

Communicating science-based recommendations with memorable and actionable guidelines

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For many domains of basic and applied science, a key set of scientific facts is well established and there is a need for public action in light of those facts. However, individual citizens do not consistently follow science-based recommendations, even when they accept the veracity of the advice. To address this challenge, science communicators need to develop a guideline that individuals can commit to memory easily and act on straightforwardly at moments of decision. We draw on research from psychology to discuss several characteristics that will enhance a guideline's memorability and actionability and illustrate using a case study from the US Department of Agriculture's communications based on nutrition science. We conclude by discussing the importance of careful research to test whether any given guideline is memorable and actionable by the intended target audience.

cognitive psychology | consumer behavior | social psychology

In many domains of basic and applied science, a key set of scientific facts is well-established, and there is a need for public action in light of those facts. And yet, individual citizens do not consistently follow science-based recommendations, even when they accept the veracity of the advice. The complexity of daily life and the limited capacity of the human mind prevent important science-based recommendations from getting the intended behavior change. To address this challenge, we argue that a specific type of communication tool is needed to promote a scientific field's most important recommendations. In this review paper, we refer to this tool as the memorable and actionable guideline.

Because of the cognitive limitations of memory and attention that we review in this article, science-based recommendations must be focused on influencing the moments when key consumer decisions are likely to be made. People do what they do in their daily lives, and communications should be structured so that they can influence particular key moments, whether it is food choices at mealtime, energy use at home in the evening, intervening when you see a friend about to do something dangerous, etc. Recommendations must be memorable at those key moments and must be usable/actionable at those key moments.

The challenge of getting people to take action is one that has interested psychologists and communications experts for decades. Research on attitude change demonstrates that persuasive communications need to convince people that the scientific facts are credible and that the science-based recommendations are sound. However, even once the audience is convinced that the facts and recommendations are legitimate, behavior change will not necessarily follow. For example, even though most Americans think it is important to be ready for emergencies, only a minority have taken the necessary actions to be prepared for a disaster (1). Science communicators need to activate people's behaviors to incorporate the science-based recommendations into their lives. Given this major challenge, considerable research in fields ranging from cognitive and social psychology to public health communications has investigated how to get individuals to act on their already-positive attitudes and behavior-change intentions. Decades of research on this topic highlight the need for recommendations that are both memorable and actionable.

In this article, we begin by briefly reviewing features of the human cognitive system that make memorability and actionability such important criteria for an effective guideline. Next, we discuss several reasons why organizations may not currently produce memorable and actionable science-based guidelines. We then describe characteristics found by social scientists to facilitate the memorability and actionability of guidelines; incorporating these characteristics will help science communicators to activate appropriate behaviors. These characteristics are then illustrated through a case study from nutrition science. We conclude with a discussion of the importance of rigorous empirical tests of guidelines to ensure that they are both memorable and actionable.

The case study examines the US Department of Agriculture nutrition guidelines and shows how the current MyPlate guideline incorporates characteristics to promote memorability and actionability that were lacking in the previous MyPyramid guideline. As will become evident in our case study, organizations that seek to develop an effective public-facing communication based on science (in this case, nutrition science) may find it challenging to develop messaging that is both memorable and actionable. The USDA's MyPyramid guideline (used from 2005 to 2011) recommended to Americans daily quantities to consume of fruit, vegetables, meat, grains and dairy, tailored to their age, sex, and amount of daily exercise. Even among individuals who believed that the recommendations were nutritionally sound, the recommended quantities were nearly impossible to commit to memory, and they were impractical for action at mealtime because individuals would need to keep running totals of their consumption across meals (e.g., 6 ounces of meat each day). Due to concerns about the complexity of MyPyramid, the USDA in 2011 replaced MyPyramid with the much improved MyPlate.

Why Memorability and Actionability Are Key Criteria

A guideline designed to be used by ordinary people in their daily, routine lives is different from a tool for experts, technicians, or systems operators. It is helpful to think of ordinary people as "cognitive misers" (2), who are simply unable to attend to all information they encounter throughout the day. Guidelines for ordinary people therefore need to be designed to work with the human mind's very limited cognitive capacities (primarily with respect to memory and attention) given the competing demands of daily life.

