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Unity vs. Conflicts of Enneagram Personality Types in Problem Solving

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Abstract: The aim of the study is to contribute to collaboration in the analogical problem-solving process by investigating the interaction among three factors: enneagram intelligence centers, execution of problem-solving steps and the creative solutions achieved. An experiment is conducted to understand how designers with three centers differ from or unite to each other in the way they execute each step of a problem-solving process for a given design task. Participants took part in the experiment consisting of three tasks: retrieval of source information, mapping, transferring, and adapting the whole information selected and evaluating the final solution achieved. In an individually executed analogical problem-solving process, the possible synergetic points of personalities are tried to be revealed.

In this research first we analyzed the enneagram of the experimenters, the relation between intelligence centers and distance of source domains retrieved. Second, we analyzed the relation between these centers and the level of similarity mapped, transferred, and adapted to the target domain. Third, we analyzed the overall relationship between personality types, distance of similarity, and depth of analogical thought.

Results showed significant differences among different personality types. One aspect, i.e., the strong need to acquire understanding the behaviors of personalities may present obstacles to the successful execution of stages in analogical transfer process specially to prevent conflicts, but to create unity in a teamwork. Conflict versus unity are both the terms the first of which is used to express dissociation and the second one is used to express association between different personalities for an effective teamwork.

Keywords: Enneagram, creativity, problem solving, analogical reasoning, unity.

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1. INTRODUCTION

Interdisciplinary knowledge transfer can be characterized as a potential strategy for creativity, originality, novelty, and innovation as well. The transfer occurs by taking parallel ideas from other interdisciplinary fields and altering or seeing alternatives of these ideas to fit them in new circumstances.

Analogy is considered as an essential tool for the conception of creative ideas (Koestler, 1964; Hesse, 1966; Dunbar, 1999; Hofstadter, 2001) and for the transference of relevant information from the source domains to the target domains (Holyoak & Thagard, 1997).

Analogy enables problem solving connecting to different source domains. Previous research in analogy has focused primarily on the role of analogy in creative domains. In literature there is a lack in understanding different enneagram intelligence centers' use of analogy and the way how they think, act, and react in a design process and in teamwork. This paper aims to explore and develop how to improve design processes and effective design problem solving strategies by involving the three centers in the various problem-solving steps of a creative process. This is a study where cognitive science is applied in design research to improve design process methods using enneagram model. The three main parameters (source domain, target domain and the reasoner) of analogical reasoning are represented in Figure 1. The operation of the three instinctual biases corresponds to the analogical reasoning mechanism. These biases are preserving, navigating and transmitting (Sikora & Munita, 2020).

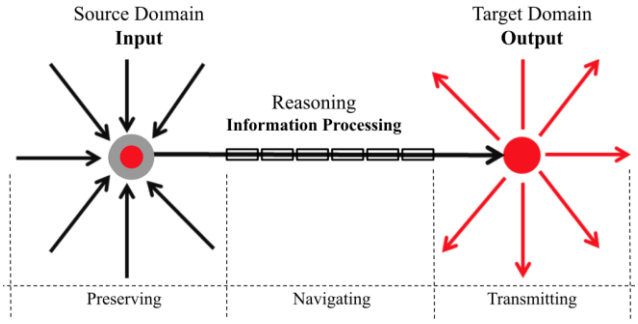


Figure 1. The three main parameters of analogical reasoning and instinctual biases.

Despite, on analogy there are too many studies have been achieved in literature with various aspects, there is still a need for cognitive, qualitative empirical research on analogical reasoning of designers who have different personality traits. In a systematic review of the relevant empirical studies, it is found an absence of published work on the interplay of personal differences of designers while carrying out analogical reasoning tasks in a design process (Mair et al., 2009). With this motivation for the empirical study reported in the remainder of this paper and with its focus on the identification of hidden potential, the Enneagram typology might provide a powerful tool for design process and talent management. The integrative rather than reductionist approach to personality encourages a more realistic understanding of individual behavior on each stage of problem solving. In that respect, it is decided to use the Three Centers of Intelligence in the Enneagram.

