Downsizing EPMcreate to Lighter Creativity Techniques for Requirements Elicitation *

Luisa Mich (0000-0002-0018-6883) [a], Victoria Sakhnini (0000-0001-6350-3885) [b], and Daniel Berry (0000-0002-6817-9081) [b]

[a] Department of Industrial Engineering, University of Trento, Italy
luisa.mich@unitn.it
[b] Cheriton School of Computer Science, University of Waterloo, Waterloo, Canada
{vsakhnini,dberry}@uwaterloo.ca

Abstract. EPMcreate is a creativity technique for requirements elicitation based on a 16-step process. These steps suggest focusing on requirements related to every combination of two different target users or viewpoints. A series of experiments confirmed its feasibility; its applicability, both as individual and group technique; and its greater effectiveness than brainstorming. However, analysts involved in some of the experiments highlighted the large number of steps as a limitation of the technique. Recent experiments tested a variant of the EPMcreate, named Power-Only EPMcreate, based on 4 of the 16 steps. The experiments showed that it works better than EPMcreate for at least website requirements. Nevertheless, the question of whether any other combination of the steps of the original technique could work is still open. This paper illustrates a number of criteria for generating lighter creativity techniques, each based on a subset of the 16 steps of EPMcreate.

Keywords: Requirements elicitation • Creativity process • Creativity step • Target user • Viewpoint

1 Introduction

The *E*lementary *P*ragmatic *M*odel (EPM) *crea*tivity *te*chnique, EPMcreate, was defined in 2004. EPMcreate operationalized a creativity technique for problem solving [1], adapting it to requirements elicitation. That problem-solving technique was in turn based on a model of the pragmatics of communication, the EPM [2].

The role of creativity in software development has been addressed in two main ways. Some authors recognized the creativity as relevant for designing software systems (see for example, [3–4]). Others worried about its impact on the software development process and described it as a factor to be controlled (among them [5]). These two approaches do reflect the dual nature of creativity that needs to be both enhanced and methodically applied [6], as confirmed by the large number of existing methods for creativity enhancement.

The 16-step process characterizes EPMcreate as a requirements elicitation technique nicely satisfying these two goals. Since its introduction, EPMcreate has

been applied in a number of experiments. The first experiments tested its applicability in real projects [7] and involved groups of analysts; results of these experiments also showed that EPMcreate performs better than the well-known and widely applied brainstorming. Another experiment, run in 2007, investigated the applicability of EPMcreate as an individual creativity technique [8] by junior analysts and also by domain experts. Then a series of experiments was designed to start addressing a specific question: "Could a creative process implementing a subset of the EPMcreate steps be as effective as the full 16-step process of EPMcreate?" A technique, named Power-Only EPMcreate, or POEPMcreate, based on 4 of the 16 steps was defined. Experiments with POEPMcreate showed that for at least websites, it works better than EPMcreate [9]. This paper proposes some criteria to define other lighter variants of EPMcreate, based on different subsets of its 16 steps.

In the rest of the paper, Section 2 introduces the EPM to give a conceptual framework to downsize EPMcreate. Section 3 illustrates the possible criteria to generating creativity techniques based on processes with fewer steps than the 16 needed for EPMcreate. Conclusions are drawn in Section 4, highlighting some of the open questions to be addressed in future work, on both theoretical and empirical grounds.

2 The Elementary Pragmatic Model and EPMcreate

The Elementary Pragmatic Model (EPM) is based on the relational theories of the Palo Alto School [10–11]. It formalizes the interactions between two subjects in terms of elementary messages whose pragmatic content is interpreted using a two-value logic. A sequence of messages is then represented by a sequence of 0 and 1 [2], and analyzed using the 16 Boolean functions of two variables [12]. These 16 functions can be illustrated by a Hasse diagram shown in Figure 1 and by the well-known truth tables shown in Table 1. EPMcreate takes advantage of the 16 functions, f_0, ..., f_{15}, of the EPM, suggesting a structured creative process for requirements elicitation [6]. Each step of the process corresponds to one of the sixteen Boolean functions, combining in a systematic way the viewpoints of two target users, U_1, U_2, of the software system to be designed.

