Optimal Ideation–Evaluation Ratios

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ABSTRACT: The theory that different ideation-evaluation (I-E) ratios are optimal for creative problem solving in different fields of endeavor in organizations is presented. Preliminary field data (n = 622), which support the theory, are reported. As predicted, higher I-E ratios were found for work classified as more problem finding in nature, such as research; lower ratios were found for work classified as more solution implementation in nature, such as manufacturing; moderate ratios in-between were found for work classified as more problem solving in nature, such as nonprofit organization administration. Implications for training and for increasing the understanding of innovation in organizations are discussed.

Creative thinking and problem solving (PS) are necessary for organizational effectiveness. Mott's (1972) comparative research showed that effective organizations are simultaneously (a) productive and efficient and (b) adaptable and creative. Organizational efficiency means routinizing, optimizing, stabilizing, and polishing processes to provide the highest quantity and quality of goods and services at the lowest possible cost. Organizational adaptability, on the other hand, means being deliberately creative and continuously upsetting the routine to find new processes, goods, and services and to change current processes to reach new levels of quantity, quality, cost, and customer satisfaction. Mott showed that organizations weaken if they emphasize only short-run efficiency; good bottom-line organizations facing a rapidly changing environment must equally emphasize long-run adaptability. Similarly, John and Snelson (1987, 1988) found that less successful firms consider product innovation a necessary evil and thus focus only on improving existing products; more successful firms both improve existing products and create new ones.

In the literature on processes of creative thinking and PS, some writers deliberately separate idea-producing thinking processes from idea-selection thinking processes (Joyner & Tunstall, 1970; Maier, 1967; Simon, 1960; Simon, Newell, & Shaw, 1962). In his structure-of-intellect model, Guilford (1967) differentiated between idea-producing abilities (divergent production) and idea-judging abilities (evaluation). Wallas (1926) proposed that formation of a new thought was a four-stage process in which imagination is employed in the second and third stages, incubation and illumination, and reason is employed in the first and last stages, preparation and verification. (As in much of this literature, the terms creativity, creative problem solving, and the creative process are used interchangeably in this article.)

Within this general area, two separate schools of thought, both supported by empir-
ical research, have emerged (Basadur, Graen, & Green, 1982; Basadur, Graen, & Scandura, 1986; Joyner & Tunstall, 1970; Runco & Basadur, 1993). One school allows for some use of judgmental, convergent-thinking processes during idea production, such as trial-and-error searches (Simon et al., 1962). The other does not; it prohibits such thinking processes during idea production and advocates use of only totally divergent, imaginative thinking during idea production to generate options without judgment or rules of logic. Von Fange (1959) advocated employing deliberate techniques to activate one’s imagination to combine knowledge into new ideas and eliminate ridicule and negativism. The principle of deferred judgment—deferring the evaluation of options until as many ideas as possible have been produced—has many advocates (deBono, 1971; Osborn, 1963; Parnes, 1961; Parnes & Meadow, 1959; Parnes, Noller, & Biondi, 1977; Prince, 1970, 1976). The process of deferring judgment to separate divergent thinking from subsequent convergent thinking is called ideation—evaluation (I–E; Basadur et al., 1982). During ideation, all judgmental, rational, convergent thinking is deliberately deferred in favor of nonjudgmental, imaginative, divergent thinking. Thus, ideation can be defined as option generation without evaluation—the diverging step of the two-step process. Evaluation can be defined as the application of judgment to the generated options—the converging step of the two-step process. Both diverging and converging are believed essential to creativity (Farnham-Diggory, 1972).

Most creativity researchers agree that the creative process requires both ideation and evaluation. They also agree that additional stages exist in the creative process above and beyond PS. Finding new useful problems to solve is a separate and more important stage of the creative process than finding useful solutions to identified problems (Getzels, 1975; Mackworth, 1965). Einstein said that formulating a problem is often far more essential than solving it, which may merely require mathematical or experimental skill (Parnes et al., 1977). Problem finding (PF) includes both aspects: discovering problems to solve and formulating them for subsequent solution. Other researchers emphasize solution implementation (SI) as another important stage of the creative process. For example, Levitt (1963) stated that businesses must both generate and implement creative solutions.

