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# Magical Contagion Beliefs and Fear of AIDS<sup>1</sup>

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Extreme overreaction to nonrisky contact with persons with AIDS is considered to be a case of the operation of the sympathetic magical *law of contagion*. Prior work has shown that this principle (once in contact, always in contact) holds in the belief systems of American adults. In this paper, we show that four characteristics of this law correspond to the attitudes of college students toward AIDS: (a) actual physical contact is a critical factor in determining negative reactions, (b) even very brief contact is capable of transmitting substantial negative properties (dose insensitivity), (c) the effects of even brief contact are long lasting (permanence), and (d) the effects of contact can occur in a direction opposite to that of the normal causal arrow (backward contagion). We conclude that the magical law of contagion provides a useful way of formulating overconcern about the transmission of AIDS.

Exaggerated concern about casual contact with people who have AIDS is a significant aspect of the stigmatization of people with AIDS (Herek & Glunt, 1988; Hunter, 1989). Overreaction to AIDS has been manifested in many ways: a ban on importing used clothing into Pakistan after the first case appeared in that country, refusal by a mail carrier to deliver mail to an AIDS task force office, disputes in California over whether past ownership of a home by a person with AIDS must be revealed to a prospective buyer, and reluctance to donate blood (see Herek & Glunt, 1988; Hunter, 1989, for a review). We believe that these responses can be understood in terms of an implicit belief in the magical law of contagion.

The magical law of contagion, one of the laws of sympathetic magic, was first propounded by Tylor (1871) and was elaborated by Frazer

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(1890/1959) and Mauss (1902/1972). It is a description of a principle believed to underlie a set of beliefs in traditional cultures. Essentially, it holds that, when two objects touch (especially when they are of an animate nature), they pass properties to one another. This influence on the contacted object may be permanent; hence, the principle was summarized as "once in contact, always in contact" (for recent reviews of this law see Rozin & Nemeroff, 1990; Tambiah, 1990). We have recently shown (Rozin, Millman, & Nemeroff, 1986; Rozin, Nemeroff, Wane, & Sherrod, 1989) that belief in accordance with this law is widespread among educated Americans.

We shall explore four features of the law. First, actual contact, by definition, is critical for the passage of properties. Second, a substantial transfer of properties can occur with very minimal contact, so that contagion is relatively dose insensitive. Third, contagious effects can last for a long time, measured in years, after contact is terminated (permanence). Fourth, contagious effects can operate in a backward direction (backward contagion). This is best illustrated by cases of sorcery in which, for example, a piece of hair from a person is burned with the intent and expectation of causing harm to the person. This implies that damage to personal residues (containing a personal essence) can reflect back on the original source. In this paper, we will show that these four features apply to current fears regarding AIDS.

### *Methods*

Two separate, brief questionnaires were distributed to psychology classes at both the University of Pennsylvania and Arizona State University. The students completed the questionnaires in class. The questions on the two questionnaires were similar, but one dealt with a sweater and the other with a fork. The sweater questionnaire used as a target a sweater worn either by a healthy man or by a man with AIDS. A picture of a man in a sweater (a model from a clothing catalog) was included on the questionnaire as a reference point for the sweater ratings and the man referred to in the questions. It was clear from the instructions (see below) that this same photograph was the reference for all questions. The subjects were asked to rate their attitudes toward wearing the sweater for 1 day by assigning a number on a scale ranging from *as pleasant as anything that might happen in everyday life* (+100) to *as unpleasant as anything that might happen in everyday life* (-100), with 0 as neutral. The first two questions probed the reaction to wearing the brand new sweater (unwashed and washed). All subsequent questions were subject to the following instructions: "Rate the pleasantness of wearing each of

the sweaters described below, each for 1 day. Assume that each of the sweaters is identical in appearance to the sweater on the man. All sweaters were worn by the man in the picture."

The next two questions probed the attitudes toward wearing the sweater the day after it was worn for 1 day by the healthy man or the man with AIDS (the baseline question). These and all subsequent sweaters were described as having been washed after the man wore them.

