Intuitive Theories of Human Immunodeficiency Virus Transmission: Their Development and Implications

Carol K. Sigelman
George Washington University

Antonio L. Estrada
University of Arizona

Eileen B. Derenowski
University of Denver

Teresa E. Woods
University of Miami

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Explored the use of cluster analysis to characterize the development of intuitive theories of HIV transmission and examined relationships between children’s theories and their attitudes regarding AIDS. In Study 1, analyses of interviews with 188 children and adolescents led to the identification of three relatively immature theories (undifferentiated thinking in which anything can cause AIDS, uncertainty about its causes, and a hybrid theory emphasizing germs as well as any form of drug use) and two relatively mature ones (both emphasizing true AIDS risk factors but differing in their understanding of blood exchange as a cause). Unwillingness to interact with persons with AIDS and worry about AIDS...
decreased with age and the former in particular was most closely associated with
the belief that AIDS is spread through casual contact. In Study 2, analyses of
data from a largely Mexican American sample of 306 third, fifth, and seventh
graders yielded largely similar findings despite use of different risk factor sub-
scales. Overall, the intuitive theories approach and the use of cluster analysis in
its service appear to be promising ways of assessing children's knowledge of
disease so that appropriate interventions for different subgroups of children can
be designed.

KEY WORDS: AIDS; children; beliefs; attitudes.

Slowing the spread of human immunodeficiency virus (HIV) and combating
discrimination against individuals who must live with HIV and AIDS hinge on
providing effective AIDS education, starting in childhood. Providing effective
AIDS education, in turn, depends on identifying any inaccurate beliefs and
maladaptive attitudes that children of different ages bring to the learning situa-
tion. In this paper, we conceptualize children's beliefs about HIV transmission as
intuitive theories of disease causality, apply cluster analysis to characterize these
intuitive theories, and explore their development and implications for attitudes
toward AIDS and people who have it.

Most previous studies of children's understandings of disease have been
guided by Piagetian cognitive-developmental theory (e.g., see Bibace & Walsh,
1980; Burbach & Peterson, 1986; Perrin & Gerrity, 1981; Simeonsson, Buckley,
& Monson, 1979). This work describes a stagelike, developmental shift from
magical thinking to the identification of concrete, external causes of disease and
ultimately to more abstract, physiological theories of disease causality—a shift
evident in children's understandings of AIDS (Osbome, Kistner, & Helgemo,
1993; Walsh & Bibace, 1991). However, Piagetian research focuses on the form
or complexity of thinking and ignores its accuracy. Because children's explana-
tions of disease can be scientifically correct or incorrect at any of the proposed
levels of conceptual complexity, this work has had little to say about how the content
of children's thinking about AIDS and other diseases changes with age.

Most other information about children's understandings of disease has been
obtained from testlike surveys guided by no theory at all. Such tests implicitly
assume that children's knowledge of disease consists of isolated bits of informa-
tion. A search for a more promising conceptual framework to guide our research
led us to the work of theorists such as Carey (1985, 1991) and Keil (1989, 1992).
They emphasize that young children's understandings of the world are theory-
like in nature, coherently organized around causal principles (see also Wellman
& Gelman, 1992). As children acquire additional information in a domain, their
initial intuitive theories might either become more specific and differentiated or
give way to fundamentally different theories. At any age, their specific ideas
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about what causes a disease, right or wrong, are regarded as part of a coherent conceptual structure.

In this paper, we explore the utility of cluster analysis as a methodology for characterizing intuitive theories of AIDS transmission. Cluster analysis allows one to identify distinct “theoretical camps” of children, each group holding a unique constellation of beliefs about possible risk factors for AIDS. What does earlier work suggest about what theories of HIV transmission children might hold and how they might change with age?

In a study of knowledge of risk factors for AIDS, colds, and cancer among fourth, sixth, and eighth graders and college students (Sigelman, Maddock, Epstein, & Carpenter, 1993), the main developmental trend was toward increased differentiation between true and false risk factors for each disease. The youngest children studied, 9- to 10-year-olds, were as knowledgeable as college students about the primary risk factors for AIDS but held many more misconceptions about the dangers of saliva exchange and drug use (see also Brown, Nassau, & Barone, 1990; Fassler, McQueen, Duncan, & Copeland, 1990; Glenister, Castiglia, Kanski, & Haughey, 1990). It seems likely, then, that children's earliest theories of AIDS will either be undifferentiated and associate the disease, in "magical" fashion, with any number of causes (e.g., see Walsh & Bibace, 1991), or assume that AIDS, like the common cold, is an infectious disease caused by germs. Additionally, children who have encountered information about AIDS risk factors may mistakenly conclude that one can get AIDS from any form of drug use, even smoking cigarettes and drinking alcohol (Schonfeld, Johnson, Perrin, O'Hare, & Cicchetti, 1993; Sigelman et al., 1993). Similarly, they may infer that any activity involving blood or needles is risky (Brown et al., 1990; Fassler et al., 1990; Sly, Eberstein, Quadagno, & Kistner, 1992). As they get older, children should shed such misconceptions and approximate a scientific understanding of HIV transmission.