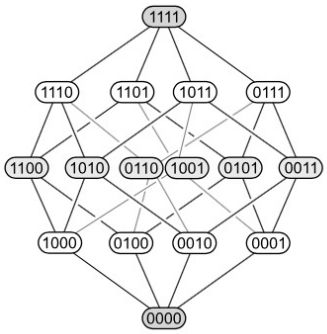

Fig. 1. Hasse diagram for the 16 Boolean functions of two variables

Table 1. Truth tables for the 16 Boolean functions of two variables

U_1	U_2	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Step 0, the first step, f_0, requires the analyst to empty her mind. In Step 1, f_1, she identifies requirements shared by the viewpoints of U_1 and U_2; in Step 2, f_2, she identifies requirements for the viewpoint of U_1 not shared by the viewpoint of U_2; in Step 3, f_3, she identifies requirements for the viewpoint of U_1 independent of the viewpoint of U_2; ...; and in Step 15, f_{15}, she identifies requirements for both viewpoints, including those coming from external issues.

Many of the steps of EPMcreate can be connected to other creativity techniques. First of all, Step 0, corresponding to f_0, encapsulates the Creative Pause Technique [13]. Step 15, corresponding to f_{15}, encapsulates the withhold-criticism principle of brainstorming, because it says that each requirement has to be accepted. Another interesting step is that corresponding to f_8, which in EPM, describes behaviours giving unexpected results as in the comic strip in Figure 3. Step 8 suggests that the analyst empty her mind and think of requirements not related to either viewpoint adopted for the requirements elicitation session. Also, Step 8 is similar to the Synapsis technique [14], whose *turning point* suggests deviating from the real context, suspending logical thinking, in order to find uncommon ideas; many other techniques suggest the same using different words. Being paradoxical by definition, Step 8 forces looking for new issues, looking at the problem in a new way, represented by the external area in the Venn diagram in Figure 2. Each step following Step 8 in EPMcreate includes that external area, and for this reason, in EPM, functions from f_8 onwards are called "anti-functions".

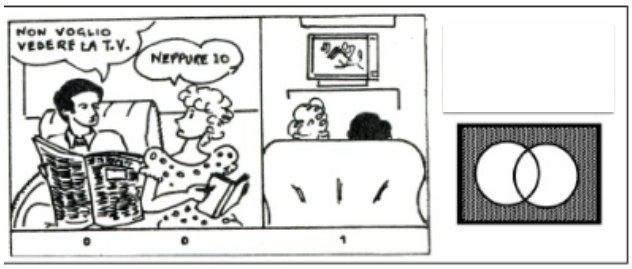

Fig. 2. Paradoxical interaction included in f_8, (translation: I don't want to watch TV. Neither do I), adapted from [1]

3 Downsizing EPMcreate

EPMcreate foresees a requirements elicitation process in 16 steps, more steps than any of the existing creativity techniques include in its idea generation phase†. On one hand, the systematic covering of the combinations of the target users' viewpoints is the core of EPMcreate and forces an analyst to discover any user's requirements by thinking in Steps 8 through 15, also of unexpected and external requirements. On the other hand, in some of our experiments, analysts said that the large number of steps of the technique is a limitation and complained about their repetitive nature. To reduce the number of steps, POEPMcreate was defined. It includes the 4 steps corresponding to the atoms of the Boolean algebra for 2 variables, that is, the steps for f_1, f_2, f_4, and f_8, in the first row of nodes up from the bottom in Figure 1. In terms of a Venn diagram as in Figure 2, these steps cover exactly the four regions of the viewpoint space. But the question of whether other subsets of the steps of EPMcreate could work is still open. The problem is that there is a huge number of combinations of the 16 steps: according to the combinatorial calculus, even assuming that we are not repeating any step and that order matters, there are $16!/(k! \times (16-k)!)$ steps for each subset with k of the 16 steps. The goal of this paper is to propose criteria that could be applied to choose from among so many combinations.