A PS process that includes both ideation and evaluation and that extends beyond solution finding to include PF and SI considerations is called a complete process of creative problem solving (Parnes et al., 1977). In this article, organizational creativity is modeled as a complete, continuous, three-stage process in which ideation and evaluation alternate in each of the stages of PF, PS, and SI, as in Figure 1 (Basadur, 1993; Basadur et al., 1982). Other researchers have presented theories and models compatible with that in Figure 1. Although many of these models contain additional steps or stages within these three stages, it is difficult to get away with fewer than three steps. Basadur (1982, 1987, 1992, 1994) presented a circular three-stage model that includes eight smaller steps, each consisting of alternating ideation and evaluation. Linear models that contain three, five, and six steps, with divergence and convergence in each step, were suggested by Osborn (1963), Parnes et al. (1977), and Isaksen and Treffinger (1985), respectively. Leavitt (1975) advocated a
three-phase model of PF, solution finding, and implementation finding for managers to improve performance beyond mere analytical thinking. Similarly, Isaksen and Treffinger (1991) organized the six steps of their model into three main components: understanding the problem, idea generation, and planning for action.

Basadur et al. (1982) investigated the effects of training applied researchers in industry in the three-stage model in Figure 1 using a multiple-method and multiple-measure design. The training was expected to improve acceptance of the I–E process, practice of the I–E process, PF performance, PS performance, and SI performance. It was hypothesized that the first two (attitudinal and behavioral) variables were necessary antecedents of the latter three (performance) variables. Not only did the training work, but there were two unexpected discoveries.

First, both antecedent variables were multidimensional. The degree to which a person might accept and practice I–E depended on whether the person was in PF, PS, or SI. Basadur et al. (1982) hypothesized that each
of the two antecedent variables (i.e., acceptance of the I-E process, practice of the I-E process) should be replaced by three new variables—acceptance of the I-E process in PF, acceptance of the I-E process in PS, and acceptance of the I-E process in SI; practice of the I-E process in PF, practice of the I-E process in PS, and practice of the I-E process in SI—making a total of nine variables (as in Figure 2) instead of five (Basadur, 1993).

Second, different optimal balances between ideation and evaluation might exist in each of the three stages. Ideation might be more important in the PF stage; evaluation might be more important in the SI stage; and ideation and evaluation might be equally important in the PS stage. This discovery led to a revision of the basic model in Figure 1, in which the lengths of the ideation and evaluation symbols are equal within and among each of the three stages. In Figure 3, the lengths of these symbols are equal only within Stage 2. In Stage 1, the ideation symbol is longer than the evaluation symbol; in Stage 3, the reverse is true. These differences in Figure 3 represent relative optimal amounts of ideation and evaluation in each stage.

The primary purpose of the present research was to explore this notion of relative contributions of ideation and evaluation at each of the three stages of the process shown in Figure 1. For example, do these relative contributions differ by field of organizational endeavor? Perhaps different optimal I-E ratios exist for any job or any organizational function. Perhaps in short-range, time-pressured, high-implementation-oriented jobs, evaluation (convergence) is relatively more important than ideation (divergence). Perhaps in long-range, less time-pressured, low-implementation-oriented jobs, the reverse is true. Perhaps jobs exist between these extremes in which ideation and evaluation are about equal in importance.

In manufacturing, which is characterized by short-term, clear-cut activities leading to
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Figure 3. Revising Figure 1 in light of optimal ideation-evaluation ratio theory—a complete creative problem-solving process emphasizing ideation-evaluation in each of three stages but in different ratios. The three quadrilateral figures representing the three stages are all equal in area. This represents equal time or equal activity. The ratios of ideational and evaluational time or activity are different in the three quadrilaterals.

action within specific time limits, an evaluational, converging approach would likely be favored over an ideational, diverging approach. This would be an SI field of endeavor. In such work environments as pure research, in which time is a less limiting factor and action is secondary to understanding, a diverging approach would likely be favored over a converging approach. This would be a PF field of endeavor. Between these two extremes lie various fields in which, based on PF already done by others, one develops solutions for others to implement. Here, moderate time limits for action exist, and these may favor diverging and converging about equally. This would be a PS field of endeavor. Examples of such fields include (a) administrative tasks in organizations in which field representatives provide services to meet previously diagnosed customer needs and (b) marketing tasks in which new opportunities already discovered in the marketplace or by research and development departments are turned into solutions for manufacturing and sales departments to implement (see Figure 4).