How might children's intuitive theories of AIDS be linked to their attitudes toward AIDS and persons with AIDS (PWAs)? Children who subscribe to an undifferentiated, magical theory of AIDS transmission (implicating a wide range of causal factors) and children who have constructed a germ theory (in which AIDS is regarded as a readily transmitted infectious disease) should be more likely than those who have acquired an accurate theory, as well as those who have formulated a theory emphasizing drug use as the cause, to fear contact with infected individuals and to worry that they or their loved ones might fall prey to the disease. The more misconceptions children have about how AIDS is spread, the more they tend to be concerned about it and reluctant to interact with PWAs (see Brown et al. 1990; McElreath & Roberts, 1992; Osborne et al., 1993).

In two studies, we attempt to characterize children's and adolescents' intuitions about modes of HIV transmission. We then examine relationships between their causal beliefs and both their attitudes toward interacting with PWAs and concerns about the disease. Building on the intuitive theories perspective, we
assume that children use information they acquire about AIDS, as well as stored knowledge of other diseases, to construct meaningful theories of AIDS causality. We hypothesize the following:

1. Children's initial theories will be relatively undifferentiated and will reflect faulty inferences based on either a belief that illness is transmitted in magical ways, application of a germ theory of illness to AIDS, and/or overgeneralization of information about AIDS in relation to drugs and blood.

2. With age, children's theories will become more accurate, differentiating more sharply between true and false risk factors.

3. Adherence to a global, undifferentiated theory or a general infectious disease theory will be associated with unwillingness to interact with PWAs and worry about AIDS.

STUDY 1

The first study involved children ranging in age from 6 to 18, a wider age span than has been studied previously. Our objectives were to describe age differences in knowledge of HIV transmission, to use cluster analysis to characterize children's theories of HIV transmission, and to examine the implications of cluster membership for attitudes surrounding AIDS.

Method

Participants

The sample consisted of 188 children and adolescents, ranging in age from 6 to 18, recruited from 10 after-school care and recreational facilities in a Southwestern city. Packets with parent consent forms and surveys (in Spanish if preferred) were given directly to parents as they picked up their children or were sent home with children; 33% of parents returned signed consent forms, and it should therefore be borne in mind that this is a volunteer sample not necessarily representative of the larger community. The sample was ethnically and socioeconomically diverse: 50% were female; 66.0% were non-Hispanic whites, 16.5% Hispanics, 11.7% blacks, and 5.8% Asian, Native American, or other ethnic background. Consenting parents' years of education ranged from 10 to 18 ($M = 14.8$). For purposes of analysis, children were grouped into five educationally meaningful age groups that had relatively equal $n$s: 1st/2nd graders ($M = 7.1$), 3rd/4th graders ($M = 8.6$), 5th/6th graders ($M = 10.5$), 7th–9th graders ($M = 13.0$), and 10th–12th graders ($M = 16.1$). They provided written consent after hearing an oral explanation of the study.
**Procedure and Measures**

Each child was interviewed individually by a trained interviewer (one of nine individuals, five of whom were Anglo females, two of whom were Hispanic females, and two of whom were Anglo males). Each participant first completed an open-ended interview covering AIDS-related risk factors, effects, treatment, prevention, attitudes, and information sources. They then completed a structured interview on similar topics. Elementary school students were scheduled for two sessions on separate days in order to prevent fatigue, whereas most adolescents completed both interviews on the same day. The measures of interest here were derived from the structured interview.

The surveys were designed with young children in mind, were pilot-tested, and appear to have been comprehensible to early elementary school children. In response to an initial question checking for AIDS awareness, all but four children (98% of the sample) either said that AIDS is a disease when asked what it is or correctly indicated in response to a follow-up multiple-choice question that AIDS is a disease rather than a kind of candy, place to go, or drug. The four children who failed this screening item were told, “AIDS is a disease,” and were retained in the sample.

**Knowledge of HIV Transmission.** Children responded to a section describing 32 behaviors and asking them about the chances that each behavior could cause AIDS (0 = no chance, 1 = very little chance, 2 = pretty good chance, 3 = big chance). Based on preliminary factor analyses and internal consistency analyses (n = 183), we formed eight specific risk factor subscales, each a mean endorsement score that could range from 0 to 3: (a) Sex and intravenous drugs (4 items involving sharing drug needles or engaging in high-risk sexual behavior, α = .74), (b) Risky blood (4 items including becoming blood brothers or sisters and being born to an infected mother, α = .69); (c) Airborne (2 items involving being breathed on or sneezed and coughed on by a PWA, α = .82); (d) Saliva (3 items—kissing, sharing a drinking glass, and so on, α = .87); (e) Contact/proximity (6 items covering touching and hugging, as well as indirect contacts such as using the same toilet seat, α = .85); (f) Low-risk drugs (4 items: smoking marijuana, getting drunk, and the like, α = .88); (g) Low-risk blood (4 items, including donating blood and being bitten by a mosquito that bit a PWA, α = .57); and (h) Magic (2 items about whether or not believing in God or stealing and lying a lot cause AIDS, α = .89). The last subscale sheds light on whether young children believe that bad behavior can cause illness through what Piaget (1932/1965) termed immanent justice.

