that are generalizable across variables and products. We exemplify this extension by illustrating how one of the five templates identified in this study, namely, the Attribute Dependency template, is derived. Note that, in the Domino's Pizza example, a replicable pattern is obtained by duplicating the dependency between the two specific independent variables (price and time) through a step function. New product ideas can be generated by introducing a dependency between two previously independent variables through a step function. This rule is far more general than the mere duplication of a pattern, as was suggested in the cases of the supermarket or laundry delivery services. The template and its generalizability across products can be illustrated with an example drawn from a recent study by Andrews and Smith (1996). Hungry Jack syrup bottles are designed for microwave oven use. The bottle labels change color on reaching a certain temperature, thereby informing consumers that the syrup is ready. Although, at first glance, the analogy may appear remote, this example contains the key features of the same template. The two independent variables in this case are temperature and label color. A dependency is created by a step function between these two variables. Up to a critical temperature, the label color is not activated, and on reaching it, the color changes. The generalized form no longer involves the specific variables of the pizza example, nor does it necessarily involve the same product (or service). Yet it is identifiable and general across products and services, and thus, it is defined as a template.

Because the operation of templates involves manipulating product attributes rather than market parameters, they can be used in considering new market needs in currently underdeveloped product markets. For example, the aforementioned template might be applied to generate a new idea in pizza delivery services by creating a meaningful dependency between two different attributes, such as price and temperature. Accordingly, a company might offer a price discount if the temperature of the pizza falls below a predetermined level at the time of delivery.

The added value of the template approach is that it draws on the identification of similar structures in former product changes and provides a different angle and sometimes more accessible resource for ideation compared with the information obtained from analysis of current market needs. For example, the idea of creating a dependency between pizza temperature and price might originate from market-based information (i.e., information derived from the current market environment; Griffin and Hauser 1993), such as that implied by research indicating that temperature at delivery is a crucial factor in the choice of pizza service. Alternatively, it might be derived from product-based information (i.e., information that is inferred from inspecting the internal dynamics of the product), such as the incidence of dependencies between variables among new food-delivery services. Although the price–temperature idea might evolve both from market- and/or product-based information, the template approach may be more accessible because it specifies a structured framework for obtaining such an idea.

The added value of product-based information is especially apparent in more complex ideation contexts, such as in the following example: A new idea in the category of drinking glasses might be a glass with a dual insulation capability. When the temperature of the content is high, the insulation is low; when the normal drinking temperature is reached, the insulation is high. The advantage of such a glass would be that the content would reach the optimal drinking temperature rapidly, which then would be maintained for an extended period of time. Market-based information that suggests that the two factors—rapid cooling and heat preservation—are important for consumers could lead to such an idea. However, relying on product-based information by adopting the Attribute Dependency template might be even more useful. The information about these relevant parameters and the desired dependencies is contained in changes in products over time. Other examples of an Attribute Dependency in this category are a drinking glass with a colored lower section to camouflage residual juices or extracts and a transparent top, the dependency between height and diameter as manifested in cone-shaped cups that enable compact storage (in stacks), or a glass with base wider than its rim to reduce the danger of spilling when carried around. This information, and thus the template, should be valuable especially when market-based information is less accessible or invalid.

Many important product inventions have been derived from market-based information using a variety of marketing research methods. However, the value of these methods in offering a rich and exhaustive set of tools for ideation has been criticized (e.g., Petroski 1994). Durgee, O'Connor, and Veryzer (1996) note that many wants lie beneath the surface and that current product users are not able to express wants and needs for nonexistant products. Referring to the common method of asking buyers to describe problems with current products (e.g., Crawford 1991), they note that big leaps to new product ideas might not be uncovered when respondents describe problems in terms of current products.

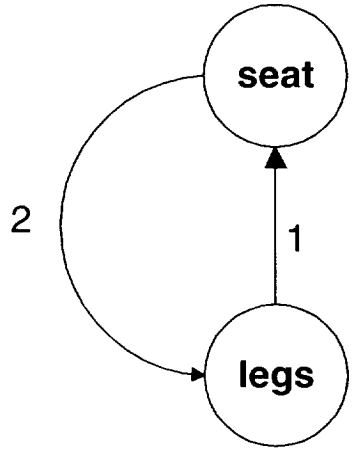
One possible outcome of excessive reliance on market-based information is the disproportionate effort that currently is devoted to "me-too" products, namely, products that mainly involve product line extensions, improvement of current products, and cost reduction (Wind and Mahajan 1997). In contrast, product-based information has been shown to be effective in various other decision-making contexts (e.g., reverse engineering in Srinivasan, Lovejoy, and Beach 1997; product archaeology in Ulrich and Pearson 1993). It is our contention that such information will be similarly effective in the context of ideation.