Memorability is a necessary criterion for an effective guideline because, in order for people to do a newly prescribed action, they

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must first remember what that recommended action is. The human memory system and its limitations have now been the object of study in cognitive psychology for over 100 y. Two signature limitations of the memory system are that memory traces can decay very quickly and that relevant facts are frequently not recalled when they are needed. The psychologist Daniel Schacter has called these limitations the memory “sins” of transience and absent mindedness (3). To develop guidelines that people will remember, designers must address these two limitations and develop guidelines that can avoid decay and that can be remembered at just the right time (i.e., at the time of the required behavior).

In a later section, we will describe some characteristics that make guidelines memorable. However, we readily concede that not all communication tools need to be memorable. For example, checklists are important for many situations although they contain too much information to commit to memory (which is why they must be written down in list form) (4). Similarly, tip sheets are a commonly used tool to communicate recommendations. Although an individual tip may be memorable enough, a set of tips probably is not. Both checklists and tip sheets are reference tools and are thus, by definition, not memorable. It is important for a guideline to be memorable when the required behaviors must be performed without reliance on a written guide. For example, when decisions need to be made repeatedly, such as daily decisions about what foods to eat, it becomes impractical to rely at each occasion on a written recommendation tool. For daily, repeated decisions, a guideline that can be remembered without prompting will be much more likely to be acted upon (5–8).

Memorability is also very important in cases where forgetting to even initiate a behavior is likely. The problem of failing to adhere to drug prescriptions is considered a common but major health risk (9, 10), and patients consider forgetfulness to be the biggest contributor (10). Providing timely reminders through text messages or other prompts has been effective in improving drug adherence and many other health behaviors (11–13). However, beyond delivery of the message, properties of the message itself can reduce forgetfulness by increasing memorability.

For-profit advertisements and public-service announcements (PSAs) often have high standards for memorability, with the objective of increasing the likelihood that people will think of their message at key moments: for advertisers, these key moments will often be in a store at the moment just before purchase, and, for PSAs, these key moments will be moments of risk. The Ad Council, for example, produced their classic Smokey Bear campaign to get people to remember the reality of wildfire risk when they are in or near forested areas. The success of the campaign is measured explicitly in terms of memorability: 75% of adults were able to recall Smokey’s message of “Only You Can Prevent Wildfires” or a similar version without prompting (14). It is difficult to isolate the specific effects of a campaign on behavior change (15), but it can at least be noted that human-caused wildfires decreased substantially in the years after the campaign launched (14).

Other findings indicate that people who recall a public service message are more likely to take action consistent with it. For example, in a campaign designed to inform people that even one drink too many can impair their driving (“Buzzed Driving is Drunk Driving”), 74% of those who recalled the campaign said they had recently chosen not to drive after drinking, compared with only 55% of those who did not recall seeing the campaign (16). Likewise, awareness was very high of the “Click It or Ticket” media campaign to promote seat-belt use, and states that used media campaigns saw seat-belt use increases that far exceeded the increases in states that relied only on law enforcement (17). Even if causality is difficult to demonstrate in the case of any particular campaign, it is certainly best practice to carefully measure how memorable a message is sometime after it has been presented. Scientific organizations should have the same objective in measuring the effectiveness of their guidelines.

The second criterion for effective guidelines is actionability. Even when remembered, there are still many cognitive and social

barriers to action, and effective guideline design needs to work around these barriers. For example, homeowners in tornado-prone parts of the United States are aware that a safe room can save their lives but perceive the needed actions to engage in the one-time actions to create a safe room as very costly to follow (18). Even for behaviors that should be enacted frequently—such as to follow a healthy diet or get daily exercise—only a minority of Americans take the recommended actions even when they believe they should (19, 20).

The issue is that human behavior and human thought processes are primarily guided by automatic processes (2, 21). These automatic processes can be distinguished from the careful attentional processes that are controlled in a second, and evolutionarily newer, system. The two systems interact. The deliberative system controls the impulses of the automatic system when such self-control is needed. This more deliberative system can make important corrections to human behavior, but it is limited in capacity and simply cannot engage in all of the myriad decisions and actions that people take on a daily basis (2, 21). To change behavior, a guideline must be sensitive to this constraint. To be actionable, the guideline’s recommended new behavior should be possible to do easily, and with minimal effort and attention.

