Interattitude Structure and Attitude Dynamics

A Comparison of the Hierarchical and Galileo Spatial–Linkage Models

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*Theories of attitude change have failed to identify the architecture of interattitudinal structures and relate it to attitude change. This article examines two models (a hierarchical and a spatial–linkage model) of interattitudinal structure that explicitly posit consequences for attitude change. An experiment (*N *= 391) was conducted that manipulated type of hierarchy (explicit versus implicit), whether the hierarchy was primed or not, and the location in the hierarchy to which a message was directed. Whereas the hierarchical model predicts only top–down influence of attitudes on each other, a spatial–linkage model predicts that linked attitudes may influence each other regardless of hierarchical position. The results support the spatial–linkage model in that interattitudinal change is constrained less by a concept's relative position in a hierarchical structure than by the concept's association with other concepts in that structure. Furthermore, within these interattitudinal structures, concepts directly targeted by a persuasive message often exhibit less attitude change than related concepts to which the focal concept appears to be linked. Finally, an explicit hierarchy of concepts appears to facilitate interattitudinal influence much more than an implicit hierarchy of concepts does; the key to this facilitation seems to be the mental accessibility of the organizational structure.*

Attitudes have been conceptualized as simple evaluations of an object, associations of objects in memory, arguments for or against a given proposition, or knowledge about a conceptual domain, and beliefs (e.g., Eagly & Chaiken, 1993; Fazio, 1989; Kerlinger, 1984). The many conceptualizations of attitude extant in the literature raise questions regarding the organization, or structure, of related attitudes. If there were absolutely no attitude structure, then people might possess random

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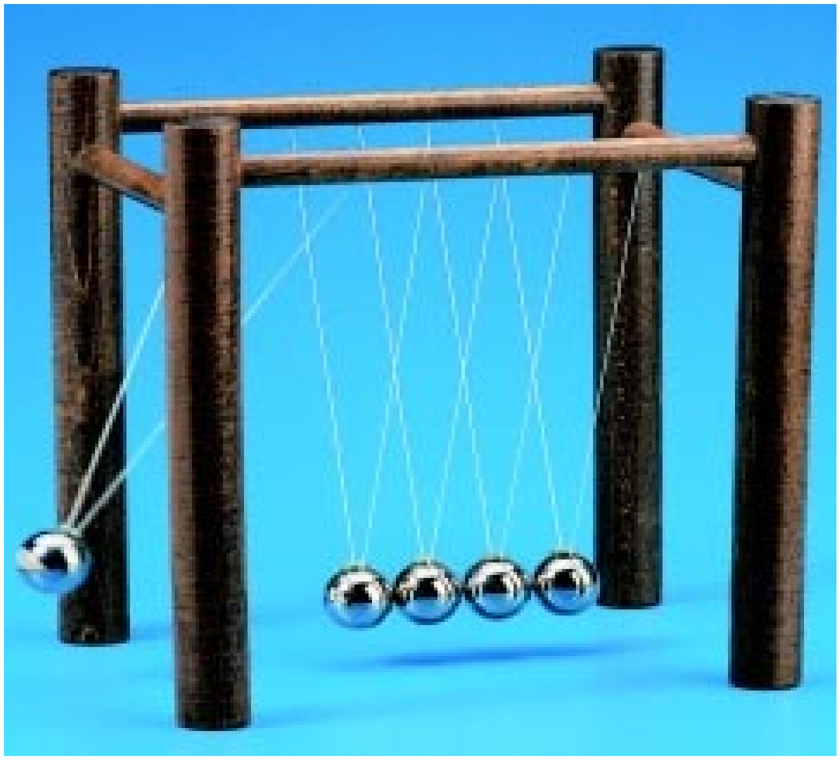

Figure 1. A Newtonian Demonstrator

assortments of unassociated thoughts and feelings, but we know that this is not the case (Eiser, 1994). Thus, one goal of attitude researchers is to determine the global mental structures that encompass multiple attitudes and facilitate the ability to store, access, and manage the affect and information contained in attitudes (i.e., interattitudinal structure). This article uses the attitude-change process to investigate and determine interattitudinal structures.

Consider the Newtonian demonstrator, a device in which five steel balls, each at the end of a thin line of rigid wire, hang in a linear series (Figure 1). If the first ball in the series is pulled back and then released, it swings back to the series and hits the next ball (ball #2). Ball #2 does not move, however. The force from ball #1 moves through balls #2–4, and causes ball #5, at the other end of the series, to move.

What if persuasive messages act like the force that moves ball #1, and the target concept of the persuasive message acts like ball #2? In that case, persuasive messages could induce change in concepts linked to the focal concept of a persuasive message (e.g., ball #5), even if there was no attitude change toward the focal concept itself (e.g., ball #2 does not move). In this study, we examine and test two interattitudinal structures for their implications for attitudinal dynamics; the Newtonian demonstrator provides one way of looking at the interrelationship of structure and dynamics to which we will return.

INTERATTITUDINAL STRUCTURE

The building blocks of interattitudinal structure are, of course, attitudes. A person may hold related attitudes about different objects (e.g., "I like the beach *and* I like the mountains for vacationing") or may hold different attitudes about a single object (e.g., "I am not in favor of legalized abortion; I am in favor of abortion for my teenage daughter"). Thus, a formidable part of attitude research has been the attempt to determine the structure of associated attitudes in order to understand how individual attitudes interact, and how such interaction might affect how attitudes are formed, maintained, and changed (e.g., Eagly & Chaiken, 1993; Petty & Krosnick, 1995; Pratkanis & Greenwald, 1989).

Research across disciplines, in areas such as spreading activation and priming, has demonstrated how interrelated concepts and ideas, such as attitudes and beliefs, can significantly affect one another (e.g., Anderson, 1983; Domke, Shah, & Wackman, 1998; Iyengar & Kinder, 1987; Klinger & Greenwald, 1995; Wyer & Srull, 1989). Moreover, this research has provided evidence for the important role of structure in explaining the dynamics of interrelated attitudes (e.g., Fazio, 1993; Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Thomsen, Lavine, & Kounios, 1996). Judd, Drake, Downing, and Krosnick (1991) have proposed a structure of attitudes in memory characterized by the dynamic property of spreading activation, in which the activation of one bit of information increases the probability of activation of linked information (p. 200). Similarly, Tourangeau, Rasinski, and D'Andrade (1991) have presented evidence that attitudes are structures in memory that encompass linked beliefs about an issue, that the act of retrieving any one particular belief can activate the retrieval of linked beliefs, and that structural linkages facilitate attitude formation.

TWO MODELS OF ATTITUDE CHANGE

In an effort to understand attitudinal structure's influence on attitude change, two models will be examined. Each hypothesizes a specific interattitudinal structure and makes testable predictions about the conditions of attitude change among related attitudes

The Hierarchical Model

A hierarchy is a system in which concepts are ranked one above another; typically, as one moves down a hierarchy, there are an increasing number of concepts per level. Hierarchies provide logical structure to, and imply relationships between, concepts. People tend to use structures like hierarchies to categorize concepts; a hierarchical structure therefore seems to be a good candidate to represent attitude objects (Jackendoff, 1992).

If concepts are organized hierarchically, then the hierarchy should have an effect on attitude stability and change with respect to the included concepts. Poole and Hunter (1979) and Hunter, Levine, and Sayers (1976, 1984) have proposed that at least some attitude objects can be organized hierarchically. According to Hunter et al. (1984), attitude concepts organized hierarchically have attitudes that could themselves be organized into "logical classes or subclasses that form superordinate–subordinate relationships with each other" (p. 231). Hunter et al. suggested an isomorphism between a hierarchy of attitude concepts and a hierarchy of attitudes towards those concepts. They did not distinguish between attitude and concept hierarchies, which has resulted in a failure to clarify the kinds of expressions (e.g., "I like the concept" or "the concept is good") that they consider when they measure attitudes. Thus, the hierarchical model has some ambiguity.

For any particular conceptual hierarchy, Hunter et al. (1976, 1984) asserted that messages directed toward the top of the hierarchy can affect attitudes toward concepts at lower levels of the hierarchy (i.e., "top–down" influence). This prediction leads to our first hypothesis:

> H1: When an individual receives a persuasive message directed toward a superordinate concept in a particular concept hierarchy, attitude change will occur with respect to concepts subordinate in the hierarchy.

