Prescriptive scientific narratives for communicating usable science

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Edited by Baruch Fischhoff, Carnegie Mellon University, Pittsburgh, PA, and accepted by the Editorial Board June 6, 2014 (received for review November 6, 2013)

In this paper I describe how a narrative approach to science communication may help audiences to more fully understand how science is relevant to their own lives and behaviors. The use of prescriptive scientific narrative can help to overcome challenges specific to scientific concepts, especially the need to reconsider long-held beliefs in the face of new empirical findings. Narrative can captivate the audience, driving anticipation for plot resolution, thus becoming a self-motivating vehicle for information delivery. This quality gives narrative considerable power to explain complex phenomena and causal processes, and to create and reinforce memory traces for better recall and application over time. Because of the inherent properties of narrative communication, their creators have a special responsibility to ensure even-handedness in selection and presentation of the scientific evidence. The recent transformation in communication and information technology has brought about new platforms for delivering content, particularly through interactivity, which can use structured self-tailoring to help individuals most efficiently get exactly the content that they need. As with all educational efforts, prescriptive scientific narratives must be evaluated systematically to determine whether they have the desired effects in improving understanding and changing behavior.

decision making | adolescents | interactive video

Scientific concepts have traditionally been communicated as isolated ideas in a way that may not be particularly meaningful to public audiences (1). In this paper I discuss how delivering scientific findings in a well-constructed narrative with high coherence can help make complex processes seem more accessible, intuitive, and memorable (1–3).

The Role of Narrative

Humans appear to be predisposed to process information most efficiently when it is presented in narrative format (4–6), especially when that information has social relevance (2, 7). Compared with more expository forms of communication, such as procedural explanations or descriptive lists, communicating through stories drives our narrative appetite (8), providing motivation to continue the story until resolution is reached (9). This intrinsic reinforcement can provide a powerful tool for science communicators vying for the public's attention and engagement.

There is no standard definition of narrative, with different researchers defining it according to their focus or interests (7, 10). However, there is basic agreement about its core components, which are represented along the left-hand side of Fig. 1. First, narrative uses a narrator's voice (Fig. 1, box 1) to set up a conflict within a given context (Fig. 1, box 2), and describes action, unfolding over time, to resolve that conflict (Fig. 1, box 3) (5, 7, 9). Within this general structure, narratives may take many different forms, such as fact or fiction, case studies, or dramatic conversations and first-person or third-person perspectives. The relative benefits of these different forms have been examined to some degree (3, 4, 11), especially as they pertain to a narrative's persuasive power (5, 12–14), but this paper primarily focuses on the use of narrative to explain science so that a target audience can use concepts to make better decisions in their own lives.

Narrative in Science Communication

Any complex idea is difficult to communicate but scientific concepts pose additional challenges. In particular, new empirical findings may require people to discard long-held beliefs or familiar structures for understanding how the world works. Scientists tend to be so steeped in their literature that they often fail to appreciate how novel their findings might be to the general public. This schism can create barriers to communication, especially when little context is provided for the new information.

People by nature will impose coherence onto new information that they receive, incorporating it into their existing knowledge in an effort to interpret it. Scant prior understanding of a problem can easily lead people to make inaccurate assumptions or draw unwarranted conclusions in making sense of new information. To the extent that new facts do not fit coherently into people's existing understanding of the world—a common occurrence if their understanding is flawed—the new information will be harder for them to understand and believe (15).

Use of narrative in science communication can help to overcome these problems by addressing limitations of both the communicator and the audience. Communicators using narrative are forced to consider a context in which the concepts will provide some elucidation, and to make explicit how the new concept expands knowledge by identifying its importance in a narrative voice. The audience then gains a new framework for organizing their knowledge, or reinforces an existing one when they already have a reasonable understanding.

Prescriptive Scientific Narratives

There is a special challenge in delivering scientific information to people who can use it directly in their lives, such as those at risk for outcomes that could be mitigated by a better understanding of the risk-related science. Typically, this involves an important behavioral change that could improve outcomes for people at risk for certain threats, such as obesity-related diseases or smoking-related illness, which may be stymied by poor understanding of risky behaviors. In this paper, I discuss the use of narrative for communicating scientific understanding and advice directly to the audiences who have the most use for the information, using "prescriptive narratives." The review that follows is broadly represented by the key factors identified in Fig. 1.