DERIVING AND FORMULATING THE TEMPLATES

An approach for analyzing the dynamics of evolution of technological innovations was developed by Altschuler (1985). We examined it for suitability in the context of product evolution. Altschuler conducted a backward analysis of problem–solution relationships and succeeded in identifying approximately 200 common phenomenological patterns, which he termed "standards." Although Altschuler's approach was aimed at inventive problem solving of technological systems rather than inventing new products, it is conceptually consistent with our template approach, in the sense that it focuses on internal operations. Here, only those operations that are relevant to the context of products are examined and adapted.

We obtained the initial identification of templates in our study by mapping structural changes in the soap category. A preliminary condition for inferring templates is knowledge of the chronological development of products. We used existing data on the evolution of soap-related products in

Figure 1
LINKS IN A CHAIR



Link 1: Legs support the seat and hold it at the desired height. Link 2: The seat holds the legs in place.

describing the original product in each stage, as well as the transition to the new product in the following stage.[1] We classified the commonalties identified in the transition between products in relation to Altschuler's (1985) typology and considered candidate product templates. We then replicated this procedure for three other product classes, namely, hygiene products, bank accounts, and sneakers. In these mapping studies, five major templates were revealed. In the following section, we formulate the template taxonomy. We provide several basic definitions required for the development of the template taxonomy subsequently.

Definitions

The characteristics of a product can be divided into *components* (objects such as the legs or seat of a chair) and *attributes* (variables of the product, such as the color or height). At the stage of template construction, we consider only attributes that consist of factual information. Abstractions and inferences (e.g., aesthetics; Chattopadhyay and Alba 1988) are considered only at a subsequent stage.

In addition, we make a distinction between *internal* attributes and components, which are under the manufacturer's control, and *external* attributes and components, which are not controllable by the manufacturer but present in the neighboring environment of the product in its common usage. Thus, the legs and seat of a chair are internal components, whereas color and height are internal attributes. Floor and table are external components, and the height and weight of the person sitting on the chair are external attributes. Because these components and attributes belong to the product and its neighboring environment, they are considered legitimate product-based information.

The relations between two given characteristics (either between two components or two attributes) are defined by links. In the case of attributes, the links are defined as dependency. In the case of links between components, two requirements must be met: (1) direct influence, for which a change in one component is directly responsible for changing parameters in the other, and (2) assignment of function, for which the influence has been designated by the manufacturer.

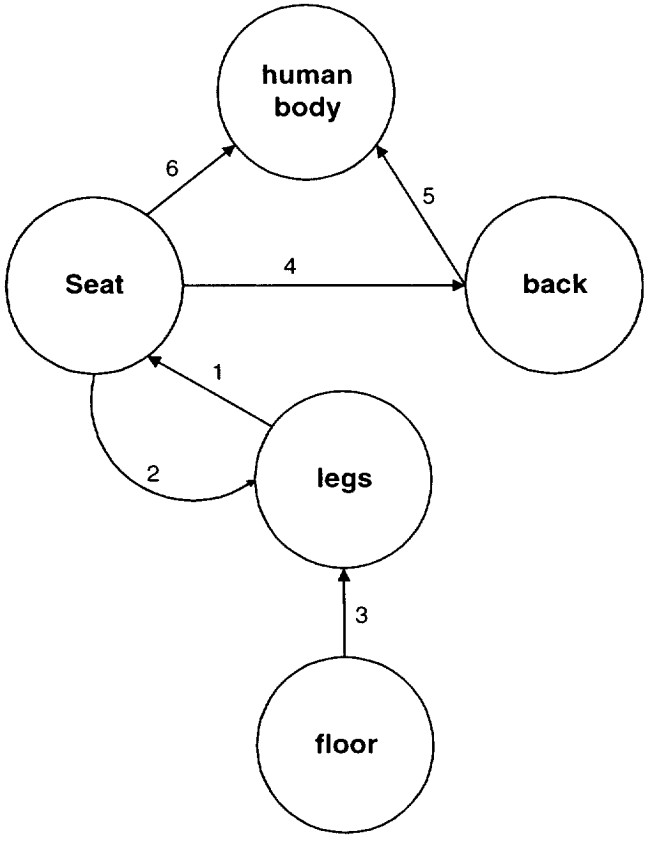
The links between the seat and legs of a chair are illustrated in Figure 1. In this example, there are two links between the legs and the seat: Link 1, the legs support the seat, and Link 2, the seat holds the legs in place. Note also that the seat has a buckling effect on the legs. However, the latter is not defined as a link because it does not comply with the second requirement (assignment of function).

The complete set of links, along with the internal and external components, defines the product configuration and its boundaries (see Figure 2). Note that the configuration depends on both the product structure and its usage context.

TEMPLATES AS MACRO OPERATORS

The configuration of a product is similar to a snapshot of the product-based information. To create a new product, the dynamics of change must be defined as well. We define *templates* as systematic changes between an early configuration (i.e., previous product version) and the one that follows it (i.e., the next product version). The changes between configurations can be expressed as combinations of elementary steps, termed "operators." Figure 3 presents six elementary

Figure 2
THE CONFIGURATION OF AN ORDINARY CHAIR
(ORIENTED GRAPH)



[1]The description of the development of the soap-related category is based on a research project conducted by Brand Genetics Inc. (Research Report No. 96-01) and presented here by permission from the company.

