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Judging the Risk of Becoming Infected Through Sexual Encounters

Arnaud Simeone, Danièle Hermand & Etienne Mullet*

Introduction

The way people estimate the risk of becoming infected from sexual acts has been studied using the mathematical framework offered by Sandberg and Awerbuch's formulation and the methodological framework offered by A Functional Theory of Cognition¹, drawing on the results of their experiments. Experiment 1 showed that when participants estimated the risk of becoming infected they considered: (a) the probability that the partner was infected; (b) the infectivity level of the sexual act; and (c) the more-than-additive way in which these pieces of information must be combined. Experiment 2 replicated these results and, more importantly, showed that the number of sexual acts was not considered in the risk estimation. Experiment 3 showed that participants did not consider the information regarding the number of acts as relevant, even when it was the only piece of information communicated. In addition, implications for health education and prevention are discussed.

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Judging the Risk of Becoming Infected Through Sexual Encounters

In everyday life, every time you meet somebody, there is some probability of becoming infected as a result. You can become infected at home by parents, a spouse, or your children. Colleagues and clients can infect one another at work. You can even be infected while sitting in the doctor's waiting room or while being treated in a hospital.

When meeting other people, in most cases, you are not thinking in terms of infection. You continue to meet people, despite possible infection at every meeting because the benefits associated with meeting people (e.g., pleasure, money, fun) largely override risks (e.g., harm, infection). In some cases, however, the problem of infection is much more salient. When the probability of infection or the pain incurred as a result of infection is high, or when the treatment is costly, you are much more concerned with becoming infected. This is the case when there is an epidemic or the infection is associated with a sexually transmitted disease. Finally, when the probable outcome of infection is lethal, as with AIDS, the problem of infection tends to dominate the risk assessment.

By using the mathematical framework offered by Sandberg and Awerbuch and the methodological framework offered by *A Functional Theory of Cognition*, the present study is aimed at examining the way people estimate the risk of becoming lethally infected as the result of sexual acts.  

The Probability of Becoming Infected as the Result of One Encounter with One Particular Person

According to Sandberg and Awerbuch, the probability of becoming infected as the result of one encounter with one particular person is $PT$. This formula depends on: (a) $p$, the probability that the person is infected; and (b) $i$, the infective character of the act. In each case, the exact relationship between $i$ and $PT$ is specific to the kind of infectious agent considered. For example, kissing somebody can be, in some cases, very contaminating and, in other cases, not contagious.

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2 See *supra* n. 1.
3 Sandberg & Awerbuch, *supra* n. 1.
The relationship between the three terms, $PT$, $i$, and $p$ is multiplicative, expressed in the equation: $PT = p \times i$. When the other person is not infected, or when the contact is not infective, the probability of becoming infected as a result of a meeting with the person is nil.\(^4\)

**The Probability of Becoming Infected as the Result of Several Encounters with One Particular Person**

Generally speaking, the probability of becoming infected as the result of several encounters with one particular person ($PT$) depends on: (a) $p$, the probability that the person is infected; (b) $i$, the infective character of the sexual contact; and (c) $N$, the number of encounters. The relationship between these four terms is complex. For example, when you meet somebody several times, the probability of a resulting infection is higher than when you meet this person once.\(^5\)

If the infectivity of each sexual act is ($i$), then: (a) the probability it will not result in infection is $(1 - i)$; (b) the probability that a number ($N$) similar encounters with the same person will not result in infection is $(1 - i)^N$; (c) the probability that a number ($N$) similar encounters with the same person will not result in infection is $[1 - (1 - i)^N]$; and (d) the probability ($PT$) of becoming infected through multiple encounters with a particular person is $p [1 - (1 - i)^N]$.

**Risk of Becoming Lethally Infected as the Result of Sexual Contacts**

Many studies devoted to risk perception have shown that people, generally, are not proficient at estimating risk.\(^6\) In some studies, participants were presented with a list of substances, technologies, or activities and are asked to rate the risk level they associate with each item.\(^7\) A typical result was that AIDS is perceived as a major threat in relation to other hazards, ranked just after nuclear waste, despite the

\(^4\) Sandberg & Awerbuch, supra n. 1; Ronny A. Shtarkshall & Tamara E. Awerbuch, *It Takes Two to Tango but One to Infect*, 18 J. Sex & Marital Therapy 121 (1992).