Hunter et al. (1976) concluded that "the model assumes that downward influences are so much stronger than upward influences that the upward influences can be ignored" (p. 6).[1] Furthermore, they found little empirical evidence of upward influence. (Hunter, personal communication, March 25, 1999, asserted that evidence for bottom–up influence among attitudes organized in a hierarchy had not been found in his research.) Thus, the second hypothesis:

> H2a: When an individual receives a persuasive message directed toward a subordinate concept in a particular concept hierarchy, attitude change will occur for the targeted concept but not for any superordinate concept.

In addition to predicting the absence of upward influence among attitudes, Hunter et al. (1984) posited that "concepts that are located side-by-side in a concept hierarchy represent mutually exclusive sets. Thus, from a purely logical point of view, there is no sideways influence" (p. 233). We define concepts that are at the same level in a hierarchy as *equipollent* concepts. Thus, our third and final hypothesis from the hierarchical model of attitude change:

H3a: When an individual receives a persuasive message directed toward a subordinate concept in a particular concept hierarchy, attitude change will occur for the targeted concept but not for any equipollent concept.

As previously mentioned, there seems to be some ambiguity about the kinds of relationships that would satisfy Hunter et al.'s (1984) definition that a hierarchy contains "an attitude toward a *logically* [emphasis added] superordinate concept . . . [which] acts as a source of messages about the given concept" (p. 231). Hunter et al.'s elaboration of the definition simply suggests that "concepts can be frequently organized into *logical* [emphasis added] classes or subclasses that form superordinate–subordinate relationships with each other" (p. 275). These statements imply that the hierarchical model applies to concepts that people consistently conceptualize as being hierarchical without much thought. That is, there are some sets of concepts that, when presented as a set, directly suggest a hierarchical organization; the hierarchy is available and easily accessible when an individual is presented with the set of concepts. This type of hierarchical relationship will henceforth be referred to as *explicit*. Concepts with explicit hierarchical relationships are superordinate, subordinate, or equipollent to each other as a result of their denotative meanings, and there is general consensus about the location of these concepts in the hierarchy. One explicit hierarchy would be the taxonomic scale for the classification of animals (i.e., kingdom, phylum, class, order, family, genus, species); regardless of the context in which one sees a monkey, for example, a monkey will always be a mammal within the animal kingdom taxonomy.

People, however, can and do organize all kinds of concepts into hierarchies, often based on context-dependent meanings rather than denotative meanings. People create these kinds of hierarchies, because hierarchical organization seems to be an easy way for people to manage the concepts that they know. Jackendoff (1992) explained that people encode the entities that are considered relevant to a domain of interest and then develop a system of categories for these entities. Then people consider the situations in which these entities might be encountered and within which their meaning can be understood (p. 8). Such a process of categorization can give rise to *implicit* hierarchies, or hierarchies of concepts for which there are super- and subordinate relationships between more abstract and more specific concepts, but these relationships are not embedded in the meanings of the concepts in the same way as explicit hierarchies. For example, an individual might construct the following implicit hierarchy: relationships (superordinate) → friendship and love (mid-level) → co-workers and gym buddies (subordinate to friends) → and parents and spouse (subordinate to love). Concepts in implicit hierarchies like this are—at least temporarily—semantically related; however, the particular hierarchical organization of this particular set of concepts is subject to change as different meanings for the concepts develop or are invoked (Tversky & Gati, 1978). Recall that such context dependence is not present for explicit hierarchies.

Explicit hierarchies are more readily apparent to individuals, and their emergence does not depend on the context of the concepts; as a result, explicit hierarchies should be more psychologically accessible than implicit hierarchies. That is, if accessibility is defined as the activation potential of available knowledge (Higgins, 1996, p. 134), then an explicit hierarchy should be available and accessible as a function of the presence of several members of the hierarchy. The dependence of an implicit hierarchy on situational or contextual factors suggests that implicit hierarchies are less accessible than explicit hierarchies. It is, therefore, hypothesized that:

H4: Explicit hierarchies are more accessible than implicit hierarchies.

If an implicit hierarchy is, indeed, less accessible than an explicit one, this difference is expected to affect attitude change within the hierarchical structure. Attitude change should occur more easily over accessible links as opposed to links that are less accessible (as in the case of the implicit hierarchy). In other words, accessibility functions as a lubricant that facilitates attitude change: In the explicit hierarchy we expect that the propagation of change from one concept to another will occur with little effort.

Explicit hierarchies are unlikely to have their accessibility increased by priming because their accessibility is already at or near its upper limit. On the other hand, implicit hierarchies are likely to have their accessibility increased by priming, because their accessibility is far from its upper limit. Thus, we hypothesized that:

H5: Priming an explicit hierarchy will have little or no effect on attitude change within it, whereas priming an implicit hierarchy will.

A Spatial–Linkage Model: Galileo

A general spatial model of attitudes represents psychological distances between concepts (attitude objects) in a spatial coordinate system; the more similar or closely related two concepts are, the less the psychological distance between them (Woelfel & Fink, 1980; see also Abelson, 1967; Kruskal & Wish, 1978; Torgerson, 1958). The space becomes a model of the cognitorium of the individual who generated it. Attitude change is represented by the movement of the concepts in that space.

One particular spatial model is the Galileo spatial–linkage model, described in detail by Woelfel and Saltiel (1988; see also Kaplowitz & Fink, 1988; Woelfel & Fink, 1980).[2] The Galileo spatial–linkage model describes and predicts the movements of concepts in the space. According to Woelfel and Fink (1980), the Galileo spatial–linkage model "defines cognitive . . . processes as changes in relations among sets of cultural 'objects' or concepts. Cognitive . . . processes may be defined within the framework as motions of these objects relative to the other objects within the space" (Preface, p. x).

The space for a set of concepts is defined by the psychological distances between every possible pair of concepts, typically assessed through paired-comparison magnitude-scale judgments. Once a space has been defined for a group of concepts, the motions of the concepts within the space can be addressed. Woelfel and Fink (1980) suggested that the motions conform to the laws of Newtonian physics. Specifically, the Galileo spatial–linkage model of attitude change starts with a multidimensional space. In this space are attitude objects (concepts). A message directed toward an attitude object can be seen as imparting a force on that object; the amount of movement (attitude change) is a function of that force. Finally, associated attitude objects can be linked as if by a spring (Kaplowitz, Fink, & Bauer, 1983; Woelfel & Fink, 1980); thus, the motion of an attitude object will affect the motion of concepts linked to that object.

The Galileo spatial–linkage model, in contrast to the hierarchical model, predicts attitude change for concepts linked to a focal concept when there is a force (i.e., a persuasive message) that impacts the focal concept. Recall our earlier discussion of the Newtonian demonstrator: If a persuasive message acts like ball #1, and the target concept of the persuasive message acts like ball #2, then all of the linked balls have the potential to move under the right circumstances, even if ball #2 does not move. Similarly, the Galileo spatial–linkage model predicts that persuasive messages will induce motion in concepts linked to the focal concept without the necessity of attitude change in the focal concept itself.

The Galileo spatial-linkage model makes some predictions that are consistent with the predictions of the hierarchical model. H1, above, will be considered a convergent hypothesis, support for which indicates support for both the hierarchical and Galileo spatial–linkage models. The predictions of the models diverge for H2 and H3, which will therefore provide the basis for inferring which of the models may be correct. The Galileo spatial–linkage model's predictions with respect to upward and sideways influence are:

H2b: When an individual receives a persuasive message directed toward a subordinate concept in a particular concept hierarchy, the force of that message will cause attitude change that will result in motion in linked superordinate concepts in that space.

H3b: When an individual receives a persuasive message directed toward a subordinate concept in a particular concept hierarchy, the force of that message will cause attitude change that will result in motion in linked equipollent concepts in that space.

METHOD

Overview

In the study, participants were randomly assigned to one of 28 questionnaire conditions: 2 (Hierarchy: explicit versus implicit) x 2 (Priming: primed versus unprimed) x 3 (Message Target: superordinate versus subordinate 1 versus subordinate 2 concept) x 2 (Question Order: ascending versus descending) plus two control groups (explicit and implicit, each with two question orders).