(first principle) operators that underlie the construction of the templates.[2]

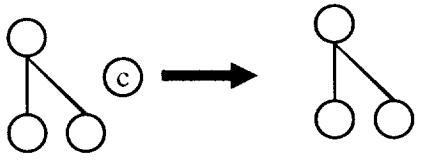
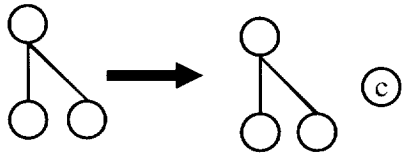
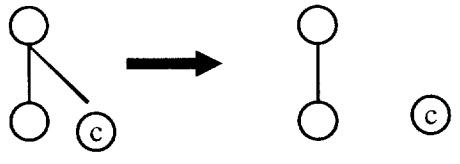
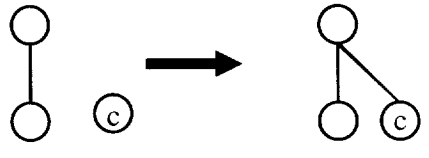
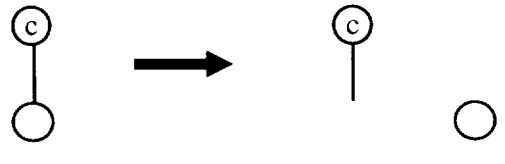
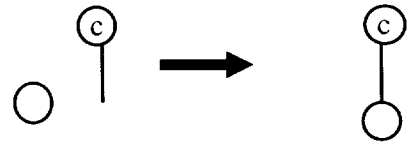
Transition from an existing product to a new idea can be accomplished by applying these fundamental operators in a defined sequence. These macro operators, when applied to both the internal and external attributes and components, constitute the template. Note that external attributes and components are drawn from objectively measurable factual information about the product and its immediate environment. Although the template initially draws solely on product-based information, market-based information is examined subsequently to complete the formulation of the product idea. In the following section, we define and describe the five templates identified in the mapping study. For ease of comprehension, all the examples analyzed pertain to the automobile category.

The first template (described previously, see the Domino's Pizza and glass examples) operates in the context of product attributes. Links in this case pertain to dependencies between product attributes. Therefore, the Attribute Dependency template is obtained by applying inclusion and linking operators sequentially.

For example, on April 1, 1995, as part of a promotion campaign, the Volkswagen Motor Company announced a new car model, the "Polo Harlequin," that featured differently colored parts. The announcement was not intended by the company and was inserted merely as an April Fool's Day joke. However, massive response by customers calling in to place orders convinced the manufacturer to go ahead and produce it. It seems that neither the customers nor the researchers could foresee the demand for such a car. The car became quite popular in Europe and the concept of differ-

[2]Note that these six operators are three operators and their inverse counterparts.

Figure 3
THE OPERATORS UNDERLYING THE TEMPLATES

Operator	*Definition*	*Illustration*
(1) Exclusion	The exclusion operator removes an unlinked component from the configuration boundaries.	
(2) Inclusion	The inclusion operator introduces an external component into the configuration boundaries.	
(3) Unlinking	An unlinking operator eliminates a link.	
(4) Linking	A linking operator connects two unlinked components or attributes.	
(5) Splitting	A splitting operator removes an internal component from the link. The link maintains the original functions.	
(6) Joining	A joining operator adds a (new) component to a dangling link.	

ently colored parts even has been adopted since by some of Volkswagen's competitors.

The concept of Polo Harlequin is consistent with the Attribute Dependency template and can be obtained by creating a dependency between color and the specific location of a car's parts (e.g., door, roof). It is analogous to the already existing dependency in this category between color and climate. Lighter colors long have been used in warmer climates to avoid overheating and paint damage.

Unlike the Attribute Dependency template, which operates in the context of product attributes, the other four templates revealed in the mapping studies operate in the context of product components. They are the following: Component Control, Replacement, Displacement, and Division. The formulation, examples, and their sequence of operators are described in Table 1. Overall, the mapping studies conducted among several product classes (soaps, hygiene products, bank accounts, and sneakers) indicate that, despite some variation, the five templates account for almost 70% of new product emergence.[3]

THE TEMPLATE APPROACH AND IDEATION RESEARCH

The preceding taxonomy of templates can be used to approach the ideation task from a perspective based on product rather than market information. Such a perspective is particularly useful, given the traditional view of ideation as "ill-defined" (Simon 1979) or "ill-structured" (Tauber 1972). The ill-defined nature of ideation stands in contrast to other important new product activities (such as screening, diffusion, and various marketing assessment tools; e.g., Narasimhan and Sen 1983), which are characterized as well-defined because they lend themselves to specific definitions in terms of numerical variables and well-defined solution plans.