\(^5\) Sandberg & Awerbuch, supra n. 1.


fact that many more people die from other diseases or accidents than from AIDS.⁸

In other studies, participants were presented with a list of questions specifically referring to AIDS.⁹ The typical result was that people, generally, are well informed about AIDS, its symptoms, its mode of transmission, and the possible preventive actions — condom use in particular.¹⁰

Being well informed about infection risks is indisputably important. It is, however, not enough to correctly judge the actual risk for yourself or others.¹¹ It has been repeatedly shown, for example, that people considerably overestimate the risk of contracting AIDS as a result of ordinary sexual intercourse.¹²

Correct risk judgment supposes not only appropriate information inputs but also appropriate processing of these inputs. In other words, a proper risk judgment is appropriate information integration.¹³

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Basically, relevant information must be considered when estimating risk, and irrelevant information must be totally discounted. In addition, correct information integration rules must be applied.

Information Integration and Risk Judgments

Several studies have revealed a number of surprising results regarding the way people integrate information to formulate their risk judgments. A study by Hermand, Mullet, and Lavieville showed that when people judged the risk associated with the joint consumption of alcohol and tobacco, they did not judge the combined effects of alcohol and tobacco in a synergetic or cumulative way. Apparently, instead, people considered that indulging in one of the two behaviors could, on its own, represent a maximum health risk. In other words, people thought that a heavy smoker had little to lose if he was also a heavy drinker, and vice versa.

Another example of poor information integration can be found in a study by Blanton and Gerrard. This study showed that when people judged the probability that one female sexual partner was infected, they integrated both the relevant information (i.e., the protective habits of this person and the number of previous sexual partners) and irrelevant information (i.e., the sexual attractiveness of the person and her personality features). With other variables remaining constant, the probability of infection of a female partner who was highly sexually and personally attractive was estimated as lower than that of a female partner who was less sexually or personally attractive. In addition, the higher the number of her previous sexual partners, the stronger the discounting effect.

Knowing how people estimate risk would allow: (a) a better understanding of why risk overestimation is so common with regards to AIDS; (b) anticipation of what strategy people would be willing to use to reduce risk; and (c) what alternative strategy people would reject.

14 Hart Blanton & Meg Gerrard, Effect of Sexual Motivation on Men's Risk Perception For Sexually Transmitted Disease: There Must be 50 Ways to Justify a Lover, 16 Health Psych. 374 (1997).  
16 Id.  
17 Blanton & Gerrard, supra n. 14.
outrightly. As a consequence, it constitutes an important research topic.

First, if people consider the probability that a partner is infected \((p)\) as a valid input in their judgments when estimating risk, they will probably be more reluctant to have sex with a partner considered to be very probably infected than with a partner considered not to be very probably infected.\(^{18}\) This remains true even if people cannot, because of social norms or violence, avoid having sex with the partner considered to be probably infected.

Second, if people consider that unprotected intercourse is much riskier than protected intercourse \((i)\) when estimating risk, they will probably be reluctant to have unprotected sex.\(^{19}\) This remains true even if people cannot avoid having unprotected sex because of social norms or the desire to have children. At least in some circumstances, people are willing to bargain about condom use with their partner.

Finally, if people perceive that numerous sexual contacts are riskier than few sexual contacts when estimating risk, they will probably be reluctant to have many sexual contacts with somebody suspected of being infected. This remains true even if they cannot completely avoid having sex with their potentially infected partner because of social norms or violence. Furthermore, there are many strategies that can be implemented for minimizing the number of encounters, even for married couples.

However, if, to the contrary, people believe that the number of sexual contacts has no effect on the probability of risk, they will see no reason to stop having sex with a partner who is possibly infected once they have had unprotected sex with that partner. Is it clear that the risk of becoming infected through one sexual contact is actually low? In other words, if people exhibit dichotomized thinking about contagion, they tend to think that one contact is enough for complete contamination. Paradoxically, as a result, people think that the risk of becoming infected through one sexual contact is very high but the actual risk is low.\(^{20}\)

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\(^{19}\) Poppen \\& Reisen, \textit{supra} n. 18.