Participants

The sample consisted of 391 students (119 men, 271 women, and 1 unidentified) enrolled in communication courses at the University of Maryland. The necessary sample size had been estimated prior to sampling. A target sample size of 336 was calculated as the minimal sample necessary to afford the study a .05 level of significance and .80 power to detect a critical effect size of $\Delta = .50$ in an ANOVA with the control groups excluded (see Kraemer & Thiemann, 1987, p. 42, for the definition of Δ).

Measures and Manipulations

Explicitness of Hierarchy

The variable hierarchy had two levels, implicit and explicit. Two pilot studies were conducted to generate a domain of concepts that would be

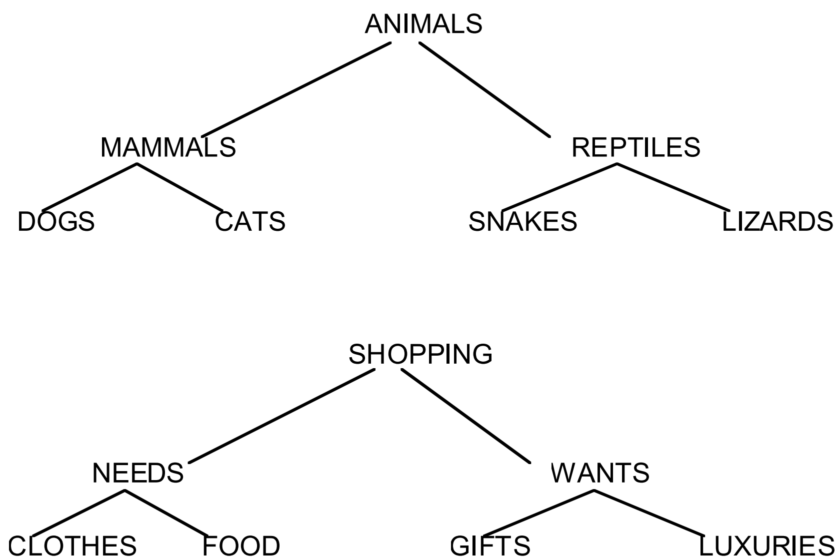

Figure 2. The Two Hierarchies: (a) Explicit Hierarchy, (b) Implicit Hierarchy

relevant to the proposed study sample and determined the explicit and implicit concept hierarchies that would be manipulated.[3] Similar to the hierarchies used by Hunter et al. (1984), each of the study's hierarchies consisted of one superordinate concept, two mid-level subordinate concepts, and four bottom-level subordinate concepts (each mid-level concept being superordinate to two bottom concepts). Figure 2 shows the two hierarchies. The explicit hierarchy involved the names of animals, whereas the implicit hierarchy involved concepts related to shopping. Two additional concepts, *things I like* and *good*, were added to the seven hierarchical concepts in the questionnaire to allow the assessment of attitudes (see below for a detailed discussion of attitude measurement).

Priming of Hierarchy

To determine the effect of hierarchy accessibility on attitude change, each hierarchy had a primed, unprimed, and control condition (see Higgins, 1996, p. 134, for a discussion of priming and accessibility). In the primed condition, participants were asked to study a diagram of one of the hierarchies at the beginning of the questionnaire prior to reading the experimental message and answering paired-comparison judgments. They then completed the paired-comparison judgments for the concepts in that hierarchy.

In the unprimed condition, participants were also asked to study a diagram of an experimental hierarchy at the beginning of the questionnaire. Unprimed participants, however, received an experimental message and completed paired-comparison judgments for concepts in the experimental hierarchy that they were not shown. (Primed participants were coded "1," unprimed participants were coded "2.")

In the control conditions, participants were asked to study a diagram of a hierarchy of plant types, which was neither the explicit nor the implicit hierarchy, and they did not receive an experimental message prior to completing the paired-comparison judgments regarding either the implicit or explicit set of concepts.

Message Targets

There were six variations of the message "X is good" used to induce attitude change where X was a target concept from a hierarchy. The message and its supportive arguments were contained within a short passage (7 sentences, about 175 words) about college student self-esteem (see Appendix). Within each hierarchy, there was a message for each target (the superordinate concept, subordinate concept 1, or subordinate concept 2). The messages directed toward the superordinate target were "Animals are good" (explicit hierarchy) and "Shopping is good" (implicit hierarchy). The messages directed toward the first subordinate target were "Dogs are good" (explicit) and "Clothes are good" (implicit). The messages directed toward the second subordinate target were "Cats are good" (explicit) and "Food is good" (implicit). These kinds of messages have been shown to induce attitude change successfully (see Woelfel, Holmes, Newton, & Kincaid, 1988).

Contrasts

Two variables representing planned contrasts (super and sub) were created for use in the structural equation model analyses. First, super differentiated messages to the superordinate concept versus messages to either targeted subordinate concept. Participants who received a message directed toward the superordinate concept were assigned a value of 1 for super, and participants who received a message directed toward either subordinate concept were assigned a value of -0.5. Second, sub differentiated messages to subordinate concept 1 versus messages to subordinate concept 2. Participants who received a message directed toward the superordinate concept were assigned a value of 0 on this variable; participants who received a message directed toward subordinate concept 1 received a value of 1; participants who received a message directed toward subordinate concept 2 received a value of -1.

Gender

The variable gender was added to hierarchy, priming, and message target as an exogenous variable because a preliminary examination of the data suggested gender differences in response to the hierarchies. (Men were coded "1," women "2").

Explicitness

As previously discussed, explicit hierarchies should be more accessible than implicit hierarchies—and therefore easier for participants to recreate. To measure accessibility, each participant was asked to recreate a hierarchy using concepts in a list that included, but was not limited to, the concepts of interest in their hierarchy. This task occurred after the attitude measures, near the end of the questionnaire. To measure the correctness of the recreated hierarchy, a measure called hierarchy score was created. The hierarchy score was a 0–7 point rating of the correctness of a recreation when compared to the relevant experimental hierarchy. Participants received one point for each element of the hierarchy that appeared in its proper place in the hierarchy, relative to other elements of the hierarchy. To assess the reliability of this score, two independent coders rated a random sample of 50 hierarchy drawings (the intercoder $r = .92$).

Manipulation Check: Priming

If priming was successful in making a hierarchy more accessible, participants who were primed with a picture of the hierarchy they were consequently asked to recreate should have been more likely to recreate it correctly than participants who were not primed. Therefore, hierarchy score was also used as a manipulation check for priming.

Manipulation Check: Message Target

An open-ended question asked participants to recollect the original message and supporting arguments that they had read; they were to list what they considered to be the three main points of the passage. Participants' responses were coded to reflect whether they recollected that the passage they read stated "X is good" or "X increases self-esteem," where X indicates the target concept to which they were exposed.

Attitudes Toward Targeted Concepts

Consistent with our conceptualization of attitudes as linkages between objects and evaluations, and also consistent with our stated purpose to investigate interattitudinal structure, magnitude estimates of the psychological distance between concepts were employed. Participants were asked to make paired-comparison judgments for every pair of concepts in the hierarchy, relative to a hierarchy-specific *yardstick* (reference dissimilarity). Attitude was defined as the distance (dissimilarity) between an attitude object (e.g., animals or shopping) and the evaluation "good." Based on pilot studies, for the explicit hierarchy, the reference yardstick was the distance between snakes and lizards; for the implicit hierarchy, the yardstick was the distance between gifts and wants (see Neuendorf, Kaplowitz, Fink, & Armstrong, 1987, for discussion of procedures for development of an appropriate yardstick).

From these proximity measures, three attitude variables were created for use in the structural equation models: supergood, the transformed distance between the superordinate concept (e.g., animals or shopping) and the good concept; sub1good, the transformed distance between subordinate concept 1 and the good concept; and, sub2good, the transformed distance between subordinate concept 2 and the good concept.

For example, in the explicit hierarchy, after careful training, participants were asked:

> *Snakes and lizards are 100 units apart.*
> . . .
> How far apart are . . .
> 1. Animals and Good?

Participants were instructed that they could respond with any nonnegative number.

