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Gist Representations and Communication of Risks about HIV-AIDS: A Fuzzy-Trace Theory Approach

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Abstract

As predicted by fuzzy-trace theory, people with a range of training—from untrained adolescents to expert physicians—are susceptible to biases and errors in judgment and perception of HIV-AIDS risk. To explain why this occurs, we introduce fuzzy-trace theory as a theoretical perspective that describes these errors to be a function of knowledge deficits, gist-based representation of risk categories, retrieval failure for risk knowledge, and processing interference (e.g., base-rate neglect) in combining risk estimates. These principles explain how people perceive HIV-AIDS risk and why they take risks with potentially lethal outcomes, often despite rote (verbatim) knowledge. For example, people inappropriately generalize the wrong gist about condoms' effectiveness against fluid-borne disease to diseases that are transferred skin-to-skin, such as HPV. We also describe how variation in processing in adolescence (e.g., more verbatim processing compared to adults) can be a route to risk-taking that explains key aspects of why many people are infected with HIV in youth, as well as how interventions that emphasize bottom-line gists communicate risks effectively.

Keywords

Class inclusion; development; fuzzy-trace theory; health; judgment; risk communication

INTRODUCTION

Few decisions involve more potential personal consequence than decisions to expose oneself to sexually transmitted infections (STIs). Adolescents are a particularly vulnerable population for these risky decisions. According to the Center for Disease Control and Prevention (CDC), the period from adolescence to young adulthood is one of inordinate risk taking: almost half of the 19.8 million new sexually transmitted infections that occur each

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CONFLICT OF INTEREST

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year affect 15- to 24-year-olds, despite the fact that this group only represents a quarter of those sexually active [1]. In light of these findings, it is worth noting that the United States has the highest teenage birth rate in the developed world (despite recent declines; [2]), which is linked to an array of harmful outcomes including low birth weight and low academic achievement [3].

Although most interventions to reduce risk taking in the context of sexual health focus on increasing knowledge and awareness of risks, research has shown that adolescents and young adults are generally aware of their vulnerability [4]. Adolescents estimate some of their risks, such as the odds of becoming a mother by age 20, quite accurately [5]; and they actually overestimate their risks for negative outcomes such as contracting HIV and other STIs [6].

In this article, we discuss how fuzzy-trace theory's predictions about risky decision making explain how people perceive HIV-AIDS risk and why they take what seems to be irrational risks with potentially lethal outcomes. Initially, we present the criteria for assessing the quality of judgments about risk. Then, we present an overview of the theory, describing its core principles applied to risky judgments as well as illustrative evidence. Specifically, we address how perceiving and estimating risk is a function of knowledge deficits, gist-based representation of risk categories, retrieval failure for risk knowledge, and processing interference in combining risk estimates. We then discuss fuzzy-trace theory's predictions of paradoxical effects of how information on risk taking is mentally represented. We discuss how people predictably misestimate risk despite rote (verbatim) knowledge, and why people with a range of training—from untrained adolescents to expert physicians—are susceptible to variability in risk estimation based on the presence of retrieval cues and processing interference (e.g., base-rate neglect). Next, because so many people are infected with HIV in youth, we discuss developmental differences in risk taking, explaining how adolescents' thinking about risk differs from adults'. Finally, we present examples of evidence-based practices to communicate risk effectively, with implications and recommendations for future research.

BENCHMARKS FOR ASSESSING THE QUALITY OF RISKY JUDGMENTS

Much of the research in judgment and decision making has characterized the quality of judgments in terms of principles of either coherence or correspondence [7]. Coherence refers to the logical consistency in one's judgments [8, 9]. In this view, people are said to be irrational when their decisions conflict with one another according to formal constraints of logic or probability, indicating a failure in coherence. An individual's attitude towards risky decisions can be affected purely by how a decision is framed (in terms of what is to be gained or lost), and thus seemingly irrelevant details can lead to incoherent preferences (i.e., preferences that are inconsistent with one another) in risky decision making [10, 11].

An example of such incoherence is when individuals display conjunctions fallacies, an error in judgment when dealing with overlapping classes of events—for instance, the probability of both contracting HIV-AIDS (its prevalence rate in a given population of potential sexual partners) and the probability of getting pregnant from unprotected sex [6, 12, 13]. A

conjunction of probabilities (of both HIV-AIDS and pregnancy) from unprotected sex is generally overestimated because people become confused about how events overlap [14]. This confusion regarding overlapping classes of events also occurs in real-world situations involving the perception of risk, especially conditional probabilities because of their complex overlapping classes. For example, when judging the chance of having an infection given a positive test result, people often overestimate their risk (based on confusion distinguishing the class of people who have a positive test result from the class of people with an infection), resulting in a neglect of the low base rate of infected individuals in the population. Thus, in the context of risk perception, failures of coherence involve lack of consistency in risk judgments.