\(^{20}\) Linville et al., \textit{supra} n. 12.
Research Questions

The present study considered two principal questions. First, when judging the risk of becoming infected through one sexual contact, how do people combine information about: (a) \( p \) the probability that one partner is infected; and (b) \( i \) the infective character of the sexual act. The fact that people will use the two pieces of information in formulating their judgments has already been demonstrated.\(^{21}\) In this study, we were interested in the exact way which these pieces of information are integrated. In other words: Are people aware that the infective character of the sexual contact is more important when the probability that the partner is infected is high? This question was examined in the first experiment.

Second, this study was concerned with how people integrate the information regarding the number of sexual acts. Although the use of this information to formulate risk judgments appears evident on \textit{a priori} grounds, previous studies have shown that people generally are not able to accurately evaluate the information regarding the number of sexual acts when judging risk, especially when judging risk of HIV transmission. This question was examined in the second experiment.

A study conducted by Linville, Fischer, and Fischhoff showed that people underestimate the cumulative risk of HIV transmission.\(^{22}\) Participants' risk estimates for 10 and 100 protected sexual encounters (respectively 10\% and 20\%) were much lower than what could have been expected (respectively 40\% and 99\%), considering their own single-encounter risk estimates (approximately 5\%).\(^{23}\) The study related its results to earlier works in the judgment and decision-making area which showed that "people have difficulty judging rates of accumulation, typically underestimating how quickly risks mount up."\(^{24}\) Other examples of systematic underestimation of cumulative


\(^{22}\) Linville et al., \textit{supra} n. 12.

\(^{23}\) \textit{Id.}

risk can be found with regards to car accidents, contamination by chemical products, contraceptive failure, drunkenness, and cancer.\textsuperscript{25}

\textit{A Graphic Presentation of Sandberg and Awerbuch’s (1989) Formulization}

Figure 1 is an application of Sandberg and Awerbuch’s equation to a set of theoretical but plausible data taken from Rothberg, Sandberg and Awerbuch.\textsuperscript{26} In Panel A, three chosen levels of probability that one contact will result in infection \(i\) are on the horizontal axis. The three curves correspond to the three chosen levels of probability that the partner is infected \(p\). The probability of becoming infected \(PT\) is on the vertical axis.\textsuperscript{27} The three curves are ascending, are clearly separated, and form a right-open fan. The fan character of the pattern corresponds to the multiplication operation at work. The question, Are people aware that the infective character of the sexual contact is more important when the probability that the partner is infected is high?, can be restated as, Will the corresponding data pattern, issued from subjective judgments, be fan-shaped the same way as Panel A of Figure 1?

In Panel B, the three levels of probability that one contact will result in infection \(PT\) are on the horizontal axis and the four curves correspond to the four numbers of sexual acts \(N\). In Panel C, the three levels of probability that one partner is infected \(p\) are on the horizontal axis and the four curves correspond to the four numbers of sexual acts \(N\). Each time, the four curves are ascending, are clearly


\textsuperscript{27} Rothberg et al., \textit{supra} n. 26. (the mean probability of becoming infected as the result of 1 to 7 unprotected sexual acts with somebody without a history of risky behavior is very low: \(p < 0.0000008\)).
separated, and form a right-open fan. The question, Are people aware that the number of contacts is especially important when the probability that the partner is infected is high?, can be restated as, Will the data pattern issued from subjective judgments be fan-shaped the same way as in panels B and C in Figure 1?

Figure 1

![Graph](image-url)
Experiment Methods

Participants

In Experiment 1, the sample consisted of forty French male adults aged 18 to 22. In Experiment 2, the sample consisted of forty adults, twenty one men and nineteen women, aged 19 to 23. In Experiment 3, the sample consisted of the same forty adults who participated in Experiment 2. All participants were non-paid volunteers from the Université of Nantes, France.

Material

The material in Experiment 1 consisted of 15 scenarios: (1) nine complete scenarios; and (2) six incomplete scenarios. Each of the nine complete scenarios, comprising of two pieces of information, described the situation of two people who had engaged in only one sexual act. This act was of a varying infective degree (i.e., low, moderate, and high). In each complete scenario, one of the partners had some probability (i.e., low, moderate, or high) of being infected due to previous risky behavior. An example of a complete scenario is the following: "Person A had a sexual encounter with Person B. Person B is assumed to have a high probability of being infected. The sexual act was of a low infective character (e.g., oral sex). What is the probability
that Person A is now infected as a result of the sexual encounter?” The six incomplete scenarios mentioned only one piece of information (i.e., either the infective character of the sexual act or the probability one of the partners was infected).