There are numerous benefits of using narrative to communicate new information, drawing strength from the fundamental nature of how narrative information is processed (2, 4, 6, 7). A well-designed narrative can be far more appealing than just facts

This paper results from the Arthur M. Sackler Colloquium of the National Academy of Sciences, "The Science of Science Communication II," held September 23–25, 2013, at the National Academy of Sciences in Washington, DC. The complete program and video recordings of most presentations are available on the NAS website at www.nasonline.org/science-communication-II.

Author contributions: J.S.D. designed research, performed research, and wrote the paper.

The author declares no conflict of interest.

This article is a PNAS Direct Submission. B.F. is a guest editor invited by the Editorial Board.

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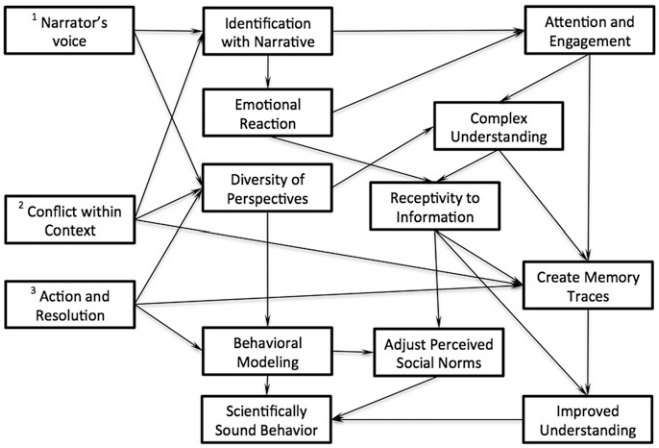

Fig. 1. A synthesis of the literature suggests that prescriptive scientific narrative applies the components of narrative communications (boxes 1–3 on the far left) to improve understanding and behavior (bottom boxes) through multiple reinforcing pathways.

and can capture attention more easily, in part because it can allow the viewer to better process and understand information (2, 16). A compelling narrative can garner more constructive attention than what is achieved by mere fear appeals, which often fail to improve decisions (17, 18). Fear appeals, whether in narrative format or not, focus attention primarily on the threat, leaving less cognitive processing capacity available to continue taking in and making sense of further information (4). For example, sex education messages that heighten the fear of HIV, without providing a broader context in which to mitigate the threat, tend to detract from important lessons about condom use (19).

In contrast, a broader narrative with a compelling voice captivates attention by promoting identification with the story and eliciting deeper emotional reactions (20, 21), keeping the audience anticipating developments and conclusions. Indeed, serial writers have relied on this phenomenon for decades, using cliffhangers at the ends of comic book issues and television episodes to draw viewers back for the next installment. (The 1980 *Dallas* episode resolving "who shot J.R." was the highest-rated show in TV history at the time.) This involvement reduces the kind of resistant reactions that may arise in other contexts (5, 7, 12), creating a self-motivating vehicle for information delivery (3, 20).

The benefit of engagement can be especially important for audiences who otherwise have little interest in learning the new information, such as adolescents, skeptics, or people with competing demands for their attention (12). With an engaged audience, the narrative will have considerable power to convey more information, especially for more complex phenomena and processes (22). Narratives can directly address known misconceptions, explaining underlying flaws in reasoning or correcting facts. Once misconceptions are addressed, the narrative can then build a more correct model for understanding relevant processes in a scientifically accurate way (23). All of this bolsters understanding and memory, while laying the groundwork for future information to be incorporated more easily (2, 24).

When better understanding of science creates a basis for context-specific behavior change, then the narrative can also help to lay the groundwork for remembering to engage in the preferred behavior when the time arises. Many behaviors require real-time decision making, such as choosing a healthy meal, turning down an offered cigarette, or insisting on a condom. Although plans may be made in advance, they are of little use if situational cues overwhelm good general intentions. Narratives can harness common situational cues by incorporating them into the context of the story, turning them into signals inherent in the conflict needing resolution. Thus, the narrative itself can trigger awareness of relevant cues, creating memory traces that will be more strongly evoked in the situations where the scientific message is most relevant.