In contrast, correspondence refers to the accuracy of judgments as they pertain to reality and outcomes of decisions in real-world environments. For example, research has shown that people who consider categorical information in their decisions—such as considering an all-or-none presence of risk—will generally have healthier real life outcomes as opposed to those who prefer to trade off precise values of risks and benefits [10, 15]. For example, adolescents who accurately know that the objective probability of contracting HIV is small can still nonetheless think categorically about avoiding unprotected sex— meaning they understand that the severity of the outcome involves death or loss of quality of life, and is thus qualitatively different from the other outcomes and the risk should be categorically avoided. Adolescents who think in this categorical way have better health outcomes than those who weigh the probability of HIV infection. Correspondence can also refer to real-world accuracy, such that experts' judgments of risk correspond well with actual outcomes (e.g., those females are more biologically susceptible to STIs than males) (see also, 6, 16, 17).

According to fuzzy-trace theory, both criteria— coherence and correspondence—are relevant to evaluating people's judgments about risks. Correspondence criteria include accuracy in knowledge about real-world outcomes and the corresponding quality of real-world outcomes, while coherence criteria include consistency in judgments about risks. People of varying levels of expertise are often about equally vulnerable to coherence errors, but people with differing degrees of training vary in their susceptibility to correspondence errors (i.e., knowledge of real-world risks) [7, 18, 17]. It is important to understand how coherence and correspondence errors each contribute to decision making and what mechanisms underlie specific biases, as has been investigated [7] and will be discussed later in this chapter in greater detail.

In the next section, we review one theory that has clear predictions regarding how different cognitive processes relate to biases and decision making—fuzzy-trace theory [6, 19]. Risk communicators need to identify the reason why coherence and correspondence errors happen before deciding how to best communicate risks [16, 20, 21]. Fuzzy-trace theory makes predictions regarding when to expect violations of coherence and correspondence, and how to reduce reasoning errors based on both of these criteria. In particular, the theory makes recommendations regarding how to prevent coherence violations through communication of risk in such a way that reduces retrieval failures and inhibits interference from class inclusion, as well as how to improve reasoning according to correspondence

criteria through interventions that emphasize expert gist understanding of risks and reliance on these gists in risky contexts [10, 12, 17, 20, 22–24].

FUZZY-TRACE THEORY

Fuzzy-trace theory provides an explanatory framework in which different sources of judgment errors (i.e., coherence and correspondence errors) that involve risk estimation (e.g., of HIV-AIDS) are distinguished. Fuzzy-trace theory builds on earlier work in psycholinguistics distinguishing verbatim from gist renditions of narrative, extending this distinction to include nonverbal information such as numbers and pictures [25].

According to fuzzy-trace theory, people use their memories to represent information even when the information is visible, and it is these memory representations that support reasoning, deciding, and judgment. Fuzzy trace theory describes the encoding, storage, and retrieval of representations of experiences with two mental processes involving distinct memory representations and separable brain networks [10]. Gist-based processing is vague, qualitative, and intuitive; the gist captures the bottom-line meaning of information. The gist memory representations on which this process relies incorporate subjective interpretation of information based on emotion, education, culture, experience, worldview, and development [19].

In contrast to gist-based processing, verbatim processing is precise and operates on the exact surface form of information. When information involves numbers, verbatim representations are quantitative, and can involve deliberative calculation. Thus, representations used in verbatim processing capture the literal facts and details of information. This process often corresponds to the classical analytical models of economics in that risky decision problems presented in the laboratory typically involve trade-offs between outcomes and probability—for example, a sure option with a lower reward (sure \$100) vs a risky option with a higher potential reward (.5 probability of \$200). Processing these options formulaically involves trading off risk and reward in a compensatory way.

Unlike other theories, fuzzy-trace theory predicts that gist and verbatim processes happen in parallel instead of either/or. If people are numerate, they process the exact numbers, while in parallel they assign the numbers to meaningful categories that are represented in categorical gists. They start with categorical gists because that is the simplest level [25]. This categorical gist representation is not just simple-minded misunderstanding because it increases with development (from childhood to adulthood) and with expertise. Fuzzy-trace theory predicts, and studies show, that with greater age (from childhood to adulthood) and greater life experience and expertise in adulthood, people increasingly rely on gist processing to make decisions and that such intuition generally reduces unhealthy risk taking [16, 20, 26]. In other words, people show a fuzzy processing preference; the reliance on the least precise representation of a problem that the constraints of a task will allow. For example, the categorical representation of 2% chance of HIV-AIDS from unprotected sex for older, experienced adults is “some” risk (as opposed to “no” risk). This representation of “some” risk does not necessarily mean “big” or “more than a little,” but just that the risk is “some” as opposed to “none”—meaning that an accurate encoding of the gist is not an