Most widely used ideation methods (e.g., brainstorming and Random Stimulation) do not transform the ill-defined nature of the problem into a defined and channeled process. Their validity has been questioned in many experimental studies regarding creativity and effectiveness (e.g., Bouchard 1969; Diehl and Stroebe 1987, 1991; Weisberg 1992). The main conclusion from these studies is that such methods lead to an excess of ideas and analogies, which actually obstructs the ideation process. It has been found that the source of satisfaction from this kind of ideation session is the process of ideation itself, rather than the quality of the ideas (note the "illusion of group productivity"; Paulus et al. 1993). In addition, Tauber (1972) has pointed out that the search for new ideas typically suffers from a lack of synchronization between the two different activities—screening, which is well-defined, versus ideation, which tends to be ill-defined.

Coping with the ill-defined nature of ideation tasks may be made easier by using an approach that is consistent with two principles. The first, which originates in cognitive psychology, predicts that restricting the scope of an issue enhances inventive productivity. Perkins (1981) indicates that thinking within a frame of reference requires sensitivity to the rules of the game and that, by functioning within such a frame, a person is better able to notice or recognize the unexpected. Finke (Finke, Ward, and Smith 1992, p. 32), whose research focuses on the impact of visual information (e.g., Finke and Pinker 1981, 1982), notes that

> restricting the ways in which creative cognitions are interpreted encourages creative exploration and discovery and further reduces the likelihood that the person will fall back on conventional lines of thought. Restricting the categories, for example, forces people to think about conceptual implications in more atypical ways, which tends to promote creative discovery ... and can force one to consider novel interpretations of those concepts.

The second principle recommends the adoption of a structured ideation process that best mimics the thinking pattern that people follow when engaged in inventive thinking. Introspective reports in experiments conducted by Finke, Ward, and Smith (1992) indicate that subjects often search for emergent features in the forms (e.g., images and objects), then contemplate their functional properties, imagine themselves actually using these forms, and finally, mentally elaborate on the context in which the forms should be found. This sequence of events underlies the notion of function following form. Accordingly, people are more likely to make creative discoveries when they analyze novel forms and then assess what benefits they might project, rather than when they try to create the optimal form solely on the basis of the desired benefits.

Compliance with these two principles should enhance the efficiency and productivity of inventive thinking. It transforms the ideation process from ill-defined to more well-defined. Some techniques specifically tailored for ideation tasks, such as morphological analysis (cf. Urban and Hauser 1993; also note the Heuristic Ideation Technique [HIT] procedure, Tauber 1972), attempt to cope with the ill-defined nature of ideation by manipulating both market- and product-based information. Morphological analysis initiates the ideation process by referring to existing rather than to imaginary product features. It calls for identifying the dimensions of the problem or the product (e.g., type of ignition in cars, packaging in food categories), listing all possible combinations of dimensions, examining the feasibility of the alternatives, and selecting the best one. However, one drawback of this method, relative to the template approach, is that it does not define specific guidelines regarding which dimensions should be used and how they are to be combined. Furthermore, because the meaning of dimensions is defined broadly and potentially could lead to the generation of high order working matrices, a large number of ideas can be generated. In the absence of a prescribed reduction mechanism, the selection process for the best ideas may be compromised (see the discussion of limitations in Tauber 1972).

[3]The distribution of templates in the soap study, based on brand–template matching of 1508 facings that appeared in two large department stores by two trained judges, who achieved 97% agreement, was as follows: Attribute Dependency 43%, Component Control 13%, Replacement 1.5%, Displacement 6%, and Division 1.5%. Additional mapping studies were conducted on other product classes (hygiene products, bank accounts, and sneakers), following the same procedure as in the study of the soap category. They produced the same template typology and a similar order of proportions of template-matched product versions. In the three categories, the explanation of templates ranged as follows: Attribute Dependency 40%–68%, Component Control 10%–30%, Replacement <1%–19%, Displacement 1%–3%, and Division 2%–4%. These distributions indicate recurrence of templates among both tangible products and services used by segments that do not necessarily overlap.

Table 1
THE OTHER FOUR REVEALED TEMPLATES

Template	*Description*	*Example*	*Sequence of Operators*
Component Control	The template involves the creation of a link in the form of control of one internal component over another internal or external component.	A new electronic device connects the battery of a car to the car body to inhibit corrosion and rust. The control is obtained by providing an excess of electrons to the cathode, thus enabling regulation of the electrostatic charge, because positive charge hinders electrochemical corrosion.	Inclusion and linking
Replacement	Application of this template involves the removal of an essential internal component from the configuration while maintaining the link between the removed component and the remaining components. This operation creates a temporarily inconsistent abstract structure. Because of the dangling link, the operation is completed only when the missing component is replaced by another existing component. The replacement must be an external component that can perform a function similar to that provided by the one removed.	Consider a car radio. The internal component, in this case the car antenna, is removed, but its associated intrinsic function (reception of broadcast waves) is maintained. The resultant intermediate configuration is a necessary step in the replacement procedure, even though it represents an incomplete product structure. The unsaturated function can be fulfilled by a component that is external to the car radio, in this case a defroster. Finally, the external component is incorporated by applying the joining operator, and the configuration of a new product is obtained—a car radio that does not require an external antenna.	Splitting, excluding, including, and joining
Displacement	An essential internal component is removed from the configuration. However, in contrast to the Replacement template, its associated link is removed as well. In this case, a new idea for the product must be based on a new appeal, one that the former product did not provide.	Excluding the car roof and its function, and the new product is a convertible car.[a]	Splitting, excluding, and unlinking
Division	Splitting one component into several components that either contribute individually to the accomplishment of its function or become responsible for differential subfunctions.	Dividing a shock-absorbing system into a four-way suspension to improve smooth driving and balance.	Splitting and linking