Next, the reported distances had outliers recoded and were adjusted to be consistent with a yardstick of 100 units. Then they were logarithmically transformed to improve the normality of their distribution. Finally, each of these distances was adjusted to control for participant differences in the magnitude of numbers that they tend to use. For each participant, on each of these three variables, the average transformed distance of concepts in that participant's space (i.e., the variable averagespan) was subtracted from the original distance; averagespan eliminated the effect of individual differences in space size on the endogenous variables. As stated above, these transformed values were used to represent attitudes.[4]

Attitudes Toward Nontargeted Concepts

Using the same procedures as for the attitudes toward the manipulated concepts (see above), a new variable, midgood, was created for each hierarchy. It was the sum of four transformed distances: the transformed distance between each of the four nontargeted concepts (e.g., in the explicit hierarchy: mammals, reptiles, snakes, and lizards) and the concept good. This variable comprises a set of concepts that are not directly targeted by the persuasive message; as a result, changes in this variable represent the spread of attitude change across the concepts of the hierarchy.

Procedures

After granting informed consent, participants were given a questionnaire to complete. The first part of the questionnaire asked participants to read a fictional research passage regarding college students' self-esteem. Participants were then asked to underline the main points of the passage, circle the most important point, and finally formulate arguments in favor of the message "X is good," where X was one of the six experimentally manipulated concepts. Participants in the control condition read the same passage as participants in the experimental conditions to the point of the experimental message (where their passage ended). All participants were given 5 minutes to write their arguments and instructed to keep trying to generate reasons why "X is good" (or, for the control, what affects college students' self-esteem) even if they thought they had run out of things to write. Participants were asked to formulate arguments so that the messages would be cognitively processed. The manipulation check for message target evaluated the extent to which this goal was achieved by assessing recall of the arguments that the participants received. Participants then completed the paired-comparison judgments and the rest of the questionnaire (manipulation checks and other measures).

Structural Equation Modeling

Structural equation modeling was employed to determine the causal relationships between the variables of interest (i.e., the impact of the attitude change messages on the attitude measures). Even though the hierarchical and Galileo spatial models make predictions about the beginning and end states of attitude change, the intermediate processes that may generate these end states are not theorized in either model and are not known a priori. That is, a generic model can be drawn to represent relationships between attitudes that are specifically suggested by the two theoretical models, but there are additional possible paths between variables whose causal order is not predicted. We decided, therefore, that automatic modification would be used to adjust the generic structural equation model to its best fitting form. Automatic modification sequentially modifies a model by specifying paths one at a time whose release would significantly improve the overall goodness of fit of the model being tested.[5]

A generic recursive structural equation model, without any modification and with all covariances between the errors of prediction fixed at zero, is illustrated in Figure 3. This model includes paths that represent

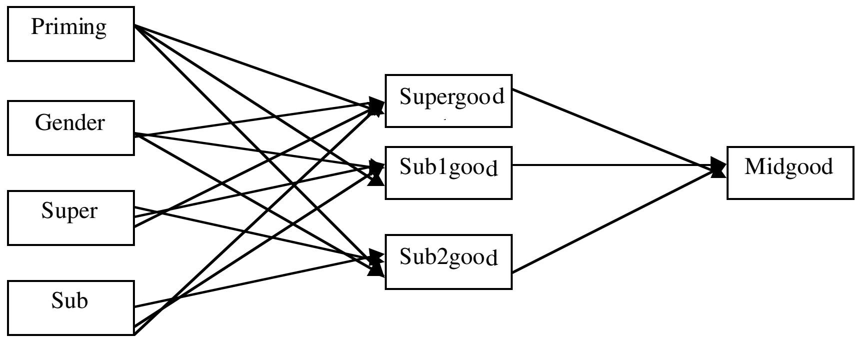

Figure 3. A Generic Recursive Structural Equation Model Designed to Test the Predictions of the Study Hypotheses
NOTE: Individual variance in estimating distances is controlled by subtracting the variable averagespan from each endogenous variable. Errors of prediction do not covary. Covariances among the exogenous variables are free.

the predictions of the hierarchical and Galileo spatial–linkage models and was the starting model input to the LISREL structural equation modeling computer program (Jöreskog & Sörbom, 1993) for both the explicit and implicit hierarchy conditions.

Each of the four exogenous variables (priming, gender, super, and sub) was allowed to affect the attitudes toward the targeted concepts (i.e., their paths were free). For priming, super, and sub, these paths represent specific model predictions. Gender had been found to affect the attitude variables; therefore, we also included it as an exogenous variable affecting all message target variables.

According to the hierarchical and Galileo spatial–linkage models, attitudes can affect related attitudes in systematic ways. In the structural equation models, therefore, paths from the message target variables (e.g., supergood) to midgood were free.

There were four endogenous variables in each structural equation model. The first three endogenous variables were (a) attitude toward the superordinate concept in the hierarchy (animals or shopping), (b) attitude toward the first subordinate target concept in the hierarchy (dogs or clothes), and (c) attitude toward the second subordinate target concept in the hierarchy (cats or food). Each of these three endogenous variables, in turn, had a path to the fourth endogenous variable, a measure of attitudes toward the nontargeted concepts (i.e., midgood). This fourth variable initially had no direct paths from the exogenous variables; it was initially set to be caused only by the other attitudes represented in the model. That is, significant paths from attitudes about message targets to this fourth endogenous variable represented the possible spread of attitude change.[6]

The generic model was estimated twice, once for the set of explicit concepts and once for the set of implicit concepts. We used full-information maximum likelihood estimation.[7] Bentler and Chou (1988) have suggested that structural equation model estimates require a ratio of sample size to the number of free parameters to be greater than 5.00. This ratio was exceeded in both experimental conditions (implicit hierarchy, 5.17; explicit hierarchy, 5.13).

RESULTS

Preliminary Analyses

Manipulation Check: Priming

The manipulation check for priming was the degree of correctness of the recreation of the experimental hierarchy: Primed participants should be more likely to recreate a hierarchy correctly than unprimed participants. In a 2 (Hierarchy) x 2 (Priming) x 2 (Gender) x 3 (Message Target) between-subjects factorial design, participants who were primed had higher hierarchy scores ($M = 5.76$, $SD = 1.98$) than participants who were unprimed ($M = 4.48$, $SD = 2.24$), $F\ (1, 330) = 22.78$, $p < .001$, $\eta^2 = .07$. The interaction of hierarchy and priming was not significant.

Manipulation Check: Message Target

We asked participants, via an open-ended question, the main points of the passage that they had read. Eighty-one percent of non-control participants recalled correctly that their passage contained the message "X is good" or "X increases self esteem," where X indicates the target concept to which they were exposed ($\chi^2\,[1, 331] = 124.50$, $p < .001$ with a null hypothesis of 50% expected). It was inferred that message target was successfully manipulated.

Model Fit

A summary of the goodness of fit indices for the models can be found in Table 1; the covariance matrices for the models are presented in Tables 2 and 3. An absolute fit index (Adjusted Goodness of Fit Index [AGFI; Jöreskog & Sörbom, 1989]), a relative fit index (Bentler-Bonett Normed Fit Index [NFI; Bentler & Bonett, 1980]), and the Standardized Root Mean Square Residual (SRMR)—which, according to Hu and Bentler (as cited in Bentler, 1995) discriminates between fitting and misspecified models substantially better than any other fit index (p. 272)—are reported. Both of the models demonstrated a good fit; each produced positive squared multiple correlations of the structural equations, and an acceptably low

TABLE 1
Goodness of Fit Indicators for Structural Equation Models

	df	χ^2(p)	*CFI*	*NFI*	*AGFI*	*SRMR*	R^2 *for structural equations*[a]
Explicit[b] (Figure 4)	4	2.58 (.63)	1.00	.99	.96	.018	.25, .49, -.01, .25
Implicit[c] (Figure 5)	5	2.30 (.81)	1.00	.99	.97	.015	.07, .50, .05, .14[d] .07, .05, .50, .14[e]

NOTE: Degrees of freedom reported are after automatic modification.
[a] For the following endogenous variables: the set of nontargeted concepts, the superordinate concept, the subordinate concept 1, and the subordinate concept 2, respectively.
[b] *n* = 154.
[c] *n* = 150.
[d] When the ambiguous path is forced to run from sub1good to supergood.
[e] When the ambiguous path is forced to run from supergood to sub1good.

chi-square value with an associated $p > .05$. Consistent with guidelines for good fit (see, e.g., Hu & Bentler, 1999), the AGFI and NFI values were greater than .90 and the SRMR values were below .08 for the final models.