overestimation. An accurate gist understanding of this risk would be that it carries some risk of severe consequences (as opposed to no risk), and should be categorically avoided (despite knowledge that the risk is small). Adolescents usually do not rely on the same simple gist representations; they are more likely to trade off verbatim risks and rewards. Thus, because objective risks of HIV-AIDs are low and rewards of sex are high, they are more likely to take a chance, and therefore risk getting HIV-AIDS [4, 10].

According to fuzzy-trace theory, judgments and decisions, and, consequently, adult behavior is generally determined by the simplest gist that is derived (e.g., *some* risk, as opposed to *no* risk), rather than the verbatim facts that are presented (e.g., 2% risk). The levels of gist described here follow a hierarchy that is roughly parallel to the scales of measurement [25]. The simplest gist distinctions are categorical (e.g., *some* or *no* risk). The next most simple gist distinctions are ordinal or relative (e.g., *more* or *less* risk). Finer distinctions are made as the level of gist moves up the hierarchy (i.e., interval or ratio) until the representation captures the exact verbatim number. Gist-based thinking is the distillation of the meaning of past experiences into an intuitive bottom-line interpretation (that is then recognized in, and applied to, current instances).

A mental representation, whether gist or verbatim, does not determine judgments and decisions by itself, however [27]. After information is represented, people retrieve their values, principles, and knowledge about risks and apply them to that representation in order to make a decision about whether to take a risk, such as engaging in unprotected sex. The values or principles applied to representations of risks are also vaguely represented in long-term memory as simple, qualitative gists (e.g., “avoid risks”), as filtered through their experience, culture, and worldview [4, 19]. Studies have shown that younger adolescents are more likely to base decisions on verbatim representations of details compared to older adolescents and adults; this thinking has been linked to risky behavior that exposed them to HIV-AIDS, and it explains more variance in risky behavior than does reward sensitivity (e.g., sensation seeking) or self-control [4, 10].

ANATOMY OF A RISK JUDGEMENT

As health care professionals are a vital link in risk communication, psychological processes that can determine or interfere with their ability to understand risk are critical in communicating risk of acquiring sexually transmitted diseases. These processes can describe both patients’ and professionals’ estimates of risk, although specific effects may be determined by their differing levels of expertise. Fuzzy-trace theory predicts that distortions and biases in risk estimation can be predicted from one’s level of expertise and from the cognitive step that is relevant in the task. Specifically, distortions can be linked to deficits of prior *knowledge*, gist-based *representations* of risk information, failure to *retrieve* relevant knowledge, and errors in *processing* that are often the result of interference.

The simplest of the possible risk estimation errors are those that occur merely because individuals lack knowledge needed to answer a given question (e.g., whether females have a greater biological susceptibility to STIs than males). Accurate risk estimates require more specific knowledge (e.g., about the prevalence of STIs). Naturally, medical professionals

with specific domain-specific training about STIs are more likely to provide accurate estimates than would a non-expert. Thus, the simplest knowledge errors are likely to be related to domain-specific training. In some instances, knowledge errors can be observed even in those who are highly trained [17]. One example of such an error would be regarding recent research that indicates that females have higher rates of STI infection and re-infection than previously estimated [28]. Such knowledge has not yet been spread widely, and thus risk estimates differ across a range of levels of expertise [6, 15].

According to fuzzy-trace theory, people will encode an understanding of risk information as a gist representation in parallel with the verbatim numbers, and the accuracy of the gist will depend on the background knowledge and expertise of the person [29]. In addition to individual differences in reliance on gist, including within developmental class (e.g., 25) there is also evidence that low background knowledge contributes to the encoding of ill-formed or inaccurate gist (e.g., 6, 17, 30). For example, individuals with low levels of numeracy cannot understand and use numbers—such as erroneously thinking that 0.001 represents a greater quantity than 0.01 because it has more numbers—and are thus less likely to encode an accurate gist of numeric information [31]. Thus, it is not the case that all gist is automatically good, or that more gist is automatically better than less gist. Accurate gists need to be based on a mature expert understanding. However, the tendency to rely on gist representations as opposed to verbatim representations is more developmentally advanced (occurs later in development).