1.1 Distance of Source Domain

In analogical processes, based on their scientific disciplinary relations, the distance between inspirational source domain and target problem domain may change (Dunbar, 1995; Dunbar & Blanchette, 2001). Depending on whether the source and the target domain belong to the same subject domain, two types of analogy are defined in literature: between-domain or inter-domain analogy and within-domain analogy or intra-domain analogy (Bonnardel, 2000). From the perspective of cognitive science Dunbar classified analogies as;

- Local.
- Regional.
- Distant.

In this research the terminology of Dunbar will be used. Local source domain represents existing inter-domain solutions of target design problems. Regional source domain represents all inter-domain solutions (artifacts) that lead interdisciplinary information transfers. Finally, the distant domain represents intra domain sources (nature) which trigger multidisciplinary thinking and information transfers.

1.2 Depth of Analogical Observation

According to the similarity level between source and target, analogy involves at least two distinct forms of relation. At one level, there is a (1) superficial or attributional similarity that involves a recognized correspondence and mere appearance similarity between source domain and target. At another level, there is (2) structural similarity that involves a resemblance of underlying systems of relations within the source and target domains (Gentner, 1983; Rips, 1989; Holyoak & Koh, 1987; Forbus & Gentner, 1995; Novick, 1988). Structural similarities have been understood as the most essential characteristics of analogical reasoning (Gentner & Markman, 1997) since deeper knowledge involves generative central properties of source domains. This kind of information access has a strong influence on the quality of the solutions. Reasoning with deeper structural relations is the core of creativity and leads to innovative solutions.

Table 1. The levels of analogy (Gertner & Markman, 1997)

	Superficial Similarity	**No Superficial Similarity**
Deep Structural Similarity	Literal Similarity	Analogy
No Structural Similarity	Attribute or Mere Appearance Sim.	Anomaly

The levels of analogy thus, can be characterized by matching source domain to target domain with structural properties, or superficial properties, or both as shown in Table 1. These levels of relations are.

- Mere appearance similarity,
- Analogy,
- Literal similarity,
- Anomaly (Gentner, 1983).

In mere-appearance matches, just the source domain attributes are transferred. In analogy, only deep-structural relations are transferred. In literal similarity, both deep-structural and superficial relations attributes are transferred. In anomaly neither deep-structural nor superficial relations are transferred (Gentner & Markman, 1997).

1.3 Stages of Analogical Transfer

In cognitive science, there is consensus that analogical transfer involves different sub-processes. These are retrieval, mapping, transfer and adaptation, evaluation, and learning (Figure 2).

In idea generation stage retrieval is used, in solution generation stage mapping, transfer and adaptation, evaluation is used. It appears that different sub-processes are affected by different levels of similarity. As a problem solver moves through design stages, relevant similarity shifts from superficial relations to structural ones. Retrieval is accessing a source domain that is strongly influenced by superficial similarity. This means that attributional properties attract perceivers at first glance.

Analogical mapping consists of aligning systematicity between source and target and success of mapping strongly depends on structural similarity. (Keane & Ledgeway & Duff, 1994; Holyoak & Thagard, 1995; Gentner, 1993; Novick & Holyoak, 1991; Schunn & Dunbar, 1996).

Transfer and adaptation involve creating new similarities and adapting them to the target domain. Success of transfer depends critically on the level of structural relation (Holyoak & Koh, 1987; Novick, 1988). Evaluation is improving the achieved solution by taking it as the final system model and considering its strengths and weaknesses (Forbus & Gentner, 1989). It is chiefly influenced by structural similarity and systematicity. Finally, to store for later use, extracting the principle of the final system model seems likely to be governed by structural similarity and systematicity (Keane, 1988).