[a]Some convertible cars have a folding roof, whereas in others, the roof is attachable but not an integral part of the car. The latter is a case of displacement.

In summary, the template approach integrates three major invention-enabling perspectives. The first stems from the proposition that several identified templates underlying the internal dynamics of product evolution can predict new candidate products by providing guidelines for ideation. The second is the "restricted scope" principle, which is embodied in the template approach by channeling thinking along predefined inventive routes. The third perspective is the function follows form principle, which is manifested in the sequence of first proposing new configurations of the product (which are template-based) and then considering the benefits, aesthetic values, and other market parameters. The initial configuration and the consideration of consumer benefits jointly form the product idea.

Structures resembling product templates that were developed and applied in other fields have been valued as creative (e.g., Koestler 1964). Creativity perception may be enhanced because these structures match certain attractors, namely, paths that the self-organized mind tends to follow (Kelso 1997), and because they preserve the original level of complexity (i.e., no new attributes or components are introduced beyond those that exist in the product or in its neighboring environment) while adding new utilities (Altschuler 1986). The perception of linking previously unlinked phenomena as a creative act first was reported by Koestler (1964). Koestler performed such linking in a multidimensional matrix of unlinked parameters regarding other phenomena. The Attribute Dependency template is a reduction of his multidimensional matrix to a more simplified, two-dimensional structure, recurring in the context of new products. We therefore expect that ideas matching the Attribute Dependency template will be perceived as creative in the context of new product ideation.

The procedure for using the dominant template (Attribute Dependency) is outlined subsequently, followed by a report of two experiments that examine its usefulness.

THE ATTRIBUTE DEPENDENCY TEMPLATE: A PROCEDURAL FRAMEWORK

Construct a Dependency Matrix

Following the identification of a product's internal and external attributes, a matrix of attributes is constructed in which the columns list internal attributes and the rows list both internal and external attributes. The task at this stage is to identify potential new dependencies between attributes that appear on the two axes.

In Figure 4, we show a submatrix of the dependency matrix constructed for the case of drinking glasses, a category used in Experiment 2. The dependency matrix cell receives a zero if the attributes are independent (e.g., color versus sugar concentration) and a nonzero value if the col-

Figure 4
DEPENDENCY SUBMATRIX FOR THE CASE OF A DRINKING GLASS.

	Height of glass	*Diameter*	*Color*	*Heat conductivity*
Thickness of base	1			
Height of glass		b		c
Temperature			a	
% Sugar			d	

umn variable depends on the row variable (e.g., capacity depends on height).

For illustrative purposes, assume that four cases of zero cells (i.e., cells that are initially independent) can be identified. These are denoted as a–d in this submatrix. One case (marked as 1) represents a natural dependency. For convenience, other zero cells are not marked, though they too might be relevant.

Introduce the Attribute Dependencies

The Attribute Dependency procedure is performed at this stage by introducing a dependency between previously independent attributes. In terms of the dependency matrix, this entails changing the value of a zero cell. For example, the color of the glass could be made dependent on the temperature of the content (Case a in Figure 4). This dependency may be created by introducing a color change (e.g., from green to red) at a critical temperature. This task is best performed by people who belong to the operating environment or those with high levels of macroenvironmental knowledge (Lehmann and Winer 1994), because they will be more efficient in acquiring new information and eliciting related knowledge (Alba and Hutchinson 1987; for a detailed review, see Andrews and Smith 1996).

Obtain a Candidate New Idea

The objective at this stage is to scan the potential benefits of the ideas using the function follows form principle. Consider the dependency created in Case a between color and temperature. By examining the potential benefits, at least three product ideas can be generated. First, the threshold for color change could be made dependent on the risk of breakage due to overheating. The resulting idea may be a glass that changes color when it reaches a certain temperature in a microwave oven. Second, we could maximize the benefit for the user of the glass. In this case, the purpose of the color change may be to avoid overheating the content of the glass. This might be particularly suitable in the case of use by children. Third, the dependency may be applicable in a related product domain, for example, a baby bottle that changes color when the contents reach a certain temperature.