**Willingness to Interact with PWAs.** The first measure of attitudes surrounding AIDS was a 10-item social distance scale asking whether children would definitely, probably, probably not, or definitely not engage in such behaviors as sitting next to, touching, and drinking from the same glass as a PWA, as well as...
how they would feel about interacting with a nurse or doctor who treats PWAs and a teenager, teacher, or classmate with AIDS (α = .86). Two items were reverse scored and items were averaged so that total scores could range from 0 to 3, high scores indicating willingness to interact.

Worry About AIDS. The second attitudinal measure consisted of three items assessing how much a child worried that he/she, a family member, or a friend might get AIDS (not at all, a little, some, a lot). Average scores could range from 0 to 3, maximum anxiety (α = .80).

Results

We briefly present descriptive data concerning age group differences in beliefs about AIDS causality and attitudes surrounding AIDS. Then we present the cluster analysis findings, the demographic characteristics of the members of each theoretical camp identified, and the implications of intuitions about HIV transmission for attitudes.

Age Group Differences in Endorsement of Risk Factors

Table I reports, for the five age groups, mean levels of endorsement of the eight specific types of risk factors. Age Group × Sex ANOVAs revealed significant age group differences on all eight subscales. The main trend is toward sharper differentiation with age between true risk factors and false risk factors; true risk factors are more strongly endorsed, false risk factors are more decisively rejected.

Follow-up Tukey’s tests (see Table I) indicated that first and second graders often distinguished themselves from other age groups. They were significantly less likely than the three oldest groups to endorse intravenous drug use and sex as causes of AIDS, and they were significantly more likely than all other groups to believe in transmission through the air, contact with an infected person, low-risk drug use, and low-risk contacts with blood. The most widespread and tenacious misconception among elementary school children was the belief that AIDS can be spread through saliva exchange. Junior and senior high school students did not differ significantly from each other. Adolescents had basically accurate views of AIDS transmission, although many clung to saliva and blood-related myths.

Although differentiation between classes of risk factors clearly increased with age, even first and second graders had intuitions that are on the right track. Most believed that intravenous drug use and sex can cause AIDS and rejected the magical idea of AIDS as immanent justice. Their ideas about the dangers of saliva exchange are reasonable inferences from a germ theory of AIDS. Yet these young children also hold many potentially fear-provoking misconceptions. Many
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Table I. Age Group Differences in Mean Transmission Knowledge and Attitude Scores: Study 1*

<table>
<thead>
<tr>
<th>Age group (grades 1–12)</th>
<th>1st–2nd</th>
<th>3rd–4th</th>
<th>5th–6th</th>
<th>7th–9th</th>
<th>10th–12th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk factor subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex &amp; IV drugs</td>
<td>2.13a</td>
<td>2.25ab</td>
<td>2.53bc</td>
<td>2.56bc</td>
<td>2.76c</td>
</tr>
<tr>
<td>Risky blood</td>
<td>1.88b</td>
<td>1.99ab</td>
<td>2.18ab</td>
<td>2.27ab</td>
<td>2.31b</td>
</tr>
<tr>
<td>Airborne</td>
<td>1.67c</td>
<td>1.07d</td>
<td>0.92e</td>
<td>0.35f</td>
<td>0.27g</td>
</tr>
<tr>
<td>Saliva</td>
<td>1.97a</td>
<td>1.63bc</td>
<td>1.65bc</td>
<td>0.74a</td>
<td>0.45b</td>
</tr>
<tr>
<td>Contact/proximity</td>
<td>1.45g</td>
<td>0.71h</td>
<td>0.60i</td>
<td>0.36j</td>
<td>0.32k</td>
</tr>
<tr>
<td>Low-risk drugs</td>
<td>1.83h</td>
<td>0.99g</td>
<td>0.87f</td>
<td>0.21e</td>
<td>0.05d</td>
</tr>
<tr>
<td>Low-risk blood</td>
<td>1.32i</td>
<td>0.87h</td>
<td>0.88g</td>
<td>0.81f</td>
<td>0.70e</td>
</tr>
<tr>
<td>Magical</td>
<td>0.71k</td>
<td>0.31ab</td>
<td>0.06a</td>
<td>0.14b</td>
<td>0.06c</td>
</tr>
<tr>
<td>Atitudes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willing to interact</td>
<td>0.90a</td>
<td>1.39b</td>
<td>1.50c</td>
<td>2.03d</td>
<td>2.20e</td>
</tr>
<tr>
<td>Worry about AIDS</td>
<td>2.15i</td>
<td>1.70ab</td>
<td>1.69ab</td>
<td>1.43bc</td>
<td>1.20bc</td>
</tr>
<tr>
<td>n</td>
<td>30</td>
<td>37</td>
<td>31</td>
<td>36</td>
<td>51</td>
</tr>
</tbody>
</table>

*Means in each row that do not share a subscript in common are significantly different (p < .05). ns are maximal ns; missing data lowered the effective ns for some scales. All scales can potentially range from 0 to 3, high scores indicating a strong belief that risk factors cause AIDS, willingness to interact with PWAs, and concern about AIDS.

first and second graders, for example, believed that there is a pretty good or big chance of getting AIDS by sharing a drinking glass with someone who has it (77%), by smoking cigarettes (72%), or by getting drunk a lot (60%).