The importance of contact was assessed by questions that compared the effects of ownership and association with the effects of contact. The first question for the healthy man was: "The sweater was bought by the healthy man but never worn. The sweater was left in its sealed plastic wrapper in the man's drawer for a few months. The actual sweater was never touched, The sweater was then washed. Rate the pleasantness of wearing the sweater for 1 day, the next day after it was washed" (coded as man owned). The contact version of this question was: "The sweater was bought by the healthy man. The sweater was left in its sealed plastic wrapper in the man's drawer for a few months. The sweater was then worn for 1 day by the man. The sweater was washed after it was worn by the man. Rate the pleasantness of wearing the sweater for 1 day, the next day after it was worn by the man" (coded as man owned/used). Each of these questions was followed by a corresponding question for the man with AIDS (coded as AIDS owned and AIDS owned/used).

Dose insensitivity was assessed by variation in the degree of exposure of the man with AIDS to the sweater (5 minutes, 1 hour, 1 day, or worn and washed frequently for 1 month or 1 year).

Permanence was probed by questions in which the time that had elapsed since the sweater was worn for 1 day by the man with AIDS was set at 1 day, a full month, or a full year.

Backward contagion was measured by two items. One was a question for both the healthy man and the man with AIDS, reading as follows for the man with AIDS: "Rate the pleasantness of wearing the brand new sweater for 1 day, knowing that you will give it to a used clothing store and that it will be bought and worn by the man who has AIDS." For the healthy man, the same phrasing was used, but the sentence ended with "by the healthy man." A second measure of backward contagion was obtained with the two questions: "Rate the pleasantness of staying in a Holiday Inn hotel in San Francisco," and "Rate the pleasantness of staying in the same Holiday Inn hotel in San Francisco, which will become a hospital for AIDS patients next year."

For the sweater scenario, the baseline question (i.e., a man with AIDS wears a sweater for 1 day, and it is then washed and worn by the

subject 1 day later) was asked both at the beginning and end of the questionnaire, and twice in the middle, in association with the series of questions on permanence and dose insensitivity.

The questionnaire dealing with a fork had a nearly identical format. It also had a picture of the same man. The subjects were told to imagine a new fork about which they felt neutral and to rate it 0 on the scale. They were then instructed: "In each question below, you will be asked to rate how much you would like to use that fork for one meal 1 day after it was washed in a dishwasher. All forks were used by the man in the picture."

Contact was measured with questions that closely paralleled the sweater questions (i.e., a fork in a sealed plastic wrapper was kept in a drawer, and it was either never used or it was used for one meal by either the man with AIDS or the healthy man). Dose insensitivity was measured by varying exposure to the fork, specifying either one bite, one meal, or regular use for 1 year by the man with AIDS. Permanence was measured by post-single-meal-use intervals of 1 day, a full month, or a full year. Backward contagion was also measured in a situation parallel to that of the sweater scenario (i.e., "Rate how much you would like to use the new fork knowing that you will then give it to a thrift store and it will be bought by the man who has AIDS" or "by the healthy man").

The baseline fork question (i.e., the man with AIDS used the fork for one meal; the fork was washed in a dishwasher and used by the subject 1 day later) was asked both at the beginning and end of the questionnaire, and in the middle, in association with the series of questions on dose insensitivity.

## Results

Ninety complete sweater questionnaires were returned. Twenty-one of them (23%) showed no difference between the rating for the healthy man sweater and the average of the AIDS (worn 1 day, 1 day later) baseline sweaters. Thus, 77% of the subjects showed an AIDS contagion effect for the sweater. There were 112 completed fork questionnaires. Twelve subjects (11%) showed no difference between the rating for the healthy man fork and the average of the AIDS (used for one meal, 1 day later) baseline forks. Thus, 89% of the subjects showed an AIDS contagion effect for the fork. We included all subjects, even those who showed no contagion effects, in the subsequent analysis so that our analysis could be carried out on an unselected group of subjects. Many of the subjects ignored the instruction to rate the unused fork at zero, but we included their data, since our interest was in the relative value of different forks.