Implications of Automatic Modification

Automatic modification freed significant paths in both models: three paths in the explicit model and two paths in the implicit model. Furthermore, in the implicit model, one iteration of the automatic modification resulted in a circumstance in which both a path and the one representing the reverse direction (i.e., the path from sub1good to sub2good and the

TABLE 2
Covariance Matrix for the Explicit Structural Equation Model

	Midgood	*Supergood*	*Sub1good*	*Sub2good*	*Priming*	*Gender*	*Super*	*Sub*
Midgood	3.8450							
Supergood	.5228	.3257						
Sub1good	.2623	.2832	.4772					
Sub2good	.6202	.1729	.2118	.4612				
Priming	-.0129	.0055	.0554	.0513	.2465			
Gender	-.0083	.0207	-.0039	-.0170	-.0065	.2184		
Super	.1069	-.0459	-.0814	.0380	-.0042	-.0009	.4966	
Sub	.0710	-.0169	-.0299	-.0772	-.0009	-.0107	.0064	.6796

NOTE: *N* = 154.

TABLE 3
Covariance Matrix for the Implicit Structural Equation Model

	Midgood	*Supergood*	*Sub1good*	*Sub2good*	*Priming*	*Gender*	*Super*	*Sub*
Midgood	2.0849							
Supergood	.0941	.4273						
Sub1good	-.0062	.2837	.3883					
Sub2good	.2254	.1293	.1371	.4732				
Priming	.0034	-.0125	-.0045	.0517	.2441			
Gender	-.0338	-.0624	-.0153	.0158	.0242	.2114		
Super	-.0068	-.0154	.0107	-.0381	-.0203	-.0322	.4816	
Sub	-.0121	-.0137	.0302	.0209	.0563	.0322	-.0494	.6865

NOTE: N = 150.

path from sub2good to sub1good) had equal modification values from which the LISREL computer program's decision tree could choose.

The program's choice for freeing paths that have equal modification indices is arbitrary. As a result—although the choice did not ultimately affect support of the hypotheses—it was necessary to discover the model results if the program had arbitrarily chosen the alternative path that had an equal modification index. The implicit model was subsequently modified and rerun as if the program had arbitrarily chosen the other path. As specified, the direction of the path changed but the (unstandardized) magnitude changed only slightly (from .73 to .69). The model in Figure 5 represents this "ambiguous" path with two separate arrows and two starred path coefficients. Note that for ease of interpretation, only significant path coefficients are displayed in the figures.

Tests of Hypotheses

Hypothesis Regarding Attitude Change in the Superordinate → Subordinate Direction

The first hypothesis addresses conditions that are predicted by both the hierarchical and the Galileo spatial-linkage models, namely that attitudes about a superordinate concept should affect attitudes about subordinate concepts.

The effects that attitudes about a superordinate concept have on attitudes about a subordinate concept can be seen in two places in the models. First, significant paths from the exogenous variable super (the manipulated message target) represent the direct effect of a persuasive message directed toward a superordinate concept versus the effect of a

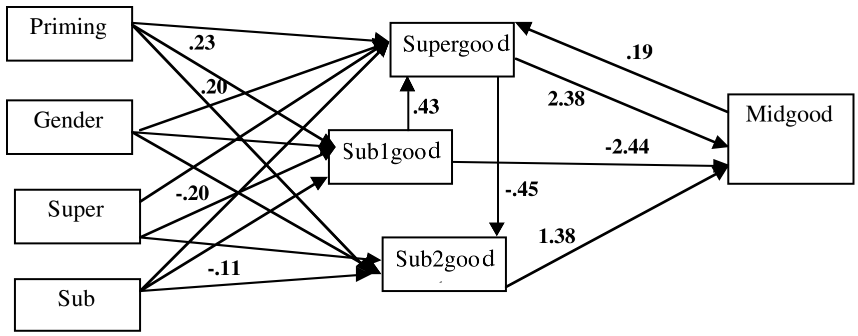

Figure 4. Results of the LISREL Structural Equation Model for the Explicit Hierarchy Condition

NOTE: Only significant ($p < .05$) path values are indicated; path values are unstandardized. Errors of prediction do not covary. Covariances among the exogenous variables are free. The variable priming represents primed (coded 1) versus unprimed (coded 2) participants. The variable gender represents men (coded 1) versus women (coded 2). The variable super differentiates messages to the superordinate concept (coded 1) versus messages to either targeted subordinate concept (coded -.5). The variable sub differentiates messages to subordinate concept 1 (coded 1) versus messages to subordinate concept 2 (coded -1) and to the superordinate concept (coded 0). The variable supergood represents the transformed distance between the superordinate concept and the good concept (i.e., attitude toward animals). The variable sub1good represents the transformed distance between subordinate concept number one and the good concept (i.e., attitude toward dogs). The variable sub2good represents the transformed distance between subordinate concept number two and the good concept (i.e., attitude toward cats). The variable midgood represents the sum of the transformed distances between each of the four nontargeted concepts and the concept good.

persuasive message directed toward a subordinate concept. One of these paths was significant in the explicit model (see Figure 4); none were significant in the implicit model (see Figure 5). In the explicit model, the path from super to sub1good (i.e., the evaluation of dogs) was significant and negative; receiving the message "Animals are good" caused participants to evaluate dogs as better than did participants who received other messages (e.g., "Dogs are good," or "Cats are good").[8] This result supports H1 in the explicit model because the message about animals (superordinate) affected attitudes about dogs (subordinate).

Second, the effect that attitudes about a superordinate concept have on attitudes about a subordinate concept can also be seen in significant paths than emanate from the superordinate-concept endogenous variable in each model. That is, the relevant significant paths are from attitudes toward animals or shopping to any other endogenous variable in the model, all of which are subordinate to animals or shopping. These significant paths represented the direct influence of attitudes about a superordinate

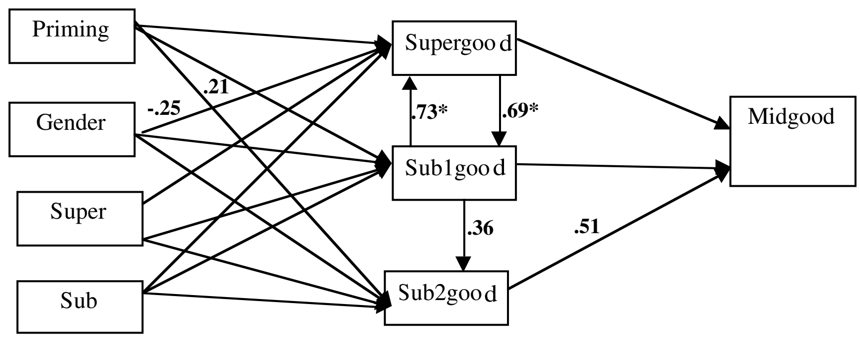

Figure 5. Results of the LISREL Structural Equation Model for the Implicit Condition
NOTE: Only significant ($p < .05$) path values are indicated; path values are unstandardized. Starred path values indicate ambiguous paths (see text for explanation). Errors of prediction do not covary. Covariances among the exogenous variables are free. The variable supergood represents the transformed distance between the superordinate concept and the good concept (i.e., attitude toward shopping). The variable sub1good represents the transformed distance between subordinate concept number one and the good concept (i.e., attitude toward clothes). The variable sub2good represents the transformed distance between subordinate concept number two and the good concept (i.e., attitude toward food). The variable midgood represents the sum of the transformed distances between each of the four non-targeted concepts and the concept good.

concept on attitudes about a subordinate concept. There are a number of such significant paths in the models:

In the explicit model, the path from the evaluation of animals significantly and positively affected the evaluation of both cats and the non-targeted distances: Positive sentiment toward animals caused positive sentiment toward both cats and the set {mammals, reptiles, snakes, and lizards}, all concepts that are subordinate to animals. This result supports H1.