First of all, if no information were available, even the criteria of choosing a random set of functions could be applied, but this hypothesis can be discharged thanks to the theoretical basis of the EPMcreate.

General criteria to choose the number of steps and the steps of EPMcreate with which to generate a lighter creativity technique are:

- time constraints: According to the experiments, a minimum time of 6 minutes per step should be given. In the experiments run so far, when the time for each step was from 15 to 30 minutes, no one complained about not having enough time. Data about the number of requirement ideas generated per unit of time could be used for more precise suggestions.
- requirements to be gathered vs. viewpoint: If one of the target users is more important, steps producing more requirements for that viewpoint could be chosen. Another possible approach could be to include only the steps that generate requirements for a given viewpoint. That is, for U1, all steps would be used except for Steps 0, 4, 8, and 12.
- number of sessions: To maintain the 16 steps of EPMcreate, an EPMcreate session could be split into two or more sessions that partition the 16 steps, i.e., that share no steps with each other, but that collectively cover all 16 steps.

Two other factors that can be taken into account for choosing the steps are the size of the project and the type of the requirements (e.g., high-level vs. usability, or functional vs. non-functional).

A three-viewpoint variant of EPMcreate could be applied to take into account of three different targets [17], but that would require experiments to test how analysts could manage to think in three different viewpoints at the same time.

---

† EMPcreate covers only the first idea generation phase of a creative process. Many a creativity method suggests including other, follow-on phases, such as idea evaluation and pruning.

An exhaustive analysis of the combinations of steps starting from 1-step technique and finishing with 16-step ones could be useful, but too complex. Applying a criterion similar to that used to define POEPMcreate, in this paper we will start considering techniques with 1, 2, 4, and 8 of the EPMcreate steps.

1-step techniques. As explained in Section 2, three of EPMcreate steps correspond to existing creativity techniques, and applying any one of these existing techniques is equivalent to a reduction of EPMcreate to the technique. In particular, Step 0 is similar to the Creative Pause Technique [13]; Step 8 is similar to Synapsis [14], and, in a sense, Step 15 is similar to brainstorming [15]. In Boolean algebra, f_0 and f_{15} correspond respectively to the null and the universal subsets. Both Step 0 and Step 15 are relevant from a theoretical point of view, as they are basic elements of any algebra.

2-step techniques. There are 120 two-step techniques. A first reasonable assumption is that Step 0, a good first step with which to start any creative requirements elicitation process, should always be included. This step is always implicitly run whenever mind blanking is required to allow concentration for the upcoming session. Adding Step 15 to Step 0 yields the basic process of many a creativity technique: Blank your mind and then start to say anything that comes to your mind. According to the criterion of combining two steps to cover all the areas of the Venn diagrams, there are 7 pairs of steps that could be used, that is Steps 1 and 14, Steps 2 and 13, etc. In each of these pairs, the sum of the step numbers is 15. Combining Step 3 and Step 5 corresponds to the classical looking for the requirements for the two target users, U_1 and U_2.

4-step techniques. These techniques include POEPMcreate, that for at least websites, works better than EPMcreate. Another 4-step technique, based on Step 0, Step 3, Step 5, and Step 15 corresponds to a requirements elicitation session in which after a mind-blanking step, Step 0, requirements for targeted users U_1 and U_2 are gathered with Steps 3 and 5, finishing with a catch-all requirements check with Step 15.

8-step techniques. The definition of the EPMcreate steps according to the EPM suggests that the steps from Step 8 onward, corresponding to the anti-functions, should be more creative. More information is needed to suggest other combinations with 8 steps.

Conclusion

This paper illustrates that EPMcreate can be used to generate lighter creativity techniques based on subsets of its 16 steps. It offers a preliminary description of the criteria that could be applied to choose among the large number of subsets of the original 16-step technique. The effectiveness of variants of EPMcreate based on one or more of these criteria need to be tested by experiments. To test all the possible combinations of the steps in a significant way is very demanding. Therefore, theoretical insights are valuable to point the way to promising subsets of steps. A research strategy for future work should be defined to tackle the variety of issues and questions raised in the paper. First of all, future work can use the results of past

experiments in a meta-analysis to obtain data to support selection of the variants of EPMcreate. The list of open questions includes a systematic comparison of the steps of EPMcreate with other creativity techniques, the ways in which to test a given combination of steps against another combination, an analysis of the factors to be taken into account for choosing a given subset of steps (as for example, the type of software projects, time constraints, analysts expertise).