Material in Experiment 1 also consisted of a questionnaire related to the understanding of the risks associated with sexual acts and the importance of information for judging the degree of risk. An excerpt of this questionnaire is shown in Table 1.

In Experiment 2, the material consisted of 36 three-item scenarios. Each scenario incorporated the information from the complete scenarios in Experiment 1 plus additional information regarding the number of sexual acts, ranging from one to seven distinct sexual acts (i.e., either 1, 3, 5, or 7 sexual acts were used in each scenario). These numbers were chosen so that the factor would, at least in theory, have an effect of the same order of magnitude as the infectivity and probability factors (see Figure 1).

In Experiment 3, the material consisted of twenty four two-item scenarios and four one-item scenarios. All two-item scenarios described the situation of two people who engaged in sexual acts, ranging in number from one to seven (e.g., either 1, 3, 5, or 7 sexual acts were used in each scenario). In twelve two-item scenarios, information was presented regarding the varying infective character of the sexual acts (i.e., low, moderate, high), but no information was given about the probability that one partner was infected. The other twelve two-item scenarios presented the opposite: No information was given about the infective degree of the sexual act, but information was given about the probability that one partner was infected (i.e., low, moderate, or high). The four one-item scenarios only contained information about the number of acts.

In each experiment, each scenario was printed on a separate sheet of paper with a 20 cm scale beneath it in the lower portion of the page. The left-hand anchor was labeled “Nil probability.” The right-hand anchor was labeled “High Probability,” after several alternative terms had been tested, and participants agreed that one chance out of one thousand of becoming infected with AIDS represented a high risk. It
was, however, emphasized that “High probability” was to be taken in a relative sense.

Table 1
Responses to the Questionnaire,
Numbers in Parentheses Correspond to Experiment 2

<table>
<thead>
<tr>
<th>Item</th>
<th>A</th>
<th>B</th>
<th>Impossible to know</th>
<th>I do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sexual contact between partners of couple A is of low infective character. Sexual contact between partners of couple B is of very high infective character. Which, A or B, is more exposed to infection?</td>
<td>1</td>
<td>25</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>One partner in couple A has a low probability of being infected. One partner in couple B has a very high probability of being infected. In which, A or B, is the other partner more exposed to infection?</td>
<td>0</td>
<td>31</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Sexual contact between partners of couple A has occurred only once. Sexual contact between partners of couple B has occurred many times. Which, A or B, is more exposed to infection?</td>
<td>(0)</td>
<td>(15)</td>
<td>(22)</td>
<td>(3)</td>
</tr>
<tr>
<td>Sexual contact between partners of couple A is of low infective character. Sexual contact between partners of couple B is of very high infective character. Which, A or B, has the highest probability of infection?</td>
<td>7</td>
<td>13</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>One partner in couple A has a low probability of being infected. One partner in couple B has a very high probability of being infected. Which couple, A or B, has the kind of sexual contact with the highest infective character?</td>
<td>(1)</td>
<td>(24)</td>
<td>(15)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Somewhat</th>
<th>Much</th>
<th>I do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>When sexual contact is of very high infective character, is the probability that one of the partners is infected important for judging the overall probability of becoming infected?</td>
<td>0</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>When the probability that one of the partner is infected is very high, is the infective character of sexual contact very important for judging the overall probability of becoming infected?</td>
<td>(1)</td>
<td>(4)</td>
<td>(32)</td>
</tr>
<tr>
<td>When the probability that one of the partner is infected is very high, is the number of sexual contacts between partners very important for judging the overall probability of becoming infected?</td>
<td>0</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>When sexual contact is of very high infective character, is the number of sexual contacts between partners very important for judging the overall probability of becoming infected?</td>
<td>(0)</td>
<td>(10)</td>
<td>(26)</td>
</tr>
<tr>
<td>When sexual contact is of very high infective character, is the number of sexual contacts between partners very important for judging the overall probability of becoming infected?</td>
<td>4</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>When the probability that one of the partner is infected is very high, is the number of sexual contacts between partners very important for judging the overall probability of becoming infected?</td>
<td>(6)</td>
<td>(16)</td>
<td>(15)</td>
</tr>
</tbody>
</table>
Procedure