If we treat the marked zero cells (b–d) of the dependency matrix in Figure 4 similarly to Case a, we may produce additional new product ideas, such as a coned-shaped glass that could be inserted easily into the sand at the beach (by making the diameter of the glass proportional to height) or a glass with an insulation strip (by making the heat insulation of the glass dependent on its height).

The two experiments reported subsequently were designed to examine whether training in the Attribute Dependency template improves outcomes compared with two widely used unstructured methods, Lateral Thinking and Random Stimulation (Experiment 1), and with a structured method, HIT (Experiment 2).

EXPERIMENT 1

Overview. The experiment was composed of two phases. In the first phase, the idea-generation setting was manipulated between groups. Participants were trained in the template approach, Lateral Thinking, or Random Stimulation. Following training, they were asked to generate ideas regarding either baby ointment or mattresses. In the second phase, the ideas were rated by senior marketing professionals. All subjects participating in idea generation were university graduates or close to graduation. Their age range was 23 to 40 years, with a mean age of 30 years. Preliminary analysis showed that the groups did not differ significantly in age, education, or occupation.

Design and procedure. One hundred twenty subjects were assigned randomly to six groups that were generated by crossing the training factor (template, lateral thinking, random stimulation) with the product category factory (baby ointment, mattresses). Comprehension of the techniques was verified, and explanation ceased only when participants indicated that they could implement them in ideation. The template training involved approximately four hours, including practice tasks. Training time in the competing methods was approximately two hours, including practice tasks.

The efficacy of the template approach was assessed by comparing outcomes of the template training group (hereafter, the TT group) with those of the lateral thinking (TL) and random stimulation (TR) training groups. The time framework for generating ideas (30 minutes) was identical in all three groups. Overall, the three groups generated 277 ideas, 132 for baby ointment and 145 for mattresses.

The ideas generated by the TT group for the ointment category included an ointment that issues a specific odor upon urination by the baby; a series of ointments that differ in their concentration of active ingredients, depending on the sensitivity of the baby's skin; and introduction of two types of ointment, one for day use and one for night use (higher consistency for increased protection at night by isolating the skin from the urine and lower consistency to allow skin to breathe during the day). Among the ideas generated by the TL group were an ointment made of natural ingredients and an ointment with scent. The TR ideas included long-lasting ointment and a colored (instead of the traditional white) ointment.

Three senior marketing professionals were invited to participate as judges in the evaluation procedure. All three professionals held MBAs, had a record of at least ten years of experience in the marketing of consumer goods, and held high ranking marketing positions (at least vice president or equivalent). These professionals were asked to rate the ideas on two scales, chosen in accordance with Finke's (1990) suggestion to assess ideas by their originality level and practical value. These scales are also compatible with the originality and usefulness measures recently adopted in the context of new product design by Dahl, Chattopadhyay, and

Gorn (1999). Accordingly, one scale measured originality with scale anchors (1) "Not original at all" and (7) "Very original." The second scale measured the overall value of the ideas. The judges were asked to indicate whether they would recommend investment in implementing the idea on a scale ranging from (1) "Not recommend at all" to (7) "Highly recommend." The judges were blind to the identity of the group members, to one another, to the notion of templates, and to the purpose of the experiment.

Results

In Table 2, we display the mean originality and value ratings for the three training groups. In the ointment category, significant differences were obtained among the three groups for both the originality of the ideas ($F(2,129) = 52.13$, $p < .0001$) and the value ratings ($F(2,129) = 97.46$, $p < .0001$).

Comparison between the TT group and the TL and TR groups combined indicated that ideas produced by the TT group were superior both in originality ($t(129) = 10.10$, $p < .001$) and value ($t(129) = 13.85$, $p < .001$). Comparison between the TL and TR groups showed no significant differences in terms of originality ($t(129) = 1.34$, $p > .15$) or value ($t(129) = 1.25$, $p > .20$).

In planning the analysis, we recognized that unstructured techniques are geared to the production of a large number of ideas that vary widely in quality and value, whereas structured methods are prescreened and more focused (Perkins 1981). Accordingly, the smallest number of ideas produced by the TT group was selected and compared with a matching number of the highest ranking ideas obtained in the TL and TR groups. The ideas were sorted in descending order of rating. On the basis of this procedure, the top 20 ideas were selected from each group. The second panel of Table 2 summarizes the results of this analysis. Significant differences were obtained among the three groups, both when originality was the dependent measure ($F(2,57) = 50.50$, $p < .0001$) and when value served as the dependent measure ($F(2,57) = 69.64$, $p < .0001$). The comparison between the TT group and the TL and TR groups indicated the superiority of the TT group ideas in both originality ($t(57) = 10.04$, $p < .001$) and value ($t(57) = 11.79$, $p < .001$). No significant difference was obtained between TL and TR in either originality ($t(57) < 1$, n.s.) or value ($t(57) < 1$, n.s.).

