Perceived Risk of Emerging Recreational Drugs: Impact of Anecdotal and Statistical Evidence

Kevin Michael Gutierrez¹† and Lawrence D. Cohn²

Abstract
This study investigated the relative impact of personal stories and base rate evidence on the perceived risk of using two emerging recreational drugs: kratom and Spice. A 3 × 2 × 2 mixed-methods design was employed. Four hundred fifty-three young adults were randomly assigned to read internet postings that presented either 1) base rate information depicting the frequency of adverse reactions to Spice and kratom; 2) base rate information plus four personal web-postings describing beneficial reactions to Spice and kratom; or 3) base rate information plus four personal web-postings describing adverse reactions to Spice and kratom. Respondents subsequently evaluated the risk of using both drugs. Anecdotal evidence (personal stories) outweighed the impact of base rate evidence only when the personal stories described adverse drug reactions. Effective risk communication will benefit from differential use of both base rate evidence and personal stories.

Keywords
perceived risk, emerging recreational drugs, narrative evidence versus statistical evidence

The recreational use of emerging drugs of abuse is a growing public health concern (Corazza, Parrott, & Demetrovics, 2017; Mounteney et al., 2015; National Institute on Drug Abuse, 2018a, 2018b). Spice and related synthetic cannabinoids are often marketed as legal alternatives to marijuana, but a growing body of evidence indicates that these legal drugs can produce dangerously high blood pressure, delusions, and paranoia (Johnson, Johnson, & Alfonzo, 2011; Zimmerman et al., 2009). Calls to U.S. Poison Centers regarding Spice, K2, and other synthetic cannabinoids rose from 13 calls in 2009 to almost 7,794 in 2015 (American Association of Poison Control Centers, 2018). Yet, little is known about how young adults perceive and evaluate the health risks associated with using novel and emerging recreational drugs. The current study addressed this gap in knowledge.

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**Risk Perception**

Risk perception underlies many health-related decisions and serves as a central component of several models of health behavior (Ferrer & Klein, 2015; Sheeran, Harris, & Epton, 2014). For example, protection motivation theory (PMT) posits that risk perception is a function of two factors: perceived vulnerability to a particular threat (e.g., likelihood of experiencing an adverse drug reaction) and perceived severity of the threat. Both perceptions influence overall threat appraisal, which subsequently affects one’s motivation to engage in health threatening behavior. Similarly, the health belief model (HBM) posits that risk perception is influenced by the perceived susceptibility to a threat and the perceived seriousness of the threat. Several findings also suggest that the formation of risk perceptions is influenced by several additional factors, including personality dispositions, contextual issues, and numeracy level (Ferrer & Klein, 2015).

Historically, the majority of theories that sought to explain the process of risk evaluation were conceptualized as primarily analytical. Such theories assumed that individuals consciously weigh the risks and benefits of possible outcomes before arriving at logical, reasoned, decisions to engage or not engage in particular behaviors (Leiserowitz, 2006). Investigators subsequently recognized the role of affect in risk perception and evaluation. The role of affect is elaborated in dual information processing models that describe the routes by which one evaluates risk (Chaiken & Trope, 1999). These two distinct processing “routes” are referred to as the experiential system or System 1, and the analytic system or System 2. The experiential system is characterized as reflexive, affect oriented, and instinctual, whereas the analytic system is characterized as more logical, reason oriented, and deliberate. The experiential system utilizes intuition and gut-based emotionally laden visceral reactions in the assessment of risk, whereas the analytic system utilizes logic, reason, and statistical thought in the assessment of risk (Slovic, Peters, Finucane, & MacGregor, 2005).

The latter two systems have implications for understanding how individuals weigh the relative importance of anecdotal information and statistical information when evaluating the risk of using emerging recreational drugs. Anecdotal information will likely activate the experiential system, and statistical information will likely activate the analytic system. The current research investigates how individuals respond to both types of information when evaluating the risk of using new recreational drugs.

**Emerging Recreational Drugs of Abuse**

Coulson and Caulkins (2011) identified 63 emerging recreational drugs that were subject to legal restrictions during the past 40 years: phencyclidine (PCP, that is, angel dust) and nitrite inhalants (i.e., poppers) in the 1970s, crack and methamphetamine (i.e., ice) in the 1980s, ecstasy and other club drugs (e.g., 3,4-methylenedioxymethamphetamine [MDMA], γ-hydroxybutyric acid [GHB]) in the 1990s and 2000s, and synthetic marijuana (e.g., Spice, K2, Genie) and synthetic amphetamines (“bath salts”) since 2009. By 2015, more than 560 new psychoactive substances (NPSs) were reported to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), and approximately 70% of the latter NPSs were detected between 2011 and 2016 (Pirona et al., 2017). Yet, large-scale surveys of drug use do not typically assess NPS use or the perceived harmfulness of using new substances. For example, Spice was available in the United States in the early 2000, but national data regarding its perceived harmfulness were not collected until 2011 (Johnston et al., 2013a).