Minimal effort and attention demands will help for several reasons. First, such a guideline will more easily fit into the streams of largely automatic actions that constitute our daily activities. Second, easy behaviors have a better chance of being repeated (or even deliberately rehearsed) and thus have a better chance of becoming habitual, automatic behaviors themselves (22, 23). A third benefit of minimal effort and attention relates to planning. Some actions will require planning, especially if they involve coordination with other people or coordination with other events in one’s life (e.g., scheduling a colonoscopy or making plans to remodel one’s home to include a safe room). And the more easily a behavior can be planned (for example, by being specific in nature and easy to visualize), the more likely it will be to be performed (24). Some behavioral guidelines are more actionable in all of these senses than are others, and we will describe characteristics of such actionable guidelines in a later section.

Before discussing characteristics that enhance the memorability and actionability of guidelines, we will first discuss some reasons why we believe such guidelines are not more prevalent.

Obstacles to Creating Memorable and Actionable Guidelines

We believe there are at least four reasons why it is difficult to find examples of science-based communications that are memorable and actionable. The first is that many scientific organizations are not really in the recommendation business. There will be some cases where this claim of a limited mandate is strictly true, but we suspect that, in many cases, a scientific organization will have some well-informed basis for directing public action of some kind. And in many cases, communicating science-based recommendations are an important objective of the organization. This objective certainly applies for the USDA, the Centers for Disease Control and Prevention, the Department of Energy, and many other government organizations, and it is also an objective for many public service and professional organizations.

A second obstacle is that it can be difficult to prioritize recommendations and distill them down to a memorable and actionable message. Indeed, many organizations produce technical guidelines that provide a comprehensive set of actions to be applied in dozens of relevant situations. The World Health Organization, for example, produces a report on hand washing that is over 250 pages long (25). Such technical guidelines are needed for professionals, but their existence can highlight the challenge of distilling a central, important message for the general public.

A third reason is that it is very easy to overestimate how feasible something is for someone else. People think more abstractly when thinking about actions that will be performed by others than by themselves, and research shows that this higher level of abstraction leads to a greater focus on the desirability of

others' actions rather than their feasibility (26). Communicators need to remember that recommendations are not just meant to express the exhaustive state of expert knowledge—they are meant to be applied by nonexperts and need to be user-friendly.

Finally, developing memorable and actionable guidelines can be difficult and time-consuming. In most cases, the task should be conducted by communication professionals, but the central content must come from scientists, and the tradeoffs about what gets cut and what stays in must be made by scientists. The determination of this central content is not a new activity for scientists. Prioritization and determination of best practices are central objectives of comparative effectiveness research (27, 28), standard-of-care guidelines (29), and cost-benefit analyses (30), to name a few. For a message to stick in the minds of the intended audience, it needs to be simple, and simplicity requires prioritizing what information is in the message and what is left out (6).

Despite the obstacles to their creation, there are many situations when memorable and actionable guidelines should play an important role in communicating recommended actions to the general public. These situations will be cases when the public has already been largely persuaded that there is some need for change (i.e., they are ready to prepare for change and take action) (31). When public persuasion is largely still needed (i.e., at the precontemplation and contemplation stages) (31), there is a considerable literature on attitude change to guide that effort. For example, messages are more likely to be accepted when message sources are perceived as expert and nonbiased (32), message wording is not perceived as dogmatic (33), and the message is presented repeatedly (34). People who are first prompted to engage in a small, token behavior show greater attitude change (35). Audience characteristics matter as well: what persuades some people may not persuade others if their motivation and ability to attend to the message differ (36, 37).

In the present article, we focus on cases in which people already hold a positive attitude on the advocated issue but are not yet taking action at the required level. Here, it will be particularly important for guidelines to be memorable and actionable. Such guidelines are not easy to create, and, although we do not offer a playbook, we can offer some general principles. This endeavor should be undertaken in collaboration with communications professionals, but scientists should be aware of some characteristics that make guidelines more memorable and actionable.

Characteristics That Promote Memorability

Simplicity. A basic finding from cognitive psychology is that an individual's ability to recall information declines sharply when that information becomes more complex (6, 38). Early, classic experiments demonstrated the limits to short-term memory beyond a few pieces of disparate information. For items to make it into long-term memory, the need for simplicity is even greater (3).