The procedure of Experiment 1 consisted of four phases. The first, or the familiarization phase, presented the participants with fifteen scenarios in a random order. The participant read each scenario and placed a mark on the response scale. At the end of this phase, the participants were allowed to compare their responses and change their ratings until they were satisfied with the entire set of ratings. The second and third phases were the test phases, the only difference from the first phase was the order in which the scenarios were presented. In the second and third phases, the scenarios were presented in opposite order of each other. The participants were no longer allowed to compare their responses. Finally, in Phase 4, participants could work, individually and at their own pace, on the questionnaire presented.

The procedure in Experiments 2 and 3 consisted of three phases. The first, or the familiarization phase, presented each scenario in random order to the participants. The second phase was the test phase proper. During the third phase, participants could work, individually and at their own pace, on the questionnaire presented.

Several precautions were taken to ensure the understanding of scenario information by the participants. A low probability of being infected was associated with no previous risky sexual behavior, whereas a high probability of being infected was associated with many previous risky sexual behaviors. A moderate probability was in between the low and high probability. To illustrate, participants agreed that a 15% chance of being infected was indeed a high probability. Further, sexual acts with low infective potential were associated with oral sex, and those sexual acts with highly infective potential were associated with complete intercourse without a condom. Since most participants were not familiar with it, anal sex was not used as an example of a highly infective sexual practice.

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28 Gerd Gigerenzer et al., *AIDS Counselling for Low-Risk Clients*, 10 AIDS Care 197 (1998). For the sake of comparison, note that a person detected for the first time as sero-positive has only about 50% chances of being truly infected.
Results of Experiments & Discussion

Experiment 1

In Phases 2 and 3 of Experiment 1, the distance between each mark for each participant on each scenario and the Nil Probability anchor, was measured. The means for these distances appear in Figure 2. The participants used the entire range of the response scale to rate the fifteen scenarios. The highest mean (18.80) was still 1.20 points distant from the maximum, suggesting there was no ceiling effect.

Figure 2

Panel A shows the mean probability estimations of becoming infected as a function of the infectivity level of the act and the probability that the partner is infected. Panels B and C show the differential impact of infectivity and probability as a function of what importance people gave to both information pieces.

Panel A of Figure 2 is constructed similar to Panel A of Figure 1, allowing for comparisons. The three levels of probability (PT) that one act will result in infection are on the horizontal axis. The three plain
curves correspond to the three levels of probability that the partner is infected (p). The judgment of risk is on the vertical axis. The three plain curves are ascending and clearly separated. When the infective character of the sexual act (i) is high, the judged risk is higher. This effect was significant, \( F(2, 78) = 188.6; \ p < .0001 \). When the partner’s probability of infection (p) is high, the judged risk is higher. This effect was also significant, \( F(2, 78) = 221.6; \ p < .0001 \).

![Graph showing judgment of risk as a function of infective character and probability](image)

The bottom curve, corresponding to a low probability (p) that the partner is infected, is slightly ascending as a function of the infective character (i) of the sexual act. The top curve, corresponding to a high probability that the partner is infected (p) is more rapidly ascending than the bottom curve. As a result, the form of the graph is of a fan open to the right. Although both factors clearly had an effect on the participants’ evaluations of risk, this effect varied as a function of the level of the other factor. There was a significant interaction between partner’s probability of infection (p) and degree of infectivity (i) exemplified by \( F(4, 156) = 6.5; \ p < .0001 \). The dotted curve,
corresponding to the three incomplete scenarios with only the infective character information, was slightly ascending and close to the low probability curve.

Thirty-nine out of forty participants took into account infective character when judging the overall level of risk, while thirty-eight participants took into account the partner’s probability of infection. The mean importance attributed to infective character \((i)\) and the probability of partner’s infection \((p)\) was 3.82 and 3.92 respectively (out of 5). The actual use of information regarding infective character and the probability of partner’s infection was compared as a function of declared importance. It was found (see Figure 2, Panels B and C) that among participants who had given more weight to infective character than to the probability of partner’s infection \((i > p)\), the effect of infective character was higher and the effect of the probability of partner’s infection was lower than among those who had given more weight to probability of partner’s infection than to the infective character \((p > i)\). These differences were significant, \(F(2, 58) = 2.95\) and \(5.82\); \(p < .05\) and \(p < .005\), respectively.