This line of thought is consistent with the findings of Carlsson, Keane, and Martin (1976), who showed that organizations' research and development projects may flow through four different kinds of activity, with evaluative, converging thinking successively more important in each. These four activities follow Kolb's (1976) learning model as follows:

1. **Divergence**—generation of alternatives, sensing problems and opportunities.
2. **Assimilation**—establishing criteria for evaluation, formulating hypotheses.
3. **Convergence**—decision making among alternatives and designing experiments.
4. **Execution**—implementation of decisions, execution of plans, commitment to schedules.

Similarly, Johne (1987) found that an industry's most innovative organizations took looser, more informal approaches to
managing their product initiation stages and more rigid, formal approaches through the implementation stages. Less innovative organizations did the reverse.

This line of inquiry is also consistent with MacKinnon’s (1962) finding that significant differences existed in average judgmental–nonjudgmental balance among individuals performing at high creative levels in varying fields of endeavor. Training in a complete creative problem solving process emphasizing I-E at each stage (see Figure 1) promotes a balanced approach valuing both ideation and evaluation. The educational film called The Dot and the Line (Norton, 1965) illustrates the pitfalls of the two extremes of total rigidity and total flexibility and promotes an optimal concept called disciplined freedom. Perhaps training can serve to move individuals who may be too close to either extreme on an I–E spectrum toward some optimum. The location of this optimum would depend on the type of work or field of endeavor involved and would differ for work requiring varying relative levels of PF, PS, and SI.

Within a field of endeavor, the optimal emphasis on evaluation may increase as the successive stages of the complete process unfold from PF through SI (and vice versa for ideation). This concept is illustrated in Figure 5. For decision-oriented PS fields (e.g., marketing, advertising, and engineering, which convert basic research into practical decisions and plans), the optimums in each stage may lie between the optimums for question-oriented PF fields (e.g., research and development, in which asking the right question is vital) and implementation-oriented fields (e.g., secretarial/administrative support and manufacturing, in which implementing answers successfully is vital).
Perhaps appropriate training in these fields will promote a preference for such optima. These optimal ratios of emphasis and time devoted to I–E for fields such as marketing, advertising, and engineering would then be lower in each stage than for fields such as research and development but higher in each stage than for SI fields such as secretarial/administrative support and manufacturing.

In pursuits requiring relatively more PF and with fewer time restrictions, the optimal I–E ratios in each stage would be relatively higher than in pursuits requiring quick, good-judgment decisions and more attention to evaluation. For example, a researcher or training-and-development specialist might face a great diversity of both acceptable problems and acceptable solutions. However, for a manufacturing production engineer or warehouse shipping manager, the number of acceptable problems and solutions may be more heavily constrained by the organization’s or customer’s short-term needs. The number for a marketing specialist, engineering specialist, or advertising account manager probably lies somewhere in-between. The diversity of acceptable problems may be constrained, but the range of possible good solutions for those problems may be far wider. This article reports empirical testing of the idea that fields of endeavor with differing emphases on various stages of the complete creative problem-solving process may differ correspondingly in the I–E preference ratio of individuals working in these fields.

It was hypothesized that people working in various fields of endeavor in organizations will have different I–E preference ratios that

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will correspond with the varying relative amounts of PF, PS, and SI that their work entails. People working in fields favoring PF will have higher I–E preference ratios than those of people working in fields favoring PS and SI. People working in fields favoring PS will have higher I–E preference ratios than those of people working in fields favoring SI.

Method

Sample

Data were gathered in the field during organizational training and application sessions. In every session, the participants were seeking improved understanding of the creative problem solving process and improved organizational performance. The data were drawn from 33 separate subsamples and are reported as one aggregate sample (N = 987).