The finding that simple messages are more memorable than complex ones has a clear implication for science communication. Some information will need to be left out of an otherwise complex message if the audience is to remember it. Science communicators will thus need to prioritize and make decisions about exactly what their core message ought to be (6).

Consider for example the communications campaign: "Friends Don't Let Friends Drive Drunk." According to the Ad Council, awareness of this tagline is extremely high (over 90%) even 20 y after its introduction (39). This simple message became a memorable phrase. Following this Ad Council public-service campaign, more than two-thirds of Americans (68%) report that they have taken steps to stop someone from driving after drinking (39). The message did not list all of the things that one could do to reduce drunk driving but instead focused on one simple idea.

Ease of Visualization. Information is easier for people to remember when they can visualize it. For this reason, material that is represented pictorially is easier for people to recall later. Research by cognitive psychologists demonstrates that dual encoding of both perceptual (visual) and semantic cues facilitates

retrieval of information (40). Concrete words (e.g., bird, hurricane) that are readily visualized are better recalled than abstract words (e.g., moral, truth) that are harder to visualize. A related finding is that, when multiple pieces of information are presented, individuals are better able to recall this information when they are instructed to form a mental image linking these pieces together in a single image rather than to form a separate image of each one (41).

The message "Safe Rooms Save Lives" is easy to visualize, especially for those living in tornado zones. A family gathered in a safe room is protected against the high-force winds during a tornado. The recommendation to have a safe room installed in your home if you live in a tornado-prone area is memorable (18).

Chunking. When disparate content is clustered into just a few key ideas, recall can improve dramatically. As in the example just described, combining distinct images into a single, connected image creates a unifying structure that facilitates memory. Likewise, a phone number presented in a small number of meaningful chunks (1-800-FOR-SALE) is substantially easier for people to remember than one presented as a series of disconnected digits (18003677253) (cf. refs. 38, 42, and 43). In the context of science-based communications, it will be easier for people to remember these ideas if presented as one unified message than a series of disconnected tips or recommendations.

Embedding Triggers. Information is more likely to be recalled if cues in the environment activate its recall. Including a "trigger" can therefore facilitate the likelihood that a message will be recalled and acted upon. In one demonstration of this principle, college students on a university meal plan saw one of two health-related messages. Participants in the control condition read: "Live the healthy way, eat five fruits and veggies a day." Participants in the experimental condition read: "Each and every dining-hall tray needs five fruits and veggies a day." The reference to the dining-hall tray was designed to trigger recollection of the recommendation to eat fruits and vegetables. Compared with rates of fruit and vegetable consumption 1 wk before presentation of the message, the control group showed no increase in fruit and vegetable consumption, but the group that saw the message containing the dining-hall tray increased fruit and vegetable consumption by 25% (from 2.16 to 2.69 servings per day) (44). This effect emerged only for those students who ate in dining halls that provided trays: the trigger needed to be present in the environment to cue the guideline. Embedding triggers into a guideline can therefore help individuals later to recall and act on it.

We have reviewed some factors that increase the likelihood that a guideline will be remembered accurately and brought to mind at key moments. Although a high level of memorability is necessary for a guideline to influence behavior, it is not sufficient. Guidelines can still fail on actionability, and it is to that criterion that we turn next.

Characteristics That Promote Actionability

Research in psychology documents many features of messages that will make them actionable: that is, possible to perform without excessive effort and attention. Some of these features are the same ones that make a message more memorable so we will mention them again, this time emphasizing actionability. Other message features can affect actionability without necessarily impacting memorability as well, and we will describe some of those, too.

Simplicity. People tend to defer choice and action when they face excessive complexity (45). Individuals are most likely to implement a plan if it contains a series of very simple, well-understood steps (46, 47). An actionable guideline will involve only a small number of straightforward steps; communications that recommend a simple action or set of actions can boost self-efficacy, as can communications that affirm that the individual "can do it" (37, 48, 49).

Of course, a simple guideline cannot comprehensively guide all aspects of behavior in all relevant situations. Comprehensiveness and thoroughness will increase complexity and have the unintended effect of reducing compliance. Comprehensive and thorough guidelines have their place, too, just not as the first line of communication with the general public.