The prevalence of NPS use varies by subgroup. For example, a telephone survey of 13,128 European adolescents and adults, aged 15 to 24, revealed lifetime prevalence use of less than 8% (Pirona et al., 2017). However, the lifetime use of NPS was 4 to 25 times higher (depending upon the substance) among 25,790 young adult Internet survey respondents who regularly visited
Findings from several studies suggest that individuals gravitate to NPS for many reasons, including presumed lower physical risk, increased social approval among some peers (Netemeyer, Burton, Delaney, & Hijjawi, 2015), and easy access. In addition, some NPS users believe that these drugs are the safest legal alternatives to illicit substances (Sutherland et al., 2017). Illustrative of this belief is a statement from a NPS user: “An important reason to choose NPS is that the perceived risk of legal trouble from using illicit drugs is far greater than the perceived risk of serious health issues resulting from occasional research chemical use” (Martin & Anette, 2016). The current research partially addresses the latter belief, investigating how individuals weigh anecdotal and scientific evidence when evaluating the risk of using emerging recreational drugs.

**Narrative Versus Statistical Evidence**

Young adults increasingly rely on websites and social networking sites to obtain information, including information about a variety of drugs and their effects. When exposed to information regarding the consequences of recreational drug use, young adults typically encounter two types of information: *anecdotal evidence* depicting personal-drug-related experiences and *statistical evidence* depicting the likelihood of harm based on data from large samples of recreational drug users. Anecdotal reports can come from friends, newscasts, or personal web postings uploaded onto drug-related Internet sites such as Erowid.com, a website that attracts approximately 13 million unique visits per year (Erowid, 2014). Statistical evidence can come from health educators and drug-related fact sheets. The current study investigates the *relative impact* of both types of evidence (anecdotal and statistical) on the perceived risk of using emerging recreational drugs.

Several factors may influence the perceived harmfulness of emerging recreational drugs, including the type of evidence (anecdotal or statistical) encountered when evaluating the potential benefits and harm of using these drugs. Greene and Brinn (2003), for example, examined the impact of base rate information and narrative information on tanning behavior in college women. Participants were exposed to one of three messages: (a) a message containing *base rate information* that described the health risks of using tanning beds, (b) a message containing a *narrative account* about a young woman who used tanning beds and later developed skin cancer, and (c) a *control message* in which participants read neither base rate evidence nor narrative evidence regarding the consequences of using tanning beds. Participants who encountered base rate evidence regarding the hazards of tanning beds reported significantly less tanning usage at 1 month posttesting compared with participants in the control condition. In contrast, participants who encountered narrative evidence did not report significantly less tanning bed usage compared with participants in the control condition.

A meta-analysis of 15 additional persuasion studies suggests that statistical evidence is rated as more persuasive than narrative evidence ($d = 0.20$) when some participants received narrative information (personal testimonies) regarding the advantages and disadvantages of a health-related behavior or consumer purchase, and the remaining participants received base rate information (Allen & Preiss, 1997). Yet, individuals rarely encounter only one type of evidence (either base rate evidence or narrative evidence) when evaluating the risk of a particular behavior, medicine, or recreational drug. Thus, between-subjects research designs are inappropriate for investigating the *relative impact* of anecdotal and statistical information on risk.

**Relative Importance of Narrative and Statistical Evidence**

Only a few studies have investigated the *relative impact* of anecdotal and statistical evidence on judgment and decision making when both types of evidence are evaluated simultaneously (Betsch, Haase, Renkewitz, & Schmid, 2015). The latter research suggests that anecdotal
evidence has exaggerated influence on adult judgments even in the presence of statistical (base rate) information that contradicts anecdotal reports. For example, Ubel, Jepson, and Baron (2001) investigated the impact of anecdotal and statistical evidence on a hypothetical decision to undergo either angioplasty or bypass surgery. Community participants were given hypothetical base rate information regarding the percentage of patients who benefit from each procedure (50% and 75%, respectively). In addition, participants read positive and negative testimonials from patients who had undergone the procedures. Participants who read testimonials that were consistent with base rate data “decided” to have bypass surgery 44% of the time; in contrast, participants who read testimonials that contradicted base rate data “decided” to have bypass surgery 30% of the time. These findings suggest that the presence of counterevidence in the form of testimonials, narratives, or anecdotal reports may reduce an individual’s reliance on statistical information when evaluating risk.