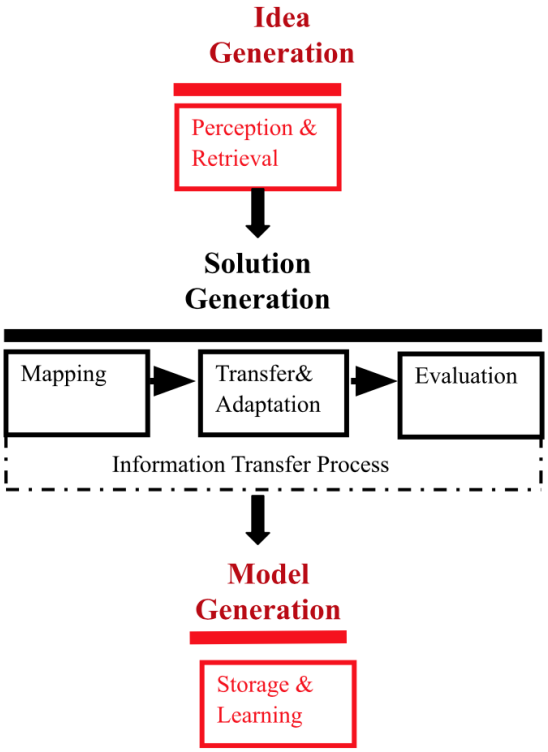


Figure 2. Phases of analogical knowledge transfer

1.4 Personality Characteristics and Analogical Transfer

In literature researchers found that personality type is an important factor to define social behavior. Riso Hudson stated that understanding our primary center allows us to develop our personal and professional potentials and overcome our blind spots (Hudson, 2002). There are three centers of intelligence.

- mind centered (5,6,7),
- emotion centered (2,3,4),
- action centered (8,9,1).

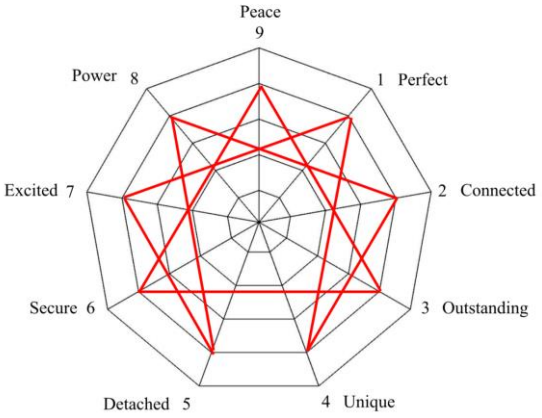


Figure 3. The nine types of the enneagram (Sikora & Munita, 2020)

They combine three more detailed personality types for each center in that triad. In Awareness to Action Program and in their book Mario Sikora and Maria Jose Munita revealed nine types as shown in Figure 3; (5) disconnected, (6) secure, and (7) excited, (2) connected, (3) outstanding, and (4) unique, (8) power, (9) peace, and (1) perfection (Sikora & Munita, 2020).

Each center is characterized by a tendency which deeply influences how you react and how you experience relationships based on the ability to think, to act and to feel (Sutton & Allinson & Williams, 2013).

In this study just the main triad is taken as primary types to clarify their performance in the above-mentioned stages of the analogical problem-solving process. The nine personality types will be explored later in a broader and deeper research. Based on a distinguishing mark of personalities, it is claimed that collaborative analogical transfer can be successfully achieved in different stages matching individuals to the appropriate stage of the design process regarding their potentials. With this motivation it is important to understand strengths and weaknesses of personalities to prevent possible conflicts and develop synergy and unity with a better role definition in a design process.

2. MATERIAL AND METHOD

2.1 Participants

152 experimenters completed a questionnaire survey assessing their personality types and each type was identified. Then participants were eliminated to 35 for each type. Out of 105 selected, 96 participants (mind centered n = 31, action centered n = 32, emotion centered n = 33) participated in the experiment.