Other errors in risk estimation result from how specific risk information is represented. As previously mentioned, people tend to base decisions and judgments on qualitative gist representations rather than quantitative verbatim information. For example, estimates of condoms' effectiveness are primarily based on the qualitative gist that they are barriers against fluid, and fluid transmits disease [20, 6, 7]. However, this gist is mistakenly overgeneralized to other sexual infections that are transmitted *via* skin-to-skin contact, such as Human Papilloma Virus (HPV) and herpes simplex virus. Note that we do not claim that people are unaware of atypical categories of STIs, but that they will fail to fully consider the atypical categories if they do not fit the gist of typical categories (see also 16). Thus, even highly trained experts will overestimate the effectiveness of condoms in preventing prevalent infections that are psychologically atypical because they do not “fit the gist” of fluid-borne disease [6,7].

Even if experts have domain-specific knowledge and the relevant gist of disease, they still must retrieve the appropriate knowledge to make judgments of risk [25]. Fuzzy-trace theory predicts that improvements in risk estimates can result from environmental cues that elicit retrieval of specific relevant knowledge. Specifically, cuing the relevance of knowledge by listing specifics—such as listing exemplar diseases included in the category of STIs—will increase the probability that relevant knowledge is retrieved, improving risk estimates provided that knowledge is accurate (e.g., as with expert knowledge; see 6).

For example, asking someone to estimate the risk of a 40-year-old male dying of HIV-AIDS in the next year should elicit a fairly low estimate. Asking for a judgment of the risk that the same 40-year-old male has of dying from HIV-AIDS linked to intravenous drug use,

unprotected sexual contact including with high-risk groups, being a health worker (e.g., from needle sticks), and all other causes of HIV-AIDS, however, should elicit a higher estimate [30]. This disparity in probability judgments is an “unpacking” effect (the class of “dying from HIV-AIDS” is unpacked into subclasses) that is predicted by both support theory [32] and fuzzy-trace theory [7, 17]. However, support theory does not explain the mechanisms of retrieval cuing, whereas fuzzy-trace theory provides a detailed model of representations and retrieval cuing that also explains errors in judging conjunctions and disjunctions of events (e.g., 13, 33).

Specifically, even if reasoners have the relevant knowledge, are aware of its relevance, and have retrieved it to make risk estimations, errors in reasoning are still predicted to occur during the processing of this information under certain conditions. Conjunction errors, as well as errors in syllogistic reasoning (e.g., *Some A are B* and *Some B are C*; therefore, *Some A are C*, which is an invalid inference) or Bayesian updating (e.g., a diagnostic test result “updates” the probability of disease with respect to the pretest base rate or prevalence of disease) involve the confusion of overlapping classes that occurs when processing information. An example of this sort of class-inclusion confusion is the common overestimation of likelihood of infection with a low base rate, such as HIV, after having tested positive for the disease with a rapid test that has good specificity (those without disease are likely to test negative). That is, in a low prevalence population of 0.1% (typical HIV prevalence in some areas of the world), a specificity of 99.4% produces a positive predictive value (the probability that those with a positive test have disease) of just 14%. Six of every 7 positive tests are false positives, but people tend to neglect base rates, and estimate a much higher probability of disease after a positive test (e.g., 16). Positive predictive value improves with rising prevalence, being 97% with a prevalence of 15% (HIV prevalence in London gay men; 34). Providing an accurate post-test probability in such a task requires the reasoner to maintain the correct denominator, which is hard to accomplish given class-inclusion interference, as well as keep overlapping classes (e.g., the class of people with the disease and the class of people with positive test results) accurately represented [12, 13, 20, 22, 35].

These errors can affect professionals at all levels of training, as they do not reflect a lack of reasoning competence, but merely a coherence error in executing the competence as a result of interference from class inclusion. In fact, these errors tend to be drastically reduced when the task is accompanied by some form of graphic (such as 2×2 tables or icon arrays) that makes the overlapping classes clear [13, 36]. However, in the absence of such intervention, fuzzy-trace theory predicts that these risk estimation errors affect professionals at all levels of training, as processing errors such as these are the most advanced sort of error [7, 17].

EVIDENCE FOR THE FUZZY-TRACE THEORY MODEL

These predictions are not just relevant to laboratory tasks, but are applicable to health care professionals at a variety of levels of training. For example, one such study sampled health care professionals including physicians, medical students, nurses, and other health professionals, as well as a group of professionals with specific expertise in STI prevention (i.e., attendees of a national workshop sponsored by the National Institutes of Health—NIH

—and CDC). These participants responded to a questionnaire that assessed many of the aforementioned biases [6].