In the implicit model, the path from the evaluation of shopping to the evaluation of clothes was ambiguous; the significance of the path could not support any hypothesis. Recall that an ambiguous path is one in which both directions of the path (i.e., from sub1good to sub2good and from sub2good to sub1good) possessed equal index values during automatic modification; thus, the "true" direction of the path is unknown.

Hypotheses Regarding Attitude Change in the Subordinate → Superordinate Direction

H2a and H2b represent divergent predictions that the theoretical models make. Hunter et al.'s (1976) model indicated that attitudes about concepts should not affect attitudes about concepts that are superordinate to them. Woelfel and Fink's (1980) model posited that all linked concepts, regardless of hierarchical position, can and do affect each other.

The effects that attitudes toward a subordinate concept have on attitudes toward a superordinate concept can be seen in three places in the models. First, recall that the paths from the exogenous variable super represent the direct effect of a persuasive message directed toward a superordinate concept versus the direct effect of a persuasive message directed toward a subordinate concept. A significant positive path from super to any superordinate endogenous variable would suggest that messages directed toward a subordinate concept directly affected attitudes about superordinate concepts. There were no such significant paths in either the explicit or implicit models.

Second, the effects that attitudes toward a subordinate concept have on attitudes toward a superordinate concept can be seen in significant paths that come from subordinate endogenous variables to the superordinate endogenous variables. These significant paths were not part of the original model, but were added during automatic modification. In the explicit model there was a significant and positive path from attitude toward dogs to attitude toward animals: The more dogs were viewed as good, the more animals were viewed as good. This result supports H2b.

In the implicit model, there was an ambiguous path from the evaluation of clothes to the evaluation of shopping; the significance of the path could not support any hypothesis.

Finally, the effects that attitudes toward a subordinate concept have on concepts superordinate to them can be seen in significant paths from the single-concept subordinate endogenous variables to the nontargeted attitudes. These upward effects were included with the effects that attitudes about a subordinate concept have on attitudes about an equipollent subordinate concept (which will be discussed further below). Even though the set of nontargeted attitudes includes both concepts that are superordinate and concepts that are equipollent to subordinate concepts 1 and 2, significant paths from attitudes about subordinate concepts 1 and 2 to the set of nontargeted attitudes aids in evaluation of the hypotheses, because both subordinate → superordinate and subordinate → equipollent influences contradict Hunter et al.'s (1976) predictions.

In the explicit model, there was a significant and negative path from evaluations of dogs to the set of nontargeted attitudes. The more dogs were evaluated as good, the more the set {mammals, reptiles, lizards, and snakes} was evaluated as bad. Furthermore, there was a small, but significant, path from the evaluation of the set to the evaluation of animals. Finally, in the explicit hierarchy condition, there was a significant and positive path from the evaluation of cats to the set of nontargeted attitudes.

The evaluation of cats directly affected the evaluations of the set. All of these significant paths support H2b and H3b.

In the implicit model there was one significant and positive path from the evaluation of food to the set of nontargeted attitudes. If food was evaluated as good, then the set {needs, wants, gifts, and luxuries} was also evaluated as good. This finding supports H2b and H3b.

Hypotheses Regarding Attitude Change in the Subordinate → Subordinate Direction

H3a and H3b address another set of the divergent predictions that the theoretical models make. Hunter et al.'s (1976) model predicted that attitudes about concepts should not affect attitudes about concepts that are equipollent (i.e., sideways) to them. Woelfel and Fink's (1980) model suggested that all linked concepts, regardless of hierarchical position, can and do affect each other.

The effects that attitudes toward a subordinate concept have on an equipollent subordinate concept can be seen in three places in the models. First, significant paths between the single-evaluation endogenous variables and the variable midgood can represent sideways influence. These types of significant paths were discussed above.

Second, significant paths from the exogenous variable sub represent the direct effect of a persuasive message on subordinate concept 1 versus the direct effect of a persuasive message on subordinate concept 2. Recall that sub creates a distinction between participants who received a message directed toward subordinate concept 1 and participants who received a message directed toward subordinate concept 2, with a message directed to the superordinate concept having an intermediate value. A positive path from sub to attitudes about dogs or clothes (sub1good) would suggest that participants who received a message directed toward subordinate concept 2 (cats or food) liked subordinate concept 1 more than participants who received a message directed toward subordinate concept 1 itself. Such a path would be one way to reflect sideways influence.

For the explicit model, there was a significant, negative path from sub to the evaluation of cats: The message "Cats are good" caused cats to have a rating *worse* than the ratings caused by the other two messages. In addition, the message "Dogs are good" caused cats to be rated as comparatively better. This result indicates sideways influence and supports H3b. None of these types of paths was significant for the implicit model.

The third representation of sideways influence in the models comes from significant paths between equipollent subordinate-concept endogenous variables, for example, a path from attitude toward dogs to attitude toward cats. These types of paths were not part of the original model but were added during automatic modification. No such paths were added for the explicit model. In the implicit model, there was a significant and positive path from the evaluation of clothes to the evaluation of food. The greater the evaluation of clothes, the greater the evaluation of food. This finding supports H3b.

Explicitness and Accessibility

H4 predicted that explicit hierarchies would be more accessible than implicit hierarchies. Explicitness was assessed by the degree of correctness of the recreation of the experimental hierarchy: It was expected that the explicit hierarchy was more likely to be recreated correctly than the implicit hierarchy. This hypothesis was supported. First, within the control groups, in which participants saw an example of a hierarchy, but did not see either the explicit or implicit hierarchy, participants asked to draw the explicit hierarchy had higher hierarchy scores ($M = 6.19$, $SD = 1.25$) than participants asked to draw the implicit hierarchy ($M = 4.24$, $SD = 2.23$), F (1, 58) = 17.79, $p < .001$, $\eta^2 = .24$. Second, an analysis of variance of the hierarchy scores was conducted on those participants who received an experimental message (i.e., all of the participants except those in the control groups). In a 2 (Hierarchy) x 2 (Priming) x 2 (Gender) x 3 (Message Target) between-subjects factorial design, hierarchy score was found to be significantly higher for experimental participants who were asked to draw the explicit hierarchy ($M = 5.82$, $SD = 1.94$) than for experimental participants who were asked to draw the implicit hierarchy ($M = 4.59$, $SD = 2.25$), F (1, 306) = 24.88, $p < .001$, $\eta^2 = .08$.

H5 predicted that priming an explicit hierarchy would have little or no effect on attitude change within it, whereas priming an implicit hierarchy would have an effect. In the explicit model, priming caused dogs and cats to be evaluated more highly, as demonstrated by significant and positive paths from priming to both sub1good and sub2good. In the implicit model, priming caused food to be evaluated more highly, as demonstrated by a significant and positive path from priming to sub2good. Thus, contrary to H5, priming had an effect in both types of models.

Gender

Gender had a significant influence in the implicit model. There was a negative path from gender to the evaluation of shopping: Women evaluated shopping more highly than men did.

DISCUSSION

H1: The Effects of Attitudes About Superordinate Concepts on Attitudes About Subordinate Concepts

Overall, the results tended to support H1. There was evidence of the influence of attitudes about superordinate concepts on attitudes about subordinate concepts. As a result, these findings affirm predictions shared by the hierarchical and Galileo spatial–linkage models.

H2a and H2b: The Effects of Attitudes about Subordinate Concepts on Attitudes About Superordinate Concepts

There was clear evidence that attitudes about subordinate concepts affected attitudes about superordinate concepts; these results supported H2b (i.e., the Galileo spatial–linkage model), but not H2a (i.e., the hierarchical model). Attitudes about subordinate concepts significantly affected attitudes about superordinate concepts. This upward influence was represented by a direct, unambiguous path from a subordinate concept to a superordinate concept in the explicit model. For the implicit model, the upward influence was inferred from significant paths from a subordinate concept (e.g., clothes) to the set of nontargeted distances, a measure that includes superordinate concepts (e.g., needs) within it.

Interestingly, the direction of the spreading attitude change was not consistent. For example, evaluating cats highly resulted in a greater evaluation of the set {mammals, reptiles, lizards, and snakes}, but evaluating dogs highly resulted in the set to be evaluated less highly. Thus, it is not the case that the diffusion of attitude change among a set of linked concepts could be accounted for by a simple consistency explanation (e.g., the greater evaluation of any animal leading to the greater evaluation of all linked animals).