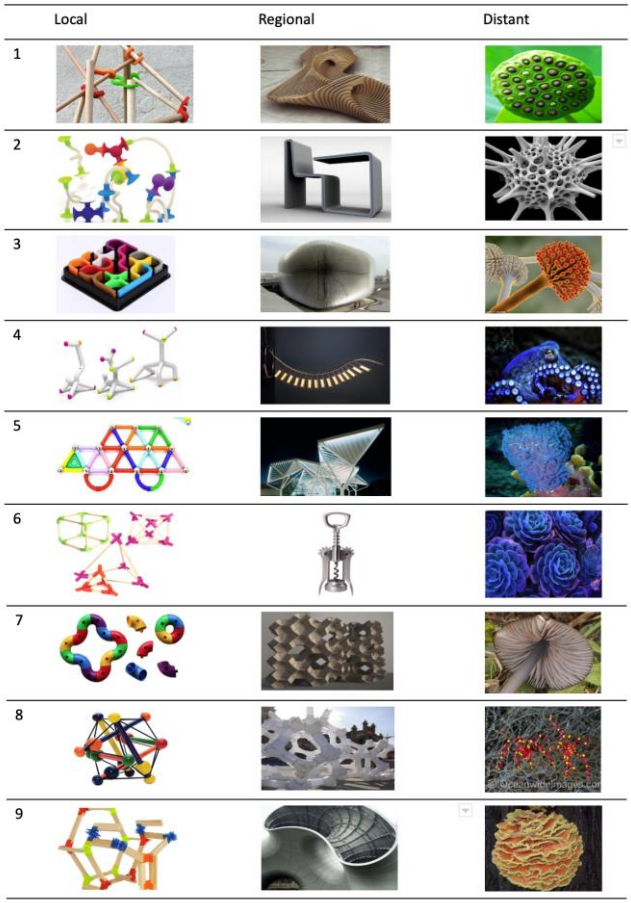
2.2 Materials

An experimental study is conducted to better understand the interactions of these whole parameters explained above. As target domain experimenters are given a toy design problem. The important point in the selection of the problem was the

simplicity for all possible experimenters. The source domain groups were defined in four different categories: (1) local, (2) regional, and (3) distant. These are first, toy design examples as local, second, examples from industrial design as regional, and third, examples from nature as distant respectively (Table 2).

The examples were determined in a two-phase selection process. In the first phase 240 source examples with 80 examples from each category were identified. Then 80 examples were eliminated to 20 for each category. 3 expert designers selected the remaining source examples unanimously with Delphi. With the %87 agreement, 30 source examples were selected by independent judges in two rounds (Table 2).

Table 2. Selected source domain examples



2.3 Procedure

In the experiment, the participants were told to imagine themselves designing a geometry toy which is not so complex for all levels of expertise. Then, they were expected to derive some information from the given source examples, and then apply it to the given design problem. In order to compare and contrast personality types in terms of their use of analogy the experiment was conducted in three tasks: the first task, asking participants to rate a randomly shown 30 source examples as source of information for the given design problem; the second task focused on selecting one of the source domain categories with 10 examples in each. From the selected category participants also selected one example out of 10 and explained the reasons for their selections. The third task focused on the toy design by transferring the information from the chosen source example. In the first and second task data were analyzed according to analogical distance; (1) local, (2) regional, and (3) distant. In the third task final design solutions of participants were categorized by three judges. The categorization is made according to similarity levels; (1) mere-appearance similarity, (2) analogy, (3) literal similarity, and (4) anomaly (Figure 4). Chi-square test, ANOVA, and MANOVA were conducted to better analyze the relations and differences between these parameters. To make a comparison between textual and numerical data collected, experimenters also were asked for the parameters they considered during the design process.