Finally, as shown in Table 1, a majority of participants agreed with statements expressing that: (a) a couple is more exposed to infection if they practice acts of high, rather than of low, infective character, and if one partner has a high, rather than a low, probability of being infected; (b) the partner’s probability of being infected cannot be inferred from an act’s level of infectivity, and inversely; (c) when either infective character or partner’s probability is high, the other factor has much more importance.

Granted that people will use the information about their partner’s probability of being infected and the infective character of a sexual act in formulating their risk judgments, we were especially interested (in Experiment 1) in the way these information pieces were integrated.\(^{29}\) The question was: Are people aware that the infective character of the sexual act is much more important when the probability of partner’s infection is high?

The answer to this question is obviously positive. Participants were sensitive to the fact that the two information pieces have to be

\(^{29}\) Blanton & Gerrard, supra n. 14; Firhbein et al., supra n. 21.
combined in more than an additive way to produce risk judgments. In addition, the way participants answered the questionnaire was consistent with the findings issued from the judgmental technique. Most participants said that both information pieces count and more importantly that: (a) when infective character is high, the partner’s probability of infection has more importance for judging risk; and (b) when the partner’s probability of infection is high, infective character has more importance for judging risk. Both sets of results, functional and declarative, were thus consistent.

It is possible to further characterize the way the pieces of information were integrated. As seen in Figure 2, when information about the probability of partner’s infection was missing, judgments were between those given when the act’s infective character was low and those given when it was moderate. Therefore, the judgments were closer to the first set of judgments than to the second. The important thing is that the curve drawn for these judgments (the dotted curve) formed part of the fan obtained with the three other curves. This particular feature of the data constituted important evidence favoring a true multiplication combination model for probability and infective character.30

**Experiment 2**

In Phase 2 of Experiment 2, the distance was measured between each mark for each participant on each scenario and the Nil Probability. The means for these distances appear in Figure 3. The participants used the entire range of the response scale to rate the thirty six scenarios. The highest mean (18.98) was still 1.02 points distant from the maximum suggesting there was no ceiling effect. No gender effect was detected.

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30 Anderson, *supra* n. 1.
Figure 3

Panel A displays the mean probability estimations of becoming infected as a function of the infectivity level of the contact \((i)\) and the probability that the partner is infected \((p)\). Panel B displays the mean probability estimations as a function of the infectivity level of the contact and the number of contacts \((N)\). Panel C displays the mean probability estimations as a function of the probability that the partner is infected and the number of contacts.
Similar to Panel A in Figures 1 and 2, the three curves in Panel A of Figure 3 are ascending, are clearly separated, and form a right-open fan, as in Experiment 1. The effect of the infective character of the sexual act was significant, \( F(2, 78) = 222.3; p < .0001 \). The effect of the probability of this partner's infection was also significant, \( F(2, 78) = 360.4; p < .0001 \). Finally, the interaction between the infective character \((i)\) multiplied by the probability of partner's infection \((p)\) was significant, \( F(4, 156) = 3.31; p < .02 \).

Similar to Panel B in Figure 1, the three levels of probability that one contact will result in infection \((PT)\) are on the horizontal axis in Panel B of Figure 3. The four curves, corresponding to the three numbers of sexual acts \((N)\), are ascending but not clearly separated. The effect of the number of acts \((N)\) was, however, significant, \( F(3, 117) = 14.5; p < .0001 \). The interaction between infective character multiplied by the number of sexual acts \((N)\) was not significant.

Similar to Panel C of Figure 1, the three levels of probability of the partner's infection \((p)\) are on the horizontal axis in Panel C of Figure 3. The four curves, corresponding to the four numbers of sexual acts, are ascending but merged. The interaction between the probability of partner's infection \((p)\) multiplied by the number of sexual acts \((N)\)
was not significant, nor was the interaction between infective character \((i)\) multiplied by the probability of partner's infection \((p)\) multiplied by the number of sexual acts \((N)\) (not shown).

Thirty-seven out of forty participants considered the information about the infective character of the sexual act \((i)\) when judging the overall level of risk. Also, thirty seven participants considered the information about the partner's probability of infection \((p)\). Only twenty four participants considered the information about the number of acts \((N)\). The mean importance attributed to infective character, partner's probability of infection, and the number of sexual acts was 3.82, 4.26, and 2.16 respectively (out of 5).