For all comparisons in the study, we used as a reference point the four sweater or three fork ratings of the standard AIDS sweater or fork in order to obtain a more stable base. For the sweater, the four means (taken at four different points during the survey) differed by a maximum of 5.38 points on the 200-point scale. For the fork, the maximum difference between any pair of the three means was 5.20. In both cases, the last measurement was somewhat lower than the previous measurements.

*Contact.* The importance of contact was evaluated by a comparison of the owned item with the owned/used item. There was a drop of 43.7 points (+30.7 to -13.0; dependent  $t = 8.71, p < .001$ ; Table 1) for the AIDS sweater between owned and owned/used. The equivalent drop for the AIDS fork was 63.6 points (50.1 to -13.5 points;  $t = 10.10, p < .001$ ). Thus, there was a major effect of contact, over and above ownership. There was also a much smaller but significant effect of pure association (ownership). The AIDS owned sweater ( $X = 30.7$ ) was rated 12.4 points below the man owned sweater ( $X = 43.1$ ;  $t = -4.27; p < .001$ ). However, the effect of AIDS ownership alone ( $30.7 - 43.7 = -12.4$ ) was only 22% of the effect of 1 day of contact with an owned sweater ( $-13.0 - 43.1 = 56.1$ ). The AIDS owned fork (50.1) was 13.3 points less desirable than the man owned fork (63.4;  $t = 3.97, p < .001$ ). However, the AIDS owned effect ( $X = -13.3$ ) was only 17% of the effect of AIDS owned/used ( $-13.5 - 63.4 = -76.9$ ). The modest effect of ownership without contact disappeared when combined with contact. That is, the AIDS owned/used sweater ( $X = -13.0$ ) was slightly less negative than the baseline once-worn AIDS sweater (not described as owned) ( $X = -18.9; t = -3.56, p < .001$ ). Similarly, the AIDS owned/used fork ( $X = -13.5$ ) was also less negative than the baseline AIDS fork ( $X = -19.2, t = 3.07, p < .01$ ). Hence, in the face of brief contact, a few months of ownership had no additional negative effect; indeed, it seemed to have a slightly positive effect.

*Dose insensitivity.* Even 5 minutes of exposure to the sweater worn by the man with AIDS produced a drop in value to -16.0 (a drop of 35.0 points from the healthy man sweater;  $t = -7.61, p < .001$ ). One bite with the fork by the man with AIDS reduced the fork value to -10.5 (a drop of 58.1 points from the healthy man fork;  $t = 11.06, p < .001$ ). For 88 of 90 sweater subjects, AIDS 5 minutes was worse than healthy man 1 day. For all 112 fork subjects, AIDS 1 bite was worse than healthy man 1 meal. Therefore, very low doses produce substantial effects. Furthermore, for quite a few subjects, there was a flat dose-response curve; 34 sweater subjects showed a totally flat dose function (11 of these scored -100 for all doses) and 45 fork subjects showed a flat function (13 of these scored -100 for all doses). However, there was an overall effect of dose size, such

Table 1  
*Ratings of Sweaters and Forks After Specified Contact*

Condition	Sweater <sup>a</sup>				Fork <sup>b</sup>			
	Interval				Interval			
	Duration of contact	Delay after contact	Mean	(s.d.)	Duration of contact	Delay after contact	Mean	(s.d.)
Brand new (washed)			40.1	(35.9)				
Healthy	1 day	1 day	19.0	(40.6)	1 meal	1 day	47.6	(43.5)
AIDS <sup>c</sup>	1 day	1 day	-18.9	(51.1)	1 meal	1 day	-19.2	(53.0)
Contact								
Man owned	—	1 day	43.1	(38.9)	—	1 day	63.4	(45.8)
AIDS owned	—	1 day	30.7	(42.8)	—	1 day	50.1	(53.4)
Man owned/used	1 day	1 day	23.4	(40.5)	1 meal	1 day	44.5	(51.5)
AIDS owned/used	1 day	1 day	-13.0	(51.9)	1 meal	1 day	-13.5	(55.9)
Dose insensitivity								
AIDS	5'	1 day	-16.0	(51.1)	1 bite	1 day	-10.5	(53.7)