Why should attitudes about cats have different effects within the structure from attitudes about dogs? Recall that the study employed random assignment in order to achieve equivalent groups, and there was no significant difference among the message target groups within the explicit condition with respect to attitudes toward the nontargeted set of concepts (F [2, 151] = 0.60, p = .55, $\eta^2 < .01$). In the explicit model, it appears that interattitudinal influence could have started with a positive attitude toward animals spreading downward to positively affect attitudes toward cats, which in turn positively affected the nontargeted set {i.e., mammal, reptiles, snake, and lizards}. A positive attitude toward animals also directly and positively affected the nontargeted set. These changes might represent a chain of positive interattitudinal influence from which dogs are excluded. The concept dogs was found to be linked to animals, but its sideways influence, with respect to the nontargeted set, was negative.

H3a and H3b: The Effects of Attitudes About Subordinate Concepts on Attitudes About Equipollent Subordinate Concepts

The results supported H3b but not H3a. Attitudes about subordinate concepts directly and significantly affected attitudes about equipollent subordinate concepts. These effects were consistent with the Galileo spatial–linkage model rather than the hierarchical model.

It would be easy to assume that the participants in the study who positively evaluated clothes, food, and the set {needs, wants, gifts, and luxuries} simply failed to make distinctions among their consumables. This nonetheless does not explain why participants' attitudes about clothes positively affected their attitudes about food but not their attitude about the set. In spite of the significant correlations between attitudes about food and, for example, attitudes about gifts (r = .59, p < .001, n = 166, control group excluded), the evaluation of clothes did not have a significant causal effect on the evaluation of the nontargeted concepts variable that includes gifts.

H4 and H5: Explicitness and Accessibility

Consistent with our notions about how explicit and implicit hierarchies differ, the explicit hierarchy was found to be more accessible than the implicit hierarchy, for control participants as well as for experimental participants. This finding helps validate the distinction between these types of hierarchies. Future research should sample various hierarchies and examine whether they are distributed along the accessibility continuum bimodally, suggesting that our types are part of natural cognition, or whether they appear all along the continuum, suggesting that we happened to choose the endpoints of a natural continuum.

H5, which predicted that priming would affect attitude change only for the implicit hierarchy, was not supported. The hypothesis assumed that the explicit hierarchy was as accessible as it could be, and that priming could not increase its accessibility further. Examining the relevant hierarchy scores, we see that means by condition were as follows: primed explicit hierarchy, 6.16 (SD = 1.75); unprimed explicit hierarchy, 5.38 (SD = 2.10); primed implicit hierarchy, 5.34 (SD = 2.13); unprimed implicit hierarchy, 3.81 (SD = 2.11).

Note that the control participants who assessed the unprimed explicit hierarchy had a mean hierarchy score of 6.19 (SD = 1.25). These control explicit hierarchy participants saw a picture of a neutral explicit hierarchy during the manipulation, whereas the experimental explicit hierarchy participants saw a picture of the implicit hierarchy. This experimental procedure apparently degraded the accessibility of the explicit hierarchy for the experimental participants—thereby creating an explicit condition that was more like the implicit condition than anticipated. If we are correct in attributing the outcome of H5 to this methodological problem, future research should be designed to retest the hypothesis.

Attitude Dynamics

The structural equation models demonstrated excellent goodness of fit—but also, more importantly, consistent results that informed the comparison of two theoretical models. The originally designed model provided a critical test of the hierarchical versus the Galileo spatial–linkage model: If there was only hierarchical influence, then only superordinate to subordinate paths would be significant; if there was spatial–linkage influence, then paths between linked attitudes would be significant. Automatic modification did not compromise the initial design of the models, and the goodness of fit of the models was less important than the emergence of significant paths in the models. Any of the constrained paths in the generic model could have been freed by automatic modification, but four of the five paths that were freed were paths that supported spatial–linkage influences over hierarchical influences—in addition to the other significant paths.[9]

Overall, the structural equation models illuminate the fact that attitudes about concepts can cause change, often in unexpected directions, in related attitudes. Patterns in the structural equation models suggest that the Galileo model is generally supported if we assume that some, but not all, concepts in the hierarchy were linked.

The results suggest that explicitness facilitated the propagation of attitude change within the hierarchy in a manner that the implicit hierarchy did not. In the explicit hierarchy models, six paths of interattitudinal influence were significant. In the implicit hierarchy, three of those paths were significant. This difference may be explained by the accessibility of the explicit hierarchy; recall that the explicit hierarchy was found to be more accessible.

If it is true that the explicitness of a hierarchy creates the conditions that foster evaluative change in concepts related to the focal concept of the message, then we expect that an implicit hierarchy made accessible by priming should behave similarly. In other words, priming a specific hierarchy, even an implicit one, makes that hierarchy at least temporarily accessible. As noted above, priming the implicit hierarchy resulted in significantly better evaluations of food. It can be seen in the model, in the significant path from sub2good to midgood, that these evaluations consequently caused better evaluations of the set of nontargeted concepts {needs, wants, gifts, luxuries}. Thus it appeared that activating an implicit hierarchy, providing an evaluative message (e.g., "Shopping is good"), and making the relationships between concepts accessible in a particular context facilitated the spread of the message throughout the hierarchy.

CONCLUSION

The results of this study are relevant to recent connectionist approaches to interattitude structure that posit a spreading activation model, in which positive or negative relationships between attitude concepts move from one concept to the next through a network of related concepts. A spreading activation model represents a map of attitudinal structure derived from an assessment of people's attitudes in a given domain (Eagly & Chaiken, 1998). According to Petty (1995), one of the most important implications of this approach is "that if you modify some particular aspect of the attitude structure . . . this will likely lead to some change in the overall evaluation of the object (i.e., the attitude) itself" (p. 200). In this respect the Galileo spatial–linkage model and the spreading activation models are remarkably similar; support for the Galileo model provides support for the spreading activation models. Furthermore, similarities between the Galileo spatial–linkage model and spreading activation models could make the Galileo model a more prominent and useful tool for spreading activation research (Woelfel, 1993).

The results of this study have significant practical implications as well. First, they support the Galileo model's operationalization of a process of interattitudinal or interbelief influence that has been previously described but for which no consistent cognitive mechanism has been suggested. For example, Converse's (1964) renown and popular discussion of belief systems in mass publics proposes that people's attitudes and beliefs toward politicians and political issues are enmeshed in a greater network of peculiar—often irrelevant—ideas that exert influence over the network. The Galileo spatial–linkage model provides a model of cognitive processing that explains why such influence occurs. Moreover, because the model suggests that this influence is not uncommon, support for the Galileo model as demonstrated in this study also suggests that more attention should be paid to the possible unintended consequences of persuasive messages on attitudes that are related to the target attitude.

Second, and more importantly, the results suggest that it is possible to affect attitudes indirectly, which could have tremendous implications for those who design persuasive messages about sensitive topics. For example, health communicators attempting to persuade people at moderate-to-high risk of colon cancer to undergo colonoscopies encounter difficulty in producing effective message; a typical message is "get tested" (see, e.g., Perry, 2004). A list of concepts currently associated with colon cancer, however, is likely to include negative concepts like colonoscopy, pain, death, and blood, and positive concepts like checkups, family, prevention, male, female, Katie Couric, healthy lifestyle, cure, and self; this set reflects a complex attitude structure. This list of concepts may be used to generate a multidimensional space, which would represent an individual's cognitive structure for this disease. Persuasive messages could be produced that use the existing interattitudinal structure among these concepts to generate attitude change indirectly and thereby increase the number of people persuaded to undergo the procedure.

Indeed, we suspect that the message "Katie Couric had a colonoscopy" had the effect, at least among those whose self concept is linked to the concept "Katie Couric" (i.e., young to middle-aged females living a healthy lifestyle), of moving the self concept closer to colonoscopy and consequently influencing those individuals to get a colonoscopy. We do know that "Couric effect" is real: It resulted in "an increase in the percent of colonoscopies performed on women" (Cram, et al, 2003, p. 1601).