Ease of Visualization. People are not only more likely to remember information that they previously visualized, but they are also more likely to take action when they previously pictured themselves doing so (50). A classic demonstration required participants to imagine either successfully putting a golf ball into a hole or putting the ball but missing the hole. Those prompted to visualize taking steps toward the successful putt were more likely to make a subsequent successful putt than those not prompted to do so (a 30% improvement for those in the success-imagery condition vs. a 20% decline compared for those in the failure-imagery condition, compared with previsualization levels) (51). One feature of easy-to-visualize information is that people can more readily see whether they have fallen short of doing what is required. In that sense, an easy-to-visualize guideline can make it easier to get the needed feedback about whether the desired action has been obtained (52).

Embedding Triggers. Information is more likely to be acted on when cues in the environment bring the information to mind (6, 44, 53). For this reason, psychologists sometimes refer to those cues that are embedded into messages to later activate the behavior as “action triggers.” When a trigger activates the desired behavior, then individuals can enact that behavior without expending much cognitive effort. As a result, automatic processing can kick in, increasing the likelihood that the behavior will follow despite other demands on the individuals’ attention (21).

One characteristic of the “Friends Don’t Let Friends Drive Drunk” communication is that it embeds a trigger (a friend who has been drinking) to later enact the recommended behavior. When people are in a situation where they are drinking with friends, this trigger activates thoughts of the recommendation to make sure the friends get home safely. The best triggers will be ones that are commonly present in the environment at the time individuals will need to enact the behavior (44).

Specifying When to Act. Individuals will be more likely to engage in a desired behavior if they plan in advance when they will take the necessary steps (54). These plans are particularly effective if they take the form of “if–then” implementation intentions (e.g., “If I am in situation X, then I will engage in behavior Y”). Individuals who develop implementation intentions know precisely in what situation they plan to engage in the behavior: when they are subsequently in that situation, their previously formed implementation intention comes to mind and drives behavior.

Implementation intentions have been shown to increase people’s likelihood of enacting desired behaviors in many domains, from adherence to medical regimens to the successful completion of professional tasks (54). One such experiment showed the benefits of implementation intentions for individuals taking a vitamin C tablet every day. Participants who were randomly assigned to the implementation condition were asked to create a plan for when they would take their daily vitamin C. Those in the control condition were not instructed to create such a plan. The researchers provided all participants with a 3-wk supply of vitamin C tablets and measured after the 3 wk how many of the tablets were taken. The results were striking: adherence nearly doubled as a result of the implementation intentions. Whereas only 39% of the vitamin C tablets were taken in the control condition, 74% of the tablets were taken daily in the implementation-intentions condition (54). These findings suggest that those developing guidelines could encourage people to identify precisely when they will engage in a specific desired behavior (e.g., “When you are in situation X, then engage in behavior Y”).

These if–then implementation intentions should not be too complex (i.e., avoiding contingencies such as if in X, engage in Y, but only if Z is not present), or they may then become hard to enact.

Subjective Norms. The anticipated reactions from others, which psychologists refer to as subjective norms, have a major impact on people’s willingness to enact recommended behaviors (55). People may perceive that they will be unable to engage in a desired behavior without others’ buy-in (e.g., condom use). Or they may simply perceive that it will be more difficult for them to engage in the behavior if others will question their actions (56). As a result, subjective norms can impact how actionable people will perceive behaviors to be. One characteristic of the “Friends Don’t Let Friends Drive Drunk” message is that it changed the norms around the acceptability of intervening when a friend has had one drink too many.

Although science-based communications do not need to incorporate all of these characteristics for a message to be effective, communications that incorporate many of them will be more likely to succeed. These characteristics and principles apply beyond science-based messaging, but they are particularly important in science-based contexts because of the inherent complexity of science-based knowledge. Science embraces complexity and precision, and this embrace poses a communication challenge because of the limitations of human cognition. Of course scientists are human too, but, in their role as scientists, they have developed expertise and discipline that allow them (and force them) to grapple with complexity. For nonexperts, complexity and abstraction are obstacles to action so, if science-based ideas are to change the behavior of nonexperts, the ideas will have to be simple, easy to visualize, etc. to be memorable and actionable.