AIDS	60'	1 day	-18.3	(52.4)				
AIDS <sup>c</sup>	1 day	1 day	-18.9	(51.1)	1 meal	1 day	-19.2	(53.0)
AIDS	1 mo.	1 day	-25.8	(53.9)				
AIDS	1 yr.	1 day	-30.1	(53.5)	1 yr.	1 day	-33.2	(56.6)
<b>Permanence</b>								
AIDS <sup>c</sup>	1 day	1 day	-18.9	(51.1)	1 meal	1 day	-19.2	(53.0)
AIDS	1 day	1 mo.	-19.3	(51.0)	1 meal	1 mo.	- 6.9	(54.6)
AIDS	1 day	1 yr.	-15.7	(50.6)	1 meal	1 yr.	- 0.9	(57.5)
<b>Backwards</b>								
Man	1 day	N/A	46.6	(41.5)	1 meal	N/A	50.3	(47.0)
AIDS	1 day	N/A	46.2	(43.6)	1 meal	N/A	41.0	(53.0)

Note. N = 90 for sweater, N = 112 for fork.

<sup>a</sup>All sweaters are washed before subject wears them.

<sup>b</sup>All forks are washed in a dishwasher before subject uses them.

<sup>c</sup>These constitute the baseline condition.



that the negativity of both the sweater and the fork increased monotonically with the dose (Table 1). The maximum sweater dose of 1 year ( $X = -30.1$ ) was significantly larger than the effect of 5 minutes ( $X = -16.0$ ,  $t = 6.51$ ,  $p < .001$ ), and the maximum fork exposure of 1 year ( $X = -33.2$ ) was significantly larger than one bite ( $X = -10.5$ ,  $t = 7.27$ ,  $p < .001$ ). Since 5 minutes of exposure to an AIDS sweater produced 71% of the effect of 1 year of sweater use (measured in terms of drop from healthy man, 1 day used) and one fork bite produced 72% of the effect of use of the fork for 1 year (measured as the drop from healthy man, 1 meal fork use), we considered relative dose insensitivity to be demonstrated by these ratings.

*Permanence.* The AIDS sweater remained very negative even a full year after it was worn just once by the man with AIDS ( $X = -15.7$ , a drop of 34.7 points from the healthy man sweater,  $t = 8.46$ ,  $p < .001$ ). For the sweater scenario, 49 of 90 subjects showed a totally flat permanence function (7 of these scored -100 for each delay). Similarly the AIDS fork retained substantial negative value after 1 year ( $X = -0.9$ , a drop of 48.5 points from the healthy man fork,  $t = 8.94$ ,  $p < .001$ ). For the fork scenario, 40 subjects showed a totally flat permanence function (9 scored -100 for each delay). Negativity did not decrease significantly with time after contact in the sweater scenario: 1 year after the AIDS sweater was worn ( $X = -15.7$ ) was not significantly better than 1 day after it was worn ( $X = -18.9$ ;  $t = 1.09$ ,  $p > .1$ ). However, 1 year after the AIDS fork was used ( $X = -0.9$ ) was significantly better than 1 day after it was used ( $X = -19.2$ ;  $t = 5.61$ ,  $p < .001$ ). Nonetheless, the major part of the negative AIDS effect did not wear off after 1 year as compared with the healthy man sweater (measured as the drop from the healthy man effect); 92% of the 1 day AIDS sweater effect (measured as drop from the healthy man) remained after 1 year, and 72% of the 1 day AIDS fork effect remained after 1 year.

*Backward contagion.* There was no backward contagion effect for the sweater. The sweater bought by the man with AIDS after the subject wore it had almost the same value ( $X = 46.2$ ) as the sweater bought by the healthy man ( $X = 46.6$ ,  $t = .24$ , n.s.). However, the fork bought by the man with AIDS after it was used by the subject was rated significantly lower than the same fork bought by the healthy man (41.0 vs. 50.3,  $t = 2.53$ ,  $p < .05$ ). This effect was produced by only 11 subjects, who showed a mean drop of 102.5 points for the fork bought by the AIDS man. There was a more substantial and general backward effect with the hotel example. The hotel that would become an AIDS hospital was rated at 30.4, 6.7 lower than the other hotel ( $X = 41.0$ ,  $t = 2.94$ ,  $p < .01$ ). Twenty-nine of 88 subjects gave a lower rating to the AIDS hotel than to the other hotel.