Narratives can also guide action by demonstrating or "modeling" the behavior, forging a memorable incident in which someone engages in the relevant behavior, overcoming obstacles similar to those that others face (7). This approach is especially helpful when future behaviors will be context-dependent, such as refraining from a tempting behavior like eating unhealthy foods. In these cases, the narrative can help the individual to create memory traces that automatically bring strategies to mind when those future contexts arise.

Narratives typically do not engage systematic processing of information, and so are not conducive to eliciting verbatim memory recall (11). However, narratives should not be used merely as dumbed-down science, choosing a couple of key details and pretending that other aspects of the problem don't exist. That approach could set the audience up for future problems when exceptions to the simple story create unanticipated outcomes. For example, an acquaintance of mine, having heard that an aspirin a day can be healthy, started taking a Tylenol a day because it was easier on his stomach, only to land in the emergency room with liver damage. As this anecdote illustrates, an oversimplified story risks leaving the audience to make unwise inferences when filling in the details themselves.

Rather than keeping the message too simple when extensive information may be necessary, a narrative might instead aim to help people think of resources for finding details when needed. Narratives have the greatest power when used to lay the framework for new ideas or causal arguments, within which detailed information will make sense and perhaps even be intuitive (10, 25).

Developing Scientific Narratives. It is not yet well understood what factors are most important in the development of narratives (13, 14). Fiction and nonfiction narratives can engage audiences about equally (22), opening the possibility for creating content without needing to remain true to the details of a particular case study. Conversational narrative appears to be more believable than testimonial narrative (26). The use of multiple voices and perspectives can help to convey more complex ideas and processes (5).

The historical overreliance on testimonials in many narrative science communications, conveying a single party's perspective on a desired behavior (10), is not optimal. This deficiency may have contributed to the inconsistency of effects found in studies of narrative (23). In the development of educational program content more generally, face validity and intuition have tended to trump empiricism, leading to communications that seem compelling to their creators but fail to achieve their desired goals (5). Recent calls for evidence-based strategies in public health may be well applied to educational program content, including the development of narratives (27).

Identifying Scientific Content. To generate the content that will form the narrative, a domain-specific assessment is needed. Although many communications are guided by social cognition models of health, such as the health belief model (28, 29) and theory of reasoned action (30, 31), such models highlight only general aspects of behavior, such as benefits and self-efficacy for behaviors. For content development, the models are helpful but essentially interchangeable (32–36), their very generality precluding any ability to provide directed, content-specific guidance for actual intervention content.

Expanding on social cognition models, the "mental models" approach embeds theoretical concepts in the context of a given domain, creating an "expert model" to identify relevant content that must be communicated (37). This approach is particularly useful for revealing gaps in knowledge and misunderstandings

that need to be rectified (38). In essence, this approach compares the expert model of a given domain to a descriptive model of people's actual understanding. Discrepancies between the two determine what needs to be communicated.

The expert model is created by consulting the scientific literature, typically augmented by input from experts, to identify the most relevant variables and how they are linked to one another. This model characterizes what a person would need to know to make the best decision within the domain (39, 40). The expert model is then used to structure descriptive research, guiding interviews and surveys to determine what people know and how they think about the problem, revealing areas where misconceptions or gaps in knowledge may be impeding general understanding.

For example, in a project aimed at understanding parents' vaccination decisions, the expert model included links from vaccination to a reduction of disease by way of improved immunity, which further contributes to protection via herd (or collective) immunity. However, a significant subset of this study's interview population had virtually no understanding of the concept of immunity; they perceived a health benefit from vaccinating, but with no apparent awareness of this important mechanism. Failure to understand immune processes in individuals' bodies, or vectors within groups, precludes any appreciation of the social good of high vaccination rates (41). Such results reveal gaps in understanding and misconceptions that might impede decision making, which a prescriptive narrative should address (38, 39). Interview transcripts provide insights into natural wording, contexts, and metaphors that will make the resulting narrative most useful and meaningful to the target audience, precisely because the narrative will feel familiar and use concepts that are commonly understood (42, 43).