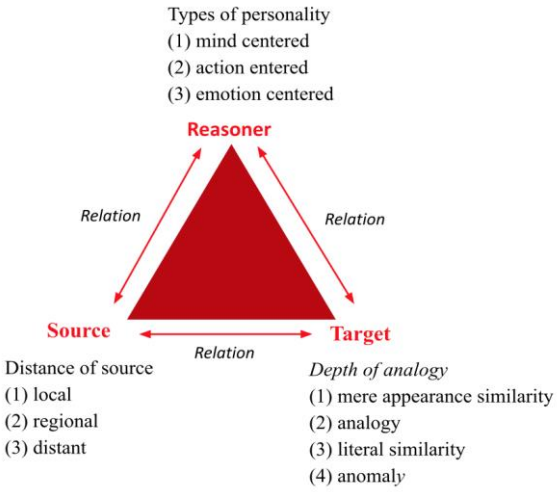


Figure 4. Parameters of analogical problem-solving process

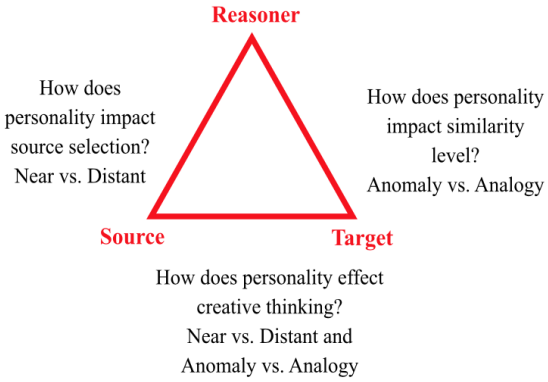


Figure 5. Questions of the research

The hypotheses are first, mind centered personalities would tend to establish near domain analogies whereas action centered personalities will tend to establish more distant domain analogies. Second, action centered personalities would more likely establish deep structural similarities whereas mind centered personalities would use superficial similarities. Third, action centered personalities design with more steps in the analogy process. The frequency of design stages would differ depending on the designers' type of personality and their source domain retrieval. Emotion centered personalities would probably behave like both mind and action centered personalities. Briefly, analogical transfer

in design is strongly influenced by personality types of designers (Figure 5).

3. RESULTS AND FINDINGS

3.1 First Task Results

In this task, participants were expected to rate 30 source examples (1-poor, 2-average, 3-excellent). The results are given in Table 3. Multivariate test (MANOVA) indicates that there was a significant difference among three groups in their rating of source examples (Wilks'Λ=0.076, F (90, 178) =2.4, p<.05 alpha level) (Table 4).

Table 3. Personality types and local, regional, distant source domain rating frequency percentage (1- poor, 2- average, 3- excellent). Mind Centered (MC), Action Centered (AC), Emotion Centered (EC).

	Geometry Toys			Artifacts			Nature		
	MC	AC	EC	MC	AC	EC	MC	AC	EC
1_poor	0.26	0.20	0.28	0.27	0.26	0.29	0.21	0.37	0.46
2_average	0.28	0.21	0.28	0.29	0.30	0.29	0.20	0.26	0.24
3_excellemt	0.46	0.59	0.54	0.44	0.44	0.42	0.59	0.36	0.29

Table 4. Multivariate test (MANOVA) results

Multivariate Test						
		Value	F	Hypothesis df	Error df	Sig.
Personality types	Wilks' Lambda	,076	2,397	2	178	,000

The results show that action centered designers generally gave high scores to near domain examples, i.e., the group of toy design (59% and excellent rating) and the group of artifacts (44% excellent rating). Mind centered designers generally rated distant domain examples high, i.e., the group of nature (59% excellent rating) and the group of artifacts (44% excellent rating). Emotion centered personalities rated all the groups almost homogeneously (Table 3).

3.2 Second Task Results

In the first task, participants were given randomly ordered source examples. So, they rated them without receiving any information about the categories. In the second task the categories of source examples were clarified. The participants were expected to select one of the three categories (i.e., geometry toys, artifacts, or nature) and one example out of ten within the group (Figure 6).

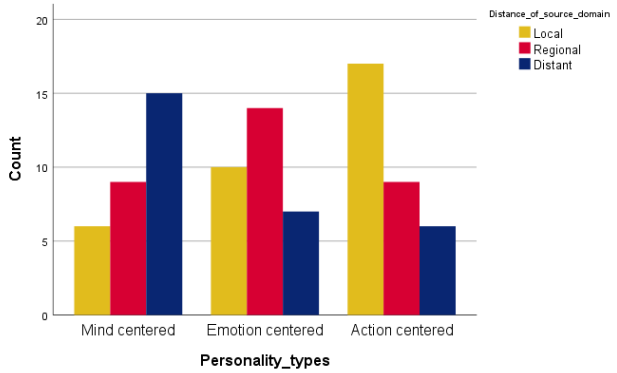


Figure 6. Differences between personality types and local, regional, distant source domain retrieval