To test knowledge errors, participants were asked to rank the effectiveness of different methods of birth control (including birth control pills, condoms, Depo-Provera, diaphragm, withdrawal, and abstinence) and were asked to rank a teenagers' risk of contracting various STIs (including HIV-AIDS, HPV, chlamydia, gonorrhea, and syphilis). All groups—physicians, medical students, experts at an STI workshop, and other health care professionals—demonstrated accurate rank-orders of various birth control methods (i.e., abstinence, Depo-Provera, birth control pills, condoms, diaphragm, and withdrawal), both according to theoretical effectiveness and effectiveness in practice, which is routine knowledge among health care providers. They were all also roughly in agreement with published data regarding the rank order of infection risks for various STIs, with the exception of the group of nurses and other health care professionals who perceived chlamydia to be a greater risk than HPV, despite studies largely reporting HPV prevalence as much higher. However, differences in training were observed when participants were asked about biological susceptibility to sexually transmitted infections. In this study, 100% of the experts from the national workshop were able to correctly identify females as more susceptible to infection. Following this group, medical students were the next most accurate, followed by physicians and other health care professionals. These results are consistent with the prediction that risk estimates are based on qualitative gists that are imprecise, in that risk estimates differ significantly from published estimates, but ordinal ranking of risks and prevention methods are generally accurate.

To test biases regarding overgeneralization of condom effectiveness, subjects were asked to interpret direct quotes from the CDC and Food and Drug Administration (FDA) labeling on condom packages in terms of numeric estimates of risk reduction. According to fuzzy-trace theory, if professionals have this particular mental model—in which condoms represent a physical barrier against fluid-borne infection—this gist will be overextended and relied on even for infections that are not fluid-borne. All groups of professionals were susceptible to these errors of overextension of gist representation. In making estimates of condoms' risk reduction effectiveness according to both CDC and FDA statements about condoms, every group—physicians, medical students, experts at an STI workshop, and other health care professionals—overestimated the effectiveness in risk reduction against skin-to-skin transmitted infections such as HPV. Those with less medical expertise (medical students) were found to exhibit more of the error based on inaccurate over-extension of a gist representation (physicians and experts at the STI workshop)—that condoms represent a physical barrier against fluid-borne infection and can (erroneously) be relied on for skin-to-skin transmitted infection [6]. This is consistent with the prediction that people will rely on the gist—that condoms are effective against fluid-borne infections—and mistakenly overextend that gist.

To test for effects of knowledge retrieval errors, subjects were also asked to estimate how much a young woman's risk of contracting an STI increases with each new partner, a teenage girl's re-infection risk after seven months of treatment, and the re-infection risk for that same teenage girl's male partner. The estimate of a young woman's risk of contracting

an STI with each new partner appeared twice; the latter item included a sample list of possible STI infections (e.g., HPV, genital herpes, chlamydia, syphilis, or gonorrhea) to test the aforementioned “unpacking” effect. All groups were susceptible to the “unpacking” effect: Everyone gave a significantly higher estimate of contracting an STI when the question was accompanied by a list of example STIs (i.e., the “unpacked” version”) than when asked for the risk without the additional memory cues (i.e., the “packed” version). This was also consistent with the prediction that the additional memory cues will increase the likelihood that relevant information will be retrieved, resulting in less underestimation of risk.

To test for processing errors, subjects were finally asked to make a diagnostic judgment based on a positive result from a diagnostic test, a given specificity and sensitivity of the test, and a base rate of the illness’s incidence in the general population. Given a disease that has a general prevalence in the population of 10%, and given that a patient tested positive on a diagnostic test with 80% sensitivity and 80% specificity, subjects had to decide on whether the actual likelihood of an infected patient was closer to 30% or 70%. Processing errors were exhibited across a range of training levels; most groups of professionals had a less than 50% likelihood of choosing the correct answer (closer to 30%), roughly the same probability as a group of high school adolescents [16]. The group with the highest average, the group of experts attending a national conference, obtained the correct answer at only around chance levels. Because all numeric information was present in the problem and the disease was not named (thus subjects would have no existing background knowledge), this error was evidently the result of a processing error. As discussed earlier, it was the fuzzy-trace theory predicted result that this error would be observed over a range of levels of training, as this error is an advanced error that does not depend on existing knowledge or retrieval of that knowledge.