The main effect of gender was never significant in the ANOVAs, and the interaction between gender and age group was significant for only two subscales. First- and second-grade girls were somewhat more likely than boys their age (2.30 vs 1.81, p < .06) to endorse intravenous drug use and sex as AIDS risk factors, although the sexes did not differ at other age levels. Junior high school boys were more likely than junior high school girls to believe in the possibility of airborne transmission (.62 vs. .51, p < .01).

Willingness to interact with PWAs increased substantially with age, F(4, 167) = 28.75, p < .0001; 1st and 2nd graders were less willing than all older age groups, and 3rd–4th and 5th–6th graders were less willing than both junior and senior high school students. The interaction between age group and sex was also significant, F(4, 167) = 3.18, p < .05; F tests for simple effects revealed that 1st/2nd-grade girls were less willing to interact than 1st/2nd-grade boys (.69 vs. 1.31, p < .05), but that senior high school girls were more willing to interact than senior high school boys (2.36 vs. 2.02, p < .05).

Finally, worry about being personally affected by AIDS decreased with age, F(4, 171) = 6.19, p < .0001, with first and second graders worrying more than junior and senior high school students that they or loved ones might get AIDS.
No sex differences were evident. In sum, these descriptive analyses reveal substantial gains with age in knowledge of what does and does not cause AIDS, accompanied by greater receptivity to interacting with people who have the disease and reduced concern about being personally affected by it. Now we apply cluster analysis to the data in order to identify distinctive constellations of beliefs about which behaviors can cause AIDS.

**Cluster Analysis to Identify Theoretical Camps**

The cluster analysis was conducted on six risk subscale scores which had been converted to z scores, as the relative influences of dimensions in a cluster analysis are affected by their variances (Aldenderfer & Blashfield, 1984). The airborne transmission, saliva, and contact/proximity risk factor subscale scores were averaged to create a Cold Risks subscale (11 items, $\alpha = .92$). This was done because these scales were conceptually similar, highly intercorrelated, and therefore redundant.

Clusters were generated using SPSS/PC+ by Ward’s method, which minimizes the squared Euclidean distances between individuals within clusters and therefore produces homogeneous but distinct groups, each with a different pattern of beliefs about HIV transmission. There is no agreed-upon method of determining the optimal number of clusters in a cluster analysis (Aldenderfer & Blashfield, 1984). Examination of means and standard deviations of the classifying variables for two- to seven-cluster solutions led to a decision that the five-cluster solution was most satisfactory. It captured meaningful differences in children’s thinking without introducing trivial distinctions (as indicated by comparing means across clusters), did not lump highly heterogeneous subgroups together (as indicated by SDs), and yielded clusters large enough to be analyzed statistically (i.e., greater than 10). Table II presents, for each cluster, mean scores on the six risk factor subscales. The five clusters can be characterized as follows:

1. Undifferentiated Thinking: These 14 children were about average in their endorsement of true risk factors (sex/intravenous drugs and risky blood) but had many misconceptions. They were the only individuals to endorse the magical notion that failing to believe in God or stealing and lying can cause AIDS. Basically, these children believed that almost anything, not just behaviors associated with the transmission of infectious diseases, can cause AIDS.

2. Reject True/No Clue: These 26 children were less likely than most students to view true AIDS risk factors as causes of AIDS. They were typically near the sample mean on the four transmission myth scales. They appeared to have no strong intuitions about what causes AIDS and responded very tentatively to the risk factor items.
### Table II. Mean Endorsement of True and False Risk Factors by Cluster Membership: Study 1*

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1 Undifferentiated thinking</th>
<th>2 Reject true/ no clue</th>
<th>3 Germs &amp; drugs</th>
<th>4 True risks/ not blood</th>
<th>5 True risks/ blood myths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex &amp; IV drugs</td>
<td>2.46, 1.51, 2.51, 2.58, 2.83</td>
<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
<tr>
<td>Risky blood</td>
<td>2.46, 1.51, 2.51, 2.58, 2.83</td>
<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
<tr>
<td>Cold risks</td>
<td>2.46, 1.51, 2.51, 2.58, 2.83</td>
<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
<tr>
<td>Low-risk drugs</td>
<td>2.46, 1.51, 2.51, 2.58, 2.83</td>
<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
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<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
<tr>
<td>Magic</td>
<td>2.46, 1.51, 2.51, 2.58, 2.83</td>
<td>2.13, 1.85, 1.94, 1.97, 2.65</td>
<td>1.98, 1.05, 1.59, 0.30, 0.57</td>
<td>2.09, 0.74, 1.75, 0.12, 0.16</td>
<td>1.70, 0.81, 1.12, 0.49, 0.96</td>
</tr>
<tr>
<td>n</td>
<td>14</td>
<td>26</td>
<td>37</td>
<td>55</td>
<td>53</td>
</tr>
</tbody>
</table>