Table 5. Chi-square test for personality types and distance of source domain relation

Chi Square Test			
	Value	df	Asymp. Sig.(2-ided)
Pearson Chi-Square	34.178	4	,000

Results are given in Figure 5. The frequency results indicate a difference between personality types and source domain group selection. Mind centered personalities selected the distant domain with 40%. On the contrary, action centered

personalities selected the local domain with 52%. The selection differences between emotion centered designers were less than the other two groups. Chi-square test (Table 5) results indicate that there is a significant relationship between personality types and distance of source domain parameters; x^2 (4, N=96) = 34.178, p=.000, p < 0.05. Briefly, group selection and personality type significantly related factors when source domains are grouped in the retrieval process.

Findings from the second task are parallel to the first task results. Second task findings show the consistency of the reasoner in their rating procedure. Participants rated the source examples in the first task as if they knew about categories.

In the second task we also asked the participants the reasons for their selections. This task was a follow-up to the previous one and participants were asked to explain the reasons for their source domain selections. The items of content analysis were mere appearance (formal) characteristics, function, structural relation, causal relation, originality, and design process. Approximately 96 answers to questions and approximately 4000 words of relevant excerpts were transcribed, and keywords were color-coded during transcription to facilitate subsequent analysis and collation. The results are given in frequencies of parameters mentioned as a reason for source domain group selection (Table 6).

Table 6. Parameters generally considered for source domain group selection. Mind Centered (MC), Action Centered (AC), Emotion Centered (EC).

	MC	AC	EC
Mere Appearance	0,98	0,85	0,68
Function	0,73	0,81	0,59
Structural Relation	0,07	0,56	0,50
Causal Relation	0,02	0,20	0,45
Originality	0,41	0,08	0,09
Design Process	0,06	0,24	0,45

Second task textual data revealed that mind centered personalities generally focused on distant domains with the aim of originality, novelty, and creativity, whereas action centered personalities generally focused on near domain in the aim of practicality and productivity.

Emotion centered personalities on the other hand considered neither originality nor productivity exclusively. On the contrary, action centered personalities generally considered how to use the source examples in the design process and focused on practicality and design process concepts.

3.3 Third Task Results

The descriptive analysis of target domain analogy levels is given in Figure 7.