Similar results were found in a study of public health educators, including doctors, nurses, physician’s assistants, and those with public health training regarding risk prevention and education, who were given a similar survey [7]. This group of health educators was more accurate in terms of knowledge than other well-educated professionals, even if some risk estimates differed significantly from published estimates of risk (an exception again was an underestimation of HPV prevalence). Even the highly knowledgeable health educators were consistently biased and distorted in their risk estimates that involved representation, retrieval, and processing of that knowledge. For example, despite being fully aware that the items on the “unpacked” list of infections (e.g., syphilis, gonorrhea) are STIs, including this list with a question of risk estimates for infection resulted in a significant increase in estimates. This group also exhibited similar representational biases, giving an overestimate of condoms’ effectiveness against skin-to-skin transmission of infections (e.g., HPV). This overestimation was despite knowledge of the modes of transmission, yet still it illustrated an overgeneralization of the gist of condoms’ effectiveness against fluid-borne infection. Finally, accurate advanced knowledge did not prevent the bias in estimating probability of infection given a positive test result on a diagnostic test with a given sensitivity and specificity and a given base rate in the population: only 24% selected the accurate probability. This is consistent with the theoretical explanation that this error was unrelated to

knowledge or level of training—and instead reflected errors in keeping track of classes of risks and categories.

This body of evidence demonstrates that although professionals may have high levels of risk knowledge—reflecting correspondence criteria—they were still susceptible to common errors associated with representation, retrieval, and processing—errors of coherence [7,6]. This undermines the criticism that coherence errors are often the result of people making judgments about subjects with which they are unfamiliar.

GIST REPRESENTATIONS AS A PROTECTIVE FACTOR

The fact that people encode and retrieve multiple representations of risk information can also lead to paradoxical predictions regarding risk taking in practice. Fuzzy-trace theory predicts that when people respond to a task that cues retrieval of a verbatim representation of risk (e.g., being asked to give a specific numeric estimate of personal risk associated with having sex), that risk estimate will show a positive relationship with risk taking [26]. This is because those who are of high risk have specific examples of risky behaviors to call to mind, yielding higher estimates, while those who do not have specific examples are lead to give lower estimates. Conversely, if a global or gist-based cue to risk perception is used (e.g., being asked to categorize the risks associated with having sex from low to high), a negative relationship between categorization of risk and actual risk-taking behavior will emerge. This effect occurs because the gist representation that an action is risky is more likely to be relied on in decision making, so those who endorse the action as risky tend to avoid it. This paradoxical prediction is what has been found in practice in a study of adolescents that assessed risk perceptions using both verbatim measures (e.g., the percentage risk of getting an STI in the next 6 months) and gist measures (e.g., global categories of “low,” “medium,” or “high” risk), as well as measures of sexual behavior (e.g., intentions to have sex, sex initiation, and number of sexual partners [26]). As predicted by fuzzy-trace theory, the gist-based measures all correlated negatively with these risky sex behaviors (a protective effect) and the verbatim-based measures correlated positively (a reflective effect). The strongest protective effects on risk taking stemmed from both categorical thinking (e.g., “it only takes once”) and the endorsement of simple values (e.g., “avoid risk”). Specific questions about personal risk estimates (e.g., “what are the chances you have an STI?”) produced positive relationships with risk taking. This is consistent with the principle that specific questions will elicit verbatim memories of examples of risk-taking behaviors, whereas the global perceptions will reflect the values and principles that are retrieved when people are in risky decision context [4, 20].

Mills *et al.* [26] further tested whether reliance on gist principles can be associated with reductions in risk taking through testing the endorsement of two principles about risk. As mentioned earlier, adults have a fuzzy processing preference that emerges with age from childhood to adulthood, meaning that adults prefer to make decisions using the least precise representation possible (i.e., they have a fuzzy processing preference). Thus, mature decision making would be characterized less by a trading-off of precise values and more categorical thinking about risk, and this latter type of thinking would also be characterized by less risk-taking. To assess differences in reliance on the simplest categorical gist, participants were

given a choice to endorse a principle “no risk is better than some risk” to represent a categorical treatment of risk information. This principle represents a level of gist representation that involves an absolute, all-or-none, categorical distinction. Conversely, they could endorse the principle “less risk is better than more risk” representing an ordinal treatment of risk information, and focusing on relative distinctions that can be weighed against each other. Adolescents who endorsed the ordinal principle (but not the categorical principle) were more than twice as likely to be sexually active than those who endorsed the opposite pattern (61% to 30%; endorsing both or neither resulted in intermediate levels). This effect was found despite the fact that those who rated themselves with a high percentage of risk of getting an STI also had the highest ratings of sexual initiation and sexual intentions, indicating that the effect is not driven by mere risk perception. This finding supports the prediction that gist processing is relied on in real life decision making, and that those who perceive risk qualitatively, making fewer distinctions, will have healthier outcomes and take fewer risks [26].