We turn now to a discussion of how these characteristics come into play in the examination of a case study: the USDA nutrition communications embedded within MyPyramid and MyPlate.

Case Study: Evolution of Nutrition Guidelines

We illustrate the importance of a memorable and actionable guideline with a nutrition science case study, but the basic points can generalize to other domains in which science-based recommendations need to be communicated. Any organization that is tempted to promote detailed guidelines should consider, instead, a memorable and actionable guideline that will leave many details out, but will retain the essence of the message. A design firm could be tasked with the development of ideas. We believe that there are opportunities in most areas of science-based recommendations including exercise physiology, public safety, disease prevention, energy use, etc. A guideline as simple as the MyPlate may not be feasible in every domain. However, we urge readers to consider how a simpler guideline probably did not seem feasible to the USDA officials when they began promoting the original Food Pyramid. To experts, the more detailed guideline may seem better because it is more comprehensive, but people cannot efficiently remember and act on comprehensive information in their day-to-day lives.

Original Food Pyramid. The USDA and Department of Health and Human Services have updated their *Dietary Guidelines for Americans* regularly since the guidelines were first presented in 1980. To communicate key points from the guidelines to the American people, the USDA hired the public relations firm Porter Novelli to design an appropriate graphic. This graphic was tested extensively in focus groups and resulted in the now-famous Food Pyramid introduced in 1992 (57). A majority of Americans became familiar with this widely disseminated food guideline, along with its basic messages that people should consume a variety of foods, more items from some food groups than others, and some foods only sparingly (58, 59). However, although people were generally familiar with the 1992 Pyramid, not very many Americans’ diets met the guidelines set out by the Pyramid. For example 88% of respondents in one study failed to

consume the recommended number of fruit and vegetable servings per day (60). These failures led to calls for research on how best to communicate nutrition information and how to increase people's likelihood of incorporating the guideline information into their food choices (59, 61).

In response to these concerns, and to accommodate scientific developments in the field of nutrition, the USDA undertook an extensive process to create a new set of dietary guidelines and an updated graphic and slogan to replace the original Food Pyramid. The process included input from nutrition experts to develop the nutrient profiles (62), which are comparable in key respects to other major nutrition guidelines (63). In addition, a series of focus groups was conducted to examine consumers' reactions to the 1992 Food Pyramid (58). This research revealed a number of points of confusion for consumers involving the 1992 Pyramid. For example, focus-group participants were confused about what a "serving" referred to (64) and tended to overestimate its size (58, 65). Study participants also were confused about why there was a range of serving sizes (e.g., 5–7 servings of fruits and vegetables), thinking that these quantities could be minimum and maximum daily amounts, whereas the intended purpose of the range was to show that the amounts would depend upon consumers' necessary caloric intake (which would vary in terms of age, sex, activity level, etc.).

Based on this feedback, Porter Novelli created an updated set of nutrition guidelines and collected qualitative data regarding consumers' reactions to the new guideline (58, 66). Content analyses of focus-group responses indicated that people wanted some continuity with the original Pyramid guideline in terms of shape and liked a slogan that related to that shape. Interestingly, although such insights from the qualitative work were useful, the researchers themselves noted that quantitative assessments would have enriched the research approach.

MyPyramid. In 2005, the Department of Agriculture introduced "MyPyramid" as the redesigned, updated national nutrition guideline. The MyPyramid Food Guidance system featured a website to which consumers would go to determine their recommended nutrition intake. This new MyPyramid website provided a customized recommended portion size as a function of the consumer's age, sex, and amount of weekly exercise (67). Each guideline featured the same five food groups presented in the original Food Pyramid (grains, vegetables, fruits, milk, and meat/beans), with specific quantities recommended for each one (i.e., how many cups of fruits, how many ounces of grains, etc. to consume each day). MyPyramid was customized to reflect the appropriate servings for people based on age, sex, and amount of exercise daily. In terms of helping consumers get closer to the amounts recommended by the nutrition scientists, MyPyramid seemed quite good. However, as soon as it was launched, it received widespread criticism.

