attenuate the relationship between the exposure and outcome variables. In other words, making room for creative exploration enhanced our attention to scientific validity, particularly internal validity. Even so, our flexibility was modest, given the constraints of time and funding and the complexity of the preexisting plans.

Limitations

Research studies have their limitations, and ours are no exception. We employed methods, and sequenced and executed our studies, to minimize threats to reliability and validity. Our discussion also has its limitations—chiefly, hindsight. While we can look back on the past five years of collaboration, we are still engaged in an ongoing initiative. It is plausible that with additional hindsight, we may modify our insights or introduce new considerations. Additionally, we are just one team working on one initiative, albeit a very large project. Consequently, caution should be used when applying our insights; we did not attempt to provide generalizable knowledge, but rather endeavored to share our team's experiences.

Conclusion

Conducting a series of studies in three countries, our team developed and tested pictorial HWLs for hookah smoking prevention and cessation over several years. The HWLs, designed in local Arabic dialects of Tunisia and Lebanon, and English, continue to be disseminated through the medical, public health, and health communication literature, as well as shared with other research teams in the US and abroad, including the WHO's Jordanian office. Additional plans involve the development of hookah prevention and cessation campaigns in the US and the expansion of this research into HWLs for ENDS, or vaping devices, and vaping-related products.

Many factors influenced the sustainment of our interdisciplinary collaboration. Some of these factors apply to collaborative efforts in general: respect for each other's disciplines and perspectives, a shared vision, a clear understanding of goals and objectives at each stage, effective task management and, of course, funding. Other factors are specific to research science: rigorous but feasible study protocols, institutional review board approvals (and the biomedical and clinical studies certifications required for each team member), study participant recruitment, breadth and depth in quantitative and qualitative data analysis skills, and capacity to publish and obtain federal grants. The primary factors, in our view, are team

building and genuine collaboration, which are critical to obtaining funding and advancing scientific collaborations.

Securing funding from federal agencies, such as the NIH, increasingly requires interdisciplinary and multidisciplinary research teams. The competition for this funding is intense, and applicants must demonstrate, among many other things, breadth and depth in their team's capacity to conduct the proposed research. Likewise, disseminating research through medical and public health journals increasingly demands novel contributions. Many excellent manuscripts that would have been published just a few years ago are now being rejected. In publishing, too, the competition is intense. This is not necessarily a bad thing, but it may indicate that public health researchers need to combine rigor with new approaches and insights, perhaps from other fields, if they are to share findings they have worked so hard to obtain.

Medicine and public health need researchers who are curious about the processes, or formative work, behind the graphic design of artifacts they seek to utilize in their studies and interventions. Likewise, graphic design needs more educators, researchers, and practitioners interested in scientific research methods—both quantitative and qualitative. Excellent efforts have already been made to establish a shared vocabulary (see Muratovski, 2021). Through mutual interest and collaboration, our fields can continue to bridge the knowledge divide to build and sustain long-term interdisciplinary collaborations for the benefit of public health.

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Figures

Figure 1.

hookah device

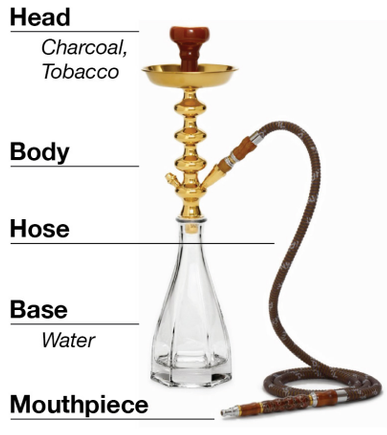

Figure 2.

The Message Impact Framework
(Noar, Hall, et al., 2016).

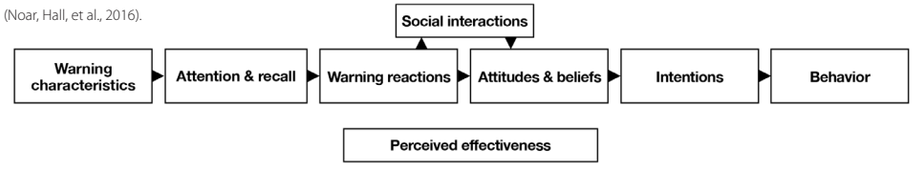

Figure 3.

example

Example of a pictorial HWL developed over the project's exploratory through experimental research phases

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Dr. Michael Schmidt is a public health social and behavioral research scientist and graphic designer. He is a professor in the Department of Art and affiliate faculty member in the School of Public Health at The University of Memphis. His past work includes design-based interventions for pediatric informed consent in clinical trials, child development and health, and children's rights impact assessment in local, state, and national policy development. Currently, he is working with two research teams as a co-investigator on several federally funded research grants. His present areas of research include (1) design-as-intervention for smoking cessation and prevention; (2) social and behavioral determinants of substance use disorders, treatment access, and recovery; and (3) domestic violence prevention and intervention. Along with his research colleagues, he is a regular contributor to the scientific literature in public health, psychology, and medicine.

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