GIST AND DEVELOPMENT

The principle that reliance on gist representations of risk has protective effects on risky health behaviors also contributes to the decrease in risk-taking that occurs between adolescence and adulthood [4]. Specifically, it is a central tenet of fuzzy-trace theory that reliance on gist processing increases with age. This prediction has been tested using a framing task to measure the extent to which a person uses gist representations to make a decision [10]. For example, in a risky choice framing task, a person is given the choice between a sure win (e.g., “win \$10”) and a risky win (e.g., “50% chance of winning \$20”) of the same expected value (i.e., the average amount won if that option is selected repeatedly, equal to the magnitude of the award times the probability, or $0.50 * 20 = 10$). Fuzzy-trace theory argues that values are represented in a very simple way in long-term gist memories, rather than in highly detailed format (see, however [37]). Most adults rely on these simple gist values in making decisions between sure and risky options (e.g., “it is better to win something than nothing”) leading them to prefer the sure win when the options are framed as gains, and to prefer the risky choice when equivalent options are framed as losses (e.g., starting with \$20 and choosing between a sure loss of \$10 and a 50% chance of losing everything). There are variations in gist reliance, however, and some display the reverse pattern (e.g., selecting risky choices for gains), which reflects greater emphasis on the precise, verbatim values presented in the problem, and tends to reflect deciding between those values in a compensatory fashion.

The prediction that adults would rely more on gist representations of the options—and that this reliance is a protective factor in risky decision making about sex—was tested using this risky choice framing task in a study that compared adolescents to adults [10]. First, adolescents exhibited more of the reverse-framing pattern than adults, meaning that they selected sure options when choices were described as losses and risky options when choices were described as gains. This result demonstrates less of the reliance on simple gist values described above. This effect was strongest in particular when possible gains from the risky option were high, which suggests that the adolescents were responding more to the precise value in the options, demonstrating more reliance on verbatim, quantitative reasoning.

Moreover, there were differences in the framing pattern among the adolescents, and those who displayed this reverse-framing pattern most strongly were also more likely to be sexually active and have a greater number of partners. This further corroborated the notion that reliance on simple gist principles about risk was associated with risk prevention, suggesting that interventions regarding risky sexual behavior could be more effective by emphasizing such principles, rather than relying on rote knowledge about risks [10, 26].

COMMUNICATING GIST

In order to successfully modify behavior, such as whether to engage in risky sex, not only is it important to influence how these situations are represented, but also whether the simple gist values are retrieved in the decision making context. In the previous section we showed that endorsement of categorical gist principles such as “avoid risk” tends to correlate negatively with risk taking, though principles such as “known partners are safe” tend to correlate positively [10, 26]. This categorical gist representation is not just simple-minded misunderstanding because it increases with development (from childhood to adulthood) and with expertise. Thus, interventions targeting behavior change regarding risky sex and prevention of HIV-AIDS transmission should—in addition to teaching other important knowledge and behavioral skills, including sexual communication and condom use (e.g., 38)—encourage representation of this decision information at the level of gist, both the representation of the decision and the values that are relevant [16, 20, 21, see also 30,17]. This approach of emphasizing bottom-line gist and automatic retrieval of values can be applied to any health message or educational curriculum, including those that already have achieved some success in reducing risky behaviors (e.g., 39). Interventions based on this perspective should communicate a mature and expert gist understanding of the options. Successful communication of this gist does not persuade anyone necessarily to choose a particular option. The representation of options, such as representing engaging in risky sex as a choice between a risky option and an option with no risk, does not “force” a choice. Gist representations are interpretations of what the options are, but do not persuade anyone necessarily to choose a particular option. Choosing is driven by retrieved values (e.g., health, family, money, status etc.)—and interventions based on FTT do not attempt to change people’s values or social norms. Instead, sufficient information should be given so that people can extract their own gist representations of the facts and retrieve their own values to apply to those gist representations.

As interventions based on this perspective should identify the expert gist understanding of options and communicate them, this may include the possibility that an expert understanding of some probabilities represents negligible risk, as is the case in some screening behaviors. Merely advocating for an increase in risk perception could result in increased screening behaviors such as mammography, which would likely lead to over diagnosis, false positives, and added costs of a variety of sorts. Thus an increase in risk perception is not the goal: the point of gist interventions is not to increase risk perceptions. The benefits associated with understanding the gist are from understanding an accurate gist, as inaccurate gist can result in unnecessary increases in clinical utilization. There are contexts in which a mature gist understanding would be that a risk is so low it is basically no risk to worry about—despite knowledge of the precise risk value. There are circumstances in which having a

mammogram does not make sense (e.g., for women under the age of 20 years old). The risk might not be 0%, but may be 0.00001. Stone, Yates, and Parker [40] demonstrated that extremely low risks are considered “nil” risks, supporting fuzzy-trace theory. Although people with a range of expertise (from novices to highly-trained public health educators) will tend to lose accuracy over time in their recollection of verbatim numeric values, gist representations will endure and form the basis of most decisions. Thus, if public health educators are concerned about behavior change, they should focus on communicating a gist that represents an expert understanding of the outcomes of options, such as whether choices represent basically negligible risk, or could possibly result in death.