Similarly, Betsch, Ulshöfer, Renkewitz, and Betsch (2011) investigated if exposure to base rate information and personal reports of adverse vaccine reactions influence the perceived risk of childhood vaccinations. Participants read a set of hypothetical web postings regarding adverse reactions to childhood vaccinations. The first web posting cited a (hypothetical) study by the World Health Organization reporting the incidence of adverse reactions to the target vaccination (e.g., 20 adverse reactions of 100). The remaining web postings contained first-hand personal anecdotes, with some personal anecdotes reporting adverse reactions in children to the target vaccination, and other personal anecdotes reporting no adverse reactions. The personal anecdotes were obtained from real websites in which parents posted descriptions of vaccination reactions in their children. Notably, the perceived risk of an adverse reaction to a childhood vaccination increased as the number of adverse anecdotal reports increased, regardless of the base rate information. Similarly, intentions to vaccinate decreased as the number of adverse anecdotal reports increased. These findings again suggest that exposure to anecdotal evidence can decrease reliance on base rate information when evaluating the risks and benefits of medical treatments.

No studies have examined the extent to which young adults are influenced by base rate evidence and personal testimonies (anecdotal information) when evaluating the risk of using novel and emerging recreational drugs. The current study addressed this gap in knowledge. Two hypotheses were tested: (a) exposure to anecdotal evidence that contradicts base rate information will minimize the perceived likelihood of harm of using novel recreational drugs, and (b) exposure to anecdotal evidence that is consistent with base rate information will magnify the perceived likelihood of harm of using novel recreational drugs.

Method

Participants

Four hundred fifty-three young adults were recruited from a large urban university (M_age = 19.60). Participants were recruited from introductory psychology classes and awarded 1 hr of research credit for their participation, helping them complete an 8-hr research requirement for the course. Using Sona System’s cloud-based subject recruitment software, potential participants read descriptions of a range of ongoing studies in the Psychology Department and subsequently volunteered to participate in the current study. Approximately 51.2% of the participants were freshmen, 26.2% were sophomores, 16.9% were juniors, and 5.1% were seniors. Fifty-nine percent of the participants were female; 84% were Hispanic, 6% White, and 2.2% African Americans.

Measures

Participants were administered a battery of measures and tasks, including the following:
Demographic survey. A seven-item measure assessed basic demographic information, including age, gender, and ethnic background.

Recreational drug use. A 39-item self-report measure assessed lifetime, past year, and past 30-day use of several recreational drugs, including marijuana, kratom, salvia, and synthetic marijuana (Spice). Items were adapted from the 2010 Monitoring the Future (MTF) survey (sample item: *On how many occasions (if any) have you used [substance] . . . in your lifetime . . . during the last 12 months . . . during the last 30 days?*). Eight response options were provided: (1) never, (2) 1-2, (3) 3-5, (4) 6-9, (5) 10-19, (6) 20-29, (7) 30-39, and (8) 40 or more.

Perceived harmfulness I. A 10-item self-report measure assessed the perceived harm of using 10 substances, including alcohol, cigarettes, cocaine, hallucinogens, heroin, hookah tobacco, marijuana, methamphetamine, over-the-counter (OTC) medication, and salvia. For each substance, perceived harm was assessed for three levels of use: experimental use, occasional use, and regular use. Item wording was adapted from the 2010 MTF survey (sample item: *In your opinion, how much will you harm yourself (physically or in other ways) if you use alcohol occasionally?*). Response options ranged from (1) no harm to (5) great harm.

Perceived harmfulness II. Two items assessed the perceived harm of using synthetic marijuana and kratom. Perceived harm was assessed for three levels of use: experimental use, occasional use, and regular use. Item wording was identical to the wording described above (sample item: *In your opinion, how much will you harm yourself (physically or in other ways) if you use synthetic marijuana (such as Spice, K2) occasionally?*). Response options ranged from (1) no harm to (5) great harm.

Perceived probability of experiencing an adverse event. A single-item assessed the perceived probability of experiencing an adverse event. Participants responded using a scale ranging from 0% to 100% (sample item: *In your opinion, on a scale from 0–100%, how likely are you to harm yourself (physically or in other ways) if you . . . use [substance] once or twice, occasionally, or regularly?*).

Intentions to use emerging substances. Single-item scales assessed intentions to use emerging drugs (sample item: *During the next 12 months how many times do you think you will use [substance] during the next 12 months?*). Eight response options included (1) never, (2) 1-2, (3) 3-5, (4) 6-9, (5) 10-19, (6) 20-29, (7) 30-39, and (8) 40 or more.