*Means in each row that do not share a subscript in common are significantly different (p < .05). ns are maximal ns; missing data lowered the effective ns for some scales. High scores on the 0-to-3 scales reflect a belief that the factor causes AIDS.

3. Germs and Drugs: These 37 students had a strong sense that both drug use of any sort and behaviors that can cause colds cause AIDS. Thus they were not as indiscriminate in their beliefs as the Cluster 1 undifferentiated thinkers were (e.g., they rejected magical and low-risk blood explanations), and they had stronger intuitions than the Cluster 2 (Reject True/No Clue) children did. They seem to have constructed a hybrid theory blending a germ theory of disease and newly acquired but overgeneralized knowledge about the dangers of sharing drug needles.

4. True Risks/Not Blood: The 55 students in this cluster had a relatively accurate view of HIV transmission. They viewed sex and drug needle sharing as causes of AIDS, and they firmly rejected most myths about HIV transmission. However, they seemed skeptical that AIDS is caused by contact with the blood of PWAs.

5. True Risks/Blood Myths: Finally a cluster of 53 students also had a basically correct view of AIDS causality. They distinguished themselves from members of Cluster 4, however, by their stronger endorsement of both true risk factor subscales and their less decisive rejection of nonrisky blood contacts (and cold risk factors as well) as causes of AIDS. It is as if they had more fully assimilated messages about the dangers of blood but had overgeneralized these messages.

One might hypothesize that members of Clusters 1, 2, and 3 are younger than members of Clusters 4 and 5, and that Cluster 1 undifferentiated thinkers are the youngest of all. Moreover, because members of Clusters 1 (Undifferentiated Thinkers) and 3 (Drug and Germ Theorists) believe that one can get AIDS easily through casual contact, they should be less willing to interact with PWAs and
more worried that they or their significant others will get AIDS than other students.

Demographic Characteristics of Children in the Five Groups. Table III presents the demographic characteristics of the five clusters of students. An ANOVA for age differences, followed up by a Tukey’s test, revealed that members of Clusters 1, 2, and 3 were younger than members of Clusters 4 and 5, \( F(4, 179) = 41.58, p < .0001 \). Although undifferentiated thinkers were indeed the youngest group, they were not significantly younger than members of Clusters 2 and 3. The percentages of children at each grade level belonging to each cluster are also reported in Table III. Over half of first and second graders were Cluster 3 drug and germ theorists. The rest were either Cluster 1, undifferentiated thinkers or Cluster 2, uncommitted thinkers. None had an accurate theory of HIV transmission. Middle elementary school appears to be an important transitional period, as all five theoretical camps were well-represented among third and fourth graders. The shift from the three immature theories to the two more accurate theories continued in fifth and sixth grade, and, by junior high school, all but a few students held basically accurate, Cluster 4 or 5, theories of AIDS transmission.

Table III. Demographic Characteristics and Attitude Scores for Each Cluster: Study I

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1 Undifferentiated thinking</th>
<th>2 Reject true/no clue</th>
<th>3 Germs &amp; drugs</th>
<th>4 True risks/not blood</th>
<th>5 True risks/blood myths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/grade level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age</td>
<td>8.36(_a)</td>
<td>9.19(_b)</td>
<td>8.65(_a)</td>
<td>13.57(_b)</td>
<td>13.62(_b)</td>
</tr>
<tr>
<td>% 1st/2nd grade</td>
<td>20.0</td>
<td>26.7</td>
<td>53.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>% 3rd/4th grade</td>
<td>16.2</td>
<td>27.0</td>
<td>27.0</td>
<td>13.5</td>
<td>9.4</td>
</tr>
<tr>
<td>% 5th/6th grade</td>
<td>3.2</td>
<td>29.0</td>
<td>29.0</td>
<td>25.8</td>
<td>15.1</td>
</tr>
<tr>
<td>% 7th/9th grade</td>
<td>2.8</td>
<td>5.6</td>
<td>2.8</td>
<td>50.0</td>
<td>38.9</td>
</tr>
<tr>
<td>% 10th/12th grade</td>
<td>0.0</td>
<td>3.9</td>
<td>2.0</td>
<td>43.4</td>
<td>51.0</td>
</tr>
<tr>
<td>Ethnicity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minority</td>
<td>9.8</td>
<td>14.7</td>
<td>23.0</td>
<td>19.7</td>
<td>32.8</td>
</tr>
<tr>
<td>Anglo</td>
<td>6.5</td>
<td>13.7</td>
<td>18.5</td>
<td>34.7</td>
<td>26.6</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
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<td>17.6</td>
<td>20.9</td>
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<tr>
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</tr>
<tr>
<td>Attitudes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willing to interact</td>
<td>90.0(_a)</td>
<td>1.42(_b)</td>
<td>1.36(_b)</td>
<td>2.01(_e)</td>
<td>1.72(_b)</td>
</tr>
<tr>
<td>Worry about AIDS</td>
<td>2.12(_a)</td>
<td>1.52</td>
<td>1.61</td>
<td>1.61</td>
<td>1.66</td>
</tr>
</tbody>
</table>