The MyPyramid guideline still left consumers with a very complex task. First, consumers did not learn their recommended nutrition information unless they went to a computer to obtain the information, which diminished the likely impact of the guideline on the large numbers of people who are overweight but not sufficiently motivated to gather this information (68). As noted earlier, people often defer choice and action when facing excessive complexity (45) and are more likely to implement a plan when it has a series of very simple steps (47). Second, some reacted with confusion about the MyPyramid recommendations because it was unclear what the cups and ounces translate into (58); this confusion led others to design interventions to teach people what the graphic represented (69) and how much is in a cup or an ounce (70).

Quantitative Tests of MyPyramid Versus a Simpler Guideline. Might there be a much easier to remember and more actionable guideline that the USDA could use to communicate with the American people about nutrition? The Half-Plate guideline that we studied ("Fill half of your plate with fruits and vegetables at

every meal") was also developed by Porter Novelli for the USDA and had fared well in qualitative focus group research. This simpler guideline captures a key nutritional component of the more complex guideline (i.e., roughly half of one's diet consisting of fruits and vegetables). We predicted that this message would be both more memorable and more actionable than MyPyramid.

In one study, we randomly assigned participants to see either the MyPyramid guideline or the Half-Plate guideline (71). This experiment and the others reported here were approved by the institutional review boards at the University of Maryland and Harvard University, and participants provided their informed consent to participate. Participants in the MyPyramid condition were directed to a screen in which they entered their age, sex, and typical amount of daily exercise—as required on the USDA website—to receive their MyPyramid customized guideline. Participants then saw the same recommended numbers and units for each of five food categories that they would have seen if they had gone to the actual www.mypyramid.gov website (e.g., 6 oz. of grains, 1 1/2 cups of fruit, etc.). Participants in the Half-Plate condition read the following guideline, identified as a nutrition tip: "Fill half of your plate with fruits and vegetables at every meal." Participants were instructed to take as much time as they needed to study the guideline they had been presented so that they would be able to describe that guideline to someone else.

Next, we asked participants to recall the guideline they had just seen. Seventy-one of the 84 participants (85%) who viewed the Half-Plate guideline were able to describe it correctly immediately after seeing it whereas only 16 of the 83 respondents (19%) who viewed the MyPyramid guideline reported their guideline correctly immediately after seeing it (i.e., correctly recalled quantities and units for all five food categories). These large memory differences occurred despite the fact that participants spent on average significantly more time looking at the MyPyramid guideline (on average 30.3 s) compared with the Half-Plate guideline (10.5 s). We also examined users' perceptions of the guidelines. A significant main effect of guideline type emerged on all measures. Most notably, participants in the Half-Plate condition said the guideline was more motivating, more beneficial, and less complex than did those in the MyPyramid condition (71).

In a second study, we examined the actionability of these two guidelines by asking people directly how easy it would be to follow it. We compared Half Plate to MyPyramid and also to a much simpler guideline ("Eat a piece of fruit every day"). Participants were randomly assigned to read one of these three guidelines and then rate it on a 1–7 scale (1 = not very easy, 7 = very easy to follow). The Half-Plate rating ($M = 6.2$) was substantially higher than the MyPyramid rating [$M = 4.4$, $F(1, 85) = 23.06$, $P < 0.0001$] and not different from the piece-of-fruit guideline ($M = 6.4$). These low ratings indicate a problem for MyPyramid in meeting the actionability criterion.

In a third study, we investigated the impact of the MyPyramid guideline, again compared with the Half-Plate guideline, on the choices that people make after a delay (71). All participants, ~1 mo after studying the respective guidelines, indicated which foods they would select from a cafeteria that offers an assortment of options. They were also, separately, asked to recall the guideline. We were particularly interested in the amount of fruits and vegetables that people would consume following exposure to the two guidelines (60). We expected the memory and motivational advantages of the guideline to lead to greater choice of fruits and vegetables in the Half-Plate than MyPyramid condition. After the 1-mo delay, only 1 of the 190 subjects in the MyPyramid condition (less than 1%) correctly recalled the correct numbers in all five categories whereas 62% of subjects in the Half-Plate condition recalled the guideline correctly. In the choice task 1 mo after exposure to the message, participants were asked to imagine that they were eating at a cafeteria and to indicate which six selections they would make from a menu containing various options. Participants in the Half-Plate condition

selected more fruits and vegetables than did participants in the MyPyramid condition [$M = 2.6$ vs. $M = 2.3$, respectively, $F(1, 285) = 6.6$, $P = 0.01$].