This pattern of results was replicated for the mattress category (Table 2). As in the ointment task, the analysis first focused on the raw ideas. Significant differences were observed among the three groups when both originality and value were the dependent measures ($F(2,142) = 45.94$, $p < .0001$ for originality; $F(2,142) = 147.82$, $p < .0001$ for value). Similarly, dominance of the TT group over the TL and TR groups was obtained for both originality ($t(142) = 9.48$, $p < .001$) and value ($t(142) = 17.17$, $p < .001$). There was no significant difference between the two nontemplate training techniques ($t(142) = 1.27$, $p > .20$ for originality; $t(142) < 1$, n.s. for value).

The procedure comparing the best ideas was performed subsequently and resulted in significant differences for the originality ($F(2,57) = 28.61$, $p < .0001$) and the value ($F(2,57) = 140.18$, $p < .0001$) ratings. Similarly, dominance of the TT group over the TL and TR groups was obtained for both originality ($t(57) = 7.47$, $p < .001$) and value ($t(57) = 16.74$, $p < .001$). However, between the TL and TR ideas, there was no significant difference ($t(57) = 1.18$, $p > .20$ for originality; $t(57) < 1$, n.s. for value).[4]

In addition to the advantage of the template approach, as manifested in both the analysis of the total set of ideas and the "best ideas," the highest ranking idea was an outcome of the TT in both the ointment and the mattress categories.

Discussion

The comparison between TT and training in competing unstructured techniques demonstrates the added value of incorporating the template approach in ideation. It should be noted that a major component of the costs involved in using the TT technique is the relatively longer training time

[4]Examination of the ideas generated by all three groups in both Experiment 1 and Experiment 2 indicated that template-matched ideas were used almost exclusively by the TT participants. Because the division between the TT and the remaining groups also dichotomizes the use or nonuse of the templates, it can be concluded that templates are learnable and that they lead to more productive ideation.

Table 2

EXPERIMENT 1: MEAN ORIGINALITY AND VALUE RATINGS

	Originality			*Value*		
	TT Trained in Templates	*TL Trained in Lateral Thinking*	*TR Random Stimulation*	*TT Trained in Templates*	*TL Trained in Lateral Thinking*	*TR Trained in Random Stimulation*
			Raw Ideas			
Ointment	5.47[a]	3.57	3.36	5.97[a]	3.09	2.82
	(.31)	(.82)	(.93)	(.43)	(.93)	(.97)
Mattress	5.83[a]	3.47	3.22	5.79[a]	2.71	2.64
	(.50)	(1.19)	(.51)	(.42)	(.75)	(.83)
			Best Ideas			
Ointment	5.47[a]	4.27	4.22	5.97[a]	3.75	3.68
	(.31)	(.45)	(.55)	(.43)	(.76)	(.83)
Mattress	5.83[a]	4.86	4.66	5.79[a]	3.27	3.21
	(.50)	(.55)	(.51)	(.42)	(.55)	(.67)

[a]Represents significance (at least at $p < .05$ level) in the contrast between TT and the combined TL and TR groups.

required. However, the high ranking of the ideas generated by the TT group suggests a self-screening effect. Moreover, the TT group generated fewer ideas, which suggests that the next step of new product (screening followed by concept testing) should require reduced resources and time.

The effect due to training technique in Experiment 1 may be confounded by the required training time that differs between the techniques, and therefore, difference in training time might account for the results. In addition, Experiment 1 did not use subjects who were not trained at all prior to idea generation. Such subjects might serve as a benchmark for assessing the added value of training in templates.

Experiment 2 was devised to address these issues. The technique taught to the control group in Experiment 2 was HIT (Tauber 1972, presented previously), which requires equivalent training time and is deemed to be the closest "rival" technique to the template approach. In addition, in Experiment 2, the template approach was compared with a "no training" (hereafter NT) group.

EXPERIMENT 2

Overview. Experiment 2 used a different product category, drinking glasses. Similar to Experiment 1, this experiment was composed of two phases. In the first phase, the idea-generation setting was manipulated between groups by training in the TT approach, the HIT technique, or no training at all. In the second phase, the ideas were rated by three senior marketing professionals.

Design and procedure. One group consisted of 18 subjects who were trained specifically to use the Attribute Dependency template (the TT group). The second group was composed of 19 subjects who were trained to apply the HIT procedure (the HIT group). The training in the TT and HIT groups lasted four hours, including practice tasks. The third group consisted of 18 subjects who received no training at all (the NT group). As in Experiment 1, the efficacy of the template approach was assessed by comparing outcomes of the TT group with those of the HIT and NT groups. The time framework for generating ideas (30 minutes) was the same for all three groups. Overall, the three groups generated a total of 82 ideas.

Among the ideas generated by applying the TT group were a drinking glass for babies for which the color varied according to the temperature of the milk (when the milk is ready for drinking, the color of the glass changes from red to blue) and a tea cup with varying insulation capabilities according to the temperature of the tea (when the tea is too hot, the glass enables fast cooling off, and upon reaching an optimal drinking temperature, the glass maintains the desired heat for an extended period of time). Among the outcome ideas generated by applying HIT were a glass that is purchased with a ready mixture of coffee and milk, one that automatically cools the fluid content when it is poured in, and a glass that glows in the dark for night feeding. The NT group generated ideas that included glasses that have exotic shapes and a unique combination of colors for a set.