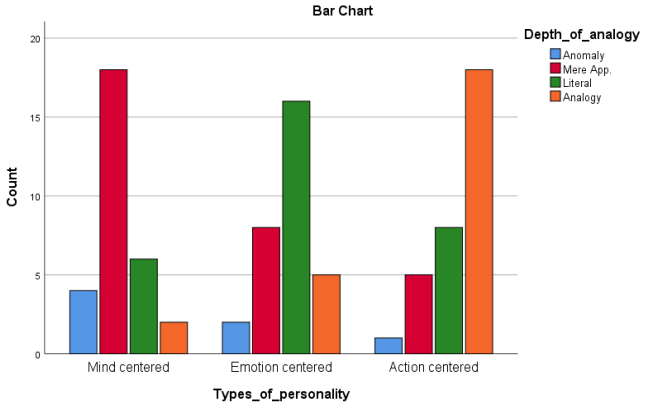


Figure 7. Depth of analogy according to personality types

Table 7. Relation between personality types and analogy levels

Chi Square Test			
	Value	df	Asymp.Sig.(2-ided)
Pearson Chi-Square	33.833	6	,000

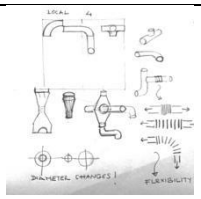
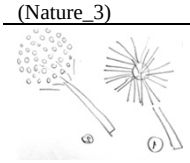
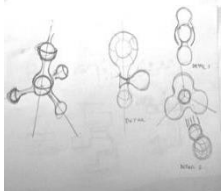
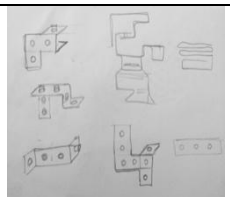
Results show that mind centered personalities designers generally transferred mere-appearance knowledge and focused on the attributional characteristics of source domain. They could not make analogical connections with the source example but just pictorial representations. The frequency percentage of mere-appearance similarities made by mind centered personalities designers is 52% which was the highest result in this level. The percentage of anomalies in the mind centered personalities is 26%. On the contrary, action centered personalities generally transferred deep-structural knowledge and were able to make analogies. They made an analogy with 56%. Emotion centered personalities generally established literal similarity with the source domain with %48. Third task visual data analysis shows that mind centered personalities were better in creative idea generation from distant domains, whereas action centered personalities were better in productive analogical process generation from near domains. Emotion centered personalities transferred generally literal information from regional domains in the thought that literal transfer from distant domain would not be the solution to the problem, literal transfer of near domain would yield plagiarism, but literal transfer from artifacts will lead to an innovative solution.

Action centered personalities are more successful in perceiving and transferring deep-structural relations with a strong effect on the ability of analogical reasoning in the solution generation process. The descriptive statistics indicate that there is a linear relationship between personality and similarity level. Chi-square test results show that there is a significant relationship between personality types and the levels of analogy; x^2 (6, N=96) = 33.833, p=.000, p<0.05 (Table 7).

Compare the performance of participants in this study, it is observed that the solution-relevant higher-level abstractions

and representation of structural features are developed by the action-centered personalities. Emotion centered designers generally focused on source objects itself and reasoned generally with literal connections. Action centered designers on the contrary considered the causal relations with a pragmatic approach regarding productivity. They were able to make abstractions at multiple levels discovering the system relations and the main aspects of source examples. Mind centered designers generally reasoned with mere appearance similarities and made lower levels of abstractions. They could only benefit from the superficial object attributes of the source domains.

Table 8. Examples from design solutions

EC - Mere App._Ditstant (Artifacts_7)	MC - Literal _Distant (Nature_7)	AC- Analogy_Local (Toy Design_3_4_5)
		
MC - Mere App. Sim. Distant Domain (Nature_3)	EC - Literal Regional (Artefacts_2)	AC Analogy Regional (Nature_10)
		

These analyses reveal that personality types affect the level of analogical transfer. Source domain selection criteria are mainly based on the goal of the reasoner. Similarly, the goal of the reasoner also may depend on the personality type. In their explanations often mind centered designers expressed that the geometry toy to be designed should be unique and different, i.e., original, novel, eye-catching, pleasing to the eye and aesthetic. They offered nature as a primary source which offers more unique design opportunities. However, they mainly focused on superficial characteristics. Action centered designers on the other hand were more concerned about strategizing the design process, i.e., effective design process, productivity, efficiency. Compared to other groups, they are concerned more about how their selections will shape the design process and expected quality of the product. They generally stated that using near domain examples would ensure the success of the product since it was closer to the problem in hand.

In the light of the results given above, the following can be derived (Table 9).

Table 9. Comparison of personality types. Mind centered (MC), Action centered (AC), Emotion centered (EC).

Comparison parameters	MC	AC	EC
Level of Similarity	Superficial Similarity	Deep-structure Sim.	One-to-one
Similarity Type	Mere Appearance	Analogy	Literal
Level of Knowledge	Domain Specific	Domain General	Domain Itself
Analogical Reasoning	Formal	Relational/Causal	Structural
Idea Generation	Playful	Rigid	Emotional
Solution Generation	Confused	Masterful	Use existing solutions
Reasoning Type	Analytically	Analogically	Abductive
Consideration	Originality	Practicality	Both
Thinking Type	Divergent/ Creative	Convergent/ Critical	Fixated