Narrative Voice and Content. Putting the identified content into narrative form requires consideration of the audience, typically with their direct involvement. Subtle differences in the narrator's voice can greatly affect the overall tone of the communication, affecting how the audience receives it. A voice that feels too authoritarian can be off-putting, making the audience feel like they are being told what to do. Presenting the same information in a voice that the audience more readily identifies with can greatly increase its impact (44).

In creating prescriptive narratives for a variety of audiences, finding the right voice can be a challenge. The communication must enlist the audience to welcome the communication and accept what it has to say. For example, adolescents don't want to hear messages about risky sex from their parents, whose motives they may find suspect; they want to learn what their peers and people they admire have to tell them. A useful approach is to conduct iterative testing of draft content to identify areas where the voice is off key, and elicit revisions to improve the tone as well as to ensure the practicality of the advice.

Getting the voice right is especially important in domains requiring social negotiation. When communicating about interpersonal relationships, behavioral expectations, or other social challenges, narratives can take advantage of numerous social tools. These tools include the ability to present a diversity of perspectives, the power to engage emotional reactions, and the demonstration of behavioral modeling. For example, a narrative can be used as a substitute or supplement to otherwise difficult interpersonal conversations, like explaining sex or bodily functions to adolescents, where a peer-like narrator using a nonjudgmental tone may have the greatest impact.

Similarly, the conflicts central to a narrative and the context in which it takes place can help the audience to identify with it and better remember its lessons. Concepts that are already well understood can serve as a foundation, making the story feel comfortable and providing a context for new information. Familiar characters wondering about commonly held misconceptions can bring the audience to share in the questions, making the explanation a welcome resolution rather than a critical voice.

Unfortunately, narratives have a greater potential to convey biased information, given their high emotional impact and limited ability to provide citations (10). For someone with a narrow agenda, a narrative can be a tempting format to moralize by presenting a one-sided case, or to harangue the audience about a particular issue without presenting a complete account. Even for topics with broad scientific consensus, such as the risks of smoking or climate change, there is often a temptation to show worst-case scenarios rather than the most-likely outcomes (45, 46). Such use of narrative may be considered highly manipulative by both scientists and audiences, and is likely to undermine trust in narratives from similar sources or on similar topics, potentially escalating hostility in ongoing debates.

To maintain trust, creators of narratives have a responsibility to be true to the science when communicating. This requires scientists to consider the strength of data on all sides of an issue and not just cherry-pick supportive incidents to make a particular argument. Presenting a worst-case scenario implicitly conveys the impression that the scenario is typical and thus misrepresents likely outcomes (47). Because narrative must limit information more than other forms of communication, it may be more vulnerable to such selection bias, and therefore requires additional vigilance to guard against such bias. In cases where there is substantial disagreement or controversy, a narrative might even require a companion source document to link all claims and explanations to reputable, peer-reviewed original scientific sources.

Interactive Delivery of Narrative Content. Technological advances in recent decades have brought about a major transformation in how content is delivered, through the "communication revolution" of interactivity (48). The rise of Internet use has led to a growing familiarity with surfing between websites to gather information that may be delivered using different voices and perspectives (49, 50). These advances, along with increased comfort with active rather than passive media consumption, have made interactivity as a powerful new technique for science communication (51). The "structured self-tailoring" made possible through interactivity can allow audiences to get the most personally relevant information while keeping them within the confines of the communication (42).

Complex problems, such as compound, contingent decisions, are good targets for interactivity, especially where the situation may vary according to someone's circumstances (sex, age, disability status, medical condition, and so forth). Interactivity can provide individuals with the content that is relevant for them, unencumbered by irrelevant information that might otherwise lead to fatigue or dilution of the message (52). Alternatively, a broad range of material may be structured as reference material by using more specific menus nested within more general ones, allowing the viewer to easily navigate to answer a certain question that is relevant at the time. For example, Fig. 2, from the case study presented below, shows a menu of options to learn some fundamental properties of sexually transmitted infections (Fig. 2*A*), with each title linked to a short general introduction. These primary segments are each then followed by another menu (Fig. 2*B*), allowing the viewer to dig deeper and learn more about any specific infection.