*Means in each row that do not share a subscript in common are significantly different (\( p < .05 \)). Missing data lowered the effective ns for some analyses. Percentages reported for each grade level, ethnic group, and gender indicate the percentage of all children in that category (e.g., 1st/2nd graders or females) falling in each cluster; the percentages in each row add to 100%. Means for Willingness to Interact and Worry are adjusted for age differences between clusters.
The distribution of minority group children across clusters was not significantly different, as indicated by a chi-square test, from the distribution of non-Hispanic white children. Similarly, males were no more or less likely to fall in one theoretical camp or another than were females. Age, then, is the individual characteristic most predictive of cluster membership.

**Implications of Transmission Theories.** The last two rows in Table III speak to the implications of theories of AIDS transmission for attitudes. To determine whether the association between cluster membership and attitudes was more than a function of age differences between clusters, we conducted one-way analyses of variance by cluster with age as a covariate, using the regression, or unique sums of squares, approach to ANOVA. Age, \( F(1, 170) = 17.68, p < .0001, \) and cluster membership, \( F(4, 170) = 9.49, p < .0001, \) each influenced willingness to interact even with the other controlled. As the adjusted means reported in Table III indicate, Cluster 1 undifferentiated thinkers were less willing to interact with PWAs than all other groups. Cluster 2 (no clue) and Cluster 3 (germ and drug) children were less willing to interact with PWAs than knowledgeable Clusters 4 members, and Cluster 5 members were intermediate. Differences between clusters in AIDS-related worries were not significant with age controlled, but young children worried more than older children even with cluster membership controlled, \( F(1, 174) = 9.44, p < .01. \) Thus, knowing a child's theory of AIDS, as revealed by cluster membership, tells us something about his or her willingness to interact with infected persons that age alone does not but has little independent association with AIDS-related worries.

**STUDY 2**

We conducted similar analyses using data from a sample of children ranging in age from 8 to 14, many low-income Mexican American children. The risk factor survey used did not include any magical, immanent justice items and did not contain enough blood myth and risky blood items to allow the construction of reliable risk factor scales. Thus, Study 2 can shed light on whether the broad findings of Study 1 hold true in an ethnically different sample using a smaller set of risk-perception dimensions to characterize children's thinking.

**Method**

**Participants**

The base sample consisted of 306 third-, fifth-, and seventh-grade children from 12 classrooms in three Catholic parochial schools in a Southwestern city. Two of the participating schools were chosen because they served lower income,
heavily Hispanic neighborhoods and would, in combination with the third, more middle-class school population, create a socioeconomically and ethnically diverse sample. None of the participating schools offered AIDS education at these grade levels at the time of the study; yet 96.2% of the children passed a multiple-choice AIDS-awareness item by identifying AIDS as a disease rather than a hospital, place to go, or drug.

The sample represented 87.2% of the 351 students given parent consent forms and parent surveys to deliver home. Mean ages were 8.7, 10.6, and 12.5 for third, fifth, and seventh graders, respectively. The racial/ethnic breakdown was 58.8% Hispanic, 35.0% Anglo, 2.6% African American, 2.0% Asian, and 1.6% Native American; 58% were girls.

Measures

Data were collected via written surveys administered during in-class testing sessions conducted as part of the pretest phase of an AIDS intervention study. Knowledge of HIV transmission was assessed by having children respond to items of the sort used Study 1 on a 4-point scale ranging from 0 (no chance) to 3 (big chance). Four internally consistent risk factor subscales were formed on the basis of a preliminary factor analysis: (a) True Risks (7 items describing true risk factors for AIDS; \( \alpha = .61 \) based on \( N = 288 \)); (b) Ingestion (5 inhalation and ingestion risk factors of the sort that cause colds; \( \alpha = .85 \)); (c) Contact/Proximity (6 items involving direct or indirect contact; \( \alpha = .75 \)); (d) Low-Risk Drugs (6 items about drug-using behaviors that pose little risk of AIDS; \( \alpha = .81 \)).

As in Study 1, two attitudinal measures were administered. The first gauged willingness to interact with infected individuals, using eight social distance items (seven of which were employed in Study 1). The four response options were printed on students' answer sheet as follows: NO, no, yes, and YES. Alpha was .88 for a total score based on the average of item scores and potentially ranging from 0 to 3. The second was a 5-item scale assessing worry about AIDS (concern that a good friend, family member, or oneself might get it someday, as in Study 1, as well as concern that one might do something that causes AIDS or might not know enough to prevent it). Item responses (not at all, a little, some, a lot) were averaged to form a scale with ranging from 0 (no worry) to 3 (high worry) with an alpha of .86.