## Discussion

At a minimum, we have shown that the law of contagion is a valuable heuristic, since it has led us to identify some properties of the fear of AIDS that have not been documented previously. The high level of agreement between the predictions and the data further suggests that the law of contagion is a plausible mechanism to explain people's feelings about AIDS. The weakest effect we obtained was for backward contagion, which was manifested by only a minority of our subjects. This is in keeping with our previous data about interpersonal contagion not specifically involving illness (Rozin et al., 1989). It is possible that a backwards effect would be larger if, unlike in the current or prior studies, the object in question was owned, rather than simply used, by the subject. We suspect that the great reluctance of many people to donate blood, of late, may include an element of fear concerning backward contagion.

In terms of mechanism, the most salient question raised by these data is: What is the nature of the entity or essence that is passed by contact? Does this psychological entity have the properties of a material (e.g., a germ) or is it better characterized as symbolic or spiritual? We (Nemeroff & Rozin, 1992) have evidence that both models exist, frequently in the same person, depending on the source of contagion. For most people, contagion from AIDS or hepatitis behaves like a material substance (e.g., it can be substantially weakened by washing or sterilization), whereas contagion from an undesirable person (e.g., Adolf Hitler) behaves more like a spiritual/symbolic entity (e.g., it is resistant to washing and responds more to contact with opposite-valenced people, such as Mother Teresa). However, a substantial minority of subjects treat AIDS contagion as spiritual/symbolic or undesirable-person-contagion as material (Nemeroff & Rozin, 1992). For the case of AIDS, there is evidence that there is a substantial moral threat of contact over and above any effect of fear of infection. Pryor and his colleagues (Pryor, Reeder, & McManus, 1991; Pryor, Reeder, Vinacco, & Kott, 1989) distinguish between fear of contracting AIDS (what they call an instrumental function of the attitude) and a fear of stigmatization by association with AIDS (what they call a symbolic function of attitudes). They demonstrate that anti-AIDS attitudes have both components and that they operate somewhat independently. However, the linkage is complex because the attitude toward homosexuality predicts negativity toward a presumably nonhomosexual person with AIDS (Pryor et al., 1989). We have also collected data indicating a complex interaction between moral and disease-risk factors in fear of AIDS (Nemeroff,

Brinkman, & Woodward, 1992; Rozin, Markwith, & McCauley, 1992).

Another major issue for investigation is the cause of the large individual differences in response to AIDS contagion: To what extent is it a function of degree of adherence to magical contagion beliefs, personal concern about the risks of contracting AIDS, or feelings of guilt about one's own sexual and drug-use behavior (see Nemeroff et al., 1992, for evidence on this point)? Overall, the clearest predictor of fear of AIDS seems to be antihomosexual sentiment (Bouton et al., 1989), but other associates of high fear include knowing less about the causes of AIDS, and political and religious conservatism (Bouton et al., 1989). Of course, all of these characteristics probably correlate with one another and may possibly correlate with the degree of magical beliefs in contagion.

There are alternative explanations for overreaction to the threat of AIDS that may or may not share common components with the contagion view put forth in this paper. One is that the high anxiety associated with death and incurable illnesses, as well as the catastrophic sense associated with AIDS, may lead to hypervigilance (Herek & Glunt, 1988). Fear of the unknown may be a contributing factor here (Triplet & Sugarman, 1987). There is a general tendency to overestimate the transmissibility of AIDS, which may be, in part, a confounding of the seriousness of the disease with its infectiousness (Herek & Glunt, 1988). This may be a case of the application of the representativeness heuristic. Furthermore, there may be widespread skepticism about pronouncements by health officials as to limitations of routes for transmitting AIDS, based perhaps on the high frequency of somewhat contradictory statements on health risks that have come from health authorities in the last decade.