Interactivity provides special benefits for communications using narrative, but also special challenges, such as the need for nonlinear storylines to allow viewers to make choices within a narrative (53). It can be uniquely helpful in situations where unfolding circumstances may call for different responses, such as precise medical procedures or complex social interactions (54). Role playing such behavior under varying circumstances can help the audience to discern patterns and rules and when to apply them. Additionally, a narrative communication may include alternative

Fig. 2. Example of nested menus, taken from *Seventeen Days* (68), with an initial menu (*A*) offering options to learn about general questions, and a submenu (*B*) offering more detail on the selected question for different infections.

stories that are structurally parallel but superficially different in ways that create interest, providing an opportunity for multiple exposures to critical material without making it feel redundant. Allowing audiences a feeling of control in selecting options can promote both involvement and feelings of agency, while still controlling exposure to content.

A potentially powerful vehicle for delivering interactive content, especially for narratives, is video. Dramatized video has been found to increase identification with characters, enhancing the degree of narrative engagement (7), promoting acceptance of the information being presented, and creating episodic memories that are easier to recall in similar situations (14).

Communicating science through interactive video narrative thus has the potential to be a powerful, self-reinforcing medium, akin to video games. This approach exploits the somewhat addictive nature of video entertainment in which the audience loses track of time, repeating variations on the same tasks over and over and getting efficient at them (55). These elements can be a gold mine for communication, holding the audience's attention and providing interactive exercises to reinforce material, all while modeling desired behavior.

The games that most effectively achieve these states are often highly produced, well-funded enterprises. Putting substantial resources behind development of scientific communications can similarly pay off, if done well and kept true to the science. Indeed, a significant monetary investment may still be extremely cost-effective when there are considerable costs associated with the outcomes to be avoided, such as sexually transmitted infections (56). The cost of the requisite normative and descriptive research can easily run into hundreds of thousands of dollars to cover the labor-intensive interviews, coding, and iterative testing of content. Using similar levels of funding for production may be warranted to avoid squandering the research findings on communications that fail to engage the audience as a result of poor production values.

Evaluation. To determine whether a communication is effective, it must undergo scientific evaluation of its impacts on outcome measures (57). In the case of a prescriptive scientific narrative, those outcome measures may include both improved understanding of the science and engagement in scientifically sound behavior (Fig. 1). In cases where a communication was developed to address suboptimal behavior in a population, an outcome evaluation would aim to measure behavior change or risk reduction. In addition, process evaluation should ensure that the communication can be delivered with fidelity over multiple instances (58). For example, if teachers are using a validated narrative communication in a science class, they should not change key elements according to what they think their own students might prefer or need. Such deviations are more likely to decrease a communication's effectiveness than to increase it (59–61).

The costs of such an evaluation often dwarf the costs of creating the communication. To follow sizable populations for months or years to measure behavior change or clinical outcomes can cost many hundreds of thousands of dollars, potentially even millions. This dynamic creates a strong disincentive for evaluating communications, as it is certainly easier and cheaper to just assume something works than to test it and discover that it does not. However, a communication that does not achieve its desired outcome is not only a waste of time and money, it also represents the loss of an opportunity to have done something that would have worked.

When funds are limited, other approaches to evaluation can be considered. Measuring self-reported perceptions of how people think they were affected by a communication is considerably cheaper than randomized trials, but much less accurate because people often lack sufficient insights into their own behavior to predict how information will change them (57). An alternative approach is a "delayed treatment" design, where half of the participants are randomly designated to receive the communication immediately and the other half to get it at a future time. Behaviors of the two groups can be compared after the former has received the communication but before the latter has. Outcome measures might be further simplified to focus on knowledge, understanding, and intentions, all of which can be collected in a single session with the communication, to avoid the need for longitudinal data collection.

Case Study: Adolescent Pregnancy Prevention

As an example of prescriptive scientific narrative, I describe an interactive video that my colleagues and I developed to help female adolescents prevent pregnancy and sexually transmitted infections (42, 62). Adolescents constitute a particularly good target for narrative because they tend to be less willing to direct their attention without some payoff. For this project, we relied on the science of decision making to communicate to adolescents what is known about managing sexual risks. We created a narrative using a mix of dramatized video and direct address, with a female adolescent narrator who asks the audience to identify with her plight as she guides viewers through the content.