Procedure

Parent consent packages were delivered home and returned to school by children. They contained an introductory letter signed by the school principal
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stating that participation was voluntary, a consent form, and a parent survey, all written in English on one side and Spanish on the other. Written consent was also obtained from children themselves at the start of their group testing sessions. A male and a female read all items aloud to the class in standard form, repeating each once, while monitors helped children who needed assistance. Students answered in a response booklet typed in large print that displayed the response options but not the items themselves.

Results

Table IV reports mean scores on the four risk factor scales for five clusters of children generated by applying Ward’s method of clustering to z scores using the same procedures and criteria for determining number of clusters as in Study 1. Also shown are significant differences between the five clusters in age and attitudinal measures.

Descriptions of Clusters

Members of Cluster 1 (Undifferentiated Thinkers) believed that virtually everything, including casual contact with infected individuals, could cause AIDS; they resembled the undifferentiated thinkers in Study 1, although they were not asked whether AIDS could be a punishment for bad behavior. Cluster 2 (Reject True/No Clue) children were considerably less likely than other children

<table>
<thead>
<tr>
<th>Cluster</th>
<th>True risks</th>
<th>Ingestion</th>
<th>Contact</th>
<th>Low-risk drugs</th>
<th>Age</th>
<th>Willingness to interact</th>
<th>Worry</th>
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<tr>
<td>1</td>
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<td>2.01</td>
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</table>

*Means in each row that do not share a subscript in common are significantly different (p < .05). Means for the last two variables are adjusted for age. Missing data lowered the effective ns for some analyses.
to endorse true AIDS risk factors (although they, like all other groups, believed that true risk behaviors were more likely than other behaviors to transmit AIDS). They generally seemed uncertain what causes AIDS. Children in Cluster 3 (Germs Plus) stood out most with respect to their belief in ingestion and inhalation as causes of AIDS but also tended to be above average in their endorsement of other risk factors. They distinguished themselves from Cluster 1 undifferentiated theorists by being less convinced that contact and nonintravenous drug use cause AIDS.

Clusters 4 and 5 contained the most knowledgeable students. Members of Cluster 4 (True Risks/Some Myths) were above average in their endorsement of true risk factors but were less likely than members of Cluster 5 (True Risks/Few Myths) to reject myths about HIV transmission decisively. Overall, then, Clusters 1 and 2 closely match Clusters 1 and 2 in Study 1. Cluster 3 (Germs Plus) children resemble the “Drugs and Germs” group in Study 1 but were not as convinced that low-risk forms of drugs use such as smoking cause AIDS. Moreover, despite our inability to group children based on their beliefs about risky and nonrisky forms of blood contact, we again identified two groups that were relatively knowledgeable about HIV transmission, one of which, as in Study 1, maintained more mistaken beliefs than the other.

**Correlates of Cluster Membership**

A one-way ANOVA revealed that the five groups differed significantly in age, $F(4, 267) = 38.78$, $p < .0001$. As Table IV shows, undifferentiated theorists were younger than germ theorists, and these two groups, along with the Reject True/No Clue children, were younger than either of the two most knowledgeable groups. In addition, the True Risks/Some Myths students were younger than the True Risks/Few Myths students.

As in Study 1, age was used as a covariate in analyses of variance testing for cluster differences in attitudes. Willingness to interact with PWAs was no longer a function of age when cluster membership was controlled, but the effect of cluster membership survived the control on age, $F(4, 262) = 25.15$, $p < .0001$. As the adjusted means in Table IV indicate, undifferentiated theorists proved to be less willing to interact with PWAs than all groups except germ theorists; both of these groups, along with children in the Reject True/No Clue cluster, were less willing to interact than the most knowledgeable group; and Cluster 4 (True Risks/Some Myths) members were intermediate.

Although age was unrelated to worry about AIDS with cluster membership controlled, cluster membership predicted worry independent of age, $F(4, 265) = 3.29$, $p < .05$. Worry was greater among undifferentiated theorists and germ theorists than among those knowledgeable students who retained some myths
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(Cluster 4 members). As expected, then, children with the strongest conviction that AIDS is easily spread displayed the least adaptive attitudes; however, children with little idea how people get AIDS were also concerned.

DISCUSSION

Cluster analysis involves subjective judgment and is more appropriately used in a confirmatory rather than an exploratory fashion. For those reasons and because some of the subgroups we analyzed were small, the findings reported here should be viewed as preliminary, requiring further replication and validation. We also cannot be sure that items were interpreted similarly by younger and older children, and we would be better able to characterize children’s theories if we had asked them to justify their responses. Nonetheless, we regard this research as a demonstration that cluster analysis can play a useful role in the study of children’s understanding of disease causality—and in the study of children’s and adults’ intuitive theories of any number of health-related phenomena. As applied here, cluster analysis supplements Piagetian assessments of the complexity of children’s thinking about disease with characterizations of the substance of their thinking. Moreover, it facilitates attempts to conceptualize the child’s knowledge of disease, not as a collection of isolated facts and misconceptions but as a coherent, theory-like set of propositions (see Wellman & Gelman, 1992).