4. DISCUSSION AND CONCLUSIONS

On the contrary to our prediction, mind centered designers generally rated randomly given distant source domains with highest scores. Action centered designers on the other hand generally rated local domains with highest scores. Emotion centered designers' source domain group selection differences are less than the others. In the third task, action centered personalities designed with deeper levels of analogies. Experiments show that mind centered designers are more likely driven by originality, novelty, and creativity in their selection of source category to enhance creative solutions. However, they were fixating on the pictorial information and generally focused on the given representation of source examples. They inferred and made pictorial, attributional, or superficial or mere appearance transfers or end up with anomaly. Mind centered designers retrieved original ideas whereas their execution of problem-solving steps was not enough to solve the problem. Action centered designers, on the other hand, generally focused on productivity and retrieved near source examples but achieved analogical transfer. Emotion centered designers were between these two cognitive behaviors. They were generally insufficient to perceive higher-level causal relations and generally made literal transfers.

Third task visual data analysis revealed that mind centered designers were better in creative idea generation from distant domains with their divergent thinking ability, whereas action centered designers were better in productive analogical process generation from near domains with their convergent thinking ability. They also mapped, transferred, and adapted the information of the source domain, and evaluated the final solution. Emotion centered designers generally used information as it is. It can be suggested that emotion-based designers are better at memorizing the information as it is.
Although mind centered designers generally aimed for originality and behaved as a creative thinker in the retrieval stage, they made pictorial transfers with single step processing mode (Hummel & Holyoak, 1997) throughout the solution generation stage. In the idea generation phase, distant analogies are seen as creative mental leaps. However, the originality in novel solutions is bound to using new strategies for the execution of problem-solving steps

(Holyoak & Thagard, 1995 & Ward, 1998), superficial transfer of them leads to incorrect procedures (Novick, 1988). In this experiment action centered designers made deep structural transfers with multi-step processing mode. In the idea generation phase, action centered designers generally selected near domains because they saw near domains as useful respectfully for practicality. They made analogical transfer with productive mental hops (Ward, 1998). Contrary to mind centered designers, action centered designers behaved more as a problem solver in mapping, transferring, adapting, and evaluating stages. Action centered designers were more qualified in goal-oriented strategic thinking (Holyoak & Thagard, 1995), in managing design processes regarding the time. They were able to construct the solution generation process with more related multiple sub-stages. Emotion centered designers aimed originality and practicality together. However, they made one-to-one correspondence by adapting the source domain to the target domain. They neither succeeded in the creative mental leaps (Holyoak & Thagard, 1995), nor worked with effective mental hops (Ward, 1998). They retrieved ideas from regional domains and associated them literally both for the sake of both novelty and practicality as well.

Information transfers from distant domains are more likely to be potential for extraordinary creative analogies, thinking with creative mental leaps, and reasoning with creative mental hops. This is just possible by the synergies of designers regarding the potential of them according to their personalities and being aware of the weaknesses to prevent possible conflicts and dissociations. Findings lead us to make comparisons between personality types with a view to manage collaboration better.

Creative analogies can be achieved by thinking as mind centered designers in the idea generation phase, reasoning as action centered designers in the solution generation phase and memorizing solutions as the models for any design problem. Effective use of analogy might be the core of the organization of collaborative design processes.

Creativity in the idea generation phase, productivity in the solution generation phase can be developed by systematical and methodological use of analogies by the correctly defined roles. Action centered personalities have the developed ability of analogical knowledge transfer since they present deeper-structure knowledge transfer, convergent thinking abilities based on their action-based life. However, they were conditioned in the selection of source domains. In the light of these findings, it can be concluded that mind centered designers need more productive thinking support from action centered designers whereas action centered designers need more divergent or support from mind centered designers. With their memorization potentials, emotion-based designers can take the role as the memory of the team.

Collaboration and teamwork, or briefly synergy, association rather than conflicts will yield creativity because of creative idea generation and effective solution generation and information organization. It can be said that collaboration between personality types might yield interesting creative outcomes. Based on the potentials and traits of designers, well defined roles for the design stages, will create synergy and eliminate dissociations through conflict resolution between individuals in collaborative analogical design processes.

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