Based on a normative expert model (40), we conducted descriptive research to reveal ways in which adolescents' actual decisions deviated from the model (62). Here I highlight three key empirical findings that emerged from this research, and describe how we addressed them using narrative. The first and arguably most central finding of the descriptive research was that adolescents perceived sexual behaviors to be overwhelmingly "scripted." This term refers to actions that are so strongly anticipated as a function of the context that people don't even realize that they are making choices (63). The prototypical scripted situation is eating in a restaurant: you go inside, sit at a table, order from a menu, wait for your food, eat it, pay the bill, tip, and leave. Violating this script is so unusual that contemplating it is almost nonsensical: you wouldn't consider, for example, tipping

before you had ordered. The power of violation becomes obvious when eating out in different countries, where the script may differ in subtle ways. Americans dining in Europe often become irritated when the server does not bring the check immediately after dinner, and Europeans feel that American servers are being rude when they do bring it.

In our research, young women described sexual encounters in highly scripted ways, with broad agreement about what happens in situations leading to sex. Two story lines emerged very quickly in our interviews, which we heard over and over with little variation. In one story, the girl and boy meet at a party and end up alone together in a room to have sex (often with "a line outside the door" of other couples). In the second story, the boy and girl are dating, find themselves alone together, and proceed to have sex. In neither case did we hear much about social pressure from partners or peers, nor did we hear about the intrinsic (e.g., physiological) benefits of sexual behavior. Although these factors are certainly present, they seemed secondary to the normative progression of events. Indeed, when pressed about how they had decided to have sex, young women often seemed perplexed by the question, answering that "it just happened."

We followed up our initial interviews with a more directed approach. We presented interviewees with both story lines up to the point where the characters were alone. Then we asked what they thought happened next, with 100% of interviewees saying that the characters had sex. When asked to identify points in the story where the female protagonist could do something differently if she didn't want to have sex, interviewees were often stumped. Most said that she shouldn't go somewhere alone with a boy, not a wholly unreasonable strategy but a pretty broad one. In the story about the new sexual partner, a common answer was that the female character shouldn't go to the party, a strategy that essentially translates into a choice between normal social interactions versus control over one's sexual behavior. These findings reflect a profound lack of self-efficacy, such that young women apparently feel very little perceived control over sexual situations.

To address this finding, our communication highlighted the choices inherent in these typical situations and then reinforced nonscripted options. The guiding story line of the narrative focuses on a character who has had unprotected sex and is currently waiting for pregnancy and infection test results. She discusses her dilemma with a set of friends, each of whom later finds herself in one of the two familiar, scripted sexual situations (either with a boyfriend or someone new). The familiarity of the situation is meant to highlight cues that will arise later, in high-risk situations, triggering the viewer's memory of the lessons and strategies covered by the communication.

The viewer chooses a character to follow and watches as the story begins with the highly scripted narrative. However, that story is interrupted multiple times, punctuated with highly salient and heavily reinforced efforts to highlight opportunities for alternative choices (64). These alternatives are presented as options for different directions that they storyline might go, akin to a choose-your-own-adventure story, shown in a sample menu in Fig. 3. This technique was designed to make the gap in knowledge very obvious to the viewer: *of course* you could do something else here, if you wanted to. This key lesson was then reinforced using multiple psychological techniques, including behavioral modeling and cognitive rehearsal (65, 66).

The second gap was neglect of relative risk in considering different sexual behaviors and mitigation strategies. Adolescents tended to think of behaviors as either risky or completely safe, which led to a general failure to appreciate the benefits of risk reduction. For example, kissing would be considered by experts to be extremely safe, but interviewees were sometimes fraught with confusion about it, apparently reinforced by health class messages about bleeding gums. Such conflicts evoked extensive deliberation from our participants about the presence or absence of risk, leaving them vacillating between judgments of certain behaviors as risky or safe, rather than placing them at intermediate points on a risk continuum.

Another instantiation of this gap emerged when discussing the benefits of condom use. A popular refrain, presumably also learned in health classes, was that condoms are not 100% effective, an important caveat for any mitigation strategy. However, this observation often prompted further reasoning that there was thus no point in using condoms because they don't make sex safe. The absolutist view of risk fundamentally undermined important messages for reducing the risk of sexual behavior for a population that is currently sexually active.