Subjective Numeracy Scale (SNS). An eight-item measure assessed participants’ self-reported numerical ability (Fagerlin et al., 2007). The measure has adequate internal consistency, Cronbach’s alpha = .82 (Fagerlin et al., 2007).

Objective Numeracy Scale (ONS). A 11-item measure assessed mathematical aptitude. Items include questions involving probability, proportions, and percentages. Scores on the ONS range from 0 (none correct) to 11 (all correct), with higher scores indicating greater numeracy. The measure has adequate internal consistency, Cronbach’s alpha = .78 (Lipkus, Samsa, & Rimer, 2001).

Drug use familiarity. The following item assessed each participant’s familiarity with 13 substances, including alcohol, tobacco, cocaine, kratom, marijuana, and synthetic marijuana: “Before taking part in this study had you heard of any of the following substances?” Participants responded using a dichotomous scale (yes/no).
Experimental Manipulation

Web-posting Task (adapted from Betsch et al., 2011). Participants were randomly assigned to one of three experimental conditions: (a) base rate information only (BRO), in which participants were provided with a single web posting from a medical doctor reporting the base rate of adverse reactions after using either synthetic marijuana or kratom (e.g., “800 in 1000 individuals who try synthetic marijuana will experience an adverse reaction”); (b) base rate information plus mostly positive web postings (BRPP), in which participants were provided with the same base rate information described above plus four web postings reporting positive drug experiences and one web posting reporting a negative (adverse) drug experience; and (c) base rate information plus mostly negative web-postings condition (BRNP), in which participants were provided with the same base rate information described above plus four web postings reporting adverse drug experiences and one web posting reporting a positive drug experience.

All participants read real web postings obtained from Erowid.com regarding (a) the consequences of using synthetic marijuana and (b) the consequences of using kratom. One half of the participants responded to web postings regarding synthetic marijuana (i.e., Spice) followed by web postings regarding kratom; the remaining participants received these scenarios in reverse order.

Within each of the three experimental groups (BRO, BRPP, and BRNP), the base rates reporting the likelihood of an adverse event were counterbalanced, so that one half of the participants read that the base rate of negative reactions to synthetic marijuana was 80% (800 of 1,000), and the base rate of negative reactions to kratom was 50% (500 of 1,000). The remaining participants read that the base rate of negative reactions to synthetic marijuana was 50% (500 of 1,000), and the base rate of negative reactions to kratom was 80% (800 of 1,000; Table 1).

The above combination of experimental conditions (BRO, BRPP, BRNP), order of drug presentation (kratom/marijuana vs. marijuana/kratom), and base rate information (50% vs. 80%) generated 12 distinct experimental groups (Table 2). Participants were randomly assigned to one of the 12 groups using an iterative process. Using the software provided at random.org, we randomly ordered the numbers 1 through 12 (e.g., 5, 7, 2, 3, 1, 10 . . .) for each new set of 12 participants. Participants were then assigned to experimental condition based on the order of their arrival at the study.

After reading the drug-related web postings associated with their experimental condition, participants rated the likelihood of experiencing an adverse reaction after using the drug once or

<table>
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<tr>
<th>Target drug</th>
<th>Base rate info only</th>
<th>Base rate info plus positive web postings</th>
<th>Base rate info plus negative web postings</th>
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<td>Synthetic marijuana&lt;sup&gt;a&lt;/sup&gt; (Spice)</td>
<td>80% likelihood of adverse reaction&lt;sup&gt;b&lt;/sup&gt;</td>
<td>80% likelihood of adverse reaction&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>One negative report</td>
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<td>Kratom&lt;sup&gt;b&lt;/sup&gt;</td>
<td>50% likelihood of adverse reaction&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>One negative report</td>
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<sup>a</sup> Order of presentation counterbalanced.

<sup>b</sup> Base rates for Spice and kratom counterbalanced.
twice, occasionally, and regularly; participants also rated the perceived harmfulness of using the drug once or twice, occasionally, and regularly; finally, participants reported their own intentions to use each drug during the ensuing 12 months.

**Selection of Web Postings**

Web postings were obtained from Erowid.org, a website that provides information about numerous drugs, their legal status, their physical and psychological effects, and personal experiences posted by individual users; the website receives more than 13 million unique visits per year (Erowid, 2014). One hundred twenty web postings and personal accounts were selected for potential use in the current study. Each web posting was evaluated for its positive and negative emotional valence. Four positive and four negative postings describing personal experiences using synthetic marijuana were selected for use in the study; similarly, four positive and four negative postings describing personal experiences using kratom were selected for use in the study. All web postings were approximately ¼ to ½ page in length (see the Appendix).