The two analyses reported here suggest the following: (a) Even 6- and 7-year-olds view the major risk factors for AIDS as a likely causes of AIDS, whether because these behaviors sound dangerous on their face or because they have been widely publicized; (b) initially, some young children (undifferentiated thinkers) believe that virtually anything can cause AIDS, whereas other young children are very unsure of it causes and/or believe that it is very hard to “catch,” and still others apply some variant of a germ theory of disease to AIDS; (c) as children age, they are likely to become more firmly committed to a germ theory (e.g., see Bibace & Walsh, 1980; Perrin & Gerrity, 1981) and yet may graft onto it beliefs about AIDS risk factors such as drug use to create a hybrid, and probably internally inconsistent, transitional theory; (d) with further development, they differentiate more sharply between true risk factors and behaviors that only superficially resemble them, most likely because they come to understand that all modes of HIV transmission involve internalization of the virus through an exchange of blood or sexual fluids; (e) as children shift toward the view that only the major AIDS risk factors can cause AIDS, many of their concerns about coming in contact with infected individuals and being personally affected by AIDS are likely to be allayed.

This tentative description of development is largely consistent with the results of previous work (e.g., Brown et al., 1990; Osborne et al., 1993; Sigel-
Further, despite differences in the operationalizations of risk factor knowledge in the two cluster analyses we conducted, the clusters that emerged were quite similar. Yet much remains to be learned about children’s earliest theories of AIDS. Although our data hint that undifferentiated thinking may be the most developmentally primitive belief system, other research indicates that few preschool children really believe that bad behavior magically causes disease through immanent justice (Springer, 1994; Springer & Ruckel, 1992). Moreover, given our methodology, we cannot determine whether undifferentiated thinkers truly have a coherent theory or simply endorse many risk factor items because they lack a theory. Only longitudinal research with young children would tell, but it could be that none of the three relatively immature perspectives we identified is developmentally prior to the others. Indeed, a main message of this study is that, at any age level, distinguishable subgroups of children exist, each with its own, qualitatively different set of beliefs about HIV transmission.

The present data also suggest that knowing a child’s theoretical perspective on AIDS causality allows one to predict—better than one can on the basis of age alone—receptivity to interacting with persons with AIDS and, to a lesser extent, AIDS-related worries. As hypothesized, children’s concerns appear to derive rather straightforwardly from a belief that one can get AIDS through casual contact with PWAs (see also McElreath & Robert, 1992; Osborne et al., 1993). Uncertainty about what causes AIDS may also breed fearful attitudes, however. Moreover, the fact that children worry more than adolescents about AIDS may have less to do with their theories of HIV transmission—and certainly less to do with their actual odds of becoming HIV-infected in the immediate future—than with their greater concern about physical harm in general (Campbell & Rapee, 1994) or lower sense of control over their health (Cohen, Brownell, & Felix, 1990; Maddux, Roberts, Sledden, & Wright, 1986).

Theoretically, these findings suggest that it is fruitful to conceptualize the development of knowledge of AIDS and other diseases as a process of formulating and reformulating intuitive theories, although it must be recognized that some young children, although they may have some intuitions, have not yet constructed a coherent theory at all. Methodologically, cluster-analytic techniques appear to be a useful tool in describing children’s beliefs. The challenge that remains is to further delineate the nature and evolution of naive theories of disease, as well as the factors that influence their development.

Practically, the present data constitute strong evidence in favor of earlier and more aggressive AIDS education than is currently being provided. Ideally, this education would be based on a careful analysis of children’s existing beliefs and the broader theories in which they may be embedded. It would seek to replace faulty intuitions with sound ones. Such education might need to take different forms for members of different “theoretical schools.” For instance, undifferenti-
ated thinkers, and perhaps “no clue” thinkers as well, may need basic grounding in the distinction between infectious and noninfectious diseases before they are ready to understand AIDS. Germ theorists may merely need to learn that the particular “germ” that causes AIDS is transmitted through the medium of blood but not through air or saliva; they would then be able to grasp why some forms of drug use cause AIDS and others do not. At the higher grade levels, some students need to be convinced that contact with other people’s blood can be dangerous, while others need to be disabused of their fears of donating blood or being bitten by mosquitoes. Especially during the late elementary school years, when representatives of several theoretical camps are likely to populate the same classroom, educators may want to group like-minded children together and engage them in debates with members of other “camps.” In this way, children can be helped to understand why they are wrong to fear that they can get AIDS from a sneeze or a touch, from smoking cigarettes, or even from failure to believe in God.

REFERENCES