Finally, as can be seen in Table 1, a majority of participants agreed that: (a) a couple is more exposed to infection if they practice acts of high rather than low infectivity and if one partner has a high rather than low probability of being infected; (b) it is not possible to know whether a couple who has practiced many sexual acts is more exposed to infection than a couple who has practiced few sexual acts; (c) the partner's probability of infection cannot be inferred from the act's level of infectivity, and inversely; (d) when either infective character or probability is high, the other factor has more importance; and (e) when infective character or probability are high, the number of acts have "somewhat" or "much" importance.

The goal of Experiment 2 was to study the way a third piece of information, the number of sexual acts, was taken into account and integrated with information about the probability of partner's infection and the infective character of the act. Experiment 2 also looked to determine if there were any gender effects. Participants did not make much use of information about the number of acts. Statistically speaking, the effect of this factor was significant, but when compared with both other effects, the probability of partner's infection and the infective character of the sexual act, the effect of the number of acts \((N)\) appeared very small. In addition, whatever the partner's probability or the infective character, the importance given to the number of acts was the same. This set of results holds true irrespective of the gender of the participant.\(^{31}\)

\(^{31}\) Linville et al., supra n. 12.
Results indicated that: (a) a majority of participants could not determine which of two couples runs more risks - the one with few acts or the one with many acts; and (b) the mean importance rating for the number of sexual acts factor was clearly lower than for both other factors. Both sets of results, functional and declarative, were again consistent.

Before trying to interpret this set of findings, it seemed prudent to replicate them, which was a purpose of Experiment 3. The one important difference between Experiment 1 and 2 was the number of information pieces (i.e., 2 versus 3). One reason it was so difficult to integrate the number of acts with other information pieces may have resided in the complexity of the risk judgment task. Not only did one more information piece need to be integrated, but the way in which it should have been integrated was itself complex. Information about number of acts had to be integrated in a multiplicative way with other information pieces that had been integrated in a multiplicative way.

**Experiment 3**

The main results of Experiment 3 are shown in Figure 4. In Panel A, the four numbers of sexual acts \((N)\) are on the horizontal axis, while risk judgment is on the vertical axis. The three curves, clearly separated but only slightly ascending, correspond to the three levels of probability that one partner was infected \((p)\). The effect of the probability of partner’s infection \((p)\) was significant, \(F (2, 78) = 129.4; p < .0001\). The effect of the number of sexual acts \((N)\) was also significant, \(F (3, 117) = 14.4; p < .0001\).

In Panel B, the four numbers of sexual acts \((N)\) are on the horizontal axis. The three curves, corresponding to the three levels of probability that one act will result in infection \((i)\) are again clearly separated but only slightly ascending. The effect of infective character of the sexual act was significant, \(F (2, 78) = 84.3; p < .0001\). The effect of number of sexual acts was also significant, \(F (3, 117) = 4.84; p < .005\). In Panel C, the four numbers of sexual acts \((N)\) are on the horizontal axis. The curve is only slightly ascending. The effect of the number was significant, \(F (3, 117) = 5.83; p < .001\).
Experiment 3 was conducted to determine whether people were unwilling to give much consideration to the number of sexual acts or if, on the contrary, they were handicapped by the structure of the task. The question considered in this third experiment was: Are people actually unwilling to give much consideration to the information about the number of sexual acts? This question can now be answered positively. Even when presented with only one piece of information (e.g., the number of sexual acts), participants did not use it in their risk assessment. The number of acts seemed quite irrelevant.

Figure 4

Panel A of Figure 4 shows the mean probability estimations of becoming infected as a function of the probability that the partner is infected ($p$) and the number of contacts ($N$). Panel B shows the mean probability estimations as a function of the infectivity level of the act ($i$) and the number of acts ($N$). Panel C shows the mean probability estimations as a function of the number of acts ($N$). The four numbers of acts was the only information provided.
General Discussion

The objective of the present study was to examine the way people estimate the risk of becoming infected as the result of sexual acts, using the three-factor framework offered by Sandberg and Awerbuch’s formulation: probability that the partner is infected ($p$); infectivity of the sexual act ($i$); and total number of sexual acts ($N$).\footnote{Sandberg & Awerbuch, supra n. 1.}
Experiment 1 showed that when participants estimated risk, as expected, they were able to take into account the information regarding probability of partner’s infection and infectivity of the sexual act. In addition, Experiment 1 showed participants were sensitive to the multiplicative way in which these pieces of information must, from a normative viewpoint, be combined.