Included in the aggregate sample were managers, supervisors, and professionals from a large consumer goods company and a large public works facility; graduate business students (MBAs); health care administrators and service professionals; managers, supervisors, professionals, and foremen from three large industrial companies; professionals, lead hands, and first-line supervisors from a government ministry of mines and natural resources; manufacturing and headquarters managers, supervisors, professionals, and clerical and shop floor employees from a large consumer goods company; marketing staff and salespeople from a medium-size outdoor advertising company; top managers from a medium-size consumer goods company; human resource professionals, training-and-development managers, and professionals from a wide variety of organizations; advertising account managers from a large advertising agency; and university administrators and professors. All were assigned to categories by field of endeavor, such as training and development, manufacturing production, nonprofit organization administration, and so on.

Measures

The I–E preference ratios were measured using the I and E scales of the Basadur Creative Problem Solving Profile (CPSP) inventory (Basadur, Graen, & Wakabayashi, 1990). These two scales measure an individual’s relative preference for using ideation and evaluation, respectively, in the creative problem solving process. The CPSP inventory identifies an individual’s unique preferred blend of four creative problem solving process styles that affect organizational performance and has already demonstrated accuracy in predicting differences in acceptance of the I–E two-step process (Basadur, Wakabayashi, & Graen, 1990) and differences in creativity style (Basadur, Takai, & Wakabayashi, 1990). The two scales also correlated as predicted with the Kirton (1976) Adaption–Innovation measure of creative style (Kirton, 1976). In a sample of 110, the I scale correlated significantly (.41) with the innovator style, and the E scale correlated significantly (.51) with the adaptor style. The innovator style favors PF activity, including defining problems in new ways. The adaptor style favors PS activity that stays within the given bounds of problems and leads to successful SI.

All participants completed the CPSP inventory, and the I–E preference ratios were calculated for each. The CPSP inventory is composed of 12 item groups. Each item group contains four words or phrases that are force-ranked by the respondent according to
his or her relative preferences in creative PS for Ideation and Evaluation for using knowledge and Experiencing (concrete, involved) and Thinking (abstract, detached) for gaining knowledge. For example, 1 typical item group is composed of the four words divergence, convergence, action, and abstract, representing each of the four previously mentioned scales, respectively.

Analysis

The test–retest reliability of the I–E ratio measure was estimated using a subsample (n = 129) of organizational managers and nonmanagers. The participants filled out the CPSP inventory on two occasions 1 week apart. The Pearson correlation coefficient was .71 and represents satisfactory reliability.

From the total sample, 11 fields of endeavor with base sizes greater than 20 were identified. This used up 622 participants. These 11 fields of endeavor were clustered into three groups according to their expected relative emphasis on PF, PS, or SI. The classifications were predicted by two judges based on judgment and experience. Interrater reliability was based on the amount of agreement between independent rankings of I–E ratios for the 11 fields of endeavor and also between assignments of the fields to the PF, PS, and SI categories of relatively greatest emphasis. The correlations were .79 (p < .001) and .84 (p < .001), respectively. The final assignment to clusters was made by consensus. The remainder of the 365 participants represented 36 miscellaneous fields of endeavor with base sizes smaller than 20; these fields will be reported in future research as the base sizes are increased in an ongoing research program.

Two of the 11 fields of endeavor (professor/researcher; training and development) were predicted to favor a PF emphasis. In these 2 fields, (a) understanding and discovering fruitful problems and areas of inquiry and (b) diagnosing people’s needs for long-term career development are vital. Time frames for taking action are long and probably expressed in terms of years. Individuals have wide discretion in the selection of both problems and solutions.

Three of the 11 fields of endeavor (marketing, nonprofit organization administration, advertising agency account management) were predicted to favor a PS emphasis. These fields of endeavor typify moderate time frames for action. Problems such as customer needs are already relatively well identified by others, but individuals have considerable discretion in choosing solutions. Developing solutions is more important than implementing the solutions—a task left to others. Time frames for action are shorter and probably expressed in terms of months.