Our communication addressed this finding using the metaphor of a scale showing risk going up and down. This metaphor was presented within a broader narrative of students in a sex education class building a large, physical scale (Fig. 4) in which behaviors and mitigation strategies could be literally weighed to determine the relative risk of any given behavior compared with other options. Behaviors ranged from extremely low on the continuum, such as talking and kissing, up to highly risky sexual behaviors. For each, the base level of risk was established on the scale and then the benefit of risk reduction was explicitly associated with mitigation techniques, especially condom use for sexual behaviors and hormonal contraceptives for pregnancy prevention.

A third general finding was that adolescents appear to have greatly limited health knowledge, including misconceptions about infections, their transmission and treatment, and other aspects of health. More extensive knowledge about HIV, which has several anomalous properties compared with other sexually transmitted infections, seemed to underlie many misconceptions that arose through conflation of HIV with other infections. When we asked interviewees to choose any infection for detailed discussion, they all chose HIV. When asked to make another choice, they often selected *Chlamydia*, herpes, or warts, but then ended up providing descriptions that would better apply to HIV: blood-borne, fatal, and incurable. This confusion led to a general sense of futility in dealing with infections, combined with a lack of appreciation for how they are caught and might be better prevented, especially those that can be transmitted by skin-to-skin contact.

Rather than bombard the audience with details about a list of infections, the communication provided a taxonomy from which they might draw inferences about any particular infection given some basic information. Within the narrative setting of the sex education class, students each "caught" a pathogen represented by a plush toy, such as the *Chlamydia* bacterium or the herpes virus. The students then presented a more substantive foundation for knowledge, discussing fundamental differences between

Fig. 3. Sample menu from *Seventeen Days* (68) of a character's choice to go somewhere alone with a boy, presenting three options, two of which will exit the sexual script.

Fig. 4. Students demonstrating the "Risk-O-Meter" to reinforce the concept of relative risk for sexual behaviors and mitigation strategies in *Seventeen Days* (68).

bacteria (which can typically be cured with antibiotics) and viruses (which can't). The communication used nested menus (Fig. 2) to allow the viewer to find more specific information as desired.

Particularly important misconceptions about infections were reinforced elsewhere in the narrative by having characters confront them directly, challenge them, and then provide the logic underlying the correction. In a discussion among a group of female characters before the unfolding of their stories, one character espouses the common misconception that oral sex is generally safe, and other characters then correct her and explain the logic behind skin-to-skin transmission. During iterative testing of this particular exchange, participants were often incredulous, interjecting "that's not true" when reading drafts of the communication. This type of resistance to strongly held misconceptions is common (67). It required us to conduct extensive editing and testing to arrive at a presentation that acknowledged participants' skepticism and addressed it sufficiently for them to change their strongly held beliefs, as corrections of misconceptions often must do.

We conducted a longitudinal randomized controlled trial to evaluate the effects of our narrative communication, measuring behavioral and clinical outcomes in the months following its delivery. A pilot evaluation of an early version revealed statistically significant effects on sexual behaviors, including increases in abstinence and correct condom use, as well as decreases in self-reported incidence of sexually transmitted infections (and a similar but nonsignificant trend for clinically documented *Chlamydia* infections) (62). A large-scale field evaluation is currently underway at 15 clinical sites across three US states to test for wider-scale dissemination and clinical outcomes.

Conclusions

Use of narrative helps to convey scientific findings in a coherent manner that can help the audience better understand and remember complex processes that are otherwise difficult to explain. Prescriptive scientific narratives can explain science to people who can then use their improved understanding to make better decisions for themselves. By using narrative to convey scientific information, a communication can help its audience to reconsider long-held beliefs that may be inaccurate, and develop understanding that will serve as a framework for new information.

Interactive narrative science communication provides important additional benefits. In particular, it allows for structured self-tailoring, delivering the most relevant information to the audience efficiently, while boosting feelings of engagement and agency. The case study presented in this paper demonstrates how a prescriptive scientific narrative reduced adolescents' risky sexual behavior. This approach has promise for other domains requiring communication of complex scientific processes that underlie risky human behaviors.

ACKNOWLEDGMENTS. This research was supported by Grant IU19 AI 38513 from the National Institute of Allergies and Infectious Diseases, and Grant TP1AH000040 from the Office of Adolescent Health.

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