Three senior marketing professionals were invited to participate as judges in the evaluation procedure. Two of the judges were owners of marketing consulting agencies and one was a senior product manager. All three judges (who did not participate in Experiment 1) had at least seven years of experience in marketing positions. The evaluation procedure and scales were identical to those used in Experiment 1.

Results

In analyzing the total set of ideas, a significant difference was obtained among the three groups for both the originality of ideas ($F(2,79) = 7.5$, $p < .001$) and their value ratings ($F(2,79) = 29.8$, $p < .0001$). The results appear in Table 3.

Comparison between the TT group and the combination of the HIT and NT groups indicated that the TT group produced superior ideas in both originality ($t(79) = 3.3$, $p < .005$) and value ($t(79) = 7.6$, $p < .001$). A comparison between the HIT and NT groups showed no advantage in terms of originality ($t(79) = 1.1$, n.s.) or value ($t(79) < 1$, n.s.).

Because Tauber's (1972) HIT does not limit the number of ideas, the more stringent analysis performed in Experiment 1, which focused only on the better ideas, was repeated in Experiment 2. Accordingly, the ideas were sorted in descending order of rating, and the top 17 ideas were selected from each group, which matches the lowest number of ideas generated by the TT and NT groups. The results appear in the second panel of Table 3. Significant differences were obtained among the three groups for originality ($F(2,48) = 5.44$, $p < .001$) and value ($F(2,48) = 32.3$, $p < .0001$). The comparison between the TT and the HIT and NT groups combined indicated that the TT group ideas domi-

Table 3
EXPERIMENT 2: MEAN ORIGINALITY AND VALUE RATINGS

	Originality			*Value*		
	TT Trained in Templates	*HIT Trained in HIT procedure*	*NT No training at all*	*TT Trained in Templates*	*HIT Trained in HIT procedure*	*NT No training at all*
			Raw Ideas			
Glass	5.20[a] (1.02)	3.83 (1.35)	4.15 (1.15)	4.82[a] (.90)	2.99 (.99)	2.91 (.36)
			Best Ideas			
Glass	5.20[a] (1.02)	3.94 (1.48)	4.15 (1.15)	4.82[a] (.90)	3.59[b] (.65)	2.91 (.36)

[a]Represents significance (at least at $p < .05$ level) in the contrast between TT and the combined HIT and NT groups.
[b]Represents significance (at least at $p < .05$ level) in the contrast between HIT and NT.

nated in both originality ($t(48) = 3.2$, $p < .005$) and value ($t(48) = 7.6$, $p < .001$). The HIT training outperformed NT in value ($t(48) = 2.78$, $p < .01$), though not in originality ($t(48) < 1$, n.s.). In addition to the observed superiority of the TT approach, both in the analysis of the total set of ideas and the "best ideas," the highest ranking idea was also template-based.

CONCLUSIONS AND IMPLICATIONS

The advantages of the template approach lie in both its consistency with related theories on ideation and its practical usefulness. On the theoretical level, the templates are obtained by analyzing the trends in the evolutionary process of successful products at their mature stage and applying them in nonmature situations. This process is analogous to stepping back in time. By learning the regularities of product evolution through their internal dynamics, the uncertainty associated with innovative ideas is reduced.

The template taxonomy represents a step toward modeling the dynamics of product ideation. If the parameters of such a model are based on product-based trends, the templates may have the capacity to facilitate the generation of new ideas using limited external information (e.g., consumer needs). In addition, the template approach removes thought barriers that might hinder ideation when traditional methods are used. Consider, for example, the car radio with its antenna removed. On first examination, this situation would appear inconsistent and unrealistic. It provides no immediate cues as to how to resolve the inconsistency other than reinstating the antenna. The template scheme opens routes for taking advantage of and resolving such inconsistencies.

With regard to its practical usefulness, several key advantages are worth noting. First, as demonstrated in the mapping studies, the majority of product versions can be described by as few as five templates. Furthermore, analysis within each of the categories supports the template framework. Second, the learning of the procedure facilitates common understanding regarding how to cope with the creativity task. Third, the template approach has a technological advantage, in that the ideation task begins with existing (and therefore available) products.

With regard to generalizability, two important issues must be taken into account. First, whereas the majority of products lend themselves to natural decomposition into components and assignment of functions, others do not. This does not preclude the use of the template approach, but it requires consideration of other assumptions that are specific to the product and its environment. Second, because of the simplicity and the prescribed method sequence, people from heterogeneous backgrounds (e.g., different product lines, departments) can apply the template approach and share a common language of design (Mahajan, Rao, and Srivastava 1994; Wagner and Hayashi 1994).

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