The 6 remaining fields of endeavor (secretarial/administrative support, distribution/logistics/warehousing, sales, manufacturing production, MBA student, and finance) were predicted to favor an SI emphasis. For these fields, time frames for action are short, often expressed in terms of weeks, days, or hours, and deadlines must be met. Individuals have relatively little discretion over either problems or solutions. Whether it be carrying out orders, moving and installing products or services for customers, securing customer purchase orders, memorizing formulas for answering examination questions, or compiling precise, timely financial statements, successful delivery of predetermined solutions is paramount. Most problems encountered are of a nondiscretionary, last-
minute nature and must be handled immediately to achieve successful implementation of products or services already determined by others. It should be noted that the MBA students in this study were from an analytically oriented business school stressing the short-run optimization and calculation skills of management science, accounting, and finance. Student performance is largely assessed on short-run examination performance.

Specific Hypotheses

1. Organizational members working in basic research and in training and development will have higher I-E ratios than those of members working in:
   - H1A: Marketing, advertising, and nonprofit organization administration and higher ratios than those of members working in:
   - H1B: Secretarial/administrative support, distribution/warehousing/logistics, sales, manufacturing production, graduate MBA programs, and finance.

2. Organizational members working in marketing, advertising, and nonprofit organization administration will have higher I-E ratios than those of members working in:
   - H2A: Secretarial/administrative support, distribution/logistics/warehousing, sales, manufacturing production, MBA graduate programs, and finance.

Results

Table 1 displays the mean I-E ratios for the 11 selected fields of endeavor and the three clusters of fields arranged in descending order. Predicted emphasis (PF, PS, SI), base size, mean I-E score, and standard deviation for each of the 11 fields of endeavor and for each of the three clusters of fields of endeavor are also presented.

The I-E mean ratios fell into three clusters along the lines predicted. The three cluster ranges were 1.35 to 1.50 for fields predicted to favor PF; 1.10 to 1.11 for fields predicted to favor PS; and .88 to .95 for fields predicted to favor SI. Cluster means were 1.39 for PF fields; 1.10 for PS fields; and .93 for SI fields. Professor/researcher and training and development were in the highest cluster, at 1.50 and 1.35, respectively. Marketing, advertising agency, and nonprofit organization administration were in the next highest cluster, at 1.11, 1.10, and 1.10, respectively. In the lowest cluster were 6 fields ranging from .95 to .88 (sales, .95; MBA student, .94; manufacturing production, .95; finance, .92; distribution/logistics/warehousing, .89; and secretarial/administrative support, .88). The overall mean was 1.02 (n = 622).

Analyses of variance (ANOVAs) were conducted using the mean I-E ratios for each of the 11 selected fields of endeavor and for each of the three clusters to test for significance of differences. This was followed by the Tukey honestly significant difference (HSD) procedure. In this "protected t test," an overall F test is applied. Only when the overall F test demonstrates statistical significance are all the pairs tested and interpreted post hoc to test for significant differences between pairings.

The results of the ANOVAs using the 11 fields of endeavor and the three clusters of fields revealed a significant main effect in both cases, $F(10, 611) = 13.56$ and $F(2, 619) = 65.80$, both $p < .0001$.

The results of the Tukey HSD procedure for the three clusters of fields, at the $p < .05$ level of significance, showed the PF cluster to be significantly higher in mean I-E ratio (1.39) than either the PS (1.10) or the SI (.93)
Table 1. Mean Ideation–Evaluation Ratios