**Procedure**

Tasks were administered in the following order: Background Survey, Survey of Recreational Drug Use, Web-Posting Task, Perceived Harmfulness, Perceived Likelihood of Experiencing an Adverse Event, Behavioral Intentions, SNS, ONS, and the Drug Familiarity Survey. Completion of the tasks required approximately 30 to 45 min. Participant names were only recorded on consent forms, which were not attached to the surveys themselves. No other identifying information was collected. The study was approved by the University’s Institutional Review Board for the protection of human subjects. No extramural funding supported this research.
Design

The study was a mixed $3 \times 2 \times 2$ design with evidence type as the single between-subjects factor (i.e., BRO, BRPP, BRNP), and base rate information (i.e., 80% vs. 50%) and drug scenario (synthetic marijuana and kratom) as the two within-subjects factors. Participants were randomly assigned to the between-subjects condition described above.

Results

Preliminary Analyses

The majority of participants reported familiarity with hookah tobacco (92.2%), synthetic marijuana (76.9%), and recreational use of OTC medications (89.8%); approximately 47.7% of participants reported familiarity with salvia, and 8.9% reported familiarity with kratom. Participants reported high levels of lifetime use of alcohol (91.4%), cigarettes (58%), hookah (61.9%), and marijuana (52.7%). As expected, fewer participants reported lifetime use of cocaine (8.8%), hallucinogens (8.2%), synthetic marijuana (11.9%), and recreational use of OTC medications (12.6%). No participants reported lifetime use of kratom. Intercorrelations among the key dependent measures are reported in Table 3.

Evidence Type: BRO, BRPP, BRNP

Synthetic marijuana (Spice). Separate univariate ANOVAs revealed significant main effects of experimental group on the following dependent variables: (a) likelihood of experiencing an adverse reaction to using synthetic marijuana “once or twice,” $F(2, 446) = 31.00, p < .001$; (b) likelihood of experiencing an adverse reaction to using synthetic marijuana occasionally, $F(2, 446) = 18.14, p < .001$; (c) perceived harmfulness of using synthetic marijuana once or twice, $F(2, 446) = 40.19, p < .001$; and (d) perceived harmfulness of using synthetic marijuana occasionally, $F(2, 446) = 22.30, p < .001$.

Two-tailed post hoc analyses were conducted to determine the source of the above differences. Controlling for multiple comparisons, the perceived likelihood of harm arising from using synthetic marijuana “once or twice” was significantly higher in the BRNP condition than in the BRO condition ($M = 57.6\%$ vs. $38.7\%, p < .006$) and BRPP condition ($M = 57.6\%$ vs. $30.9\%, p < .006$). No significant differences were found in likelihood ratings between the BRPP and BRO conditions (Figure 1).

The perceived likelihood of harm arising from using synthetic marijuana occasionally was significantly higher in the BRNP than in the BRO ($M = 70.4\%$ vs. $57.9\%, p < .004$) and BRPP conditions ($M = 70.4\%$ vs. $49.6\%, p < .004$). In contrast, the perceived likelihood of harm arising from the occasional use of synthetic marijuana was not significantly different between the BRO and BRPP conditions (Figure 1).

The perceived harmfulness of using synthetic marijuana “once or twice” was significantly higher in the BRPP than in the BRO ($M = 5.1$ vs. $3.9, p < .004$) and BRPP conditions ($M = 5.1$ vs. $3.3, p < .004$; Figure 2). The perceived harmfulness of using synthetic marijuana once or twice was not significantly different between participants in the BRO and BRPP conditions.

The perceived harmfulness of using synthetic marijuana occasionally was significantly higher in the BRNP than in the BRO ($M = 5.9$ vs. $5.3, p < .004$) and BRPP conditions ($M = 5.9$ vs. $4.7, p < .004$). The perceived likelihood of harm was not significantly different between the BRO and BRPP conditions (Figure 2).

Reported intentions to use synthetic marijuana did not vary significantly between the three experimental groups (mean values for BRPP, BRO, and BRNP were 1.14, 1.07, and 1.05, respectively).
Table 3. Intercorrelations Among Dependent Variables Based on Target Drug.