It might be argued the Couric effect is easily explained simply by source characteristics. We contend, however, that much like its illumination of the cognitive processes underlying Converse's (1964) descriptions, the Galileo spatial–linkage model subsumes the purely descriptive parameters of source characteristics such as credibility, expertise, and similarity and provides a rationale for their often inconsistent influences: The position of the source within an individual's cognitive space relative to the other concepts in the space, as well the number of concepts to which the source is linked, will determine the influence of the source on the individual.

The evidence of attitude dynamics that this study has provided fills a gap in our fundamental understanding of interattitudinal structure and suggests important directions for future study, both theoretical and applied.

APPENDIX

Sample of the Paragraph Used to Induce Attitude Change in Participants

Six variations of the message "X is good" were used. Within each hierarchy, there was a message for each one of three targets (the superordinate concept, subordinate concept 1, or subordinate concept 2). The messages directed toward the superordinate target were "Animals are good" (explicit) and "Shopping is good" (implicit). The messages directed toward the first subordinate target were "Dogs are good" (explicit) and "Clothes are good" (implicit). The messages directed toward the second subordinate target were "Cats are good" (explicit) and "Food is good" (implicit). Pilot tests indicated positive believability for all variations of the message. A sample follows:

From "Indicators of Self-Esteem in College-Aged Young Adults: Ethnographical Revelations," in the *Journal of Contemporary Personality*, vol. 65, no. 2, pp. 1132–1146.

Several recent studies (e.g., Marcus & James, 1999; Zimmer, Frank, & Watson, 2000) have examined the mental health of college students and found that as many as half of all students suffer from low levels of self-esteem. This is a critical finding because decreased levels of self-esteem can negatively affect academic performance, and can contribute to campus problems such as alcohol misuse and abuse. Conversely, increased levels of self-esteem are related to improved academic performance and better health. In an innovative series of studies, Zimmer et al. (2000) have interviewed thousands of students, and studied some of the many methods that students have reported using to improve the way they feel about themselves. Interestingly, a number of students have reported that animals can represent an excellent source of pleasure that has been shown to directly increase self-esteem. According to Zimmer, "*Animals are good*; in fact, they are better than most people would think they are. Animals provide a number of individuals with some comfort that they use to support their overall sense of well-being" (p. 199).

NOTES

1. Upward influence could be achieved by induction. Simple observation suggests that induction indeed occurs. Holland, Holyoak, Nisbett and Thagard (1986) discussed how individuals make generalizations in a "bottom–up" manner where specific instances (e.g., attitudes toward subordinate concepts) affect general conclusions (e.g., attitudes toward superordinate concepts). Even though the failure to address inductive processes represents a weakness of the hierarchical model, it could constitute a limiting condition rather than a falsification of the hierarchical model if it were found that the hierarchical model makes accurate predictions about the conditions under which certain attitudes change.

2. According to Barnett and Woelfel (1988), the Galileo spatial–linkage model refers to a specific theoretical concept. "We have been involved with Galileo theory since before it was called Galileo," they wrote, "and have seen it grow from a philosophical conjecture into a concept. . . . Galileo is a philosophy of social science" (p. v). More specifically, Barnett (1988) stated that "The Galileo system may be considered a paradigm, an integrated theoretical and methodological model for describing and predicting cognitive and cultural processes as changes in the relations among a sets of cultural 'objects' or concepts" (p. 1). Thus, we refer to the spatial–linkage model employed in this paper as the Galileo spatial–linkage model.

3. Ten pilot studies were also conducted, with a total N of 271. Their purposes were as follows:

Pilot study 1 generated a list of concepts on the topic of consumerism.

Pilot studies 2–5 created the explicit and implicit concept hierarchies that were used.

Pilot study 6 created two reference yardsticks to serve as the criterion distance for the remaining distances to be estimated.

Pilot studies 7–9 created and tested messages to be used in the experiment.

Pilot study 10 pretested all procedures and scales to be used in the experiment.

4. This strategy creates variables that have a common term subtracted. So, letting X represent one distance and Z represent another, we are subtracting Y, which is a measure of the overall size of the space, from both X and Z. This strategy eliminates the effect of individual space size on the included distances, correcting the problem of individual differences in the size of the cognitive spaces. It creates the possibility, however, that covariance among participants' estimates is created as an artifact of the subtraction (i.e., the variables $[X - Y]$ and $[Z - Y]$ will covary because Y is a variable common to both terms.) We chose this subtraction strategy because the former problem is a more significant one than

the latter problem, and alternative strategies failed to produce appropriate structural equation models.

5. It is well documented that automatic modification should be used with caution (e.g., MacCallum, 1986; MacCallum, Roznowski, & Necowitz, 1992; Silvia & MacCallum, 1988). Even though MacCallum (1986) has stated that the likelihood of specifying a model correctly when using automatic modification increases as the initial model corresponds closely to the true model, when the model begins with valid restrictions, and when a large sample is used (p. 107), he has more recently expressed "a position of considerable skepticism" regarding specification searches (MacCallum et al., 1992, p. 502). Note that, with respect to MacCallum's criteria for careful automatic modification as listed above, the model for the current research conforms to the predictions of the theories and therefore is considered to be very close to a "true" representation of the theories. The model also begins with restrictions among a number of paths, most notably from the exogenous variables to the set of nontargeted concepts. The sample sizes for the models are moderate; the sample size for the explicit hierarchy models is 154 and for the implicit hierarchy models it is 150. And finally, for each hierarchy condition, the explicit and implicit models have each been run on three different sets of data; within each hierarchy condition, the results are quite consistent across these sets (Dinauer, 2003). The likelihood of specifying the current study's models correctly using automatic modification is thus considered high.

6. Consistent with the results of a number of ANOVAs and ANCOVAs run on the data, there were no interaction effects represented in the model because there were no noteworthy disordinal interactions found.

7. The degree of multivariate normality in the structural equation models is not known. There are a number of concerns surrounding the analysis of non-normal variables; if maximum likelihood estimation is used, standard errors and indexes of fit may be incorrect. Even though some have argued that a WLS or GLS solution might produce a more correct result, Bollen (1989) has indicated that "it is not clear that [WLS] outperforms [ML, GLS, or UL] in the cases where only moderate nonnormality is present" (p. 432). Furthermore, Olsson, Foss, Troye, and Howell (2000) concluded that "despite recommendations found in the literature that WLS should be used when data are not normally distributed, we find that WLS under no conditions was preferable to [maximum likelihood estimation or generalized least squares] in terms of parameter bias and fit" (p. 558). Maximum likelihood estimation was therefore chosen as the best estimation method for the study.

8. Recall that participants who received a message directed toward the superordinate concept were assigned a value of 1 for the variable super, and participants who received a message directed toward a subordinate concept were assigned a value of -0.5. Also recall that, because the endogenous variables are psychological distances, small values mean high association between concepts (i.e., if the distance between a concept and good is small, the evaluation is "better") and large values mean low association (i.e., the evaluation is "worse"). Thus, for example, a *negative* value for the path between super and sub1good means that high values of super (i.e., receiving the message "Animals are good") caused low values of sub1good (i.e., better evaluations of dogs) or the converse. A *positive* value of the path between super and sub1good means that low values of super (i.e., receiving the message "Dogs are good") caused low values of sub1good (i.e., better evaluations of dogs).

9. It might appear that the hierarchical model was subjected to a more stringent test than the Galileo spatial–linkage model: The spatial linkage model predicts significant paths between attitudes that are linked, so neither the presence nor the absence of a path was considered evidence against this model, whereas the hierarchical model requires paths between a superordinate concept and its subordinates, and therefore the absence of such a path or the presence of contradictory paths was considered evidence against this model. We therefore considered an alternative test of the hierarchical model: All paths consistent with the hierarchical model were included in a structural equation model to see if such a model would have acceptable goodness of fit. For the explicit hierarchy, $\chi^2(7, 154) = 43.23$, $p < .001$. For the implicit model, $\chi^2(7, 150) = 14.58$, $p < .05$. Therefore, neither structural equation

model fits when all paths consistent with the hierarchical model are freed. We already know that adding paths consistent with the spatial–linkage model results in structural equation models that fit both for the explicit and the implicit hierarchies.

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