Experiment 2 replicated the results of Experiment 1. More importantly, however, Experiment 2 showed that the information about the number of sexual acts was not considered to a sufficient extent, which was consistent with the participants’ declarations at the end of the experiment. Experiment 3 confirmed that participants did not consider the number of acts as relevant, even when it was the only piece of information.

Implications of these results must now be considered. Sandberg and Awerbuch’s formulation clearly shows that three kinds of strategies can be developed in order to reduce the risk of infection: (a) avoid partners with a high probability of being infected, especially if they are willing to have frequent unprotected sex; (b) avoid highly infective acts, especially with partners who have a high probability of being infected and are willing to engage in many such acts; and (c) avoid having numerous sexual acts, especially with partners who have a high probability of being infected and are willing to have unprotected sex.33

The formulation above can lead one to think that these three strategies, (a), (b), and (c), are identical. Despite being mathematically equivalent, the three strategies are quite behaviorally distinct and represent different challenges.

The first strategy, (a), rests on the person’s ability to estimate her/his potential partner’s risk of being infected. This strategy is probably very common. It is a passive strategy, a priori easy to implement (except in the case of violence). Some previous work has already shown, however, that it is not easy to carry it out successfully. As shown by Blanton and Gerrard, many irrelevant factors can interfere with the estimation of the probability that a partner is infected.34

33 Id.
34 Blanton & Gerrard, supra n. 14.
The second strategy, (b), rests on the person's ability to convince his/her partner to use protective devices or to have only non-infective contacts. This strategy is common but not to the desired extent. It is an active strategy, \textit{a priori} not easy to implement (even in stable couples), despite its efficiency. This fact is attested to in the considerable amount of literature on condom use and misuse.\textsuperscript{35}

The third strategy, (c), rests on the person's ability to reduce the number of risky sexual acts. This strategy was probably very common in the past among people willing to avoid pregnancy. It is a passive strategy, \textit{a priori} the easiest of all three strategies to implement. It is, for evident reasons, not always possible to refuse to have unprotected sex with a loved partner. However, it is possible to voluntarily reduce the number of sexual acts with him/her without running the risk of losing this partner.

Paradoxically and unsurprisingly, nothing is known about the implementation of strategy (c) in the case of AIDS avoidance. As shown in the present study, people are generally unaware of the importance of the number of sexual acts. As a result, people are generally unaware of the efficacy of the strategy of reducing the number of sexual acts.

Despite its modest character, strategy (c) can help. Application of Sandberg and Awerbuch's equation (and data) shows that if a person is able to "resist" his/her three infected partners from having unprotected sex one out of every two times for one hundred consecutive times, the risk of becoming infected will fall from 0.18 to 0.09.\textsuperscript{36} This result contrasts favorably with a frequently heard recommendation that people, instead of reducing the number of sexual encounters, reduce the number of partners. Having unprotected intercourse 100 times with the same partner leads to exactly the same probability of becoming infected (0.18) as having unprotected intercourse 100 times with three different infected partners. This remains true if the partner’s probability of being infected takes a much lower value.

\textsuperscript{35} Poppen \& Reisen, \textit{supra} n. 18.

\textsuperscript{36} Sandberg \& Awerbuch, \textit{supra} n. 1.
After having been informed for years that the AIDS epidemic is a terrific plague for humanity, now people must be told that: (a) contracting AIDS through sexual acts is not that easy; and (b) infection is not an all-or-none matter.

More concretely, people must be sensitized to the fact that risk can only be expressed as a gradient, not as a dichotomy. A person's position on this gradient depends on his/her cumulative past, present, and future behaviors, not on a single behavior. Even if people cannot resist having unprotected sex, at times, with a very attractive infected partner, people can still have a risk reduction policy by being more selective in regards to their partners or by protecting themselves as often as possible. Even if people cannot resist having unprotected sex with a beloved partner, they still can have a risk reduction policy by reducing the number of potentially infective sexual acts.