To determine the effectiveness of an intervention regarding reducing pregnancy and STI risk, which emphasizes gist principles about risk and retrieving these values in the appropriate context, over 700 adolescents were tested in a randomized control trial [23]. This gist-based intervention was compared to a standard intervention grounded in social inoculation, social learning, and cognitive behavior theories that emphasizes delaying initiation of sex and prophylactic measures to reduce risk through activities such as role-playing, as well as an unrelated control group. All groups had the same 14-hour contact time in school settings, and were assessed at three, six, and twelve months after the intervention. The fuzzy-trace theory intervention included all the same content as the standard, but emphasized the gist principles that have been found to have a protective effect on risk taking (e.g., “no risk is better than some risk” and “avoid risk”) as well as subjects’ own values that would guide their behavior. Overall, the students in this intervention were encouraged to understand the gist principles about risk, retrieve relevant values in risky situations, and engage in gist-based thinking (as these representations endure in memory longer and are processed more quickly than deliberative analysis). Follow-ups with the adolescents revealed that this modified intervention was more effective than the control condition on 17 out of 26 outcomes relating to knowledge, attitudes, and behaviors.

The benefits of gist representation were also demonstrated in another intervention using representation-targeted risk communication techniques based on fuzzy-trace theory [41]. In this intervention, Brewer *et al.* investigated the effectiveness of a standard detailed report of the Oncotype DX genomic test that estimates 10-year risk of distant recurrence of early stage estrogen receptor-positive breast cancer compared to four simpler formats: a simple explanation of risk, the explanation followed by a simple graphic presenting recurrence risk information on a continuum (i.e., gist representation), both explanation and graphic accompanied by a description of the graphic and confidence interval reports, and an additional format that involved an icon array. Subjects were randomly assigned to 1 of the 5 conditions and asked to estimate level of risk (low, medium, or high) of 10-year recurrence as well as to rate their understanding and easiness of understanding of the material. Overall, the standard detailed report generated more errors in risk estimation than simpler formats, and was rated the least understandable format. Consistent with fuzzy-trace theory’s predictions that a simple, qualitative representation of risk increases healthy decisions, a gist-based risk continuum format generated the fewest number of errors among all conditions and was rated the most understandable and most liked format [41].

CONCLUSION

Given prior theory and evidence, the next challenge for health communication is specifying the best practices for communicating the gist of health issues. It is important to know what level of specificity is required to best inform the public, as well as patients in the healthcare system. It is not enough to inform individuals of their risk, but it is necessary that we develop ways of ensuring that individuals understand the information that is being provided. Work has already begun on specifying levels of gist representations and how they apply to differing concepts in healthcare. For example, categorical gist may be appropriate when informing people that a risk exists, however many decisions require an understanding of relative risks between options and categorizing different levels of risk [19–21]. As most patients arrive at medical decisions as novices, the appropriate level of gist representation that represents a sufficient understanding of the options should be determined and communicated. Finally, it is important for both experts and novices that information is presented in such a way that encourages understanding and reduces unnecessary complexity (i.e., overlapping classes). When higher levels of gist are needed (if lower levels fail to allow a person to complete a task), adults will recruit those higher levels accordingly.

The theory and evidence presented in this article points to a shift in how we should communicate risk from an emphasis on specificity and detail to a focus on qualitative meaning. Numbers should be presented so that people can extract their own gist, but they should be ordered and organized to facilitate recognition of patterns and basic meaning, with explicit labels summarizing the bottom line as judged by experienced patients and providers (e.g., Drug A has more side effects than Drug B, but they are both very low). Gist reflects understanding, as evidenced by the increasing reliance on gist with development as well as the fact that gist representations are relatively stable in memory. Furthermore, relying on gist is related to less risk-seeking behavior in real life, which ultimately reduces the chances for poor health outcomes such as HIV-AIDS. Finally, these theory driven interventions have demonstrated success in communicating the gist of pregnancy and STI risks, as well as other health risks [42]. Hence, interventions designed to disseminate risk information and improve risk estimates should include support for effective representation, retrieval, and processing of risk information, in addition to basic facts that provide background knowledge. Recommendations for interventions based on fuzzy-trace theory's predictions may present a surprising contrast to standard approaches that emphasize the importance of more detail and precision. However, tests of fuzzy-trace theory's predictions have repeatedly demonstrated the importance of the qualitative meaning and understanding that gist messages provide.

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Biography

Valerie F. Reyna

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