Acknowledgements. Daniel Berry's work was supported in part by a Canadian NSERC grant NSERC-RGPIN227055-00.

References

1. De Giacomo P.: Mente e Creatività: Il Modello Pragmatico Elementare quale strumento per sviluppare la creatività in campo medico, psicologico e manageriale. Franco Angeli, Milano, IT (in Italian) (1995)
2. Silvestri. A., De Giacomo P., Pierri G., Lefons, E, Pazienza, M.T., Tangorra F.: A basic model of interacting subjects. Cybern Syst International Journal 11, 115–129 (1980). doi:10.1080/01969728008960230
3. Glass R.: Software creativity. Prentice Hall, Englewood Cliffs (1995)
4. Robertson J.: Eureka! Why Analysts Should Invent Requirements, IEEE Software 19(4), pp. 20-22, (2002). doi:10.1109/MS.2002.1020281
5. Nguyen, L., Carroll, J., Swatman, P.A.: Supporting and monitoring the creativity of IS personnel during the requirements engineering process, 33rd Hawaii Int. Conf. on System Sciences (Vol. 7), January 4–7, 2000 Maui, Hawaii (2000). doi:10.1109/HICSS.2000.926899
6. De Pisapia N, Bacci F, Parrott D, Melcher D.: Brain networks for visual creativity: a functional connectivity study of planning a visual artwork. Scientific Reports 6:39185 (2016). doi:10.1038/srep39185
7. Mich, L., Anesi, C., Berry, D.M.: Applying a pragmatics-based creativity-fostering technique to requirements elicitation. Requirements Engineering, 10(4), pp. 262–275 (2005). doi:10.1007/s00766-005-0008-3
8. Mich, L., Berry, D.M., Alzetta, A.: Individual and end-user application of the EPMcreate creativity enhancement technique to website requirements elicitation. In 1st Work. on Creativity in Requirements Engineering (CreaRE) at REFSQ 2010, pp. 22–31 (2010).
9. Sakhnini, V., Mich, L., Berry, D.M.: The effectiveness of an optimized EPMcreate as a creativity enhancement technique for Web site requirements elicitation. Requirements Engineering, 17(3), pp. 171–186 (2012). doi:10.1007/s00766-011-0133-0
10. Watzlawick, P., Behavin, J.H., Jackson, D.D.: Pragmatics of human communication. Norton, New York (1967)
11. Bateson, G.: Steps to an ecology of mind, New York, Ballantine (1972)
12. Preparata, F.P., Yeh, R.T.Y.: Introduction to discrete structures for Computer Science and Engineering. Addison-Wesley Longman, Boston, MA, USA (1973)
13. De Bono, E.: Lateral thinking: creativity step by step. New York; Harper & Row; (1970)
14. Aznar G.: la Creativité dans l'enterprise. Organisation pratique et technique d'animation, Paris, Les Editions d'organisation (1971). doi:10.7202/1003695
15. Osborn, A.: Applied imagination. Charles Scribner's, New York (1935)
16. Sakhnini, V., Mich, L., Berry, D.M. (2017): Group versus individual use of Power-Only EPMcreate as a creativity enhancement technique for requirements elicitation. Accepted to Empirical Soft Eng (2017). doi:10.1007/s10664-016-9475-z
17. Sakhnini, V., Mich, L., Berry, D.M.: Group Versus Individual Use of an Optimized and the Full EPMcreate as Creativity Enhancement Techniques for Web Site Requirements Elicitation. Technical Report, University of Waterloo (2016). https://cs.uwaterloo.ca/~dberry/FTP_SITE/tech.reports/SakhniniMichBerryTR.pdf