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<td><strong>Spice</strong></td>
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<td>3. Likelihood of adverse event (experimental use)</td>
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<td>4. Likelihood of adverse event (occasional use)</td>
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<td>5. Intentions to use</td>
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<td><strong>Kratom</strong></td>
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<td>6. Perceived harm (experimental use)</td>
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<td>7. Perceived harm (occasional use)</td>
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<td>8. Likelihood of adverse event (experimental use)</td>
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<td>9. Likelihood of adverse event (occasional use)</td>
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<td>10. Intentions to use</td>
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*p < .05. **p < .01.
Kratom. Separate univariate ANOVAs revealed significant main effects of experimental group on the following dependent variables: (a) likelihood of experiencing an adverse reaction to using kratom once or twice, $F(2, 446) = 24.23, p < .001$; (b) likelihood of experiencing an adverse reaction to using kratom occasionally, $F(2, 446) = 17.74, p < .001$; (c) perceived harmfulness of using kratom once or twice, $F(2, 444) = 46.88, p < .001$; and (d) perceived harmfulness of using kratom occasionally, $F(2, 445) = 33.97, p < .001$. 

Figure 1. Synthetic marijuana: Perceived likelihood of harm by type of evidence, base rate, and level of use.

Note. BR = base rate; BRPP = base rate plus positive postings; BRO = base rate only; BRNP = base rate plus negative postings.

Figure 2. Synthetic marijuana: Perceived degree of harm by type of evidence, base rate, and level of use.

Note. BR = base rate; BRPP = base rate plus positive postings; BRO = base rate only; BRNP = base rate plus negative postings.
The perceived likelihood of harm arising from using kratom once or twice (experimental use) was significantly higher in the BRNP condition than in the BRO condition ($M = 53.6\%$ vs. $36.0\%, p < .006$) and the BRPP conditions ($M = 53.6\%$ vs. $30.3\%, p < .006$). The perceived likelihood of harm arising from using kratom once or twice was not significantly different between participants in the BRO and BRPP conditions (Figure 3).

The perceived likelihood of harm arising from using kratom occasionally was significantly higher in the BRNP condition than in the BRO condition ($M = 68.6$ vs. $55.8$, $p < .006$) and the BRPP conditions ($M = 68.6$ vs. $48.7\%, p < .006$). The perceived likelihood of harm arising from using kratom occasionally was not significantly different between participants in the BRO and BRPP conditions (Figure 3).

The perceived harmfulness of using kratom once or twice (experimental use) was significantly higher in the BRNP condition than in the BRO condition ($M = 4.9$ vs. $3.5$, $p < .004$) and the BRPP conditions ($M = 4.9$ vs. $3.0$, $p < .004$; Figure 4). The perceived harmfulness of using kratom was not significantly different between participants in the BRO and BRPP conditions.

The perceived harmfulness of using kratom occasionally was significantly higher in the BRNP condition than in the BRO condition ($M = 5.8$ vs. $5.0$, $p < .004$) and the BRPP condition ($M = 5.8$ vs. $4.4$, $p < .004$). The perceived harmfulness of using kratom occasionally was significantly lower in the BRPP condition than in the BRO condition ($M = 4.4$ vs. $5.0$, respectively, $p < .004$; Figure 4).

Reported intentions to use kratom did not vary significantly between the three experimental groups (mean values for BRPP, BRO, and BRNP were 1.10, 1.11, and 1.04, respectively).

**Effect of Base Rate Information (80% vs. 50%)**

Base rate information significantly influenced the perceived likelihood of experiencing an adverse reaction to using kratom “once or twice.” When the reported base rate of adverse reactions to kratom was 80%, then participants perceived the likelihood of experiencing an adverse reaction as significantly higher than when the reported base rate was only 50% ($M = 44.1\%$ and
35.8%, respectively); $F(1, 451) = 7.77, p = .006$. Base rate information did not significantly influence the perceived likelihood of experiencing an adverse reaction to occasionally using kratom; $F(1, 451) = 5.62, p = .018$.

No significant main effect was found for the impact of base rate information (80% vs. 50%) on the perceived likelihood of experiencing an adverse event for the experimental and occasional use of synthetic marijuana, $F(1, 451) = .468, p = .494$ and $F(1, 451) = .648, p = .421$, respectively.

**Numeracy**

Four hierarchical linear regressions examined the impact of experimental condition on likelihood of harm ratings after controlling for individual differences in numeracy: The first two regressions examined the impact of experimental condition on the perceived likelihood of harm when base rate information for Spice depicted (a) a 50% likelihood of harm and (b) an 80% likelihood of harm. The remaining two regressions examined the impact of experimental condition on perceived likelihood of harm when base rate information for kratom depicted (c) a 50% likelihood of harm and (d) an 80% likelihood of harm.

ONS scores were entered in the first step of these analyses, and experimental group (BRO, BRNP, BRPP) was entered in the second step. For each regression analysis, the effect of the experimental manipulation on the perceived likelihood of harm remained statistically significant even after controlling for individual differences in numeracy. Moreover, in each analysis, ONS scores were unrelated to likelihood of harm ratings ($ps > .05$). Thus, the impact of experimental condition on risk perception is not simply a function of numeracy level.