<table>
<thead>
<tr>
<th>Field of Endeavor</th>
<th>Expected Emphasis</th>
<th>Field</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor/Researcher</td>
<td>PF</td>
<td>Base</td>
<td>M</td>
</tr>
<tr>
<td>Training and Development</td>
<td>PF</td>
<td>21</td>
<td>1.50</td>
</tr>
<tr>
<td>Marketing</td>
<td>PS</td>
<td>31</td>
<td>1.11</td>
</tr>
<tr>
<td>Advertising Agency</td>
<td>PS</td>
<td>29</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonprofit Organization Administration</td>
<td>PS</td>
<td>61</td>
<td>1.10</td>
</tr>
<tr>
<td>Sales</td>
<td>SI</td>
<td>96</td>
<td>0.95</td>
</tr>
<tr>
<td>MBA Student</td>
<td>SI</td>
<td>74</td>
<td>0.94</td>
</tr>
<tr>
<td>Manufacturing Production</td>
<td>SI</td>
<td>145</td>
<td>0.93</td>
</tr>
<tr>
<td>Finance</td>
<td>SI</td>
<td>27</td>
<td>0.92</td>
</tr>
<tr>
<td>Distribution/Logistics/Warehousing</td>
<td>SI</td>
<td>40</td>
<td>0.89</td>
</tr>
<tr>
<td>Secretarial/Administrative Support</td>
<td>SI</td>
<td>40</td>
<td>0.88</td>
</tr>
<tr>
<td>Overall M</td>
<td>SI</td>
<td>622</td>
<td>1.02</td>
</tr>
</tbody>
</table>

cluster; the PS cluster (1.10) was significantly higher than the SI cluster (.93); all ps < .05.

The results of the Tukey HSD procedure for the 11 selected fields of endeavor showed that, at the p < .05 level of significance, the professor/researcher field (1.50) was the highest in mean I–E ratio. It was significantly higher than all the other fields—except the next highest, training and development (1.35). The training-and-development field was significantly higher than the 7 lowest of the remaining 9 fields, including nonprofit organization administration (1.097), sales (.95), MBA student (.94), manufacturing production (.93), finance (.92), distribution/logistics/warehousing (.89), and secretarial/administrative support (.88). The next 2 highest fields of endeavor, marketing (1.11) and advertising agency (1.100), were not significantly different from each other or from the lowest 7 fields.

Discussion

These results provide important support for both Hypotheses 1A and 1B. The three clusters of fields of endeavor were differentiated from one another in mean I–E ratios in exactly the predicted direction. Among the 11 individual fields of endeavor, significant differences in I–E mean ratios existed in the predicted direction between the highest and lowest fields and between the highest and intermediate fields. Although the base sizes were insufficient to call the differences between the intermediate and lowest fields statistically significant, these differences were in the predicted direction.

These results offer encouragement that I–E ratios can be meaningfully used to describe various fields of endeavor in terms of their relative emphasis on different phases of the complete process of creative problem solving shown in Figure 1. In virtually every case, the expected emphasis was consistent with the mean I–E ratio score. Work should continue to increase base sizes, obtain more representative sampling, and include additional fields of endeavor. The possibility that, within each field of endeavor, different optimal I–E ratios exist in each stage of the complete process of creative problem solv-
ing with higher evaluation at each succeeding stage should be tested (see Figure 5). Kirton (1987) found that departments more involved with implementation (e.g., production) have more adaptive creative styles. By contrast, Kirton found that departments more involved with finding new long-term opportunities (e.g., research and development) have more innovative creative styles. These findings make sense because adaptive styles likely favor PS and SI over PF because they prefer to address problems by staying within given paradigms (addressing problems as defined). In contrast, innovative styles likely favor PF because they prefer to address problems by breaking given paradigms (redefining problems). The styles of the engineering departments appear roughly halfway between those of production and those of research and development—which fits the optimal I–E theory, as engineering interfaces both with research and development in translating new concepts (problems) into new designs (solutions) and with production in translating new designs (solutions) into manufactured products (implementation).

I–E ratios appear to offer the opportunity to increase understanding of innovation and creativity in organizations, particularly in understanding how different fields of endeavor may be integrated to encourage synergy in the entire creative process. The possibility of using appropriate training to move individuals from extreme positions of evaluation or ideation toward the optimum in their field of endeavor or, even more precisely, toward the optimum consistent with the stage of the creative process their work is presently requiring within their field should also be fully explored. Some research already supports the usefulness of such exploration. Basadur, Wakabayashi, and Graen (1990) showed that training has differential impact on acceptance of the I–E process—which is consistent with differences in preference for employing different parts of the complete process of creative problem solving.

References