The memorability test involves three stages: (i) study, (ii) delay, and (iii) recall test. During the study stage, subjects should be shown the guideline and told to take as much time as they need to learn it. During the delay stage, the guideline should be removed from view while participants do some unrelated activity to prevent them from mentally rehearsing the guideline. Either a short or long delay can be used; in our studies, we sometimes used a very short delay to see whether even in that time participants could no longer remember the message. During the recall-test stage, participants should be asked to recall the guideline in as much detail as they can. The majority of participants should be able to accurately recall the guideline.

The memorability tests that we performed for the Half-Plate guideline (and discussed in *Quantitative Tests of MyPyramid Versus a Simpler Guideline*) were variations of this basic idea. Groups of participants were randomly assigned to study the Half-Plate guideline or the MyPyramid guideline. After both very short delays and long delays, the vast majority of subjects could accurately recall the Half-Plate guideline, but very few could recall the MyPyramid guideline.

The actionability test should assess whether users will straightforwardly be able to act on a guideline. We suggest asking subjects something like, "How easy would it be for you to use this guideline?" or "How confident do you feel that you will be able to take the recommended actions?" Asking them how motivated they feel to adhere to the guideline is another way to assess whether they intend to follow it.

Behavior-based tests of how people actually use the guideline in their daily lives are much more difficult and expensive to conduct. We offer the simple memorability and actionability tests here as initial tests of whether or not a guideline could impact people in their daily lives. However, ongoing tests to examine long-term effects of presentation of guidelines are needed as well.

Conclusion

When an audience already believes scientific facts and recommendations to be sound, the challenge is to activate the desired behaviors. In such cases, science-based communications need to be memorable and actionable. Drawing from research in cognitive and social psychology, we reviewed some of the features that increase the likelihood that a guideline will be memorable and actionable: They will be simple, be easy to visualize, specify when to act, embed triggers that naturally cue the desired action, and impact subjective norms. We illustrated the importance of using a memorable and actionable guideline as a communication tool using a case study from nutrition science: the evolution of the Food Pyramid to MyPlate.

We focused in this paper on a nutrition-based case study; however, we believe these basic principles apply beyond food. Our principles are relevant to a situation where many consumers already have favorable attitudes and these consumers have regular opportunities to make relevant decisions in their daily lives. Memorable and actionable guidelines can be effective in such cases because they can be brought to mind at key moments of decision, and they can prompt a straightforward course of action. They can, therefore, increase attitude-behavior alignment. For example, consumers who have favorable attitudes toward eating a healthy diet, conserving energy, engaging in preventive health behaviors (e.g., self-check examinations), being prepared for a weather-related emergency, etc. all fall into this category. Decisions about nanotechnology or stem cells may not (yet) be as strong of a fit because the key communication challenge there is likely to be attitude change rather than behavior change, and most consumers do not interact with these technologies on a regular basis, and it is therefore not clear what the moment of decision is, nor is it clear which consumer behaviors would be prompted.

We hope that we have advanced the case for the need and opportunity to make memorable and actionable guidelines more widespread. Much is known from the social sciences about how to make communications memorable and actionable. We encourage science communicators to incorporate these characteristics and conduct the rigorous tests needed to gauge the effectiveness of the communications designed to activate individuals' behaviors.

We noted that there are many obstacles to making memorable and actionable guidelines, including that experts are themselves comfortable with detailed information so it can be hard for them to appreciate limitations of lay people. However, the limitations of human memory and attention are substantial (21), and memorable and actionable guidelines address these limitations.

Finally, it is worth mentioning that, even though we believe that there is much opportunity for the development of better messages, messages themselves will only be a part of behavior-change solution. The messages will have to be delivered effectively, and the effectiveness of mass-media campaigns is limited (15, 75). The use of personal reminders through SMS (short message service) text messages is a promising approach to message delivery (11, 12), and this channel will benefit from messages that are simple because they must be short. Finally, the consumer environment itself will have to change, through wider availability of healthier foods, exercise opportunities, and energy-saving devices, and through other products and services that make it easier for consumers to make wise, healthy, and sustainable choices.

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