**Discussion**

Several factors influenced the perceived risk of using synthetic marijuana and kratom, including the presence of a small number of personal narratives, base rate evidence depicting the likelihood of harm, and the anticipated frequency of drug use. Personal narratives that described adverse reactions...
to synthetic marijuana and kratom increased the perceived risk of using both drugs; yet, personal narratives that described pleasant reactions to the experimental or occasional use of synthetic marijuana, and pleasant reactions to the experimental use of kratom, had no impact on risk perceptions. These findings suggest that the relative persuasiveness of anecdotal evidence may be limited mainly to personal narratives and testimonials that depict adverse outcomes. Importantly, young adults did not inevitably fall prey to base rate neglect when evaluating the risk of using emerging recreational drugs. Group II (BRO) participants only received base rate information depicting the likelihood of an adverse reaction to Spice, a synthetic form of marijuana, while Group I (BRPP) participants received the identical base rate information plus four personal anecdotes describing positive Spice-related experiences. Yet, the perceived harmfulness of using Spice was not significantly lower among Group I participants, suggesting that positive anecdotal reports (“data”) collected from four drug users did not override the influence of base rate data derived from 1,000 recreational drug users. This finding is consistent with Bar-Hillel’s (1980) suggestion that individuals do not ignore base rate information when the information is relevant to their judgments.

Personal web postings that describe pleasant (positive) drug-related experiences may also carry less weight in the evaluation of risk than personal web postings that describe unpleasant (negative) drug-related experiences. Findings from the current study support the latter proposal. Specifically, Group II (BRO) participants received base rate information depicting the likelihood of an adverse reaction to Spice and kratom, whereas Group III (BRNP) participants received the identical base rate information as well as four personal anecdotes describing unpleasant (negative) drug-related experiences. Notably, the perceived likelihood of harm and the perceived degree of harmfulness were significantly higher among Group III participants than among Group II participants. These findings suggest that anecdotal “evidence” derived from only four recreational drug users who described adverse drug-related experiences overrode base rate data derived from 1,000 drug users. Prior research reveals that negative events are more salient, potent, and impactful than positive events, reflecting a “negativity bias” observed in several domains (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Betsch et al., 2015; Rozin & Royzman, 2001; Rozin, Berman, & Royzman, 2010). The current findings may reflect a similar negativity bias.

Participants in the current study were clearly influenced by negative web postings. Yet, these participants may not be ignoring base rate information but, rather, using base rate information as an anchoring point, one in which they adjust risk estimates upward as a result of negative anecdotal reports. When the consequences of drug use are reportedly severe (e.g., overdose, death) and the potential benefits are low (e.g., warm pleasant feelings), then individuals may be more likely to err on the side of caution, and judge the risk of harm and likelihood of harm as even higher.

In one instance, positive web postings reduced the perceived harmfulness of drug use (relative to the BRO condition). Specifically, web postings describing positive experiences with kratom significantly reduced participants’ perceived harmfulness for the occasional use of kratom. This finding might reflect a form of base rate neglect. Notably, familiarity with kratom was low relative to familiarity with synthetic marijuana. When familiarity with a novel drug is low, then positive anecdotes may affect perceived harmfulness more than base rate information. The latter speculation is consistent with a study of 126,000 true and false news stories that were retweeted by approximately 3 million twitter users. False stories were estimated to be more novel than true stories, and false stories were also 70% more likely to be retweeted than true stories, suggesting that novelty of false stories attracts added attention (Vosoughi, Roy, & Aral, 2018). The impact of novelty, and negativity, on the relative impact of anecdotal and statistical information merits further investigation.

Information Processing, Narrative Evidence, and Heuristic Biases

In his book, “Thinking, fast and slow,” Kahneman (2011) suggests that individuals process information using two independent but interacting mechanisms, which he labels as System 1 and
System 2. System 1 is associated with automatic processing, which relies on heuristics and mental shortcuts that can lead to decision-making biases and systematic errors in judgment. In contrast, System 2 is associated with deliberate and analytical information processing. Past research suggests that inclusion of narrative information encourages automatic and heuristic processing (System 1) rather than deliberate (System 2) information processing (Winterbottom, Bekker, Conner, & Mooney, 2008). Heuristic processing is associated with errors in judgment, including a tendency to overweight narrative evidence and underweight statistical evidence, such as base rate information, when making decisions under uncertainty. Heuristic processing may explain, in part, individuals’ tendency to minimize base rate information when individuals are provided with anecdotal (narrative) evidence. Moreover, because heuristic processing is associated with a pronounced reaction to losses (rather than gains), it could be that reading negative anecdotes primed heuristic processing to a greater extent than did positive anecdotes, reflecting a negativity bias that has been observed in many domains.