Mere association is an alternative to the contagion view. Goffman (1963) points out that the negative effect of stigma may follow a chain of what seem like arbitrary associations. Association with something negative could, in principle, account for permanence, dose insensitivity, and most critically, backward contagion, but none of these predictions would follow directly from association theory. They are simply consistent with it. The potency of physical contact does not follow from any principle of association. It is a specific prediction of the law of contagion. It would not be unreasonable to believe that physical contact enhanced association, but, as an added feature of association, this would in itself be an argument for contagion.

The present study suggests the existence of a set of attitudes or beliefs that may be a major influence in responses of humans to infection, illness, and interpersonal contact. The specific implication for understanding attitudes toward AIDS is that fear of AIDS cannot be dealt with only in terms of providing information that defines the risk and routes

of infection (a conclusion also reached by Pryor et al., 1989, 1991). Some of the effect may be independent of this: Permanence and backward contagion are not properties of microbial transmission, and dose insensitivity allows for a great exaggeration of minimal risk.

### References

- Bouton, R. A., Gallaher, P. E., Garlinghouse, P. A., Leal, T., Rosenstein, C. D., & Young, R. K. (1989). Demographic variables associated with fear of AIDS and homophobia. *Journal of Applied Social Psychology, 19*, 885-901.
- Frazer, J. (1959). *The golden bough: A study in magic and religion* (T. H. Gaster, Ed.). New York: Macmillan. (Original work published 1890)
- Goffman, E. (1963). *Stigma: Notes on the management of spoiled identity*. Englewood Cliffs, NJ: Prentice-Hall.
- Herek, G. M., & Glunt, E. K. (1988). An epidemic of stigma. Public reactions to AIDS. *American Psychologist, 43*, 886-891.
- Hunter, N. D. (1989). *Epidemic of fear*. New York: American Civil Liberties Union.
- Mauss, M. (1972). *A general theory of magic* (R. Brain, Trans.). New York: W. W. Norton. (Original work published in 1902)
- Nemeroff, C. J., Brinkman, A., & Woodward, C. K. (1992). *Cognitions about AIDS: Magical thinking in a college population*. Manuscript submitted for publication.
- Nemeroff, C., & Rozin, P. (1992). *The contagion concept in modern United States culture: Psychological nature of the contagious entity in interpersonal and germ contagion*. Manuscript submitted for publication.
- Pryor, J. B., Reeder, G. D., & McManus, J. A. (1991). Fear and loathing in the workplace: Reactions to AIDS-infected co-workers. *Personality and Social Psychology Bulletin, 17*, 133-139.
- Pryor, J. B., Reeder, G. D., Vinacco, R. Jr., & Kott, T. L. (1989). The instrumental and symbolic functions of attitudes toward persons with AIDS. *Journal of Applied Social Psychology, 19*, 377-404.
- Rozin, P., Markwith, M., McCauley, C. R. (1992). *The nature of aversion to indirect contact with other persons: AIDS aversion as a composite of aversion to strangers, infection, moral taint and misfortune*. Manuscript submitted for publication.
- Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of the laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology, 50*(4), 703-712.
- Rozin, P., & Nemeroff, C. (1990). The laws of sympathetic magic: A psychological analysis of similarity and contagion. In J. W. Stigler,

- R. A. Shweder, & G. Herdt (Eds.), *Cultural Psychology: Essays on comparative human development* (pp. 205-232). Cambridge, England: Cambridge University Press.
- Rozin, P., Nemeroff, C., Wane, M., & Sherrod, A. (1989). Operation of the sympathetic magical law of contagion in interpersonal attitudes among Americans. *Bulletin of the Psychonomic Society*, 27, 367-370.
- Tambiah, S. J. (1990). *Magic, science and religion*. Cambridge, England: Cambridge University Press.
- Triplet, R. G., & Sugarman, D. B. (1987). Reaction to AIDS victims: Ambiguity breeds contempt. *Personality and Social Psychology Bulletin*, 13, 265-274.
- Tylor, E. B. (1974). *Primitive culture: Researches into the development of mythology, philosophy, religion, art, and custom*. New York: Gordon Press. (Original work published in 1871.)