**Implications for Drug Prevention**

Only a few studies have directly compared the relative importance of base rate information and anecdotal information on decision making and risk assessment. These studies generally examine whether inclusion of narratives in patient decision aids helps or hinders one’s ability to make informed medical decisions. The persuasiveness of personal narratives and other forms of anecdotal information may be influenced by several variables, including the relevance of the target issue to an individual (So, Jeong, & Hwang, 2017). Currently, there is insufficient evidence to conclude that the inclusion of personal stories improves decision making (Bekker et al., 2013). Yet in the context of drug prevention, the goal is not necessarily to improve formal decision-making skills but rather to increase perceptions of risk. Results from the current study are promising from a social marketing standpoint. For example, findings from the current study suggest that risk communications designed to reduce young adults’ experimentation with emerging recreational drugs would benefit by including anecdotal reports that describe negative drug experiences in addition to base rate information depicting the likelihood of harm. Moreover, findings from the present study suggest that risk communications that include positive anecdotal reports might not reduce the impact of negative anecdotal reports on risk perceptions. This finding might be particularly important for risk communications that seek to promote a balanced, two-sided, prevention message. Such messages may be perceived as less coercive and authoritarian.

Several variables may influence how young adults weigh the relative importance of anecdotal and statistical information when evaluating the risk of using emerging recreational drugs. Drug use familiarity, depth of drug knowledge regarding a target substance (e.g., kratom vs. electronic tobacco products), severity of potential hazards, and the credibility of information sources could affect how adults weigh the relative importance of anecdotal and statistical information. The development of drug reduction interventions would benefit from studies addressing the latter issues. Future research should also investigate how young adults weigh both base rate information and anecdotal information in the context of other emerging recreational drugs, including synthetic cathinones (also known as “bath salts”) as well as more commonly used drugs such as marijuana, which may be of particular importance in countries (or states) that legalize its use. The current line of research may also be important to pursue in the context of modified risk tobacco products (e.g., E-cigarettes, Snus, Orbs). Little is known about how young adults evaluate the dangers associated with using modified risk tobacco products, and even less is known about how young adults weigh the relative importance of statistical and anecdotal information when evaluating those risks. Yet, the development of effective risk communications may increasingly depend upon knowing how young adults weight the relative importance of base rate evidence and
personal testimonies (anecdotal reports) obtained from web postings and Internet searches. Future studies will need to determine how much a single personal anecdote is "worth" in the evaluation of risk relative to base rate information derived from a large sample of participants. Identifying the exchange rate between anecdotal reports and base rate evidence has important implications for developing effective drug prevention efforts.

Appendix

Sample Web Postings for Kratom: Base Rate Posting, Positive Posting, Negative Posting

Imagine you posted a question on an online discussion forum about the effects of the herb kratom, a drug you recently heard about. You receive the following replies that all deal with experiences that result from using kratom. Some of the replies describe positive experiences, while others describe negative experiences.

(Please read each reply carefully)

1. Sample Web Posting: Base Rate Information

Kratom is a plant native to Thailand and Malaysia and has opiate-like (analgesic) properties. The American Medical Association recently studied 1000 young adults, ages 18–25, who reported using kratom. Approximately, 500 of these young adults experienced negative symptoms such as nausea, vomiting, and difficulty breathing.

—Timothy Shulgin, MD, senior scientist, Johns Hopkins University

2. Sample Web Posting: Negative Web posting (Adverse Drug Reaction)

After taking kratom I was put in the hospital after my parents noticed my eyes were yellow. The whole thing seems to start the day after taking kratom. My mom called the ambulance, as I was suffering from chest pain, itchy skin, and shortness of breath. After doing some tests they found my liver enzymes were sky high. I was released from the hospital that night. Since then, I’ve been in and out of the hospital for the last 5 days having tests done. I can’t blame the kratom directly, but it seems it was the only thing I did different.

3. Sample Web Posting: Positive Web posting (Beneficial Drug Reaction)

Wow! What to say about Kratom other than I found it an excellent tool for self-healing. Kratom (for me) simply showed me myself, like looking into a mirror and showing me my true Reflection. There were no tassels or glittery sparks, just honest introspection. I don’t consider it addictive. I think Kratom is something I’ll take maybe twice a year, alone, as a sort of periodic self-healing session. I had mild nausea which soon subsided. I spent the remainder of the night glowing with the energy I had gained working through my tensions. I felt very free, happy, and euphoric. All I can say is that Kratom is a real hidden gem. The kind of substance no-one really talks about, but it’s nothing less because of it.

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